Written Representation for SPR EA1(N) and EA2 Projects (Deadline 1)

Concerning Noise and Vibration Issues

Interested Party:	**Mr Alan Thomas**	
PINS References	**Identification No**	**20024089 & 20024090**
	Relevant Representation Number	**RR-804**

SUMMARY

1. This written representation follows up on that made by me in January 2020 when registering with PINS as an interested party. That submission listed 5 basic objections to the proposed developments by Scottish Power Renewables (SPR) primarily on the basis of:

    - Size and proximity of the development to Friston
    - Loss of footpath as an amenity to residents of Friston
    - The irresponsibility of SPR in seeking to blight the rural landscape and 'soundscape'
    - Lack of proper understanding of how far sound travels in this area, especially at night
    - The irresponsibility of SPR in their approach to light pollution

2. This updated written representation concentrates primarily on the matter of the low frequency noise generated by electrical substations and realisation by residents of Friston that they could have to live with a permanent background "hum" emanating from 4 large HVAC transformers and associated phase correction hardware plus the noise from banks of cooling fans, for the rest of their lives, and which SPR glibly refer to as "the Operational Phase.

3. Observations and comments that follow are derived from a detailed examination of the Applicant's DCO submission for the EA1(N) substation and outlines perceived shortcomings in the Applicant's approach to noise . The comments expressed below in regard to EA1(N) apply equally to EA2.

OVERVIEW

4. The National Policy Planning Framework (NPPF) requires that ***"….planning policies and decisions should identify and protect tranquil areas which have remained relatively undisturbed by noise, and are prized for their recreational and amenity value for this reason…"*** The Applicant acknowledges that the operational phase of the project will impose an 'industrial noise' soundscape on an otherwise 'rural noise' area. For those living in the area, the night time environment is 'tranquil' and has been so for many years and thus the Applicant's submission should be viewed as **'non-compliant'** with the stated aims of the NPPF.

5. It is considered that the Applicant made a serious error of judgement in assuming that two substations similar to that recently constructed at Bramford, plus a totally new National Grid substation could be constructed within a restricted site at Friston, without imposing an unacceptable noise environment upon the residents of nearby properties. The Applicant's Site Selection RAG assessment (see Reference 1 below) highlights this basic error

6. *"……A target conservative buffer of 250m was agreed by the project team and applied within initial site selection. The buffer of 250m is deemed conservative at this stage as the substations are committed to reducing all potential operational noise impacts to below limits that are audible due to embedded mitigation (harmonic filters). The onshore study area was subdivided into zones based on available space for two onshore substations, whilst minimising interaction with the 250m buffer on residential properties*…..

7. At this point it seems that the Applicant was quite unaware that harmonic filters, as suggested above, do not ***"mitigate"*** noise: they **generate** noise. [See reference 2 below]

8. Given the significant levels of low frequency noise generated by substation infrastructure, the originally declared intention to meet a noise level that is ***"below limits that are audible"*** is risible. The limit of human audibility is 0dB with respect to a Sound Pressure Level (SPL) of 20µPa. To become "inaudible" at nearby properties, the Applicant would need to achieve a noise spectrum similar to that of the background and be 3dB below the prevailing night time noise level, which is typically 27 dBA or below.

9. There is no explanation in the Environmental Statement of why the Applicant considered a 250 metre buffer as 'conservative', knowing that the vastly smaller Greater Gabbard substation at Sizewell required a buffer of not less than 500 metres. A further error is the above reference to "two onshore substations" when it was clear that 3 substations (EA1(N), EA2 and the NG substation) needed to be sited.

10. At the initial Public Information Days (PIDs) organised by the Applicant, residents of Friston were assured that the Sound Pressure Level (SPL) produced by the substation(s) at the exterior façade of any of the surrounding properties would not exceed 30 dBA. This statement was challenged at the time as being almost impossible to meet without enclosing the infrastructure in thick concrete enclosures or burying the bulk of the infrastructure below ground level, an approach rejected outright by the Applicant on the grounds of cost. A simple calculation using ISO 9613 methodology, and the noise spectrum output of a single HVAC transformer, as then published by the Applicant, would have shown that at 250 metre range, one might reasonably have expected levels well in excess of 30 dBA.

It is thus considered reasonable for the ExA to ask the Applicant on what basis the 250 metre buffer zone was deemed appropriate?

MATHEMATICAL MODELLING OF NOISE

11. The Applicant has relied extensively upon desk based estimates of the noise environment at designated locations arising from the electrical infrastructure during the 'Operational Phase' of the development, which seems likely to exceed 25 years. The Applicant refers at various points in the DCO submission to the use of SoundPLAN, which is a commercially available software package, but gives no indication to the non-technical reader of:

    - Software Version
    - Its suitability for this type of infrastructure at this site
    - Functionality
    - Prediction Accuracy
    - Limitations

12. There appears to be no acknowledgement within the Applicant's Volume on Noise and Vibration that low frequency sound, such as that produced by high powered electrical equipment ie "hum"

can travel a considerable distance and under night time conditions, and well beyond the notional 250 metre buffer zone referred to above.

13. The sound emitted by the substation electrical equipment is listed in Tables 25.30 and 25.32, however, these tables are deficient in that:

- they do not locate the position or orientation of the emitters in earth coordinates
- They do not indicate if the sources are 'isotropic', that is the sound power per unit solid angle is uniform over the above ground hemisphere
- there is no qualifying statement to indicate whether these values are "average" or "worst case", or if there is diurnal or seasonal variance.

14. Received sound intensity is highly influenced by:
- radial distance
- topography
- the height above ground of both source and observer
- the magnitude and phase angle of the power being transformed
- equipment ageing characteristics
- directivity in the source, ie non-isotropic sound emission
- ground reflectivity at substation, receptor and intervening surface texture
- atmospheric absorption (frequency dependent on temperature & humidity))
- sound wave refraction of as a consequence atmospheric vertical temperature gradient (temperature inversion effects)
- wind and air temperature induced turbulence
- wind direction and the effect of vertical wind shear on atmospheric refraction
- diffraction by objects close to the transmission path
- surface reflexions from objects not in the direct transmission path.

15. Apart from radial distance, there is little evidence within the Applicant's documentation to show which, if any, of the above parameters have been taken into account when predicting noise levels at specific receptors surrounding the site.

16. Likewise there has been no disclosure of input parameters that would enable independent verification of predictions. The Applicant should thus be required to disclose:
- Software status and Version number
- Relevant Input files
- Whether the software can take account of the parameters listed above
- Validity of the model in this application ie ground truth vs prediction
- The distance at which predictions become unreliable
- Known limitations eg prediction accuracy vs frequency

17. The Applicant has now produced cumulative noise contours for EA1(N) and EA2 are these shown in 6.3.25 Appendix 25.5, Plate A25.5.3. These indicate that the noise level at the nearest receptor (SSR2) will be in the region of 31 dBA to 34 dBA, which is still above the original level indicated at the start of the consultation process.

18. A further shortcoming of the Applicant's approach to noise assessment has been to assume that only the two closest receptors, SSR2 and SSR5(new) need to be considered. Receptors SSR3, SSR9, and SSR4 have direct line of sight to much of the substation complex, and could easily experience the same or greater noise levels as a consequence of:
- the noise emitted from the substation being non-isotropic
- the emitters being large and occupying elevated positions

- variability in the ground cover and topography
- variability of wind direction and strength
- temperature inversion which can make distant sound appear much nearer

TONALITY ISSUES

19. A major concern to the residents of Friston is the prospect of sleep disturbance by a persistent "hum" traceable to large scale electrical apparatus. There appears to be no acknowledgement within the Applicants Volume on Noise and Vibration that it has carried out any literature search that low frequency sound, such as that produced by high powered electrical equipment ie "hum", can travel a considerable distance under night time conditions, and well beyond the notional 250 metre buffer zone referred to previously.

20. There is no indication within the DCO documentation that the Applicant has appreciated that all electrical equipment in the EA1(N) substation will be phase-locked to the UK mains frequency, (50 Hz). Even the noise from the cooling fans will be conditioned by the 50 Hz fundamental: there will also be a degree of "hunting" as the asynchronous rotors endeavour to minimise a slip. Motors running at slightly different speeds will create a range of very low frequencies as a consequence of mixing within the human auditory system producing "beat frequencies". There will thus always be a significant tonal disparity between substation noise and that of the prevailing rural noise spectrum.

21. Regarding Tonality, the Applicant makes the statement [Reference 4] that:
    - No acoustic features present.
    - Tonality screening assessed using a derivative of the Objective Method described in Appendix C of BS 4142
    - All fixed plant assessed using a method based on source levels detailed in ***Chapter 25 Noise and Vibration (Table 25.32)***
    - Further assessment undertaken of the predictive noise levels at the receptor using a derivative of the Objective Method
    - No tonality identified based on current available information

22. Nowhere in the Applicant's documentation is the above laid out for proper scrutiny and validation. This is far from a satisfactory response regarding residents' concerns over the potential for sleep deprivation as a consequence of permanent and intrusive low frequency noise.

23. Table 25.32 referred to in §21 above sets down the plant noise on the basis of the standard 8 octave spectrum as frequently used in standard textbooks on acoustics. The Applicant has chosen not to provide the 1/3rd octave levels, and thus has prevented an independent assessment of whether or not a penalty (typically +5dB) should to be applied the overall noise signature of the substation(s).

24. At this point it should be noted that large HVAC transformers exhibit strong noise outputs at double the mains frequency (ie 100 Hz in UK). This a direct consequence of large magneto-strictive forces forces within the core laminations as the field current reverses each half cycle. Significant noise is also to be expected at harmonics of the fundamental (50Hz). the Applicant should have presented the acoustic signature at 50 Hz, 100Hz, 150 Hz (third harmonic) et seq up to 1000 Hz. Again, proper use of FFT techniques would have eased comprehension.

CONCLUDING REMARKS

25. The Environmental Statement (Chapter 6.1) shows that the Applicant now recognises the potentially serious nature of the Operational Phase sound emission and that a Noise and Vibration Management Plan will be necessary to discharge requirements of the draft DCO.

26. Any decision by ExA to allow the development to proceed should be predicated by strict conditions requiring the developer to show:

- That the quietest equipment has been selected, regardless of cost
- Sensitive location and orientation of equipment to reduce potential noise signature at nearby residences, and not just following the site layout adopted for EA1 at Bramford.
- That maximum use has been made of sound absorbing acoustic enclosures having guaranteed noise attenuation performance.
- Wherever practicable, use of sound barriers to disrupt sound emissions from the substation site, particularly the silencing of exhaust vents and sound emitted from banks of cooling fans.
- That engineering steps have been taken to damp out mechanical noise originating in Harmonic Filters and other reactive components.
- That confirmatory measurements will be conducted at receptor sites: SSR1, SSR2, SSR3, SSR4, SSR5(new) & SSR9 and not just those closest.

REFERENCES

1. 6.3.4.2 Environmental Statement - Appendix 4.2 - Red Amber Green (RAG) Assessment for Onshore Substations Site Selection in the Sizewell Area Paragraph 21 [APP-443]

2. 6.1.25 Environmental Statement, Noise and Vibration Chapter 25, Table 25.30 [APP-073]

3. 6.3.25.2 Environmental Statement - Appendix 25.2 - Noise and Vibration Cumulative Impact Assessment with the Proposed East Anglia TWO Project [APP-523]

4. 6.3.25.5 Environmental Statement - Appendix 25.5 - Operational Phase Assessment [APP-526]

A. Thomas