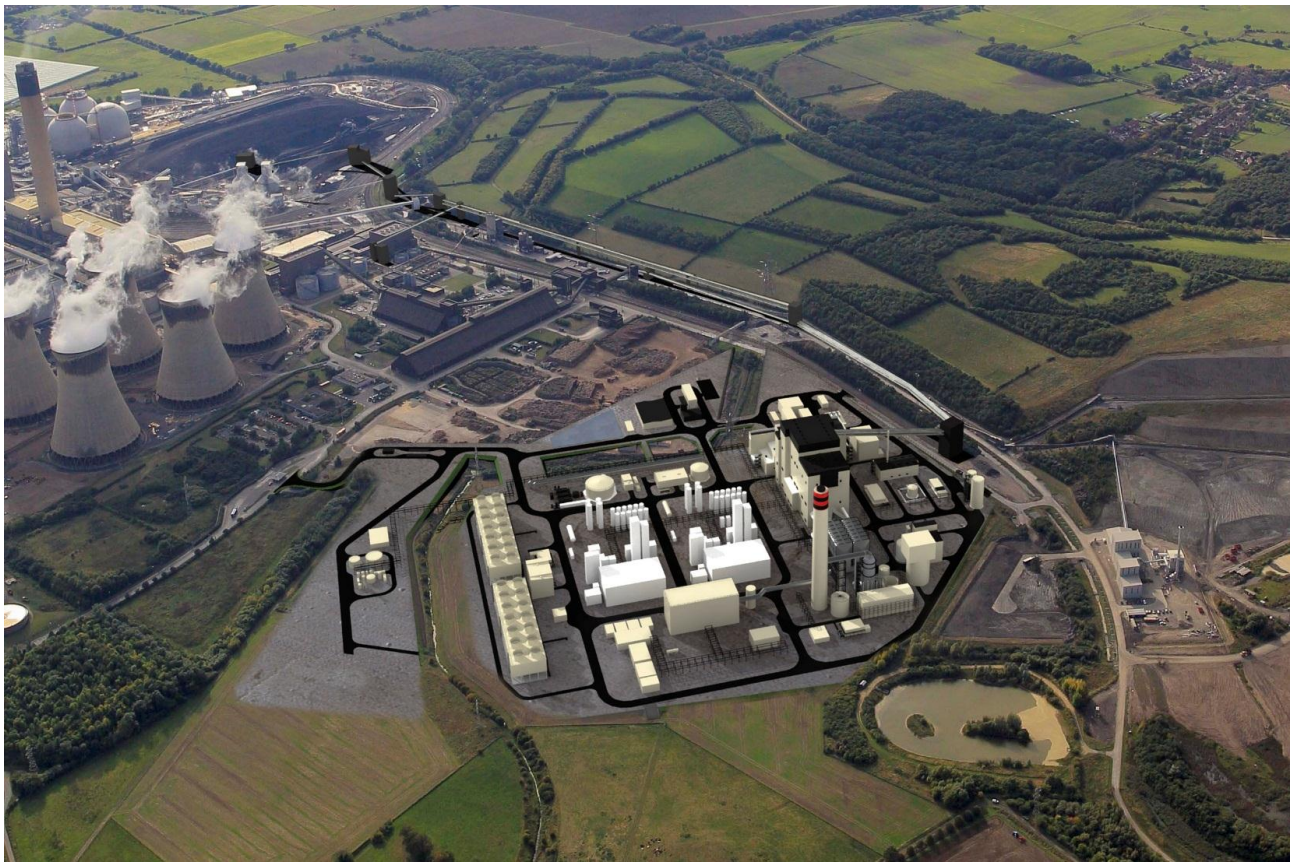
White Rose Carbon Capture and Storage (CCS) Project

Land adjacent to and within the Drax Power Station site, Drax, near Selby, North Yorkshire

Environmental Permit
Chapter X - Noise and Vibration



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Glossary of Abbreviations and Definitions	
AOD	Above Ordinance Datum
ASU	Air Separation Unit
BS	British Standard
CCS	Carbon Capture and Storage
CEMP	Construction Environmental Management Plan
CPL	Capture Power Limited
dB	Decibel
EA	Environment Agency
EIA	Environmental Impact Assessment
ES	Environmental Statement
FGD	Flue Gas Desulphurisation
FRA	Flood Risk Assessment
GPU	Gas Processing Unit
HGV	Heavy Goods Vehicle
LWS	Local Wildlife Site
MWe	Megawatt
NERC	Natural Environment and Rural Communities (Act 2006)
NSIP	Nationally Significant Infrastructure Project
PEIR	Preliminary Environmental Information Report
SAC	Special Area of Conservation
SINC	Site of Importance for Nature Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
WFD	Water Framework Directive
WHO	World Health Organisation
WSI	Written Scheme of Investigation

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1.0 INTRODUCTION

Capture Power Ltd (CPL) plans to construct a new 448 MWe (gross output) ultra-super critical coal fired power station. The Project will have the capacity to provide electricity sufficient for 630,000 households whilst capturing two million tonnes of carbon dioxide (CO_2) per year arising from the combustion process (approximately 90% of CO_2 emissions generated by the plant). The generating station and the means to capture CO_2 together comprise the White Rose Carbon Capture and Storage (CCS) Plant.

The Project is a key part of the UK's development and commercialisation of CCS, which the Government is supporting through over £1billion of capital and research and development funding. Additionally, the Project will support the development of a CO_2 transmission pipeline (a separate project developed by National Grid Carbon Ltd (NGCL)) which it is hoped will, in the future, be used by other industries and power stations in the Yorkshire and Humber area to transport their CO_2 emissions for permanent storage in the North Sea in geological features.

The application site (henceforth the 'Project site') is located on land adjoining the existing Drax Power Station in North Yorkshire, England. CO_2 captured will not be stored on site as the Project will link to a CO_2 transport and storage solution as noted above. The Project is in line with Government strategies (for instance the CCS Roadmap (1)) for controlling the construction / operation of new electrical generation infrastructure whilst meeting carbon reduction targets for the energy sector in the UK.

A separate Development Consent Order has been submitted to The Planning Inspectorate and was 'Accepted for Examination' on 17 December 2015 but did not include application for a deemed Environmental Permit. Due to the proposed activities of White Rose Carbon Capture and Storage it has been agreed with the Environment Agency that the current Drax Power Limited Environment Permit (VP3530LS) can be varied to accommodate the operations of the White Rose Carbon Capture and Storage Plant.

This Environmental Permit application is made in order to make a variation to the existing Drax Power limited Environment Permit (VP3530LS). The application forms and the associated chapters form the application for a variation to the Environmental Permit which will seek to add the activities of the White Rose Carbon Capture and Storage project to the existing Drax Power Limited Environmental Permit

This chapter on noise and vibration specifically covers the emissions generated through the operation of infrastructure for the White Rose Carbon Capture and Storage project (CCS project). Assessment of the noise emissions generated included the development of and several iterations of a computer model which assisted in generating feedback and meetings held with consultees following the publication of the Preliminary Environmental Information Report in June, 2014. The Environment Agency provided a response in October, 2014, although this was not submitted as part of the PEIR consultation as the specific consultation window had closed by this point and the final documentation for the Development Consent Order were being drawn together for submission in November, 2014. CPL, via ERM provided a response to the Agency regarding the points raised. Further discussion has been held with Selby District Council regarding noise data and assessment criteria for the project, both for construction and operational phases.

2.0 BASELINE CONDITIONS AND METHODOLOGY

Baseline noise measurements were undertaken at various Noise Monitoring Locations (NMLs) surrounding the existing power station and which, from previous development work, had been utilised and agreed with consultees as part of the Section 36 process for the Ouse Renewable Energy Plant. Baseline surveys were undertaken initially in September 2012 and repeated again in September 2013. Further NMLs were added following consultation with Selby District Council. The NMLs and the monitoring undertaken is provided below in Table X.X

Monitoring positions	Monitoring Locations (2012)	Monitoring Locations (2013)	Monitoring Location (2014)	Grid Reference
1		Foreman's cottage		SE668284
2	Wren Hall (Carr Lane)	Wren Hall		SE672271
3	Camblesforth	Camblesforth		SE653260
4	Barlow	Barlow		SE652284
5	Drax Abbey Farm	Drax Abbey Farm		SE670283
6		Long Drax		SE681280
7		Old Lodge		SE675281
8			Landing Lane	SE670297

Noise emissions have been based on noise modelling provided by Alstom and BOC Linde for the plant items within their current scope of supply. An additional conveyor system has also been modelled. Noise input data for this source has been based on measured noise data from Parsons Brinkerhoff who have acted as engineer for this element of the Project (on behalf of Drax Power Ltd). Mitigation has been applied to the plant at source to represent the normal level of mitigation that can be applied. Predictions have been carried out using the prediction methodology in ISO 9613(1) using Cadna-A 4.3.

Following feedback on the PEIR, refinements have been made to the assessments undertaken to complete the EIA where appropriate. Refinement arising from consultation is detailed in *Section 1.3*. Additionally as the Project is progressing through the FEED process this has led to a number of refinements since the publication of the PEIR, chiefly comprising:

- refined traffic noise predictions including comparison with and further available baseline traffic flow measurements; and
- revised predicted noise levels from operation of the plant and confirmation of the likely mitigation options.

It is important to note that operational traffic movements have been reviewed, but were found to be considerably lower than during the construction phase and noise changes that are not significant are predicted. Therefore, they have not been considered further in this assessment.

The baseline noise measurements were made under normal operating conditions for the existing Drax Power Station units and without any influence from extraneous sources such as construction noise and are therefore considered to be a robust basis for the establishment of noise standards in the EIA.

Where noise logging was carried out over day and evening time, the average evening time background noise measurements were found to agree closely with the daytime noise level calculated using the method

(1) ISO 9613, Attenuation of Sound during Propagation Outdoors, Part 2 General Method of Calculation, ISO, 1996.

proposed by Surrey County Council as described above. The assessment of daytime noise is also expected to represent the evening time and other quieter times of the day robustly.

Measurements were not made at Landing Lane during the initial surveys, as noise levels were expected to be similar to NMLs on the northern and north-eastern perimeter of the Operational Area (NMLs one, five and six) or at least not significantly lower. Noise levels below 30 dB L_{A90} were recorded at some of these locations (NMLs four, six and seven) at some times which were sufficiently low to not be likely to affect noise criteria (see discussions below). This conclusion was subsequently confirmed by noise measurements taken in the rear garden of No 40 Landing Lane and evening measurements at the end of Landing Lane facing the site (2). The measurements were limited to checks in the evening and night to confirm that noise levels were below the lower threshold, and are not therefore presented in the full table of results.

The noise level difference between day-time and night-time observed at NML seven (Old Lodge) is due to farm equipment operating very close to the monitoring area during the day-time measurements. This noise dominated the soundscape and it is believed that it might have also affected the levels measured at NML six (Long Drax), although to a lesser extent. Since the two NMLs are close to each other facing the same side of the site boundary, a cautious approach was taken and the lower value that was recorded (32dB L_{A90}) was used to represent daytime background noise at NMLs six and seven.

It should be noted that the measurements at Drax Abbey Farm in 2013 consisted of seven days measurements at 15 minute intervals i.e. 672 samples, the minimum value was 30 dB L_{A90} and the maximum value was 48 dB L_{A90} during the night. However, there are a number of ways in which background noise can be interpreted when long term 'logging' measurements are available. ERM has worked with a number of averaging systems including one cautious system proposed by Surrey County Council in its guidance for noise control relating to minerals and waste disposal. These guidelines give a fairly precise definition of 'background noise level' for the night-time situation. The guidelines require noise measurements to include calm settled weather, with monitoring extended over at least three days and preferably a week. The quietest 25% of the measured values between 00:00 and 06:00 are discarded and the lowest of the remaining is used to define the night-time L_{A90}. The 2013 survey has been used because it covered a longer period and included measurements at Foreman's Cottage and operation conditions at the Drax Power Station were confirmed to be representative of normal conditions.

The weather was calm and settled except for the night of the 02 October 2013 when there was some rain. This sample has therefore been excluded from the averaging above. Based on the above proposed averaging approach the background noise for Drax Abbey Farm has been derived as 32 dB L_{A90} at night.

This method does not specifically apply to daytime, but has also been used here as a way of generating representative background noise levels at Drax Abbey Farm. A value of 36 dB L_{A90} was calculated from the noise levels which ranged between 31 and 50 dB L_{A90}.

Single 30 minute samples were taken at other locations in 2013, and these follow a logical pattern around the site assuming noise levels in the area were at their lowest. Since the sample measurements at Foreman's Cottage in 2013 were taken at a time when noise levels at Drax Abbey Farm were at a minimum, and the same noise source affects Drax Abbey Farm and Foreman's Cottage (3), the same correction (of 2 dB) has been applied to the measured 30 minute night-time sample noise level (i.e. 26 dB L_{A90}) to calculate the background noise. Based on this averaging the background noise for Foreman's Cottage has been derived as 28 dB L_{A90}.

During the day levels at Foreman's Cottage were approximately 1 dB lower than the measurements logged at the same time at Drax Abbey Farm and a value of 35 dB L_{A90} has been derived from the logged measurements at Drax Abbey Farm.

The noise levels recorded at each sample location and the derived night time average values for Foreman's Cottage and Drax Abbey Farm are given in

(2) Additional survey conducted on the 24th and 25th of July 2014.
(3) The existing power station and distant traffic dominated noise at this time.

Summary of Background Measured (Free-field) Background (La_{90}) Noise Levels from Surveys in 2012 and 2013

Monitoring Location	2012 Day-time (0700 – 2300)	2012 Night-Time (2300 – 0700)	2013 Day-time (0700 – 2300)	2013 Night-Time (2300 – 0700)	Adopted Value Day	Adopted Value Night
1 Foreman's Cottage	-	- -	34	28	35 (note b)	28
2 Wren Hall (note a)	50	50	35	36	35	35
3 Camblesforth	43 to 44	40	46	-	43 to 46	40
4 Barlow	35 to 44	27	41	24	35 to 44	24
5 Drax Abbey Farm	34 to 49	40 to 48	31 to 50	32	36	32
6 Long Drax	-	-	32	26	32	26
7 Old Lodge	-	- -	39	27	32 (note c)	27

Note a) – Measurements in 2012 made at Carr Lane – equivalent to Wren Hall in terms of constant industrial noise.
Note b) – Based on Drax Abbey Farm measurements with 1 dB subtracted as a result of simultaneous samples at the two locations.
Note c) - Based on the measurements at Long Drax which was not influenced by operation of a tractor. The tractor resulted in noise levels increasing to 39 dB.

The noise impacts during construction and operation are quantified in the following Sections. The approach that has been taken for the EIA stage is to undertake refinements to the prediction and assessment of noise impacts where project data have become available after the PEIR. Noise levels have then been predicted based on data that reflects the current project stage, and these have been compared with the noise assessment criteria to establish the magnitude of noise impacts.

3.0 ASSESSMENT OF POTENTIAL EFFECTS

The noise impacts during construction and operation are quantified in the following Sections. The approach that has been taken for the EIA stage is to undertake refinements to the prediction and assessment of noise impacts where project data have become available after the PEIR. Noise levels have then been predicted based on data that reflects the current project stage, and these have been compared with the noise assessment criteria to establish the magnitude of noise impacts

Assessment of Potential Effects during Operation

The usual guidance used for the assessment of industrial noise is British Standard (BS) 4142. This suggests a system of criteria which is based on the background noise level. The background noise level is the L_{A90} which is the noise level which is exceeded for 90% of the time. BS4142 is currently under revision, but the draft cannot be adopted at this time as it is subject to consultation and may change.

The standard is generally interpreted as having a range of applicability for background noise levels as low as 30 dB L_{A90}. Where background noise is lower than this a value of 30 dB is adopted. Therefore, when using this standard the background noise level criteria for night-time adopted for all receptors would be 30 dB L_{A90} except at receptor two (Wren Hall) where a minimum noise level of 35 dB L_{A90} was recorded, receptor three (Camblesforth) where the noise levels reached a minimum of 40 dB L_{A90} and receptor five (Drax Abbey Farm) where noise levels of 32 dB L_{A90} have been adopted.

Where plant has no tonality and acoustic features that are noticeable then higher, less stringent, noise criteria are adopted than if it has such features. Assuming the plant can be designed to be non-tonal then the noise from the plant (measured using L_{Aeq} parameter) is compared directly to this background noise level without any corrections. A predicted noise level five dB above baseline (and/or the 30 dB minimum baseline noise level) would be 'marginal' in terms of the likelihood of complaints and would usually be acceptable (although the views of local authorities vary in this regard). Noise levels that are around 10 dB or more above the background noise would indicate that "*complaints are likely*" according to BS 4142.

Other benchmark criteria are provided by the World Health Organisation (WHO) that have been used as a basis for the recent guidance in BS 8233 (4). The British Standard gives guidelines for avoiding disturbance at night which are 30 dB L_{Aeq} at night between 2300 and 0700 inside residential buildings. The external noise levels that are equivalent to this value are typically 10 to 15 dB higher so that a reasonable benchmark would vary between 40 and 45 dB L_{Aeq}. These noise targets, which apply outside a building, are based on preserving good standards for sleep within the building (5). The night-time criterion does not aim primarily to preserve residential amenity outside the buildings and is less stringent than BS 4142 criteria in areas where baseline noise levels are low. BS 8233 recommends the use of BS 4142 for the purposes of assessing noise changes. The derived standards assume that buildings are not fitted with noise insulation, so higher external noise levels could be acceptable to residents if noise insulation were provided which resulted in suitable internal noise levels.

During the survey it was noted that the background noise varied considerably with time. This makes it difficult to determine a representative baseline, and therefore makes the criteria in BS4142 less likely to reflect the community reaction to noise from the project. Whilst plant noise predictions have been compared to the background noise using the approach in BS4142 in line with standard practice, it should be noted that this is based on background noise level samples or average values representing the lower end of the background noise variation over time. This forms a cautious basis for the assessment because for a large proportion of time baseline noise levels are higher than this, making plant noise less noticeable.

External amenity areas are also affected by substantially higher baseline noise levels at times, which also forms part of the baseline situation. Ensuring that suitable threshold noise standards are applied for plant noise within neighbouring residential properties is a way of avoiding a misleading indication of community

(4) BS8233: 2014, Guidance on Sound Insulation and Noise Reduction for Buildings, BSi, 2014.

(5) A criterion of 45 to 50 dB LAeq can also be derived during the day outside the building to allow for daytime resting, and an external criterion of 50 to 55 dB LAeq has been proposed for more typical daytime activities. External areas such as gardens should also meet a desirable level of 50 dB L_{Aeq} where practicable.

reaction based on comparison with baseline at night when outside areas are generally not used and it is more likely that internal noise levels will be the major concern in most cases.

During the day a noise threshold outside of buildings (of 50 dB L_{Aeq}), below which noise impacts are not expected for external areas, has also been adopted based on BS 8233 and WHO Guidance when defining lower levels at which mitigation will be considered for consented transport schemes. WHO does not suggest that the use of this guidance should be limited to transport schemes and the noise from the Project has been assessed taking this level into account.

Predicted Impacts - Noise Level Predictions and Assessment (BS4142 Criteria)

The predicted noise levels and the assessed noise impacts are included in *Table X.X* below. The predicted noise levels include a 2 dB margin which has been added to represent the typical equipment guarantee margins that are applied by vendors(6). In some cases it may be possible to reduce this margin, but this is usually confirmed during the detailed design stage when equipment vendor information is available for the equipment in question. The data for the conveyors have been based on measured noise levels around conveyor systems that are similar to those that will be installed. Where there is a range of data, the highest values have been chosen, and the data have been rounded to the next highest 5 dB. This has led to a similar margin to the other equipment to account for uncertainty within the data. Since the conveyor noise levels already include a cautious margin, no further margin has been added for this equipment.

Predicted noise levels and the assessed noise impacts

	Monitoring /Prediction Location		Predicted Noise Level dB L_{Aeq}		Adopted Background L_{A90} for BS4142 Assessment			Exceedance of L_{A90} BS4142 Assessment	
			Day	Night	Day	Night		Day	Night
1	Foreman's Cottage		49	47	35	30		14	17
2	Wren Hall (equivalent to Carr Lane)		39	38	35	35		4	3
3	Camblesforth		35	34	43 to 46	40		-8 to -11	-5
4	Barlow		40	40	35 to 41	30		+5 to -1	10
5	Drax Abbey Farm		46	45	36	32		10	13
6	Long Drax		35	35	32	30		3	5
7	Old Lodge		37	37	32	30		5	7
8	Landing Lane		37	37	32	30		5	7

The predicted noise levels exceed baseline noise levels at times, and BS4142 would suggest that complaints may be likely in these situations at some locations (specifically receptors one, four and five) based on night-time noise levels. A situation which is worse than marginal, but not a level where complaints become likely is expected at receptor locations seven and eight. A further situation which is below a marginal situation is predicted at receptor locations two and three (Wren Hall and Camblesforth).

During the day lower impacts are predicted with all receptors being below the marginal situation, which is not expected to result in significant impacts, except at locations 1 and 5 (Foreman's Cottage and Drax Abbey Farm).

As noted above, this forms a cautious assessment because for a proportion of the time baseline noise levels are higher than assumed, making plant noise less noticeable.

(6) As specified by Alstom and BOC 2014.

4.0 NOISE LEVEL PREDICTIONS AND ASSESSMENT (BS 8233 CRITERIA)

The predicted noise levels are above the BS 8233 night-time criteria by 2 dB at Foreman's Cottage even with mitigation applied. However, it may be possible to ensure that these noise levels are acceptable within these buildings. This would involve ensuring that suitable internal noise levels could be achieved to avoid sleep disturbance by using noise insulation and appropriate acoustic ventilation. External daytime noise levels would be below BS 8233 daytime criteria (50 to 55 dB L_{Aeq}) which would result in no significant internal noise levels, even for resting conditions by at least 1 dB, and by 6 dB for more typical internal activities. Noise levels in the garden areas will also be below the desirable noise levels for such spaces that are specified in BS 8233 (50 dB L_{Aeq}).

It is also noted that the buildings at Foreman's Cottage and Drax Abbey Farm are owned by Drax so that they can ensure that such off-site mitigation could be installed as required.

5.0 COMMENT ON RESIDUAL EFFECTS

Clearly, further mitigation is likely to be required, either by further attenuation at source, or by considering noise insulation of affected properties. The latter would normally only be considered by planners when further mitigation at source through plant design has been considered. However, the equipment suppliers have already confirmed that a high level of mitigation has been applied to the key items of equipment. The noise modelling results also showed that provision of noise screening between the source and receptor was unlikely to provide significant benefits due to the height of noise sources on the new plant.

Other factors such as wind direction are also likely to reduce noise levels on average so the noise impacts may be lower at times but this has not been taken into account during the conduct of this assessment to ensure a worst case scenario is modelled.

6.0 MITIGATION

General Considerations

The plant design has included mitigation on all the key noise generating plant items. The types of mitigation that will be applied will generally include the following:

- Placing loudest noise sources indoors;
- Procuring low noise equipment (transformers, cooling tower fans etc.);
- Adding silencers on air intakes/outlets and upstream/downstream of main boiler fans;
- Using acoustic screens or enclosures on major outdoor items such as pumps, motors and conveyors, and
- Acoustically insulating valves and pipes.

Specific mitigation measures for the various plant items are described in the following sections. However as the Project is still in an early stage of the FEED process the exact mitigation measures to be employed by the EPC contractor may vary as the plant configuration / attenuation is further refined. Nonetheless the overall sound power levels considered in this report and therefore the effects predicted at receptors represent a worst case scenario and the continuing FEED process will meet or ideally better these levels (e.g. lower).

The effect of providing screening around the boundary of the site was tested and found to have no significant effect due to the height of the noise sources on site. The effects of a barrier at receptor locations was also tested, but given the height limitations and minimum separation requirements that must apply to a barrier these options were found to be ineffective.

Conveyors

The conveyor system has been assumed to be fitted with a local shielding/enclosure. The conveyor drives are either located in transfer towers in which case it is assumed that the transfer tower provides acoustic screening, or they are assumed to be enclosed. For sources such as conveyor drives and tails that are located inside transfer towers a reduction of 15 dB(A) has been assumed, and for conveyor belts and idlers noise levels are assumed to reduce by 10 dB(A).

Limestone Preparation Building

The limestone ball mill sets (2 x 100%) will be located inside a building which will limit the transmission of the internal emitted noise to the outside environment. The limestone preparation building walls and roof will provide an average sound insulation R = 35 dB(A).

Gypsum Silo Dewatering System

The gypsum silo dewatering system will be enclosed inside a penthouse placed on top of the concrete silo. This penthouse will be constructed with single steel sheet cladding.

Air Separation Unit

To date a number of noise mitigation measures have been incorporated in the design of the various elements of the ASUs. Moving forwards there is relatively little scope for further noise reduction at source. The mitigation measures set out below have been allowed for in calculating the contribution of the ASUs to predicted noise levels at receptors as presented in this ES.

Air Compressors

Air compressors will be located inside noise hoods. Noise hoods will be located inside a light construction steel machine house. Air intakes of compressors and air intake/outlet of noise hoods will be equipped with silencers.

Molecular Sieve

The molecular sieve will have in-line silencers for pressure valves, acoustic insulation on piping and a blow-off silencer between the expansion turbine and the cold box.

Expansion Turbines

Expansion turbines will be located inside noise hoods and there will be in-line silencers between the expansion turbines and the cold box.

Pumps

Large motors associated with pumps will be fitted with low-noise cooling fans. Additionally sound insulation will be provided for the piping if required. For large pumps, noise hoods will be considered, if required.

Valves

The noise radiation of control valves depends on the flow rate, expansion ratio, temperature and medium. The main part of the sound is generated in the valve and will be radiated by the pipes. Low noise valves will be specified as required. For gas and steam service, special-design low-noise valves are preferred or alternatively in-line silencers may be used. For liquid flows, valves will be selected that will prevent cavitation, erosion, and vibration.

Piping

Acoustic sound insulation for piping will be provided where required.

Turbine Hall Building Cladding

The turbine hall building walls and roof will provide sound insulation. Furthermore, the vertical walls will have a sound absorbing inner liner in order to limit the reverberant noise level due to sound reflections.

Turbine Hall Ventilation

Silencers will be provided for the air inlet and outlet openings for the turbine hall building.

Feedwater Pumps

Sound insulation will be achieved by installing the main pump and its coupling inside an acoustic enclosure.

Boiler Building Cladding

The boiler hall building walls and roof will provide a significant sound insulation. In this case the design work undertaken to date showed that cladding, but no acoustic absorption is required to control the noise contribution from this source.

Air Intake Louvers

Silencers for select air inlet and outlet openings for the boiler building will be provided.

Other Equipment in the Boiler Area

The maximum surface sound pressure level (free-field conditions) at a distance of one meter from any equipment item in the boiler area, other than mentioned above, will be limited to an overall sound power level of 83 dB(A).

Primary Air Fan

To reduce the noise emission of upstream ducts, silencers or insulation will be provided upstream of the primary air fan. The downstream duct is located within the building and is does not require specific mitigation.

In order to meet the noise limits, as far as practicable, at off-site receptors the primary air fan (fan casing plus drive) will be enclosed in a building or acoustic enclosure.

Forced Draft Fan

To reduce the noise emission of upstream ducts, silencers or insulation will be provided upstream of the forced draft fan. In order to fulfill the very stringent far field noise requirement, the forced draft fan (fan casing plus drive) will be enclosed in a building or acoustic enclosure.

Electrostatic Precipitators

The sound power level will be emitted by the whole electrostatic precipitator units including precipitator insulated walls and roof, insulated flue gas ducts between air heater and precipitator, hammer drives, high voltage transformers and blow tanks for fly ash. The noise level will be limited to the lowest practicable level.

Induced Draft fan

To reduce the noise emissions of the induced draft fan, it will be necessary to put a sound insulation cover on the fan casing, typically made of minimum 250 mm of high density mineral wool (~130 kg/m3) + 1.6mm heavy visco-elastic layer fixed on the inner side of the jacketing steel sheet + 1 mm jacketing steel sheet. To reduce the noise emission of upstream and down-stream ducts, silencers will be provided up and downstream of the induced draft fan.

In order to fulfill the far field noise requirement, the whole induced draft fan (fan casing plus drive) will be enclosed in a building or acoustic enclosure.

Flue Gas Desulphurisation Plant

Flue Gas Desulphurisation Pump Building Ventilation Equipment, no air intake louvers will be installed on the northeast and southeast sides of the buildings.

Vacuum Pump Skids (2 x 50%)

The vent for the vacuum pump will be equipped with a suitable silencer (with an attenuation of about 10 dB(A)).

Oxidation Air Blowers (2x 100%)

Each oxidation air blower will be equipped with an acoustic enclosure, and with a silencer inside the outlet pipe. A silencer will be installed on each blower air intake opening made in the building wall (in the southwest direction).

Stack Mouth (Air Mode)

The sound power level at the stack mouth including self-induced noise caused by the flow will be specified to the supplier to not exceed 100 dB(A).

Hybrid Water Cooling Tower

For the noise prediction calculation one cooling tower bank, consisting of 28 cells has been considered. For the complete cooling tower (wet air inlet, dry air inlet and outlet) silencers or sound absorbing louvers are likely to be required. In addition, an acoustic screen, from ground to fan deck height +1 m (i.e. about 20 m), with one side absorbing, 50 m long, will be placed at the eastern end of the cooling tower.

Typical material for the acoustic screen would comprise a composite panel made from 0.6 mm thick steel sheets with a core made from 50mm mineral wool with a density of 100 kg/m3. The side facing the cooling tower will be perforated to allow the mineral wool to absorb sound.

Main Cooling Water Pumps

The main cooling water pumps will be located inside a building. For the pumps that are located below ground level, no further acoustic measures are likely to be necessary.

Demineralisation Plant

The de-mineralised water production plant will be housed inside a building, which will limit the noise emissions to the outdoor environment.

Air Compressor Building

The equipment for compressed air production will be housed inside a building with concrete walls and roof, which will significantly limit the transmission of the internal noise to the outside environment. Suitable silencers will be installed in the compressor air inlet/outlet ducts.

Fly Ash Air Blower Building

The mitigation requirement will be the same as for the air compressor building.

Fuel Oil Pump House

The fuel oil pumps will be housed inside a building with concrete walls and roof, which will significantly limit the transmission of the internal noise to the outside environment. No acoustic measures are necessary, and standard weather protection will be provided for the air intake louvers.

Gas Processing Unit

The sound power level will be limited to the lowest level practicable. Noise levels have been specified based on test data. Potential noise mitigation measures may include silencers and insulation, which will be specified during the detail design stage.

7.0 RESIDUAL EFFECTS

Since the design of the plant has been developed to include a range of inherent noise mitigation measures, the residual noise effects will be as stated in *Section 6.0.* Although some impacts are predicted in terms of operational noise using the BS 4142 assessment methodology at night, the overall noise levels are sufficiently low that the recent guidance in BS 8233 indicates that noise levels within the buildings are not likely to give rise to a significant risk of sleep disturbance. At one location (Foreman's Cottage) BS 8233 night-time criterion can be met by installing noise insulation (e.g. acoustic glazing) to the property. Since the property is owned by Drax it will be possible to implement this measure. This will ensure that noise levels within all buildings will not give rise to a significant risk of sleep disturbance.

During the day at locations 1 and 5 (Foreman's Cottage and Drax Abbey Farm) BS 4142 guidance is not met, but, the noise levels are at least 1 dB(A) below criteria proposed by BS 8233 (50 dB L_{Aeq}) which indicates that conditions within the buildings would not be significantly affected and external noise levels in the garden areas will also be below desirable noise levels. Lower noise impacts are predicted at other receptors using the guidance in BS 4142 with all receptors being below a marginal situation, which is not expected to result in significant impacts.