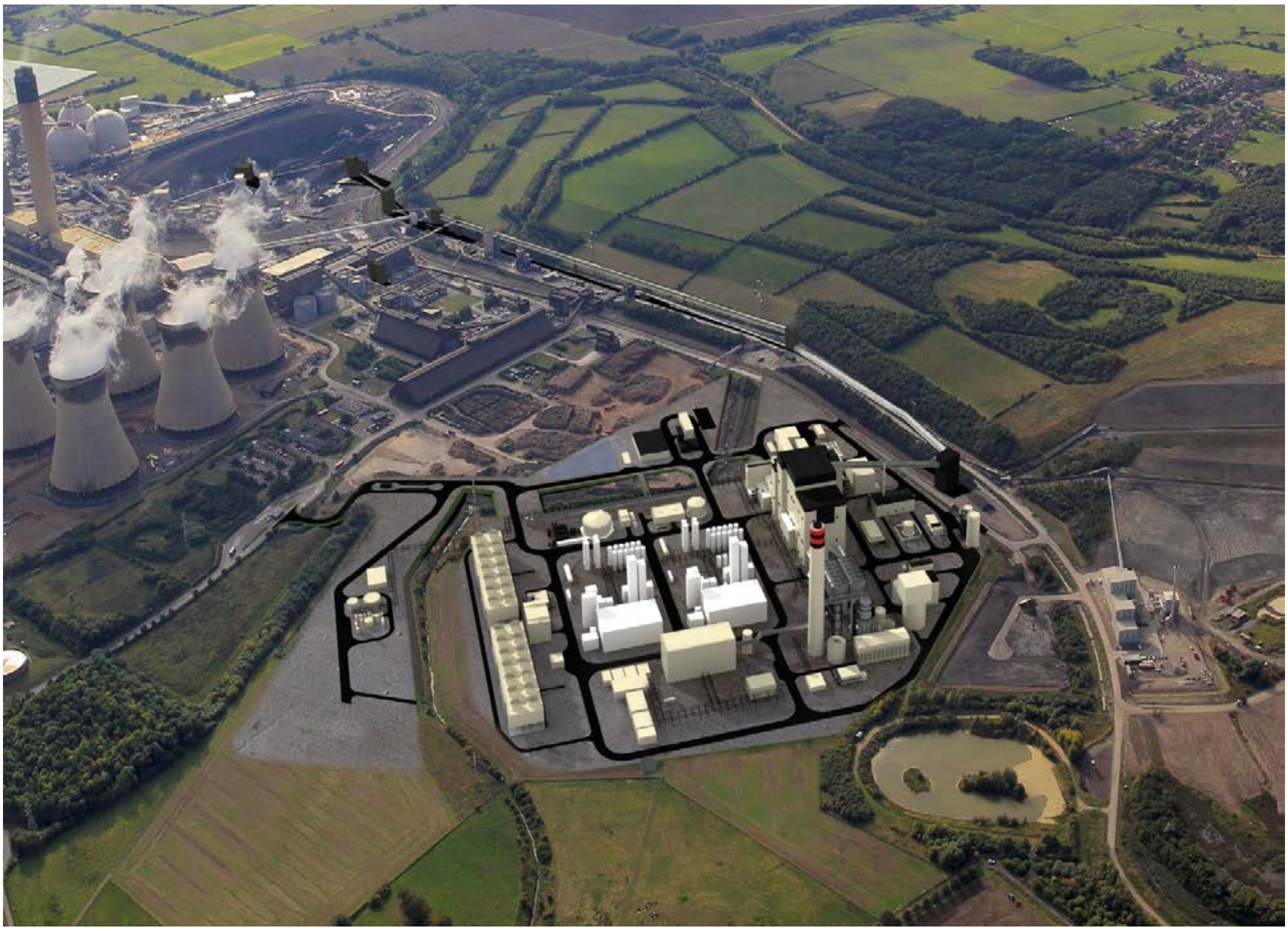
White Rose Carbon Capture and Storage (CCS) Project

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

Environmental Permit
Chapter XIII – BAT Statement



Applicant: Drax Power Limited
Date: June 2015

Document History

Document Number	1		
Revision	0.1		
Author	Jim Doyle		
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Approved By			
Signed		**Date**	
Document Owner	Drax Power Plc		

Revision History			
Revision No.	**Date**	**Reason for Revision**	**Authorised By**
0.1	**08/04/2015**	**Submission**	**JD**
0.2	**08/06/2015**	**Update following EA guidance**	**JD**
0.3	**23/06/2015**	**Update following EA guidance**	**JD**

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

CONTENTS

1.0 INTRODUCTION

1.1 The application of Carbon Capture and Storage (CCS) from the power generation sector is an emerging technology. CCS has thus far been demonstrated by a small number of projects which have looked at either relatively small scale plants or have utilised a side stream process to capture a portion of flue gas which may then be simply released to atmosphere rather than transported and stored. Currently there are three generic CCS technologies for the power sector which are believed to represented the best options for commercial deployment; pre-combustion capture, post combustion capture and Oxyfuel which is a hybrid technology. The White Rose CCS project is an Oxyfuel derivative. Oxyfuel technology provides some inherent benefits:

1. Generation of a relatively pure CO_2 stream for transport and storage
2. Significant reduction in NOx generation through nitrogen removal
3. No significant increase in use of chemicals for CO_2 capture
4. No requirement for energy input for recovery of solvents
5. Flexible operation with the ability to meet the future demands of National Grid

1.2 It would be incorrect to suggest that Oxyfuel technology in terms of CCS is BAT, until there are a number of plants which have been operating for a reasonable amount of time it is not possible to demonstrate which technology may be most suitable for CCS. Indeed, there may be a number of specific considerations which may favour one CCS technology over another for a given installation with respect to location, fuel type and flexibility of operation.

1.3 Currently there is no BAT guidance available against which CCS technologies can be appraised, The Environment Agency (the EA) have stated that CCS plants will be permitted under the existing regime and that there is no need to amend or modify the way in which applications involving CCS plants are determined.

1.4 The White Rose CCS plant will be located to the North of the existing Drax power station on an area of land which is almost identical to the area permitted for the Ouse Renewable Energy Plant (Ouse REP). In this sense the area of land has previously been appraised in terms of the risks associated with the addition of large combustion plant onsite, albeit a different technology for generating electricity and capturing the carbon dioxide. Operating in ‘Oxy-mode’ or capture mode, the plant is a more benign plant than the Ouse REP when considering emissions to atmosphere, this is due to the significant reduction in nitrogen entering the boiler as well as the iterative cycling of flue gas through the boiler hence resulting in the flue gas passing through the abatement systems multiple times. In addition, the flue gas condenser removes moisture from the flue gas which comprises a sulphur and nitrogen load prior to CO_2 processing and compression.

1.5 The White Rose CCS plant will benefit from a number of interconnections with the existing power station including fuel, water and process effluents, raw materials such as limestone and certain waste management facilities. In addition data and communications provision.

1.6 Water for a number of purposes will be abstracted from the existing station’s abstraction facility and discharged through the existing stations purge facilities hence there is no requirement for modification of the abstraction and discharge facilities. The current station’s abstraction licence is capable of meeting the demands of the White Rose CCS plant. Previous discussions with the Environment Agency identified this point and specifically the issue of the use of the abstraction licence for the White Rose CCS plant. Where necessary and in order to meet the current permit’s discharge limits, White Rose CCS will treat some of its process effluents in order to ensure compliance.

1.7 Raw materials including fuel will be conveyed to the White Rose plant with interconnections into the existing station’s limestone and gypsum storage facilities. Conveyors will run adjacent to the haulage roads to the White Rose CCS plant.

1.8 Waste will be managed according to the types and volumes of wastes generated, the generation of ash from White Rose CCS will result in ash either being transported from the station by truck or by rail or disposed of on Barlow mound.

1.9 Other areas which this application for a variation to the existing Environmental Permit will cover includes:

- Emissions to air from an additional point source including dispersion modelling
  - Modelling undertaken for both air and oxy modes of operation assuming baseload operation
  - Assessment of impacts on human and ecological receptors
  - Generation of a Habitats Regulations Assessment
- Noise generated during operation
  - Noise modelling undertaken
  - Assessment criteria agreed with Selby District Council following discussion through PEIR
- Management of the installation
  - Environmental management and compliance with specific standards and regimes
- Energy efficiency
  - Energy recovery processes and approaches in managing efficiency for the CCS plant
- H1 EIA assessments for both air mode and oxy mode operation
- EP OPRA spreadsheet

2.0 EMISSIONS TO AIR

2.1 The White Rose CCS plant has been designed to be capable of operating in both air mode (non capture) and oxy mode (carbon capture). In air mode, the plant operates as a high efficiency, conventional pulverised fuel power station utilising atmospheric air. There are a number of elements of the design which are considered BAT whilst operating in air mode and these include;

- Design of ultra-supercritical boiler
- Low NOx burners
- Electrostatic precipitators
- Selective Catalytic Reduction (SCR)
- Use of Flue Gas Desulphurisation (FGD)
- Hybrid Cooling Towers

2.2 In terms of emissions generated which are regulated through the Industrial Emissions Directive (IED), the plant has been modelled operating in air mode assuming base load operation over the course of a year. The plant is capable of complying with IED limits through the range of part load operation to full load. Air dispersion modelling has been carried out looking at the fuels which generate the greatest pollutant loads which are then treated through the flue gas abatement plant.

2.3 Whilst operating in air mode the plant is designed to achieve an efficiency of approximately 43.5% and will have a gross output of 448MWe. This is achieved through the design of the ultra-supercritical boiler which utilises high temperatures and high pressures compared with a sub-critical boiler resulting in greater energy derived from the fuel being passed into the supercritical fluid. The use of supercritical technology for new pulverised fuel combustion plant is considered BAT.

2.4 Whilst operating in Oxy-mode the additional infrastructure associated with the generation and capture of the CO_2 stream is required to operate. This results in an increase in the parasitic load across the installation and hence reduction in net output and efficiency. The efficiency in Oxy-mode will be approximately 33%. The air separation units (ASUs) which generates a high purity oxygen stream and removes atmospheric nitrogen from the combustion gases resulting in a significantly reduced NOx load emitted from the installation which is an inherent characteristic of the Oxyfuel technology. Recirculation of the flue gas into the boiler and through the flue gas abatement technologies results in further reductions in NOx and SO_2 loads being emitted.

2.5 The operation of the installation in oxy-mode inevitably results in a reduction in efficiency due to the increase in parasitic load from associated plant. This reduction in efficiency is currently synonymous with all CCS technologies. Generally speaking, lower efficiency in an unabated plant would equate to increased emissions to atmosphere per unit of electricity generated. However, in oxy-mode operation this is not the case with lower emissions being generated per unit of electricity generated in comparison with air mode operation.

3.0 NOISE EMISSIONS

3.1 Noise generated through the operation of the main power plant and associated activities, e.g. conveyors has been modelled using specific modelling software (Cadna-A 4.3). The software take account of local terrain and buildings as well as materials and acoustic enclosures and mitigation. The model generated has been updated through a number of iterations following its development as part of the PEIR submitted last year. Modelling of the plant allowed for identification of specific noise sources and their impacts on specific receptors around the plant. This resulted in mitigation being added and improved for certain specific pieces of equipment and infrastructure.

3.2 Noise was discussed in depth with Selby District Council's Environmental Health Officer following the submission of the PEIR information and agreement reached on what achievable noise levels could be reached at specific locations and the criteria of assessment for the relevant time of day. These data were also presented following re-iteration of the noise model in the DCO application. Discussion with various stakeholders followed by significant engineering design work has resulted in a design which should now meet agreed criteria.

4.0 MANAGEMENT OF THE INSTALLATION

4.1 Drax currently manages the operation of the existing Drax power station through an Environmental Management System (EMS). The EMS at Drax complies with BS EN ISO14001 and there are two surveillance visits every year and a recertification visit every three years. Internal audits are also undertaken to ensure compliance with the EMS. The EMS will be extended and augmented to include the management of the various aspects of the White Rose CCS plant.

4.2 Management of the environmental aspects of the White Rose CCS Plant takes place at all levels of the organisation. The Plant Manager will have overall responsibility for the implementation of the EMS and for environmental compliance and performance of the business. The Plant Manager will maintain an overview and strategic control by means of:

4.2.1 Inclusion of environmental issues in the regular management meetings/ reports of senior management

4.2.2 Ensuring that environmental issues are adequately incorporated into all Company Business Plans and Capital Approval processes approving and reviewing the Environmental Policy at appropriate intervals.

4.3 Each Drax Power Ltd Board Member has overall responsibility for the environmental aspects of their area of management although the majority of the responsibilities for plant management fall to the Production/Operations Director. They maintain an overview and strategic control by a range of actions, including:-

4.3.1 Providing adequate resources and training for implementing and maintaining the system on a day-to-day basis

4.3.2 Regularly setting and reviewing environmental performance and objectives;

5.0 ENERGY EFFICIENCY

5.1 The White Rose CCS will employ a high efficiency ultra-supercritical boiler which generates high pressure and high temperature steam as a supercritical fluid. Due to the significant difference in the design and thermodynamics of a supercritical boiler, the efficiency of a plant can approach 44% of the conversion of energy in the fuel to electricity. Generally speaking this means that the pollutant load generated per unit of electricity generated is significantly lower than sub-critical systems.

5.2 With regards to the White Rose CCS project and CCS plants in general, it is recognised that there will always be an impact on overall plant efficiency due to the increased parasitic load of the additional plant and infrastructure associated with the CCS elements of the plant. Regardless of the type of technology applied, fitting CCS to a plant will inevitably result in a reduction in efficiency. Although, with an abated plant the emissions to atmosphere generated will be significantly reduced.

5.3 Systems to recover and re-use energy generated through processes, e.g. heat generated through compression systems and cooled fluids generated through the operation of the Air Separation Units (ASUs) have been designed to reduce efficiency losses and integrate systems across the plant where feasible.

5.4 Key considerations with regard to energy and efficiency as part of the basis of design;

- The ethos of high efficiency against CO_2 emissions.
- Ultra-supercritical technology and the inherent high efficiency of the steam cycle.
- Heat integration with the ASU, recognising there are some operational and efficiency synergies of integrating the two technologies.
- Use of high efficiency systems e.g. boiler design, high efficiency turbine cylinders, water cooled technology improving efficiency over air cooled, high efficiency motors and VSDs.
- Identification of infrastructure that have greatest impact on parasitic load, e.g. ASU, GPU, FGD, compression systems
- Options explored to minimise parasitic loads across the plant and integrate systems.

6.0 H1 EIA TOOL

6.1 Two versions of the H1 tool have been generated which cover operations in air mode and operation in oxy mode. The rationale behind the development of the two versions of H1 stem from discussion had in October 2014 regarding the Emissions Performance Standard (EPS) and various aspects surrounding the implementation. Discussion involving the Planning Inspectorate, Natural England and the Environment Agency as well as Capture Power Limited requested that air dispersion modelling and the associated Habitats Regulations Assessment should be modified to account for the possible impact of the 3 year window of commissioning over which a CCS plant would not be required to comply with the EPS. Subsequent discussions with the Agency suggested that two scenarios should be modelled. For this reason, two versions of the H1 tool have been developed, one which encompasses generation in Oxy mode and one which encompasses generation in air mode. This then allows for the total spectrum of emissions to be considered, although once the 3 year window has passed, the EPS will constrain the plant to operate for no more than approximately 56% of the year in air mode.

7.0 EP OPRA

7.1 The EP OPRA spreadsheet tool calculates the cost of the application based on data input. Generally speaking the score is largely generated from the existence of the existing power station and hence a number of data entries cannot be changed. Certain additions may also not impact the score due to the capping of a specific number of entries.

White Rose Carbon Capture and Storage (CCS) Project

Document Ref: 6.3.2
PINS Ref: EN10048

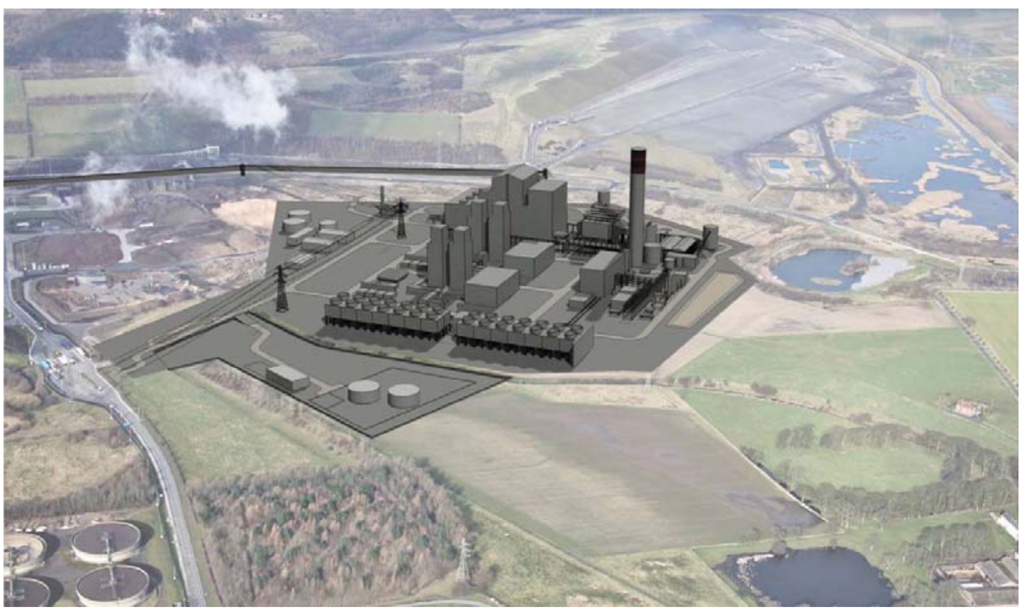
The White Rose CCS (Generating Station) Order

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

ES Volume 2 Chapter B - Noise and VibrationTechnical Report

The Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure)



Applicant: Capture Power Limited
Date: November 2014

Document Owner: **Michael Fraser**			
Revision History			
Revision No.	**Date**	**Reason for Revision**	**Authorised By**
01	17/09/2014	Technical Review	JH
01A	15/09/2014	Partner Review	KJM
02	14.10.2014	Partner Review	KJM
02.1	23.10.2014	Client comments incorporated	KJM
03.5	28/10/2014	Final Review	RE
04	06.11.2014	Issue	KJM

Glossary	
ASU	Air Separation Unit
A-weighting	Environmental noise measurements and levels are usually expressed using a variation of the decibel scale, which gives less weight to low frequencies and very high frequencies. This system was derived to correspond to the reduced sensitivity of the human hearing mechanism to these frequencies.
Background Noise Level - L_{A90}	Background noise level is a measure of the low level of noise that occurs between the higher levels from particular events, for example passing vehicles. This may be abbreviated to BNL and the symbol is L_{A90}. It is the value exceeded for 90% of the time period being considered. Note that it is higher than the minimum noise level but may be regarded as the typical noise level during 'quiet periods'.
BS	British Standard
CCS	Carbon Capture and Storage
CO_2	Carbon Dioxide
CPL	Capture Power Ltd
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
Decibels	Noise levels are measured using the decibel scale. This is not an additive system of units (as for example, metres or kilograms are) but a proportional system (a logarithmic progression). A change of 10 dB corresponds to a perceived doubling in loudness; changes in environmental noise of less than 3 dB are not normally regarded as noticeable.
EHO	Environmental Health Officer
EIA	Environmental Impact Assessment
ES	Environmental Statement
FEED	Front End Engineering and Design
GPU	Gas Processing Unit
HGV	Heavy Goods Vehicles
ISO	International Organisation for Standardisation
LA_{10}	Similarly to the L_{A90} described above, L_{A10} is the noise level which is exceeded for 10 per cent of the time.

$L_{Aeq, T}$ - Equivalent Continuous Sound Level	The L_{Aeq} level gives a single figure to describe a sound that varies over a given time period, T. It is the A-weighted steady sound level that would result in the same sound energy at the receiver as occurred in practice with the varying level. It is derived from the logarithmic summation of the sound signal and so unlike a conventional (linear) average it gives additional weighting to higher levels.
L_W or SWL - *Sound Power Level*	This is a measure of the total sound power radiated by a source. The Sound Power of a source is a fundamental property of the source and is independent of the surrounding environment.
Maximum Noise Levels	The $L_{Amax,s}$ is the highest value of the sound level over the specified period. It is sometimes referred to as 'peak' noise level. However, the term 'peak' has a special meaning in acoustics and the expression 'maximum' is preferable to avoid confusion. The 's' stands for slow response, which is the metric which has been used throughout this assessment.
NMLs	Noise Monitoring Locations
PEIR	Preliminary Environmental Impact Report
SDC	Selby District Council
WHO	World Health Organisation

CONTENTS

1 INTRODUCTION

1.1 TERMS OF REFERENCE FOR THIS TECHNICAL REPORT

This Technical Report describes the potential effects of noise and vibration from construction, operation and decommissioning of the White Rose Carbon Capture and Storage Project (henceforth the 'Project').

Potential effects of the project on noise sensitive receptors include the following:

- noise from construction plant during the various phases of site preparation and installation of equipment and structures;
- construction traffic on the wider road network; and
- 24 hour, year round operation of the facility.

1.2 BASIS OF ASSESSMENT INCLUDING REALISTIC WORST CASE SCENARIO

1.2.1 Construction

As is usual in EIAs, the inventory of construction plant items has been based on experience of similar projects and since a full set of specified equipment will not be available until after an engineering, procurement and construction contractor has been appointed. Additionally the locations of where construction plant assemblage will operate have not been fully defined. Therefore, the assessment is based on an even spread of construction sources around the Project site. This is thought to be a more realistic distribution than adopting a worst-case view assuming all the plant operates, for instance, at the site boundary. No mitigation has been assumed for construction plant in the predictions.

Whilst there may be some plant in construction laydown areas this is likely to be insignificant compared to the activities on the main construction site, and it is assumed that it will be possible to lay out and manage laydown areas so that significant noise effects do not result.

1.2.2 Operation

Only in oxy-mode do the air separation units (ASUs) operate continuously. When the plant operates in oxy-mode, the CO_2 processing and compression plant unit (GPU) is also operating.

Air-mode is used during start up and shut down, and should the ASU or carbon capture facilities be off-line (apart from when they are ramping up or down). This effectively means that the plant would then operate as a standard coal fired power plant with modern abatement technology. From the perspective of noise, oxy-mode is likely to result in higher noise levels as the ASUs and the GPU will both be operating, whereas in air-mode they will not be.

The normal operating condition (oxy-mode) for the Project can be regarded as the 'worst case' for noise and this is the scenario which has been modelled.

1.2.3 *Operational Plant Noise Emissions*

The data used within this assessment are based on noise modelling supplied by Alstom and BOC Linde for most of the operational noise sources; these data are based on their experience of what is achievable through equipment design and noise mitigation.

Measured noise levels from conveyor belts and drives have been provided by Parsons Brinkerhoff (on behalf of Drax Power Ltd) for use in the modelling and have been subject of detailed design iterations and mitigation refinement.

During detailed design, equipment vendor data will be available to ensure that appropriate noise mitigation is included so that the plant design meets the levels that have been assumed in this modelling. The modelling assumptions therefore provide a realistic representation of the likely noise emissions.

If the plant has tonality or acoustic features the assessment method in BS4142 requires an acoustic feature correction to be added to the predicted noise level from the plant before it is assessed against the criteria. As specific design detail is not yet available it has not been possible to confirm definitively if noise from the plant can be designed to be non-tonal and free of other acoustic features. However, there are a number of steps that will be taken to ensure that this will be the case as discussed in *Section 4.6.2*. Therefore, a correction has not been applied in this assessment because it is most likely that the need for a correction can be avoided during detailed design and commissioning phases of Project development.

1.2.4 *Construction Traffic*

Road traffic has been forecast during construction and is reported in *Volume 2, Chapter E* (the Transport assessment). It is expected that the traffic flows to and from the Project site will vary during the construction period based on experience of similar projects. The AADT (Annual Average Daily Traffic) flows have been provided and are used as a basis of this assessment. The data have been supplied for 2020 both with and without the construction traffic. Whilst baseline flows are annual average values, the predicted flows during construction represent the phase of construction when the daily traffic flows are expected to be highest. Therefore, the comparison is a worst-case situation. The cumulative traffic figures with the traffic generated during outages associated with Drax's existing operational units has also been supplied, but since this is part of the baseline situation, the changes in noise levels during outages are expected to be less than at other times and outages have not been considered further in this assessment.

The percentage of Heavy Goods Vehicles (HGVs) in the flow has been assumed to remain unchanged compared to the existing situation based on measured data. In fact the number of light vehicles is likely to increase much more than the number of heavy goods vehicles during construction, which indicates that the percentage of HGVs would reduce. Since assuming a high percentage of HGVs for the "with construction" scenario results in higher predicted impacts it will result in a worst-case assessment.

The cars associated with the site will follow one of two routes from the site to the M62 motorway. The HGVs will follow only the 'designated HGV' route (along New Road, the A645 and the A614 to Junction 36 of the M62). These assumptions represent a realistic worst-case assumption for the assessment.

1.2.5 Operational Traffic

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.

1.2.6 Vibration

Although the Project has not been designed in detail at his stage it is possible to describe the main activities during construction that have the potential to generate vibration. These are ground improvement works (which may include driven piling and vibro-compaction).

Vibration during concreting and structural construction works is not expected to be perceptible at the nearest receptors since these sources are recognised as generating low levels of vibration and the receptors are in excess of 100 m from the Project site, and has been scoped out on this basis.

Measured vibration levels from a variety of piling and vibro-compaction plant are provided in British Standard (BS) 5228: Part 2: 2009. Driven piling techniques are expected to produce significantly higher levels of vibration than the use of either bored piling or vibro-replacement techniques due to the impulsive action of the drop hammer striking the pile.

Studies show that levels of vibration from driven piling fall below the level at which vibration may be perceptible in a residential environment within a distance of 100 m [1]. The nearest sensitive receptor (Foreman's Cottage) is over 275 m from the part of the site where vibrating equipment is likely to be located, and is therefore not expected to experience significant impacts as a result of the construction work. Vibration has not been considered further in this assessment.

1.3 CONSULTATION

CPL has carried out two formal stages of pre-application consultation this year. The first was in April, and the second was in July with the publication of the PEIR.

All statutory consultees were contacted as required during these formal consultations. The intention of the consultation process in relation to the PEIR was to seek views in advance of the full DCO submission, and to ensure that the outcome of formal consultation stages and the matters agreed between the project team and consultees in advance are incorporated into the ES that accompanies the DCO.

In addition, during the DCO process significant 'informal consultation' was also undertaken to iteratively align the ES (so far as is practicable) with the requirements of identified environmental / social-economic sensitivities, consultees and the public.

In the Scoping Opinion a number of comments pertaining to the noise and vibration assessments were provided. These comments chiefly relate to construction and operation and also noise associated with traffic along access routes. The Scoping Opinion also states "*vibration effects, in particular from activities such as piling and demolition activities, may extend over a wide area*" and should be considered within the assessment. The effects of vibration have been considered based on empirical data in *Section 1.2.6* but significant effects are not expected to occur given the large distances between potential sources

(1) TRL Report 429. Groundborne Vibration Caused by Mechanised Construction Works. D.M.Hiller & G.I.Crabb. Highways Agency 1995

of vibration and the nearest receptors. Therefore, it is not expected that there will be any significant vibration effects.

During the preparation of this ES consultation has continued with Selby District Council (SDC) as recommended in the Scoping Opinion. The Scoping Opinion also recommended consultation was undertaken with the Environment Agency. The noise and vibration PEIR technical report was sent to the Environment Agency for comment and no significant matters were raised on the baseline conditions, assessment methodologies or predicted noise levels.

In summary the consultation conducted so far with SDC is as follows.

- Discussions were held with the Environmental Health Officer (EHO) at SDC who is responsible for environmental issues at the site to confirm baseline measurement locations and receptor sensitivity.

- Further discussions were held to discuss initial predictions and the assessment criteria for the EIA.

SDC commented on the Noise and Vibration PEIR Technical Report on the 9th of June 2014 raising several matters which were addressed as far as possible in the final PEIR as follows:

- clarification was provided that baseline noise measurements were made during operational conditions and did not include construction noise (for activities then underway on the Drax Power site);

- likely core working hours were clarified; and

- traffic routing options were considered, but the worst-case increase in traffic flow and consequential noise changes at receptors around road links were predicted to be small, which lead to the conclusion that SDC's suggestion of managing traffic to avoid passing through Carlton and Snaith was not considered necessary at the PEIR stage.

Following submission of the PEIR SDC confirmed that there were a number of aspects that still needed to be addressed further and these have been addressed in this Environmental Statement (ES) by taking the following action.

- Criteria for operational noise have been further discussed with SDC including criteria for noise levels outside of buildings where noise insulation is being proposed.

- A methodology and a selection of assessment criteria were developed to cover day time and night time. The methodology was also reviewed to ensure that evening periods were also likely to be protected.

- Operational noise predictions were refined and further mitigation options considered to refine the likely operational noise impacts from the project.

- The use of the HGV route has been confirmed avoiding HGV movements past Carlton and Snaith.

2 METHODOLOGY

2.1 BASELINE SURVEYS

A comprehensive survey was carried out to establish baseline noise conditions prior to the PEIR stage (see *Section 3)* and this has been supplemented by additional baseline noise measurements at Landing Lane (in Hemingbrough) receptor location. All monitoring locations are shown on *Figure B.1* above.

2.2 CONSTRUCTION NOISE PREDICTION

Construction noise has been predicted based on an understanding of other similar projects of the types and numbers of construction plant that will be used. For the purpose of noise assessment, the three key phases of general construction comprise:

- civil engineering and platform preparation;
- construction site preparation; and
- construction and installation.

The details of construction plant assumptions are given in *Annex A*. Sound power levels were found to be 116, 117 and 112 dB(A) respectively for each of the above phases. The plant during these phases has been predicted as being evenly distributed around the site which is realistic for this type of construction. Sheet piling may also be required, but this will tend to be a noisier source located at discrete/specific locations on the site. For the purposes of this ES the noise level from sheet piling has been modelled assuming it occurs at the closest location to a receptor on site at which major construction is likely to take place. It is noted that sheet piling would only be required for a short part of the construction period. The noise levels from sheet piling vary depending on the piling type, but a common form is the use of a drop hammer or hydraulic hammer. Sound power levels for this type of activity can be as high as 122 dB(A). Typically piling might be carried out for 40% of the time. The effective sound power is therefore 118 dB(A).

The construction noise levels have been predicted at noise sensitive properties around the site using the prediction methodology in BS 5228(1) and noise propagation calculation according to ISO 9613(2) using Cadna-A 4.3 (or a simplified version that uses worst case assumptions regarding noise

(1) Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1 Noise, BSI, 2009.
(2) ISO 9613, Attenuation of Sound during Propagation Outdoors, Part 2 General Method of Calculation, ISO, 1996.

attenuation for sheet piling which will occur high above the ground and may not reliably benefit from significant ground absorption). These have then been compared to the criteria set out in *Section 4.2*.

2.3 OPERATIONAL NOISE PREDICTION

Noise emissions have been based on noise modelling provided by Alstom and BOC Linde for the plant items within their 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 are acting 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.

2.4 COMPLETING THE ENVIRONMENTAL IMPACT ASSESSMENT

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.

2.5 INTERACTION WITH DESIGN

From the earliest stages of the EIA process, operational noise effects on the nearest sensitive receptors were identified as one of the most important issues for the Project. As such, quantifying equipment noise levels, looking at mitigation options and doing this as an iterative process between the EIA and the design teams has received considerable attention.

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

3 BASELINE CONDITIONS

3.1 SUMMARY OF DATA COLLECTED

Baseline noise measurements took place at various Noise Monitoring Locations (NMLs) surrounding the Drax power station. The original baseline survey was undertaken by ERM during September 2012. However, due to significant temporal variations in the measurements collected at one of the locations (Drax Abbey Farm), the source of which could not be identified, a further survey was necessary. This was carried out in September 2013.

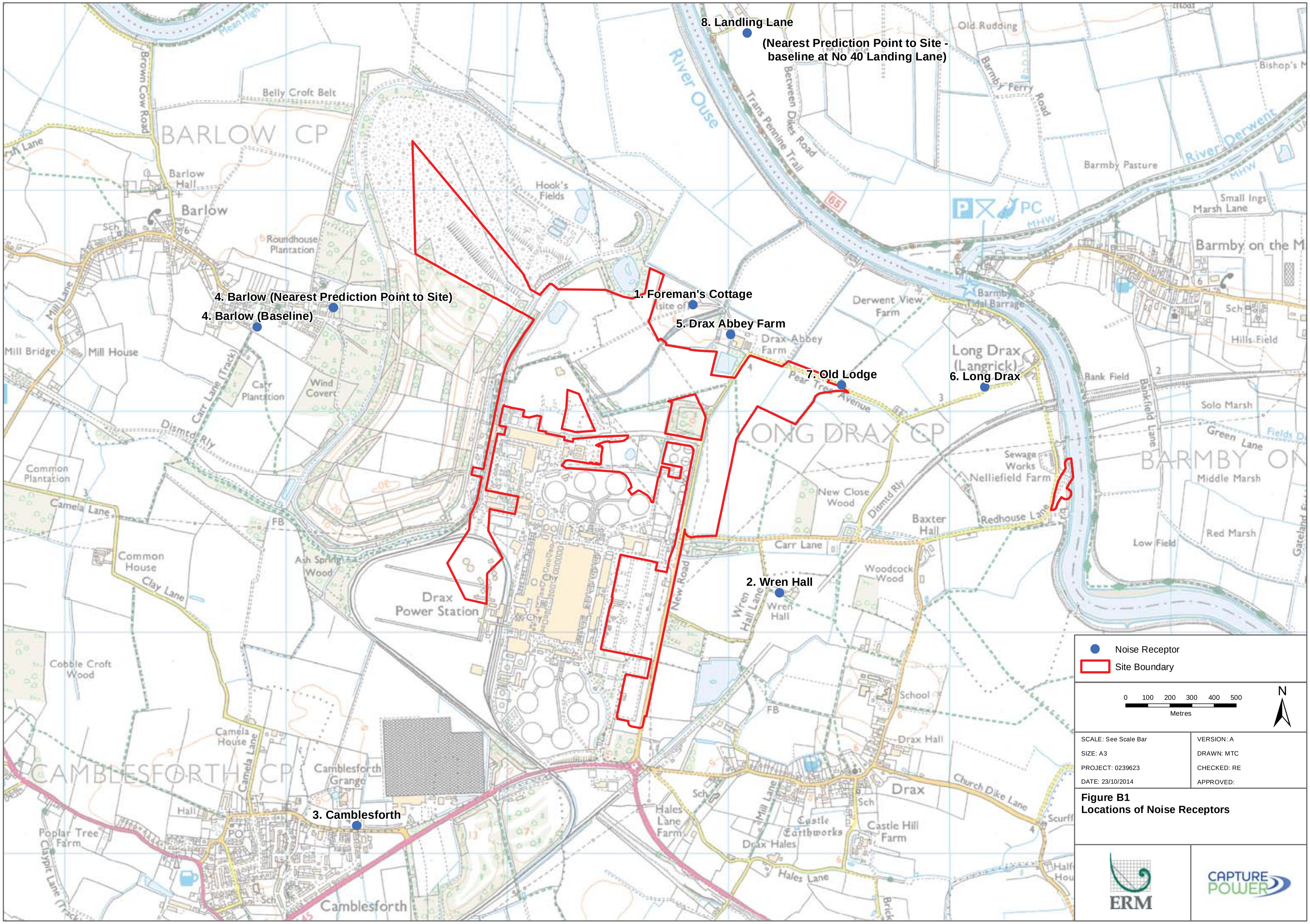
Additional NMLs were added following agreement with SDC. Greater weight was given to the data collected these locations in the second survey because the data are most up to date and were acquired over longer periods.

The NMLs of each survey are listed below in *Table 3.1* and a map of the area including all monitoring locations is presented in *Figure B.1*.

Table 3.1 ***List of Monitoring Locations for Surveys in 2012, 2013 and 2014***

Monitoring Positions	Monitoring Locations 2012	Monitoring Locations 2013	Monitoring location in 2014
1		Foreman's Cottage	
2	Wren Hall (measured on Carr Lane in 2012 survey)	Wren Hall	
3	Camblesforth	Camblesforth	
4	Barlow	Barlow	
5	Drax Abbey Farm	Drax Abbey Farm	
6		Long Drax	
7		Old Lodge	
8			Landing Lane

Figure B.1 Noise Monitoring Locations



PROJECTION: British National Grid

SOURCE: Reproduced from Ordnance Survey digital map data.

Path: T:\GIS Project\0239623_Drax_WRCCS_GIS_MTC_RE\MAPS\MAPS_ES\ES\CHB\0239623_CHB_NoiseReceptors_A01.mxd

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 (1). 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

(1) Additional survey conducted on the 24th and 25th of July 2014.

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 (1), 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 *Table* 3.2.

Table 3.2 ***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	34 to 49	40 to 48	31 to 50	32	36	32

(1) The existing power station and distant traffic dominated noise at this time.

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
Farm						
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.						

Aecom conducted three measurements at Old Lodge giving levels between 43 and 48 dB L_{A90} at night which was considerably higher than measured during the recent survey. A cautious approach has been taken and these (Aecom) measurements have not been used to assess noise from the Project.

3.2 *COMMENTS ON THE DATA COLLECTED*

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 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.

4 ASSESSMENT OF POTENTIAL EFFECTS

4.1 INTRODUCTION

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.

4.2 ASSESSMENT OF POTENTIAL EFFECTS DURING CONSTRUCTION

4.2.1 Criteria

The criteria that have been adopted for this assessment are based on BS 5228, which proposes an assessment criterion for daytime activity of 65 dB L_{Aeq} for low noise areas and for Saturday morning works. Construction hours have been established and it is assumed that works will take place in the normal weekday daytime hours and Saturday mornings prescribed within BS 5228. Although start-up periods have been proposed in the draft DCO requirements half an hour before and half an hour after the core hours, it is intended that activities be limited to arrival of staff ready to start construction at 7 am. Start-up activities are not expected to result in significant noise impacts, and criteria have been proposed assuming that the noise generating construction activities occur within core hours except the exceptions discussed below.

Working hours will be 07:00 to 19:00 Monday to Friday and 07:00 to 13:00 on Saturdays. No work will take place on Sunday or bank holidays (other than in exceptional circumstances). Some works will require working outside of these core hours. It is too early in the Project development process to define these precisely and it should be noted that the workings hours do not necessarily apply to the following:

- construction and related works which do not exceed a noise limit of 50 dB (A) at the DCO Order limits; or
- the delivery or removal of materials, plant and machinery via designated routes on the local road network; or
- the delivery of abnormal indivisible loads; or
- where the prior agreement of SDC has been obtained; or
- in the event of emergencies.

As per the outlined methodology an assessment criterion for changes in traffic noise during construction has been taken to be 3 dB(A), which represents the smallest noise change that is generally considered to be acceptable.

4.2.2 *Predicted Impacts*

The predicted construction noise levels at one metre from the facades of the receptors around the site are shown in *Table 4.1* for the noisiest phase of general construction (construction site preparation).

Table 4.1 Predicted Construction Façade Noise Levels dB L_{Aeq}

Location	Predicted Noise Level
Foreman's Cottage	56
Landing Lane	43
Wren Hall	44
Camblesforth	35
Barlow	39
Drax Abbey Farm	57
Long Drax	41
Old Lodge	47

The results show that the levels are below the BS 5228 criterion of 65 dB L_{Aeq} and therefore no significant effects are expected as a result of construction activities.

Noise levels from sheet piling were predicted to be no higher than 64 dB L_{Aeq} at the nearest sensitive receptor (Foreman's Cottage) which is over 275 m from the part of the plant where vibrating equipment is likely to be located. Although the results show that piling is likely to be noisier than other activities and may be audible at receptors it is not likely to give rise to significant noise impacts.

4.2.3 *Construction Traffic*

Based on the Transport Assessment (*Volume 2, Chapter E*) an assessment of the traffic increase has been undertaken. There are two main traffic routes between the site and the M62 motorway. Cars accessing the site are expected to split between the routes in the proportions 64% and 36%. The HGVs will follow a designated route along New Road, the A645 and the A614 to Junction 36 of the M62.

All traffic coming from the Project site will travel along New Road; however no noise sensitive receptors are close to the road in this location. The predicted noise levels changes suggests an increase in noise levels of no more than 1 dB(A) on any other road link which is used by construction traffic. Since this is below the criterion of 3 dB(A) no significant effect is predicted.

4.3 ASSESSMENT OF POTENTIAL EFFECTS DURING OPERATION

4.3.1 Criteria

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 (1). 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.

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

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 [(1)]. 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 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.

(1) 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.

4.3.2 *Predicted Impacts*

Noise Level Predictions and Assessment (BS4142 Criteria)

The predicted noise levels and the assessed noise impacts are included in *Table 4.2* 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(1). 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.

(1) As specified by Alstom and BOC 2014.

Table 4.2 *Operational Noise Level Predictions and Assessment (BS4142 Criteria)*

	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.

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.

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.

4.4 *ASSESSMENT OF POTENTIAL EFFECTS DURING DECOMMISSIONING*

Decommissioning is likely to involve similar noise levels to those that arose during construction and unless there were new noise sensitive receptors closer to the site than is the present case there will be no significant effects.

It is possible that some demolition works may involve the use of controlled explosive charges. It is assumed that any such works will be planned and consulted on in advance so as to address and manage any local concerns over noise and vibration.

Traffic levels for decommissioning will be less than for the construction phase and will not lead to significant effects at roadside receptors.

4.5 *CUMULATIVE EFFECTS*

There are no receptors that would experience cumulative vibration effects from the Project combined with any other project.

Construction of the NGCL pipeline in proximity to the northern part of the Project site has the potential to create cumulative noise effects with the Project on a small number of receptors. However, the Project itself will not have significant effects at these receptors and so if there are effects they would be dominated by construction works from the NGCL pipeline in closer proximity. In reality phasing of works between the two projects could be applied to mitigate any potential cumulative noise effects.

Construction traffic noise considered the cumulative effects of Project traffic with other sources and concluded no significant effects.

There are no projects that could have a cumulative operational effect with the Project. The operational Drax power station is considered in the baseline.

4.6 *Uncertainty and Key Assumptions*

4.6.1 *Introduction*

The following uncertainties relate to the noise and vibration assessment.

4.6.2 *Prediction of Character of Acoustic Features of Plant Including Tonality*

It has been assumed that the plant will not exhibit an acoustic tonal feature and therefore there no correction in that regard has been applied in this analysis. The EPC contractor will be required to enter into guarantees in regard to tonal noise and this issue is discussed further below. The contractor will also be required to ensure the predicted noise levels contained within this ES are not exceeded during detailed designs

The way that a number of different sources of noise combine to give the total noise emission of the plant is complex and while equipment suppliers can estimate the likely overall noise or the noise at well-defined octave frequency bands, it is not practical to model tonal noise. The well-established procedures in ISO 9613-2 (1996) (1) haves been used to predict noise propagation, and this method provides a method for calculating industrial noise propagation in octave bands or a simplified dB(A) value. It does not have a tonal prediction procedure.

The predictions have been based on noise modelling of the operational plant by Alstom, BOC Linde and Drax (for fuel and waste conveyor facilities), and it is noted that noise control has been considered thoroughly in the design, by placing loudest noise sources indoor, supplying low noise design equipment (transformers, cooling tower fans etc), adding silencers on air intakes/outlets and upstream/downstream main boiler fans, using acoustic screen or enclosure on major outdoor pumps and motors, acoustically insulating valves and pipes. These acoustic mitigation measures will reduce the overall noise levels at receptors and, at the same time, will reduce the risk of any audible tone.

Acoustic design has been optimised so that no single noise source dominates the overall plant noise. The contribution of each main group of equipment (e.g. ASU, GPU, Power Block, and hybrid water coolers) is therefore evenly distributed when measured at some distance (over 100 m) from operational plant boundary. This further reduces the risk of having tonal characteristics emanating from one specific equipment item, as it will be masked by the other noise sources of similar output.

(1) Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation

EPC contractors are used to complying with guaranteed noise limits for tonal noise.

If any audible tonal noise is observed during testing and/or commissioning it will be analysed to identify the cause and corrective measures will be applied. For example it might be necessary to optimise 'delta pressure' on a valve, add or optimise an additional silencer, acoustic insulation, screening or acoustic enclosure on the source responsible. This approach is typical to the 'commissioning stage' of power plants and again would be secured by guarantees entered into by the EPC contractor.

5 MITIGATION

5.1 INTRODUCTION

The Project is at an intermediate stage in FEED but noise control was an issue identified early in scoping and has duly received considerable attention to date from CPL. A number of mitigation measures have been identified and factored into the equipment sound power levels used to predict noise levels at receptors. It is envisaged that further definition of equipment, as well as mitigation will be developed as FEED progresses and equipment vendor data are obtained for equipment. This ES reports the current status of the design information.

5.2 SUMMARY OF MITIGATION INCLUDED TO DATE

5.2.1 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.

5.2.2 *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).

5.2.3 *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).

5.2.4 *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.

5.2.5 *Air Separation Unit*

General Considerations

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.

5.2.6 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.

5.2.7 *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 air outlet openings will be provided for some openings.

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 85 dB(A).

5.2.8 *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.

5.2.9 *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 meet the noise limits, as far as practicable, at off-site receptors , the forced draft fan (fan casing plus drive) will be enclosed in a building or acoustic enclosure.

5.2.10 *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.

5.2.11 *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, insulation will be provided.

In order to fulfill the far field noise requirement, the whole induced draft fan (fan casing plus drive) will be enclosed by a noise barrier (without a roof).

5.2.12 *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).

5.2.13 *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 103 dB(A).

5.2.14 *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.

5.2.15 *Main Cooling Water Pumps*

The main cooling water pumps will be located inside a building.

5.2.16 *Demineralisation Plant*

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

5.2.17 *Air Compressor Building*

The equipment for compressed air production will be housed inside a building 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.

5.2.18 *Fly Ash Air Blower Building*

The equipment for fly ash air production will be housed inside a building which will significantly limit the transmission of the internal noise to the outside environment.

5.2.19 *Fuel Oil Pump House*

The fuel oil pumps will be housed inside a 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.

5.2.20 *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.

6 RESIDUAL EFFECTS

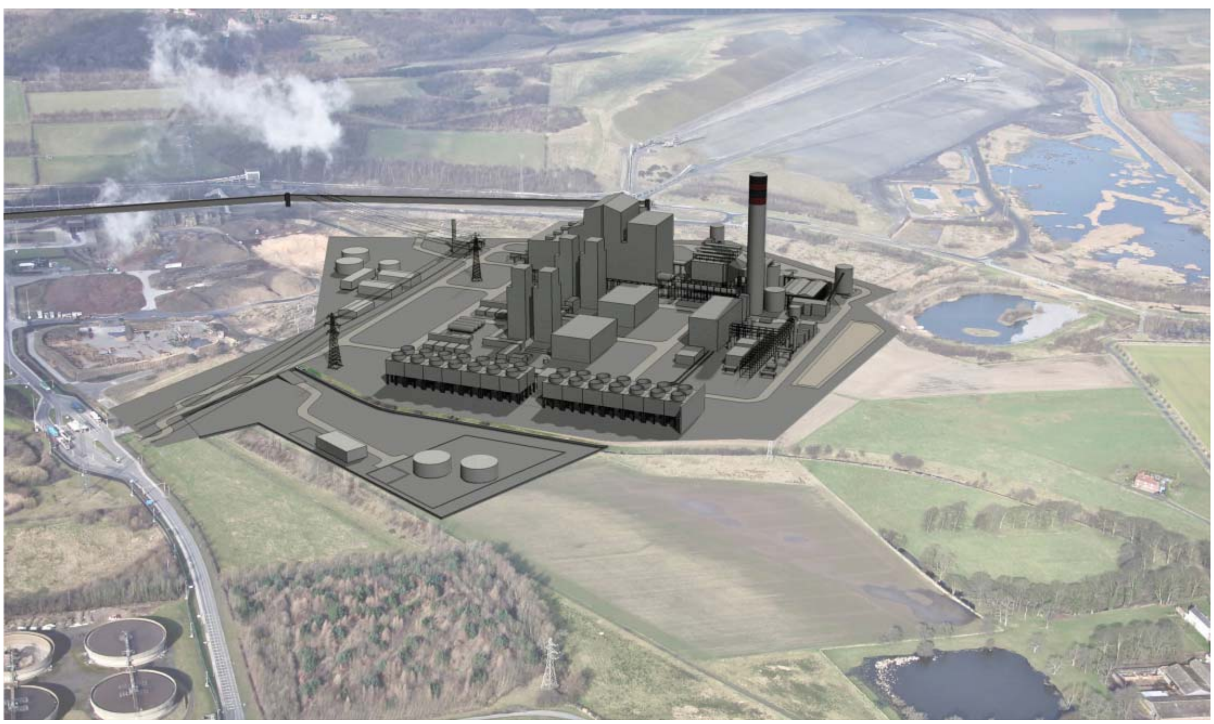
The results of construction noise predictions show that the levels are below the BS 5228 criterion of 65 dB L_{Aeq} and therefore no significant effects are expected as a result of construction activities. Predicted noise level changes on road links that are used by construction traffic suggests an increase in noise levels of no more than 1 dB(A) on any road link which is used by construction traffic. This will result in noise changes which are unlikely to be generally perceptible for roadside receptors, and would not be significant.

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 5.* 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 (eg 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.

White Rose Carbon Capture and Storage (CCS) Project

Annex A Plant Type Assumptions



Applicant: Capture Power Limited
Date: November 2014

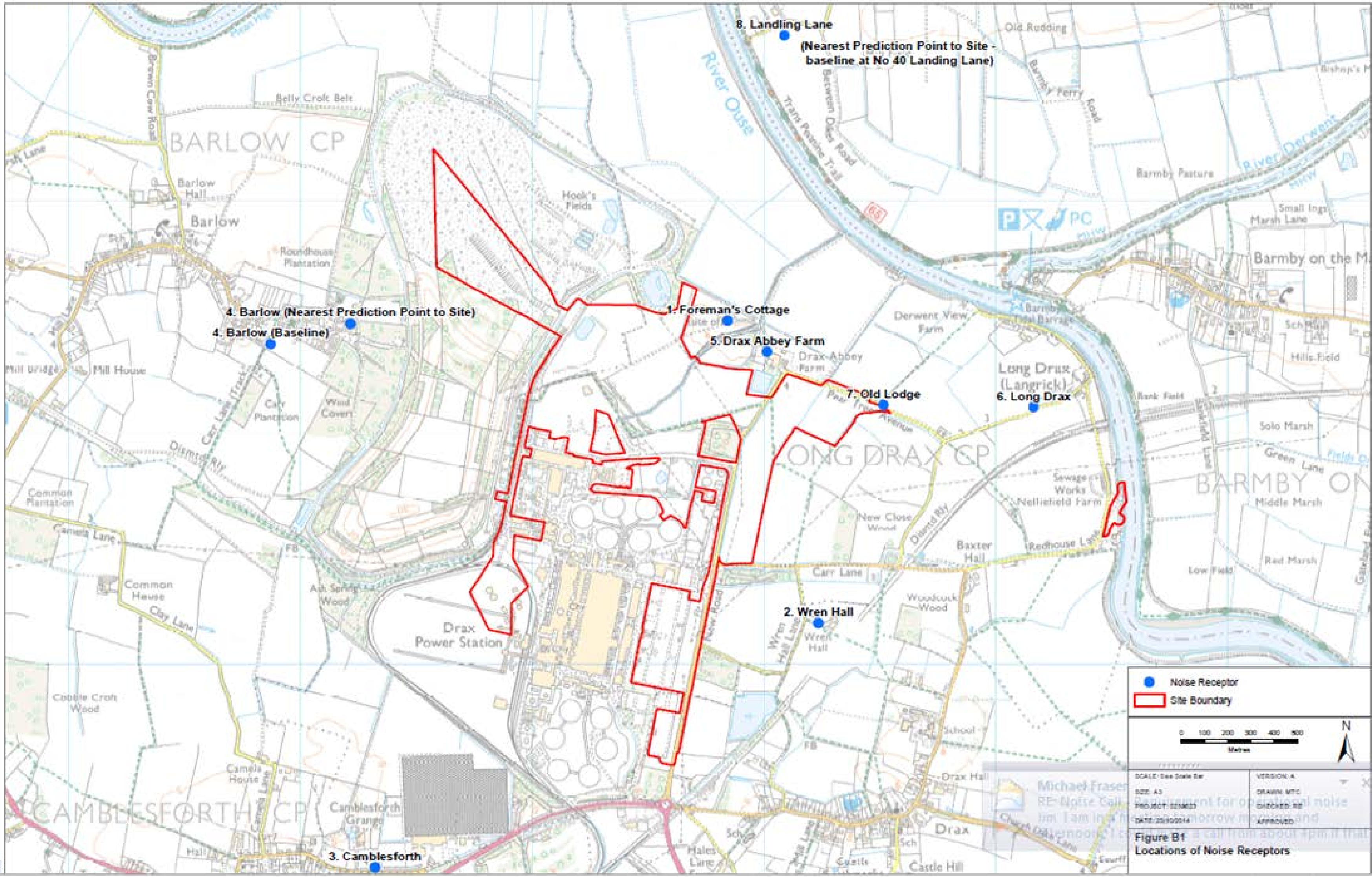
A1 ASSUMED CONSTRUCTION PLANT TEAMS

The assumed construction plant teams that have been used for the noise assessment in this EIA are based on ERM's experience of similar projects. The assumptions were discussed with the Project design team to ensure that they provide a robust basis on which to carry out the noise assessment. Plant teams have been developed for three major phases of construction that are likely to result in the highest noise levels at receptors. The plant details are shown in *Table A1.1*.

Table A1.1 Details of Plant Type

Construction Stage	Plant Type	Sound Powel Level (dB)	Number of Items	Source of Data
Stage 1 - Civil Engineering Activities and Platform Preparation	Tracked Excavator (excavation)	104	4	BS5228, C2, Ave 10-25
	Dozer (Levelling Ground)	108	2	BS5228, C2, Ave 10-13
	Tractor	108	2	BS5228, C4. Ave 74-75
	Roller	107	1	BS5228, C4, 37
	Articulated Dump Truck	108	2	BS5228, C4. Ave 1-2
	Water Pumps	92	2	BS5228, C4. Ave 45-46
	Hand held Breaker	111	2	BS5228,C1, 6
	Breaker mounted on excavator	118	1	BS5228, C1, 9
	Tracked Crusher	111	1	BS5228, C1, Ave 14-15
	Compressor	93	1	BS5228, C5, 5
Stage 2 - Site Preparation	Tracked Excavator (excavation)	104	2	BS5228, C2, Ave 10-25
	Tracked Excavator (CFA operations)	99	2	BS5228, C3, 23-24
	Dozer (Levelling Ground)	108	3	BS5228, C2, Ave 10-13
	Road Lorry	108	8	BS5228, C6, Av 19-23
	CFA Piling Rig	108	3	BS5228, C3, Av 21-22
	Tracked Mobile crane	97	3	BS5228, C3, 28-30
	Concrete Mixer Truck	105	4	BS5228, C4, Ref Av 21-22
	Concrete Pump	105	4	BS5228, C3, 25-26
	Large Lorry Concrete Mixer	105	2	BS5228, C4, 21
	Generator	101	3	BS5228, C3, Ref 32
	Angle Grinder	108	5	BS5228, C4, 93
	Water Pumps	92	2	BS5228, C4. Ave 45-46
	Poker Vibrator	104	1	BS5228, C4, 33-34
Stage 3 - Construction and Installation	Generator	101	2	BS5228, C3, Ref 32
	Angle Grinder	108	2	BS5228, C4, 93
	Road Lorry	108	10	BS5228, C6, Av 19-23

Figure B.1 Noise Monitoring Locations



Non-technical summary

2. Explain why air mode operation is described as a “temporary upset” and not as an intrinsic aspect of start-up;

Answer: Chapter I contained the following text: "‘air mode’ which is a temporary upset condition when the plant would operate in a similar way to a conventional coal-fired power station, e.g. because the carbon capture and storage facilities were not available.” Generally speaking, the plant would operate in oxy mode as normal operation, it is extremely unlikely that there would be any commercial or financial incentive for the plant to operate in air mode. However, should there be a technical issue with the pipeline, the storage facility or associated infrastructure, then the plant may be operated in air mode. There is legislation in place already which precludes the continuous operation of the plant in air mode during commercial operation. The plant would also start-up in air mode and this is an aspect which has previously been discussed with the Agency.

3. Confirm in writing that Ouse REP is not to be built and that one aspect of this variation application is to remove it from the permit;

Answer: This will be confirmed in a formal letter to be sent by DPL.

Pre-Amble

4. Provide a list of all section / table references to the Ouse REP in the current permit;

Answer: Following a review of the notice of variation and consolidation with introductory note provided by the Agency and dated 23.02.11, here are the sections and table references which include references to the Ouse REP: Introductory note, Schedule 1, tables S1.1, S1.2, S1.3, S1.4, Schedule 4, S4.1, S4.2, S4.6, Schedule 5, S5.1, S5.2, S5.3, S5.4, Schedule 7.

6. Expand on CO_2 “compressed to a specification” – to what specification and its origin?;

Answer: Current design has the following export parameters: temperature 20°C; pressure up to 135 barg; and flow 269 tonnes/hour with a CO_2 purity of typically 95%. The origin of the CO_2 is from the combustion of fuel in the boiler.

8. Comment on *primary* measures to minimise NOx emissions ahead of SCR treatment;

Answer: Due to the operation of the Air Separation Unit which is explained in Chapters IV and XII, the combustion air will have very little nitrogen present and hence the only nitrogen present which can generate NOx is in the fuel. The boiler will employ low NOx burners to reduce NOx formation and includes a Low NOx Tangential Firing System (LNTFS) with two levels within the boiler for over fire air to manage the combustion process within the boiler.

9. Explain how the existing permit limits for water discharge were considered in the design of the cooling water system;

Answer: Alstom were asked to consider the impact of Drax Power station not operating and providing significant dilution of the discharge from the Oxy Power Plant. Alstom were asked to consider meeting specific limits generated by calculating the concentration required for a number of species at which they would screen out when applying the Agency's H1 criteria and as if the plant was discharging directly into the River Ouse, which it is not; this was believed to be a precautionary approach to ensure compliance with the current Drax discharge.

Chapter IV Technical Description of CCS Plant

14. Confirm mode of operation regards positive/negative draft, comment on impacts of ingress/leakages;

Answer: The boiler operates in "balanced draft" in both air mode and oxy-mode, with fans to transport the gases into and out of the boiler. As a result the boiler itself operates at a slight negative pressure. Particular measures are taken to minimise air leakage into the boiler in order to minimise the atmospheric gas content of the CO_2 rich flue gas generated in oxy-mode as this impacts the power consumption of the Gas Processing Unit. Where the CO_2 rich flue gas is above atmospheric pressure, any leakage would be detected by CO_2 monitoring equipment.

16. and 54. Provide detail of design and emissions for GPU and enhance description of GPU;

Answer:

<u>Design</u>

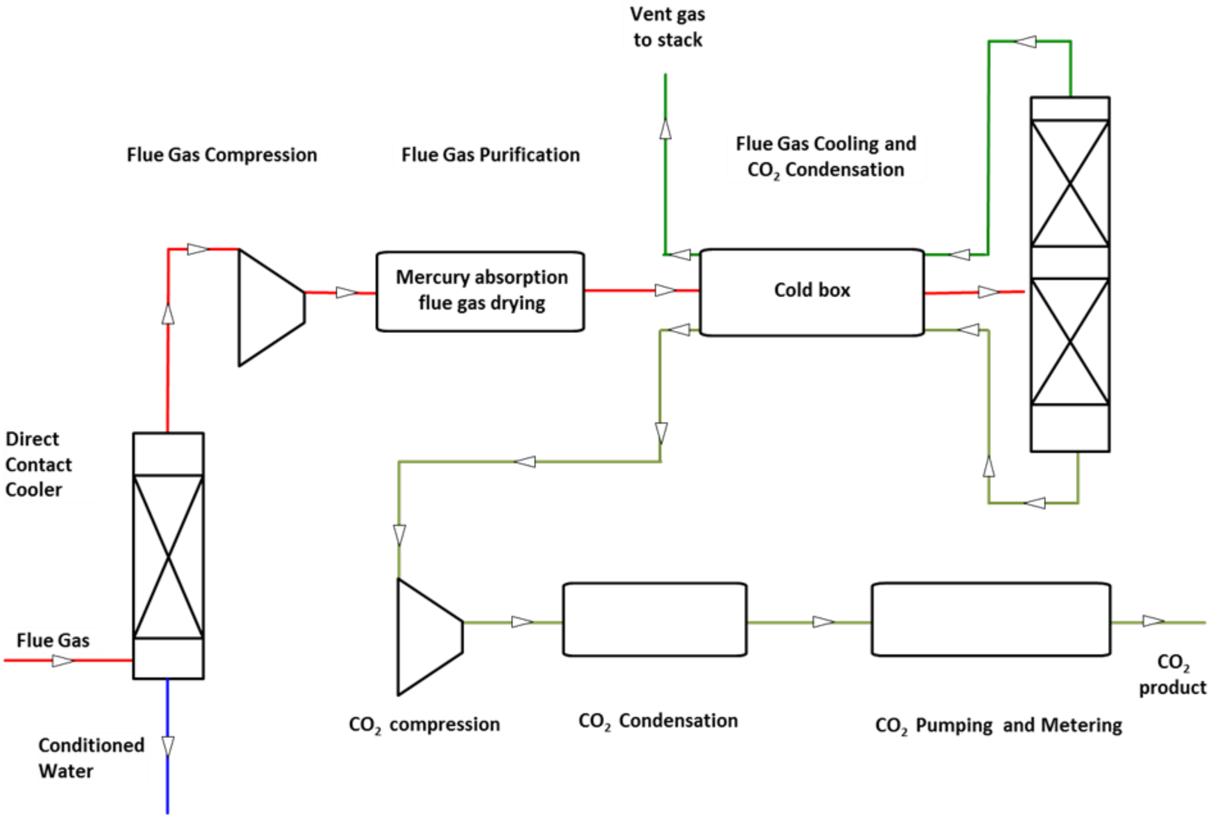
CO_2 Processing and Compression

The CO_2 processing and compression will be undertaken in the Gas Process unit (GPU). The purpose of the GPU is to purify and compress the CO_2 rich flue gas and to provide a CO_2 product stream that meets the specification for onward transport and storage.

The GPU can be divided into the following main sub-systems:

- Flue Gas Compression;
- Conditioning and Drying;
- Regeneration Gas System;
- CO_2 Chilling and Separation;
- Off-gas Handling; and
- CO_2 Recompression.

The GPU process is based on the condensation of CO_2 at low temperature and elevated pressure. The GPU is designed for a CO_2 recovery rate of about 90%.



The flue gas at the inlet of the GPU has the following main components: CO_2, H_2O, inert gas and oxygen. The GPU is designed to process the full flue gas stream. The main purpose is to remove the inert gas and the oxygen from the flue gas in order to produce a high purity CO_2 product. The residual vent gas is sent to the main stack. A CEMS is installed to monitor the emission level.

Direct Contact Cooling System

The treatment of the flue gas starts in DCC System where the flue gas is cooled and the water is condensed by means of circulating water pumped back into the DCC. Surplus condensate leaves the system and is sent to the WWTP. The cooled flue gas leaves the DCC overhead and is sent to the flue gas compression.

Flue Gas Compression

In the Flue Gas Compression system, the flue gas is compressed in a multi-stage Flue Gas Compressor. Interstage cooling is done by means of water intercoolers. Condensed water is separated after each intercooler and sent to the WWTP. The flue gas is then further processed in the Mercury Adsorption and Flue Gas Drying system.

Drying and Regeneration

Mercury must be removed from the flue gas to avoid harm to the used material for the Cold Box installed downstream. Also, the residual water must be removed by means of a drying system to avoid blockage to the downstream unit because the CO_2 is separated at temperatures below the water freezing point. If mercury and water are removed the CO_2 can be condensed out of the flue gas by the Cold Box system.

Cold Box

The purified and dried gas is sent to the cold box where the flue gas is cooled against the vent gas from the CO_2 Separation System. In the Cold Box the CO_2 condensation begins. To reach the envisaged CO_2 purity further processing of the CO_2 condensate is necessary in the CO_2 Separation system.

CO_2 Separation System

The separation of the CO_2 from the inert gas and the oxygen is completed in the CO_2 Separation System where the CO_2 achieves a purity of greater than 99.9%. The purified CO_2 is taken from the bottom of the Separation System and sent to the cold box whereas the inert gas and oxygen (vent gas) is taken from the overhead. The condensed CO_2 is expanded and vaporised (to produce cold for the process). Also, the vent gas is expanded to recover the energy and is sent to the stack after it has passed the cold box.

CO_2 Compression

Due to the vaporisation of the purified CO_2 a multi-stage compressor is used to recompress the CO_2. Interstage cooling is done by means of water intercoolers. Compression of the CO_2 is necessary to condense the purified CO_2.

CO_2 Pumping and Metering

The condensed CO_2 stream is finally pumped to the pipeline for transport to the storage site. This is more energy efficient than using a compressor to achieve the specified battery limit pressure.

Emissions

All the flue gas is processed by the GPU, so the emissions from the GPU are those in oxy mode operation as described Table 5.6 of Chapter VIII of the EP.

17. Confirm the fate of Hg and/or Hg salts;

Answer: During normal operation, i.e. operation in oxy-mode, mercury removal is achieved via the activated carbon absorbers; recent independent research appears to suggest that certain halides, which may be naturally present in the fuel, improve the mercury absorption of the activated carbon. Mercury removal via the activated carbon system results in a significant reduction in the mass load of mercury which is emitted to atmosphere.

18. Comment on the specification of the vent gas;

Answer: The vent gas is effectively the abated flue gas minus the CO_2 and hence has been modelled as such since it exits via the main stack of the Oxy Power Plant. It is believed that the general methodology for modelling emissions to atmosphere in both modes of operation has generally been accepted by the Agency.

19. Confirm current situation regards possible uses of the vent gas;

Answer: The vent gas stream from the GPU undergo two stages of expansion, each of which both generates the cold necessary to sustain the cryogenic process and recovers electrical power which is reused within the GPU to improve its efficiency. The same vent gas stream is then used to regenerate the GPU drier beds (located upstream of the cryogenic section) before finally being vented to atmosphere.

21. Provide information as to the design basis and capacity of abatement equipment;

Answer: The abatement equipment, SCR, ESP, FGD are designed so that the stack emissions during air operation mode will be compliant with EU Directive values as shown below;

Stack emissions [1]	Unit	EU Directive Value	Remarks
SOx	mg/Nm^3, 6 % O_2 dry	150	corresponds to 52 mg/MJ
NOx	mg/Nm^3, 6 % O_2 dry	150	corresponds to 52 mg/MJ
Particulates	mg/Nm^3, 6 % O_2 dry	10	corresponds to 3.5 mg/MJ

However, it must be noted that the EU Directive air emission value are not directly applicable to Oxy Combustion – the EU directive is referenced to 6% O_2 dry, whereas there will be between 20 to 25% O_2 dry in the emissions during oxy-mode operation.

However, during oxy-mode the air emission values will meet equivalent limits (as indicated in the remarks column of the table).

The SCR, ESP & FGD are designed for full boiler output in both air and oxy mode across the range of fuels specified in the basis of design.

22. Provide information as to the optimal ratio of wet (combustion temp.) / dry (fuel conveying) for flue gas recirculation

Answer: The flow ratio of the wet to the dry (fuel conveying) flue gas recirculation streams is set by the requirements of the coal drying and conveying. The ratio is approximately 8 : 3 (wet : dry).

23. Provide information regards corrosion management;

Answer: The design of the boiler will include a number of modifications versus conventional design to address potential corrosion issues that might arrive from the recirculation of flue gases. These will include:

- Corrosion resistant ducts specified upstream of the PA and FD fans
- FD fan design includes stainless steel liner and cast iron or stainless steel impellers

24. Provide information regards how the dynamic burner transition – air -> oxy - is to be managed;

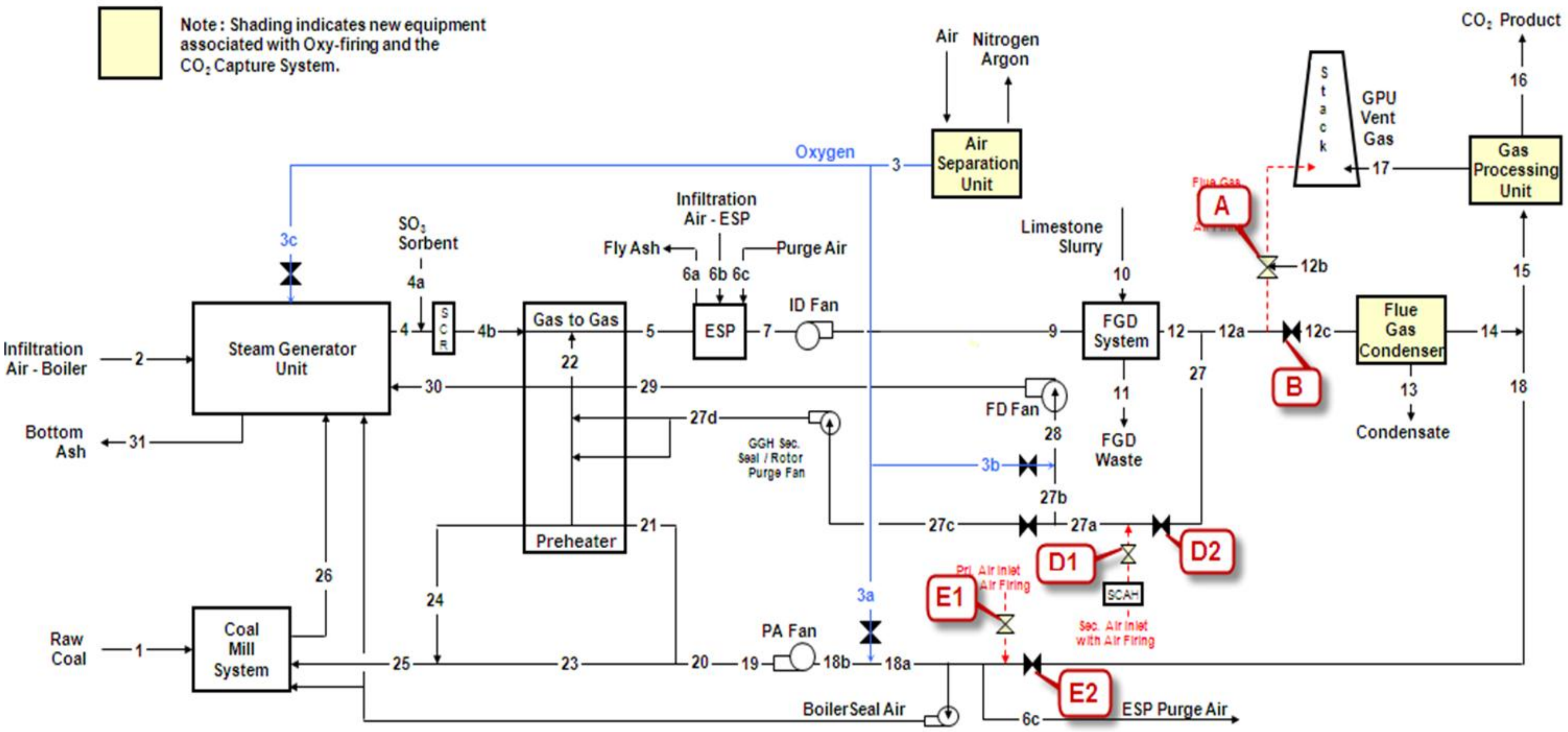
Answer: The start-up of the plant is in air mode. The normal transition from air to oxy mode takes place between 40% to 50% load. The normal transition load range from oxy mode to air mode will take place in the same range.

In the transition from air mode to oxy mode, the oxidant streams supplied to the furnace through the PA and FD fans are progressively transitioned from air drawn from the atmosphere to a mixture of GOX from the ASUs and recirculated flue gases. Switching from air mode to oxy mode takes about one hour. Once oxy-firing is established, the resultant CO_2 rich flue is introduced to the GPU, and once the CO_2 specification is achieved OPP full CCS operation can commence.

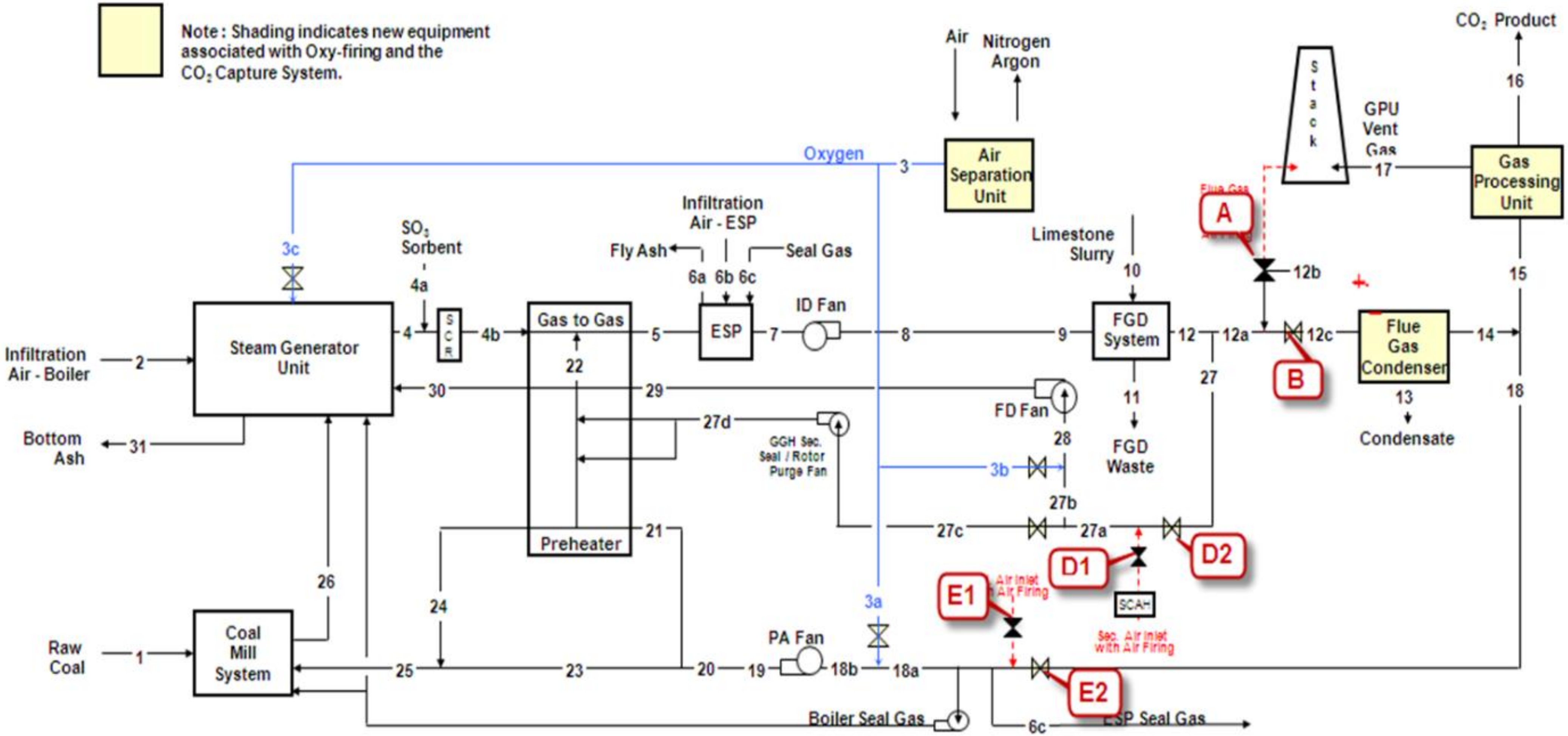
Transition is managed by the control system operating dampers (Air inlet dampers and recycled flue gas inlet dampers) in each duct system to PA & FD Fan inlets.

The two different modes of operation and damper positions are shown below:

Air mode operation:



Oxy-mode operation:



27. Comment on the operational loss of a mill (process upset) and the impact of excess O_2;

Answer: The plant is designed with four mills (3 operating + 1 spare) to allow operation at full capacity with one mill out of service. The plant can operate, at reduced capacity, on down to 2 mills. So the loss of one mill does not reduce the capacity of the plant.

O_2 content in the recycled flue gas to the mills is controlled and the mills would be tripped on high oxygen content in the flue gas.

31. Comment of use of mills, pulverisation, handling, abatement;

Answer: The coal mills will be vertical spindle bowl mills. The PF firing system allows the option to co-fire biomass with the coal fuel. Vertical hammer type mills are provided for pulverisation of the biomass fuel. The biomass system will use a pneumatic transport system, using recirculated flue gas for transport media instead of air.

One primary air fan provides the primary oxidant stream to the mills for drying and transporting the coal or biomass to the furnace. A portion of the primary oxidant stream is heated in a rotary GGH against the boiler exhaust flue gas. From the mills, the primary oxidant stream transports the pulverized coal to the furnace.

Raw coal, fed to coal mills, is dried and transported to the furnace by the heated primary oxidant stream. The raw coal flow to the mills is about 140 t/h. The total primary oxidant stream flow used to dry the coal is around 395 t/h.

In terms of milling equipment associated with flue gas abatement, limestone gravel is stored in two silos. Each silo is sized for a capacity of 314 m^3. Each silo is sized to provide 24 hours of limestone for the FGD running at 100% load with the performance coal. Two milling systems are provided to wet grind the limestone gravel to the required size. The prepared reagent slurry (suspension of powdered limestone in water) is stored in a tank and from this tank is fed to the FGD absorber to replenish the reagent consumed in the absorption phase. Feeding rate is controlled based on a pH signal from the FGD absorber.

Conveyors:

32. Expand on dust conveyor, specifically dust extraction, air emission points, fate of dust;

Answer: The fuel conveyors will likely be belt conveyors for both coal and biomass fuels. All conveyors will be enclosed within an external structure. Biomass fuel will likely be conveyed using fully enclosed air glide conveyors. Dust filter units would be fitted to conveyor transfer points since these are the points where dust generation is most likely. Dust extracted will need to be carefully managed to ensure correct fuel accounting and returned to the main fuel stock.

35. Explain choice of hybrid cooling towers, is this BAT?

Answer: The Project will employ hybrid cooling towers which are specifically designed to significantly reduce the occurrence of a visible plume. The cooling system is designed for ‘no visible plume’ down to ambient conditions of 5°C and 95 % relative humidity. Analysis of historical meteorological data shows that, on average, a visible plume would have occurred for 132 daylight hours per year or less than 3% of the daylight hours in a year.

The hybrid cooling towers are 25m high, which is far lower than the existing Drax towers, and have a cooling capacity approximately one sixth of the existing Drax power station. Therefore, given its infrequency and relative size, it is extremely unlikely that a visible plume generated by the hybrid cooling towers would substantially contribute to the larger plume from the current Drax facility and make a substantial cumulative impact to shading of local areas, an environmental issue raised by the ExA through planning.

Hybrid cooling towers are capable of providing other environmental benefits. The BREF note states the following:

"The hybrid wet-dry cooling tower is virtually cloud free and evaporates about 20% less water than a natural draught cooling tower."

Due to the low plume characteristics, smaller dimensions and efficient water use, hybrid cooling towers are considered BAT for this location and application.

36. Provide a diagram indicating plant layout and air flows;

Answer: Please see Appendix 1 which includes information on and diagrams of plant layout. There are numerous plant layouts included as part of the DCO submission, e.g. drawings section, works plans etc.

Chapter VIII Point Source Emissions to Air

38. Comment on burner design and likely NOx emissions with primary measures ahead of SCR;

Answer: The burner design is Alstom's Low NOx Tangential Firing System (LNTFS) with two levels for over fire air. Both the fuel and air are directed towards the tangent of an imaginary circle in the centre of the furnace hence the name "Tangential Firing".

The fuel firing system consists of:

- four tangential fired windboxes;
- the Separated Over Fire Air (SOFA) windboxes,
- the ignition system; and
- the flame scanners.

The unique feature of titling tangential nozzles allows for complete combustion of the fuel and for simple and reliable steam temperature control. In addition, the corner windbox firing method results in low NOx emissions with a variety of fuels, uniform furnace heat absorption patterns, and high boiler turndown capability. NOx emissions are described in of Chapter VIII of the EP.

40 Provide diagram showing air emissions points including feed-ins such as drying beds

Answer: please see diagram generated in answer to Question 40.

42 Comment on the fate of Hg in each of air and oxy modes;

Answer: In air mode the mercury present in the fuel would be split between a gaseous phase, some of which would be removed through the FGD and some of which would remain in the ash. In air mode the mercury remaining in the gaseous phase would then be emitted to atmosphere and this has been modelled. In oxy-mode the mercury present in the flue gas would be removed by the activated carbon absorber bed and then disposed of as a hazardous waste.

Chapter XII Energy Efficiency

55 Quantify water use in oxy-mode, provide metric, Litres/MW generated;

Answer: At average ambient conditions (11°C) water use has been calculated to be:

- 3900 Liter / MW exported (Gross)

Question 36. Provide a diagram indicating Plant Layout and Air Flows

Answer: Appendix 1

Key

B01	Boiler
B68	Transformer Area
C06	Coal conveyors
E05	Cooling Water Piping
E12	Cooling Tower Pumping Station
G16	Industrial Waste Water Treatment
G17	Auxiliary Boiler
G21	Ammonia Storage
L04	Pump Building
L05	Absorber/ Reactor Tower
L06	FGD Electrical Building
L08	Gypsum Storage (Silo)
L09	Emergency Scrubber Dump
T01	ASU (turnkey package)
T02	GPU (turnkey package)

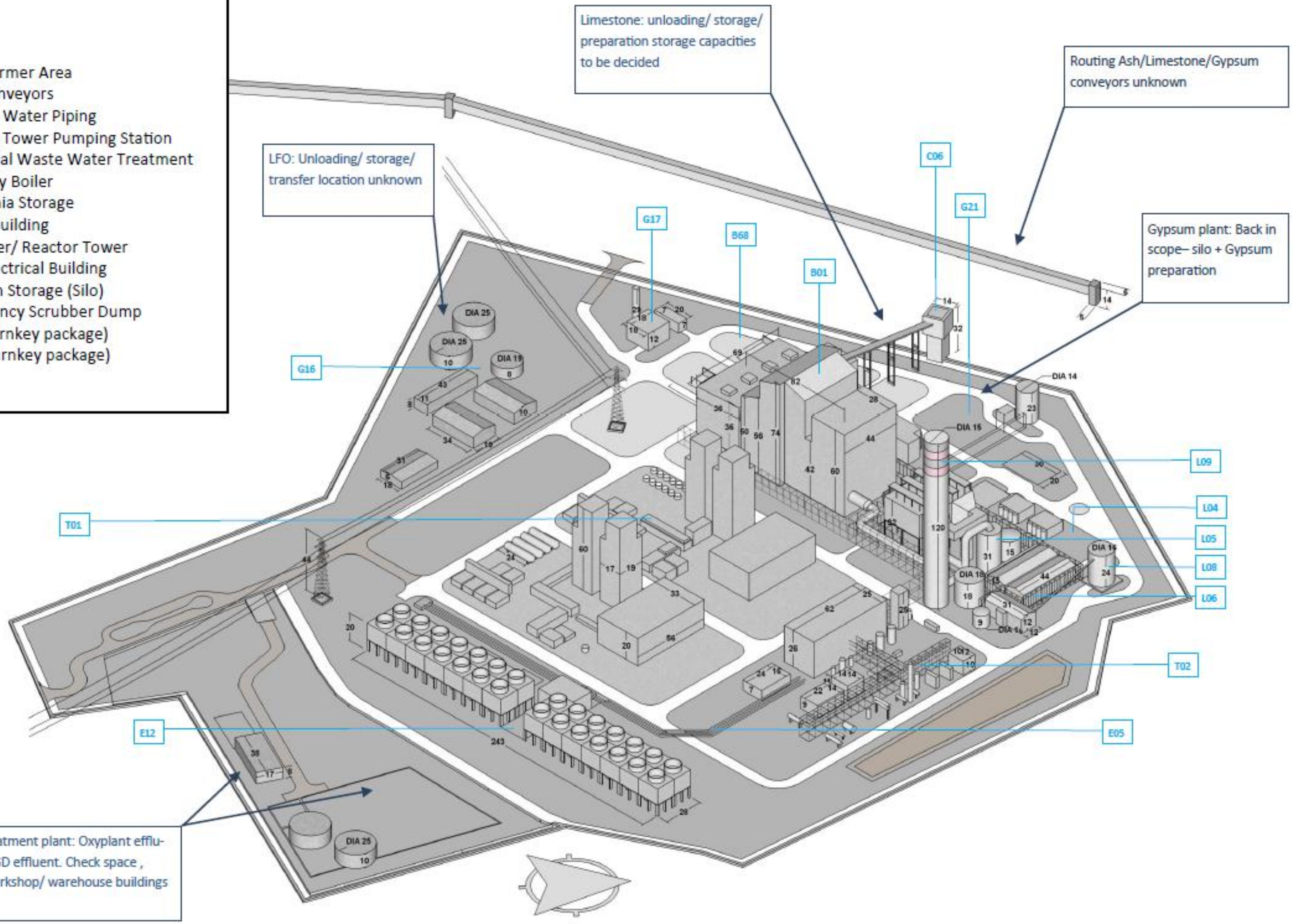


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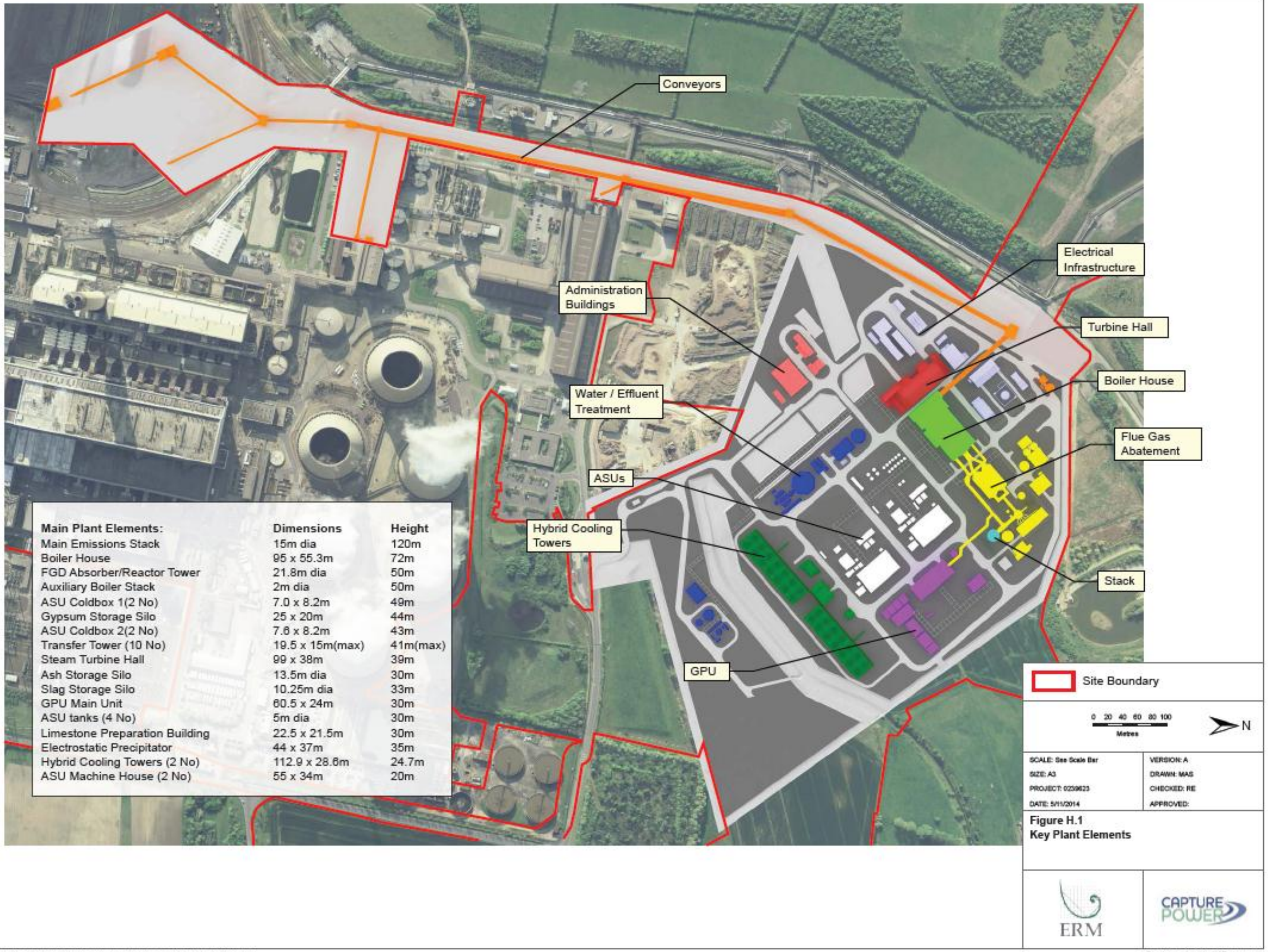
Figure H.1 Plant Layout



Main Plant Elements:	Dimensions	Height
Main Emissions Stack	15m dia	120m
Boiler House	95 x 55.3m	72m
FGD Absorber/Reactor Tower	21.8m dia	50m
Auxiliary Boiler Stack	2m dia	50m
ASU Coldbox 1(2 No)	7.0 x 8.2m	49m
Gypsum Storage Silo	25 x 20m	44m
ASU Coldbox 2(2 No)	7.6 x 8.2m	43m
Transfer Tower (10 No)	19.5 x 15m(max)	41m(max)
Steam Turbine Hall	99 x 38m	39m
Ash Storage Silo	13.5m dia	30m
Slag Storage Silo	10.25m dia	33m
GPU Main Unit	60.5 x 24m	30m
ASU tanks (4 No)	5m dia	30m
Limestone Preparation Building	22.5 x 21.5m	30m
Electrostatic Precipitator	44 x 37m	35m
Hybrid Cooling Towers (2 No)	112.9 x 28.6m	24.7m
ASU Machine House (2 No)	55 x 34m	20m

PROJECTION: British National Grid

Drawing produced by MSEnvironmental

Air Emissions Points