Chapter 7

Noise and Vibration

CONTENTS

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7. Noise and Vibration

7.1 Introduction

7.1.1 This chapter addresses the potential effects of noise and vibration resulting from the construction, operation, maintenance, and decommissioning of the Project on local NSRs.

7.1.2 A detailed description of the Project is provided in **Chapter 3: Project and Description**.

7.1.3 Effects during the construction, operation, maintenance, and decommissioning periods of the Project are assessed. In particular, the chapter considers potential effects on identified NSRs in terms of:

- Predicted noise and vibration levels during the site clearance and construction works associated with the Project;
- Qualitative assessment of changes in road traffic noise levels on the local road network during the construction phase;
- Predicted noise and vibration resulting from operation of the Project; and
- Predicted noise and vibration resulting from decommissioning of the Project based upon those that would be experienced during the construction period.

a) Objectives of the assessment

7.1.4 The objectives of the assessment are to:

- Describe the legislative, planning and technical guidance backgrounds related to noise and vibration from industrial projects;
- Determine the appropriate noise and vibration assessment method and criteria;
- Assess the proposed details of the project against these criteria;
- Demonstrate the mitigation measures necessary to achieve the criteria.

7.2 Changes since the 2014 PEIR

7.2.1 There have been changes to the design as a result of design evolution and consultation as detailed in **Chapter 3: Project and Site Description**. To aid the reader, Table 7-1 below outlines the changes to this assessment compared with the 2014 PIER.

Table 7-1: A Summary of Changes since the 2014 PEIR to the Noise and Vibration Assessment

Section	Changes since the 2014 PEIR	Section Reference
Baseline	No change as survey results were carried over. When suitable conditions occur the baseline will be re-measured. As there do not appear to have been any significant changes in the sound scape in the interim, the updated baseline measurements are not anticipated to make any changes to the assessment and required mitigation.	Section 7.5
Methodology	New approach taken to assessment of night time	Section 7.4 and 7.7

Section	Changes since the 2014 PEIR	Section Reference
	noise limits based on WHO guidelines.	
	Different plant configuration (single unit rather than five units). Details of embedded mitigation modified accordingly.	Section 7.6
	Marginally different assumptions for qualitative construction noise assessment.	Section 7.4 and 7.6
Significance of Effect	No change.	Section 7.7, 7.9 and 7.10

7.3 Legislation, policy and guidance

7.3.1 This section identifies and describes legislation, policy and guidance of relevance to the assessment of the potential noise and vibration impacts associated with the removal and replacement of facilities and their subsequent operation.

7.3.2 Legislation and policy has been considered on an international, national, regional, and local level. The legislation and guidance following is considered to be relevant to the noise and vibration assessment as it has influenced the assessment of the sensitivity of receptors and requirements for mitigation or the scope and/or methodology of this PEIR.

a) International

i. World Health Organisation

7.3.3 The World Health Organisation's (WHO) '*Guidelines for Community Noise*' (Ref. 7.1) recommend external daytime and evening environmental noise limits, and internal night-time limits to avoid sleep disturbance.

7.3.4 The WHO '*Night Noise Guidelines for Europe'* (Ref. 7.2) recommend updated guidelines on night-time noise limits to avoid sleep disturbance.

ii. ISO 9613-2:1996

7.3.5 ISO 9613-2:1996 *'Attenuation of Sound during Propagation Outdoors, Part 2: General Method of Calculation'* (Ref. 7.3) specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources.

iii. ISO 4866-2:1996

7.3.6 ISO 4866:2010 'Mechanical Vibration and Shock – Vibration of Fixed Structures – Guidelines for the Measurement of Vibrations and Evaluation of Their Effects on Structures' (Ref. 7.4) establishes the principals for carrying out vibration measurement and processing data with regard to evaluating vibration effects on structures.

b) National

i. Environmental Protection Act 1990

7.3.7 The Environmental Protection Act 1990 (EPA) Part 3 (Ref. 7.5) states that noise (and vibration) emitted from premises (including land) so as to be prejudicial to health or a nuisance constitutes a statutory nuisance.

7.3.8 Local Authorities are required to investigate any public complaints of noise and if they are satisfied that a statutory nuisance exists, or is likely to occur or recur, they may serve a noise abatement notice. A notice is served on the person responsible for the nuisance. It requires either simply the abatement of the nuisance or works to abate the nuisance to be carried out, or it prohibits or restricts the activity. Contravention of a notice without reasonable excuse is an offence. Right of appeal to the Magistrates Court exists within 21 days of the service of a noise abatement notice.

7.3.9 In determining if a noise complaint amounts to a statutory nuisance the Local Authority can take account of various guidance documents and existing case law; no statutory noise limits exist. Demonstrating the use of *'Best Practicable Means'* (BPM) to minimise noise levels is an accepted defence against a noise abatement notice.

ii. Control of Pollution Act 1974

7.3.10 Sections 60 and 61 of the Control of Pollution Act 1974 (CoPA) (Ref. 7.6) provide the main legislation regarding demolition and construction site noise and vibration. If noise complaints are received, a Section 60 notice may be issued by the Local Planning Authority with instructions to cease work until specific conditions to reduce noise have been adopted.

7.3.11 Section 61 of the CoPA provides a means for applying for prior consent to carry out noise generating activities during construction. Once prior consent has been agreed under Section 61, a Section 60 notice cannot be served provided the agreed conditions are maintained on-site.

7.3.12 CoPA requires that BPM (as defined in Section 72 of CoPA) be adopted for construction noise on any given site. CoPA makes reference to British Standard (BS) 5228 as BPM.

iii. Environmental Permitting Regulations 2016

7.3.13 The Environmental Permitting (England and Wales Regulations) 2016 (Ref. 7.7) require the application of Best Available Techniques (BAT) to activities performed within installations regulated by the legislation in order to manage the impact of these operations on the surrounding environment. This, therefore, just applies to the operational period, not construction of the Project.

7.3.14 In terms of noise specifically, the selection of BAT will have to be considered and balanced with releases to different environmental media (air, land, and water) and

to give due consideration to issues such as usage of energy and raw materials. Noise, therefore, cannot be considered in isolation from other impacts on the environment.

7.3.15 The definition of pollution includes *'emissions which may be harmful to human health or the quality of the environment, cause offence to human senses or impair or interfere with amenities and other legitimate uses of the environment'* (clause 2). BAT is therefore likely to be similar, in practice, to the requirements of the Statutory Nuisance legislation which requires the use of BPM to prevent or minimise noise nuisance. In the case of noise, *'offence of any human senses*' may be judged by the likelihood of complaints. However, the lack of complaint should not necessarily imply the absence of a noise problem. In some cases it may be possible, and desirable, to reduce noise emissions still further at reasonable costs and this may therefore represent BAT for the control of noise emissions from an installation. Consequently, the aim of BAT should be to ensure that there is no reasonable cause for annoyance to persons beyond the installation boundary.

7.3.16 Guidance regarding Environmental Permitting and noise is available in the Environment Agency's Integrated Pollution Prevention and Control (IPPC) H3 document '*Horizontal Guidance for Noise Part 2 - Noise assessment and Control'* (Ref. 7.8). However, *'Horizontal Guidance for Noise Part 1 – Regulation and Permitting'* (Ref. 7.9), which provided useful guidance relating to noise limits from industrial installations in terms of absolute *rating levels* and *rating levels* relative to background noise levels (as defined in BS 4142:1997 (now superseded)) was withdrawn in February 2016. Therefore, industry wide noise limits no longer apply.

iv. National Policy Statements

7.3.17 The Overarching National Policy Statement for Energy (NPS EN-1) (Ref. 7.10) issued by the Department for Energy and Climate Change (as was) sets out national policy with respect to energy infrastructure.

7.3.18 Section 5.11 of NPS EN-1 sets out the requirements for assessing and mitigating noise and vibration from nationally significant infrastructure projects NSIPs in the energy sector. It also sets out the approach the SoS should adopt when considering noise assessments.

7.3.19 It advises that operational noise from a proposed development and the proximity to noise sensitive receptors, quiet areas or sites designated for ecological reasons will determine the likely impact of noise.

7.3.20 Where noise impacts are likely, a noise assessment should be undertaken in line with details listed in the NPS EN-1.

7.3.21 Operational noise and vibration should be assessed using relevant British Standards (e.g. BS 4142, BS 6472, BS 8233 and BS 5228) and other guidance, including the other NPS's.

7.3.22 NPS EN-1 advises the SoS that the project should:

"*Demonstrate good design through selection of the quietest cost-effective plant available; containment of noise within buildings wherever possible; optimisation of plant layout to minimise noise emissions; and, where possible, the use of landscaping, bunds or noise barriers to reduce noise transmission*."

7.3.23 The proposal should meet the following aims before the SoS grants consent:

- *"Avoid significant impacts on health and quality of life from noise,*
- *Mitigate and minimise other adverse impacts on health and quality of life from noise,*
- *Where possible, contribute to improvements to health and quality of life through the effective management and control of noise."*

7.3.24 Section 5.11 of NPS EN-1 also sets out advice on mitigation and states:

"The IPC should consider whether mitigation measures are needed both for operational and construction noise over and above any which may form part of the project application. In doing so the IPC may wish to impose requirements. Any such requirements should take account of the guidance set out in Circular 11/95 (see Section 4.1) or any successor to it.

Mitigation measures may include one or more of the following:

- *Engineering: reduction of noise at point of generation and containment of noise generated;*
- *Lay-out: adequate distance between source and noise-sensitive receptors; incorporating good design to minimise noise transmission through screening by natural barriers, or other buildings; and*
- *Administrative: restricting activities allowed on the site; specifying acceptable noise limits; and taking into account seasonality of wildlife in nearby designated sites.*

In certain situations, and only when all other forms of noise mitigation have been exhausted, it may be appropriate for the IPC to consider requiring noise mitigation through improved sound insulation to dwellings."

7.3.25 The National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) issued by the Department for Energy and Climate Change (as was) sets out national policy with respect to energy infrastructure.

7.3.26 Section 2.20 of EN-4 advises that:

"During the pre-construction phase there could be vibration effects from seismic surveys. During construction, tasks may include site clearance, soil movement, ground excavation, tunnelling, trenching, pipe laying and welding, and ground reinstatement. In addition, increased HGV traffic will be generated on local roads for the movement of materials. These types of noise and vibration impacts will need to be assessed.

The commissioning of a new pipeline can involve extensive periods of drying after hydro-testing, using air compressors, and noise mitigation may be required for this type of activity.

A new gas pipeline may require an above ground installation such as a gas compression station on the route of the pipeline to boost transmission line pressure. A new oil pipeline may require pumping stations. These may be located in quiet rural areas, and therefore the control of noise from these facilities is likely to be an important consideration."

7.3.27 Section 2.20 of EN-4 also advises on mitigation measures and states:

"Noise mitigation measures for gas and oil pipelines, in particular their associated above-ground installations, include screening or enclosure of compressors and pumps. Other measures could include the use of sound attenuators on ventilation systems, acoustic lagging on pipework, multi-stage (inherently quiet) control valves, gas turbine exhaust silencers, and high efficiency low speed cooler fans, depending on the specific issues. Vibration mitigation measures could include the use of non-impact piling such as augur boring."

v. Noise Action Plan for Wales 2013-2018

7.3.28 The Noise Action Plan for Wales (Ref. 7.11) states in Section 1.2 as regards development:

7.3.29 "The challenge therefore is to take a balanced approach to managing noise which considers the needs of individuals as well as the requirements of business and industry, so that our quality of life is not reduced in other ways.

7.3.30 Almost everything that people do creates sound, and noise – unwanted sound – is to a certain extent an inevitable by-product of life. Yet for the reasons described in more detail in the sections below, and in the interests of a healthy, fair and prosperous society, it is important to have a legal and policy framework in place that:

- *Protects people and wildlife from unacceptable or harmful levels of noise intrusion; and*
- *Gives everyone access to tranquil places where they can find respite from man-made sights and sounds.*

7.3.31 In Wales, sustainable development means enhancing the economic, social and environmental wellbeing of people and communities, achieving a better quality of life for our own and future generations.

7.3.32 The Welsh Government's vision of a sustainable Wales includes:

- *Healthy, biologically diverse and productive ecosystems that are managed sustainably; and*
- *Communities that are safe, sustainable, and attractive places for people to live and work, where people have access to services and enjoy good health."*

7.3.33 Guidance on the *"need to consider noise when planning a new development, be it a noise generating or a noise*-sensitive" development is set out in Planning Policy Wales and Technical Advice Note 11 (TAN):

vi. Planning Policy Wales (Edition 9, November 2016)

7.3.34 Planning Policy Wales (PPW) (Ref. 7.12) sets out the land use planning policies of the Welsh Government (WG) and is supplemented by 21 topic based Technical Advice Notes (TANs).

- 11.1.11: Formal and informal open green spaces, including parks with significant recreational or amenity value, should be protected from development, particularly in urban areas where they fulfil multiple purposes, not only enhancing the quality of life, but contributing to biodiversity, the conservation of nature and landscape, air quality and the protection of groundwater.
- 13.13.1: Noise action plans, drawn up by the Welsh Ministers in relation to Wales under the Environmental Noise Directive and its transposing Regulations, aim to prevent and reduce environmental noise where necessary and preserve environmental noise quality where it is good. They are a planning consideration in the use and development of land.
- 13.15.2: Special consideration is required where a noise-generating development is likely to affect a protected species, or is proposed in or near statutorily designated areas, including urban quiet areas designated in noise action plans. The effect of noise on the enjoyment of other areas of landscape, wildlife and historic value should also be taken into account.

7.3.35 The policy also requires best practice in construction.

vii. Technical Advice Note (TAN) 11

7.3.36 Technical Advice Note TAN 11 – Noise (1997) (Ref. 7.13) is a Welsh Government document that provides guidance on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development.

7.3.37 The document talks about general principles in relation to noise and planning, and provides general guidance on both noise sensitive and noise generative developments, including draft planning conditions dealing with noise. The main detailed guidance provided in TAN 11 is the Noise Exposure Categories for new residential developments.

7.3.38 Some detailed guidance is provided on the assessment of noise from a variety of sources, but this guidance generally refers to other documents for methods of assessment and criteria. This guidance has been taken into consideration in this assessment

7.3.39 The documents makes reference to BS 8233, BS 4142, BS 5228 (Ref. 7.14 to Ref. 7-17).

viii. National Planning Policy Framework

7.3.40 The National Planning Policy Framework (NPPF) was published in March 2012 (Department for Communities and Local Government (DCLG), 2012a) (Ref. 7.18) and details the Government's planning policies for England and how these are to be applied. As such is not directly applicable in Wales but does offer guidance with a relevance to the Project particularly with reference to the evaluation of SOAEL and LOAEL levels. It is a material consideration in planning decisions made by local planning authorities in England. In respect of noise, it states:

"The planning system should contribute to and enhance the natural and local environment by: preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability…" (paragraph 109)

7.3.41 The NPPF supersedes the previous guidance document PPG 24 '*Planning and Noise'* (Ref. 7.12).

7.3.42 The planning system is required to contribute to and enhance the natural and local environment. Consequently, the aim is to prevent both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of noise pollution.

7.3.43 The NPPF states that planning policies and decisions should aim to:

- "*Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
- *Mitigate and reduce to a minimum other adverse impacts on quality of life arising from noise from new development, including through the use of conditions;*
- *Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established [subject to the provisions of the Environmental Protect Act 1990 and other relevant law]; and*
- *Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason*." (paragraph 123)

ix. Planning Practice Guidance

7.3.44 In March 2014, Department for Communities and Local Government (DCLG released its Planning Practice Guidance (PPG) web-based resource to support the NPPF (Ref. 7.19). The guidance advises that local planning authorities' should consider: Again this document is only strictly applicable to England but does give useful information on the setting of observable adverse effect levels (~OAEL):

- "*Whether or not a significant adverse effect is occurring or likely to occur;*
- *Whether or not an adverse effect is occurring or likely to occur; and*
- *Whether or not a good standard of amenity can be achieved."*

7.3.45 This guidance introduced the additional concepts of NOAEL (No Observed Adverse Effect Level), and UAEL (Unacceptable Adverse Effect Level). Full details of the PPG on effects are provided in Table 7-2.

7.3.46 Factors to be considered in determining if noise is a concern are identified including the absolute noise level of the source, the existing ambient noise climate, time of day, frequency of occurrence, duration, character of the noise and cumulative impacts.

7.3.47 With particular regard to mitigating noise impacts on residential development, the guidance highlights those impacts may be partially off-set if residents have access to a relatively quiet façade as part of their dwelling or a relatively quiet amenity space (private, shared or public).

Table 7-2: Planning Practice Guidance

Perception	Examples of outcomes	Increasing effect level	Action
Not noticeable	No effect	No observed effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude; can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No observed adverse effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude (e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise). Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed adverse effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude (e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise). Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life	Significant observed adverse effect	Avoid

Perception	Examples of outcomes	Increasing effect level	Action
	diminished due to change in acoustic character of the area.		
Noticeable and very disruptive	Extensive and regular changes in behaviour and/ or an inability to mitigate effect of noise leading to psychological stress or physiological effects (e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, *e.g.* auditory and non-auditory).	Unacceptable adverse effect	Prevent

x. British Standard 7445-1:2003 and 7445-2:1991

7.3.48 BS 7445 *'Description and measurement of environmental noise'* (Ref. 7.20 and Ref. 7.21) defines parameters, procedures and instrumentation required for noise measurement and analysis.

xi. British Standard 5228:2009+A1:2014

7.3.49 BS 5228-1 *'Code of practice for noise and vibration control on construction and open sites. Noise'* (Ref. 7.16) provides a 'best practice' guide for noise control, and includes Sound Power Level (*L*w) data for individual plant as well as a calculation method for noise from construction activities. BS 5228-2 *'Code of practice for noise and vibration control on construction and open sites. Vibration'* (Ref. 7.17) provides comparable 'best practice' for vibration control, including guidance on the human response to vibration.

xii. British Standard 6472:2008

7.3.50 BS 6472-1 '*Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting*' (Ref. 7.22) presents recommended frequency weighted vibration spectra (for continuous vibration) and vibration dose values (VDV) (for intermittent vibration) above which adverse comment is likely to occur in residential properties.

xiii. British Standard 7385:1993

7.3.51 BS 7385-2 'Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration' (Ref. 7.23) presents guide values for transient and continuous vibration, above which there is a likelihood of cosmetic damage. The standard establishes the basic principles for carrying out vibration measurements and processing the data, with regard to evaluating vibration effects on buildings.

xiv. British Standard 4142:2014

7.3.52 BS 4142 '*Methods for rating and assessing industrial and commercial sound*' (Ref. 7.15) can be used for assessing the effect of noise of an industrial nature, including mechanical services plant noise. The method compares the difference between

'*rating level*' of the industrial noise, with the 'background level' at the receptor position.

xv. British Standard 8233:2014

7.3.53 BS 8233 *Guidance on sound insulation and noise reduction for buildings* (Ref. 7.14) contains guidance on internal noise levels for buildings of various types and used.

xvi. Calculation of Road Traffic Noise

7.3.54 Department of Transport (DfT)/Welsh Office Memorandum '*Calculation of Road Traffic Noise*' (Ref. 7.24) describes procedures for traffic noise calculation, and is suitable for environmental assessments of schemes where road traffic noise may have an effect.

xvii. Design Manual for Road and Bridges (DMRB)

7.3.55 The Highways England '*Design Manual for Road and Bridges* (DMRB) *Volume 11 Section 3 Part 7 HD213/11 (Revision 1) Traffic Noise and Vibration*' (Ref. 7.25) provides guidance on the appropriate level of assessment to be used when assessing the noise and vibration effects arising from all road projects, including new construction, improvements and maintenance. The guidance can also be used for assessing changes in traffic noise levels as a result of non-road projects such as this.

c) Local

i. City and County of Swansea Unitary Development Plan (2008)

7.3.56 Policy EV40 (Ref. 7.26) on Air, Noise and Light Pollution states that:

7.3.57 *"Development proposals will not be permitted that would cause or result in significant harm to health, local amenity, natural heritage, the historic environment or landscape character because of significant levels of air, noise or light pollution*."

ii. Draft Swansea Local Development Plan (July 2017)

7.3.58 The Draft Swansea Local Development Framework is not yet adopted planning policy, but a draft has been submitted for Examination in Public. Consequently, whilst it is a material consideration, it does not yet attract full weight as adopted policy.

7.3.59 Policy 14: Safeguarding the Environment (Ref. 7.27):

> *"The County's environment will be protected from materially harmful development and where possible enhanced. Development that would result in unacceptable adverse environmental effects will not be permitted, particularly in respect of: Air, noise, or light pollution."*

7.4 Methodology

a) Scope of the assessment

7.4.1 The scope of this assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken to obtain a formal Scoping Opinion from the Secretary of State. Comments raised on the EIA Scoping Report have been taken into account in the development of the assessment methodology and these are detailed where relevant in this chapter. Responses to the comments raised in the Scoping Opinion can be found in Table 7-4.

7.4.2 The elements of the project scoped out from this assessment are listed in Table 7-3.

Table 7-3: Summary of Elements Scoped out of Assessment

Element	Rationale
A detailed assessment construction traffic assessment has been scoped out on the basis of <50 HGVs per day over the construction Phase.	DMRB advises that an increase in road traffic flows of 25% (where the traffic speed and composition remain consistent) equates to an increase in road traffic noise of 1 dB L_A. A doubling of traffic flow would be required for an increase in 3 dB L_A. As there will be less than 25 % increase in traffic flows, the impacts will be negligible, and therefore not significant. No further assessment is deemed necessary. The actual traffic flows associated with construction for the project are expected to be below these levels except for a very brief period when a maximum of 146 movements may occur per day. This will affect very few receptors for a brief period and will be managed through the CEMP to minimise impacts when the exact details of the programme and construction options are known. As a result a detailed assessment would add little beneficial information at this stage.
Operational noise and vibration for AGI	The equipment on the AGI will be restricted to passive pipework with no pressure reduction valves, water bath heaters or other potential noise sources.
Operational noise and vibration for Electrical Connection	The Electrical Connection will be in the environs of the existing substation and will not introduce any new sources. The Electrical Connection will form part the Substation and is not expected to include any new noise emitting sources.
Detailed assessment of construction vibration	In the absence of specific information on likely construction activities and plant, a qualitative assessment based upon professional judgement has been undertaken at this stage. Given the significant distance to residential receptors, this qualitative judgement made is that no significant vibration (medium or high magnitude impacts) is expected to result at residential NSRs from construction and therefore assessment beyond the qualitative assessment in paras 7.7.20 and 7.7.21 is scoped out.
Assessment of generating plant operational vibration	No causes of significant vibration associated with the Project are anticipated. The primary rotating equipment within the generator set will be balanced to a high degree and constantly monitored for any changes in the vibration levels it produces. Therefore, further assessment of operational vibration has been scoped out of this assessment.

b) Consultation

7.4.3 The scope of the assessment has also been informed by ongoing consultation with statutory consultees throughout the design and assessment process, including the SoS and CCS Environmental Health Department. The discussions centred on the methodologies to be used to assess the noise emissions from the Project in the context of the area in which it is located.

7.4.4 A summary of the comments raised and responses are detailed in Table 7-4.

Table 7-4: Summary of Consultation Responses that have Informed the Scope and Methodology of the Noise and Vibration Assessment

Consultee	Date	Comment	Response
Secretary of State (SoS) (Scoping Report paragraph 3.32)	August 2014	The SoS notes the intention for noise measurement locations for the baseline assessment to be agreed with the local EHO but draws attention to the comment from NRW that the discussion on noise surveys also needs to be communicated to NRW with particular reference to an A1 EPR permit which will include noise conditions.	The baseline noise levels used in this preliminary assessment are taken from previous surveys. More baseline measurements will be required in future and NRW will be consulted before that takes place.
SoS (Scoping Report paragraph 3.33)	August 2014	The SoS draws attention to the comments of NRW regarding the requirements of the Environmental Noise Directive, and the Environmental Noise (Wales) (Amendment) Regulations 2009, which have introduced a 'Noise Action Plan for Wales.' This covers industrial noise sources, impacts on designated Quiet Areas and the impact of creeping background, and should be taken into consideration by the Applicant.	The Noise Action Plan for Wales has been taken into consideration within the context of a wide range of available guidance.
SoS (Scoping Report paragraph 3.34)	August 2014	The SoS recommends that information be provided on the types of vehicles and plant to be used during the construction phase. Noise impacts on people should specifically be addressed and in particular any potential noise disturbance at night	Detailed assessment of construction vehicle noise has been considered and scoped out due to the insignificant expected effects. The reasoning behind this is explained in more detail in Table 7-

Consultee	Date	Comment	Response
		and other unsocial hours such as weekends and public holidays.	3
SoS (Scoping Report paragraph 3.35)	August 2014	The SoS welcomes that the CEMP will set out best practice methods of limiting noise and vibration on site during construction and decommissioning.	Noise mitigation will be included in the CEMP.
SoS (Scoping Report paragraph 3.36)	August 2014	The SoS recommends that the noise and vibration assessment takes account of traffic movements along access routes during the construction phase.	Assessment of construction vehicle noise has been considered and scoped out due to the insignificant expected effects.
SoS (Scoping Report paragraph 3.37)	August 2014	The noise assessment should accurately identify the proximity of the identified noise sensitive receptors to the proposed development. With regards to the operational noise assessment, this should cover all modes of operation of the proposed development. The applicant's attention is drawn to NRW's comments in these respects.	The assessment is based on the effects at the receptors closest to the Project Site.
City and County of Swansea (CCS)	Consultation with Mr Tom Price (Environmental Health Officer) on 20th October 2017	Confirms that the proposed approach to assessing Noise and Vibration in PEIR is acceptable and agrees with requirements of scoping report. The methodology discussed was based on BS 4142 for the daytime and WHO Night Time Noise Guidelines for the night. The six NSR locations were discussed and agreed as appropriate	The assessment has been completed in line with the methodology set out in the discussion.

c) Study area

7.4.5 The extent of the study area has been defined to include the nearest receptors/communities in each direction from the Project Site that may be affected during the construction, operational and decommissioning phases of the Project.

Representative NSRs within this study area in all directions from the Project Site have been identified for the purposes of assessment, to ensure all effects are appropriately considered.

7.4.6 Key NSR locations have been selected which are considered to be representative of the nearest and potentially most sensitive existing receptors to the Project Site. It is considered that if noise and vibration levels are suitably controlled at the key receptors identified, then noise and vibration levels would be suitably controlled at other sensitive receptors in the surrounding area, including the amenity of local footpaths and leisure facilities as the requirements for these will be less onerous. Impacts upon ecological receptors are considered in the **Chapter 8: Ecology**.

7.4.7 Those NSRs are listed in Table 7-5 and located in Figure 7.1.

Table 7-1: Noise Sensitive Receptors and Monitoring Locations

Noise Sensitive Receptor	Address	Details (distance from point source)
NSR1	Cefn-betingau	Isolated farm house 500 m east of the Project Site
NSR2	Feline Wen Farm	Isolated farm house 800 m south east of the Project Site
NSR3	Llwynhelig	Isolated farm house 750 m south east the Project Site
NSR4	Maes-eglwys	Isolated farm house 700 m south of Project Site
NSR5	Lletty Morfil Farm	Isolated farm house 875 m west of Project Site
NSR6	Abergelli Farm	Isolated farm house 600 m north west of the Project Site

d) Sensitivity

7.4.8 In accordance with the principles of EIA, the sensitivity of existing receptors to noise (or vibration) impacts has been defined in Table 7-6.

Table 7-2: Sensitivity/Value of Receptors

Sensitivity/ value of resource/ receptor	Description	Examples of receptor usage
Very high	Receptors where noise or vibration will significantly affect the function of a receptor	Auditoria/ studios Specialist medical/teaching centres, or laboratories with highly sensitive equipment
High	Receptors where people or operations are particularly susceptible to noise or vibration.	Residential Quiet outdoor areas used for recreation Conference facilities Schools/ educational facilities in the daytime

Sensitivity/ value of resource/ receptor	Description	Examples of receptor usage
	Sensitive ecological receptors known to be vulnerable to the effects of noise or vibration	Hospitals/ residential care homes Libraries Ecologically sensitive areas for example Special Protection Areas (SPAs)
Medium	Receptors moderately sensitive to noise or vibration where it may cause some distraction or disturbance	Offices Restaurants/ retail Sports grounds when spectator or noise is not a normal part of the event and where quiet conditions are necessary (*e.g.* tennis, golf)
Low	Receptors where distraction or disturbance of people from noise or vibration is minimal	Residences and other buildings not occupied during working hours Factories and working environments with existing high noise levels Sports grounds when spectator or noise is a normal part of the event

e) Magnitude

i. Assessment of Construction Noise Effects

7.4.9 Before the appointment of a construction contractor, site specific details on the construction activities, programme and number or type of construction plant are not yet available. Therefore, detailed construction noise predictions at specific NSRs have not been undertaken. As stated in the scoping report, a qualitative assessment will be undertaken, based on review of the indicative worst case construction noise predictions which were undertaken for a representative project using the calculation methods set out in BS 5228:2009+A1:2014 *'Code of practice for noise and vibration control on construction and open sites'* (Ref. 7.16). The predictions for each phase of the construction will be adjusted to reflect the distances to the actual receptors at the Project Site.

7.4.10 BS 5228 contains a number of example methodologies for identifying significant construction noise effects based on fixed thresholds or noise level changes. Taking into account this guidance the threshold values detailed in Table 7-7 have been adopted in this PEIR to define the SOAEL (the 'significant observed adverse effect level', as defined in Section 7.3) and the LOAEL (the 'lowest observable adverse effect level') for residential receptors.

Table 7-7: Construction Noise SOAEL and LOAEL for Residential Receptors

Time of Day	SOAEL $L_{Aeq,T}$ dB (façade)	LOAEL $L_{Aeq,T}$ dB (façade)
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	75	65
Evenings (19:00 – 23:00 weekdays) and Weekends (13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays)	65	55
Night-time (23:00 – 07:00)	55	45

7.4.11 The criterion for the SOAEL at residential receptors corresponds to the threshold values for Category C in the BS 5228 example ABC method. Similarly, the criterion for the LOAEL corresponds to the threshold values for Category A in the BS 5228 example ABC method. In accordance with the NPPF and NPSE (used here as they give more quantitative information then the Welsh national guidance), it is important to consider receptors that exceed the LOAEL and ensure adverse effects are mitigated and minimised.

7.4.12 When considering exceedances of the SOAEL and LOAEL, other project-specific factors have been taken into account, such as the existing ambient noise levels, number of receptors affected and the frequency and duration of the impact.

7.4.13 Based upon the above, the magnitude of the impact of construction noise on residential receptors has been classified in accordance with the descriptions in Table 7-8.

Table 7-8: Construction Noise Magnitude of Impact Criteria for Residential Receptors

Magnitude of Impact	Daytime $L_{Aeq,T}$ dB (façade)	Evening / Weekend $L_{Aeq,T}$ dB (façade)	Night-time $L_{Aeq,T}$ dB (façade)
High	> 80	> 70	> 60
Medium	>75-80	>65-70	>55-60
Low	>65-75	>55-65	>45-55
Very Low	≤ 65	≤ 55	≤ 45

ii. Assessment of Demolition and Construction Vibration Effects

Effects on Humans – Annoyance

7.4.14 Vibration due to construction activities has the potential to result in adverse impacts at nearby NSRs. The transmission of ground-borne vibration is highly dependent on the nature of the intervening ground between the source and receiver and the activities being undertaken. BS 5228-2: 2009+A1: 2014 *'Code of Practice for Noise and Vibration Control on Construction and Open Sites - Vibration'* (Ref 7.17) provides data on measured levels of vibration for various construction works, with

particular emphasis on piling. Impacts are considered for both damage to buildings and annoyance to occupiers.

7.4.15 Table 7-9 details Peak Particle Velocity (PPV) vibration levels and provides a semantic scale for the description of demolition and construction vibration effects on human receptors, based on guidance contained in BS 5228-2.

Table 7-9: Construction Vibration threshold at Residential Dwellings

Peak Particle Velocity (PPV) level	Description	Magnitude of impact
>= 10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	High
1.0 to < 10 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.	Medium
0.3 to < 1 mm/s	Vibration might be just perceptible in residential environments.	Low
0.14 to < 0.3 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Very low

7.4.16 For residential receptors and other high sensitivity receptors, the LOAEL is defined as a PPV of 0.3 mm/s (millimetres per second), this being the point at which construction vibration is likely to become perceptible. The SOAEL is defined as a PPV of 1.0 mm/s, this being the level at which construction vibration can be tolerated with prior warning.

7.4.17 At receptors above the SOAEL, further consideration of whether an effect is significant is undertaken using professional judgement, taking account of the duration and frequency of the effect, as well as the time of evening/night that the effect would be experienced.

Effects on Buildings

7.4.18 In addition to human annoyance, building structures may be damaged by high levels of vibration. The levels of vibration that may cause building damage are far in excess of those that may cause annoyance. Consequently, if vibration levels are controlled to those relating to annoyance (*i.e.* 1.0 mm/s), then it is highly unlikely that buildings will be damaged by construction vibration levels.

7.4.19 The criteria used in this assessment relate to the potential for cosmetic damage, not structural damage. The principal concern is generally transient vibration, for example due to piling.

7.4.20 BS 7385-2: 1993 *'Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration'* (Ref. 7.23) provides guidance on vibration levels likely to result in cosmetic damage and is referenced in BS 5228-2: 2009+A1:2014. Guide values for transient vibration, above which cosmetic damage could occur, are given in Table 7-10.

Table 7-10: Transient Vibration Guide Values for Cosmetic Damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
NOTE 1: Values referred to are at the base of the building. NOTE 2: For un-reinforced or light framed structures and residential or light commercial buildings, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded		

7.4.21 BS 7385-2:1993 states that the probability of building damage tends to zero for transient vibration levels less than 12.5 mm/s PPV. For continuous vibration, such as from vibratory rollers, the threshold is around half this value.

7.4.22 It is also noted that these values refer to the likelihood of cosmetic damage. ISO 4866:2010 defines three different categories of building damage:

- Cosmetic – formation of hairline cracks in plaster or drywall surfaces and in mortar joints of brick/concrete block constructions;
- Minor – formation of large cracks or loosening and falling of plaster or drywall surfaces or cracks through brick/block; and
- Major – damage to structural elements, cracks in support columns, loosening of joints, splaying of masonry cracks.

7.4.23 BS 7385-2:1993 defines that minor damage occurs at a vibration level twice that of cosmetic damage and major damage occurs at a vibration twice that of minor damage. Therefore, this guidance can be used to define the magnitude of impact identified in Table 7-11.

Table 7-11: Magnitude of Impact – Construction Vibration Duilding Damage

Magnitude of impact	Damage risk	Continuous vibration level ppv mm/s
High	Major	30
Medium	Minor	15
Low	Cosmetic	6
Very low	Negligible	<6

iii. Assessment of Operational Noise

7.4.24 The assessment of operational sound levels has been based upon calculations using plant emissions data available at this stage. The data currently available includes generating equipment, sound power levels (L_W), distance between the Power Generation Plant and NSRs and the acoustic screening offered by the existing landscape

7.4.25 Based upon the predicted sound levels, an assessment of potential impact at nearby NSRs has been undertaken using the guidance in WHO Night time noise guides.

7.4.26 BS 4142: 2014 *'Methods for rating and assessing industrial and commercial sound'* (Ref. 7.15).

7.4.27 BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The method compares the rating sound level with the existing *background sound level*. The standard uses the following definitions to describe various aspects of the soundscape of the scenario being assessed:

- *Background sound level,* $L_{A90,T}$ dB - defined in the Standard as the 'A-weighted sound pressure level that is exceeded by the residual sound for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels'.
- *Specific sound level, Ls =* $L_{Aeq,Tr}$ *dB* – the 'sound source at the assessment location over a given reference time interval, T_r,'.
- *Rating level,* $L_{Ar,Tr}$ – the '*specific sound level* plus any adjustment made for the characteristic features of the sound'.
- *Ambient sound level*, $L_{Aeq,T}$ dB - defined in the standard as 'the totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far when present. The ambient sound comprises the residual sound and the specific sound.'
- *Residual sound level*, L_r = $L_{Aeq,T}$ –the *'Ambient Sound* remaining at the assessment location when the *Specific Sound* source is suppressed to such a degree that it does not contribute to the *Ambient Sound'*.

7.4.28 When assessing a new sound source such as the Generating Equipment it is important to consider the context of the site and the nature of the existing noise sources in the area. The Substation is part of the background sound environment

in the area and the impact of the generators should to be viewed in the context of that existing environment. However, it is also necessary to consider the risks of new sources causing the ambient sound levels in the area to 'creep' up.

7.4.29 Whereas the previous version of BS 4142:1997 allowed for a single correction of +5 dB to be made to the Specific Noise Level if one or more of the distinguishable, impulsive or irregular features were considered to be present, BS 4142:2014 allows for corrections to be applied based upon the presence or expected presence of the following:

- Tonality: up to +6 dB penalty;
- Impulsivity: up to +9 dB penalty (this can be summed with tonality penalty); and
- Other sound characteristics (neither tonal nor impulsive but still distinctive): + 3 dB penalty.

7.4.30 Once any adjustments have been made, the *background sound level* and the *rating level* are compared. The standard states that:

"Typically, the greater the difference, the greater the magnitude of impact.

A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending upon the context.

A difference of around +5 dB is likely to be an indication of an adverse impact, depending upon the context.

The lower the rating level is to the measured background sound level, the less likely it is that the specific sound will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending upon the context." (Section 11)

7.4.31 Importantly, as suggested above, BS 4142:2014 requires that the *rating level* of the noise source under assessment be considered in the context of the environment when defining the overall significance of the impact.

7.4.32 BS 4142:2014 suggests that a one hour assessment period is considered during the day and a 15-minute assessment period at night.

7.4.33 Table 7-12 illustrates the adopted magnitude of impact scale used in this assessment based upon the numerical level difference. For BS 4142 assessment purposes the SOAEL is set at a *rating level* above the *background sound level* of +10 dB, and the LOAEL at +5 dB, although it should be remembered that the context assessment (including the absolute level of the sound under consideration) can vary the overall classification of effects.

7.4.34 The nature and context of the site mean that BS 4142 would produce an inappropriate assessment of operational noise impacts at night. As a result it was agreed in discussion with CCS to base the night time assessment upon the WHO document Night Noise Guidelines for Europe (Ref. 7.2).

7.4.35 The Night Noise Guidelines for Europe build on the earlier WHO Comity Noise Guidelines (Ref. 7.1) and assess the health and sleep effects of noise experienced by people at night. It observes that below the level of 30 dB L_{night}, no effects on sleep are observed except for a slight increase in the frequency of body movements during sleep due to night noise. There is no sufficient evidence that the biological effects observed at the level below 40 dB L_{night} are harmful to health. However, adverse health effects are observed at the level above 40 dB L_{night}, such as self-reported sleep disturbance, environmental insomnia, and increased use of sleeping pills and sedatives. Therefore, 40 dB L_{night} is equivalent to the lowest observed adverse effect level (LOAEL) and 30 dB L_{night} is equivalent to the no observable adverse effect level (NOAEL) for night noise.

7.4.36 It this site the very low background sound levels at some of the receptors mean that SOAEL and LOAEL values based on the BS 4142 method, which are based on comparison with background sound, fall below the absolute SOAEL and LOAEL values in the WHO guidance. Therefore, the WHO values give the more appropriate assessment.

7.4.37 These values apply to the total ambient sound incident on a dwelling not just to the contribution from an individual source such as the Project. For this assessment it will therefore be necessary to predict the future *ambient sound level* by adding together the measured *residual sound level* and the predicted *specific sound level*.

7.4.38 The WHO document recommends that for the prevention of subclinical adverse health effects related to night noise in the population, it is recommended that the population should not be exposed to night noise levels greater than 40 dB of L_{night} during the part of the night when most people are in bed. The document also suggests an interim target (IT) of 55 dB L_{night} in the situations where the achievement of the NOAEL is not feasible in the short run for various reasons.

f) Significance Criteria

7.4.39 Table 7-12 below lists the magnitudes of impacts for day time noise based on BS 4142.

Table 7-12: Magnitude of Impact for Industrial Noise in the Day

Daytime		
Magnitude of impact	**BS 4142 descriptor**	**Excess of *rating level* over *background sound level* (dB)**
High	No BS 4142 descriptor for this magnitude level	>15
Medium	Indication of a significant adverse effect, depending upon context	+10 approx.
Low	Indication of an adverse effect, depending upon context	+5 approx.

Daytime		
Very low	Indication of low impact, depending upon context	≤ 0

7.4.40 Table 7-13 below lists the magnitudes of impacts for night time noise based on the WHO guidelines.

Table 7-13: Magnitude of Impact for Industrial Noise at Night

Night time		
Magnitude of impact	**Descriptor**	**Total ambient sound level outdoors (dB L_{Aeq})**
High	Based on level considered by WHO to be "increasingly dangerous to public health"	>55
Medium	Based on level considered by WHO to produce observable "adverse health effects"	40<55
Low	Based on LOAEL in WHO	30<40
Very low	Based on NOAEL in WHO	≤ 30

g) Effect definitions

7.4.41 Effects are classified based on the magnitude of the impact and the sensitivity or value of the affected receptor. The criteria for assigning the magnitude of impacts are outlined for the various potential impacts during construction, operation and decommissioning, and these are followed by a scale of receptor sensitivity in Table 7-6 and overall classification of effects matrix in Table 7-14.

7.4.42 The following terminology has been used in the assessment to define effects:

- Adverse – detrimental or negative effects to an environmental resource or receptor;
- Neutral – effects to an environmental resource or receptor that are neither adverse nor beneficial; or
- Beneficial – advantageous or positive effect to an environmental resource or receptor.

7.4.43 The effect resulting from each individual potential impact type above is classified according to the magnitude of the impact and the sensitivity or value of the affected receptor using the matrix presented in Table 7-14 but where necessary also considering the context of the acoustic environment.

Table 7-14: Classification of Effects

Sensitivity/ value of resource/ receptor	Magnitude of impact			
	High	Medium	Low	Very low
Very high	Major	Major	Moderate	Minor
High	Major	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible

7.4.44 For the purposes of this assessment, negligible and minor effects are not considered to be significant, whereas moderate and major effects are considered to be significant.

7.5 Baseline Environment

7.5.1 This section describes the baseline environmental characteristics for the Project and surrounding areas with specific reference to noise and vibration. The baseline sound levels presented within this report were measured by Parsons Brinckerhoff in August 2014 and presented in their report 287521A of March that year (Ref. 7.28) which was an appendix to the 2014 PEIR. The measurements were of limited scope at the time and will be updated before the construction of the Project. This update will occur at a time of suitable weather conditions.

7.5.2 Representative *background and ambient sound levels* have been taken from the Parsons Brinckerhoff report (Ref. 7.28), which was an appendix to the 2014 PEIR. Table 7-15 summarises the results for each NSR. The values are still relevant but were limited in scope and are now three years old. They will therefore be repeated prior construction of the Project.

Table 7-15: Representative Background and Ambient Sound Levels

NSR	Observations of baseline sound environment	Day time background sound level L_{AF90}	Day time ambient sound level L_{Aeq}	Night time background sound level L_{AF90}	Night time ambient sound level L_{Aeq}
NSR1	Animals, farming activities and distance road traffic during the day and the wind in trees and distant road traffic at night	41	49	25	28
NSR2	Animals, farming activities and distance road traffic during the	40	50	24	27

NSR	Observations of baseline sound environment	Day time background sound level L_{AF90}	Day time ambient sound level L_{Aeq}	Night time background sound level L_{AF90}	Night time ambient sound level L_{Aeq}
	day and the wind in trees and distant road traffic at night				
NSR3	Animals, farming activities and distance road traffic during the day and the wind in trees and distant road traffic at night	43	57	30	37
NSR4	Animals, farming activities and distance road traffic during the day and the wind in trees and distant road traffic at night. Also located in vicinity of existing substation	40	51	37	47
NSR5	Animals, farming activities and distance road traffic during the day and the wind in trees and distant road traffic at night Also located in vicinity of existing substation	39	42	27	40
NSR6	Animals and distance road traffic during the day and the wind in trees and distant road traffic at night	40	41	25	28

7.5.3 The results show significant differences between the background sound levels during the day and at night at NSRs 1,2,3,5 and 6 (12 to 16 dB). This reflects the variation in the principal noise sources such as farming activities and road traffic. The difference at NSR 4 was smaller due to more steady contributions from the sources in that area, but as a result the level at night at NSR 4 was significantly higher than at the other NSRs.

7.5.4 The night time background sound levels at NSRs 1, 2 and 6 are below 30 dB and would therefore be considered low.

7.5.5 The ambient sound levels showed a similar pattern with large day/night differences at NSRs 1, 2, 3 and 6 and smaller differences at NSRs 4 and 5.

7.5.6 The baseline ambient sound level (residual sound level) at NSR 4 already exceeds the LOAEL from the WHO guidelines by 7 dB L_{Aeq}.

7.5.7 In the absence of the Project, future baseline sound levels at NSRs would depend largely on traffic flows on surrounding road networks and the future operations at other industrial and commercial premises in the area.

7.6 Embedded Mitigation

7.6.1 As detailed in **Chapter 3: Project and Site Description**, a number of embedded mitigation measures have been identified through the iterative EIA process and have been incorporated into the design and construction planning of the Project.

7.6.2 As these mitigation measures have been embedded into the design, are legal requirements or are standard practices that will be implemented, the assessment of likely significant effects assumes that they are in place.

7.6.3 The preferred approach for controlling construction noise and vibration is to reduce levels at source where possible, but with due regard to practicality. Sometimes a greater noise or vibration level may be acceptable if the overall construction time, and therefore length of disruption, is reduced.

7.6.4 During operation, monitoring is considered appropriate in order to track the success of delivery of proposed mitigation. Ideally this monitoring would be based on regular or fixed measurements close to the Project Site boundary to give consistency by minimising the impact of weather and extraneous sources. The measured levels at these locations must be calibrated against the levels at the receptors as part of the plant commissioning sound test procedure. Any change in Project Site boundary levels can then be related directly to changes at the receptors.

7.7 Assessment of Effects

7.7.1 This section presents the findings of the noise and vibration assessment for the construction phase, the operational phase and the decommissioning phase of the Project.

7.7.2 This section identifies any likely significant effects that are predicted to occur and Section 7.8 highlights the additional mitigation and monitoring measures that are proposed to reduce or eliminate the identified significant effects if required.

a) Construction

7.7.3 This section sets out the preliminary assessment of the potential noise and vibration effects on sensitive receptors arising during the construction period.

7.7.4 Noise levels experienced by local receptors during such works depend upon a number of variables, the most significant of which are:

- The noise generated by plant or equipment used on-site, generally expressed as Sound Power Levels (L_w) or the vibration generated by the plant;
- The periods of use of the plant on-site, known as its on-time;
- The distance between the noise/vibration source and the receptor;
- The noise attenuation due to ground absorption, air absorption and barrier effects;
- In some instances, the reflection of noise due to the presence of hard surfaces such as the sides of buildings; and
- The time of day or night the works are undertaken.

7.7.5 At this stage, the final construction methods are not confirmed, therefore the worst case indicative construction noise levels have been based on information from other technically similar projects provided by the client and taken from published standards and AECOM archives.

i. Power Generation Plant

7.7.6 The Residential NSRs are located at a range of distances in different directions around the Project Site, where the Generation Equipment is to be installed. The closest residential NSRs are Cefn-betingau, located approximately 500 m to the east, and Abergelli Farm located approximately 600 m to the north-west of the Generating Equipment Site.

7.7.7 The predicted levels are given in Table 7-16 below.

Table 7-16: Predicted Construction Sound Levels $L_{Aeq,T}$

Location		Power Generation Plant
Cefn-betingau	NSR1	50
Felin Wen Farm	NSR2	46
Llwynhelig	NSR3	46
Maes-eglwys	NSR4	48
Lletty Morfil Farm	NSR5	45
Abergelli Farm	NSR6	48

7.7.8 The predicted indicative construction noise levels for the power generation plant are below the LOAEL level in Table 7-17. The sensitivity of all residential receptors is High as outlined in Table 7-14 and a magnitude of very low. So the significance of effects is predicted to be **Negligible** at all NSRs, and is therefore considered not significant.

ii. Gas Connection

7.7.9 Abergelli farm is located within 60 m of the closest part of the Gas Connection.

7.7.10 The predicted levels are given in Table 7-17 below.

Table 7-17: Predicted Construction Sound Levels $L_{Aeq,T}$

Location		Gas connection
Cefn-betingau	NSR1	45
Felin Wen Farm	NSR2	42
Llwynhelig	NSR3	43
Maes-eglwys	NSR4	46
Lletty Morfil Farm	NSR5	48
Abergelli Farm	NSR6	66

7.7.11 The predicted indicative construction noise levels for the Gas Connection were below the NOAEL level in Table 7-7, apart from at NSR 6 where a level just exceeding the LOAEL during the day time but significantly below the SOAEL is predicted. The sensitivity of all residential receptors is High as outlined in Table 7-14 and a magnitude of low or very low. So the significance of effects is predicted to be **Minor** or **Negligible** which is not significant at all NSRs.

iii. Electrical Connection

7.7.12 The Residential NSRs 4 and 5 are located close to the Electrical Connection.

7.7.13 The predicted levels are given in Table 7-18 below.

Table 7-18: Predicted Construction Sound Levels $L_{Aeq,T}$

Location		Electrical substation	Electrical cable	Electrical connection
Cefn-betingau	NSR1	40	41	33
Felin Wen Farm	NSR2	39	39	31
Llwynhelig	NSR3	42	41	33
Maes-eglwys	NSR4	48	48	40
Lletty Morfil Farm	NSR5	58	54	46
Abergelli Farm	NSR6	45	43	35

7.7.14 The sensitivity of all residential receptors is High as outlined in Table 7-14 and the predicted indicative construction noise levels for the Substation, cable and connections were below the LOAEL level in Table 7-7, so the significance of effects is predicted to be **Negligible** for the NSRs during the various construction phases. Therefore, this is considered to be not significant.

iv. Project Inter-relationship Effects

7.7.15 The in combination effects of all construction activities taking place simultaneously on each of the receptors are summarised in the table below.

Table 7-19: Predicted Construction Sound Levels $L_{Aeq,T}$

Location		Predicted in combination construction noise level levels L_{Aeq}
Cefn-betingau	NSR1	52
Felin Wen Farm	NSR2	49
Llwynhelig	NSR3	49
Maes-eglwys	NSR4	54
Lletty Morfil Farm	NSR5	60
Abergelli Farm	NSR6	66

7.7.16 The predicted indicative construction noise levels for three components of the Project were below the NOAEL level in Table 7-7, apart from at NSR 6. This was due to a very brief period during construction of the Gas Connection, which passes within 60 m of that NSR. As such, the significance of effects is predicted to be **Negligible** for the NSRs during the various construction phases.

v. General

7.7.17 It may be necessary for some project critical construction activities, such as concrete pours, to take place continuously over day, evening and night periods during peak construction times of the Project, although the exact nature of the works is unknown. SOAEL and LOAEL threshold values during non-weekday daytime periods have been defined in Table 7-7.

7.7.18 Comparison of the predicted daytime noise levels against the lower limit values for evening, weekend and night-time working indicate that there is a potential for minor/moderate adverse effects should work be undertaken outside daytime hours, which could be considered significant for a localised, temporary period. Therefore, construction activities taking place outside normal working hours will be avoided where possible. If they cannot be avoided, these events will be planned, managed and mitigated appropriately through the CEMP, so as not to exceed the SOAEL threshold values and reduce levels towards the LOAEL (or less) where practical. Provided the SOAEL threshold values are not exceeded, construction activities outside of normal working hours can be considered as having a **Minor Adverse** effect or less, and therefore not significant. Potential measures to ensure that appropriate mitigation is in place during the works have already been discussed in Section 7.5.

7.7.19 The level of impact at different receptors would be dependent upon a number of factors, including distance between the works and receptors, ground conditions, the nature and method of works required close to receptors and the specific activities being undertaken at any given time.

7.7.20 There are no residential receptors in close proximity to the Project to be significantly affected by construction vibration. However, there is the potential for some vibration impacts upon any buildings or structures close to the Project Site. Whilst it is considered unlikely that most typical construction working routines would generate levels of vibration above which building damage would be expected to be sustained (subject to final plant and working requirements).

7.7.21 Where piling, heavy earthworks, vibratory rollers or other significant vibration producing operations are proposed in close proximity to any existing sensitive buildings, further consideration would be given to potential impacts, once the contractor is appointed and the construction methods requirements are developed. It is not possible at this stage to evaluation what the vibration levels produced might be. The vibration limits set out in Section 7.3 would be included as part of the CEMP. As the construction of the Project is within the control of the Applicant, any identified issues can be effectively managed by the Applicant and their contractor(s). Potential measures to ensure that appropriate mitigation is in place during the works are described in Section 7.5.

b) Operation

7.7.22 The preferred configuration of the Project, including Generating Equipment is yet to be confirmed but will be within the Rochdale Envelope employed for the Project. Therefore, operational noise modelling has been undertaken for the indicative plant configuration outlined in **Chapter 3: Project and Site Description** in order to give a view of the noise levels that could be produced by the Generating Equipment. The predictions were undertaken based on all noise sources being located at the closest part of the Project Site within the Rochdale envelope parameters to each receptor and with no allowances for source directivity or on-site screening. This was to give a worst case within the Rochdale envelope.

7.7.23 Input L_W data was either provided by the potential suppliers or has been taken from AECOMs archive of data for similar installations. The sound power level data was provided for various source components. The typical source components included the following, although there were some minor differences in the data provided by each supplier:

- Gas turbine equipment enclosures and buildings
- Diffuser enclosure;
- Generator enclosure;
- Auxiliaries enclosure;
- Air duct;
- Air intake inlet;
- Air intake body;
- Stack body upstream silencer;
- Stack body downstream silencer; and
- Stack outlet.

7.7.24 Discussions were held with potential suppliers and the AECOM database of noise levels for similar projects was examined in order to identify the levels that can be

achieved by applying the noise control measures, sound power levels for each of the major sources. Based on that research the following levels were used:

- A sound power level of 98 dB L_{WA} from the stack in the direction of the receptors;
- A total sound power level of 96 dB L_{WA} from the Generating Equipment enclosures; and
- A sound power level of 90 dB L_{WA} from the fin fan cooler.

7.7.25 These levels can be achieved by extensive use of the mitigation measures described in **Chapter 3: Project and Site Description** during the detailed design.

7.7.26 The assessment described sets out the predicted impacts and effects associated with operation of the Project the operational assessment scenario which would be long-term).

7.7.27 The following assumptions have been made when undertaking the operational noise modelling to give a realistic worst case assessment:

- The Project would operate any time during the day or night;
- Noise levels provided by manufacturers for all principal noise emitting buildings/elements (air inlet filters, electrical buildings, transformers, workshops etc.) are understood to be external radiated SWL;
- Prediction methodologies were based on ISO 9613:2 assuming downwind propagation to each receptor. This negates effect of any screening by rolling ground and means that the sound pressure levels are determined by distance and air absorption; and
- Corrections for tonality, impulsivity, and intermittency have not been applied on the assumption that these potential features would be designed out of the Project during the detailed design phase by the selection of appropriate plant, building cladding louvres and silencers/attenuators. However, for the daytime BS 4142 assessment a +3 dB correction has been applied to the *specific noise levels* predicted from the Project Site on the basis that the noise emissions may be distinctive above the residual acoustic environment. This is considered conservative in the context of the prevailing noise environment, which includes road traffic, the existing electrical infrastructure and agricultural equipment.

7.7.28 It is currently understood that the operation of the Generating Equipment would be driven by the dynamics of the energy market; as a result the plant could run for short or longer periods, at any time of day, up to the maximum allowed under its Environmental Permit.

7.7.29 The predicted free-field operational *specific sound levels* at the NSRs around the Project Site are presented in Table 7-20.

Table 7-20: Predicted Operational *Specific Sound Levels* $L_{Aeq,T}$ – Power Generation Plant

Location		**Predicted *specific sound levels* L_{Aeq}**
Cefn-betingau	NSR1	35

Location		Predicted *specific sound levels* L_{Aeq}
Felin Wen Farm	NSR2	30
Llwynhelig	NSR3	31
Maes-eglwys	NSR4	32
Lletty Morfil Farm	NSR5	29
Abergelli Farm	NSR6	34

7.7.30 The nature of the predictions, which allow flexibility of plant location to produce a worst case at each receptor mean that exact predictions cannot be made at the site boundary line at this time. However, the calculations used to predict the levels at the receptors also indicate that the average level around the site boundary will be around 50 dB L_A with a maximum level of around 55 dB L_A. When final plant selections and locations have been set then a more detailed profile of the sound levels around the boundary can be predicted.

7.7.31 The daytime BS 4142 assessments results for receptors NSR1 – NSR6 are presented in Table 7-21. The values are the differences between the range of representative *background sound level* at each NSR and the predicted *rating level* (the specific sound level $L_{Aeq,T}$ plus a +3 dB correction for a potentially distinctive character). Positive values in the table indicate an excess of the *rating level* over the *background sound level* and negative levels indicate that the *rating level* is lower than the *background sound level*.

Table 7-21: BS 4142 Daytime Excess of Rating Over Background Sound Level

Location		Daytime background sound level L_{AF90}	Specific sound level L_{Aeq}	Rating level L_{Ar}	Excess of BS 4142 rating level over background sound level
Cefn-betingau	NSR1	41	35	38	-3
Felin Wen Farm	NSR2	40	30	33	-7
Llwynhelig	NSR3	43	31	34	-9
Maes-eglwys	NSR4	40	32	35	-5
Letty Morfil Farm	NSR5	39	29	32	-7
Abergelli Farm	NSR6	40	34	37	-3

Uncertainty: The survey information available to determine the 'representative' background sound level values was limited. Further baseline measurements will be undertaken in due course and presented in the ES.

7.7.32 The night-time WHO based assessment results for NSR1 – NSR6 are presented in Table 7-22.

Table 7-22: Changes to Ambient Sound Levels at Night

Location		Baseline ambient sound level (residual level) L_{Aeq}	Predicted Generation Equipment sound contribution (specific sound level) L_{Aeq}	Predicted total ambient sound level with proposed development L_{Aeq}
Cefn-betingau	NSR1	28	35	36
Felin Wen Farm	NSR2	27	30	32
Llwynhelig	NSR3	37	31	38
Maes-eglwys	NSR4	47	32	47
Letty Morfil Farm	NSR5	40	29	40
Abergelli Farm	NSR6	28	34	35

7.7.33 In accordance with Table 7-12 (magnitude of industrial noise during the day), the values in Table 7-21produce very low impact magnitudes at all six NSRs. This would result in a negligible significance of effect, and therefore are considered to be not significant in accordance with Table 7-6 and Table 7-14.

7.7.34 In accordance with Table 7-13 (magnitude of industrial noise at night) above, the values in Table 7-22 produce low impact magnitudes at NSRs 1, 2, 3, 5 and 6. This would result in minor adverse effects in accordance with Table 7-6 and Table 7-14 and is therefore considered not significant.

7.7.35 At NSR 4 and NSR 5 the *ambient sound levels* are unchanged by the addition of the sound from the Project. This is due to the high pre-existing ambient levels at that location. Based on the magnitude criteria in Table 7-13 the *ambient sound level* at NSR 4 both before and after inclusion of the Project produces a medium impact magnitude and therefore a moderate significance of effect due to the high pre-existing ambient levels at that location. However the predicted total ambient sound level at NSR 4 and 5 is unchanged by the additional sound from the Project, due to the high pre-existing ambient levels, therefore the impact of the scheme on the sound environment is negligible. The effect of the operation of the Generation Equipment is not significant.

i. Rochdale Envelope

7.7.36 The noise and vibration assessment has been undertaken with reference to the Rochdale Envelope (i.e. the maximum parameters for the Project and in particular its main buildings and structures). It is estimated that the potential variation in building locations and dimensions presented in **Chapter 3: Project and Site**

Description could result in a variation in predicted levels at the receptors of ± 1 dB at each location.

Table 7-23: Worst and Best Predictions of Operational Noise Effects

Location		Day		Night	
		Best	Worst	Best	Worst
Cefn-betingau	NSR1	Negligible	Negligible	Minor	Minor
Felin Wen Farm	NSR2	Negligible	Negligible	Minor	Minor
Llwynhelig	NSR3	Negligible	Negligible	Minor	Minor
Maes-eglwys	NSR4	Negligible	Negligible	Negligible[1]	Negligible[1]
Letty Morfil Farm	NSR5	Negligible	Negligible	Negligible[2]	Negligible[2]
Abergelli Farm	NSR6	Negligible	Negligible	Minor	Minor

1 *The contribution of the Project cannot be assessed at the target ambient sound levels are already exceeded by the existing ambient noise sources and the Development noise will not result in any change.*

2 *The Project makes no contribution to the ambient sound level therefore the development will not result in any change.*

7.7.37 The assessment of operational effects is based on the limits of deviation defined in **Chapter 3: Project and Site Description**, which constrains the design parameters of each element of the Project. As for construction, in any event mitigation would be integrated into the detailed design, where necessary, in order to achieve the appropriate noise levels.

7.7.38 The qualitative construction noise assessment was based on the worst-case assumption of activities occurring at the closest part of the relevant part of the Project Site to each receptor for each phase of construction.

c) Decommissioning

7.7.39 At this stage no information is available on the techniques and programme necessary for decommissioning.

7.7.40 However it is considered that the location, duration and nature of the operations associated with decommissioning will be similar to those necessary for construction. Therefore it is considered that the worst case indicative assessments presented for the construction would also apply to decommissioning.

7.8 Mitigation and Monitoring

7.8.1 As a general rule, additional mitigation measures have been proposed where a significant effect is predicted to occur. Embedded mitigation measures, which have been incorporated within the design of the Project or are standard practice measures that have been committed to are summarised in **Chapter 3: Project and Site Description.**

a) Construction

7.8.2 The qualitative assessment predicted that there is the potential for no more than minor adverse noise effects at residential NSRs during construction works. Therefore, no further specific mitigation or monitoring measures have been identified at this stage. If work is required outside normal working hours, additional management, controls and mitigation may be required as controlled through the CEMP.

b) Operational Noise

7.8.3 The noise assessment has demonstrated that noise effects as a result of the operation of the Project are not significant, and therefore no further mitigation or monitoring is proposed.

7.9 Residual Effects

7.9.1 The following tables present a summary of effects from the noise and vibration assessment. The table identifies the receptor/s likely to be impacted, the level of effect and, where the effect is deemed to be significant. The tables include the mitigation proposed and the resulting residual effect.

Table 7-24: Noise and Vibration Summary of Effects Arising during Construction Phase

Receptor	Description of Effect	Classification of effect	Additional Mitigation	Classification of Residual Effect	Significant / Not Significant
Project					
Abergelli Farm (NSR6)	Construction noise from the Project	Minor adverse	None	Minor	Not significant

Table 7-25: Noise and Vibration Summary of Effects Arising during Operational Phase

Receptor	Description of Effect	Classification of Effect	Additional Mitigation	Classification of Residual Effect	Significant / Not Significant
Power Generation Plant					
NSR 1-6	Operation of the Generation Equipment	Minor/Negligible	No further mitigation required	Minor/Negligible	Not significant

a) Project '"in combination" Effects

7.9.2 The predicted effects of the Project upon receptors to noise and vibration are limited to the power generation equipment (GT, ancillaries, cooling equipment, transformers etc.), Electrical Connection and Gas Connection and as such no significant effects are predicted from the Project.

7.10 Cumulative Effects

7.10.1 No receptors have been identified which could, potentially, experience cumulative effects generated by the construction, operational or decommissioning phases of the Project in combination with other schemes set out in **Chapter 4: Approach to Environmental Impact Assessment**.

7.11 References

Ref. 7.1 World Health Organization (1999) *Guidelines for Community Noise*

Ref. 7.2 World Health Organization (2009) *Night Noise Guidelines for Europe*

Ref. 7.3 International Standards Organization (1996) *ISO 9613-2 – Attenuation of Sound during Propagation Outdoors, Part 2: General Method of Calculation*

Ref. 7.4 International Standards Organization (2010) *ISO 4866:2010 – Vibration of Fixed Structures – Guidelines for the Measurement of Vibrations and Evaluation of Their Effects on Structures.*

Ref. 7.5 Her Majesty's Stationary Office (1990) *Environmental Protection Act 1990.*

Ref. 7.6 Her Majesty's Stationary Office (1974) *Control of Pollution Act 1974*.

Ref. 7.7 Her Majesty's Stationary Office (2016) *Environmental Permitting (England and Wales) Regulations 2016.*

Ref. 7.8 Environment Agency (2002a) *Integrated Pollution Prevention and Control (IPPC) H3 document Horizontal Guidance for Noise Part 2 - Noise assessment and Control.*

Ref. 7.9 Environment Agency (2002b) *Integrated Pollution Prevention and Control (IPPC) H3 document Horizontal Guidance for Noise Part 1 – Regulation and Permitting.*

Ref. 7.10 Department of Energy & Climate Change (2011) NPS EN-1 *Overarching National Policy Statement for Energy.*

Ref. 7.11 Noise Action Plan for Wales 2013-2018. Welsh Government.

Ref. 7.12 Planning Policy Wales (Edition 9 November 2016) Welsh Government

Ref. 7.13 Technical Advice Note (TAN) 11 Noise, Welsh Government 1997

Ref. 7.14 British Standards Institute (2014) *BS 8233 – Guidance on sound insulation and noise reduction for buildings*

Ref. 7.15 British Standards Institute (2014) *BS 4142 – Methods for rating and assessing industrial and commercial sound.*

Ref. 7.16 British Standards Institute (2014) *BS 5228-1:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites. Part 1: Noise.*

Ref. 7.17 British Standards Institute (2014) *BS 5228-2:2009+A1:2014 – 'Code of practice for Noise and Vibration control on construction and open sites. Part 2: Vibration.'*

Ref. 7.18 Department for Communities and Local Government (2012) *National Planning Policy Framework.*

Ref. 7.19 Department for Communities and Local Government (DCLG) (2014) *Planning Practice Guidance.*

Ref. 7.20 British Standards Institute (2003) *BS 7445-1 – Description and measurement of environmental noise. Guide to quantities and procedures.*

Ref. 7.21 British Standards Institute (1991) *BS 7445-2 – Description and measurement of environmental noise. Guide to the acquisition of data pertinent to land use.*

Ref. 7.22 British Standards Institute (2008) *BS 6472-1 – Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting.*

Ref. 7.23 British Standards Institute (1993) *BS 7385-2 – Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration.*

Ref. 7.24 Department of Transport/ Welsh Office (1998) *Calculation of Road Traffic Noise (CRTN).*

Ref. 7.25 Highways Agency (2011) *Design Manual for Road and Bridges Volume 11 Section 3 Part 7 HD213/11 (Revision 1) Traffic Noise and Vibration.*

Ref. 7.26 Swansea Urban Development Plan 2008

Ref. 7.27 Draft Swansea Local Development Plan 2010-2025 submitted 28 July 2017

Ref. 7.28 Peter Brett Associates *Millbrook Power Project – ES Chapter 7 Noise and Vibration* 2017