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12 September 2008

Mr Jos Delbeke
Director-General (acting)
DG Environment
1049 Brussels

D.G. ENV.	27429
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Dear Director-General,

ENVIRONMENTAL NOISE MAPPING

I refer to my previous letter of 1 August.

I apologise that I omitted to send the promised attachment explaining how the UK is demonstrating that its noise models are consistent with the Interim Method set out in the Directive. The Commission requested this information at the last Environmental Noise Steering Group. Please now find this additional information attached.

Yours sincerely,

Paul Creary
Second Secretary, Environment

European Commission Directive 2002/49/EC relating to the assessment and management of environmental noise (END)

Equivalence

1. Introduction

1.1 This document has been prepared by the United Kingdom in order to discharge our obligation under the END regarding the question of equivalence in connection with the first round of noise mapping.

1.2 Article 6 (1) of the END states that:

The values of L_{den} and L_{night} shall be determined by means of the assessment methods defined in Annex II[of the END].

1.3 The END states that the Commission shall establish common assessment methods for the determination of L_{den} and L_{night}. (Article 6(2)). It goes on:

Until these methods are adopted, Member States may use assessment methods adapted in accordance with Annex II and based upon methods laid down in their own legislation. In such case, they [the Member State] must demonstrate that those methods give equivalent results to the results obtained with the methods set out in paragraph 2.2 of Annex II.

1.4 In Annex 2 of the END, Paragraph 2.1 refers to the Adaptation of existing national methods. It states:

If a member State has national methods for the determination of long-term indicators those methods may be applied, provided that they are adapted to the definitions of the indicators set out in Annex I.

1.5 Paragraph 2.2 describes the recommended interim computation methods. For the issue of equivalence and the United Kingdom, it is only the interim methods for road traffic noise and railway noise that are of interest.

For ROAD TRAFFIC NOISE: The French national computation method 'NMPB-Routes-96 (SETRA-CERTU-LCPC-CSTB)', referred to in 'Arrêté du 5 Mai 1995 relatif au bruit des infrastructures routières, Journal Officiel du 10 mai 1995, Article 6' and in the French standard 'XPS 31-133'.

For RAILWAY NOISE: The Netherlands national computation method published in 'Reken- en Meetvoorschrift Railverkeerslawaal'96 Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 20 November 1996'

1.6 At a meeting of the Noise Regulatory Committee held in Brussels on 7th May 2008, the Commission confirmed that although, through JRC, there was available to Member States a system of protocols that could be followed to enable equivalence to be demonstrated, adopting these protocols was not mandatory (Minutes of 7th May meeting, item 3, second paragraph). However, Member States were requested to submit information to the Commission demonstrating equivalence by the end of July 2008.

1.7 This document is intended to fulfil that requirement on behalf of the UK.

2 Noise Mapping in the UK

2.1 The UK used the interim methods for industry and airport mapping. For roads and railways, the national methods were used, adapted as required by Annex 2, Para 2.1 of the END.

Road Traffic Noise

2.2 The national method for predicting road traffic noise in the UK is Calculation of Road Traffic Noise. It was developed, initially, in the late 1960s and formally became the national method in 1973. It was amended in 1988. The accuracy of the model is given in terms of a mean prediction error (predicted minus measurement) of around -0.5 dB(A), with an rms error of around 2 dB(A)[1]. It has been used ever since.

Railway Noise

2.3 The national method for railway noise predictions is Calculation of Railway Noise. This was developed in the early 1990s using very much the same principles as had been used with Calculation of Road Traffic Noise. At the heart of the process was the identification of reference SEL data for the various vehicle types at 25m based on measurements, with corrections then included for various features. It became the national method in 1995 and has been used ever since.

2.4 For the END, further work was carried out to update the source terms available within CRN. The results of this work can be found at:

http://www.defra.gov.uk/environment/noise/research/pdf/railwaynoise-sourceterms.pdf

3 Model Studies

3.1 In 2004 and 2006, Defra let contracts in support of European Commission Working Group on the Assessment of Environmental Noise (WG-AEN) to determine the likely effect on the acoustic accuracy of the results of the advice given with WG-AEN's Position Paper "Good Practice Guide for Strategic Noise Mapping and the Production of Associated Data on Noise Exposure" (GPG). The contracts covered road traffic noise (2004) and was based on Version 1 of the GPG published in December 2003, and railway noise (2006) which was based on Version 2 of the GPG published in January 2006.

3.2 The work on road traffic noise was published in May 2005 in 10 volumes and the work on railway noise was published in May 2007 in eight volumes. In both cases the work was carried out by a consortium of contractors led by Hepworth Acoustics and supported by DGMR and Acustinet. The work was managed by Defra through its research management

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[1] The Revision of Calculation of Road Traffic Noise (1988), PG Abbott & PM Nelson, Acoustics Bulletin 1989

team and its technical advisers. The work was totally funded by Defra, including paying for the project team to present the results directly to meetings of WG-AEN.

Road Traffic Noise Model study

3.3 As indicated above, the primary function of this research study was to quantify the accuracy implications of some of the advice given in the GPG regarding the values of data input. This was carried out for the UK National method, i.e. Calculation of Road Traffic Noise and the interim method, XPS 31 – 133. In addition, the study investigated the relative importance of the different input parameters in both models to determine for which parameter errors in the input data had the greatest effect on the result.

Railway Noise Model study

3.4 The railway noise model study had broadly the same objectives as the road traffic noise study. In this case the methodologies examined were the UK National method, i.e. Calculation of Railway Noise and the interim method, RMR 1996.

General

3.5 For both these studies, four sources of uncertainty were identified. These were:

1. Input uncertainties;
2. Uncertainty Propagation and Sensitivity;
3. Model Uncertainties;
4. Uncertainty in Evaluation Data.

3.6 Input uncertainties related to the accuracy or otherwise of the input data. It was noted by the Commission at the Noise Regulatory Committee meeting on 7th May 2008 that there would be variability in the input data used for the mapping. However, the Commission stated that this factor was not to be taken into account in the assessment of equivalence. For the UK funded accuracy studies, it was assumed that each input dataset had a normal distribution of uncertainties.

3.7 The second factor concerns how uncertainties in the input data propagate through the model. This was the heart of the accuracy studies. It was noted in the studies that error propagation analysis could assist in determining equivalence as required by the END.[2] If the same type of outcomes arose from the error propagation analysis through two different models, then it can be deduced that the models are equivalent.

3.8 The third factor primarily concerns how the model was translated into software. At the 7th May 2008 meeting of the Noise Regulatory Committee, it was stated that the protocols (mentioned in paragraph 1.6 above) did not take account of how different software implemented the methods. The Commission confirmed that this factor did not have to be considered when examining equivalence.

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[2] For example, Data Accuracy Guidelines for CRTN, paragraph 3.4.3, Document Code HAL 3188.3/9/2, May 2005

3.9 The fourth element is the uncertainty of the result of any measurements made to check the accuracy or otherwise of the model. Again, it has been inferred that the Commission did not regard this factor as being a consideration when examining equivalence.

3.10 Thus, the test of equivalence was to be confined to considering the algorithms within the various models and not to include the several other factors that would influence the robustness of the final mapping results.

Outline Method

3.11 The error propagation analysis used what was described as a 'crisp' model, (not unlike the models devised in the JRC protocols) and used a process based on Monte Carlo simulation to generate the outcome.

3.12 From this work, it was possible to understand the relative sensitivity of the models to the various input parameters. As indicated above (paragraph 3.7), a similar outcome for this analysis between models would indicate equivalence.

3.13 The full reports of these studies can be found at:

http://www.defra.gov.uk/environment/noise/research/wgaen-gpguide/index.htm

http://www.defra.gov.uk/environment/noise/research/nanr208/index.htm

4 Results on Equivalence

Road Traffic Noise

4.1 For both CRTN and XPS31 – 133, it was found that it was the accuracy of the vehicle velocity input parameter that most affected the accuracy of the outcome.[3]

4.2 In general, the next most important parameter was vehicle flow, although, in CRTN, this is not the case for roads where the gradient is greater than 15% (the gradient itself is more important).

4.3 After that, for both models, it is the gradient and the road surface type.

4.4 Thus it can be seen that, in terms of the non-geometric input parameters, the relative importance of the various elements is virtually the same, thus indicating equivalence.

4.5 For geometric aspects, five elements were examined across both models. These were:

- Source height;
- Ground surface type;
- Ground elevation;
- Barrier height; and
- Building heights.

4.6 A similar ranking to the non-geometric variables was not available, but the following conclusions overall were drawn about the two models.

CRTN

- Calculated noise levels within the 300m validation range are generally within 1 dB of measured levels, given high quality input data, such as that which results from observed monitoring and simultaneous data capture;[4]
- Out to 600m this calculation error is likely to increase to around 3 dB;[5]
- The potential error out to 2 – 3 km may well be up to 10 dB, or possible more.[6]

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[3] Data Accuracy Guidelines for CRTN, Table 4.1 (Document Code HAL 3188.3/9/2) and Data Accuracy Guidelines for XPS 31-133 Table 4.1 (Document Code HAL 3188.3/8/2)
[4] Data Accuracy Guidelines for CRTN, page 24, (Document Code HAL 3188.3/9/2)
[5] Ibid
[6] Ibid

XPS 31 – 133

- Calculated noise levels within the 300m validation range are generally within 1 dB of measured levels, given high quality input data, such as that which results from observed monitoring and simultaneous data capture;[7]

- Out to 600m this calculation error is likely to increase to around 3 dB;[8]

- The potential error out to 2 – 3 km may well be up to 10 dB, or possible more.[9]

4.7 It can be seen, therefore, that, based on this research, the performance of these two models is identical. Thus it can be concluded that with reference to the requirement in Article 6 (2)of the END, CRTN does give equivalent results to the Interim method, XPS 31 – 133.

Railway Noise

4.8 For both CRN and RMR Interim, it was found that, in general, it was the accuracy of the vehicle velocity that is the most important non-geometric input parameter.[10] The exception was for cases where the noise from a rail corridor was dominated by high speed trains of a certain vehicle category under RMR.

4.9 Of the common input parameters, the next most important variable was the vehicle flow. However, with the requirements of the END in mind, Defra let a contract to examine how Acoustic Track Quality (i.e. wheel and rail roughness) could be taken into account in CRN. At the time of its development, CRN assumed broadly new track and wheels. Measurements found that wear on both the track and wheels would increase the noise generated. Account, therefore, was taken in the noise mapping of the railways in the UK of the average track quality to obtain a more realistic noise exposure value from railways.[11] The accuracy study found that for CRN, the value of ATQ was more sensitive than the vehicle flow.

4.10 For geometric aspects, the following elements were examined across both models:

- Source height;

- Ground surface type;

- Ground elevation;

- Barrier height; and

- Building heights.

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[7] Data Accuracy Guidelines for XPS 31 - 133, page 26, (Document Code HAL 3188.3/8/2)
[8] Ibid
[9] Ibid
[10] Data accuracy guidelines of CRN, Table 4.1, Document HAL 4305.3/7/2 and Data Accuracy Guidelines of RMR Interim, paragraph 4.1.1, Document HAL 4305.3/6/2.
[11] Rail and Wheel Roughness – implications for noise mapping based on the calculation of Railway Noise procedure (Defra March 2004)

4.11 A similar ranking to the non-geometric variables was not available.

4.12 It should be noted that no testing was carried out of the situation where the RMR interim method is used with non-Dutch standard vehicles.

4.13 The following conclusions overall were drawn about the two models.

CRN

- Train speeds should be kept within 10% (electric and diesel locomotives off power) and 18% (diesel locomotives on power) in order to maintain a 1 dB uncertainty in the results[12];
- Train flows should be kept within 18% in order to maintain a 1 dB uncertainty in the results;[13]
- Management of the uncertainty in the vertical domain in noise modelling information is much more important than the exact horizontal location.[14]

RMR Interim

- Train speeds should be kept within 10% (vehicle category 9) and 5 – 22% (depend upon vehicle categories 1-8) in order to maintain a 1 dB uncertainty in the results;[15]
- Train flows should be kept within 18% in order to maintain a 1 dB uncertainty in the results[16]
- Management of the uncertainty in the vertical domain in noise modelling information is much more important than the exact horizontal location.[17]

4.14 It can be seen, therefore, that, based on this research, the performance of these two models is very similar. Thus it can be concluded that with reference to the requirement in Article 6 (2)of the END, CRN does give equivalent results to the Interim method, RMR interim.

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[12] Data accuracy guidelines of CRN, page 36, Document HAL 4305.3/7/2
[13] Ibid
[14] Ibid
[15] Data Accuracy Guidelines of RMR Interim, page 34, Document HAL 4305.3/6/2.
[16] Ibid
[17] Ibid

5 Conclusions

5.1 This document has been prepared to demonstrate that the UK methods for predicting noise from road traffic and railways do produce equivalent results to the Interim methods. Use has been made of detailed research, funded by Defra, on behalf of the Commission's WG-AEN that examined accuracy issues of the UK methods, CRTN and CRN and the interim methods, XPS 31 – 133 and RMR interim.

5.2 From an examination of the results of these studies, it has been concluded that the UK methods used for the noise mapping carried out with regard to the END do give equivalent results to the corresponding Interim methods.