Witness Name: Sir Jim McDonald for the Royal Academy of Engineering
Statement No.: Ref M1/RAENG/01
Exhibits:
Dated: 24 February 2023

UK COVID-19 INQUIRY

WITNESS STATEMENT OF SIR JIM MCDONALD FRENG
ON BEHALF OF THE ROYAL ACADEMY OF ENGINEERING

I, Sir Jim Mcdonald, will say as follows: -

Introduction

1. Thank you for your invitation to submit evidence.

2. The COVID-19 outbreak gave government a range of concurrent challenges. Consideration of these challenges required the combination of technical, practical, and systems thinking expertise characteristic of engineering.

3. The Academy has been hugely active in response to the pandemic, triaging engineering solutions, providing policy advice to governments (both UK and international), working alongside government to strengthen its systems thinking capability, supporting our network of entrepreneurs to increase supplies of PPE in African countries, supporting researchers and UK enterprises during the crisis, and highlighting and celebrating the role of engineering in tackling the pandemic and its consequences.

4. At least the first three of these are directly relevant to the questions in your letter, and together form a substantial body of evidence on the country's strengths and weaknesses coming into the pandemic, and what should be strengthened to ensure greater resilience to future pandemics and whole-system shocks.

5. This statement is structured as follows:
    - The nature of the Academy and its role.
    - A summary of the Academy's engagement with government up to and after 21 January 2020 and the engineering advice provided, on:
        - Emergency planning and building resilience
        - Ventilation and transmission of the virus within buildings specifically
        - Other advice and support to government on vulnerabilities and remedies in the face of COVID-19
        - Work to strengthen government's overall systems thinking capability, and its relevance to acute and chronic crises.

6. We have not undertaken an explicit assessment of government performance leading up to, or during, the pandemic.

The Royal Academy of Engineering

7. The Royal Academy of Engineering provides leadership for engineering and technology, and technical leadership for wider society.

8. It was established in 1976, initially called the Fellowship of Engineering. The Fellowship was incorporated and granted a Royal Charter on 17 May 1983 and became the Royal Academy of Engineering on 16 March 1992. It is governed according to the Charter and associated statutes and regulations (as amended from time to time).

9. We are a charity, delivering public benefit from engineering excellence and technology innovation (charity number: 293074), and a National Academy, providing progressive leadership for engineering and technology, and independent expert advice to government. We are also a Fellowship, bringing together leading businesspeople, entrepreneurs, innovators and academics from every part of engineering and technology.

10. Our 2020-2025 Strategy sets out our overarching goal for 2025 to harness the power of engineering to build a sustainable society and an inclusive economy that works for

everyone. We do this by promoting talent and diversity, by driving innovation, and through policy advice and public engagement.

11. Finally, as part of our commitment to delivering policy advice we also lead the National Engineering Policy Centre (NEPC). This is a partnership of 42 professional engineering organisations that cover the breadth and depth of our profession, led by the Academy. Together we provide insights, advice, and practical policy recommendations on complex national and global challenges. The NEPC has been highly active during COVID-19, including through many of the policy contributions discussed below.

The Academy's engagement and advice to government before and since 21 January 2020

On emergency planning and building resilience

12. Resilience is an important engineering concept, central to industries such as nuclear, chemical engineering, and many others. Ensuring the resilience of systems is a theme of many of the Academy's policy reports, and is prominent in, for instance, *Living without electricity: one city's experience of coping with loss of power* (2016) [JM/1] *(INQ000181798)*, *Extreme space weather: impacts on engineered systems and infrastructure* (2013) [JM/2] *(INQ000181812)*, and *Global Navigation Space Systems: reliance and vulnerabilities* (2011) [JM/3] *(INQ000181805)*.

13. The Academy has undertaken several works on emergency planning and resilience since 21 January 2020 and we draw out some lessons below from two of them, which may be helpful in respect of your questions on the UK's preparations for whole-system crises, notably Question 3.

14. In November 2020 the Academy was first approached about the possibility of conducting an *External Review of the National Security Risk Assessment (NSRA) Methodology* [JM/4] **INQ000068403**, and formally commissioned by the Director of the Civil Contingencies Secretariat (CCS) on 12 February 2021, working closely with CCS and the NSRA Methodology Review Board. This review was the subject of question 15 of your letter to us. Given the sensitive nature of some elements of the NSRA, the output of the commission was confidential and for government use, but

we have since prepared a summary for open publication to share the learning from the exercise with a wide range of organsations who have a stake in the resilience effort.

15. The NSRA is a classified assessment of the risks that could cause a national-scale emergency in the UK. A publicly available version, the National Risk Register, provides information on the most significant risks that could occur in the next two years, and is used to inform the public, businesses and communities.

16. The review was an opportunity to bring external perspectives into the methodology for the NSRA, and to learn from a diverse range of industry sectors, from academia, and indeed across government. Through conversations and case studies, we were able to draw out crosscutting themes, such as facilitated collaboration, the active exploration of uncertainty, transparency of assumptions, and openness to challenge from different perspectives.

17. The final report was submitted to the Cabinet Office on 17 September 2021. The report made 13 recommendations which we believe, if implemented, will strengthen the current system, including:
    - Focusing on acute risks. The NSRA should primarily focus on acute risks while chronic risks should be assessed through a separate but linked process.
    - Generating multiple scenarios. We recommended that CCS should ensure that all departments are considering multiple scenarios when undertaking risk work to explore uncertainty and additional planning requirements, and to challenge their assumptions.
    - Impact-driven prioritisation. To create a culture of preparedness, likelihood should not be the main driver for prioritisation, as this can be difficult to assess with a high degree of confidence across all risks. Decision-making should be driven by impact, and preparedness linked to capability across prevention, mitigation, response, and recovery.
    - An agile, needs based review. We recommended moving towards a more agile risk assessment process, reflecting the different pace at which different risks change, with 'no significant change' an option available to Lead Government Departments for one assessment cycle only.

18. The great majority of our recommendations have been accepted in some form by the Cabinet Office, as seen for instance in their incorporation into the Government's Resilience Framework of December 2022.

19. It is important that these changes in policy and process are acted upon, and lead to changes in practice beyond the exercise itself. All organisations, both in industry and government, need to consider how their risk assessment processes translate into action and prepare themselves for a broad range of impacts. Our public facing version of the report will include a call to action to foster a resilience-oriented culture that drives action to make the UK a safer, more prepared nation for everyone.

20. On 20 May 2021 the Academy published *Critical Capabilities: strengthening UK resilience* [JM/5] *(INQ000181815)*. The report explores how taking a wider, systems-based view of emergency capabilities can improve planning and preparedness, and thereby build resilience.

21. The report built on an examination of four crises of the past: the Eyjafjallajökull volcanic eruption in 2010, the UK's response to the Fukushima nuclear accident in 2011, the Lancaster flooding and resulting electricity outage in 2015, and the WannaCry ransomware incident affecting the NHS in 2017, understanding weaknesses and strengths in preparation and response to each crisis, and drawing out lessons of relevance to wider crisis preparation.

22. The report sets out five types of capability needed for resilience in the face of crisis:
    - Resources, including data, materials and funds
    - Skills and labour, including the workforce, training capability and those with expert skills
    - Research and innovation, including the institutions, facilities and expertise for innovation
    - Industrial capability, including manufacturing, analysis and logistics
    - National assets, including physical and digital infrastructure and institutions.

23. It illustrates the role of networks and co-ordination as an integrating function between these capabilities, a process which should extend beyond well-practiced sections of the public sector to draw upon the full national capability of industry, enterprise, academia and PSREs, standards and assurance infrastructure and international partners.

24. The study sets out a series of "practices for preparedness" for organisations to undertake, and makes three headline recommendations to government, which remain pertinent:
    - Embed an engineer's systems approach into emergency planning and preparedness, looking across the public and private sector stakeholders.
    - Carry out an audit to map existing public, private and third sector capabilities and convening bodies against the critical capability groups given above.
    - Develop the approach set out in the report into a practical tool for emergency planning, preparedness and resilience.

Advice on ventilation and transmission within buildings specifically

25. In February 2021 the Government Chief Scientific Adviser asked the Academy to explore the interventions needed in the UK's built environment and transport systems to reduce COVID-19 transmission. The Academy responded with two reports as described below, undertaken with partners to the National Engineering Policy Centre, most notably the Chartered Institute of Building Services Engineers (CIBSE).

26. An initial 12-week review, published in full as *Infection Resilient Environments: Buildings that keep us healthy and safe* (June 2021) [JM/6] *(INQ000181806)*, investigated actions to make infrastructure more resilient to infection, with a particular emphasis on what was needed to improve the safety of our indoor environments for winter 2021/22.

27. The report found that the way in which buildings and transport perform makes a great difference to how easily infections can be transferred within them, including across all three main routes of transmission for COVID-19: airborne, droplet and contact.

28. Infection control is therefore an important part of creating a good indoor environment and can, and should, be designed into buildings and transport at every stage, from design through to construction, operation and management.

29. Despite this, the role of buildings in creating healthy indoor environments has received a relatively low profile in recent years and is typically given only modest importance by designers and builders, regulators and ultimately clients.

30. Operation and management of buildings, including how they are cleaned, ventilated, their levels of occupation, and how they may be modified and adapted over time, is perhaps particularly neglected, despite being at least as important to occupants' health as design and build. Building management is often incidental to the business purposes of many owners and operators and may not receive appropriate prioritisation, investment and support. For many buildings there is no operator as such, and even where facilities management is professionalised and resourced, it is often highly complaints-driven, based around comfort, which people perceive, rather than exposure to infection, which they do not.

31. We found that all of this left a legacy of modest knowledge, skills and capacity in how buildings are maintained, compounding patchy design and build quality, which formed a significant vulnerability, and a difficult background against which to ask all those with some responsibility for managing a building to rapidly improve how they manage that space to control a pandemic.

32. Within the suite of practices which comprise buildings management, good ventilation is often particularly neglected, exacerbated by issues of visibility and communication. At the time of our report much of the available guidance lacked emphasis and useful information on ventilation, with a much heavier emphasis upon contact spread. What guidance there was could often be difficult to access, hard for the audience to understand, or conflicting, with a lack of consistent messaging across impacted sectors. We found that the most simple and inexpensive measures that government could make ahead of winter 21/22 were to provide clear, consistent communications and guidance to those with the lowest capacity and capability.

33. The report made a number of recommendations on short term communication priorities during the pandemic, leading to significant changes to government guidelines for buildings managers, increasing the visibility and depth of advice on ventilation.

34. We also made some interim recommendations on addressing the more fundamental drivers which left the country in such a vulnerable position with regards to the impact of its indoor environments on health. These issues were taken up in more detail in a successor report, *Infection resilient environments: time for a major upgrade*, (June 2022) [JM/7] *(INQ000181807)* which took a systems-based approach to identifying the transformational changes required to create healthy indoor environments which protect health both during and outside of pandemics.

35. This second report outlines eight recommendations to embed infection resilience in the commissioning, design, management, and operational stages of the building and transport lifecycle as follows:
    - To develop a clear baseline of what best practice in infection resilience looks like, the BSI should convene the relevant expertise and develop meaningful standards that are embedded into existing design and operational practices.
    - To create a culture shift toward embedding considerations of health and wellbeing in the built environment, DLUHC should increase the prominence of health and wellbeing across parts of the Building Regulations.
    - To ensure that buildings operate as designed in terms of infection resilience, industry bodies and public procurement must drive improvements to the commissioning and testing of building systems.
    - To maintain standards of safe and healthy building performance over a building's lifetime, in-use regulations need to be established with local authorities.
    - To enable innovation, assure the efficacy of technical products and systems, and provide guidance for those adopting them, BSI should develop a standard(s) that manufacturers can use and that can be independently certified.
    - BEIS (at time of publication), DfT and DLUHC must ensure major retrofit programmes also address infection resilience. This advice is relevant to other departments including, but not limited to, DoH and MoJ.

- UK Health Security Agency (UKHSA), in collaboration with others, should undertake a communications campaign for building and transport owners and management, as well as the wider public, about the role of the built environment and transport systems in public health.
- To create the joined-up policy-making that will align infection resilient environments with net zero, safety, equality, and accessibility goals, government should identify a lead department to act as a strategic coordinator.

36. It is vital that the country learns the lessons of COVID-19 and transforms how its buildings are designed, built and managed so that they provide a healthy indoor environment, in a way which respects other legitimate aims such as comfort, productivity and energy efficiency. This is needed both to address the estimated £8bn per annum cost of seasonal diseases even outside of pandemics, and in advance of any future pandemics.

Other advice and support to government on vulnerabilities and remedies in the face of COVID-19

37. Alongside Infection Resilient Environments, the Academy and partners to the NEPC advised on a range of issues relevant to the management of the crisis, including analysis of existing vulnerabilities and remedies. Some of these were proactive on the Academy's part, and some were commissioned by government; the GCSA was enormously helpful making connections and introductions to enable this to happen. Our interventions can be grouped into the following categories.

38. *Mobilising engineering capability.* In March 2020, as the crisis developed in the UK, the Royal Academy of Engineering launched a 'Positive Response' brokerage programme. This approach used our network to support innovators to come forward with ideas and solutions in response to the crisis, and provided a route for government to access the breadth of expertise and capability across the profession.

39. A total of 566 responses were received across four categories: skills, ideas, products & innovations, and facilities. Significant impacts included over 1000 offers to volunteer for field hospitals, and providing support across the pipeline for PPE

development and scaleup. The process was documented in the publication *Engineering our way out of a crisis* [JM/8] *(INQ000181803).*

40. *Advice on technical and practical issues related to the outbreak:* The Academy and partners to the National Engineering Policy Centre (NEPC) provided a great deal of advice at short timescales, drawing on engineering's ability to go beyond scientific analysis into issues of application. We can provide additional information about these on request, which included:
    - *Meeting challenges from COVID-19* [JM/9] (INQ000181808) and *Engineering a Resilient Future* [JM/10] *(INQ000181801).* Advice from the engineering community on lessening the impact of the crisis, easing the lockdown and building a more resilient future.
    - Rapid high-level advice on the draft UK Science Plan for Covid-19 [JM/11] *(INQ000181818)* (unpublished).
    - Advice on the need to assess the airborne transmission risk in the Nightingale hospitals (unpublished) [JM/12] *(INQ000181811).*
    - *Rapid review of engineering factors that will influence the spread of COVID-19 in hospital environments* [JM/13] *(INQ000181802).*
    - Considerations for PPE reprocessing based on international practices [JM/14] *(INQ000181809).*
    - *A rapid review of the engineering approaches to mitigate the risk of COVID-19 transmission on public transport* in collaboration with the Institution of Mechanical Engineers (IMechE) [JM/15] *(INQ000181799).*
    - Manufacturing methods for medical consumables (unpublished) [JM/16] *(INQ000181813).*
    - Expert review for the Rail Safety and Standards Board transmission risk model.
    - Focus group at the request of Department for Transport to inform future transport scenarios.

41. *Participation in the Scientific Advisory Group for Emergencies Environmental and Modelling Group (SAGE EMG).* Academy staff were invited to attend SAGE EMG, a sub-group of the SAGE committee which provides scientific and technical advice to support government decision makers during emergencies. They contributed to

discussions at 17 of 39 meetings of the main group, drawing upon the expertise of the Academy's Fellowship as appropriate. They also contributed to working groups within EMG that led to a large number of policy advice documents, as well as research and explainer documents in academic journals.

42. *International comparisons.* Much of the advice above draws in part on information and insight from the Academy's extensive international networks. In addition, in 2021 we commissioned *Pandemic Preparedness: Global review of the engineering response to COVID-19*. [JM/17] *(INQ000181821)*. The review aimed to build understanding of the broad and varied role played by engineers and engineering during the pandemic, to highlight case studies of successes and failures, and to develop lessons and recommendations to improve future pandemic preparedness and response and help ensure engineers play their full role in contributing to future public health emergencies.

43. The review included a call to action to the engineering community, policymakers, public health actors, academia and funders, to:
    - Systematically identify gaps in pandemic resilience and strategically channel funding to address them.
    - Bolster training and capacity of local engineers, accounting for skillsets needed for response and resilience during pandemics.
    - Create and support mechanisms for collaboration across disciplines and countries, that persevere in the context of crisis.

44. *Advice on economy and enterprise.* The Academy provided early intelligence to government, including Innovate UK, in the early weeks and months of COVID on how the crisis was impacting on high R&D intensity businesses, and important parts of the economy. We also advised on how to stimulate recovery through the R&D sector. Principle submissions and publications were:
    - *Stimulating R&D for a faster recovery* [JM/18] *(INQ000181816)*
    - *COVID-19 Impact on start-ups and high-R&D Intensity organisations*. [JM/19] *(INQ000181814)*

Advice to government and capacity building on systems thinking

45. The ability to understand whole systems and their interdependencies underpins almost all problems of scale, and adopting a systems approach is a prerequisite to managing them successfully. Systems thinking is often used in engineering, and much of the advice above came not just from a technical and business perspective, but through a systems lens. This was the subject of question 14 in your letter to us.

46. A systems approach can help policymakers frame a question in a different way; it encourages evidence gathering that draws upon the widest, most diverse and critical perspectives, leading to a 'bigger picture' view of the problem and how it might be tackled. The approach enables government to think about interactions between different parts of the system, and how these can combine to affect the desired outcome. There is no single way of 'taking a systems approach'; even for one policy challenge, there are multiple methods and tools within the field of systems science, each suited to specific purposes or sets of questions.

47. Systems approaches are important to most to long-term policy challenges, such as net zero, where policy areas previously approached separately or in isolation will need to be recognised as interconnected systems, and where policy makers must take rapid 'no regrets' decisions in the face of complexity and uncertainty. Strengthening our national capability in this area is essential as we address other chronic whole-system challenges such as climate resilience, food security, circular economy and biodiversity collapse.

48. Such skills are equally relevant to managing an acute crisis such as the COVID-19 outbreak, where major choices and interventions must be made before uncertainties can be fully resolved. They should be essential requirements for those whose role involves thinking about and preparing for future crises.

49. A systems approach is also essential to good modelling, used extensively amid the crisis, as it delivers better models that enable a broader range of factors to be considered. Understanding the impact of social patterns of interaction, the role of physical infrastructure, variations in geography, climate and economic activity are all likely to play some role in complex modeling of aspects of a crisis such as COVID-19, and a systems approach can ensure the right elements are included, and

relevant uncertainties exposed. Bringing together multiple perspectives is complex and involves significant degrees of uncertainty; nevertheless the modelling capability and the corresponding policy exploration are significantly enhanced.

50. Such models enable the system to be better understood and managed. It is vital that the right digital infrastructure is developed in advance of a crisis, and at a suitable scale. This includes a 'data infrastructure' to enable a more effective information flow across organisational and sector boundaries.

Systems advice during the pandemic

51. A systems approach is adopted in much of the advice discussed above. Additionally, we delivered specific advice explicitly applying systems thinking to aspects of the pandemic, including:
    - Expert engineering comment on the systems aspects of the modelling of Non-Pharmaceutical Interventions, based on international comparisons, submitted to the International Comparators Joint Unit (ICJU) - a joint unit between the FCO and Cabinet Office (June/July 2020 - unpublished). [JM/20] (*INQ000181800)*
    - Expert input to a Joint Intelligence Organisation (JIO) session on modelling of compounding vulnerabilities arising from the pandemic, including advice on different analytical and modelling approaches.
    - *Supply Chain Challenges, lessons and opportunities* [JM/21] *(INQ000181820)* understanding the vulnerabilities and remedies within the supply chain caused by the COVID-19 shock.
    - *Winter is coming: risks for interdependent infrastructure*. [JM/22] *(INQ000181817)* Convening leaders from different industrial sectors to share the risks they were carrying, and how they might impact on each other.

Applying systems approaches to healthcare

52. Delays in safely discharging patients from hospital creates serious strain on the NHS, and limits hospitals' ability to treat urgent patients. The National Discharge Taskforce recently invited the Academy to provide an external perspective, using a systems approach to investigate the current challenges facing hospital discharge. We have done this by working directly with NHS Trusts to understand and map their discharge processes.

53. Working in collaboration with Cambridge Engineering Design Centre we have been interviewing staff in three health and care systems to understand their local discharge system. This allowed us to create a picture of patient pathways from admission, through the hospital, then discharge planning and finally out into the community. We focused on the most important activities, flows and decision points, identifying critical dependencies and feedback loops, and overlayed staff stories to illustrate some of the challenges.

54. This analysis gave us an understanding of the whole system, which the Taskforce found very helpful in articulating the contextual challenges that need to be considered when trying to improve hospital discharge.

55. This work drew upon previous work, notably our report *Engineering Better Care* [JM/23*] (INQ000181804)*, undertaken with The Royal College of Physicians and the Academy of Medical Sciences, which explored how engineering systems methodologies could be incorporated into healthcare improvement practices.

Building Government's capability in systems thinking

56. The Academy has been working with government to support stronger systems thinking capability in policy both prior to, and since, January 2020.

57. A major focus of this work is on the development and delivery of introductory and bespoke systems workshops, in which we work alongside officials to support them to take a systems approach to cross-cutting policy challenges.

58. Recent work has included bespoke and in-depth work with the Heat Planning Team within the Scottish Government; a bespoke workshop mapping the future hydrogen network for the Department for Transport (DfT); workshops on the systems implications of fuel switching for air transport, also for DfT; and introductory 'Systems 101' workshops commissioned by the Food Standards Agency/Government Policy Profession and by the Office for Science and Technology Strategy.

59. The Academy also partners closely with the Government Office for Science (GOS), who have advocated for a systems approach across government, and we have provided a peer-review of the Government Office for Science's Systems Toolkit published in May 2022.

60. We are partnering with GOS and University College London on a CAPE-funded research project on the benefits and challenges of applying systems thinking in policy, which will result in a short policy briefing in 2023, and are connected to a range of other government initiatives in the field.

61. Systems thinking is also a strong theme within our Policy Fellowships Programme. The Academy's Policy Fellowships programme inspires people in strategy and policy positions to think differently and to use engineering and systems thinking to frame complex and wicked problems, and to design resilient solutions.

62. Participants receive a short, intensive introduction to systems thinking and how engineers tackle complex problems, before having hand-picked, one to one meetings with leading experts from research, industry and enterprise to discuss a live issue on their desks. The experience offers them a unique opportunity to make rapid progress on a chosen policy challenge, and to expand their personal networks with the Academy's community of innovators and leaders; it also builds their confidence and habit of reaching out to the worlds of engineering, research and business in the future. Further information is available on request and on our website.

63. A high proportion of Policy Fellows (around 80%) remain active alumni of the programme, sharing what they have learned for example through a series of knowledge sharing events in partnership with the Government Policy Profession Unit, and in the publication *Engineering Better Policy* [JM/24] *(INQ000181810)*.

Reflections and summary of learning

64. As detailed above, the advice offered since 21 January 2020 has revealed much about the vulnerabilities the country took into the COVID-19 crisis, and what is needed to do to ensure greater resilience going forward.

65. We have found that adopting a systems view, characteristic of engineering thinking, is essential to crisis preparation and management. Such an approach enables a better understanding of a system, to understand in advance which parts of that whole might become critical and with what consequences, and how to manage the system under stress.

66. Systems thinking capability is needed not just for acute crises, but for creeping crises such as climate change, and for most other wide-scale problems. Government should enforce a much stronger requirement on all those whose role involves addressing such challenges to acquire and to demonstrate these essential skills.

67. In industry, complex engineered systems require the role of a 'Chief Engineer' who has the responsibility to understand how all the different parts of the system come together and can effectively balance the risk across the system. We would recommend that creation of Chief Engineer or equivalent posts in government might serve a similar, vital role looking across whole systems, identifying gaps in knowledge, networks and capacity, and providing a point of contact to those who might help fill those gaps. We would be keen to work with government on their development and implementation.

68. Our review of the NSRA and our publication *Critical Capabilities* took a systems approach to resilience and preparation, and makes a number of recommendations on how we strengthen risk assessment and crisis response more widely. This must extend beyond specific risk assessment processes into action, and into a culture of resilience and preparation, an effort which endures between crises and requires knowledge, capability, standards and infrastructure which takes years not months to develop.

69. As an example, effective modeling within a national crisis requires advance planning to ensure that models are usable at the necessary scale for a reasonable worst-case scenario, including hosting them on a suitable platform/cloud infrastructure, with systems experts involved in their design, provision made to access necessary data under appropriate conditions, and a sufficient available pool of experts trained to use them.

70. We have placed particular emphasis on the need for government to have wide networks and strong links into wider industry, international communities and the R&D community. It is much easier to build strong relationships of trust in advance than when the crisis is already underway.

71. Good partners can expedite this process and are important to government. The convening powers of the National Academies, both individually and collectively, are an effective and proven way of bringing experts together to gain multiple perspectives on an issue; the Academy changed the way policy work was done in response to the pandemic, making connections and assimilating information and evidence from partners across and beyond the UK.

72. The Engineering community should be an important part of that network of relationships. Engineering expertise and advice are distinctive, and different in nature from pure science, being concerned not just with understanding, but also with diagnosis of a problem, testing of solutions and with the practicalities of implementation.

73. The role of the National Engineering Policy Centre (NEPC) has been important in convening this expertise during and since the height of the pandemic. The NEPC's work on Infection Resilient Environments highlighted vulnerabilities in the design and management of our building stock which impeded our management of the pandemic, and which remain largely unaddressed. We must take this opportunity to rectify them, both to improve health and quality of life in ordinary times, but also to lessen avoidable deaths and costs if and when another pandemic based upon an airborne virus strikes.

Statement of Truth

I believe that the facts stated in this witness statement are true. I understand that proceedings may be brought against anyone who makes, or causes to be made, a false statement in a document verified by a statement of truth without an honest belief of its truth.

Signed:

Personal Data

Sir Jim McDonald, on behalf of the Royal Academy of Engineering

Dated: 24 February 2024