

TRANSPORT AND WORKS ACT 1992
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THE NETWORK RAIL (CAMBRIDGE SOUTH INFRASTRUCTURE ENHANCEMENTS)
ORDER

REBUTTAL PROOF OF EVIDENCE
ON MATTERS OF ELECTROMAGNETIC INTERFERENCE
JOHN MCAULEY
ON BEHALF OF THE UNIVERSITY OF CAMBRIDGE

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1 INTRODUCTION

- 1.1 This rebuttal proof of evidence has been prepared in response to matters raised in the evidence of Network Rail (“**NR**”) witness Rasheed Hameed on electromagnetic interference (“**EMI**”) [NRE13.1, NRE13.2 and NRE13.3], of the consultancy company Arcadis.
- 1.2 In this proof I set out the current position of the University of Cambridge (“**University**”) with regard to EMI matters in the light of the evidence submitted by Network Rail on 7 January 2022.
- 1.3 Where I have not addressed specific points from the Network Rail evidence, this should not be taken to mean that I accept this evidence. Where Network Rail or other parties produce further evidence by way of rebuttal, I reserve the right to comment on this as necessary.

2 **MY RESPONSE TO NETWORK RAIL'S EMI EVIDENCE**

2.1 Below I identify particular paragraphs in the evidence before setting out my response.

2.2 Extracts from Rasheed Hameed's Proof of Evidence:

“(NRE 13.2, 5.5.6) Prediction of the new EMI footprint will be estimated theoretically using pessimistic assumptions, e.g., number of trains, loading conditions, harmonics distortion, etc. Those assumptions are bespoke to each project and will be formulated appropriately as the design progresses.

(NRE 13.2, 5.5.7) The predicted EMI emission will then be compared with immunity levels of equipment installed in neighbouring institutes that are susceptible to EMI.

(NRE 13.2, 5.5.8) The safety and reliability of the equipment will be assured by carrying out a quantified risk assessment and documenting all prospective risks in a Hazard log.

*(NRE 13.2, 5.5.9) Where a risk is identified as unacceptable, further actions will be undertaken **to mitigate the risk and minimise it to As Low As Reasonably Practicable (“ALARP”)**. The form and type of actions required in such a circumstance will depend on the nature of EMI and type of equipment in question, and as such it will be assessed on a case-by case basis. Some actions include (but are not limited to): re-locate some of the HV cables, use shielded cables, use shielding materials that will reduce the emission of magnetic fields, etc. **(My emphasis)***

*(NRE 13.2, 6.1.5 iv) I am also advised that heads of terms have been offered to both MRC and UoC committing **to mitigate any potential for increased electromagnetic interference from the HV/MV cabling in order that there is no increased impact,** above that which is currently experienced, on scientific equipment in close proximity to those cables. As such, both the objectors and the Secretary of State can be confident that there will be no new material adverse EMC effects as a result of the CSIE Project. **(My emphasis)***

2.3 **My response:** Section 5.5.9 states the principle of “ALARP” which suggests that there may be impacts that cannot be completely mitigated. Section 6.1.5 iv states that mitigation will be carried out to ensure that there is no increased impact. These statements are inconsistent. It is not acceptable to the University that there will be uncertain and unmitigated impacts. But in any event this suggestion runs contrary to

the commitment in 6.1.5 iv to ensuring that there will be no increased impact - which means that the EMI levels will not increase.

2.4 Extracts from Rasheed Hameed's Proof of Evidence:

“(NRE 13.2, 5.5.9) Where a risk is identified as unacceptable, further actions will be undertaken to mitigate the risk and minimise it to As Low As Reasonably Practicable (“ALARP”). The form and type of actions required in such a circumstance will depend on the nature of EMI and type of equipment in question, and as such it will be assessed on a case-by case basis. Some actions include (but are not limited to): re-locate some of the HV cables, use shielded cables, use shielding materials that will reduce the emission of magnetic fields, etc.

(NRE 13.2, 5.5.10) All the mitigation actions and solutions that will be proposed will implement tried and tested measures that have been proven on previous projects (see FCI example in 5.5.12 below), therefore, I have a high level of confidence in their likely effectiveness.”

2.5 **My response:** Apart from anticipating potentially unmitigated impacts on the AMB, the Network Rail position does not identify if the mitigation will be carried out on the railway or at the University premises. It is known that there are EMI disturbances from railways that can only be practicably carried out at the receiver side, for example the installation of shielding around the research tool. This is inconsistent with the position in the NR evidence which states that there will be no increased impact as there would be extensive disruption to University activities to facilitate the works.

2.6 Extracts from Rasheed Hameed's Proof of Evidence:

“(NRE 13.2, 5.5.12) We have extensive experience in many previous projects with similar issues as for the CSIE Project. Most notably, the challenges encountered for the Francis Crick Institute (‘FCI’) interface with Crossrail 2 (deep railway tunnel very close to FCI lab), where extremely sensitive equipment are in use. I currently consider that the issues of CBC are less complicated than FCI due to the larger separation distances involved and also due to the fact that extremely sensitive equipment are used in the FCI lab. Furthermore, the Crossrail 2 project uses auto transformer (AT) system, which has a larger power capacity and as such a larger EMI impact on sensitive neighbouring equipment.”

- 2.7 **My response:** I was also involved in the FCI project at the construction phase. The works at FCI involved extensive shielding and active cancellation within the FCI premises. No mitigation measures were undertaken at the railway as they were considered impractical. The distances involved at FCI and Cross Rail 2 proposed route were similar to those at AMB. The Network Rail evidence does not explain the form that any mitigation would take, or its extent.
- 2.8 Extracts from Rasheed Hameed's Proof of Evidence:
- “(NRE 13.2, 6.1.7) NR Response: i. The immunisation study is one of three main elements incorporated in the overall EMC assessment. The two other studies include harmonics distortion calculations and RFI quantitative assessment. The immunisation study focuses on 50 Hz power frequency, whilst the harmonics distortion assessment is for a frequency range up to 20 kHz which is inherent characteristics of modern railway vehicles. These two studies will be performed quantitatively. The third study will be RFI emissions which will be assessed quantitatively.”*
- 2.9 **My response:** The proposed EMC Technical Methodology is detailed in Appendix 05 of NRE 13.3. In paragraph 3.3 Item C which proposes that the further assessment referred to above will include magnetic field calculations. However, the theoretical Studies only determine the magnetic fields from 50 Hz to 150 kHz. This proposal omits to calculate the Quasi-dc magnetic fields and other influences at frequencies between DC and 50 Hz. As such, the further assessment as proposed is inadequate and should address Quai-dc magnetic fields.
- 2.10 Network Rail therefore need to commit to mitigating any potential impacts relating to Quasi-DC fields caused by trains which could alter the existing electromagnetic environment inside the AMB in order that there is no increased impact.

3 CONCLUSIONS

- 3.1 Network Rail have not carried out a full assessment of all potential effects on sensitive receptors in the AMB. Work is required to establish the mitigation that will be needed to ensure there will be no impacts on the University's research activities within the AMB.
- 3.2 The exercise to predict magnetic fields as proposed are inadequate to address Quasi-dc magnetic fields.
- 3.3 Network Rail's position is that it will assess adverse environmental effects on the AMB arising from EMI. However, Network Rail's evidence anticipates the potential for unmitigated impacts, with no detailed proposals, nor a mechanism or details to mitigate those effects, in particular at their source, prior to construction. Any alteration of the existing electromagnetic environment within the AMB (or impacts on AMB electrical services) will require mitigation that must be identified and agreed with the University prior to construction.
- 3.4 This is inconsistent with the suggestion that Network Rail will mitigate any potential for increased EMI from the HV/MV cabling in order that there is no increased impact above that which is currently experienced. This commitment needs to be extended to relate to the Quasi-DC fields caused by trains along the electrified line.

4 WITNESS DECLARATION

I hereby declare as follows:

- 4.1 This proof of evidence includes all facts which I regard as being relevant to the opinions that I have expressed and that the inquiry's attention has been drawn to any matter which would affect the validity of that opinion.
- 4.2 I believe the facts that I have stated in this proof of evidence are true and that the opinions expressed are correct.
- 4.3 I understand my duty to the inquiry to help it with matters within my expertise and have complied with that duty.

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