Independent Review of NATS (En Route) Plc's Flight Planning System Failure on 28 August 2023

Final report

31 May 2024

CAP2993

Contents

Summary

1. Following the major failure of NATS (En Route) Plc's (NERL) flight planning system on 28 August 2023, an Independent Panel was set up by the Civil Aviation Authority (CAA) to review the incident and its causes, and to recommend improvement measures.

2. Following the publication of the Panel's interim report, on 14 March 2024, this document contains the Panel's final report and recommendations. The Panel members' short biographies are detailed at Appendix A, and the scope of the Panel's Terms of Reference (TORs) is appended to this report as Appendix B. The Panel members bring a wide-ranging and relevant set of skills and experiences but are independent of any individual stakeholder. The Panel was established and began its inquiry in October 2023.

3. The Panel's interim report focussed on the failure, its immediate causes, and timeline. A number of further lines of enquiry were identified. In this final report, the Panel presents a more detailed description of the failure itself, and focusses on longer-term and systemic issues which its work has uncovered, making a number of recommendations for future improvements.

4. The impact of the failure was considerable. The CAA has estimated that there were over 700,000 passengers and others who were affected by the failure, often for several days, and this had considerable financial and emotional consequences for them. The Panel has commissioned consumer research which describes some of the experiences of passengers, and this is published alongside this report.[1] In pursuing its work, the Panel has been motivated to draw lessons from the incident which may help the prevention of future incidents, or at least to reduce the scale of the impact on consumers, airlines, airports, and others should they occur.

5. Based on the information provided by the airlines most affected by the incident, the Panel has estimated that the costs to airlines were approximately £65m. In addition, substantial costs were incurred by passengers, airports, tour operators, insurers, and others. The Panel was unable to accurately quantify these costs. It is likely that the total cost was in the region of £75m to £100m.

6. The Panel has grouped its eight TORs into three sections, which are reflected in the chapter headings of this report. Chapter 2 covers the cause of the incident, resilience, incident communication and investment matters (TORs 1, 2, 3 and 4). Chapter 3 deals with consumer impact, and the aviation system response (TORs 6 and 7). Chapter 4

[1] See report by Transport Focus and consumer research produced by Define and overseen by Transport Focus and the Panel. These and other documents relevant to this review are published on the review's case page.

discusses performance incentives and allocation of resilience risks (TORs 5 and 8). Chapter 5 then provides a list of recommendations.

7. The Panel would like to thank stakeholders for their constructive input to its work. The Panel would also like to record its thanks to its secretariat.

Chapter 1
Introduction

Background

1.1 Following a failure on 28 August 2023 of the flight planning system operated by NERL, the CAA commissioned an independent review into the technical issues that occurred on the day and how the aviation system as a whole subsequently managed the consequences for consumers (and others) of those technical issues. The Panel was tasked to consider the immediate cause of the failure, steps taken to prevent reoccurrence and NERL's communication with stakeholders during the incident, as well as considering broader matters relating to the resilience of NERL, the impact on consumers, and the wider aviation system responses.

1.2 The Panel was asked to examine these issues within the context of the established safety, economic and consumer regulatory and legislative frameworks and to make observations and recommendations to NERL, the domestic and international aviation system, the CAA and Government. Further information is available on the review's case page.[2]

The Terms of Reference and the review's Panel

1.3 On 6 October 2023 the CAA published the TORs[3] for this review and announced Jeff Halliwell as the chair.[4] Sarah Chambers, Phil Cropper and Mark Foulsham were subsequently announced as the other Panel members.[5] The Panel members were appointed on the basis of collectively having a broad understanding of governance, technology, consumer and economic regulation issues along with the operation of air traffic management systems and complex IT systems.

1.4 The TORs state that the review should conclude with a report to the CAA, identifying potential future actions for NERL, the CAA and airline stakeholders against the eight areas identified. As part of its conclusions the Panel may make recommendations for further analysis or work on particular issues by these parties. Following the review, the CAA will consider its findings and any further steps that may be required. Any changes to the wider UK legislative and top-level policy framework will be a matter for the UK Government to consider following the conclusion of the review.

[2] Available at NATS August 2023 system failure review

[3] www.caa.co.uk/cap2594

[4] Independent review to consider wider impact of NATS technical issue

[5] A short biography of the panel members is available in Appendix A.

1.5 The Panel of this independent review is accountable for determining the final report findings and recommendations. The final report has been shared with the CAA Board, and in turn the Secretary of State for Transport, prior to publication.

Stakeholder engagement

1.6 The Panel's engagement with stakeholders prior to publication of its interim report[6] is described in that document, and in the interests of brevity is not repeated here. Since publication of the interim report, the Panel has met with key stakeholders including NERL, airport operators, airlines, the CAA, DfT and the CAA's Consumer Panel to discuss the interim findings. The Panel has also had discussions with, and requested further information relevant to the review from, a number of overseas Air Navigation Service Providers (ANSPs) including AirNav, DFS, ENAV and ENAIRE. The Panel is grateful for all of the input from these stakeholders. Appendix E has a list of the stakeholders the Panel has received evidence from, or engaged with, during the course of the review.

Consumer research

1.7 Given the impact on consumers of the 28 August incident, the Panel was very keen to obtain a detailed understanding of the passenger perspective. To that end, the Panel sought to commission a short online survey to gather quantitative evidence directly from affected passengers. This approach would require cooperation from airlines which held contact details for all passengers on the affected flights. Unfortunately, airlines declined the Panel's request for support in this area with one airline suggesting that consumer research is a distraction, and others referring to data protection compliance issues and potential conflicts with their own passenger research.

1.8 The Panel notes the lack of support from airlines in this crucial aspect of the review. Nonetheless, the Panel worked with Transport Focus, as an independent statutory body with extensive experience of transport matters, to develop an alternative approach based on qualitative research among affected consumers. Transport Focus brought substantial expertise in commissioning authoritative research among transport users, as well as experience in understanding the impact on passengers of delays in other transport modes. Whilst this approach was not the Panel's preferred one, the research has proven to be very informative, although it has not been possible to form any accurate estimate of the total impact of the incident on consumers through this mechanism.

1.9 Interviews with affected consumers took place during January 2024. Reference to the findings is contained later in this report, and a detailed summary of the results is published alongside this report.[7]

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6 www.caa.co.uk/cap2981

7 See report by Transport Focus and consumer research produced by Define and overseen by Transport Focus and the Panel.

Chapter 2

Cause of the incident, communication, resilience and investment

TOR #1: Cause and prevention

2.1 The cause of the outage of the NERL flight plan processing system (FPRSA-R) was the inability of the system software to remain in a full operational state when processing the flight plan data for a specific flight from Los Angeles to Paris (Orly) on 28 August 2023. In the case of both the primary and the secondary systems, processing of the flight data resulted in critical exception errors being generated which triggered firstly the primary system and then the secondary system to enter maintenance mode, to prevent the transfer of erroneous flight data to the air traffic controllers. From the time at which the secondary system entered maintenance mode, automated processing of flight plan data was no longer possible, and the remaining processing capacity was entirely manual, thereby reducing the number of flight plans that could be processed from typically 800 per hour during a busy period to approximately 60. To understand fully the sequence of events leading up to the failure, some understanding of flight planning requirements is useful.

2.2 Airlines planning to operate flights through controlled airspace are required to file a flight plan containing information such as aircraft type, speed, and routing. This information is required by the various Air Navigation Service Providers (ANSPs) who will provide air traffic services (ATS) to the aircraft during the flight.

2.3 The UK is a participating State in the Integrated Initial Flight Plan Processing System (IFPS) which is part of the Eurocontrol centralised Air Traffic Flow Management (ATFM) system. IFPS is the sole source for the distribution of flight plan information within the participating European States.

2.4 The route of the flight that caused the incident took the aircraft through US, Canadian, Oceanic, UK and finally French airspace. The flight plan specified the combination of waypoints and air routes in order to define the planned track of the flight from departure at Los Angeles to arrival in Paris.

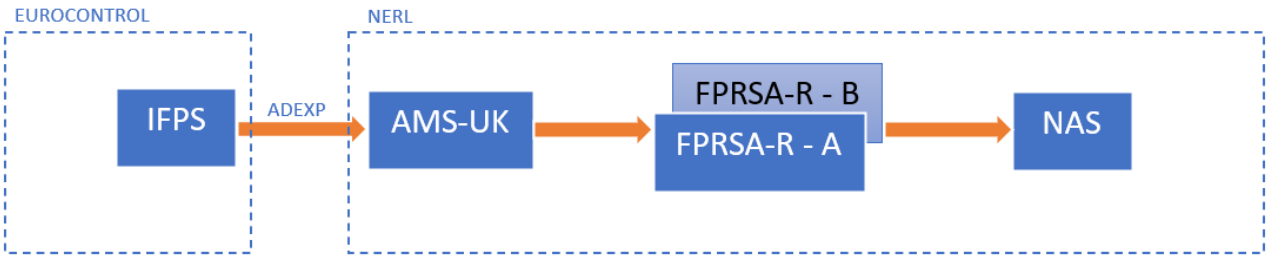
2.5 The flight plan was compiled, formatted and submitted in accordance with standard procedures and was fully compliant with the requirements of the International Civil Aviation Organisation (ICAO) Doc4444, Chapter 4.3. The flight plan was submitted to Eurocontrol for processing which involved the following standard processing steps:

1. Conversion of the original data file to a European standard format known as ATS Data Exchange Presentation (ADEXP);

2. The addition of supplementary waypoints;
3. Identification of those States which require the flight information; and
4. The sharing of the ADEXP-formatted file with those States.

2.6 The action of supplementing the original flight plan increased the total number of waypoints in the converted data file considerably. The flight plan was received by the UK's Aeronautical Message Switch (AMS-UK) from the IFPS and passed directly to the FPRSA-R at Swanwick Area Control Centre (ACC). The role of the FPRSA-R is to further process the ADEXP data to identify the portion of the route that is to be flown in UK airspace and to extract details of that route for presentation to controllers at their workstations via the UK National Airspace System (NAS).

Figure 2.1: Diagram of flight plan data transmission and processing



2.7 In the case of the flight in question, having extracted the relevant data, the FPRSA-R primary system began searching for an entry point into UK airspace; the waypoint APSOV was identified as being that point. The FPRSA-R then searched the flight data for the exit waypoint from the UK. In this case, SITET was initially identified as the exit point, however, SITET was one of the waypoints added by the IFPS during its initial processing and was not in the original flight plan. For this reason, SITET was correctly dismissed as a candidate exit point. The FPRSA-R continued to search for a valid exit waypoint and ETRAT was identified as the next possible candidate. Again, however, ETRAT was not listed in the original flight plan and hence was not validated. The third waypoint identified as a possible exit point was at Deauville. The code for Deauville is DVL. As DVL was included in the original flight plan, the FPRSA-R identified it as a valid exit point. The DVL included in the original plan, however, referred to Devil's Lake in North Dakota and not to Deauville in France. Both locations have the same three letter abbreviation.

2.8 At that point, the FPRSA-R had identified a flight whose exit point from UK airspace, according to the original flight plan, was considerably earlier than its entry point. Recognising this as being not credible, a critical exception error was generated, and the primary FPRSA-R system, as it is designed to do, disconnected itself from NAS and placed itself into maintenance mode to prevent the transfer of apparently corrupt flight data to the air traffic controllers.

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2.9 The FPRSA-R secondary system recognised that the primary system had disconnected itself from NAS and immediately assumed the task of flight data processing. Despite having created a critical exception error in the primary FPRSA-R system, the same flight plan details were presented to the secondary system which went through the same process of trying to identify a valid route through UK airspace but with the same result: namely, a second critical exception error and disconnection of the secondary FPRSA-R system from NAS. The time between receipt of the original flight plan and shut down of both primary and secondary processing systems was approximately 20 seconds. At this point, all automatic processing of flight plan data ceased.

2.10 Most waypoints are identified using five-letter abbreviations, although some older waypoints use only three. It is estimated that, globally, there are over 3000 waypoints that share the same abbreviation. This is an issue that is well known in the aviation industry and standards established by ICAO for the naming of waypoints help to minimise any impact upon route planning.

2.11 The trigger for causing both the primary and secondary processing systems to enter into maintenance mode was not simply the presence of two identical waypoints, but because of a unique set of circumstances not previously encountered on other occasions that this flight had operated, and which involved both the specific routeing of the aircraft on that day and the FPRSA-R architecture. NERL has determined that for an incident of this type to happen, the following conditions must exist:

1. The aircraft route must include at least two waypoints with duplicated abbreviations, both of which are outside UK airspace, one prior to entry and the other after leaving.
2. One duplicated waypoint needs to be close to the point of exit from UK airspace.
3. The first duplicated waypoint needs to be included in the filed flight plan and the second duplicated waypoint needs to be absent, only appearing in the flight plan supplemented by IFPS.
4. Finally, the point of exit from UK airspace needs to be absent from the filed flight plan.

2.12 Whilst the planned route from Los Angeles to Paris was nominally the same each time the flight operated, the precise track flown on any particular day is influenced by many variables. Prior to 28 August 2023, the unique combination of waypoints and routes flown, and which was required to trigger the exception errors in the FPRSA-R, had not occurred.

2.13 As an immediate response to the incident, NERL introduced software filters to the AMS-UK system to prevent the same set of circumstances from generating further exceptional errors in the FPRSA-R. Changes to the processing system of this nature are within the existing functionality of the AMS-UK system and are capable of being undertaken by NERL's engineers without recourse to the system's manufacturer. Standard safety

assurance activities were completed to ensure that introduction of the filters did not impact the safety performance of the system.

Contingency arrangements

2.14 The secondary FPRSA-R system acts as a backup to the first. If both systems cease operating, the automated processing of flight data is no longer possible. In normal operating mode, manual data entry is used to correct the small number of flight plans that are rejected by the automated systems; the number of data input terminals, and the number of trained and available staff to operate them, reflects this limited role. On the day of the incident there were 7 manually operated terminals available for data entry at Swanwick ACC. Although manual input terminals were present at Prestwick ACC, staff there have not been trained to enter full flight plans; terminals at Prestwick ACC are used for very minor data edits only and not for the uploading of complete flight plans. At peak periods the FPRSA-R processes approximately 900 flight plans per hour; a typical busy rate is between 700 and 800. Reverting to manual mode reduces this capacity to approximately 60.

2.15 In its final report into the incident NERL state that "*... there is operational contingency available to allow safe service to continue. This is provided through the ability to input flight data manually, directly into NAS using a manual input system.*" The evidence from events on the 28 August 2023 supports the view that this arrangement is satisfactory from a safety perspective as no safety occurrences were reported as a direct result of the event. Given the scale of the disruption, this was a significant achievement by NERL staff and should be acknowledged. However, because of the much-reduced processing rate (to less than 10%), the manual input of flight data was not able to support flight operations without the application of flight restrictions.

2.16 Flight restrictions limit the number of aircraft to a level that can be safely managed with the air traffic control resources available and are most commonly achieved by restricting aircraft departures through the allocation of a departure slot time. Restrictions apply only to aircraft planned to depart from airports within the EU, Scandinavia and neighbouring regions. Aircraft planned to depart from other airports are beyond the scope of the restriction process. Although civil air traffic services in the UK are provided in an integrated manner with the military, Ministry of Defence (MoD) flights are not subject to flight restrictions, and military controllers at Swanwick and Prestwick ACCs do not use the FPRSA-R to access information about MoD flights. For these reasons, military operations were largely unaffected by the events of 28 August 2023. Also, as most cargo flights operate overnight, the impact upon cargo operations of the incident was minimal. It is clearly not feasible to restrict aircraft that have already departed using a departure-slot system, and hence aircraft which are en route to UK airspace at the time that restrictions are applied are beyond the scope of such measures. The rate at which aircraft are permitted to depart is determined by specialists at both NERL and Eurocontrol whose experience and expertise is crucial in achieving the most efficient use of what limited airspace capacity remains available.

2.17 When restrictions become necessary, staff in the Flow Management Position at Swanwick ACC or Prestwick ACC contact Eurocontrol's Network Manager Operations Centre (NMOC) and confirm the need for restrictions to be applied and agree a nominal flow rate. Having agreed the requirements, the NMOC issues a notice to airspace users advising of the specific arrangements to be applied and for what period of time. On the day of the event, NERL's first formal contact with Eurocontrol was at 10:43. The NMOC issued the notice concerning flight restrictions affecting the UK two minutes later, at 10:45. That notice confirmed that restrictions would become effective at 11:00. Initially, a limit of 360 flights per hour throughout all UK airspace was imposed – 300 slots being allocated for flights in Swanwick's airspace and 60 for flights in Prestwick's.

2.18 During the course of the event, the number of permitted flights was reduced to match the ability of NERL staff to keep the flight data of aircraft that were en route updated. At 12:20 the number of permitted flights was reduced to 40 for Swanwick and 20 for Prestwick and at 13:00 this was reduced further to 20 and 10 respectively. Following identification of the fault to the automatic processing system and a repair being identified, tested and implemented, NERL began to ease flight restrictions at 15:24. All flight restrictions were lifted by 18:03. It should be acknowledged that throughout the period that restrictions were in force, NERL staff were proactive in identifying individual flights that could safely be exempted from departure restrictions, and which were allowed to depart without requiring one of the limited number of slots. This was particularly the case for flights requiring a degree of priority. However, this was very much the exception, and the effect of the restrictions was to severely limit overall system capacity.

2.19 Processed flight data is presented to NAS four hours in advance of the data being required by the relevant air traffic controller. This is done on a continuous basis so that at any given moment, NAS contains flight data for the following four-hour period. NAS will continue to present the stored flight data to controllers for as long as it has data available. Unless alternative measures are taken, the accuracy of the data stored in NAS will begin to deteriorate from the point at which automated processing ceases, due to changes in the aircraft's speed, route, level etc. not being updated. It is vital, for flight safety reasons, that data presented to the air traffic controllers remains accurate as this forms the basis for their decisions in controlling aircraft. It is for this reason that, in contingency mode, manual flight data entry capacity is focussed primarily upon updating changes to flights that are airborne and not on uploading data for flights that have not yet departed.

2.20 The Panel pressed NERL on the advantages to be gained from expanding both the period of stored data beyond the current 4-hour limit and the capacity to manually edit flight plans. NERL's view is that the current level of manual input capacity would require flight restrictions to be imposed after a period of approximately 2 hours regardless of the time for which stored data was available, because, after 2 hours, the number of flight plan changes is too great to be updated in a timely way by manual means alone. NERL has stated that it would take a roster of approximately 200 additional members of staff, on a 24/7 basis for the busiest 7 months of the year to provide, through manual editing alone,

the equivalent of 80% of the data processing capability of the FPRSA-R. NERL estimates that the cost of this would be £10.75m annually. In addition, increasing manual input capacity on this scale would, NERL maintains, introduce a higher error rate, resulting in an unacceptable safety risk. It is common, during periods of disrupted service, for flight plan changes to increase as airlines seek alternative routes or departure times to avoid the worst of the disruption, further adding to the manual input burden. NERL therefore believes that investing in further manual input capacity would not only fail to minimise the impact of automated processing failure but also incur disproportionate costs.

2.21 The Panel accepts that on both safety and cost grounds, expanding manual flight data editing capacity to the point where it might reasonably act as full or substantial operational contingency for automated processing is not justified. The Panel does, however, believe there is merit in exploring further options, short of that detailed above, and recommends that ***NERL should review in detail its contingency arrangements for significant disruption to ensure that maximum airspace capacity continues to be available without the need for flight restrictions for as long as possible, and if restrictions are required, that they are kept to a minimum [R1]***.

Fault identification and recovery

2.22 The role of the AMS-UK system is to receive data from Eurocontrol's IFPS and forward this to the FPRSA-R. The AMS-UK has a feature that enables data to be queued for processing rather than be presented directly to the FPRSA-R. Data can be held in either a pending or a pause queue, each of which operates differently.

2.23 Data in a pending queue will automatically be forwarded to the FPRSA-R whenever there is a valid connection; messages in a pause queue remain in that queue until manually released for processing. Typically, a pause queue would be created whilst system maintenance is undertaken. Data released from a pause queue is transferred to the pending queue for transfer from the AMS-UK to FPRSA-R once reconnection is established. The pause queue would then be closed.

2.24 On the day of the event, in response to both primary and secondary processing systems entering maintenance mode, a pause queue was created for the AMS-UK system to prevent it sending new data to the FPRSA-R. However, the flight plan message that could not be processed remained in the pending queue because removal from the pending queue was triggered by the completion of processing, which had not occurred. Each time a connection was established between the AMS-UK and the FPRSA-R, the AMS-UK therefore attempted to send the errant flight plan data to the FPRSA-R to be processed. Each attempt was unsuccessful and caused the FPRSA-R to re-enter maintenance mode. In maintenance mode, no acknowledgment to the AMS-UK could be sent by the FPRSA-R confirming receipt of the data and hence the flight plan remained at the front of the pending queue causing the FPRSA-R to re-enter maintenance mode each time the flight plan was sent. These actions were not the result of anomalous behaviour by either the FPRSA-R or the AMS-UK. There is no functionality in the AMS-UK or connected systems

to remove a message from the pending queue in the event of repeated unsuccessful transmission attempts. By responding in the manner they did to the data being presented, both systems were operating as they were designed to do.

2.25 The repeated cycle that occurred each time a connection was re-established between the AMS-UK and FPRSA-R was eventually ended with the assistance of the system manufacturer, Frequentis Comsoft, four hours after the start of the event. Whilst NERL's experts had detailed knowledge of the FPRSA-R and the AMS-UK as individual systems, greater understanding of the interface between the two systems by the Frequentis Comsoft engineers was key to identifying the root cause of the event. Specifically, Frequentis Comsoft engineers identified the need to transfer the flight plan causing the repeated failures from the pending queue in the AMS-UK into a pause queue. Once this was made known to NERL's engineers, resolution of the fault was quickly achieved and at that point, new flight plans could be processed automatically in the usual manner. In discussion with the Panel, Frequentis Comsoft believed it would not have been reasonable to have expected NERL engineers to have identified the cause of this event, or its solution, without their input.

Figure 2.2: Levels of engineering support

Level	Description
Level 1	Immediate incident response and recovery, rostered onsite 24/7/365 covering all systems. Individual engineers are competent to work on between 50 and 60 systems, which NERL has identified as being the most critical for immediate attention in the event of an issue.
Level 2	System experts, onsite during working days, rostered on call but offsite (within 1hr) outside of working hours for critical systems. Level 2 engineers are expected to be competent on approximately 5 separate systems.
Level 3	Design experts not rostered but available by request. Level 3 engineers are not competent to make changes to operational systems – these may only be done by Level 1 or 2 engineers.
Level 4	Equipment manufacturer.

2.26 NERL operates a four-level engineering support structure. The initial response to a system failure is provided by the Level 1 engineers, who do not have, nor are they expected to have, detailed knowledge of individual systems. They offer an initial response to a failure that might typically involve acknowledging the system failure alarm; completing an initial fault diagnosis; and initiating a system re-set. A Level 2 engineer has more detailed knowledge of a particular system and is expected to be able to identify and rectify faults that a Level 1 engineer would not. A Level 3 engineer is the most knowledgeable of

NERL's engineers and is expected to have a very detailed knowledge of the system and be able to respond to most failures with the assistance of Level 2 engineers. Should a system failure be beyond the capability of the Level 3 engineer, the ultimate recourse, Level 4, is to the system manufacturer.

2.27 On the day of the event, all elements of the FPRSA-R support structure were involved in trying to address the system failure. The timeline for the actions taken to initiate the various levels of support is included in Appendix D.

2.28 Several factors made the identification and rectification of the failure more protracted than it might otherwise have been. These include:

- The Level 2 engineer was rostered on-call and therefore was not available on site at the time of the failure. Having exhausted remote intervention options, it took 1.5 hours for the individual to arrive on-site to perform the necessary full system re-start which was not possible remotely.
- The engineer team followed escalation protocols which resulted in the assistance of the Level 3 engineer not being sought for more than 3 hours after the initial event.
- The Level 3 engineer was unfamiliar with the specific fault message recorded in the FPRSA-R fault log and required the assistance of Frequentis Comsoft to interpret it.
- The assistance of Frequentis Comsoft, which had a unique level of knowledge of the AMS-UK and FPRSA-R interface, was not sought for more than 4 hours after the initial event.
- The joint decision-making model used by NERL for incident management meant there was no single post-holder with accountability for overall management of the incident, such as a senior Incident Manager.
- The status of the data within the AMS-UK during the period of the incident was not clearly understood.
- There was a lack of clear documentation identifying system connectivity.
- The password login details of the Level 2 engineer could not be readily verified due to the architecture of the system.

2.29 NERL's arrangements for the availability of engineering support are based primarily upon the level of engineering work planned (particularly maintenance activities) and not on the level of demand for air traffic services. The rostering arrangements provide for Level 1 engineers to be available on site at all times and at least one Level 2 engineer to be available on site during normal working hours. On weekends and public holidays, when specialist maintenance is not scheduled, Level 2 engineers are rostered to be available on-call at home. On these occasions, in the event of a system fault that requires Level 2

support, initial access would be via a remote connection. Failure to resolve the matter remotely would then be likely to involve attendance on site in person by the Level 2 engineer. Level 3 engineers work normal office hours and are not usually rostered to be available on call – although there is an expectation that they will support a major incident if required. The Panel asked NERL to provide detailed information about how current on-call rosters might be expanded to provide for Level 2 engineers to be available on site at Swanwick and Prestwick ACCs at all times. Allowing for resilience and the need for additional team management capability, NERL has calculated that an additional 102 engineering staff would be required to meet this target and at a cost of between £11.5M and £16.9M per annum. NERL has further stated that there may be practical problems in developing and maintaining the expertise of this cadre as they would not be working on systems projects as their primary role which is how the current Level 2 engineers achieve their expertise. Whilst this is not an option that NERL is currently pursuing, other opportunities are under consideration for enhancing engineering capability, including enhancing remote access for critical systems; reassessing engineering service level agreements; and enhanced supplier support for critical systems. Other options are also under consideration.

2.30 The Panel is of the view that, whilst enhancing the roster to provide for a Level 2 engineer to be available at all times may not be justified on grounds of either safety or cost, there is a case for making such an enhancement during the busier summer period, and other such times as seem appropriate. Whilst the cost of this option would still be significant, it would be less than the estimate for a Level 2 engineer to be available at all times, and should be seen in the context of the overall cost to the industry and to passengers of the incident on 28 August 2023. For this reason, the Panel recommends that ***NERL should reconsider its engineering resource management arrangements to provide timely onsite coverage with engineers of sufficient skill levels that are matched to aviation system demand [R2]***.

2.31 In discussions with the Panel regarding the suitability of the engineering support arrangements, NERL emphasised that the difference between traffic levels around public holiday dates and other dates during the summer season (April to October) is minimal; all days in the summer season are very busy. However, suspension of routine work by the Level 2 engineers on public holidays provides the necessary flexibility to allow for the on-call arrangement. The Panel was told by airlines and airports that 28 August 2023 was one of the busiest days of the year in terms of passenger numbers. This added considerably to the impact of the incident which was summed up by the comment of one airline representative who told the Panel "*It was the most significant event we have faced in normal operations since the volcanic grounding of aircraft in 2010 and the impact was significant across the entire operation*".

2.32 In discussion with the Panel, Frequentis Comsoft remarked that despite the NERL engineers being under considerable pressure throughout the period of the incident, they were diligent in their approach to identifying a solution and remained focussed on

returning the FPRSA-R to service as quickly as possible. Frequentis Comsoft also confirmed that the work done by NERL's engineers as part of the initial response to the incident meant that Frequentis Comsoft was able to quickly eliminate several possible causes. This undoubtedly led Frequentis Comsoft to identify a solution more quickly than they might otherwise have done. Although precise timings are unclear, Frequentis Comsoft estimates that a solution was identified within 30 minutes of being contacted. Frequentis Comsoft characterised communications with NERL throughout the period of the incident as being very professional and entirely focussed on resolving matters as quickly as possible.

System design

2.33 NERL has a very mature and comprehensive safety management system (SMS). In planning for the introduction of new operational systems, the NERL SMS provides assurance not only that all necessary regulatory requirements have been satisfied, but that all derived safety requirements arising from the design, installation, use and decommissioning of that system are identified and adequately addressed. Both NERL and Frequentis Comsoft, have confirmed that there were no unusual circumstances regarding the safety assurance of the FPRSA-R system. Frequentis Comsoft was very complimentary about the thoroughness of NERL's processes and considered the NERL approach to safety assurance to be amongst the most robust of its many customers.

2.34 In the case of the FPRSA-R, Frequentis Comsoft has acknowledged that the supporting design document provided by NERL was used to generate the detailed requirements and that it identified the condition relevant to this event, specifically the ability to accommodate duplicate waypoint data. However, Frequentis Comsoft has advised that the overall software coding solution was more complex than anticipated. This, and other considerations, meant that the logic was missed during the coding process. The missing logical code would have caused the FPRSA-R to disregard identical waypoints identified in any flight plan that occurred prior to an aircraft entering NERL's airspace and would have prevented the events of the 28 August 2023 from ever happening. Given that the requirement regarding duplicate waypoints was identified by NERL and specified to Frequentis Comsoft, the Panel has considered the effectiveness of the quality assurance process that both Frequentis Comsoft and NERL subsequently undertook. More specifically, the Panel would have expected that the design specification was accurately translated into a code set, tested by Frequentis Comsoft, and that functionality associated with this code set was subsequently assured by NERL during Factory Acceptance Testing and on receipt of the relevant software build. For this reason, the Panel recommends that ***NERL should undertake a review of its software assurance process [R3]***.

2.35 Both NERL and Frequentis Comsoft have said that the circumstance of the flight that caused the incident could not reasonably have been identified through pre-operational safety assurance measures, because of their unique nature. In support of this view, NERL has confirmed that over 15 million flight plans have been processed successfully by the FPRSA-R without this scenario being seen.

2.36 The primary and secondary automated processing systems each have a separate power supply and data feed and are physically located in separate equipment rooms, however, each system has the same software running on the same hardware. This lack of software diversity means that any error in the software can result in a common mode failure in both systems. The Panel, together with many organisations that responded to the request for inputs to this review, questioned at length this aspect of the system design. NERL has advised that the major constraint in deploying sophisticated software diversity is the cost of development, integration and safety assurance. Software diversity is used in the most safety critical systems (e.g. radio communications with aircraft and radar systems) but neither NERL nor Frequentis Comsoft were aware of any other ANSP that uses such an arrangement for flight plan processing. The Panel recommends that ***NERL should review its policy for the diversity of software, including an evidenced explanation of which systems have such diversity and which do not [R4]***. Furthermore, there should be an associated focus on data handling practices to ensure they incorporate a clear risk-based approach to identify and mitigate shared potential vulnerabilities.

2.37 When asked about the system architecture, that had no provision for quarantining of a flight plan that generated an exception error, Frequentis Comsoft advised that this reflected the importance of ensuring that no flight plan messages are "lost" to the system. This is because of the need to ensure messages are received in their correct order and because the system provides for the over-writing of one message with another – for example to capture changes to the original flight plan updated messages may be corrupted if the initial message is missing. Although not included in Frequentis Comsoft's written response, when asked in discussions, whether the option to present data to the secondary system that has already caused the primary system to enter maintenance mode should have been eliminated at the design stage, Frequentis Comsoft agreed that, with hindsight, it should have been. However, both Frequentis Comsoft and NERL went on to state that the main purpose of the secondary automatic processing system is to mitigate against hardware failures in the primary system and failures of the interfaces with other systems. It should be noted that, notwithstanding the events of 28 August 2023, the overall performance of the FPRSA-R system is reported to be very good with only short periods of planned annual maintenance being normally required.

2.38 NERL presented the Panel with information regarding how the exception error that caused the incident might have been alternatively managed but why, ultimately, NERL considers that the option to allow the flight plan to cause both systems to enter maintenance mode was justified.

2.39 NERL advised the Panel that although the software programmer would have had several options for managing the generation of exception errors, in practice these options all had limitations. Firstly, presenting the flight plan for manual intervention was not possible because the error prevented the software from completing its checks that would have removed the flight plan from the processing queue. Secondly, because the software had no way of determining that the issue was confined to a single flight plan or whether many

flight plans were affected, abandoning the processing of that individual plan and continuing with other plans was not a practical solution. For these reasons, putting the system into maintenance mode was considered the safest option as this would immediately trigger a system alarm and allow an engineer to investigate further and resolve the matter.

2.40 Following lengthy discussions with NERL, the Panel remains of the view that the system design should have provided better mitigation (e.g. quarantining) of data that would have caused the FPRSA-R system to cease operating.

TOR #2: Industry communication and engagement

2.41 When an air traffic service provider needs to impose flight restrictions, the process for advising airspace users is common across Europe. The service provider makes an initial call to Eurocontrol's Network Manager Operations Centre (NMOC) and specific restrictions are agreed. These are usually expressed as the number of aircraft that can be accepted into a specified volume of airspace over a given period and achieved through the issue of a Calculated Take Off Time (CTOT) to aircraft intending to fly through that airspace. It is the responsibility of the airlines to ensure their aircraft are ready to depart at the correct time and the responsibility of air traffic control to allow them to do so.

2.42 On the day of the event, this process was followed and was effective in achieving the primary purpose of letting airlines, other ANSPs and airports know that air traffic restrictions were being applied. Nevertheless, in discussions with the Panel members, airport and airline representatives were consistent in their criticism of NERL's communications after the initial notification via Eurocontrol. The main concerns were about the delay in providing the initial notification of the problem; the absence of regular updates on progress in identifying the cause and finding a solution; the use of ineffective communication platforms; and over-hasty ending of communications before airlines and airports had fully recovered to normal operations. The combination of these issues resulted in confusion and uncertainty and ultimately a more severe impact upon passengers than was necessary. In the absence of an effective communications strategy, airlines and airports had minimal information upon which to base their own responses, and the decisions they took were inevitably less well informed.

2.43 Regarding the time that elapsed between the start of the incident and its notification to other stakeholders by NERL, airline and airport representatives reported inconsistencies in the time and way they first became aware that there was a problem. Despite the notification by NMOC at 10:45 which should have been available to all relevant stakeholders, the smaller airports and airlines generally reported receiving information later than the larger ones, and several of them first heard about the incident from the media. Those airports at which NATS provides aerodrome air traffic services appeared to be amongst the first to become aware of the event. The first opportunity that most airports and airlines had to discuss the situation directly with NERL, and to seek an update on

events, was during the first call from NERL's Air Traffic Incident Coordination and Communications Cell (ATICCC) at 11:45, more than 3 hours after the start of the event.

2.44 Most of the airlines and airport representatives agreed very strongly that earlier warning of a potential problem would have made a considerable difference to their ability to make precautionary preparations, which in turn would have reduced the negative impact on passengers. In response to this view, NERL expressed some concern that such precautionary warnings could cause more disruption and uncertainty than they would avert. Notwithstanding this view, airport and airline representatives felt very strongly that earlier notification of a potential difficulty, even one that was resolved quickly with no impact upon system capacity, was better than delaying until a problem had escalated to the point where significant delays were likely. The Panel recommends that ***NERL should consider the need to give earlier notification to airlines and airports of possible disruption, together with frequent updates, ideally this should be based on pre-arranged timings and frequencies [R5]***.

2.45 On the quality and style of communications by NERL, a common view expressed was that the information given by NERL was of limited utility, and there was considerable frustration about the inability to ask questions or to find out detailed information about the problem, or about the timeline for resolving it. The use of telephone conference call facilities in ATICCC was inefficient and unable to cope with the demands made upon it. The Panel considers that robust and realistic testing of ATICCC should have identified this problem prior to the event. NERL has since confirmed that it has implemented a new platform for ATICCC engagements using Microsoft Teams, which offers increased functionality and the ability to efficiently manage the large number of stakeholders involved. Regardless of the system in use, a clear communications method should be established in readiness for incidents so that for example, the decision-making process is not diluted within the details of the ongoing operational dialogue. The Panel recommends that ***NERL should review all aspects of its procedures for communicating with stakeholders during periods of significant disruption, and in particular its operation of ATICCC [R6]***.

2.46 In addition to the scarcity of information to stakeholders during the immediate period of the event, the Panel heard consistent criticism of NERL for the lack of any significant follow up engagement by senior managers in the days and weeks afterwards. Given the extent of the disruption and the costs incurred there was an expectation that NERL would have arranged one-to-one meetings, at least with the larger airlines and airports, to explain fully the cause of the incident and the actions taken subsequently to prevent recurrence. The airline and airport representatives the Panel interviewed had had no such meetings.

2.47 Almost all the airline and airport representatives the Panel spoke to were critical of the early termination of formal communications by NERL who considered the incident to be over once all flight restrictions had been lifted. However, long after the technical solution was implemented, and the automatic processing of flight plans had been fully restored,

airlines and airports continued to have to manage the consequences of the initial disruption. Flight cancellations and delays inevitably disrupt planned flight schedules for some time. Aircraft may not be at the right airport to operate a service and if they are, flight crew and cabin crew may not be, or might have exceeded their available duty hours. Airline performance in recovering their operations varied, with the ability to deploy uncommitted aircraft and crew being a major factor in how quickly normal service could be resumed. Similarly, airport capacity to accommodate aircraft holding on the ground for longer periods is finite. Because of these continuing difficulties beyond the time that systems were fully restored, and despite its limitations as an effective communications channel, airline and airport representatives felt that NERL should have continued operating ATICCC for a longer period, and certainly beyond the point at which flight restrictions were lifted.

2.48 NERL has acknowledged that communications were not effective during the incident and work has already begun to address some of the operational communications issues identified in its own investigation into the event. This work includes making improvements to existing stakeholder engagement practices as well as introducing new ones.

Sector and stakeholder involvement

2.49 It is clear from the level of readiness in the broader stakeholder group that improvements can be made to the way the sector responds to periods of significant disruption. In particular, the report into the major NERL outage on 12 December 2014 discussed a significant lack of pre-planning and coordination for major events and incidents and the alleviation and remediation of major incidents above and beyond normal operating variances. In its interim report, the Panel suggested that regular multi-agency rehearsals of major ATC outages, and their management to eliminate or reduce their impact on passengers, would be beneficial. Such rehearsals are common practice in other sectors. The Panel notes that such a rehearsal is planned to take place later in 2024 but urges that the exercise should be repeated on a regular basis, as systems, circumstances, and people will inevitably change over time. The Panel recommends that ***all relevant parts of the aviation sector should meet on a regular basis to conduct rehearsals of major incident management. The CAA should consider taking a role in facilitating this activity [R7]***.

2.50 From discussions with senior figures in airlines and airports, it is apparent to the Panel that operational level contact between NERL and its immediate customers is reasonably effective. However, the Panel heard that at a senior level, relationships are less positive, and more than one airline expressed a view that they did not feel they were generally treated as a valued customer. These poor relationships are not, in the Panel's view, in the interests of consumers, when it comes to the management of incidents such as happened on 28 August. It is for NERL and its airline and airport customers to determine ways to improve the situation. However, the Panel suggests that the CAA could also play a role, in establishing a collaborative environment in which relationships could improve. The Panel recommends that ***NERL and its customers should consider how best to achieve a***

more collaborative relationship through establishing a senior leadership forum in which matters of resilience and customer experience can be addressed. The CAA should consider how it could facilitate and encourage this process [R8]. One such mechanism might be through the Operations Directors Liaison Group (ODLG), established following a recommendation from the Voluntary Industry Resilience Group (VIRG)[8], The VIRG was a collaboration between airports, airlines, air traffic control and regulators, established to ensure that the activities and changes identified by the CAA in its report (CAP1515) to industry were delivered. The report aimed to "*support a systemised approach to the way in which the UK's aviation network is planned and operated to enhance its day-to-day operating resilience, reduce delays and the associated costs to both industry and passengers*". The ODLG was established in 2017 from the same bodies as the VIRG to provide a forum for industry and the CAA to discuss matters affecting the resilience of the UK aviation network and aviation safety, and to influence industry and regulatory thinking.

TOR #3: Resources and resilience

2.51 The Panel recognises that up to six different factors contributed to the circumstances that led to the events of 28 August 2023 (only one of which was the presence of duplicate waypoint data). It is unlikely that the same unique set of circumstances will occur again, and if they did, because of the actions already taken by NERL, the outcome would be different.

2.52 It is recognised that the overriding priority for NERL is the provision of a safe service, and the option to impose flight restrictions during periods of reduced resource is an essential tool in achieving this. However, the complexity of airline and airport operations, often functioning at maximum capacity themselves, means that the impact of such restrictions can be overwhelming. The views of the airline and airport representatives interviewed for this report can be summed up in the comment made to the Panel by one airline representative who said that "*Safety cannot be an excuse for inefficiency. We need a functioning system that is safe*".

2.53 The CAA's safety oversight activities are primarily driven by the safety performance of the service provider, and regulatory resource is allocated accordingly, to comply with the requirements of UK Regulation (EU) 2017/373. The safety oversight of NERL – including the initial and on-going approval of systems such as the FPRSA-R system – is the responsibility of the CAA's En route and College Regulation (E&CR) team and the Panel sought information concerning the resources available to this team.

[8] The VIRG was formed in April 2017. The Group consisted of senior leaders in the CAA, NERL, Airports Coordination Limited, airlines and airports. Its purpose was to pool expertise and recommend actions addressing current and future resilience needs.

2.54 The CAA has confirmed that under the leadership of the Head of E&CR there were 3 Engineering Inspectors available prior to 2018, the year that the FPRSA-R was deployed. After 2018, this number reduced to 2. Other members of the E&CR team include air traffic control Operations Inspectors who may have had some input to the approval of the FPRSA-R, but their roles are primarily focussed on air traffic management procedures and personnel licensing matters, not on engineering systems approvals. Additional resource from the CAA's team of airport Engineering Inspectors was made available when the dedicated resource within E&CR was reduced.

2.55 The safety of services provided by NERL is primarily assured through compliance with NERL's SMS, which is approved by the CAA. Any significant changes to operational systems or procedures must be notified in advance to the CAA who may choose whether to audit the change. The process for notifying such changes is common to all ANSPs and involves the completion and submission of a standard CAA form (SRG1430). The CAA uses the information included in the change notification form to assess whether an audit of the proposed change is necessary. Section 11 of this form invites ANSPs to confirm whether the proposed change will impact Cyber Security[9] controls and if this is the case, further guidance on the form requires the ANSP to provide a brief description of the impact and the controls affected. Whilst Cyber Security appears to have played little part in the events of 28 August, the Panel was concerned to learn that change notifications to the CAA which are annotated by NERL as having an impact upon Cyber Security are not routinely shared with NERL's own Cyber Security Responsible Manager. The Panel recommends that ***NERL should review change notifications previously submitted to the CAA and which have been noted as having an impact upon Cyber Security controls, and bring these to the attention of its Cyber Security Responsible Manager for any necessary actions to be completed [R9]***. The Panel further recommends that ***NERL should review its processes for the submission of change notifications to the CAA, to ensure that all necessary internal coordination is completed prior to submission [R10]***.

2.56 It would not be practical for the CAA to audit all changes notified to it by all service providers. Instead, the CAA uses several factors to determine whether to audit a change including the nature of the change, the safety performance of the service provider, and the assessed risks associated with the change.

2.57 The Panel sought some data for the number of changes notified to the CAA by NERL that were audited as part of the CAA's oversight role. These are produced below.

[9] Cyber security includes aspects of confidentiality, integrity and availability of information, data and systems.

Figure 2.3: CAA's audits of NERL's change notifications

Year	No. of change notifications	Number audited	*% audited*
2023	101	38	*38*
2022	69	17	*25*
2021	88	22	*25*
2020	48	16	*33*
2019	3	3	*100*

2.58 The FPRSA-R is a legacy system first introduced into service in 2018. It has undergone a series of developments and upgrades over several years to ensure it remains fit for purpose. Following the incident on 28 August 2023, the CAA completed a review of its oversight of NERL's management of the changes to this system. The CAA chose not to audit any of the changes made as part of the upgrades to the FPRSA-R, largely because of the absence of significant functional changes and the assessed safety impact of any failure or anomalous behaviour of the system. As mentioned above, it should be recognised that this assessment was validated by the absence of any safety incidents related to the events of 28 August 2023.

2.59 Whilst the Panel has no detailed information on safety oversight resource in comparator sectors, the CAA resource available for the oversight of NERL appears, in the opinion of the Panel, to be limited given the number of complex systems operated by NERL. The Panel recommends that ***the CAA should review its resources for the oversight of NERL's safety critical systems to ensure these remain sufficient [R11]***. In addition, the Panel recommends that ***the CAA should review its processes for the sampling of new and changed NERL air traffic systems to ensure these remain sufficient to inform its view of NERL's safety performance [R12]***.

2.60 The principal reason that the CAA give for choosing to audit the introduction of a new system, or a change to an existing system, is on the grounds of safety. Consideration of the possible contingency modes of a new system is an important aspect of that system's approval. The impact upon overall airspace capacity in the event that contingency operations become necessary is not, ordinarily, a constraining factor in choosing whether to audit a new system or a change to an existing one, provided safety risks associated with the contingency mode are considered to be acceptable. This is a matter that the Panel considers should be reviewed, and recommends that ***the CAA should ensure that the impact on airspace capacity of contingency mode operations is given sufficient***

importance when selecting air traffic control systems for audit in advance of approval [R13].

TOR #4: Investment

2.61 The panel was keen to understand the investment approach to system improvements deployed by NERL. Within this, how risk is translated to change, and in the context of the FPRSA-R, how the "information through European Collaboration" (iTEC) programme, which is planned to replace FPRSA-R and NAS, will be implemented.

2.62 The iTEC programme is now scheduled to be deployed in 2030, which is a significant delay from its target of 2015, which itself represented a delay from earlier plans which aimed for a replacement system to go-live in the 2000s. Delays to the iTEC programme were highlighted in the Egis report[10] commissioned by the CAA in 2023 to review NERL's proposed forward capital investment programme in regulatory period NR23. Given the age and criticality of the existing system, a replacement is an important factor in reducing the likelihood of flight data processing problems in the future. It is often the case that a delayed platform replacement will increase technical change overhead and heighten the level of instability due to, amongst other things, the complexity of ensuring functional currency. Furthermore, the Panel understands that the expertise required to sustain the existing FPRSA-R and NAS systems will in effect be unavailable by 2030 due to the retirement of those members of staff with the legacy knowledge of the system.

2.63 The Panel assessed the approach to technical changes based on risk modelling. The NERL risk system (Riskonnect) appears to be well overseen, designed and integrated within decision-making processes and in particular risk tolerance evaluation. The feed of this model into the change programme was seen to be based on an effective and logical approach.

2.64 Where the panel does have concerns is in the sustainable delivery of a complex and varying portfolio of change. The iTEC project is an example of an important change 'drifting to the right' and although the technical cause of the August 2023 outage is not directly related to the lack of a platform replacement, a contributing factor is likely to be the level of understanding and control around the ageing legacy system.

2.65 In its Major Investigation Report[11] into the incident, under the minor finding Mi2, NERL states that "*The complexity of the system architecture across NERL - and its regular changes and upgrades - results in any attempt to maintain up-to-date overall system mapping becoming effectively impossible*". The Panel disagrees with the assessment of this issue as being minor and instead suggests this is a major finding. NERL states in its report that improvements need to be made in the correlation of change within the wider

[10] The Egis report is available from the NERL Licence page.

[11] See NERL Major Investigation Report.

architecture, integration between systems, and ensuring overall better end-to-end knowledge across the estate. This relates to the point made above regarding improving the siloed skills of technical resources. The Panel recommends that ***NERL should review its level of strategic oversight in relation to its change programme [R14]***. A greater degree of resource risk evaluation linking to the prioritisation of change should be part of this.

2.66 It is not within the scope of the Panel's investigation to undertake a full in-depth review of NERL's investment strategy and the CAA's approach to overseeing this. Based on the Panel's findings, a review of how investment decisions are made, in particular relating to resilience improvements, and how the CAA assures this within its regulatory framework, would be a positive step forward, The Panel recommends that ***the CAA should consider how best to ensure that the interests of consumers are taken into account in setting the regulatory framework on investment and incentives for NERL [R15]***.

Chapter 3

Consumer impact and aviation system response

TOR #6: Consumer impact

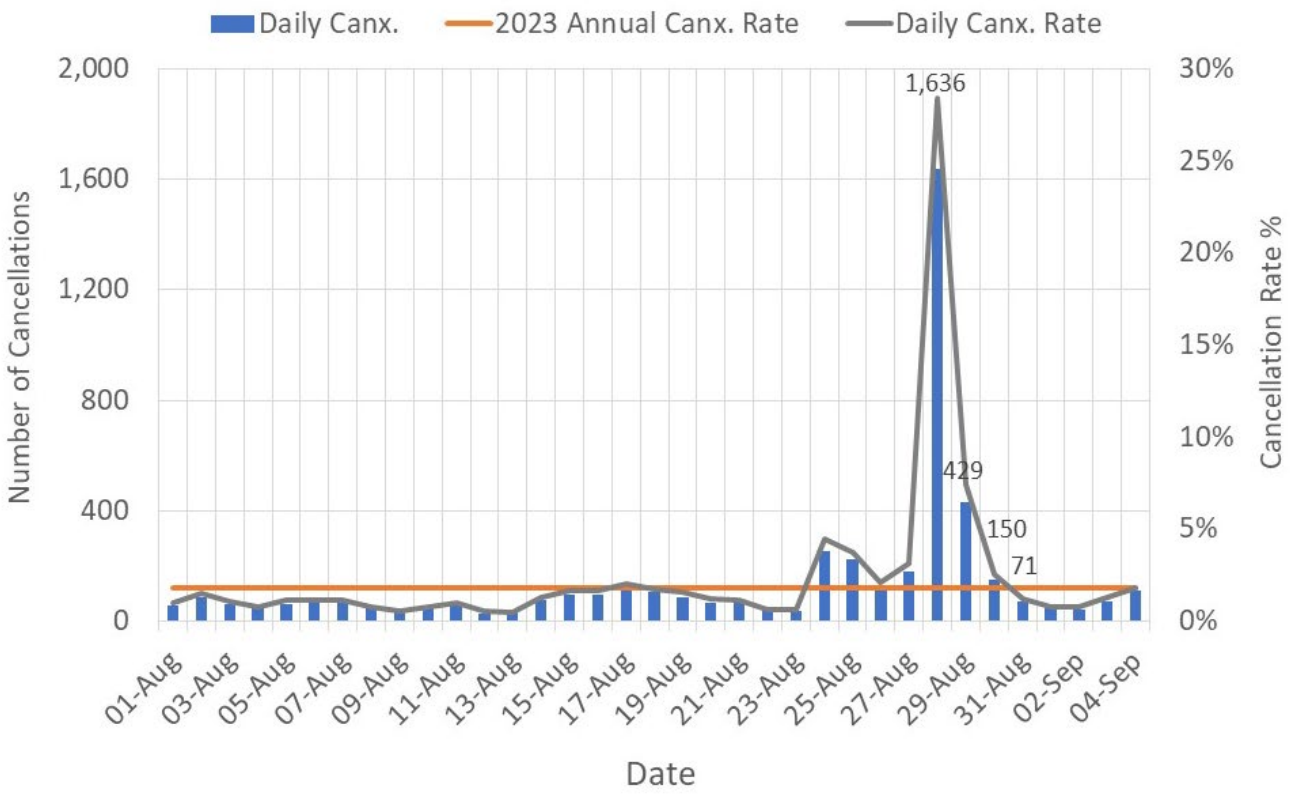
3.1 There is no doubt that the incident on 28 August had substantial negative impacts on a large number of passengers, not only on the day of the outage but for several days afterwards, as it took until the following weekend for all the re-routed journeys to be completed. For many travellers the time taken to receive refunds for their out-of-pocket expenses went on for many weeks, and in some cases months, after that. From CAA estimates, over 700,000 passengers were affected by cancellations and delays ascribed to the incident, including approximately 300,000 impacted by flight cancellations, approximately 95,000 by long delays (over three hours) and at least a further 300,000 by shorter delays. Figure 3.1 shows CAA estimates of the number of passengers whose flights were cancelled or who experienced long delays. Figure 3.2 shows the number of daily cancelled flights during August 2023, when compared with the annual cancellation rate.

Figure 3.1: Estimates of impacted passenger numbers by airline

Airline	Cancelled passengers (000s)	*Cancelled Passengers (%)*	Delayed >3h (000s)	*Delayed >3h (%)*	Cancelled + Delayed >3h (000s)	*Cancelled + Delayed >3h (%)*
easyJet	114	*37%*	9	*9%*	123	*30%*
IAG	81	*26%*	14	*14%*	95	*24%*
Ryanair	46	*15%*	17	*18%*	63	*16%*
Jet2	19	*6%*	26	*28%*	45	*11%*
Tui	2	*1%*	14	*14%*	16	*4%*
Wizzair	7	*2%*	4	*4%*	12	*3%*
Other	39	*13%*	12	*12%*	51	*13%*
Total	**308**	***100%***	**95**	***100%***	**403**	***100%***

Sources: CAA analysis of CAA Airport Statistics.
Notes: Estimates of delays due to the incident were calculated by the CAA using "excess delays" methodology, i.e. the number of delays above the average daily delays seen between 1 and 27 of August 2023. Passengers delayed by less than 3h amounted to approximately a further 300,000.

Figure 3.2: Daily flight cancellations in August 2023 and annual cancellation rate



Source: CAA analysis of CAA Airport Statistics. Note: Canx means cancelled flights.

3.2 The Panel found it hard to collect quantitative evidence about the experience of passengers affected by the incident. Which? and others, including some journalists, provided some information soon after the incident about individual experiences, but the Panel attempted in vain to get objective quantitative information about the extent of the impact. The Panel asked all major airlines for access to the passenger lists of affected flights so that it could survey the individuals most directly concerned, but the airlines declined. The CAA also told the Panel that it does not have sufficient powers to require them to provide this information. This meant that it was not possible for the Panel to confirm the precise number of passengers affected by cancellations and delays. The lack of access to passenger information and also to complaints data is a major barrier to a full understanding of the experience of airline customers, and to wider sector trends and themes. The industry is out of step in this respect when compared with other regulated sectors, such as financial services, where there is asymmetry of information or bargaining power, even those which are in other respects highly competitive (so would not be subject to price controls). When considering the complex number of intermediaries operating across aviation, gaining a true 'line of sight' from the intended service provision to the ultimate consumer is challenging. The Panel therefore recommends that ***Government should, as a matter of urgency, introduce legislative change to enhance the CAA's information powers to assist the enforcement of breaches of consumer rights laws in the aviation sector, to make them comparable with those available to other sector regulators [R21]***.

3.3 In order to gain some evidence of the impact on passengers, the Panel asked Transport Focus to commission research from Define, a respected independent research agency. Define interviewed 42 individuals who, along with their family and friends, had been directly affected by the incident. Interviews conducted with these passengers reveal some considerable dissatisfaction with how they were treated, although some were complimentary about how airport and airline staff coped in what were very difficult circumstances. Evidence from this research shows that passengers were affected by financial loss, practical and emotional impacts. The Panel also received additional reports from some individuals affected by the incident.

Financial loss

3.4 At an early stage the CAA expressed the view that the disruption caused by the incident was likely to be considered an "extraordinary circumstance" over which the airlines had no control and consequently, under the relevant regulation (UK Regulation (EC) 261/2004, as amended (Regulation 261)), passengers were not entitled to fixed sum compensation for a delayed or cancelled flight. Regulation 261 contrasts with the position in the rail sector in the UK, where the "Delay Repay" regime applies without exception. Passengers were however entitled (under Articles 8 and 9 of that Regulation) to be found an alternative flight, and to be offered suitable refreshment and/or accommodation if appropriate. The costs incurred should be reimbursed by the relevant airline or travel operator.

3.5 The airlines clearly did incur considerable costs to cover passenger needs during this period. Nevertheless, evidence from the research and other reports suggests that many passengers still ended up substantially out of pocket or having to wait a long time for reimbursement. Their financial losses included:

(a) Shortfalls between money they had spent organising their own re-routing, accommodation and/or food, and the refunds made to them by the airlines

(b) Delays between making the outlay and receiving reimbursement, in some cases for several weeks or even months

(c) Loss of earnings as a result of lengthy delays returning to their place of work, and/or having to take additional annual leave

(d) Other consequential losses such as loss of holidays for which they had paid, and the need to make additional arrangements for childcare or pet care

3.6 One example of (a) was of a passenger and her child stranded abroad, who was handed a leaflet by the airline suggesting that they should make their own arrangements to return home and then claim reimbursement. A booking link was provided in the leaflet, but using that link the passenger could only find flights available four or five days later. The airline told her that it would only reimburse for one overnight stay, and no more information was provided. The passenger incurred costs totalling £900 for accommodation, taxis, clothing and food but was only offered a refund to the value of the original flight. Other examples

included parents having to spend a lot of money buying food for their family, in excess of the sums (typically £5-10 per person) which the airlines had allowed them when issuing vouchers. Some passengers were not given any vouchers at all, and many passengers who made their own travel arrangements did not receive a full refund for the costs incurred.

3.7 An example of (b) was of a major airline which took three months to pay a refund to a passenger. Another example was of a couple who were promised a refund for their flights within seven days and were still waiting for it five months later. The Panel has not been able to discover what proportion of passengers received speedy reimbursement for the costs they incurred, nor how many of them sought the assistance of the Alternative Dispute Resolution (ADR) providers or the CAA's Passenger Advice and Complaints Team to resolve their claims. In the same vein as a generic lack of available information, unfortunately data in relation to the effectiveness of redress and reimbursement is not provided or organised in a way which makes such enquiries fruitful.

3.8 The evidence uncovered following this incident (even without the benefit of effective information powers) suggests that breaches of Regulation 261 may be quite common, and the Panel is not aware that any airline has to date been investigated or penalised for such breaches as a result of the August 2023 event. The Panel understands that CAA policy focuses in the first place on encouraging compliance, and will generally only use its enforcement powers following several reminders and successive breaches over a period of time. It may be that a more assertive approach to enforcement, including the use of powers in some cases following a single incident of a flagrant breach of Regulation 261 (or other consumer protection regulations), would provide a more effective deterrent than the current approach. The Panel appreciates that such a change in approach is likely to require more resources. It therefore recommends that ***the CAA should consider expanding the resources devoted to consumer rights enforcement and stepping in more readily in response to intelligence of a flagrant breach, not just in response to overwhelming and recurring evidence of breaches over a period [R22]***.

3.9 In discussions with the Panel, the CAA advised that it is hampered in its enforcement activities by the way in which its enforcement powers are formulated, which is different and more restrictive than those available to several other regulators. In particular, the CAA is not able to impose penalties without recourse to the courts, whereas other regulators can do so through an administrative regime which can be applied more nimbly. The Panel therefore recommends that ***Government should promote legislation to enable the CAA to take consumer enforcement action without recourse to the courts [R23]***.

Practical consequences

3.10 Practical impacts on passengers included time and effort wasted, much of which was compounded by inadequate information. The worst affected passengers were those already at airports, who felt that information should have been provided more promptly, with more frequent updates, which would have been helpful even if there was nothing new

to report. Many complained about the shortage of visible and informed staff, and the absence of any clear public announcements. With hindsight it is apparent that in the first few hours of the incident neither the airlines nor the airports were in a position to give passengers much useful information about the likely length of delay or possibility of cancellation, as they did not know this themselves. As covered in Chapter 2, the provision of information from NERL to their customers and stakeholders, enabling them to make more timely decisions, was thin and tardy. Nevertheless, the difficulty passengers encountered even trying to identify, and ask questions of, an airline or airport representative considerably compounded the practical and emotional impact on them.

3.11 An example of poor communications is of a parent travelling with a three-year old child who initially found out about the problem while at Gatwick airport by overhearing other passengers talking about delays. She found a member of the airline staff who told her to find somewhere to sit. She found seats in a cafe but then found it very hard to get any information. After waiting for two hours, she went to find a staff member who informed her that there would be no flights that day. After returning home she could not get through to the airline for over 24 hours, or access flights on the airline app as they had been booked through a booking agent, who told her to arrange new flights through the airline. When she eventually got through to the airline, she had to book new flights three days later, thus missing a vital part of her family holiday.

3.12 Practical consequences and concerns were higher for passengers travelling with children, and for those with medical or other additional needs. A number of examples were reported of passengers (including children) with health conditions who had packed most of their medication in suitcases, which they were then unable to access. This included individuals with mental health conditions as well as those with physical health needs.

3.13 The experience of UK travellers stranded in airports overseas was generally more severe than those stranded in the UK, though issues of overcrowding, poor toilet facilities and inadequate access to food and drink were experienced both in UK and foreign airports. One example was reported of disabled passengers in wheelchairs at a UK airport not receiving any assistance to collect luggage, which could only be accessed via numerous sets of stairs.

3.14 The research showed that many passengers were unaware of their rights and remained so even some time after the event. Indeed, a number of the passengers interviewed by Define only became aware of their rights when the research agency told them what they were. During the disruption many were left to make their own arrangements to complete their journeys, and/or to find suitable accommodation, with considerable uncertainty about whether and when they would be reimbursed.

Emotional impact

3.15 The impact on many passengers affected by long delays and cancellations in terms of stress and anxiety was in some cases substantial, as illustrated by the stories

summarised above. Serious concerns included anxiety and disappointment about missing family holidays and weddings, and being late getting back home to be reunited with children or to go back to work. Parents travelling with children had particular concerns, especially as the conditions at airports were in many cases chaotic, there was insufficient seating available, and families were not able to sit together in overcrowded lounges. There was severe congestion at Heathrow for example, both inside the airport and on surrounding roads, leading to concerns about possible safety risks. There were also concerns about whether families would be able to sit together on rescheduled flights. Passengers with mental as well as physical health conditions inevitably suffered from heightened levels of anxiety.

3.16 Anxiety caused by uncertainty about how and when affected passengers would return home was one of the most common issues reported, along with fear that individuals with health issues would run out of medication. The Panel is particularly concerned about the impact on those passengers with disabilities, and others who were placed in vulnerable circumstances due to the incident. One passenger reported feeling vulnerable when she realised she would be spending the night at the airport, and had to lie down on the airport floor to get her 4-year-old child to sleep. Another example from the Define research was of a passenger with Crohn's disease who was told in a brief email that her package holiday (including return flight) was cancelled, even though she was already in the holiday resort. She found it impossible to contact the airline/tour operator to get any information about what she should do, despite spending four days on the phone trying to get through to them. As a result, her entire holiday was ruined because she was worried that she could be ejected from the hotel at any time and that she would not be allowed on the flight home.

3.17 The Panel notes that there is no statutory consumer body to collect, research and represent the views of air passengers. The CAA Consumer Panel advises the regulator on aspects of the consumer interest, but it has no data collection powers of its own, and almost no budget. The Panel has found it difficult to get an overall structured view of passenger experiences. In a number of other regulated sectors, a statutory body with powers and direct access to a research budget is common and adds significant strength to the representation of otherwise individual passengers. Examples include the statutory representation of energy users by Citizens Advice, of water users by Consumer Council for Water, of financial service users by the Financial Services Consumer Panel, postal and telecommunication users by Ofcom, and rail/bus/major road users by Transport Focus. The Panel recommends that ***Government should consider the appointment of a statutory consumer body to collect, research and represent the views of air passengers and air freight users [R24]***. Options may include strengthening the status, powers and resources of the CAA Consumer Panel, or extending the remit of Transport Focus, or amalgamating the responsibilities of all consumer bodies of regulated sectors into one national body with appropriate expertise and budget, and consequently the ability to spread learnings across sectors.

3.18 If the CAA were to have powers to change the airlines' and airports' licence conditions to provide timely and accurate data about consumers and complaints, this would allow individual organisations and stakeholders to propose and where appropriate to implement improvements to customer experience, based on shared and transparent analysis. This approach already exists in respect to safety-related information within the industry, and is common practice in other sectors. A useful example of how this is framed by the Financial Conduct Authority is: "*Transparency from firms on the number of complaints they receive is helpful for industry and consumers. Firms can compare their performance in the market and consumers have an additional source of information about the firms we regulate. Further complaints data may be obtained from the Financial Ombudsman Service.*"[12]

Vulnerable customers

3.19 The Panel was keen to understand the particular circumstances of vulnerable passengers, including disabled, young and elderly people as well as those who found themselves in vulnerable circumstances due to the result of the disruption. The Panel approached a number of organisations to gain their views on this subject including Scope, a major disability equality charity.

3.20 The Panel was told of one particularly harrowing story of a disabled passenger with her family, trying to return to the UK from Portugal on the day following the outage. The airline representatives repeatedly refused to offer her a wheelchair (which had been booked) because the flight was not ready to board. There were virtually no seats available and none with back support, and she was told to just find somewhere to stand. Information was haphazard and very hard to locate. They were initially told (on the Monday evening, after the outage had been resolved) that the flight would operate as planned the following day. On arrival they discovered that it had been cancelled, but there were numerous contradictory statements given to the passengers, ranging from re-scheduling later that day to 4 days later. The 24/7 helpline, which was supposed to be available for medical emergencies, was closed, and remained closed throughout the day. Updates were given in the centre of the terminal building by a member of staff shouting, without giving passengers any time to approach. They were eventually told to return to their hotel, where some, but not all, of the affected passengers received an email informing them that they would depart the following day. After two days of anxious waiting and poor treatment at the airport, the family finally arrived back in the UK, but by that time the disabled passenger was in considerable pain and unable to take the train back home. She had to take the rest of the week off and it took her four days to get back to her normal level of medication. Several months later she is still not fully recovered.

3.21 Evidence provided directly to the Panel and from the Define research shows that some airlines and airports did not always meet the needs of disabled or otherwise vulnerable passengers. The Panel was unable to gather as much evidence as it hoped regarding

[12] FCA, complaints data

the experiences of vulnerable passengers, however the Panel recommends that ***airports and airlines should review their arrangements for meeting the needs of passengers in vulnerable circumstances during periods of significant disruption, including those travelling with children [R25]***.

TOR #7: Aviation system response

3.22 The airlines and airports had a huge and complex task on the day (and for several days after the date of the incident) to find alternative flights for affected passengers, to provide them with refreshments and hotel accommodation where appropriate, and to keep them informed. Some of the airlines laid on rescue flights at their own expense. The knock-on effect of the large volume of cancellations meant that some passengers were not repatriated until the end of the week, incurring many days of extra costs which, under Regulation 261, are the responsibility of the airlines. The scale of the necessary airline response was characterised by one senior airline representative as "*monumental*", and the Panel has no reason to differ from this judgement. The total estimated costs incurred by the airlines is summarised in Chapter 4 below.

3.23 Providing care and assistance was much harder than it would be in the event of a more minor disruption, as so many people were stranded at the same time, on a busy public holiday with more people travelling than usual. Passenger lounges and restaurants soon ran out of seating capacity and had no back-up facilities available. Hotels near the relevant airports quickly became booked up so it was hard for passengers to find accommodation. And most important of all, alternative flights were fully booked very quickly, leaving many passengers stranded for several days. The Panel recommends that ***airports should review and aim to improve their arrangements for making extra support available for passengers during periods of significant disruption [R26]***. Such facilities would include seating, toilets, food and drink supplies, and might also include charging points, activity packs for children, pillows/blankets for passengers experiencing lengthy delays, and extra car parking at no or low charge. Given that it is clearly not possible for airports to have substantial extra facilities which would be redundant during periods of normal working, consideration should be given to opening up restricted lounges to those in need. The Panel also recommends that ***the CAA, as part of its licensing arrangements, should consider whether major airports should develop a consumer resilience plan which identifies risks, contingencies and mitigations to deal with major disruptions [R27]***.

3.24 In circumstances of disruption, it remains the clear duty of the airlines to be there for their customers. In many cases they made huge efforts, and spent considerable sums doing so. Nevertheless, as noted above, the Panel has heard of some examples of very poor service. The Define research identified two large UK airlines which had no representatives at all present in two holiday destination airports, and a number of other examples of representatives appearing only intermittently. There were incidences where incomplete or incorrect information was given about passenger rights, where no food or drink was offered, or where food vouchers were not accepted or were insufficient to cover the cost of

a meal, and where hotel accommodation was offered for fewer days than was required. The Panel recommends that ***airlines operating flights to, from or within the UK should always have sufficient staff or authorised representatives at the departing airport (not just check-in staff employed by other airlines who are not authorised to do anything else) who can speak on behalf of the airline and support passengers in need of information or assistance [R28]***. Furthermore, the Panel recommends that ***airlines should review, together with the relevant airports, the adequacy of any food and drink vouchers offered to passengers, to ensure they are sufficient to cater for likely needs and are accepted at a sufficiently wide range of outlets within or near the airport [R29]***.

3.25 It is particularly disturbing that leaflets were handed out by at least one airline stating that the passengers had to make their own plans to get home, with no offer of assistance from the airline to find alternative flights, and that they should claim reimbursement for any out of pocket costs, without any offer of vouchers or other upfront means to assist in the cost of refreshments or accommodation. The Panel also heard of cases where passengers were left to make their own arrangements and have not received any refund for the costs incurred. On attempting to contact the airlines they were told that they were not entitled to any refund as the incident was outside the airline's control, or in some cases they received no information about how to make a claim.

3.26 The limitations of the Panel's evidence base make it impossible to know how common these examples of poor customer service (in breach of Regulation 261) were. Indeed, there were some good examples of individuals being offered all the appropriate assistance in line with the relevant regulations. Based on the consumer evidence, it is the view of the Panel that during a time of severe disruption the usual approach to informing passengers of their rights (standard notices at airline desks, websites and other online or call facilities that can get overwhelmed during a crisis etc.) is not sufficient, and that consideration should be given to developing a more comprehensive suite of information tools, including public announcements, appropriate numbers of representatives circulating in and around the airport (possibly with tabards to clearly identify them) with standardised leaflets about passenger rights to hand out liberally. All leaflets should contain the same information. Pro-active communication tools should include warnings of possible disruption at the earliest possible stage, and frequent updates whether or not there is anything new to report. Such communication should be multi-channel including email, text, smartphone apps, public announcements and information boards. It is vital that information is provided through digital and non-digital media, as digital communication is more convenient for many passengers, but some are unable to access digital media for a variety of reasons. The Panel recommends that ***airlines and airports should develop a comprehensive suite of tools for communicating with consumers, for example using tannoy announcements at airports alongside emails, text messages and information boards to be used whenever a major incident occurs. The CAA should have a guiding hand in ensuring the coordination and delivery of this***

recommendation and should wherever possible promote standardisation of both the means and the content of these communications [R30].

3.27 The CAA has issued the airlines with guidance on acceptable means of compliance with their duties under Regulation 261, including how the option of "pay and claim" should work. It appears to the Panel that this guidance was not followed in all cases, given the number of reports of passengers waiting for refunds weeks or months after claims were submitted. There were also examples of airlines being excessively "picky" about items in submitted claims, or example refusing taxi receipts because they did not look sufficiently "official", refusing to refund a bill for food because it was not suitably itemised or not accepting a food item once it had been translated into English. It may be that none of these behaviours contravene the guidance, but they do appear to be examples of poor customer service. The Panel recommends that ***the CAA should develop and promote the use of a standardised form of communication about consumer rights under Regulation 261. All airlines should use the communication consistently and it should be available at all airports, at all times, overseas (for passengers flying to or from the UK) as well as in the UK. Government should consider amending UK261 to require this standardised communication, which would then be enforced by the CAA. [R31]***. The Panel also recommends that ***airlines should review their claims processes to ensure that information given to passengers about how to claim (under Regulation 261 or other consumer rights legislation) is clear and provided in a timely fashion, and that all claims are processed with pace and courtesy [R32]***.

3.28 The confusion experienced by passengers as a result of inconsistent and incomplete information is compounded by the confusing landscape of redress arrangements in this sector. There are two relevant ADR providers, with some airlines belonging to one, some to the other, and some to neither as membership is not mandatory in aviation, as it is in most regulated sectors. The Panel recommends that ***Government should implement as a priority making ADR membership mandatory for all airlines operating to, from and within the UK [R33]***.

3.29 It is noteworthy that an air traffic control problem which was fixed within six hours, during which time a combination of stored data and manual processing of flight data allowed some flights to continue albeit at reduced capacity, caused so many cancellations and delays with knock-on effects for so many days. The Panel has considered whether, with the benefit of hindsight, the impact on passengers would have been reduced if more flights had been delayed rather than cancelled. However almost all those the Panel spoke to, including those representing the interests of passengers, are in agreement that any further delays in making decisions to cancel flights would have exacerbated the uncertainty and probably made passengers' experience even worse.

Chapter 4

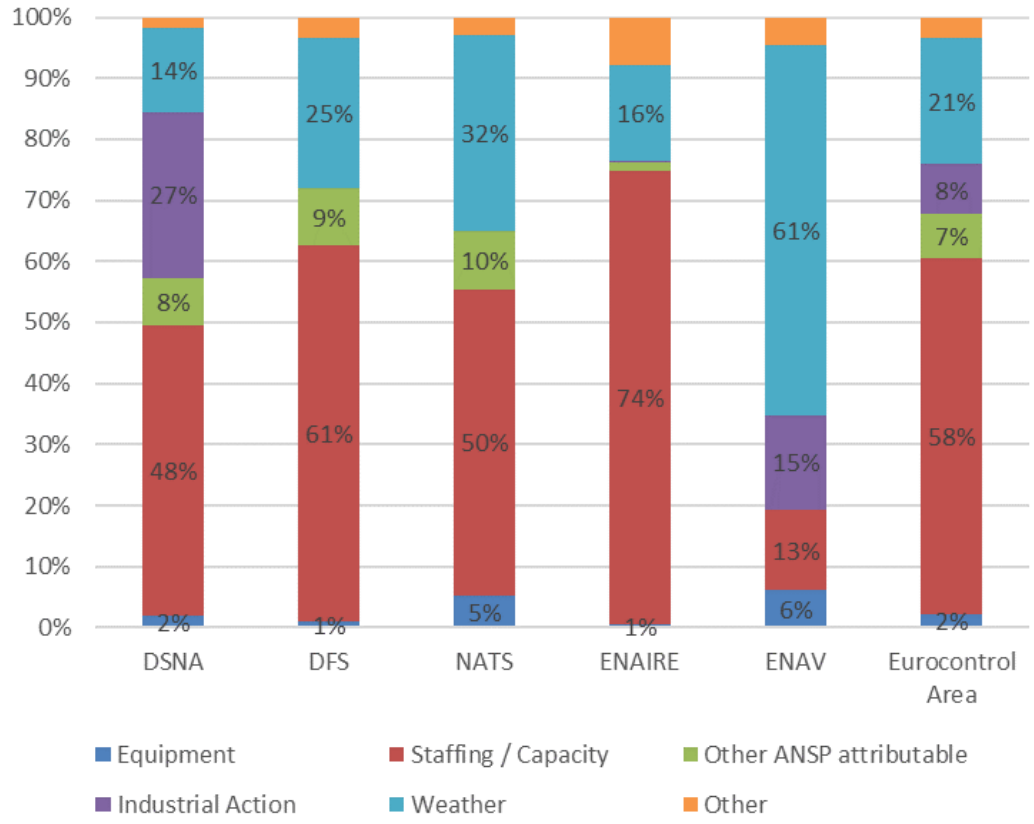
Performance incentives and allocation of resilience risks

TOR #5: Performance and incentives

4.1 The panel reviewed a number of performance measures across European Air Navigation Service Providers (ANSPs). NERL is usually compared with 4 other large European ANSPs namely those in France (DSNA), Germany (DFS), Spain (ENAIRE) and Italy (ENAV). These are considered the most relevant for comparison in terms of complexity, volume and geography, but the Panel also looked at the 20 largest ANSPs in Europe. The Panel assessed the number of overall levels of Air Traffic Flow Management (ATFM) delay minutes, the ATFM delays deemed to be ANSP-attributable and, specifically, delays caused by equipment failure.

4.2 "Equipment" delays in this context includes all system-related issues, including those attributed to software and hardware outages. Since 2011, the proportion of such failures represent just over 5% of the total en route ATFM delays for NERL. Figure 4.1 shows that air traffic control (ATC) staffing and capacity delays combined account for the vast majority of ANSP attributable delays.

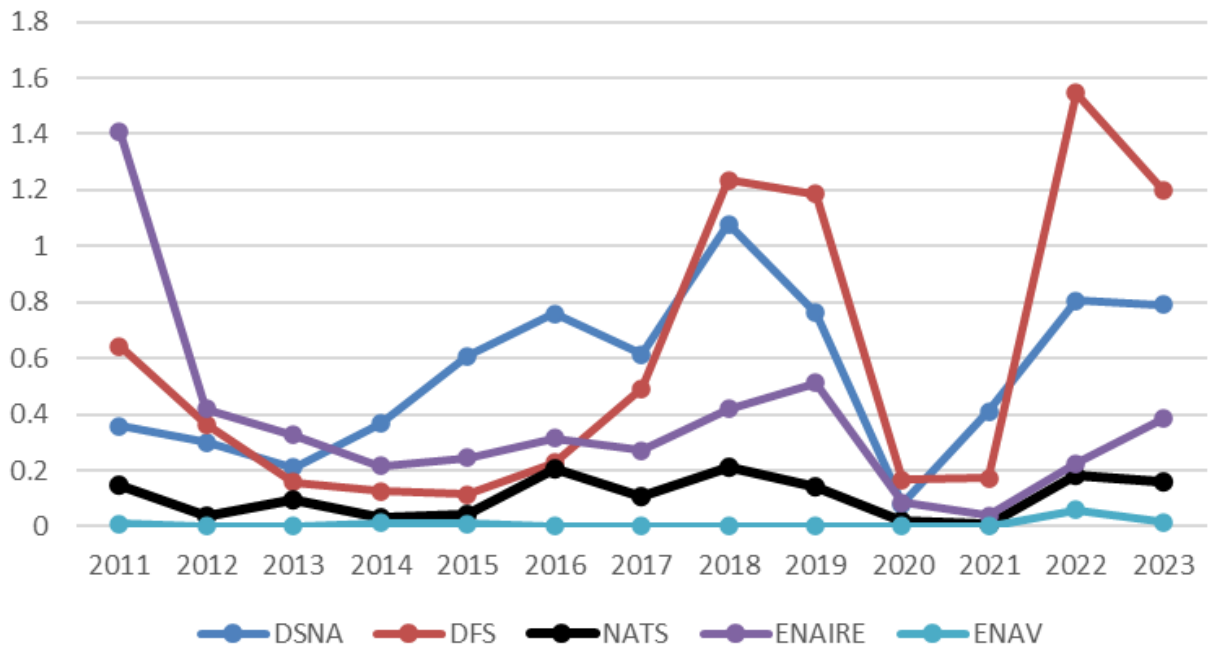
Figure 4.1: Share of en route ATFM delay minutes by reason between 2011 and 2023



Source: CAA analysis of en route ATFM delay data in http://ansperformance.eu/data/.
NERL comparators: DFS (Germany) DSNA (France); ENAV (Italy); ENAIRE (Spain).

4.3 NERL service performance, when measured in terms of ANSP-attributable delays and equipment delays, has been relatively good when compared with similar ANSPs in Europe. Figure 4.2 shows that ANSP attributable delay has generally been lower in the UK than in Germany, France and Spain but higher than Italy. Direct comparisons should be treated with caution given the varying complexity of airspace in different parts of Europe. It should be noted that ATFM "delay minutes" do not take any account of cancellations (or knock-on delays), so on a day when a lot of flights are cancelled (such as 28 August 2023) this measure significantly understates the impact on passengers.

Figure 4.2: ANSP attributable delay minutes per flight

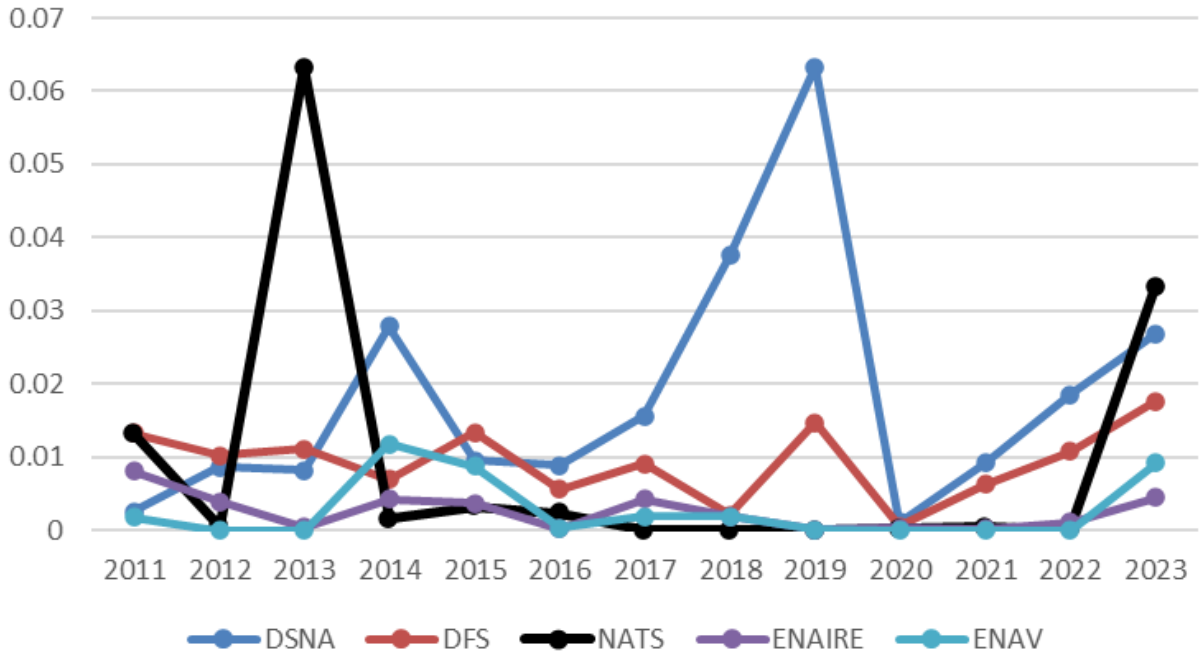


Source: CAA analysis of en route ATFM delay data in http://ansperformance.eu/data/.
NERL comparators: DFS (Germany) DSNA (France); ENAV (Italy); ENAIRE (Spain).

4.4 When looking specifically at ATC equipment delay, Figure 4.3 shows that NERL generally performs well compared with its peers. However, there were two very significant incidents in 2013 and 2023, the second of which was the trigger for this Independent Review. Both incidents had a very significant impact on delay time only matched by DSNA's 2019 and 2018 delays, when measured in terms of annual equipment ATFM delay per flight.

4.5 The high level of delay experienced by passengers from these incidents is clearly the result of a major disruption to one of the busiest airspaces in Europe but also highlights the need for commensurate contingencies and resilience to mitigate the impacts. Through conversations with European ANSPs, the panel noted a correlation between the level of sophistication of resilience and incident scenario planning on the one hand, and the general level of disruption experienced on the other.

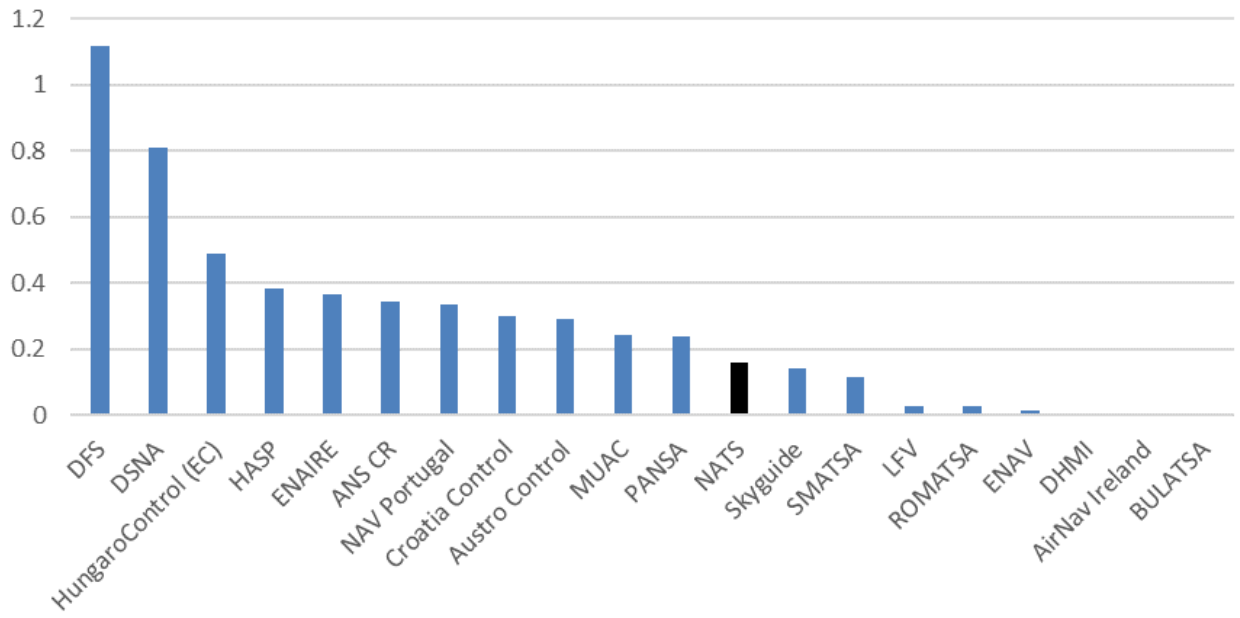
Figure 4.3: ATC equipment delay minutes per flight



Source: CAA analysis of en route ATFM delay data in http://ansperformance.eu/data/.
NERL comparators: DFS (Germany) DSNA (France); ENAV (Italy); ENAIRE (Spain).

4.6 Figure 4.4 shows that, over a period of 5 years (excluding 2020 and 2021, the years most affected by the traffic downturn caused by Covid-19, when there were few delays), compared with the top 20 other ANSPs in Europe, NERL's performance was 9th out of all 20 comparators and 2nd in the group of 4 similar ANSPs. It had lower delays compared with the two largest ANSPs, but, as some airlines have pointed out, NERL delays were much higher than some other ANSPs, including ENAV and AirNav. If the two worst performers (DSNA and DFS) are excluded from the sample, NERL's share of delays is broadly in line with its share of traffic.

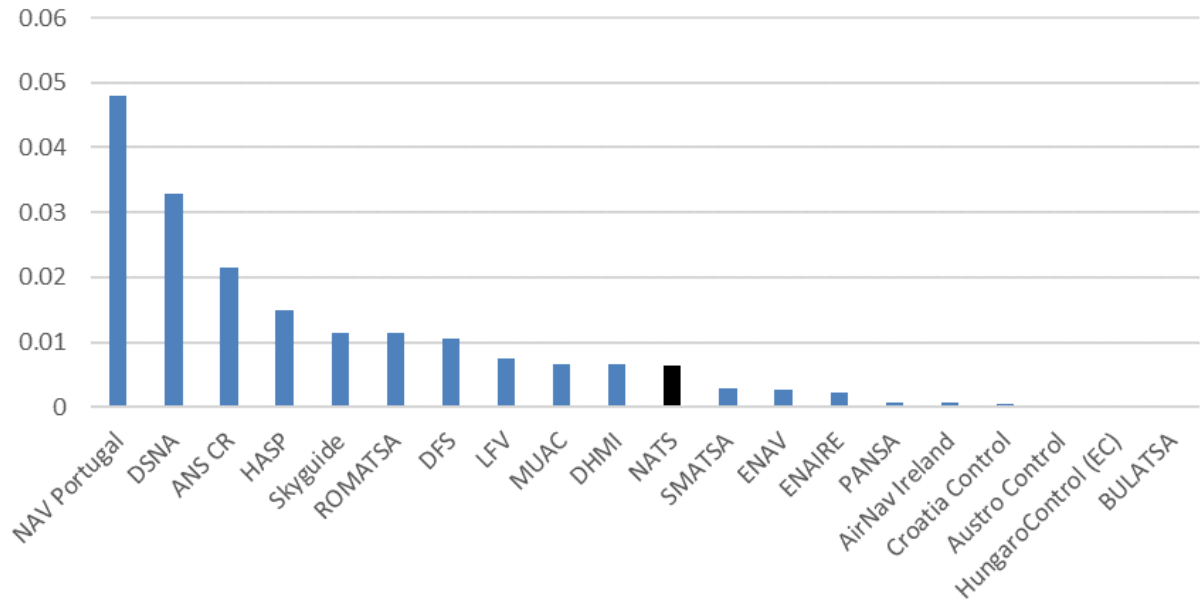
Figure 4.4: Top 20 ANSPs attributable delay minutes per flight



Source: CAA analysis of en route ATFM delay data in http://ansperformance.eu/data/.
Over 5 years excluding 2020 and 2021 – i.e. 2017, 2018, 2019, 2022 and 2023.

4.7 A similar picture emerges in terms of ATC equipment delays per flight. Figure 4.5 shows that NERL is not among the worst performers but there are other ANSPs that perform better.

Figure 4.5: Top 20 ANSPs ATC equipment delay minutes per flight



Source: CAA analysis of en route ATFM delay data in http://ansperformance.eu/data/.
Over 5 years excluding 2020 and 2021 – 2017, 1018, 2019, 2022, 2023

Measures and the basis of incentives

4.8 It is often the case that a delay on one flight often leads to knock-on delays and/or cancellations later on. The case studies about the impact of the 28 August incident on passengers, as well as the analysis of the financial impact on other parts of the aviation system, demonstrate that cancellations and knock-on delays have a significant detrimental effect on passengers and airlines. This in turn suggests that the measurement and incentivisation of NERL performance solely in terms of ATFM delay minutes should be reviewed. It is appreciated that the current metrics are based on international norms; flight cancellations and knock-on delays can be the result of a variety of causes out of the control of NERL; and these metrics have been considered previously without any resulting change. However, the complexities involved in drawing up an incentive which includes cancellations and knock-on delays, and the fact that the UK might be the first country in Europe to attempt this, should not deter the attempt and put it into the "too difficult" pile, given the huge impact of mass cancellations and knock-on delays on passengers and on airlines. The Panel therefore recommends that ***the CAA should explore ways of measuring cancellations and knock-on delays attributable to NERL for use in its incentive framework [R16]***. This should include incorporating some measure of passenger and stakeholder impact.

4.9 NERL describes itself as "a world leader in air traffic management".[13] The Panel has seen evidence that NERL does compare its performance, in terms of attributable delay minutes, to other European ANSPs. However, the Panel has not been made aware that NERL has any stated objective, in terms of its comparative performance. The Panel recommends that ***NERL should consider formulating (after discussion with its major customers and stakeholders) an ambition in terms of comparative performance as against other ANSPs [R17]***.

Oversight model and sector comparisons

4.10 NERL is the monopoly provider of en route services in the UK. Since its privatisation in 2001, it has been subject to economic regulation by the CAA under the Transport Act 2000 (TA00). A key part of these arrangements is the price controls set by the CAA. Price controls for NERL are set out under determined regulatory periods which normally cover five years. For the current regulatory period known as NR23 (covering 2023-2027), the CAA set out its final decision in October 2023. The CAA's price controls include projections of the efficient levels of NERL's costs as well as incentives for NERL to provide resilient, efficient, and high-quality services. This includes service quality targets and incentives that provide reputational and financial incentives on NERL to improve its performance on delay and the environment.

4.11 NERL maximum capacity penalties amount to a relatively modest 1.25% of NERL's "determined costs", which is equivalent to approximately 1% return on regulated equity.

[13] NATS, about us

This rises to a maximum of 1.75% of determined costs or 1.4% return on regulated equity if a flight efficiency metric is also taken into account. Potential bonuses are much smaller than potential penalties. The determined costs line is the core component of NERL's regulated revenue allowance (NERL regulated revenue allowance can be higher or lower than its "determined costs" due to application of pluriannual price adjusters). The Panel considers this to be relatively modest in relation to the overall cost of the incident, and also in relation to NERL's financial position.

4.12 The Panel has received information regarding incentive regimes in other regulated sectors. A reasonable parallel is in the economic regulation of electricity Distribution Network Operators (DNOs) by Ofgem. DNOs are regional monopolies, responsible for the delivery of electricity to houses and businesses, hence have considerable responsibility for continuity of supply as well as a strict duty to ensure safety, and are incentivised in their regulatory regime to minimise power cuts. A recent example of major outage was Storm Arwen, which resulted in considerable disruption to supply, especially in the North of England. The financial penalty incurred by the responsible DNOs (similar in size to NERL) was considerably in excess of the financial penalty incurred by NERL for the 28 August incident.

4.13 A similar parallel is Ofgem's regulation of the offshore transmission owner (OFTO) regime because there is a similarity in the industry structure. OFTOs own and manage the cables that connect offshore windfarms to the onshore grid. If an OFTO cable is unavailable, then the windfarm owner loses 100% of their revenue because they have no way of exporting their electricity to the grid. The offshore windfarm owner stands to lose much more than the OFTO in the event of an OFTO outage. So, there is the same dynamic of a relatively small player being able to disproportionately impact the business of other players. In the case of OFTOs, up to 50% of their yearly revenue is at risk, with the financial incentives applied due to significant outages being smoothed over several years (up to 10% a year for up to 5 years).

4.14 The Panel recommends that ***the CAA should review the quantum and mechanism of incentives on NERL, with a view to strengthening the incentives to provide a resilient as well as a safe service [R18]***.

4.15 The CAA's scrutiny of the effectiveness of NERL's investment programme has been described by some airlines as appearing to be relatively light compared to the scrutiny given to the investment plans of some regulated utilities by their respective regulators. The Panel notes that the level of consumer input and challenge to NERL's investment plans is low compared to other regulated sectors. The establishment of Consumer Challenge Groups and Customer Engagement Groups in water and energy is acknowledged as having significantly improved the quality of companies' business plans.

Although the effectiveness of some of these groups has been questioned, the best of them appear to represent good practice in respect of regulated monopolies.[14]

4.16 The CAA, in conjunction with the airline community and Heathrow Airport Ltd, itself set up a consumer challenge board to scrutinise and critique the airport's business plans in respect of its then forthcoming regulatory period. In a similar manner the panel recommends that ***the CAA should ensure that its NERL business plans guidance includes a clear focus on outcomes associated with resilience and consumer impact, as well as safety and efficiency [R19]***. The degree of improvement tracking should be exacting, with potentially a facility to review the consequences for allowable investment if results are unclear or not being delivered in a timely manner.

4.17 As a comparison, the UK's financial services sector operates within a multi-layered regulatory framework. This framework has a threefold aim: guaranteeing the operational resilience of financial institutions, safeguarding consumer protection and holding both firms and individuals accountable for their conduct. A cornerstone of this framework is the 2021 Operational Resilience rules. These demand proactive identification, assessment, and management of potential operational risks, including both internal vulnerabilities and external threats. Critically, firms must demonstrate their ability to absorb, adapt, and effectively respond to disruptive events while maintaining the delivery of essential services.

4.18 Consumer protection, another crucial pillar, is addressed through a diverse set of regulations overseen by the Financial Conduct Authority (FCA). These regulations shield consumers from a range of harmful practices, encompassing misleading advertising, the mis-selling of financial products, and unsuitable investments that could cause financial hardship. Reinforcing accountability within the sector is the Senior Managers and Certification Regime (SMCR) implemented in 2009. Under this regime, individuals holding key positions within financial institutions are personally accountable for ensuring their firm's compliance with regulations. Additionally, certain roles within the industry require certification by the FCA, guaranteeing the competence and ethical fitness of those entrusted with sensitive financial responsibilities.

4.19 The overarching framework for all these regulations is established by the Financial Services and Markets Act 2000. Specific regulations within this framework, such as the FCA Principles for Business, the Consumer Credit Act 1974, and Parts 7 and 8 of the Financial Services Act 2012, collectively define the expected standards of conduct and consumer protection across the financial services sector. To incentivise adherence to the standards, the framework also incorporates a system of rewards and penalties. Firms demonstrating robust operational resilience and strong consumer protection practices may be rewarded with regulatory recognition, improved market access, and reduced supervisory oversight. Conversely, non-compliance can lead to material consequences.

[14] See, for example, Chapter 2 of RIIO-ED2 Final Determinations Core Methodology.

Firms themselves may face hefty fines, licence suspension and requirements to provide redress to affected consumers. In certain cases, senior managers can be held individually accountable through personal fines, disqualification from holding regulated positions or even criminal prosecution. This multi-layered regulatory framework demonstrates the ability of a regulated sector to foster a responsible and resilient multi-agency ecosystem that prioritises not only strict operational stability but also robust consumer protection.

4.20 In the same manner as other sectors, paramount to the implementation of extended regulatory oversight and incentivisation is the availability of data. In particular, the ability for the CAA to have broader information gathering powers (as outlined in Chapter 3 above) is essential in ensuring that improvements can be made based on consistent and unambiguous information such as those associated with passenger complaints and airline/airport incident-related costs.

Trade-offs between safety, efficiency and consumer impact

4.21 The Panel recognises and supports the position that for NERL flight safety is its overriding priority. Following this, airspace efficiency is an imperative but is adapted to maintain a safe environment. The regulatory regime rightly prioritises the maintenance of "a high standard of safety in the provision of air traffic services", and NERL has statutory duties to take all reasonable steps to secure that the system is efficient and co-ordinated, as well as to secure that the demand for air traffic services is met. For passengers too, safety is clearly the top priority as is ensuring their journeys are efficiently provided. However, it is clear from the consumer research commissioned by NERL[15] that consumers value resilience as a highly ranked concern. Passengers will mostly understand that minor delays can occur regularly and that the sector is, in the main, effective at resolving these. Resilience, within the lens of major incidents for passengers, means avoiding long, disruptive delays which materially affect their journeys, subsequent plans, finances and wellbeing. Notwithstanding the economic trade-offs that are required and indeed are already considered, the Panel questions whether the overwhelming prioritisation accorded to safety has meant that less progress has been made in improving resilience and its impact on customers and passengers.

4.22 As a comparison, in terms of safeguarding consumers during disruptions, the UK's energy sector strikes an effective balance between both regulatory measures and industry initiatives. A two-pronged approach ensures consumers receive not only essential support but also financial assistance in times of need.

4.23 For vulnerable consumers, the Priority Services Register puts those most at risk at the forefront of communication, guaranteeing priority outage notifications, meter readings and welfare checks. Additionally, financial safety nets such as Winter Fuel Payments, Cold

[15] Blue Marble, Passenger research for price control reset, Dec 2021.

Weather Payments and other mandatory support measures offer further protection measures for vulnerable consumers.

4.24 Complementing these regulations are proactive industry initiatives such as the Vulnerability Commitment adopted by energy suppliers. This commits them to continual improvement in supporting vulnerable consumers through accessibility, collaboration, and innovation.

4.25 Through this approach, in a period of significant price volatility, the UK's energy sector prioritises both safety and consumer protection, demonstrating a commitment to safeguarding consumers, especially those most vulnerable, during challenging situations. A similar emphasis on vulnerability may not be quite as essential for NERL given that it has no consumer-facing role (unlike airports and airlines, who should indeed emphasise vulnerability issues), but the experience from other sectors of dealing with multiple objectives could certainly be used as a lesson in how to improve NERL's focus on resilience and communication without losing any of its safety focus. The Panel recommends that ***NERL should review its strategic approach to resilience, as is common among other safety-critical regulated sectors, recognising the importance to the public of resilience alongside safety and efficiency [R20]***.

TOR #8: Allocation of financial risks

4.26 The Panel's analysis of the incident suggests that the following stakeholders have had to shoulder the risks and financial burdens arising from it:

- **NERL:** A relatively modest penalty associated with not meeting some of its performance incentive targets (approximately £1.8m)[16], plus any costs associated with rectifying the software problem on the day and removing the risk of its re-occurrence.

- **Airlines:** Costs borne by airlines associated with re-routing or reimbursing passengers, including in some cases laying on rescue flights, and providing care and assistance (such as hotel accommodation and food). The Panel received estimates for these costs from the airlines most affected by the incident (representing, between them, over 80% of the impacted passengers); some of the airlines gave this information in confidence. Based on those declared costs, the Panel estimates that airline total costs for this incident to have been approximately £65m. Ryanair's initial estimate for this incident was £15m, however it has subsequently revised its estimated costs to approximately £4.6m. TUI estimates its costs to have been £5.3m. Costs per impacted passenger (i.e. those affected by cancellations or long delays), where figures

[16] NERL estimates that, for 2023, it will be liable to face a financial penalty of approximately £1.8m for not meeting some of its capacity targets for NERL attributable en route ATFM delay. Excluding the delays due to the incident on the 28 August 2023, NERL performance throughout 2023 would have resulted in no financial penalty.

were available, ranged between £73 and £329. To be clear, these are costs incurred by airlines per passenger; not the costs incurred by individual passengers.

- **Tour operators and travel agents:** Other costs associated with re-routing or reimbursing passengers and providing care and assistance, for those passengers who booked package holidays. Information on the scale of these costs was not made available to the Panel.

- **Passengers:** Costs borne by passengers for which they have not been reimbursed by airlines. Passengers are normally entitled to claim pre-specified amounts in compensation for delays and cancellations. This compensation ranges from £110-520 per person depending on the length of the delay and the timing of the replacement flight and the flight distance. This can help off-set any costs or loss of amenity passengers cannot recover from the airline. None of the over 700,000 passengers estimated to have been impacted by the incident were entitled to such compensation since it was considered to be an "extraordinary circumstance", though they were entitled to reimbursement of reasonable costs incurred. Even though the airlines, tour operators and travel agents were responsible for the direct costs of re-routing, care and assistance, regardless of the cause of the disruption, evidence suggests that passengers in practice had to pay a significant proportion of these costs upfront and may not have been fully reimbursed. Many passengers incurred costs which they could not recover, for example, the loss of pre-paid holidays, lost income from work to which passengers were not able to return, and other consequential losses. The total costs of this large group would be very difficult to calculate but is likely to have been many millions of pounds.

- **Airports**: Airport operators lost aeronautical revenues from passengers not flying; from lost retail sales; from waived parking charges and from other passenger services. Also, additional staff had to be called in to help cope with congestion in the terminal buildings. Again, the Panel received information from a limited number of airports about the extent of these losses, however it estimates the costs to airports to have been in the region of single digit millions of pounds.

4.27 **Overall**, it is likely that the overall downstream cost of the incident to have been in the range of £75-100m.

4.28 The Panel considered the role of Frequentis Comsoft, the organisation that developed and provided engineering support to the FPRSA-R system. In this regard, although the Panel considers that they have a degree of responsibility associated with the root cause (as covered within Chapter 2), ultimate accountability for quality control and risk mitigation lies with NERL as the service provider. NERL faces some, albeit rather limited, financial incentives to provide a resilient service. It argues strongly that it would not be appropriate to face substantial downstream liabilities arising from the interruption of the provision of air traffic services, even where this is directly attributable to its systems or mistakes, as this might discourage the use of tactical or strategic measures designed to maintain safety

performance, but which inevitably cause delays or disruption and therefore costs which would ultimately be borne by the airlines. The Panel does not share this view, as the primacy of safety is strongly embedded in the regime and in the culture of NERL, as well as in the legislation and its licence. The Panel believes that the CAA and NERL should both consider how to maintain safety as a priority whilst delivering an efficient aviation system as well as addressing the needs of consumers, as demonstrated in other sectors (see Recommendation 19). Indeed, the provision of enhanced consumer-based incentives and regulatory requirements would ensure that safety has a greater degree of transparency in the eyes of the travelling public, including a higher level of appreciation of the cost of providing a resilient and safe service.

4.29 In terms of responsibility for the costs caused by disruption, especially on the scale of this incident when compared with allocations in other jurisdictions and industries, an instructive example is provided by the rail sector, where responsibility for delays is allocated on a detailed basis between the train operating companies and Network Rail. This regime has been criticised in the 2021 Williams Report as unnecessarily bureaucratic and expensive, and adding no value to the consumer experience, though others argue that it does lead to a full examination of what went wrong which in turn drives improvement. There are three notable features of the rail industry regime that distinguish it from aviation: in rail the system of "Delay Repay" has no exceptions (e.g. for "extraordinary circumstances" as in aviation), so consumers know they are entitled to compensation from the train operating company irrespective of the cause; the amount of compensation is linked to the amount paid for the ticket rather than by reference to a set formula; and Network Rail does bear responsibility for compensating train operating companies for their outlay in reimbursing passengers where the fault is attributed to Network Rail.

4.30 The rail regime, based on "no exceptions", is clearer than the aviation regime for consumers and provides them with more certainty about their eligibility for compensation. Nevertheless, the Panel is not recommending that the aviation regime should adopt the rail precedent. To impose further financial burden on the airlines, in circumstances where they are demonstrably not at fault, would be unreasonable. To expose NERL to an unlimited risk would also be difficult because the ownership structures and economics of the respective sectors are very different, and the potential burden on NERL, in the event of a substantial system failure, would be disproportionate to its revenues. Such a liability would probably lead to a substantial increase in the annual costs of the ATC service, which could in turn lead to increased costs to airlines and passengers, and would put NERL in a very different position from those of its European or North American comparators. The Panel is therefore restricting its recommendations for change in this regard to those on financial incentives (see Recommendation 16 and Recommendation 18, described in paragraphs 4.8 and 4.14 above). However, for the avoidance of doubt, the Panel recommends that ***Government should ensure that existing consumer rights protections, including those embedded within Regulation 261, are not diluted in any future reviews of the legislative framework [R34]***.

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Chapter 5
Summary of recommendations

5.1 In Chapters 2-4 above the Panel has analysed the evidence received against the eight TORs which have guided its work and made recommendations accordingly. For the convenience of those reading this report and seeking to decide on next steps, a summary list of those recommendations is included here, listed in order of the TORs provided (as set out in Appendix B), which in some cases differs from the order in which they appear in the earlier chapters. To understand the context and rationale for each of the recommendations, readers should refer back to the relevant chapters.

5.2 The Panel encourages the CAA, Government, NERL, airlines and airport operators to implement these recommendations as soon as possible. The CAA should monitor the implementation of all of them. The Panel also considers that there should be a periodic review by the CAA, evaluating the impact of the actions taken by all relevant parties as a result of this report.

TOR #1: Cause and prevention

Recommendation 1: NERL should review in detail its contingency arrangements for significant disruption to ensure that maximum airspace capacity continues to be available without the need for flight restrictions for as long as possible, and if restrictions are required, that they are kept to a minimum. [*Para 2.21*]

Recommendation 2: NERL should reconsider its engineering resource management arrangements to provide timely onsite coverage with engineers of sufficient skill levels that are matched to aviation system demand. [*Para 2.30*]

Recommendation 3: NERL should undertake a review of its software assurance process. [*Para 2.34*]

Recommendation 4: NERL should review its policy for the diversity of software, including an evidenced explanation of which systems have such diversity and which do not. [*Para 2.36*]

TOR #2: Industry communication and engagement

Recommendation 5: NERL should consider the need to give earlier notification to airlines and airports of possible disruption, together with frequent updates, ideally this should be based on pre-arranged timings and frequencies. [*Para 2.44*]

Recommendation 6: NERL should review all aspects of its procedures for communicating with stakeholders during periods of significant disruption, and in particular its operation of ATICCC. [*Para 2.45*]

Recommendation 7: All relevant parts of the aviation sector should meet on a regular basis to conduct rehearsals of major incident management. The **CAA** should consider taking a role in facilitating this activity. [*Para 2.49*]

Recommendation 8: NERL and its customers should consider how best to achieve a more collaborative relationship through establishing a senior leadership forum in which matters of resilience and customer experience can be addressed. The **CAA** should consider how it could facilitate and encourage this process. [*Para 2.50*]

TOR #3: Resources and resilience

Recommendation 9: NERL should review change notifications previously submitted to the CAA and which have been noted as having an impact upon Cyber Security controls, and bring these to the attention of its Cyber Security Responsible Manager for any necessary actions to be completed. [*Para 2.55*]

Recommendation 10: **NERL** should review its processes for the submission of change notifications to the CAA, to ensure that all necessary internal coordination is completed prior to submission. [*Para 2.55*]

Recommendation 11: The **CAA** should review its resources for the oversight of NERL's safety critical systems to ensure these remain sufficient. [*Para 2.59*]

Recommendation 12: The **CAA** should review its processes for the sampling of new and changed NERL air traffic systems to ensure these remain sufficient to inform its view of NERL's safety performance. [*Para 2.59*]

Recommendation 13: The **CAA** should ensure that the impact on airspace capacity of contingency mode operations is given sufficient importance when selecting air traffic control systems for audit in advance of approval. [*Para 2.60*]

TOR #4: Investment

Recommendation 14: NERL should review its level of strategic oversight in relation to its change programme. [*Para 2.65*]

Recommendation 15: The **CAA** should consider how best to ensure that the interests of consumers are taken into account in setting the regulatory framework on investment and incentives for NERL. [*Para 2.66*]

TOR #5: Performance and incentives

Recommendation 16: The **CAA** should explore ways of measuring cancellations and knock-on delays attributable to NERL for use in its incentive framework. [*Para 4.8*]

Recommendation 17: NERL should consider formulating (after discussion with its major customers and stakeholders) an ambition in terms of comparative performance as against other ANSPs. [*Para 4.9*]

Recommendation 18: The **CAA** should review the quantum and mechanism of incentives on NERL, with a view to strengthening the incentives to provide a resilient as well as a safe service. [*Para 4.14*]

Recommendation 19: The **CAA** should ensure that its NERL business plans guidance includes a clear focus on outcomes associated with resilience and consumer impact, as well as safety and efficiency. [*Para 4.16*]

Recommendation 20: NERL should review its strategic approach to resilience, as is common among other safety-critical regulated sectors, recognising the importance to the public of resilience alongside safety and efficiency. [*Para 4.25*]

TOR #6: Consumer impact

Recommendation 21: Government should, as a matter of urgency, introduce legislative change to enhance the CAA's information powers to assist the enforcement of breaches of consumer rights laws in the aviation sector, to make them comparable with those available to other sector regulators. [*Para 3.2*]

Recommendation 22: The **CAA** should consider expanding the resources devoted to consumer rights enforcement and stepping in more readily in response to intelligence of a flagrant breach, not just in response to overwhelming and recurring evidence of breaches over a period. [*Para 3.8*]

Recommendation 23: Government should promote legislation to enable the CAA to take consumer enforcement action without recourse to the courts. [*Para 3.9*]

Recommendation 24: Government should consider the appointment of a statutory consumer body to collect, research and represent the views of air passengers and air freight users. [*Para 3.17*]

Recommendation 25: Airports and airlines should review their arrangements for meeting the needs of passengers in vulnerable circumstances during periods of significant disruption, including those travelling with children. [*Para 3.21*]

TOR #7: Aviation system response

Recommendation 26: Airports should review and aim to improve their arrangements for making extra support available for passengers during periods of significant disruption. [*Para 3.23*]

Recommendation 27: The **CAA**, as part of its licensing arrangements, should consider whether major airports should develop a consumer resilience plan which identifies risks, contingencies and mitigations to deal with major disruptions. [*Para 3.23*]

Recommendation 28: Airlines operating flights to, from or within the UK should always have sufficient staff or authorised representatives at the departing airport (not just check-

in staff employed by other airlines who are not authorised to do anything else) who can speak on behalf of the airline and support passengers in need of information or assistance. [*Para 3.24*]

Recommendation 29: Airlines should review, together with the relevant **airports**, the adequacy of any food and drink vouchers offered to passengers, to ensure they are sufficient to cater for likely needs and are accepted at a sufficiently wide range of outlets within or near the airport. [*Para 3.24*]

Recommendation 30: Airlines and airports should develop a comprehensive suite of tools for communicating with consumers, for example using tannoy announcements at airports alongside emails, text messages and information boards to be used whenever a major incident occurs. The **CAA** should have a guiding hand in ensuring the coordination and delivery of this recommendation and should wherever possible promote standardisation of both the means and the content of these communications. [*Para 3.26*]

Recommendation 31: The **CAA** should develop and promote the use of a standardised form of communication about consumer rights under Regulation 261. **All airlines** should use the communication consistently and it should be available at all airports, at all times, overseas (for passengers flying to or from the UK) as well as in the UK. **Government** should consider amending UK261 to require this standardised communication, which would then be enforced by the CAA. [*Para 3.27*]

Recommendation 32: Airlines should review their claims processes to ensure that information given to passengers about how to claim (under Regulation 261 or other consumer rights legislation) is clear and provided in a timely fashion, and that all claims are processed with pace and courtesy. [*Para 3.27*]

Recommendation 33: Government should implement as a priority making ADR membership mandatory for all airlines operating to, from and within the UK. [*Para 3.28*]

TOR #8: Allocation of financial risks

Recommendation 34: Government should ensure that existing consumer rights protections, including those embedded within Regulation 261, are not diluted in any future reviews of the legislative framework. [*Para 4.30*]

APPENDIX A

Review Panel's short biographies

Jeff Halliwell

Jeff's executive experience is in Chief Executive Officer roles with consumer-facing businesses such as Fox's Biscuits/Northern Foods, First Milk and Bernard Matthews. His background is in international marketing and commercial roles with blue-chip businesses such as Mars and Colgate. He also ran a private equity backed tech business. Jeff now has a varied chair and non-executive portfolio across private, public, and third sector organisations, particularly supporting organisations with a social purpose. Among other previous roles, he has been Chair of Cafedirect plc and Airport Coordination Ltd, and a non-executive director of Working Links Ltd and Natures Menu pet food. He has served as a trustee of Shaw Trust and Homestart Leicester, and as a non-executive director in a number of NHS organisations. He is a former Chair of watchdog Transport Focus and of the Customer Challenge Board in respect of Heathrow Airport Ltd. He is currently Chair of the Coal Authority, Deputy Chair of the Sea Fish Industry Authority, and a non-executive director of Widgit, a small educational software company.

Sarah Chambers

Sarah is an expert in regulation, consumer and competition policy and advocacy, with experience as Chief Executive of the postal services regulator and wide-ranging experience as a senior civil servant. She is an Electoral Commissioner and until recently chaired the Legal Services Consumer Panel. She is also a member of the Determinations Panel of the Pensions Regulator, the Consumer Expert Panel of the Office of Rail & Road, and the Judicial Appointments Commission, and has a number of other advisory and trustee roles. She is a former member of the CAA Consumer Panel and of the Competition & Markets Authority Panel.

Phil Cropper

Phil completed twenty years in operational ATC with NATS before joining the UK CAA in January 2000 as an ATS Inspector. In July 2003 he was appointed to the post of AAA (Airspace, Air Traffic Management & Aerodromes) Northern Regional Manager, the post he left in January 2019. After some project work for CAAi in the role of Senior ATM adviser, Phil is now semi-retired. Phil has a degree in aeronautical engineering from the University of Manchester.

Mark Foulsham

Mark is a highly experienced COO/CIO/CDO, Board Advisor, NED and Transformation Leader. He has a strong track record of driving digital transformation within senior operations, IT and business change delivery roles primarily within the financial services and utilities sectors. Mark originally qualified as a Chartered Civil Engineer working for multinational engineering firm Atkins and subsequently as IT Director within the French group Bouygues and Macquarie Bank. He spent 12 years as CIO at esure Group, including GoCompare, and served three years as Chief Digital Officer for the disability charity Scope. In parallel with that role, he also worked with challenger banks and FinTechs on their digital transformation journeys and authored two books addressing effective data protection. Most recently Mark was COO at Kensington Mortgages overseeing a full spectrum of operational, digital, data and technology-related change programmes.

APPENDIX B

Scope of the review

The below is an extract from the Terms of Reference.

This review will consider available evidence and, as appropriate, make observations and recommendations on the following areas:

1. **Immediate cause of the incident and preventing the occurrence of a similar incident**: The Panel will review the NATS' preliminary report[17] and any relevant subsequent reports from NATS to ensure the cause of the incident is understood and appropriate mitigating actions have been implemented. The Panel will consider whether there are aspects of the events that led to this incident – technical, organisational and cultural – that may require further analysis and whether there are further steps that NATS, the CAA and other stakeholders should take to help it prevent the occurrence of similar incidents.

2. **Incident communication and associated stakeholder engagement**: The Panel will consider the NATS Major Incident Plan and whether any changes may be needed to the way communication of a major incident takes place, both internally and to stakeholders. The Panel should consider whether the NATS policies and protocols on event escalation which were in place were adequately designed and worked effectively.

3. **The resources and resilience arrangements available to NATS' regulated business** to respond to system failures and major incidents in the UK's en route air traffic system: The Panel will consider the availability of NATS technical staff and resources from service partners to respond to major incidents (24/7) and whether it has appropriate resilience arrangements in place to prevent, deal with, and recover from, system failures and similar major incidents.

4. **Broader considerations around investment and infrastructure of NATS' regulated business**: The Panel will consider whether there are any wider lessons from the incident for NATS, the CAA as the regulator, or other parties, regarding the level and nature of previous and planned infrastructure investment by NATS as well as the procedures and approach NATS adopts as part of its infrastructure deployment.

5. **NATS performance and incentives**: The Panel will consider comparable evidence about how well NATS performs against its peers and whether there are any lessons from this incident that should inform the framework for setting of NATS performance targets in the future, and the level of financial consequences

[17] Public version of this report is available at www.caa.co.uk/CAP2582.

faced by NATS not meeting target service levels, noting the need for any incentive scheme to avoid unintended consequences and take into account NATS' responsibilities to provide safe and efficient air traffic services.

6. **Consumer impact:** The immediate impact of the incident led to significant cancellations and delays that affected customers for several days because of the displacement of aircraft and crews and non-availability of alternative flights at the time of year. The Panel will set out an explanation of the generalised impacts of the incident on airlines, airports and consumers, particularly in relation to delays and cancellations and other issues that occurred together with any lessons to be learned.

7. **Aviation system response:** The Panel will assess how the aviation system – including airlines and airports - met their passenger rights obligations and consider the extent to which the sector performed well against its obligations as well as areas for improvement that might lead to better passenger outcomes in the future. This should include airlines and airports response to the incident, their communication with affected passengers, timeliness of re-routeing and re-booking of passengers, availability of additional capacity, the level of costs passengers were expected to "pay and reclaim" and management of vulnerable passengers. The Panel will also consider whether there are further steps that could be taken by airlines, airports and by the CAA (in respect of its guidance) that could allow greater flexibility and better consumer outcomes, ensuring that affected passengers reach their intended destinations in a reasonably timely manner.

8. **Airline and airport costs of providing care, assistance, and re-routeing to consumers**: the Panel will set out how the current UK framework allocates responsibility for these risks and associated costs between different parties and how this allocation works in other comparable states and industries. This will ultimately help inform Government on whether and how it wishes to consider the wider UK policy and legislative framework on these matters.

APPENDIX C

Abbreviations

ACC	Area Control Centre
ACM	Airspace Capacity Manager
ADEXP	ATS Data Exchange Presentation
ADR	Alternative Dispute Resolution
AirNav	The main ANSP in Ireland
AMS-UK	Aeronautical Messaging Switch
ANSP	Air Navigation Services Provider
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
ATICCC	NATS Air Traffic Incident Coordination and Communication and Coordination Cell
ATM	Air Traffic Management
ATS	Air Traffic Services
ATS	Air Traffic Services
CAA	Civil Aviation Authority
CTOT	Calculated Take Off Time
DFS	The main ANSP in Germany
DfT	UK Department for Transport
DSM	Duty Service Manager (the most senior engineer on duty)
DSNA	The main ANSP in France
E&CR	En route and College Regulation
EASA	European Union Aviation Safety Agency (European Safety Regulator)
ENAIRE	The main ANSP in Spain
ENAV	The main ANSP in Italy

EUROCONTROL	International organisation responsible for the air traffic management network in Europe
FCA	Financial Conduct Authority
FPRSA-R	NERL's flight plan processing system (Flight Plan Reception Suite Automated – Replacement)
ICAO	International Civil Aviation Organisation
IFPS	Integrated Flight Planning System
iTEC	Information through European Collaboration
MoD	Ministry of Defence
NAS	UK National Airspace System (Implemented on the Host Computer System)
NATS	NATS Holdings is the parent company of a group that includes NERL, the economically regulated business of NATS Holdings.
NERL	NATS (En Route) Plc - the economically regulated business of NATS. NERL is the UK's main provider of ATS.
NMOC	Network Manager Operations Centre
OFTO	Offshore Transmission Owner
SMCR	Senior Managers and Certification Regime
SMS	Safety Management System
TORs	Terms of Reference
VIRG	Voluntary Industry Resilience Group

APPENDIX D

Incident timeline

Monday 28th August 2023

Local time	Party	Elapsed time	Actions
08:32	NERL	00:00	Flight plan for BF371 received by FPRS-A from IFPS.
08:32	NERL	00:00	Primary and secondary FPRS-A systems fail to successfully process the flight plan data and switch to maintenance mode. Automatic processing of flight plans ceases
08:32	NERL	00:00	Manual input of flight plan data begins
	NERL		Level 1 engineer begins system checks and tests.
08:59	NERL	00:27	Level 1 engineer attempts reboot FPRSA-R software.
09:06	NERL	00:34	First contact with Level 2 engineer on standby remotely.
09:23	NERL	00:51	Duty Engineering Service Mgr. (EASA) notifies Operations Supervisors (OS) at Prestwick ACC, Swanwick ACC & Oceanic ACC and advises to start preparation for operational impact in the event of continuing outage.
09:28	NERL	00:56	DSM sends SMS message to NATS collective major incident managers group.
09:35–09:50	NERL	01:03-01:18	Contact made with: - NATS Technical Services Director; NATS Operations Director; and NATS CEO
10:00	NERL	01:28	DSM, OS & Airspace Capacity Mgr. (ACM) meet. Decision taken on what traffic regulations would need to be enacted if resolution not achieved.

Local time	Party	Elapsed time	Actions
10:04	TUI	01:32	First aware of mass delays across the UK via the Group Operations Centre in Hanover.
10:08	Luton Airport	01:36	Luton informed of a technical failure by NATS at LTN.
10:12	NERL	01:40	DSM & Level 2 engineer agree engineer to attend on site.
10:14	Gatwick Airport	01:42	Notified of the failure by Gatwick control tower.
10:38	NERL	02:06	Bronze meeting convened.
10:43	NERL	02:11	Eurocontrol advised that regulations would be required for UK airspace.
10:45	Eurocontrol NMOC	02:13	NMOC promulgates regulations
10:45	Virgin Atlantic	02:13	Noticed there was an issue when slot delays were noticed.
10:45	Liverpool Airport	02:13	ATC noticed slot changes and NATS MAN informed them there was a problem. No direct contact from NATS.
10:45	Regional and City Airports	02:13	Found out information from BBC news, no comms from NATS on day of incident.
10:45	NERL	02:13	Eurocontrol Network Manager advises airline/airports of regulations effective @ 11:00
10:50	Virgin Atlantic	02:18	Call made to Heathrow Operational Efficiency Cell to query slots. Was advised that Heathrow had been told of a system failure and were waiting for further information.
10:58	NERL	02:26	NERL discussion regarding the need for Level 3 engineer.

Local time	Party	Elapsed time	Actions
11:00	Virgin Atlantic	02:28	Message appeared on Eurocontrol portal. No direct communication came from NATS until the ATICCC call.
11:00	easyJet	02:28	Call from Eurocontrol. Flight movements in the UK would be limited to 60 per hour.
11:00	NERL	02:28	Flow regulations active.
11:02	NERL	02:30	Silver command contacts NATS Duty Press Officer who in turn advises corporate comms.
11:05	British Airways	02:33	Notification from Eurocontrol Network Manager.
11:05	Ryanair	02:33	Notification through Eurocontrol Network Operations Portal
11:06	NERL	02:34	Silver command convenes.
11:07	easyJet	02:35	Contact from Eurocontrol regarding incident.
11:30	NERL	02:58	ATICCC activated.
11:30	Ryanair, Gatwick Airport, TUI, British Airways, Manchester Airport Group, Virgin Atlantic.	02:58	Email received from NATS stating ATICCC was activated.
11:40	Gatwick Airport	03:08	NATS confirmed that the fault had been identified. GAL Bronze command was stood up.
11:47	NERL	03:15	Level 2 engineer arrives on site.
11:47	NERL, British Airways, Ryanair, Manchester Airline Group, Virgin Atlantic	03:15	First ATICCC customer call.

Local time	Party	Elapsed time	Actions
11:51	[✂]	03:19	[✂]
11:53	NERL	03:21	Level 3 engineer contacted.
11:53–12:28	NERL	03:21-03:56	Full hardware reboots attempted led by Level 2 engineer.
12:12	Virgin Atlantic	03:40	Second update posted on Eurocontrol Portal informing users of a system failure and there no indication of a solution yet.
12:15	[✂]	03:43	[✂]
12:20	NERL	03:48	Gold activated
12:20	NERL	03:48	Further flow restrictions identified – 40 flights/hour for Swanwick ACC airspace & 20 flights/hour for Prestwick ACC airspace effective 12:30
12:26	NERL	03:54	Additional FPRSA-R system logs requested to assist failure mode analysis.
12:30	TUI	03:58	Meeting with senior leaders and wider team. No projected time of fix. Gatwick requesting airlines cancel 80% of flights and close check-in. MAN check in still open.
12:32	NERL	04:00	Stored flight plan data exhausted.
12:39	NERL	04:07	Teams call with level 3 engineer and software supplier, Frequentis Comsoft
12:45	British Airways	04:13	Received update from Heathrow's Demand vs Capacity team requesting all airlines to cancel UK, Ireland and European flights until 1800BST.
12:45	Gatwick Airport	04:13	Gatwick Silver stood up.
12:51	NERL	04:19	Teams call with level 3 engineer, Frequentis Comsoft and AMS-UK operator.

Local time	Party	Elapsed time	Actions
12:58	NERL	04:26	Frequentis Comsoft directs reprocessing of pending messages to isolate the message causing software exceptions.
13:00	Jet2	04:28	Second ATICCC call.
13:00	TUI	04:28	Senior management had a call with NATS.
13:00	easyJet	04:28	Second call from Eurocontrol.
13:00	NERL	04:28	Further tightening of flow regulations.
13:00	Virgin Atlantic	04:28	Heathrow call held stating that problems were still ongoing on no solution had been identified.
13:30	Gatwick Airport	04:58	Gatwick uses social media and press statements to inform pax of multiple delays and cancellations.
13:26	NERL	04:54	Test flight plans successfully processed by FPRSA-R
13:45	British Airways	05:13	Update from NATS ATICCC that the issue that not been resolved and that flight plans were being processed manually.
13:55	Gatwick Airport	05:23	Gold stood up.
14:00	NERL	05:28	4th Bronze team call.
14:00	[✂]	05:28	[✂]
14:02	Ryanair	05:30	Phone call from Martin Rolfe advising that a solution may have been identified but no timeframe for implementation or for traffic flow regulations to be removed.
14:11	Virgin Atlantic	05:39	Third update posted on Eurocontrol portal, stating that there is no current solution to the problem.
14:15	Gatwick Airport	05:43	Informed that NATS had identified and resolved fault and system would be entering recovery.

Local time	Party	Elapsed time	Actions
14:19	[✂]	05:47	[✂]
14:27	NERL	05:55	Auto processing of flight plans recommences – technical system restored.
14:30	Jet2 and British Airways, Virgin Atlantic	05:58	Third and final ATICCC call.
14:32	NERL	06:00	2nd Gold call.
14:32	NERL	06:00	3rd ATICCC call.
14:43	Virgin Atlantic	06:11	NATS advise that automatic processing is continuing and flights will be actioned on first come first serve basis with widebody flights continuing to be priority.
14:45	Bristol Airport	06:13	All Airport and BP calls chaired by ADM with latest updates cascaded.
14:54	NERL	06:22	Bronze deactivated
15:00	NERL	06:28	ATICCC deactivated.
15:06	easyJet	06:34	NATS informed the airline that a fix had been identified and hopefully they were entering recovery.
15:11	NERL	06:39	Silver deactivated.
15:15	British Airways	06:43	Final communication from NATS ATICCC that the system had been returned to normal.
15:15	Jet2	06:43	Message issued by NATS that no further calls would be made.
15:15	Virgin Atlantic	06:43	NATS update that they have identified and resolved the issue and that the system is now in recovery.
15:24	NERL	06:52	Traffic regulations begin to be lifted.

Local time	Party	Elapsed time	Actions
15:30	Virgin Atlantic	06:58	Significant improvements seen to slots from UK airports as the system begins to operate automatically.
16:00	[✂]	07:28	[✂]
16:00	NERL	07:28	3rd Gold call – Transport Secretary briefed.
16:10	Jet2	07:38	Most penalising restrictions lifted.
16:10	NERL	07:38	Most restrictive traffic restrictions lifted.
16:40	Bristol Airport	08:08	Airlines provided their respective operational plans.
16:45	Bristol Airport	08:13	All Airport and BP calls chaired by ADM with latest updates cascaded.
17:48	Virgin Atlantic	09:16	NATS update via generic email.
18:40	Gatwick Airport	10:08	Gold command stood down.
18:03	NERL	09:31	Traffic regulations end.
19:00	[✂]	10:28	[✂]
19:01	NERL	10:29	4th Gold call. Major incident investigation to be initiated

Tuesday 29th August 2023

Local time	Party	Elapsed time	Actions
09:31	NERL	1 Day 00:59	5th Gold call.
16:00	NERL	1 Day 07:28	6th Gold call.
16:00	TUI	1 Day 07:28	Flight programme normalising but airports are extremely busy.

16:00	Gatwick Airport	1 Day 07:28	9 red cancellations, 19 green cancellations and 56 arrival cancellations.
	easyJet	1 Day	First formal communication from NATS to the COO and Director of Airport Ops and Nav.

Wednesday 30th August 2023

Local time	Party	Elapsed time	Actions
	British Airways	2 Days	New seat configuration for additional capacity implemented for 28-30th period.
08:30	TUI	2 Days 23:58	Programme returned to normal but there are some knock-on crew issues.

Thursday 31st August 2023

Local time	Party	Elapsed time	Actions
All day	Jet2	3 Days	Overnight delays continue due to fleet shortage.

Monday 4th September 2023

Local time	Party	Elapsed time	Actions
All day	Bristol Airport	7 Days	Last impact of delays and cancellations due to displaced crew and aircraft. Majority of vehicles had been collected from carpark.

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APPENDIX E

List of stakeholders that contributed to the review

During the review the panel received evidence or engaged with the organisations below.

- Civil Aviation Authority
- Department for Transport
- NATS Holdings Board
- NERL

Airlines

- Airlines UK
- International Air Transport Association (IATA)
- British Airways
- Eastern Airways
- easyJet
- Jet2
- Loganair
- Ryanair
- TUI
- Virgin Atlantic
- Wizz Air

Airports

- Airport Operators Association (AOA)
- Aberdeen Glasgow Southampton (AGS)
- Belfast International
- Birmingham
- Bristol
- Cardiff
- Edinburgh
- Gatwick
- Heathrow
- Isle of Man

- Leeds Bradford
- Liverpool
- London City
- Manchester Airports Group
- Newcastle
- Regional and City Airports

ANSPs

- AirNav (Ireland)
- DFS (Germany)
- ENAIRE (Spain)
- ENAV (Italy)
- Federal Aviation Administration (US)

Consumer organisations

- CAA Consumer Panel
- Consumer Council for Northern Ireland
- Transport Focus
- Which?

Other organisations and individuals

- ABTA – The Travel Association
- Define
- Frequentis Comsoft
- EUROCONTROL
- Lloyds Banking Group
- Network Rail
- Office of Rail and Road
- Ofwat
- Paul Bircham, former Regulation Director, Electricity North West Ltd
- Payment Systems Regulator
- Peter Bucks, regulation expert
- PCS (Public and Commercial Services) Trade Union
- Prospect Trade Union
- Scope
- Simon Calder, travel journalist and broadcaster

APPENDIX F

Addendum following additional information provided by NERL in July 2024 – 29 July 2024

1. On 6 July 2024, NERL submitted an additional version of its Major Investigation Report[18] to the CAA containing new material information on the cause of the incident (in appendix 4 of that report) which was not available to the Panel prior to the completion of its final report in May 2024. The Panel considers that the additional information is of sufficient importance in understanding the failure event that the Panel has decided to produce this addendum to its final report.

2. In further testing conducted in June 2024, NERL found that the original 2018 flight plan processing system's (FPRSA-R) software would have been capable of handling the 28 August 'problem' flight plan by directing it for manual processing, while continuing automatic processing of subsequent flight plans and FPRSA-R not stopping functioning (i.e. entering "maintenance mode"). NERL has now noted that:

    a) The 2018 FPRSA-R software build did not contain the appropriate coding logic to prevent a search for the UK airspace exit point before the UK entry point. To this extent, the new information matches previously available information.

    b) However, unknown to NERL, the 2018 FPRSA-R software build did contain a separate logic test that would have been capable of recognising that the output of the processing of the problem flight plan was nonsensical and hence directing it for manual processing. This separate logic test was not identified at the time the initial NERL investigation into the August 2023 event was finalised as it was not in the software in use at the time.

    c) In 2021, there was a major change request delivered to facilitate the introduction of Prestwick Upper Airspace Free Route Airspace. That change request led Frequentis Comsoft, the supplier of the FPRSA-R system, to materially re-write the system software. The logic test referred to at (b) above was not included in the final version of the 2021 FPRSA-R software. Furthermore, the software logic to prevent a search for the UK airspace exit point before the UK entry point (as set out in (a) above), was still missing from the 2021 FPRSA-R build. As a result of the absence of both the coding logic described at a) above and the logic test described at b) above in the final version of the 2021 FPRSA-R software, the software became susceptible to

[18] See NERL Major Investigation Report.

entering maintenance mode when it was asked to process a flight plan with the specific attributes of the 'problem' flight plan.

3. Furthermore, NERL noted that the software fix required for the 2021 build was exactly the same fix as required by the 2018 build and so the urgent fix installed after the 28th August still permanently fixes the issue. This is something that the Panel believes should be evidenced to the CAA (AAA) in order to satisfy both parties that this understanding is correct.

4. NERL has stated that "… *the requirements and testing responsibilities of NERL as user of the Frequentis Comsoft 2021 software did not extend to analysing and checking the actual code provided in the solution and so the fact that the logic was missing from the 2021 code as well as from the 2018 code does not highlight any need for further or different recommendations from those in Ma2 of the NERL Major Investigation Report."* In its final report the Panel expressed a view on the importance of software assurance and the benefits to be had from a review of the associated processes currently in use by NERL (Recommendation 3 refers). Whilst it seems reasonable for NERL to take the view that the testing of software code is beyond the scope of NERL's responsibility, the Panel believes that as part of its Recommendation 3, NERL should review the process by which it is satisfied that the suppliers of system software are undertaking sufficient testing to assure the delivered functionality of the software matches their specified requirements before entering an operational environment.

5. The CAA advised that, as was the case for the deployment of the 2018 FPRSA-R software, the 2021 Prestwick Upper Air Free Route Airspace modification to FPRSA-R's software change was also not audited as it was considered to be unlikely to introduce significant safety risks. The CAA further advised that it will now engage with NERL to ensure that the FPRSA-R system is able to continue functioning even if it finds unspecified flight planning processing errors (i.e. not only following similar circumstances that led to the 28 August 2023 incident). The Panel considers that this additional information strengthens the Panel's findings and recommendations that:

    a) the system design should have provided better mitigation (e.g. quarantining) of data that would have caused the FPRSA-R system to cease operating" (Paragraph 2.40 of Final Report);

    b) NERL should review its software assurance process (Recommendation 3);

    c) NERL's minor finding (Mi2) that "*The complexity of the system architecture across NERL - and its regular changes and upgrades - results in any attempt to maintain up-to-date overall system mapping becoming effectively impossible*" should be assessed as a major finding instead and further reinforces the Panel's recommendation that NERL should review its level of strategic oversight in relation to its change programme (Recommendation 14).

d) the CAA should review its processes for the sampling of new and changed NERL air traffic systems to ensure these remain sufficient to inform its view of NERL's safety performance (Recommendation 12).

6. The Panel notes and welcomes the CAA's intention to engage with NERL to ensure its fix is generic enough not only to be able to deal with similar circumstances that led FPRSA-R to fail on 28 August 2023, but also to effectively deal with other types of flight processing errors (regardless of whether they have been previously envisaged or not).

7. While providing further evidence which strengthens a number of its Recommendations, the new information does not however alter the content of the Panel's Final Report (produced with the evidence available to it by 31 May 2024) in any material respect.