Cubbington Action Group against HS2

Offchurch and Cubbington Community Forum 20th September 2012

Questions on Presentation on Noise

Slide 3 – How sound is measured and evaluated

Question 3/1 - What we, that is those who are at risk from HS2 noise, are relying on you, the experts, to do is to assess, in as meaningful a way as is possible, the level of annoyance that noise from HS2 will cause us. So I would appreciate the benefit of your opinion on three associated matters:

Do you agree that some sources of transport noise cause, level for level, more annoyance than others and where do you think that HS2 noise fits into this hierarchy?

Do you agree that the annoyance caused by noise is, subjectively, higher during the evening and night periods?

In what way does the proposed method of using equivalent sound levels to assess annoyance take account of these effects?

Relevant extracts from literature:

"The introduction of high-speed trains has created special noise problems with sudden, but not impulsive, rises in noise. At speeds greater than 250 km/h, the proportion of high-frequency sound energy increases and the sound can be perceived as similar to that of overflying jet aircraft." - World Health Organisation, *Guidelines for Community Noise*, 1999 (paragraph 2.2.2 on page 24).

"A number of studies have concluded that equal levels of different noise types lead to different annoyance (Hall et al. 1981; Griffiths 1983; Miedema 1993; Bradley 1994a; Miedema & Vos 1998). For example, equal $L_{Aeq,T}$ levels of aircraft noise and road traffic noise will not lead to the same mean annoyance in groups of people exposed to these noises. This may indicate that the $L_{Aeq,T}$ measure is not a completely satisfactory description of these noises and perhaps does not completely reflect the characteristics of these noises that lead to annoyance.." – World Health Organisation, *Guidelines for Community Noise*, 1999 (paragraph 2.3.5 on page 28).

Question 3/2 – Bearing in mind the timescales for the HS2 project, why has the opportunity not been taken to meet the aspirations of EU Directive 2002/49/EC by employing the EU selected common noise indicator L_{den} to assess the annoyance level of HS2 noise? Use of L_{den} would also allow account to be taken of the higher potential of noise to cause annoyance during the evening and night periods, which was mentioned in Question 3/1, above.

Relevant extracts from literature:

"It is also necessary to establish common assessment methods for 'environmental noise' and a definition for 'limit values', in terms of harmonised indicators for the determination of noise levels." - *Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise*, Recital 8 in the preamble.

"The selected common noise indicators are L_{den}, to assess annoyance, and L_{night}, to assess sleep disturbance." - *Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise*, Recital 9 in the preamble.

Question 3/3 – In paragraph 6.1.6 on page 49 of Appendix 5 to *HS2 London to the West Midlands Appraisal of Sustainability* the WHO *Guidelines for Community Noise* is cited as the source of the 50 dB(A) impact threshold . However the cited WHO paragraph goes on to propose that a lower value of 40 dB(A) should be "considered the maximum allowable sound pressure level for all new developments whenever feasible". Why was this lower value not employed for HS2?

Relevant extract from literature:

"To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB L_{Aeq}. These values are based on annoyance studies, but most countries in Europe have adopted 40 dB L_{Aeq} as the maximum allowable level for new developments (Gottlob 1995). Indeed, the lower value should be considered the maximum allowable sound pressure level for all new developments whenever feasible." - World Health Organisation, *Guidelines for Community Noise*, 1999 (paragraph 4.3.1 on page 61).

Question 3/4 – Please clarify the reason for the inclusion of a peak level measurement parameter (L_{max}) in the sound metrics specified in the *HS2 London to West Midlands EIA Scope and Methodology Report* (see paragraph 14.3.26 on page 153 of the September 2012 version). In particular, does the nomination of this parameter signify an acceptance of the WHO opinion that the consideration of the continuous equivalent sound level alone is insufficient for certain types of noise sources, such as railway noise?

Relevant extract from literature:

"$L_{Aeq,T}$ should be used to measure continuing sounds such as road traffic noise, many types of industrial noises and noise from ventilation systems in buildings. When there are distinct events to the noise such as with aircraft or railway noise, measures of the individual events should be obtained (using, for example, L_{Amax} or SEL), in addition to $L_{Aeq,T}$ measurements." - World Health Organisation, *Guidelines for Community Noise*, 1999 (paragraph 2.1.5 on page 23).

Question 3/5 – Please explain why the threshold for the maximum pass-by level has been set at 85 dB L_{pAFmax} in paragraph 14.3.26 on page 153 of the September 2012 version of *HS2 London to West Midlands EIA Scope and Methodology Report*. This is a very high level. According to information provided by HS2 Ltd in response to a FOI request it is equivalent to 71 dB $L_{Aeq,18hr}$, which is considerably above the level at which a sound insulation grant applies. Clearly, it is also much higher than any reasonable assessment of the level at which annoyance starts to be experienced.

Relevant extract from literature:

"With respect to question 1 above, as all calculations have been based on a maximum speed of 350kph, HS2 Ltd does not hold the information you requested. However, the assumed pass-by noise level at 350kph at 25m is 95dB $L_{Aeq,Tp}$. This figure is derived from a number of measured noise levels at 25m from actual trains.

"However, our noise assessment has been based on the day time 'average' noise level ($L_{Aeq,18hr}$). The day time 'average' noise level assumed at 350kph is approximately 81 dB(A) at 25m." - HS2 Ltd response to FOI request 10/032, dated 28th May 2010.

Question 3/6 – Please clarify the meaning of the phrase "at the façade of the receptor" in paragraph 14.3.26 on page 153 of the September 2012 version of *HS2 London to West Midlands EIA Scope and Methodology Report*. Specifically, please advise if the meaning is the same as in clauses 4-3 and 5-3 of *The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996*. Please explain why the scope of the application of this phrase has changed from the AoS and between paragraph 13.3.24 of the March 2012 version of *HS2 London to West Midlands EIA Scope and Methodology Report* and paragraph 14.3.26 of the September 2012 version of that document.

Relevant extracts from literature:

"The noise levels referred to in paragraphs (1) and (2) shall in each case be assessed at a reception point located one metre outward from the external side of the most exposed part of any door or window in a facade of an eligible building" – Department for Transport *The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996* (clause 4-3).

"All airborne noise levels calculated and reported are free field (see glossary for further explanation) with the exception of those used to represent noise insulation criteria. In this case, a facade correction of 3 dB has been used to convert free field noise levels to facade noise levels." – HS2 Ltd *HS2 London to the West Midlands: Appraisal of Sustainability*, February 2011 (paragraph 5.8.9 on p. 47 of Appendix 5)

Question 3/7 – Please explain why, unlike Japan and other European countries such as France, no upper limit has been set to offer protection to residents for noise from HS2.

References:

Environmental Quality Standards for Shinkansen Superexpress Railway Noise, Clause 1, Notification No. 91 of 1993, Ministry of the Environment Government of Japan.

A Study of European Priorities and Strategies for Railway Noise Abatement, Appendix 1 to Annex I, Ødegaard & Danneskiold-Samsøe A/S (for EU Commission), February 2002.

Slide 9 – Example sound contour map

Question 9/1 – Whilst accepting what was said during the presentation about the example of a noise contour map shown not being necessarily representative of what we can expect for HS2, the example is drawn with absolute levels. This prompts the question of whether HS2 maps will be drawn on the basis of noise difference contours. In view of the additional impact that HS2 will have in previously tranquil areas, would not noise difference contours give a more accurate impression of the nuisance?

Relevant extract from literature:

"A mitigation strategy that takes into account the relative importance of different factors affecting relative tranquillity, as identified in the CPRE/NU study and mapping, could help to reduce the potential impacts." *HS2 London to the West Midlands Appraisal of Sustainability*, February 2011 (paragraph 8.5.2 on page 53 of Appendix 5).

Slide 11 – High speed train sound

Question 11/1 – The aerodynamic sound generated by sources high up on the train, such as the pantograph, at the operational speeds envisaged for HS2 is a cause of concern to many authorities around the World (see some typical quotes below). In contrast, HS2 Ltd has expressed the view that the significance of this effect "is often overstated" and that "the wheel-rail interface will remain the most significant part of the noise from the train, even at high speed".

In the September 2012 version of the *HS2 London to West Midlands EIA Scope and Methodology Report* we are promised that "aerodynamic sound is being explicitly calculated and used as part of the determination of mitigation requirements". We are also told that the calculation method "has been further refined … to allow for aerodynamic sound sources at speeds over 300 kph". This later undertaking reflects a similar statement made in the AoS (refer to paragraph 5.6.9 on page 46 of Appendix 5).

Since it is vital for the peace of mind of local communities that they are assured that HS2 Ltd is taking due and proper account of the impacts of aerodynamic noise and the influence that it may have on the effectiveness of mitigation measures, please explain how the promises about accounting for aerodynamic noise in the *HS2 London to West Midlands EIA Scope and Methodology Report* are being realised. Specifically, please identify what changes have been made to the CRN method and what data has been employed to refine the methodology.

Relevant extracts from literature:

"While noise from the pantograph does need to be considered, and will be reviewed at the time of the EIA, its significance is often overstated. The wheel-rail interface will remain the most significant part of the noise from the train, even at high speed" – HS2 Ltd *Review of HS2 London to West Midlands Appraisal of Sustainability* January 2012 (paragraph 7.2.5 on page 27).

"Pantograph aerodynamic sound is being explicitly calculated and used as part of the determination of mitigation requirements as set out in this Report" - HS2 Ltd *HS2 London to West Midlands EIA Scope and Methodology Report,* September 2012 (paragraph 14.3.10 on page 148).

"The airborne sound generated by rail operations associated with the Proposed Scheme, both mainlines and connecting chords, and classic lines will be calculated using the calculation method developed and validated initially for the environmental assessment, and then the design, of HS1. The method is empirical, developed from over a thousand measurements. The method has been further tested and verified since HS1; and calculates maximum sound levels for each train, as well as equivalent continuous sound levels. The method has been further refined for the Proposed

Scheme to allow for aerodynamic sound sources at speeds over 300 kph" - HS2 Ltd *HS2 London to West Midlands EIA Scope and Methodology Report,* September 2012 (paragraph 14.3.20 on page 150).

"For very high speed rail, i.e. above 300km/h it is likely that CRN would need to be adapted to have sources at two or more heights above rail: for example rolling noise and the second for aerodynamic noise, however the research basis for this change in calculation methodology is not currently available" - *HS2 London to the West Midlands Appraisal of Sustainability*, February 2011 (paragraph 5.6.9 on page 46 of Appendix 5).

"The pantograph installed on a train roof is one of the major sources of aerodynamic noise in high speed trains" - *Aerodynamic Noise Reduction in Pantographs by Shape-smoothing of the Panhead and Its Support and by Use of Porous Material in Surface Coverings*, Ikeda, M., Mitsumoji, T., Sueki, T., Takaishi, T., Quarterly Report of Railway Technical Research Institute (Japan Railways), Vol. 51, No. 4, Nov. 2010.

"The acoustic energy of aerodynamic noise is proportional to a train's speed by a power of 6 to 8, which is higher than for other kinds of noises such as rolling noise and structure-borne noise. Accordingly, as operational train speed increases, aerodynamic noise becomes the predominant source of high speed trackside noise. In the case of Shinkansen trains, aerodynamic noise becomes dominant when velocity exceeds approximately 200km/h." - *Aerodynamic Noise Reduction in Pantographs by Shape-smoothing of the Panhead and Its Support and by Use of Porous Material in Surface Coverings*, Ikeda, M., Mitsumoji, T., Sueki, T., Takaishi, T., Quarterly Report of Railway Technical Research Institute (Japan Railways), Vol. 51, No. 4, Nov. 2010.

"… it can be deduced that the reducing effect of sound insulation walls is significantly higher for freight trains compared to high speed ICE trains. This effect can essentially be put down to the reduced effect on high positioned noise sources as aerodynamically caused noises by the pantographs." - *The new German prediction model for railway noise 'Schall 03 2006' – Potentials of the new calculation method for noise mitigation of planned rail traffic*, Moehler, U., Liepert, M., Kurze, U. J., Onnich, H., Noise and Vibration Mitigation for Rail Transportation Systems, Proceedings of the 9th International Conference on Railway Noise, Munich 4-8 September 2007, Volume 99, 2008, pp. 186-192.

Question 11/2 – Why has the data measured by SCNF using an acoustic array been manipulated by the TWINS modelling software? It appears that this has resulted in the contribution from bogie noise shown in the slide being over-emphasised in relation to the equivalent noise maps that were published by SNCF.

Reference:

High Speed Trains external noise: a review of measurements and source models for the TGV case up to 360km/h, Gautier, P-E., Poisson, F., Letourneaux, F., paper no. S.1.1.4.4, Proceedings of the 8th World Congress on Railway Research 2008, Seoul

Question 11/3 – Why do you think that the noise from second pantograph does not register on the colour scale? The equivalent noise maps that were published by SNCF

show a significant noise contribution from the roof of the rear cab, particularly in the lower third-octave bands.

Reference:

> *High Speed Trains external noise: a review of measurements and source models for the TGV case up to 360km/h*, Figure 7, Gautier, P-E., Poisson, F., Letourneaux, F., paper no. S.1.1.4.4, Proceedings of the 8th World Congress on Railway Research 2008, Seoul

Question 11/4 – When talking about this slide, Mr Cobbing mentioned the contribution that track roughness makes to noise generation. The source noise level upon which the calculations presented in the AoS were based is understood to be derived in part at least from the noise limit set by EU Decision 2008/232/CE. This limit is defined for a "reference track". What margin of track degradation below "reference" quality will be assumed for the noise calculations presented in the Environmental Specification?

Relevant extracts from literature:

"assumed noise levels of HS2 trains are based on the noise levels of currently operating high speed trains together with noise level requirements for new trains from European specifications (Technical Specification for Interoperability [TSI])" - *HS2 London to the West Midlands Appraisal of Sustainability*, February 2011 (paragraph 5.6.1 on page 44 of Appendix 5).

"The limits for pass-by noise are defined at a distance of 25 m from the centreline of the reference track, 3,5 m above the upper surface of the rails for a vehicle speed indicated in Table 18 below. The indicator for the A weighted equivalent continuous sound level is $L_{pAeq,Tp}$" - Official Journal of the European *Union EU Commission Decision 2008/232/CE of 21 February 2008 concerning a technical specification for interoperability relating to the 'rolling stock' subsystem of the trans-European high-speed rail system*, (paragraph 4.2.6.5.4 on p. L 84/198).

Slide 12 – Mitigation of noise effects

Question 12/1 – I understand that the sound booth demonstrations at the roadshows in 2011 assumed that the various mitigation methods would achieve around 16 dB of noise mitigation using an absorptive noise barrier with an effective height of 3 metres. Please detail the "dB budget" behind this assumption.

Reference:

> HS2 Ltd response to Freedom of Information Request FOI11/240B, dated 27 July 2011 (section 2).

Slide 16 – Noise barriers

Question 16/1 – It looks like the noise barriers in the photograph on this slide are high enough to shield the whole of the train, including the pantograph. Do you agree and is this what we can expect for HS2?

Relevant extracts from literature:

> "In general, aerodynamic noise has lower peak frequencies than does wheel-rail noise, which means that a barrier is less effective at attenuating aerodynamic noise.

In addition, aerodynamic noise sources tend to be located higher up on the train than wheel-rail noise sources. As a result, a noise barrier high enough to shield aerodynamic noise will be relatively expensive compared to a barrier for controlling wheel-rail noise, since it must extend 15 feet or more above the top of rail. For operating speeds up to about 160 mph, a barrier high enough to shield wheel-rail and other lower car body sound sources would normally provide sufficient sound attenuation." - *High-Speed Ground Transportation Noise and Vibration Impact Assessment*, section 2.3.3 on pp. 2-15 and 2-16, U. S. Department of Transportation Federal Railroad Administration October 2005.

"A relatively low barrier will not shield sound sources located high above the guideway, since such sources would protrude above the top of the barrier. This noise includes noise from propulsion sources, such as cooling fans, as well as aerodynamic noise generated at the upper part of the train." - *High-Speed Ground Transportation Noise and Vibration Impact Assessment*, section 4.2.7 on p. 4-17, U. S. Department of Transportation Federal Railroad Administration October 2005.

"As current high speed trains exceed 300km/h, aerodynamic noise around the bogie areas, at coach connections and around the pantographs (including where they connect to the train), increases. Because these sources are higher up the coach body, and therefore higher above the rails, a barrier will be less effective in reducing the noise from these sources than in reducing rolling noise." - *Noise Source Height of High Speed Trains for the Appraisal of Sustainability*, attachment to HS2 Ltd response to FOI request 11/327, 5th December 2011.

"At higher running speeds, the energy of aerodynamic noise sources located on the roof of the train increases and the barrier height is not sufficient." - *Experimental Study of Noise Barriers for High Speed Trains*, summary on p. 495, Belingard, P., Poisson, F., Bellaj, S., Noise and Vibration Mitigation for Rail Transportation Systems, Proceedings of the 10th International Workshop on Railway Noise, Nagahama Japan 18-22 October 2010, Volume 118 2011.

"The contribution of elevated sources to overall train noise levels is a key component in the determination of overall acoustic barrier performance, which is dependent on the geometric relationship between individual sources, receiver and the barrier apex. Significant reductions in sources of noise at low height such as wheel rail rolling noise will not therefore be reflected in the net reduction of overall train noise levels where the contribution of other higher sources to train passby noise levels is significant." - 51m Response to HS2 Consultation: Appendix 18 Acoustics Review, paragraph 4.6.3 on p. 11, Southdowns Environmental Consultants Ltd, June 2011.

Slide 18 – UK experience in minimising effects

Question 18/1 – In what ways do you think that HS2 differs from HS1 and, accordingly, how good a model do you think that HS1 is for the design of HS2?