HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

6.2.21 ES Volume B - Introduction to the environmental assessments App B6-2 - Noise and Vibration Modelling and Assessment Methodology Report

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1 About this Report

1.1 Purpose and applicability

1.1.6 This Technical Note sets out the implemented approach to the modelling and assessment of noise and vibration effects on humans due to the Wylfa Newydd Project. Consideration of underwater noise and vibration effects is outside the scope of this report.

1.1.7 The scope is limited to the consents and permits required in order to construct and operate the Wylfa Newydd Power Station and associated infrastructure, and includes the consents required for Enabling Works (i.e. Site Preparation and Clearance). It does not, therefore, include modelling to support detailed engineering design except where there is an interaction with the consenting studies (such as Environmental Impact Assessment (EIA) mitigation).

1.1.8 Early versions of this Technical Note have formed the basis of detailed consultations with relevant stakeholders, in advance of formal applications for the Wylfa Newydd Project through the planning and environmental permitting systems. Stakeholders invited to comment on this Technical Note included the Environmental Health Officer of the Isle of Anglesey County Council (IACC) and officers from Natural Resources Wales (NRW). A previous version of this Technical Note was presented as an appendix to the Scoping Report submitted in 2016, and hence a wide variety of stakeholders have had the opportunity to comment on its contents. The Secretary of State welcomed the Technical Note, and requested it be updated and submitted as part of the Development Consent Order (DCO) application.

1.1.9 In section 2 of this Technical Note, the key elements of the Wylfa Newydd Project with the potential to generate noise and vibration emissions are described, and the relevant guidance documents concerning their modelling and assessment are summarised in section 3. An overview of the modelling process is also presented in section 3, along with a discussion of the tools available and comparison of alternatives. In section 4 to section 11, for each different group of noise or vibration sources, the following is presented:

- data input requirements;
- models run;
- overview of scenarios modelled;
- outputs generated;
- assessment methodology; and
- iterative approach to mitigation design and re-assessment.

1.1.10 The assessment methodologies focus on the assessment of potential effects on human receptors. The methodology for the assessment of potential effects on ecological receptors has been developed by appropriately experienced and qualified ecologists, although the assessments do use the model outputs described by this Technical Note. The exception to this is the noise modelling required to support the marine ecology seabird impact assessments contained in the Environmental Statement chapter D13 (the marine environment)

(Application Reference Number: 6.4.13) and the Habitats Regulations Assessment for the Power Station Site. Specific additional modelling has been requested by NRW to support the Habitats Regulations Assessment and these model adaptations and results are presented in appendix D13-13 (noise at Marine Ecological Receptors) (Application Reference Number: 6.4.95).

1.1.11 This Technical Note is based upon the best information available regarding the design of the Wylfa Newydd Project, and relevant policy and guidance documents. This Technical Note was first authored in 2014, in the early stages of the Wylfa Newydd Project EIA process. This current version of the document forms part of the DCO submission, and further updates are not envisaged.

1.2 Terms and definitions

Table 1-1 Terms and Explanations

Term	Explanation
Power Station Site	The indicative area of land and sea within which the majority of the permanent Power Station, Marine Works and other on-site development would be situated. It would include the two nuclear reactors, steam turbines, the Cooling Water System intake and pumphouse, outfall structures and breakwaters, as well as other ancillary structures.
Wylfa Newydd Development Area	The indicative areas of land and sea including the Power Station Site and the surrounding areas that would be used for the construction and operation of the WNDA Development. This area has been refined through the consultation process as Horizon developed a better understanding of the size and location of the areas that would be needed for construction activities and as the setting and features of the Power Station were finalised.
Associated Development	Works included in the DCO which facilitate the delivery of the Nationally Significant Infrastructure Project, and which include: the Site Campus; Park and Ride; Logistics Centre; and the A5025 Off-line Highway Improvements.
Off-site Power Station Facilities	Comprising the Alternative Emergency Control Centre, Environmental Survey Laboratory and Mobile Emergency Equipment Garage.

Term	Explanation
EIA	The process through which the likely significant effects of a development on the environment are identified and assessed.
Environmental Permit	A permit required under the *Environmental Permitting (England and Wales) Regulations 2016* for carrying out regulated activities. Environmental Permits must be sought from Natural Resources Wales in Wales and the Environment Agency in England.
L_{Aeq}	Energy Average Sound Level (or equivalent continuous sound level). The sound level of a steady sound having the same energy as a fluctuating sound over the same period. It is possible to consider this level as the ambient noise encompassing all noise at a given time. L_{Aeq} is considered the best general purpose index for environmental noise.
$L_{Aeq\ T}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "T" represents the time period to which the noise level relates. For example, LAeq 1hr is the LAeq level determined over a period of one hour.
L_{Amax}	Maximum recorded noise level during the measurement period.
$L_{A10\ T}$	This index represents the noise level exceeded for 10% of the measurement period (T), and is a widely used descriptor of road traffic noise. For example, $L_{A10\ 18\ hr}$ is the L_{A10} level determined over a period of 18 hours.
$L_{A90\ T}$	This index represents the noise level exceeded for 90% of the measurement period (T), and is used to indicate quieter times during the measurement period. It is usually referred to as the background noise level.

Term	Explanation
Noise emissions	Used to describe noise levels (and other characteristics of noise) generated by a noise source.
Noise immission	Used to describe the noise levels and other characteristics of noise received by a receptor.
Modelling	All calculation techniques that link noise or vibration emissions from sources, to noise or vibration immission levels at receptors.
Town and Country Planning Act	The Act that forms part of the land use planning regime in the UK and (among other things) establishes the legal framework in respect of applications for, and determination of, planning permissions. Associated Development, which has been identified so far, is subject to the *Town and Country Planning Act 1990* and will require the submission of separate planning applications.
DCO	The consent for a Nationally Significant Infrastructure Project required under Section 37 of the Planning Act 2008. The Wylfa Newydd Project is a Nationally Significant Infrastructure Project and its construction and operation are authorised by a DCO granted by the Secretary of State for Energy and Climate Change.

1.3 Responsible parties

1.3.6 The noise and vibration assessments required inputs from a number of responsible parties. These are summarised in table 1-2 below, along with a brief description of their roles.

Table 1-2 Responsible Parties

Responsible Party	Description
Horizon Nuclear Power Ltd (Horizon)	Horizon is a UK energy company developing two new nuclear power stations in the UK; it is a wholly owned subsidiary of Hitachi Ltd. Horizon has been responsible for supplying certain elements of the input data required.
Hitachi-GE-Nuclear Energy Ltd	Hitachi-GE-Nuclear Energy Ltd is the reactor provider and would lead the design, equipment provision and build of the main plant. Hitachi-GE-Nuclear Energy Ltd has provided (via Horizon) some technical input data required.
Jacobs UK Ltd	Consultants appointed by Horizon to undertake the EIA and support the Environmental Permit applications for the Wylfa Newydd Project and Associated Development.
The IACC	The IACC is the Local Planning Authority responsible for determining the planning applications made under the *Town and Country Planning Act 1990*, and is a key consultee for the DCO. The IACC would be responsible for the regulation of all land-based construction activities for the Wylfa Newydd Project, and for the regulation of all aspects not subject to an Environmental Permit.
NRW	NRW will determine the Environmental Permit applications, and will have responsibility for the regulation of those operational activities covered by the Permits. Where relevant, NRW will determine any Marine Licence applications.

2 Introduction

2.1 Project description

2.1.6 The *National Policy Statement for Nuclear Power Generation EN-6* [RD1] identifies the proposed site at Wylfa (and seven other sites) as potentially suitable for deployment of a new nuclear power station by the end of 2025. Horizon is currently planning to develop a new nuclear power station in the Wylfa Newydd Development Area, to deliver at least 2,700 megawatts of electricity, enough power for around five million homes.

2.1.7 The Wylfa Newydd Project includes the Power Station and Associated Development. The Power Station includes two UK Advanced Boiling Water Reactors (UK ABWR) to be supplied by Hitachi-GE Nuclear Energy Ltd, associated plant and ancillary structures and features including steam turbines, control and service buildings, operational plant, radioactive waste storage buildings, ancillary structures, offices and coastal developments. The coastal developments would include a Cooling Water System (intake and outfall) and breakwater, and a Marine Off-Loading Facility (MOLF).

2.1.8 Associated Development required to support delivery of the Power Station includes highways improvements along the A5025, park and ride facilities at Dalar Hir, a Logistics Centre and Site Campus.

2.1.9 There are four main stages in the lifetime of the Power Station:

- Stage 1: Enabling Works;
- Stage 2: Main Construction;
- Stage 3: Full Operation; and
- Stage 4: Decommissioning.

2.1.10 Noise and vibration emissions may arise within all of these stages, for example by the use of mobile plant such as excavators and bulldozers during Stage 2, and by the use of static plant items required during the operation of the Power Station in Stage 3. All of the stages have the potential to result in changes in road and marine traffic.

2.1.11 The Wylfa Newydd Project has required a number of applications to be made under different legislation to different regulators. As a Nationally Significant Infrastructure Project under the *Planning Act 2008*, the construction and operation must be authorised by a DCO. Planning permissions for other parts of the Wylfa Newydd Project, as well as Marine Licences, Environmental Permits and regulatory licences such as a Nuclear Site Licence, have also been required.

2.1.12 A phased approach to the modelling has been undertaken which reflects the evolution of the project design and availability of information at different stages of the Wylfa Newydd Project. Modelling has been undertaken using the best available information at the time of the modelling work being undertaken, and includes input from the design process, relevant new guidance and consultation feedback. As design and operating decisions have been made, and data became available, this information was fed into the modelling work

in order that the modelling outputs reflect as closely as possible the as-built, as-operated Power Station and Associated Development.

2.2 Scope

2.2.6 The Enabling Works, construction and operation of the Power Station and Associated Development have the potential to result in noise and/or vibration emissions from mobile plant and machinery, fixed plant and machinery and road and marine traffic. These emissions have the potential to affect the quality of life enjoyed by individuals and communities, and also affect protected and designated ecological habitats.

2.2.7 This Technical Note documents the data collection, modelling, and assessment required to support the consent. It should be noted however, that additional data collection and modelling have been undertaken to support the Habitats Regulations Assessment only, and this is detailed in appendix D13-13 (Application Reference Number: 6.4.95).

2.2.8 The scope of works is limited to the consents and permits required to construct and operate the Power Station and Associated Development. For each modelling requirement the necessary modelling activity is described.

2.2.9 The scope of this report does not include modelling to support engineering design except where there is an interaction with the consenting studies (such as EIA mitigation).

3 Overview

3.1 Policy and guidance

3.1.6 National, regional and local policies, in addition to other guidance documents relating to noise and vibration, have been used to inform the scope of the noise and vibration assessment, and to inform the selection of appropriate modelling and assessment methodologies.

3.1.7 The relevant national and local plans and policies, and how these relate to the noise and vibration assessment, are described in table 3-1 below.

Table 3-1 Summary of key policy

Policy	Description
Overarching National Policy Statement for Energy EN-1 [RD2]	This National Policy Statement (NPS), designated by the Secretary of State in July 2011, sets out the overarching national policy for delivery of major energy infrastructure projects. It sets out factors likely to influence effects from noise, the requirements of a noise assessment and general advice on mitigation measures.
National Policy Statement for Nuclear Power Generation EN-6 [RD1]	This NPS, designated by the Secretary of State in July 2011, sets out national policy on new Nuclear Power Stations identified as potentially suitable for deployment by 2025. It acknowledges that the operation of a new Nuclear Power Station is unlikely to lead to significant noise and vibration effects. However, it does note that greater impacts may occur from construction and transport activities, or if cooling towers (especially forced draught towers) are required. This NPS also states that "*With appropriate mitigation, the subsequent effect of these potential impacts on human health is unlikely to be significant*".
Planning Policy Wales (Edition 9) [RD3]	This document sets out the land use planning policies of the Welsh Government, forming a strategic framework to guide development. It acknowledges that noise can be a material planning consideration, sets an objective for noise policies to minimise noise emissions and reduce ambient noise levels to an acceptable standard, and recommends that development plan policies should ensure potentially noisy developments are located in areas where effects can be minimised.
A Noise Action Plan for Wales 2013-2018 [RD4]	This plan details environmental noise action plans required by European Regulations, and information on Wales-wide policies on noise not covered by those Regulations.

Policy	Description
Technical Advice Note 11: Noise [RD5]	Technical Advice Note 11 (TAN11) seeks to minimise the adverse impact of noise without placing unreasonable restrictions on development. It states that noise-generating development should not cause an unacceptable degree of disturbance (para 8). It reiterates the mitigation measures outlined in the Overarching National Policy Statement for Energy (EN-1) [RD2]. TAN11 encourages early engagement with relevant authorities to discuss mitigation measures that can be incorporated into the design.
Minerals Technical Advice Note Wales 1: Aggregates (MTAN1) [RD6]	This Technical Advice Note sets out measures, including noise and vibration limits, to reduce the effects from quarrying and similar activities. The earthworks included in the Wylfa Newydd Project have some similarities with quarrying activities.
Minerals Planning Guidance 11: The Control of Noise at Surface Mineral Workings [RD7]	This guidance provides advice on "*how planning controls and good environmental practice can be used to keep noise emissions to environmentally acceptable levels*". Some parts of this document have been superseded by MTAN1, whilst other parts remain extant for Wales.
IACC and Gwynedd Council Joint Local Development Plan 2011 – 2026, Written Statement (2017) [RD8]	The Joint Local Development Plan (JLDP) covers the local authorities of the IACC and Gwynedd Council and forms the basis for land use planning in these areas. The JLDP covers the period 2011 to 2026. The policies of relevance to the noise assessment include: • Policy PS 9 relates to Wylfa Newydd and Related Development. It sets out a number of criteria that the Council will take into consideration in preparing their Local Impact Reports, including that: The burden and disturbance borne by the community in hosting a major national or regional nuclear related infrastructure project should be recognised; and appropriate packages of community benefits provided by the developer will be sought to offset and compensate the community for the burden and disturbance imposed by hosting the project. • Policy PCYFF 2(Development Criteria) relates to planning applications and states consent will be refused where the proposed development

Policy	Description
	would have an unacceptable adverse impact on (among others): "*7. The health, safety or amenity of occupiers of local residences, other land and property uses or characteristics of the locality due to increased activity, disturbance, vibration, noise, dust, fumes, litter, drainage, light pollution, or other forms of pollution or nuisance;*" • Policy ADN 3 (Other Renewable Energy And Low Carbon Technologies) states: "*Proposals for renewable and low carbon energy technologies, other than wind or solar, which contribute a low carbon future will be permitted, provided that the proposal conforms to the following criteria: […]* *3. That the proposal is mitigated to ensure that there aren't any significant unacceptable effects on sensitive uses located nearby;"* • Policy AMG 4 (Coastal Protection) highlights a need to ensure that proposals on the coast do not cause unacceptable harm to the area's biodiversity interests due to noise (amongst other factors). • Policy GWA 2 (Waste Management And Allocated Sites) is applicable to a range of waste facilities, including for low level radioactive waste. This Policy requires that such facilities should not result in unacceptable disturbance to local communities through noise or vibration. • Policy MWYN 3 (Mineral Developments): Mineral Developments highlights a need for mineral exploration, working or extension to cause no unacceptable harm to the amenity or health of local residents in terms of noise and vibration.
New Nuclear Build at Wylfa: Supplementary Planning Guidance [RD9]	The purpose of this Supplementary Planning Guidance is to provide advice on important local matters relating to the proposed Wylfa Newydd Project and its Associated Development and to set out the IACC's response to national and local policy and strategies in the context of the Wylfa Newydd Project. The Supplementary Planning Guidance is designed to be consistent with considerations in the Joint Local Development Plan (discussed above). The Supplementary Planning Guidance also

Policy	Description
	highlights some of the readily identifiable potential impacts of the Wylfa Newydd Project and outlines potential mitigation and enhancement measures to ensure that significant adverse effects are avoided or are minimised where possible. The document sets out a number of 'guiding principles' to support the delivery of the defined visions and objectives. Guiding principle 7 refers to Associated Development and potential noise effects and planning conditions that may be imposed to control them. Guiding principle 26 relates to the Power Station Site and includes a requirement for the developers to assess measures to reduce noise-related effects.
Ynys Môn Local Plan [RD10]	The Ynys Môn Local Plan covered the period from 1991 to 2001 and set out policies to support the broader framework of the Gwynedd Structure Plan. It contained a policy for renewable energy developments, but did not consider new nuclear power. Policy 1: General Policy states that in evaluating planning applications, the Council will consider pollution and nuisance problems.
Gwynedd Structure Plan [RD11]	The Plan provided strategic guidance for development on Anglesey from 1991 to 2006, and does not therefore consider new energy-related development, such as the Wylfa Newydd Project. Policy D20 states there would be a presumption against proposals that introduce a major noise or vibration nuisance.
Stopped Unitary Development Plan [RD12]	The Unitary Development Plan recognises the need to respond to the changes in energy generation, stating "There is a need to plan appropriately for energy generation in the light of issues around new power stations; the closure process that will eventually affect Wylfa nuclear power station and the emergence of new wave energy and renewable technologies" (p.9). Infrastructure Policy SG7 Noise states that development will not be permitted when the level of noise generated does not meet relevant standards (BS4142 [RD13], BS5228 [RD14], TAN11 [RD5]) and would be detrimental to amenity of adjacent users.

3.1.8 The noise and vibration assessment has been undertaken in line with a number of key technical guidance documents. These guidance documents are widely

used across the UK and represent standard good practice for the assessment for the various consenting regimes. These are summarised in table 3-2 below.

Table 3-2 Summary of key guidance

Guidance	Description
British Standards	
BS4142:2014 Methods for rating and assessing industrial and commercial sound [RD13]	Methodology for rating and assessing the effects of new or existing sound sources on people inside or outside dwellings or other residential properties.
BS5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Noise [RD14]	This Code of Practice provides guidance on the assessment and control of noise on construction sites, along with guidance on acceptable noise levels.
BS5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Vibration [RD15]	This Code of Practice provides guidance on the assessment and control of vibration on construction sites, along with guidance on acceptable vibration levels.
BS6472:2008 Guide to evaluation of human exposure to vibration in buildings [RD16]	Sets out guidelines for assessing blast-induced and non-blast-induced vibrations in two separate parts.
BS7445:2003 Description and measurement of environmental noise [RD17]	Contains guidance of relevance to baseline measurements.
BS8233:2014 Guidance on sound insulation and noise reduction for buildings [RD18]	Includes guideline values for noise levels within domestic homes and other building uses.
BS EN 12354-3:2017 Building acoustics: estimation of acoustic	Specifies a calculation model to estimate the sound insulation or the sound-pressure level difference of a façade.

Guidance	Description
performance of buildings from the performance of elements. Airborne sound insulation against outdoor sound [RD19]	
BS EN 12354-4:2017 Building acoustics: estimation of acoustic performance of buildings from the performance of elements. Transmission of indoor sound to the outside [RD20]	Describes a calculation model for the sound power level radiated by the envelope of a building due to airborne sound inside that building.
Other guidance documents	
Acoustic design of schools: performance standards. Building bulletin 93 [RD21]	These standards define suitable indoor ambient noise levels for a number of different educational activities and environments.
Acoustics of Schools: a design guide [RD22]	Accompanies building bulletin93 and provides professional guidance and recommendations on achieving suitable indoor and external ambient noise levels.
Calculation of Road Traffic Noise (CRTN) [RD23]	The CRTN document presents a methodology for the prediction of road traffic noise from road traffic flow and other data.
Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment Section 3, Part 7 Noise and Vibration [RD24]	The DMRB contains advice on the assessment of noise and vibration from road traffic, particularly that from new/altered roads.
Guidelines for Community Noise [RD25]	Provides guideline noise levels for community noise in specific environments, e.g. outdoor living areas and outside bedrooms.
Night Noise Guidelines for Europe [RD26]	Reviews health effects associated with exposure to night-time noise and recommends noise guideline values.
Guidelines for Environmental Noise	Guidelines setting out key principles and advice on noise impact assessments, acknowledging that

Guidance	Description
Impact Assessment [RD27]	impact assessment methodologies should be specific to each project.
Horizontal Guidance for Noise Part 2 - Noise Assessment and Control [RD28]	Contains guidance issued by the Environment Agency on noise assessment for Environmental Permits and to assist in determining the 'best available technique' for an installation. Confirmed by NRW as applicable to the Wylfa Newydd Project.
Noise impact assessment: information requirements [RD29]	Sets out the information requirements for Environmental Permit applications that include noise modelling or spreadsheet calculations. Confirmed by NRW as applicable to the Wylfa Newydd Project.
ISO 9613-2:1996. Acoustics – Attenuation of sound propagation outdoors – Part 2: General method of calculation [RD30]	ISO 9613 is established as the primary standard used in the UK and much of Europe for the calculation of environmental sound propagation.
Procedure for the assessment of low frequency noise complaints. Contract no. NANR45. Revision 1 [RD31]	Aims to assist Environmental Health practitioners to distinguish cases of complaint where a low frequency environmental sound could account for the reported disturbance.

3.2 Emission sources

3.2.6 The 2016 EIA Scoping Report identified the following possible sources of noise and vibration emissions during activities included in the DCO application (associated with the Power Station Site, wider Wylfa Newydd Development Area, or the Off-site Power Station Facilities):

- Construction activities:
  - Operation of machinery and mobile plant such as excavators, earth-movers, tipper trucks, pneumatic breaking equipment, generators, compressors, pumps, rock crushers, a concrete batcher, mobile cranes, piling plant and dredgers.
  - Rock fracturing to facilitate the excavation of rock in excavation and dredging areas within the Wylfa Newydd Development Area. It is likely that fracturing would be undertaken using blasting methods similar to those commonly employed by the mineral extraction industry.
  - Transportation of personnel, materials and equipment to and from the site(s) on the public highways.

  - Transportation of materials and equipment to and from the Power Station Site via marine vessels.
- Operational activities:
  - Operation and testing of machinery such as transformers, turbine generator units and pumps at the Power Station Site; and ventilation systems and emergency generators at both the Power Station Site and some Off-site Power Station Facilities.
  - Maintenance tasks including dredging.
  - Transportation of personnel, materials and equipment to and from the site(s) on the public highways.
  - Transportation of materials and equipment to and from the Power Station Site via marine vessels.
- Decommissioning activities:
  - Operation of machinery and mobile plant such as excavators, earth-movers, tipper trucks, pneumatic breaking equipment, generators, compressors, pumps, rock crushers, mobile cranes.
  - Transportation of personnel, materials and equipment to and from the site(s) on the public highways.
  - Transportation of materials and equipment to and from the Power Station Site via marine vessels.

3.2.7 No operational sources of vibration within the Power Station Site have been identified as likely to have an effect at sensitive receptors, due to the availability and common usage of anti-vibration mounts for vibration generating machinery and plant. In addition, vibration effects from static plant would not normally be expected at receptors which are in the order of several hundred metres away from the Site.

3.2.8 The modelling and assessment methodologies relevant to each of the above sources have been identified. Note that similar methodologies apply to more than one noise or vibration source identified above, and hence the potential sources have been grouped together, e.g. the modelling and assessment methodologies in BS5228-1:2009+A1:2014 [RD14]; and BS5228-2:2009+A1:2014 [RD15] are relevant to aspects of both the Enabling Works and construction activities. The potential noise and vibration sources have been grouped into the following topics for the remainder of this report:

- construction and earthworks noise;
- construction and earthworks vibration;
- Power Station operational noise;
- road traffic noise and vibration; and
- ship emissions.

3.2.9 The above noise and vibration sources and topics are focused on the Power Station Site. However, many aspects e.g. construction noise are relevant to the Associated Development. The same modelling and assessment methodologies have been used for the Power Station Site and Associated

Development. Some additional noise sources specific to certain aspects of Associated Development have also been identified, for example the Park and Ride at Dalar Hir, and these are described fully in the 'other noise sources' section. In addition, a number of 'site suitability' assessments have been undertaken to assess the aspects of the proposals which comprise noise and vibration sensitive development e.g. Site Campus.

3.2.10 The modelling and assessment methodologies for cumulative effects are also included.

3.2.11 Table 3-3 presents these topics and their relevance to the various consents.

Table 3-3 Planning and Permitting Topics

Activity/process to be modelled	EIA	Environmental Permit	Habitats Regulations Assessment
Construction and earthworks noise	✓	X	✓
Construction and earthworks vibration	✓	X	✓
Power Station operational noise	✓	✓*	✓
Road traffic noise and vibration	✓	X	✓
Ship noise	✓	X	✓
Other noise sources	✓	X	✓
Site suitability	✓	X	X

* For sources associated with the permitted activities only

3.3 Receptor identification

3.3.6 The construction and operational noise and vibration assessments include consideration of the following sensitive receptors near the Wylfa Newydd Development Area and Associated Development:

- human receptors – when present at dwellings, schools, hospitals, places of worship, recreational areas (land- and sea-based), or other noise-sensitive locations;
- ecological receptors – within land-based areas designated for protected species (fauna only) and in the marine environment; and
- infrastructure receptors – historic such as Listed Buildings and Registered Parks and Gardens, and contemporary such as the Existing Power Station and statutory or other underground services.

3.3.7 As detailed by the Preliminary Environmental Information Report [RD32], the topic study area for the Power Station Site has been based on a buffer zone approximately 600m from the boundary of the Wylfa Newydd Development Area. The topic study area has been identified using professional judgement and the DMRB [RD24], as there is no current authoritative guidance on how far a noise study area should extend from the construction activities or operational noise sources.

3.3.8 For the Associated Development and Off-site Power Station Facilities, initial buffer zones approximately 600m from each of the site boundaries have been used as their respective study areas.

3.3.9 Whilst construction and operational noise may be audible at distances in excess of 600m, this topic study area is large enough to encompass the nearest noise-sensitive receptors, which have been used to classify the magnitude of any effects. Based on the noise impact assessment of receptors within 600m, consideration has been given to the likelihood of significant effects outside the topic study area and the area extended where necessary. Local Development Plans have been reviewed in order to identify any potential new receptors within the study area.

3.4 Baseline

3.4.6 The noise and vibration assessments make reference to a number of different baseline scenarios. These are specific to each assessment, but generally fall within the following categories:

- Existing baseline – existing conditions which occur during the assessment process, i.e. prior to submission of the relevant planning or permitting application. There can be two types of existing baseline:
  - measured baseline – determined by noise or vibration measurements at locations representative of conditions experienced by the identified sensitive receptors; and
  - modelled baseline – determined by calculation e.g. for road traffic noise this would be calculated based on the relevant number of traffic movements and other input parameters.
- Future baseline – conditions predicted to occur at a specified date in the future, in the absence of the Wylfa Newydd Project being assessed. Clearly, measurements of future baselines are not possible; hence all future baselines are modelled baselines.

3.4.7 Comparison of modelled assessment results with modelled baselines enables the change due to the development to be clearly established.

3.4.8 Noise-sensitive receptors in Tregele, Cemaes and the more sparsely populated area to the south and west of the Wylfa Newydd Development Area are likely to be most affected by noise and vibration associated with construction and operational activities at the Power Station Site. The land within and around the Wylfa Newydd Development Area is undulating and characterised by drumlin topography with nearby properties generally having a partial view of the Power Station Site. Topography would influence both baseline and future noise levels experienced by noise-sensitive receptors.

3.4.9 A noise survey was undertaken on behalf of Horizon in the vicinity of the Wylfa Newydd Development Area in 2010. The 2010 baseline noise survey indicated that noise levels near the Power Station Site were dominated by local and distant road traffic, noise generated by the passage of wind in vegetation and trees and some noise from the Existing Power Station. Noise from the National Grid transformer adjacent to the Existing Power Station includes

'audible tonality' (transformer hum), which has been the subject of some adverse community response in the past. This transformer has remained even thoughthe Existing Power Station has ceased electricity generation. The extent of the contribution of each of these noise sources will vary with weather conditions.

3.4.10 Two sets of subsequent measurements have been undertaken; the first set was taken by the IACC in 2012, and the second set taken on behalf of Horizon in 2014.

3.4.11 The 2014 baseline survey [RD33] was discussed and agreed with the IACC and NRW, and comprised continuous noise measurements for a minimum of four weeks at six locations around the Wylfa Newydd Development Area, namely:

- Tre'r Gof Isaf, east of the Wylfa Newydd Development Area;
- 10 Maes Capel, Cemaes;
- Bron Wylfa, Ffordd Caergybi (A5025);
- Ysgubor Ddegwm, Tregele;
- Maen y Bugail, Cemlyn Road west of the Wylfa Newydd Development Area; and
- Hafnan, Nanner Road, south-west of the Wylfa Newydd Development Area.

3.4.12 The equipment was deployed on 30 September 2014 at five of the locations and on 13 October at the remaining location, Bron Wylfa, due to delayed access arrangements.

3.4.13 An additional location near the Wylfa Newydd Development Area was monitored in 2015 in response to a change in the access arrangements at one of the properties south of the Wylfa Newydd Development Area.

3.4.14 Additional noise measurements have been taken to establish the existing baseline noise levels near the Associated Development sites. The noise monitoring locations and methodologies were discussed and agreed with the IACC. Further details are presented in appendix B6-1 (baseline noise monitoring) (Application Reference Number: 6.2.20).

3.5 Common elements of modelling and assessment methodologies

Noise modelling and deliverables

3.5.1 Noise modelling is commonly undertaken by either spreadsheet-based techniques, or by commercially available computational noise modelling software packages. Both spreadsheets and software packages can implement recognised British and International Standard noise calculation methodologies. The software packages enable a greater number of noise sources and receptors to be considered in a more efficient manner and are therefore less labour-intensive. Hence software packages are commonly used

to evaluate the noise effects of complex projects such as the Wylfa Newydd Project.

3.5.2 A number of noise modelling software packages are commercially available and in common use in the UK, as detailed in table 3-4.

Table 3-4 Noise modelling software packages

Software	Company	UK Distributor	Comments
CadnaA	DataKustik, Germany	Campbell Associates	Used in over 60 countries. Used for European noise mapping projects. Used for Hinkley Point C. Used by Environment Agency (England)
LimA	Stapelfeldt Ingenieurgesellschaft mbH, Germany	-	Used for European noise mapping projects.
SoundPLAN	Braunstein and Berndt GmbH, Germany	Sound Plan UK&I	Used in over 50 countries. Used for German rail network mapping.
NoiseMap	NoiseMap Ltd, UK	NoiseMap Ltd	Used for High Speed 2, Channel tunnel rail link.
IMMI	Woelfel, Germany	PC Environmental Ltd	-

3.5.3 All of the above software packages have been designed to implement the calculation methodologies (detailed in section 4.3 to section 9.3) in accordance with the relevant British or International Standards. CadnaA has been selected as the noise modelling software for the Wylfa Newydd Project due to its widespread use and proven track record on numerous infrastructure, industrial and construction projects, including the new nuclear build at Hinkley Point C. Furthermore, its use was approved by both the IACC and NRW during a meeting held on 1 September 2014.

3.5.4 The CadnaA software allows a 3-dimensional environmental model to be constructed using digital mapping and topographic data. As part of this assessment, 3-dimensional models have been constructed for the current and future baseline years and for each relevant phase of the development(s) using data obtained from Ordnance Survey and Horizon. This has allowed the assessments to incorporate changes in the topography of the site(s) and surroundings, as well as changes in the location, nature and characteristics of noise sources. The noise models also include embedded and proposed noise

mitigation measures, such as the earth bund at the perimeter of the Power Station Site adjacent to Tregele.

3.5.5 Spreadsheets have been used to process input data for use in the construction and road traffic CadnaA models produced.

Vibration modelling and deliverables

3.5.6 Spreadsheet techniques, implementing national or international calculation standards, are commonly used for the modelling and prediction of vibration effects at the planning/permitting stage, due to the lower number of sources and receptors considered when compared to noise assessments.

3.5.7 The prediction of vibration propagation through the ground is complex, and for a detailed analysis the following factors should be considered.

- Vibration propagation occurs as compression waves, shear waves, surface waves, bending waves or torsional waves, either separately or together.
- The propagation of bending waves in particular is frequency-dependent.
- Propagation may occur in different media simultaneously, for example through the water contained in porous rock and the rock itself.
- Viscosity, hysteresis and relaxation effects all contribute to damping of vibration, and not all of these effects are well understood.
- The soils, rock and structures through which vibration may propagate are often not homogeneous.

3.5.8 As a result of these factors, the accurate prediction of vibration propagation requires complex computational models populated with detailed input data, and this process is beyond the scope of a vibration assessment at this stage of project evolution. Instead, simple empirical prediction methods have been used in conjunction with basic data on equipment and ground composition. These empirical prediction methods have a tendency to overestimate vibration levels and hence provide a conservative method of establishing potential vibration magnitude.

3.5.9 The vibration modelling deliverables are predictions of vibration magnitudes at selected receptors.

Assessment methodology and deliverables

Receptor sensitivities and significance

3.5.10 In developing the site-specific significance criteria, reference has been made to the Institute of Environmental Management and Assessment Guidelines on Noise Impact Assessment [RD27]. The noise and vibration assessments consider both the sensitivity of the receptors and the magnitude of the effect.

3.5.11 The existing (or future) baselines, perceptibility of change in noise levels and relevant benchmarks have been taken into account in forming numerical assessment criteria specific to each topic and site.

3.5.12 The EIA Regulations require the significance of each potential effect to be determined; however, many of the assessment criteria presented in the guidance documents referred to in table 3-2 are not directly related to the categories of 'significant' and 'not significant' that underpin EIA.

3.5.13 The determination of significance in EIA is based on the sensitivity of a particular receptor (which depends on local circumstances and the type of receptor), as well as the magnitude of noise or vibration effect. The concept of receptor sensitivity is also acknowledged by guidance relevant to the Environmental Permit.

3.5.14 With respect to the sensitivity of receptors, TAN11 [RD5] focuses on residential properties as being noise-sensitive, although it does cite developments such as offices, hospitals and schools as containing buildings and activities that are potentially noise-sensitive. TAN11 does not differentiate between these uses in terms of the degree of sensitivity to noise; however, the World Health Organisation (WHO) guidelines [RD26] do introduce such a concept.

3.5.15 The significance evaluation methodology that has been developed for the Wylfa Newydd Project recognises that receptors have differing sensitivities to noise. For example, patients in hospitals, hospices or other healthcare facilities represent the receptors with the highest sensitivity to noise. The WHO guidelines [RD26] state that "*patients have less ability to cope with stress*" and identifies people with particular diseases, medical problems and people in hospitals as "*vulnerable subgroups*". At the other end of the scale, occupants of many commercial and industrial premises would normally be considered to be of a low sensitivity, recognising that these premises are often considerable sources of noise and vibration themselves.

3.5.16 The determination of significance has also taken into account the duration and frequency of occurrence of the noise effect, as well as the time of day or night at which it occurs. For example, a particular noise level considered to result in significant effects if it is due to a permanent noise source which operates frequently for long durations may be considered to result in no significant effects if it occurs infrequently for short periods. Similarly, a noise level which is considered to result in no significant effects if it occurs during normal working hours of a weekday, may be considered to result in significant effects if it occurred on a Sunday evening.

3.5.17 The Environmental Permit assessment presents an assessment of the noise and vibration effects of the applicable activities against the Best Available Technique principles.

Assessment criteria

3.5.18 There are a number of guidance documents which are relevant to the assessment of noise from any type of noise source, since they present benchmark noise criteria. Relevant guidance documents and criteria are discussed below.

BS8233:2014

3.5.19 BS8233 [RD18] contains guidance and acoustic design criteria for regulators and developers to reference during the construction or redevelopment of different occupied buildings. Amongst other information, the standard provides internal noise recommendations which represent acceptable living or working environments, and external area amenity criteria.

3.5.20 Table 3-5 presents the BS8233 [RD18] design criteria for residential dwellings.

Table 3-5 BS8233 design criteria for residential dwellings

Activity	Location	07.00 to 23.00	23.00 to 07.00
Resting	Living room	35dB $L_{Aeq,16hr}$	-
Dining	Dining room/area	40dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq,16hr}$	30dB $L_{Aeq,8hr}$

3.5.21 In terms of non-residential buildings, the standard also sets out acceptable internal noise standards, as detailed in table 3-6. However, for internal standards within schools the document references specific guidance produced by the Department for Education.

Table 3-6 BS8233 Design criteria for non-residential dwellings

Activity	Location	Design Range dB $L_{Aeq,T}$
Speech or telephone communications	Department store, cafeteria, canteen, kitchen	50 – 55
	Concourse, corridor, circulation space	45 – 55
Study and work requiring concentration	Library, gallery, museum	40 – 50
	Staff meeting room, training room	35 – 45
	Executive office	35 – 40
Listening	Place of worship, counselling, meditation, relaxation	30 – 35

3.5.22 Although BS8233 [RD18] is not meant specifically as an assessment guideline for new noise sources, the levels detailed within it can be used to indicate the level of effect within different types of building from different noise sources.

WHO guidelines for community noise

3.5.23 This WHO document [RD25] states that, in dwellings, the critical effects of noise are on sleep and speech interference. According to this document, to protect the majority of people from being seriously annoyed during the daytime, the sound pressure level in outdoor living areas should not exceed

55dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50dB L_{Aeq}.

3.5.24 To avoid sleep disturbance, indoor guideline values for bedrooms are 30dB L_{Aeq} for continuous noise and 45dB L_{Amax} for single-sound events. These indoor noise levels correspond to sound pressure levels at the outside façades of the living spaces of 45dB L_{Aeq} and 60dB L_{Amax}. These values have been obtained by the WHO assuming that the noise reduction from outside to inside with the window partly open is 15dB.

WHO night noise guidelines for Europe

3.5.25 The 2009 WHO publication *Night Noise Guidelines for Europe* [RD26] reviews the scientific evidence on the health effects of night-time noise exposure, and presents derived health-based guideline values. The guidelines present a night noise guideline of 40dB $L_{night\ (outside)}$ and an interim target of 55dB(A) aimed at situations where the 40dB(A) target is not achievable for various reasons. It should be noted that these guidelines are applicable to WHO European Region Member States. Furthermore, the guideline value is expressed as a yearly average, and hence occasional exceedances should not necessarily be interpreted as likely to result in harmful effects.

Iterative approach and mitigation

3.5.26 The noise and vibration assessments have implemented an iterative approach. This has ensured that identified issues have been resolved at the earliest opportunity, and allowed effective mitigation to be incorporated into the design. The mitigated design has then been reassessed, and the need for any further mitigation measures determined.

4 Construction and earthworks Noise

4.1 Scope

4.1.6 The construction and earthworks noise sources include items of mobile plant such as excavators, bulldozers, dump trucks, which would be in use during the following project activities:

- Enabling Works including Site Preparation and Clearance, for example demolition of selected existing structures, service diversions, and vegetation clearance;
- all bulk earthworks required to form the development platform and landscape mounding;
- construction of coastal development (including dredging activities);
- construction of the Power Station and supporting onshore infrastructure;
- construction of Off-site Power Station Facilities; and
- construction of Associated Development.

4.1.7 Baselines have been determined by measurement for the assessment of construction activities. A number of phases of work have been modelled for each assessment. The 'with development' models predict realistic worst-case noise levels at each group of receptors for the phases of work considered.

4.1.8 The working hours for construction activities would vary between activities and between sites. For example, at the Wylfa Newydd Development Area, earthworks activities would occur during daylight periods only, whilst other activities, such as marine works and concrete production, distribution and pouring activities, would need to extend into night-time periods. Separate models have been developed to ensure that all appropriate time periods are considered for each development.

4.2 Input data

4.2.6 In addition to the input data detailed in section 3.5, which are common to various noise models, the key input data for the construction and earthworks noise models are the plant list, working areas for each plant item and working hours. The plant lists contain the following data:

- plant item name;
- number in simultaneous use;
- size (in terms of tonnage or power output);
- noise emissions – based on measurements, manufacturer's details or data taken from BS5228-1:2009+A1:2014 [RD14]. Octave band data has been used where available; and
- on-time and activity duration – different plant items can be used either continuously or intermittently throughout the whole assessment time period, or during part of the assessment time period.

4.2.7 With respect to the on-time for each plant item, construction and earthworks operations aim to employ their machinery for as much time as possible, as it is more cost-efficient and maximises output. However, practicalities of working mean that plant may have to wait for short intervals between periods of working. For example, an excavator may have to wait for a truck to reverse into position or a dozer could have to wait for a truck to arrive and tip its load.

4.2.8 Modern machinery is designed to throttle down automatically when not under load and therefore durations under maximum engine load are reduced. Furthermore, activity levels can vary depending on the plant type and may be influenced by factors such as the weather or length of the haul route. Sound emission data has been taken from BS5228-1:2009+A1:2014 [RD14] which takes into account typical activity levels of each item of plant. The percentage of the assessment period for which the activity takes place has been estimated based on professional judgement; a value of 80% has typically been used for earth moving equipment.

4.2.9 Construction plant lists based upon the best available information for each development site are presented as an appendix to the relevant noise and vibration chapter.

4.3 Modelling methodology

4.3.6 The modelling for construction and bulk earthworks noise has been undertaken using the CadnaA software to implement the BS5228-1:2009+A1:2014 [RD14] methodology. Annex F of BS5228 [RD14] states that the methodology takes into account the following:

- the sound power outputs of processes and plant;
- the periods of operation of processes and plant;
- the distances from sources to receiver;
- the presence of screening by barriers;
- the reflection of sound; and
- soft ground attenuation.

4.3.7 Annex F of BS5228 [RD14] goes on to state that estimation of the effects of other factors such as meteorological conditions (particularly wind speed and direction) and atmospheric absorption is beyond the scope of the standard. It does, however, indicate that at distances of less than approximately 50m, the magnitude of these effects would be small, and that at larger distances, there would be a tendency towards increased sound attenuation (i.e. reduced noise levels at receptors). However, it is acknowledged that certain combinations of meteorological conditions and site circumstances can result in increased noise levels due to focusing of the sound. Meteorological effects have not been included in the construction noise modelling.

4.3.8 The spatial extent of the models was defined to ensure they encompass the closest receptors in each direction, and take into account the initial 600m study area around each site. Calculation run-times have also been taken into account when defining the spatial extent of the model, to ensure efficient use of resources.

Associated Development and Off-site Power Station Facilities

4.3.9 The models have considered construction noise on a month-by-month increment basis, with no further dissection. The sound power outputs of individual plant have been grouped together to represent specific individual construction activities as in the construction programme. The construction activities have subsequently been input into the models as 'noise sources in representative locations for a realistic worst case assessment'.

4.3.10 Further models have been developed as part of a sensitivity testing exercise to provide an indication of the higher noise levels which might be possible during certain transient phases of the works within any calendar month.

Power Station Site

4.3.11 For the Wylfa Newydd Development Area, each model represents a three-month period. Models have been produced for both the daytime and night-time construction activities.

4.3.12 For ease of modelling, the Wylfa Newydd Development Area has been divided into smaller areas, which are presented on figure D6-2 (WNDA Development figure booklet) (Application Reference Number: 6.4.101) and are referred to as construction zones.

4.3.13 Where the plant list indicated that an item of plant would be operating in multiple construction zones, it was placed in each zone with an appropriate correction to the emission level applied so that the overall sound power level remains correct for the number of plant in the plant list. For example, if one item of plant was shown to be operating in two construction zones, then two BS5228 construction noise point sources were placed in the model and a correction of -3dB was applied to both sources (a 50% reduction in sound power for each point, as both points represent the same item of plant which cannot be in two locations at once).

4.3.14 Due to the number of point sources that were generated using this strategy (up to 760 per model), and uncertainty over the exact locations that an item of plant would be working in at any given time, a mapping routine was used to randomly distribute the point sources within each construction zone, whilst maintaining a minimum spacing of between 10m and 30m between points.

4.3.15 For areas with a high density of plant this resulted in a diffuse distribution of point sources across the construction zone, which taken together share some similarities with the concept of an area source containing the sound power levels of all the plant operating within that construction zone. For construction zones which only contain fewer point sources, such as the mounds, the point sources have been moved towards the edges of the construction zone close to groups of receptors to ensure a realistic worst case is assessed.

4.4 Model outputs

4.4.6 The models have been used to predict free-field construction noise levels at selected representative receptors, and in grid format across the study area, in

terms of parameter $L_{Aeq(T)}$, for each of the relevant assessment time periods. The noise contours have been presented in 5dB(A) contour bands.

4.4.7 The predictions at receptor buildings have been undertaken using the CadnaA building evaluation technique, which generates a sequence of receptors around the perimeter of a building at pre-defined spacing and height above ground, so that noise predictions were carried out at multiple positions along each façade. This procedure was repeated for each floor of the building (receptors at ground level are set to 1.5m height above ground, with each subsequent floor being 2.5m higher). The greatest noise level predicted at any position around a building was then assigned to that building in the model output for the scenario.

4.4.8 The number of receptors predicted to experience particular noise levels is presented in tabular format. These tables include predictions for all modelled scenarios, not just the 'single realistic worst case' for each receptor, so that some of the variation in noise levels during construction can be observed, rather than just the highest levels.

4.5 Assessment methodology

4.5.6 The assessment of the construction and earthworks noise is based primarily upon guidance contained within BS5228-1 [RD14]. However, due to the commonalities of the bulk earthworks activities at the Wylfa Newydd Development Area and traditional mineral extraction activities, reference has also been made to MTAN1 [RD6] for the assessment presented in chapter D6 (Application Reference Number: 6.4.6).

4.5.7 BS5228-1 [RD14] provides two methodologies (Method 1 and Method 2) for the prediction of significance during typical construction works, based upon existing measured ambient noise levels and noise change.

4.5.8 Example thresholds of significant effects (or potential disturbance), using Method 1 'The ABC methodology' as set out in Annex E of BS5228-1 [RD14], are detailed in table 4-1. This method applies to residential receptors only. In Method 2, noise levels generated by construction activities are deemed to be significant if the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise by 5dB or more, subject to lower cut-off values of 65dB, 55dB and 45dB$L_{Aeq\ T}$, from construction noise alone, for the daytime, evening and night-time periods respectively. This applies for a duration of one month or more, unless works for a shorter duration are likely to result in significant effect. The evaluation criteria are generally applicable for residential housing, hotels and hostels, buildings in religious use, schools and health or community facilities.

Table 4-1 BS5228-1 Method 1 ABC Significance Evaluation Methodology

Assessment Category and threshold Value Period	Threshold (db L_{Aeq})		
	Category AA)	Category BB)	Category CC)
Night time (23.00-07.00)	45	50	55
Evenings and weekends (D)	55	60	65
Daytime (07.00-19.00) and Saturdays (07.00-13.00)	65	70	75
NOTE 1: A potential significant effect is indicated if the L_{Aeq} noise level, from the site, exceeds the threshold level for the category appropriate to the ambient noise level.			
NOTE 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. if the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total L_{Aeq} noise level for the period increases by more than 3dB due to site noise.			
NOTE 3: Applies to residential receptors only.			
A)	Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are lower than these values.		
B)	Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as Category A values.		
C)	Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than Category A values.		
D)	19.00-23.00 weekdays, 13.00-23.00 Saturdays and 07.00-23.00 Sundays.		

It should be noted that the thresholds in BS 5228-1 [RD14] are examples and therefore there is scope for them to be adapted, if deemed necessary, to local circumstances.

Associated Development and Off-site Power Station Facilities

4.5.9 The guidance within BS5228-1 [RD14] has been used to develop magnitude criteria for noise from construction activities at the Associated Development sites and the Off-site Power Station Facilities. These are presented below in table 4-2. No routine night-time construction activities are envisaged at these sites.

Table 4-2 Construction noise magnitude scale

Magnitude of Change	Façade construction noise level (L_{Aeq}) 07:00 – 19:00 hours Mon to Fri 07:00 – 13:00 hours Sat	Comments
High	≥75.0	75dB L_{Aeq} is presented by BS5228-1 as an example threshold for the determination of noise insulation eligibility.
Medium	70–74.9	-
Small	65–69.0	-
Negligible	<65.0	65dB L_{Aeq} is the threshold of significance defined by examples in BS5228-1 for low ambient noise areas*.
* or less than a 3.0dB increase in the pre-existing ambient noise level.		

Power Station Site

4.5.10 For many construction activities, direct adoption of values set out in table 4-1 above is appropriate. However, BS5228-1 [RD14] states that construction works involving long-term substantial earth-moving are more akin to surface mineral extraction than to conventional construction activity, and suggests that a limit of 55dB $L_{Aeq,1hr}$ be adopted for daytime construction noise where the works are likely to occur for a period in excess of six months. This corresponds to the upper limit referred to in Welsh policy MTAN1 [RD6] as discussed below.

4.5.11 The Enabling Works and main construction phases of the Power Station development would involve a substantial element of earth-moving activities. Therefore, based on the above, a free-field construction noise level of 55dB $L_{Aeq,1hr}$ has been selected to represent the onset of small magnitude effects during the weekday daytime due to noise from construction plant and machinery lasting more than eight weeks. This is a more cautious approach than the adoption of the 65dB $L_{Aeq,12hr}$ façade incident daytime noise threshold from table E.1 of BS5228-1 [RD14]; which is widespread practice.

4.5.12 In Wales, MTAN1 [RD6] sets out policy advice for aggregates extraction by Welsh mineral planning authorities and the aggregates industry. MTAN1 suggests that night-time working limits should not exceed 42dB at noise-sensitive properties. MTAN1 also suggests that noise control should strike the appropriate balance between applying the best available noise control techniques, and not entailing excessive cost. At night, a free-field construction noise level of 42dB $L_{Aeq,1hr}$ has therefore been adopted to represent the onset of small magnitude effects at noise sensitive properties.

4.5.13 MTAN1 [RD6] sets out noise thresholds for day (07.00-19.00) and night (19.00-07.00) periods, without variation in noise limits for different days of the week, or for public holidays. However, for construction activities this approach is not considered appropriate, and therefore an additional threshold has been

adopted for evenings, and at other periods of the week which are typically quieter than during a normal working day, such as Saturday afternoons (13.00–22.00), Sundays (07.00–22.00) and public holidays (07.00–22.00). For these periods, referred to collectively as 'amenity periods', a free-field construction noise level of 47dB $L_{Aeq,1hr}$ has been selected to represent the onset of small magnitude effects. This is lower than the 55dB $L_{Aeq,T}$ Category A threshold for amenity periods recommended by BS5228-1 [RD14], and does not exceed the guideline values recommended in the Guidelines for Community Noise (WHO, 1999) [RD25] as follows.

- 55dB $L_{Aeq,T}$ at outdoor living areas during the daytime and evening to prevent people from being seriously annoyed outdoors; and
- 50dB $L_{Aeq,T}$ to prevent people from being moderately annoyed outdoors during the daytime and evening.

4.5.14 For higher noise levels, above those adopted as the threshold of significance for residential receptors, BS5228-1 [RD14] is again helpful. Appendix E of BS5228-1 provides example values for the determination of eligibility for noise insulation. The values presented take into account the time of day, day of the week and the pre-existing ambient noise levels at dwellings before the construction works begin. The noise levels are expressed as façade incident values, and therefore 3dB may be subtracted from these values to obtain equivalent free-field levels.

Table 4-3 BS5228-1 Examples of time periods, averaging times and façade incident noise levels associated with the determination of eligibility for noise insulation.

Time	Relevant time period	Averaging time, T	Noise insulation trigger level (dB $L_{Aeq,t}$)
Monday to Friday	07.00 – 08.00	1hr	70
	08.00 – 18.00	10hr	75
	18.00 – 19.00	1hr	70
	19.00 – 22.00	3hr	65
	22.00 – 07.00	1hr	55
Saturday	07.00 – 08.00	1hr	70
	08.00 – 13.00	5hr	75
	13.00 – 14.00	1hr	70
	14.00 – 22.00	3hr	65
	22.00 – 07.00	1hr	55
Sunday and public holidays	07.00 – 21.00	1hr	65
	21.00 – 07.00	1hr	55

[A)] All noise levels are predicted or measured at a point 1m in front of the most exposed of any windows and doors in any façade of any eligible dwelling.

4.5.15 The selection of noise thresholds for the magnitude of change scale has taken into account the variability of noise during the construction works. As the predicted levels represent the realistic worst case expected during each scenario, it is expected that noise levels would be below the predicted values for most the time.

4.5.16 The adopted magnitude scale for long-term noise from construction plant and machinery is presented in table 4-4.

Table 4-4 Adopted magnitude scale for long-term construction plant and machinery noise, dB $L_{Aeq,1hr}$ free-field

Magnitude of change	Day/time period							
	Monday to Friday			Saturday			Sunday and Public Holidays	
	07.00-19.00	19.00 - 22.00	22.00 - 07.00	07.00-13.00	13.00 - 22.00	22.00 - 07.00	07.00 - 22.00	22.00 - 07.00
Large	≥72.0	≥67.0	≥62.0	≥72.0	≥67.0	≥62.0	≥67.0	≥62.0
Medium	62.0 – 71.9	57.0 – 66.9	52.0 – 61.9	62.0 – 71.9	57.0 – 66.9	52.0 – 61.9	57.0 – 66.9	52.0 – 61.9
Small	55.0 – 61.9	47.0 – 56.9	42.0 – 51.9	55.0 – 61.9	47.0 – 56.9	42.0 – 51.9	47.0 – 56.9	42.0 – 51.9
Negligible	<55.0	<47.0	<42.0	<55.0	<47.0	<42.0	<47.0	<42.0
	or less than a 3dB increase in the pre-existing ambient noise level							

Construction noise (short-term)

4.5.17 In relation to short-term construction works, which are defined as up to eight weeks in a year, (MTAN1) [RD6] states that daytime noise should not exceed 67dB $L_{Aeq,1hr}$ at noise-sensitive properties. To avoid overlap, the thresholds of the small magnitude of impact (upper and lower thresholds), and medium magnitude of impact (lower threshold only) have been adjusted accordingly using professional judgement.

4.5.18 For short-term construction works, it is also considered appropriate to adopt the example BS5228-1 [RD14] Category A threshold for significance during amenity periods (equivalent to 52dB $L_{Aeq,1hr}$ free-field). Therefore, the significance set out in table 4-5is adopted for short-term operations within the construction works.

Table 4-5 Adopted magnitude scale for short-term construction plant and machinery noise, dB $L_{Aeq,1hr}$ free-field

Magnitude of change	Day/time period							
	Monday to Friday			Saturday			Sunday and Public Holidays	
	07.00 - 19.00	19.00 - 22.00	22.00 - 07.00	07.00 - 13.00	13.00 - 22.00	22.00 - 07.00	07.00 - 22.00	22.00 - 07.00
Large	≥72.0	≥67.0	≥62.0	≥72.0	≥67.0	≥62.0	≥67.0	≥62.0
Medium	70.0 – 71.9	57.0 – 66.9	52.0 – 61.9	70.0 – 71.9	57.0 – 66.9	52.0 – 61.9	57.0 – 66.9	52.0 – 61.9
Small	67.0 – 69.9	52.0 – 56.9	42.0 – 51.9	67.0 – 69.9	52.0 – 56.9	42.0 – 51.9	52.0 – 56.9	42.0 – 51.9
Negligible	<67.0	<52.0	<42.0	<67.0	<52.0	<42.0	<52.0	<42.0
	or less than a 3dB increase in the pre-existing ambient noise level							

5 Construction and earthworks vibration

5.1 Scope

5.1.6 The construction and earthworks vibration topic is relevant for the same assessments as the corresponding noise topic detailed in section 4.1. There are a number of different potential vibration sources included in this topic, which each require different modelling and assessment methodologies:

- Blasting associated with the bulk earthworks and formation of a level development platform at the Power Station Site.
- Tunnelling required for the cooling water intake system at the Power Station Site; however, the methodology has not been confirmed. For the purposes of this Technical Note, it has been assumed that the method would involve cut and cover excavation and/or drill and blast techniques. The former would be unlikely to generate significant vibration effects at sensitive receptors, and the latter would be modelled and assessed in a similar way to that for the blasting associated with the bulk earthworks.
- Ground compaction may be required at the Power Station, Off-site Power Station Facilities and Associated Development sites. For the purposes of this Technical Note, a worst case of vibratory compaction has been assumed.
- Vibratory screens and rock-crushing equipment would be required on the Power Station Site. Rock would be crushed for use in the marine works and other areas of the Power Station Site.
- Piling is anticipated and would be required for the MOLF and outfall tunnelling at the Power Station Site. Use of both percussive piling and vibratory piling techniques has been assessed. For the Associated Development sites and Off-site Power Station Facilities piling works would be required and Continuous Flight Auger piling techniques have been assessed.

5.1.7 A detailed consideration of air overpressure (the increased pressure of the air caused by transient airborne pressure waves generated by explosive detonation) is not considered appropriate for this scheme, largely due to the fact that section 5.3 of BS6472-2:2008 [RD16] states that the accurate prediction of air overpressure is 'almost impossible' and goes on to state that "*…control of air overpressure should always be by its minimisation at source through appropriate blast design*". MTAN1 [RD6] states that:

"Because air overpressure is transmitted through the atmosphere, meteorological conditions such as wind speed and direction, cloud cover and humidity will all affect the intensity of the impact. In view of this unpredictability, planning conditions to control air overpressure are unlikely to be enforceable."

5.1.8 Further, the precise details of the blasting process have yet to be established, since they would be confirmed by additional on-site trials and then continually refined by monitoring of the process throughout the construction works. The

Main Power Station Site sub-CoCP (Application Reference Number: 8.7) sets out good practice measures to reduce the effects of blasting vibration and air overpressure. For example, charge-reducing techniques would be considered, such as complex decking, changing the blast pattern, using smaller diameter boreholes or adopting a combination of these measures. The strategy would require a sufficient quantity and quality of stemming material to adequately confine the explosives, and care would be taken in deciding upon the optimum detonation technique for the specific site circumstances.

5.1.9 The blasting contactor would be contractually required to adhere to the measures set out in the blasting vibration and air overpressure strategy. The blasting process would therefore be designed to ensure that relevant vibration guidelines, and all limits agreed with utilities companies and other relevant asset owners, are complied with. For these reasons, modelling and assessment of vibration and air overpressure due to blasting has not been undertaken.

5.2 Input data

5.2.6 No sources of vibration likely to have the potential to affect sensitive receptors have been identified in the existing or future baseline scenarios. The development scenarios assessed have included the likely 'worst case', where it is assumed that vibration sources are positioned at their closest approach to receptors.

5.2.7 The model input data required to predict vibration effects vary with each source and are summarised in table 5-1 below. Many details of these vibration-generating activities are commonly not finalised in the project evolution until after planning approval has been gained and a contractor appointed. In this case, relevant conservative assumptions have been made and recorded, based upon professional judgement and experience.

Table 5-1 Input data for Vibration Modelling

Vibration Source	Input Parameter
Vibratory Compaction	n_d – number of vibrating drums
	k_s – scaling factor
	A – maximum amplitude of drum vibration (mm)
	L_d – vibrating roller drum width (m)
	x – distance to receptor
Vibratory Piling	k_v – scaling factor related to prediction confidence level
	x – surface distance between source and receptor (m)
	δ – phase (start-up/run down, steady state, all operations)
Percussive Piling	k_p – scaling factor

Vibration Source	Input Parameter
	W – nominal hammer energy (J)
	r – slope distance from pile toe

5.3 Modelling methodology

5.3.6 The modelling for the construction and bulk earthworks vibration assessments has been undertaken using a verified spreadsheet, which implements relevant calculations set out in BS5228-2 [RD15].

5.3.7 BS5228-2 [RD15] presents simple empirical prediction methods that may be used to estimate vibration levels at distances from mechanised construction works using the basic data available on equipment and ground composition. These empirical prediction methods provide a range of scaling factors. Those associated with a high level of confidence (95%) have been used, and hence provide a conservative method of establishing potential vibration magnitude. The BS5228-2 [RD15] approach has been used to assess possible vibration effects from compaction and piling activities.

5.3.8 The spatial extent of the vibration models is based on the distance between vibration source and receptor beyond which the magnitude of change is predicted to be negligible. These distances are much reduced when compared to those of the noise models. However, the nearest receptors (human, ecological and infrastructure) with the potential to experience significant effects have been included.

5.4 Model outputs

5.4.6 The vibration model outputs comprise predictions of vibration magnitudes in the form of Peak Particle Velocity (PPV) in mm/s, at selected receptor locations. These are presented in tabular format and compared with the relevant benchmark criteria.

5.5 Assessment methodology

5.5.6 The assessment of vibration impacts has been based primarily on guidance in BS5228-2 [RD15], supplemented where appropriate by other standards. In particular, reference has been made to any additional vibration criteria identified by statutory service providers to protect their underground services and by Magnox for the Existing Power Station.

5.5.7 BS5228-2 [RD15] provides a summary table on human response to vibration as presented in table 5-2.

Table 5-2 Human Response to Vibration

Vibration Level	Effect
0.14mm/s	Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.

Vibration Level	Effect
0.3mm/s	Vibration might just be perceptible in residential environments.
1.0mm/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.
10mm/s	Vibration is likely to be intolerable for any more than a brief exposure to this level.

5.5.8 BS 5228-2 [RD15] also provides guidance on building structure response to vibration. The response of a building to ground-borne vibration is affected by the type of foundation, underlying ground conditions, the building construction and the state of repair of the building. Table 5-3 reproduces the guidance detailed on building classification and guide values for cosmetic building damage.

Table 5-3 Transient vibration guide values for cosmetic building damage

Line	Type of Building	PPV in frequency range of predominant pulse	
		4Hz to 15Hz	**15Hz and above**
1	Reinforced or framed structures	50mm/s at 4Hz and above	50mm/s at 4Hz and above
	Industrial and heavy commercial buildings		
2	Un-reinforced or light-framed structures	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above
	Residential or light commercial buildings		

Note 1 Lines 1 and 2 refer to the two lines on Figure B.1 provided within BS5228-2 [RD15]

Note 2 Values referred to are at the base of the building.

Note 3 For line 2, at frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) is not to be exceeded.

Vibration from plant and machinery

5.5.9 For vibration from plant and machinery operations, a level of 1mm/s has been selected to represent the onset of small magnitude of change, which according

to BS5228-2 [RD15] represents a level that can be tolerated if warning and explanation has been given to residents.

5.5.10 A level of 10mm/s has been adopted to represent the onset of a large effect magnitude and is a point at which vibration is likely to be intolerable to humans for anything more than a very brief period of exposure inside buildings.

5.5.11 Whilst not directly stated in the relevant guidance, a further value of 5mm/s has been applied to provide a suitable threshold for the onset of a medium effect magnitude.

5.5.12 The adopted magnitude of change scale for vibration from plant and machinery is presented in table 5-4 and jointly caters for potential effects on building occupants and also potential effects on buildings in terms of the risk of cosmetic building damage.

Table 5-4 Adopted magnitude scale for plant and machinery vibration effects

Magnitude of change	Vibration level (peak particle velocity, mm/s)
Large	≥10
Medium	5.0 – 9.9
Small	1.0 – 4.9
Negligible	<1.0

5.5.13 The values in table 5-4 relate to free-field vibration in the ground outside a building and which can be assumed to be representative of vibration experienced at the point of entry to the body by building occupants (or humans in outdoor spaces). The free-field vibration also provides a likely overestimate of vibration at the foundation of the building.

5.5.14 When applied for the purposes of assessing the risk of cosmetic damage at buildings considered to be in a poor state of repair or structurally vulnerable, the upper and lower ranges for the values in table 5-3 should be reduced by up to 50% from those shown.

5.5.15 When applied to buildings, it should be noted that the scale in table 5-4 provides for a precautionary assessment to cover all eventualities, including the possibility of vibration at very low frequencies (where damage risks become greater), and the possibility or dynamic magnification in building structures from continuous vibration sources. BS5228-2 [RD15] confirms that higher magnitudes than those applied in table 5-4 can be safely applied and, as such, suitable flexibility would be required during the detailed planning of such works where the specific circumstances enable higher vibration magnitudes to be justified.

5.5.16 The Wylfa Newydd Development Area includes existing infrastructure potentially sensitive to vibration. The Site Sensitive Receptors include:

- underground high voltage cables;
- overhead high voltage cables;
- water mains;

- foul water drains; and
- the Existing Power Station.

5.5.17 Suitable vibration threshold limits have been derived previously for the above Site Sensitive Receptors as part of conducting vibration trials during on-site rock fracturing activities. The selected thresholds vary from 5mm/s for oil-filled high voltage cables up to 50mm/s for buried water utility structures.

5.5.18 These threshold values are assumed to have been set to prevent the risk of damage or disturbance to assets and as such works would comply with the threshold limits to avoid any exceedances.

Vibration from blasting

5.5.19 The blasting process would be designed to ensure that relevant vibration thresholds are complied with. The assessment of vibration from blasting is therefore based on compliance with the following guidelines:

- BS6472-2 [RD16] set of satisfactory vibration magnitudes for residential receptors;
- offices and workshops; and
- BS5228-2 [RD15] for buildings (including those of historic value that are considered structurally sound).

5.5.20 For residential receptors, BS6472-2 [RD16] indicates that satisfactory magnitudes for vibration due to blasting would be in the range 6.0 to 10.0 mm/s PPV, and that the lower satisfactory magnitude should be used with the higher magnitude being justified on a case-by-case basis. On this matter, BS6472-2 [RD16] also states that: “for civil engineering projects, such as tunnels and foundation excavations, it should be recognized that the application of human response criteria, rather than conservative damage criteria, could significantly prolong project durations”. The standard states that in these circumstances “careful action by the operator, including negotiation, public relations and property surveys might result in agreed levels of vibration in excess of those recommended”.

5.5.21 All blasting methods would therefore be designed to comply with the vibration threshold values set out below.

1. To prevent undue disturbance at residential dwellings, education facilities, bat roosts and barn owl roosts, the following vibration levels set out in BS6472-2 [RD16] as measured outside the building would apply:
    i. the vibration level shall not exceed
        a. *, or*
        b. *any higher limits agreed with IACC on a case by case basis; and*
    ii. the vibration level from any single event shall not exceed 10mm/s PPV.

2. To prevent undue disturbance at offices and workshops, the following vibration levels set out in BS6472-2 [RD16], as measured outside the building, would apply:
    iii. the vibration level shall not exceed 14mm/s PPV for 90% of blasting events in any three-month period; and
    iv. the vibration level from any single blasting event shall not exceed 21mm/s PPV.
3. To prevent the onset of minor cosmetic damage to buildings (including those of historic value that are considered structurally sound), the following peak component particle velocities in the frequency range of the predominant pulse and measured on a structural element at the base of the building would apply (source: table B.2 of BS5228-2 [RD15]:
    v. At residential or light commercial buildings 15mm/s at a frequency of 4Hz increasing linearly to 50mm/s at a frequency of 40Hz;
    vi. At industrial and heavy commercial buildings 50mm/s at frequencies of 4Hz and above; and
    vii. Important buildings which are difficult to repair, or those thought to be structurally unsound, shall require special consideration on a case-by-case basis.

5.5.22 The above limits are based on up to three blasting events per day. If it is necessary to conduct more than three blasts per day, then the permitted vibration level of each blast would be reduced in accordance with the formula set out in section 6.2 of BS6472-2 [RD16]. Blasts for the Main Construction works will be scheduled Monday to Friday between 10.00 and 16.00, and Saturday between 10.00 and 13.00.

5.5.23 Additionally, suitable vibration threshold limits have been derived previously for the above Site Sensitive Receptors as part of conducting vibration trials during on-site rock fracturing activities. The selected thresholds vary from 5mm/s for National Grid installations up to 50mm/s for buried water utility structures.

5.5.24 The above limits would be set out in the blasting vibration and air overpressure strategy that would form part of the Code of Construction Practice, and are considered to represent the threshold below which the blast vibration magnitude can be considered negligible.

6 Power Station operational noise

6.1 Scope

6.1.6 The Power Station operational noise assessment is relevant to the EIA for the DCO and the combustion plant Environmental Permit. The modelling and assessment for EIA purposes includes all environmental noise sources at the Power Station Site, whilst for the Environmental Permitting only the environmental noise sources which form part of the permitted installation are considered. For the purposes of both assessments, an 'environmental noise source' is defined as any part of the Power Station development that would generate or radiate noise that would be audible in the outdoor environment at the site or installation boundary.

6.1.7 The baselines relevant to these assessments have been determined by measurement of existing noise levels at selected sensitive receptors. It is acknowledged that the baseline conditions may have changed since the surveys were undertaken due to the closure of the Existing Power Station.

6.1.8 The noise assessment chapter of the Environmental Statement for the decommissioning of the Existing Power Station [RD34] presented baseline data measured in 2007 whilst two reactor units were generating electricity. Acknowledging that the baseline for the decommissioning activities would be a situation in the future after the closure of the Existing Power Station, future baseline noise levels were modelled. This involved the modelling of noise emissions from the Existing Power Station. These modelled noise levels were then subtracted from the 2007 baseline measurements to estimate noise levels in the absence of the Existing Power Station.

6.1.9 This exercise predicted that when compared to the 2007 measurements, when the Existing Power Station closed, ambient noise levels would reduce by approximately 2dB at Tregele and Cafnan, and by less than 1dB at Cemaes during daytime periods. (Data for evening and night-time periods were not presented, as decommissioning activities were expected to focus on daytime periods only.)

6.1.10 However, the 2014 survey (and subsequent 2015 survey) undertaken to support the Wylfa Newydd DCO application indicated that noise levels may already be lower than those predicted for the future once the Existing Power Station had stopped generating (which it did in December 2015). It was agreed with the IACC that additional surveys to characterise the baseline conditions in the absence of the Existing Power Station operations were not necessary, and no modelling of the future baseline was required.

6.1.11 With respect to the assessment scenarios, these cover the following activities for the Power Station and, where relevant:

- normal operations;
- commissioning of standby emergency generators;
- routine testing of standby emergency generators;
- routine testing of the reserve ultimate heatsink;

- Loss of Off-Site Power/Loss of Coolant Accident;
- testing of emergency alarm systems; and
- outage.

6.1.12 Operations at the Power Station would be on a continuous basis. It is assumed that the Power Station would supply a constant base load of electricity to the National Grid, which would not vary with diurnal or seasonal changes. Assessments are presented for both daytime and night-time periods.

6.2 Input data

6.2.6 The input data specific to the Power Station Operational Noise assessment include the plant list and building construction details. The plant list contains the following data:

- plant item name and location;
- number in concurrent use;
- noise emissions – based on measurements at similar facilities, manufacturer's details or data taken from published sources. Octave band data has been used where available;
- on-time and activity duration – different plant items can be used either continuously or intermittently throughout the whole assessment time period, or during part of the assessment time period; and
- source-specific mitigation measures and their effectiveness e.g. acoustic enclosures, silencers etc.

6.2.7 The building construction details include the following:

- building dimensions and internal layout;
- construction materials and thicknesses; and
- locations and dimensions of openings.

6.2.8 The recognised conservative industry standard assumptions for the UK (downwind or neutral wind conditions, temperature of 10°C and relative humidity of 70%) have been adopted.

6.3 Modelling methodology

6.3.6 The modelling for the Power Station operations has been undertaken using the CadnaA software set to implement the ISO9613-2 [RD30] noise propagation algorithms. The noise prediction method described in Part 2 of the standard is general and is intended to be suitable for a wide range of engineering applications where the noise level outdoors is of interest. The ISO9613-2 method considers the following major mechanisms of noise attenuation:

- geometrical divergence (also known as distance loss or geometric damping) (A_{div});
- atmospheric absorption (A_{atm});

- ground effect (A_{gr});
- reflection from surfaces;
- screening by obstacles (A_{bar});
- miscellaneous effect (A_{misc}); and
- meteorological effects (C_{met}).

6.3.7 The method has been used to predict noise levels under meteorological conditions favourable to noise propagation from the sound source to the receiver, such as downwind propagation, or equivalently, propagation under a well-developed moderate ground-based (surface) temperature inversion as can occur during low wind conditions at night. Downwind propagation conditions are quantified as those where the wind direction is within 45 degrees of line between the noise source and the receiver, at wind speeds in the range of between 1m/s and 5m/s.

6.3.8 Where there are a number of noise sources located within a building, the internal reverberant noise level has been determined by a spreadsheet methodology, either by the use of standard acoustic formulae in conjunction with sound power level information, or by using data from measurements undertaken in similar facilities. The sound insulation properties of the building façade have been calculated in accordance with BS EN 12354-4 [RD20]. The noise emissions from the façade have been calculated using standard acoustic formulae, and then entered into CadnaA to determine the noise level at the receptor locations.

6.3.9 The spatial extent of the models has been defined to ensure they encompass the closest receptors in each direction, and take into account the 600m initial study area around the Power Station Site as defined by the Preliminary Environmental Information Report. Calculation run times were also taken into account when defining the spatial extent of the model, to ensure efficient use of resources.

6.4 Model outputs

6.4.6 The model has been used to predict noise levels at selected representative receptors, and in grid format across the study area, in terms of the $L_{Aeq(T)}$ parameter, for each of the relevant assessment time periods. The noise contours are presented in 5dB contour bands. Predicted noise levels at the selected receptors representative of a receptor group are presented in tabular format, along with the relevant numerical assessment criteria.

6.5 Assessment methodology

6.5.6 The following guidance documents have been used to form relevant numerical assessment criteria.

- BS4142 [RD13] – provides methods for the assessment of the likely effects of sound on people inside or outside residential dwellings. The standard is used for the purposes of investigating complaints, assessing industrial noise sources, and assessing noise at proposed new dwellings.

The procedure contained in BS4142 is to compare the measured or predicted noise level from the source(s) in question (including any penalty applied to reflect certain acoustic features) at dwellings, with the background noise level measured in the environment.

- BS8233 [RD18] – as outlined in section 3.5;
- Building bulletin 93 [RD21] – provides indoor ambient noise level criteria for different room types within new build and refurbished schools, together with guidance noise levels for outdoor teaching areas;
- WHO *Guidelines for Community Noise* [RD25] – as outlined in section 3.5; and
- WHO *Night Noise Guidelines for Europe* [RD26] – as outlined in section 3.5.

6.5.7 The magnitude scale for operational noise effects is based primarily upon the assessment methodology contained in BS4142 [RD13]. This standard compares the rating level (i.e. noise from the Power Station plus any adjustment for the characteristic features of the sound) against prevailing background sound levels. However, as stated in BS4142 [RD13]:

"The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/would occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context."

6.5.8 BS4142 [RD13] goes on to outline the factors that should be considered in order to place a sound into context:

- the absolute level of sound;
- the character and level of the residual sound compared to the character and level of the specific (development-related) sound; and
- the sensitivity of the receptor.

6.5.9 The first two bullet points of paragraph 6.5.8 need to be taken into account when assigning a magnitude of change. The third has already been considered in this assessment methodology.

6.5.10 With respect to the absolute sound level, consideration has been given to the guidance within the *Guidelines for Community Noise [RD25]*, the *Night Noise Guidelines* [RD26] and BS8233 [RD18].

6.5.11 The character and level of the residual and development-related sounds have been taken into account using professional judgement and reference to the baseline monitoring measurement results and observations.

6.5.12 The magnitude scale developed for operational noise sources at residential receptors is summarised in table 6-1 below.

Table 6-1 Operational noise impact criteria (residential receptors)

Magnitude of change	BS4142 difference between rating and background noise levels (dB)	Description of impact from BS4142
Large	≥15	A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.
Medium	10-14	
Small	5-9	A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.
Negligible	0-4	No description in BS4142 [RD13], but described as between low and adverse impact for the purpose of this assessment.
	<0	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 on the context.

6.5.13 When considering the context of the potential noise impacts at residential properties, reference has been made to the following additional guideline values from the *Guidelines for Community Noise* [RD25] and the *Night Noise Guidelines* [RD26].

Table 6-2 Guideline values used to the inform the context of operational noise levels at residential receptors

Free-field noise level	Description of effect
<50dB $L_{Aeq,16hr}$ (07.00–23.00)	Moderate annoyance for community noise in outdoor living areas, from *Guidelines for Community Noise* [RD25]
<45dB $L_{Aeq,8hr}$ (23.00–07.00)	Sleep disturbance with a window partially open, when measured outside, from *Guidelines for Community Noise* [RD25]
Annual average of 40dB L_{night}	Lowest observed adverse effect level for night noise. A health-based limit value for protection of the public, including most of the vulnerable groups such as children, the chronically ill and the elderly, from the adverse health effects of night noise. Taken from *Night Noise Guidelines* [RD26].

6.5.14 The magnitude scale developed for operational noise sources at non-residential receptors is summarised in table 6-3 below.

Table 6-3 Operational noise magnitude criteria (non-residential receptors)

Receptor Type	External free-field noise level that relates to an onset of a small magnitude of change (dB $L_{Aeq, T}$)	Relevant guidance	Description of level in guidance document
Educational	45	Building bulletin 93 [RD21]	Level below which no special measures are likely to be necessary to protect buildings or playing fields from external noise.
Places of worship	47	BS8233 [RD18]	Internal acoustic design criteria for new places of worship of 35dB L_{Aeq}.
Commercial	52	BS8233 [RD18]	Internal acoustic design criteria for offices in new buildings of 40dB L_{Aeq}.
Industrial	52	BS8233 [RD18]	Internal acoustic design criteria for offices in new buildings of 40dB L_{Aeq}.

6.5.15 Whereas the guidelines published by WHO [RD25] provide specific reference to the appropriate and equivalent external noise levels which are required to protect occupants within residential buildings assuming partially opened windows, similar external guideline values are not available for non-residential receptors in BS8233 [RD18]. To ensure a cautious approach for the derivation of equivalent external free-field noise levels (from published guideline internal levels) a reduction of 12dB in noise has been assumed across a partially opened window for places of worship, commercial and industrial receptors. This is at the conservative end of the range identified by studies into open window sound reduction at Napier University [RD35]. It is also at the lower end of the range of between 10dB and 15dB that is often cited for partially open windows in some WHO guidance and other contemporary European noise guidelines.

6.5.16 The reporting requirements of the NRW-endorsed Environment Agency document *Noise Impact Assessment: information requirements* [RD29] have been met.

6.5.17 The determination of Best Available Techniques for each source has been undertaken with reference to the following documents:

- Section 3 of the Horizontal Guidance for Noise Part 2 [RD28];
- The 2016 edition of *Best Available Techniques (BAT) Reference Document for Large Combustion Plants* [RD36]; and
- The 2006 edition of *Reference Document on Best Available Techniques for Large Combustion Plants* [RD37].

6.5.18 In recognition of the potential for low frequency noise to be associated with certain noise sources, such as power transformers and backup diesel generators, consideration has been paid to the guidance contained in *Procedure for the assessment of low frequency noise complaints*, NANR45 (hereafter referred to as NANR45) [RD31].

6.5.19 The objective of the NANR45 project [RD31] is described in the project summary, as follows:

"The aim of this study is to recommend a method for assessing low frequency noise (LFN), suitable for use by Environmental Health Officers (EHOs) in the UK."

6.5.20 The report goes on to state:

"The procedure is intended to assist in the evaluation of existing problems. It is not intended as a means of predicting when disturbance might occur, for example in a planning situation, and would not be reliable to use as such. This is because disturbance by LFN depends on a number of factors, such as the character of the sound, whose effects are neither well understood, nor readily predictable. Levels of sound above criteria based on the average threshold of hearing are frequently found to be acceptable and levels falling marginally below can occasionally cause disturbance, so no generic approach to prediction of disturbance appears to be possible."

6.5.21 Although NANR45 [RD31] is not intended to be used to predict when disturbance might occur, it is considered that the frequency-dependent 'criterion curve' detailed in the report provides the best available guidance on the levels of low frequency noise that are likely to generate complaints in the UK. For this assessment, professional judgement has been used to derive frequency-dependent values, below which levels of LFN are not considered significant. These values have been derived as follows.

- The NANR45 criterion curve is defined in terms of third octave bands. As the data describing the frequency content of noise from combustion sources are available only in octave bands, the third octave band centre frequencies from the NANR45 criterion curve have been converted to the equivalent octave band values.
- The lowest octave band centre frequency for which data describing the frequency content of noise from noise sources, such as power transformers and backup diesel generators, are available is 63Hz. Therefore, noise at lower frequencies cannot reliably be predicted or assessed, and is not considered in this assessment. Should complaints in relation to LFN be reported by any local residents, then Horizon would undertake a full assessment within the relevant property in accordance

with NANR45, which would include a comparison of measured frequencies between 10Hz and 160Hz with the criterion curve.

- Whereas the NANR45 criterion curve relates to measured levels of noise within bedrooms, this assessment considers free-field levels external to local receptors. This is a conservative approach, as in reality the walls and windows of receptor buildings would provide a further degree of noise reduction that this assessment does not take account of.
- NANR45 provides the best available guidance on the levels of LFN that are likely to generate complaints. This assessment aims to identify any significant effects, and it is recognised that significant effects can occur below the level at which complaints might be generated. To account for this, the adopted thresholds for LFN have been set at 3dB below the NANR45 criterion curve. This margin of 3dB has been agreed with the IACC, in the absence of definitive criteria for the prediction and assessment of LFN effects.
- As recommended in NANR45, the thresholds during the day are set 5dB higher than the night values.

6.5.22 The adopted thresholds for LFN are detailed in table 6-4.

Table 6-4 Low frequency noise assessment criteria

Third octave Band Centre Frequency, Hz	NANR45 reference curve, L_{eq}	Octave band centre frequency, Hz	Octave band NANR45 reference curve, L_{eq}	Adopted threshold of significance for LFN (Night)	Adopted threshold of significance for LFN (Day)
50Hz	43dB	63Hz	47dB	44dB	49dB
63Hz	42dB				
80Hz	40dB				
100Hz	38dB	125Hz	41dB	38dB	43dB

7 Road traffic noise and vibration

7.1 Scope

7.1.6 The road traffic noise topic is subject to the following assessments:

- construction stage of all developments; and
- operational stage of all developments.

7.1.7 However, it is considered that the assessment of traffic noise and vibration is more appropriately undertaken at the project-wide level rather than for each component development in turn. This is because the assessment is based on the project-wide traffic model. This model does not distinguish between traffic movements associated with different development components, as many of the predicted project related vehicle movements would interact with more than one development; for example, a heavy goods vehicle would visit the Logistics Centre before travelling along the A5025 to the Power Station Site.

7.1.8 With respect to road traffic vibration, guidance within DMRB states that there are two impacts which need to be considered.

- Impacts on buildings – DMRB reports that extensive research has found no evidence that traffic-induced vibrations are a source of significant damage to buildings. Any significant ground-borne vibrations are associated with irregularities in the road surface, which should not be present in new roads, and can easily be rectified by maintenance in older roads.
- Disturbance to occupiers – ground-borne vibration is much less likely to cause disturbance than airborne vibration and can be rectified as detailed above. Disturbance due to traffic-induced airborne vibration has been found to be closely correlated with the $L_{A10,18hr}$ noise index, and can hence be assessed using noise modelling, rather than vibration models.

7.1.9 No traffic-induced vibration modelling is therefore considered necessary for any of the assessments.

7.1.10 The modelled existing and future baselines ('do minimum' scenarios) are of key importance to the road traffic noise assessments. Future baseline (do minimum – i.e. no Wylfa Newydd Project) and with development (do something – i.e. with all components of the Wylfa Newydd Project) models have been prepared for the following assumed design years:

- opening year of the A5025 Off-line Highway Improvements (assumed to be 2020);
- peak year of project construction traffic (modelled as 2023); and
- peak operational traffic year (modelled as 2033).

7.1.11 In addition to the scenarios above, a 2020 model has been prepared assuming that all construction traffic uses the existing A5025 alignment i.e. prior to the opening of the A5025 On-line Highway Improvements. This has been

undertaken to ensure that traffic noise effects due to the Wylfa Newydd Project are characterised.

7.1.12 The modelling and assessment work has been undertaken on the basis of an assumed implementation year, which is subject to change, but which would not materially change the conclusions of the assessment

7.1.13 For each scenario, the following assessments have been undertaken:

- daytime – 06.00 to 24.00 (as defined by CRTN) [RD23]; and
- night-time – 23.00 to 07.00 (as defined by DMRB) [RD24].

7.2 Input data

7.2.6 The input data specific to the Road Traffic Noise and Vibration modelling includes both the existing and proposed highway improvement layout details, and traffic flow information. The input data contain the following information for each road segment included in the model:

- typical weekday volumes of traffic during the 18-hour period from 06.00 to 24.00 (18-hour Annual Average Weekday Traffic (AAWT) flows) – for the daytime assessment;
- typical weekday volumes of traffic during the 8-hour period from 23.00 to 07.00 (8-hour AAWT flows) – for the night-time assessment;
- percentage of heavy vehicles (vehicles of unladen weight >3.5 tonnes);
- traffic speeds (banded speed based on *Interim Advice Note 185/15* [RD38] for daytime);
- road gradient;
- local topography;
- nature of the ground cover between the road and the receptor;
- shielding effects of any intervening structures, including allowances for limited angles of view from the road and any reflection effects from relevant surfaces; and
- road surfacing type.

7.2.7 The input data for night-time noise assessments where traffic flows preclude the direct use of CRTN [RD23] include:

- noise emission data obtained from measurements or published sources, for light vehicles and heavy goods vehicles.

7.2.8 In addition to the above, details of road traffic noise mitigation measures have also been considered. Such measures include low noise road surfaces and roadside barriers.

7.3 Modelling methodology

Calculation of daytime road traffic noise

7.3.7 The modelling for the road traffic noise operations has been undertaken predominantly using the CadnaA software which implemented the Department of Transport's CRTN methodology [RD23].

7.3.8 The noise prediction method described in the document relates to the calculation of the Basic Noise Level (BNL) at a reference distance of 10m from the edge of the nearside carriageway. This is calculated using CRTN formulae and inputs from the first four bullet points in section 7.2 above. In some cases, verified spreadsheets have been used to calculate the BNL for simple assessments, or to provide support to establish the spatial scope of CadnaA modelling required.

7.3.9 The remainder of the CRTN methodology involves the propagation of noise based on the BNL and takes into consideration:

- actual distance between receptors and carriageway edge;
- the presence of barriers to propagation, including buildings;
- ground cover correction;
- reflection(s) from surfaces including both the receptor façade and any other reflecting façades on the opposite side of the carriageway; and
- angle of view.

7.3.10 The above CRTN methodology can be used for traffic flows over certain thresholds (200 vehicles/hour or 4,000 vehicles/18hr day). For roads with traffic flows lower than these thresholds (i.e. 50 to 200 vehicles/hr or 1,000 to 4,000 vehicles/18hr day) an alternative procedure which incorporates a 'low flow' correction is available within section 2 of CRTN [RD23] which has been implemented where necessary.

7.3.11 DMRB [RD24] provides specific guidance in relation to the noise level correction that should be applied when using low noise road surfaces for new carriageways. DMRB states that for the future assessment year, a -3.5dB correction should be applied for a low noise road surface that is expected to be in place on the existing road.

7.3.12 DMRB [RD24] also states that:

"where new carriageways are to be constructed and a thin surfacing system *[low noise surfacing]* used, or where an existing surface is to be replaced with a thin surfacing system, a -3.5dB correction should be assumed for the thin surface system *[equivalent to a Road Surface Influence (RSI) of -5dB]* unless any information is available regarding the specific surface to be installed. This advice applies where the mean traffic speed is >=75kph (47mph). Where the mean speed is <75kph (47mph), a -1dB correction should be applied to a new low-noise surface."

7.3.13 For daytime $L_{A10,18hr}$ noise levels at dwellings, community facilities and other noise-sensitive properties, façade noise levels have been predicted.

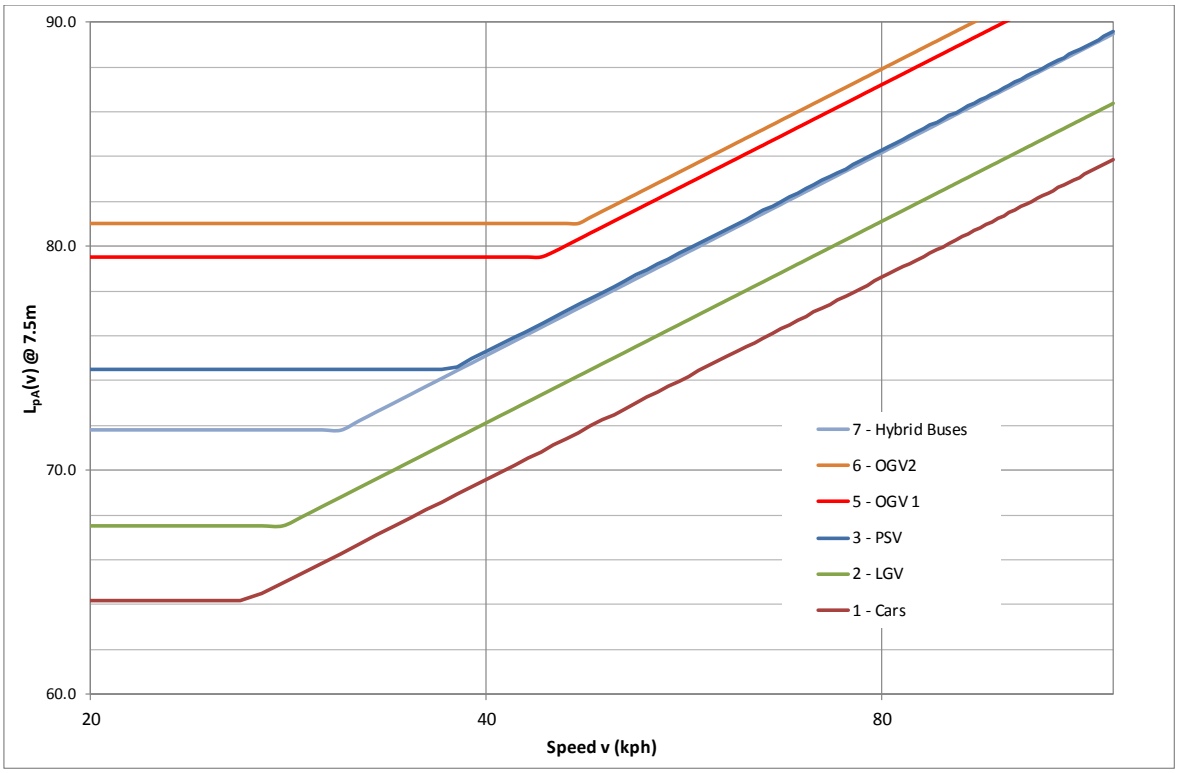
Modelling of night-time road traffic noise

7.3.14 Some night-time vehicle flows are outside the range of validity of even the CRTN low flow corrections (i.e. below 50 vehicles/hour or 1,000 vehicles/18hr day), an alternative methodology has been developed in order to model traffic noise with vehicles at these flow volumes.

7.3.15 An adapted night-time road traffic noise calculation methodology has been developed and applied for both $L_{Aeq,T}$ and $L_{Amax,F}$. The methodology is based upon the basic principles and methods described in the Noise Advisory Council (NAC) publication *A guide to measurement and prediction of the equivalent continuous sound level* [RD39] and the techniques described in the TRL *Laboratory Report 752* [RD40] for classifying vehicles for the purposes of calculating noise.

7.3.16 Speed relationship curves for maximum noise levels for six types of vehicle classification are provided in the NAC guide at a distance of 7.5m from the carriageway edge. The speed relationships for each vehicle are shown in figure 7-1 below.

Figure 7-1 Speed relationship curves for maximum noise levels for six types of vehicle classification



7.3.17 The above figure also includes the speed relationship for a hybrid bus type vehicle. This has been developed for this project based upon research conducted by Ross and Staiano *A comparison of green and conventional*

diesel bus noise [RD41]. The figure shows that according to that research, maximum noise levels from hybrid type buses only display benefits in noise over traditional diesel buses at speeds below around 40kph.

7.3.18 The TRL report [RD40] suggests that a minimum of three vehicle categories should be used for low flow prediction model. The following categories have been established for the assessment of night-time road traffic for the Wylfa Newydd Project:

- heavy goods vehicles (OGV1 and OGV2);
- light vehicles (cars and light good vehicles); and
- public service vehicles.

7.3.19 The above grouped classifications have been used in the model rather than the six classifications defined in the TRL report, to avoid the situation where very low flows or fractions of traffic movements (as opposed to true integer numbers of movements) unrealistically influence the model outputs. The proportional composition of the three classifications on any road link considered in the calculation area was based upon inspection of the typically existing distributions for the Isle of Anglesey road network as a whole.

7.3.20 The NAC guide provides methods for calculating the sound exposure level (L_{AE}) of a road traffic vehicle at a distance of 7.5m from the kerb edge, from the maximum sound pressure level at a given speed on the vehicle's trajectory using the following relationship:

$$L_{AE} = L_p(v) - 10\log_{10} v - 10(F-1)\log_{10} d + 10\log \theta + 5.5$$

7.3.21 Where:

$L_p(v)$ = A-weighted maximum sound pressure level at 7.5m from carriageway edge at a given velocity

F = ground-type correction (F=2 for hard ground)

d = shortest distance from the position of interest to the vehicle trajectory

θ = angle subtended by the trajectory in degrees

7.3.22 When a 180-degree angle is assumed and hard ground only, the resulting L_{AE} at the given velocity is representative of a vehicle pass-by on an open unimpeded section of road.

7.3.23 The above approach has provided reference roadside noise levels for enabling the calculation of both $L_{Amax,F}$ and $L_{Aeq,T}$ at specific locations.

Maximum sound pressure level $L_{Amax,F}$

7.3.24 The $L_{Amax,F}$ criterion used to assess night-time road traffic noise is based upon a threshold for the onset of a potential adverse sleep disturbance effect and not a scale of magnitude of change. As such the approach adopted in this assessment has been to calculate a horizontal 'buffer zone' around the highways improvements, which shows the approximate distance within which the potential adverse sleep disturbance effects from $L_{Amax,F}$ alone could be expected to occur. This is considered to be represented by free-field noise

level of 60dB $L_{Amax,F}$ at the façade of a property based upon guidance set out in the WHO guidelines

7.3.25 The reference roadside $L_{Amax,F}$ noise levels (at 7.5m) using the curves in figure 7-1 above have been calculated for each individual section of road ('link') along the highways improvement scheme that lie within the study area, corrected for speed (either maximum permitted speed for the vehicle type or the speed limit for the section of road, whichever is the lower).

7.3.26 Where applicable, a correction has been made to account for any low noise road surface, and a cautious 5dB reduction in $L_{Amax,F}$ has been applied to account for roadside noise barriers where these are proposed as embedded or additional mitigation in the design of the new off-line sections of highway. The 5dB reduction is based upon the barrier attenuation method presented in BS 5228-1 [RD14] for receptors with only partial screening ('line of sight') from noise sources.

7.3.27 The buffer distance around each link (for free-field 60dB $L_{Amax,F}$) has been calculated assuming hemispherical geometrical spreading from a point source using a 20 x log (d/d_{ref}) relationship where d is distance and d_{ref} is the reference distance. This method is based on the principles of the propagation model described in ISO 9613-2:1996 [RD42]. ISO 9613-2 uses the following acoustic algorithm:

$$L_{fT}(DW) = L_w + D_c - A$$

Where:

$L_{ft}(DW)$ = equivalent continuous downwind octave-band sound pressure level at a receiver location
L_w = Octave-band sound power level of the noise source
D_c = directivity correction
A = octave-band attenuation that occurs during propagation from the point sound source to the receiver. $A = A_{div} + A_{atm} + A_{gr} + A_{bar} + A_{misc}$
A_{div} = attenuation due to geometrical divergence
A_{atm} = attenuation due to atmospheric absorption
A_{gr} = attenuation due to the ground effect
A_{bar} = attenuation due to a barrier
A_{misc} = attenuation due to miscellaneous other effects including the presence of dense vegetation

7.3.28 The method then calculates the equivalent continuous downwind A-weighted sound pressure level under meteorological conditions favourable to propagation from sources of known sound emission. If only A-weighted source information is known the above algorithm may still be used, but parameters in the 500Hz octave band are to be applied.

7.3.29 Only D_c (hemispherical spreading) and A_{div} have been applied in the calculation of road traffic noise $L_{Amax,F}$. No corrections have been applied in the noise model (to account for intervening buildings, other topographical features, propagation over soft ground, air absorption or other miscellaneous

attenuation effects), ensuring that the resulting buffer zone is considered to be conservative.

7.3.30 The overall $L_{Amax,F}$ buffer area has been generated from an outline of the individual buffer zones calculated from each type of vehicle around each link within the calculation area.

7.3.31 The buffer zones have been used to assist in the quantification of the total number of residential receptors which could be at risk from potential sleep disturbance for the highest potential $L_{Amax,F}$ expected from any vehicle classification.

Night-time $L_{Aeq,8hr}$ (or L_{night})

7.3.32 The L_{AE} values calculated from the NAC methodology have been converted to an equivalent L_{night} value for each road link taking into account the traffic composition and speeds.

7.3.33 The equivalent L_{night} values have been input into the existing CadnaA models as replacement BNLs and levels calculated at each façade of each receptor, and on each floor. The resulting predicted noise levels therefore include the CRTN calculation algorithms as normal. The corrections for low flow have been switched off in the software to ensure that there is no double counting of such effects in the calculations.

7.3.34 The calculations have been repeated for each relevant night-time do-minimum and do-something scenario.

7.4 Model outputs

7.4.6 The standard CRTN methodology implemented in CadnaA predicts noise levels at all selected receptors, and in grid format across the study area, in terms of parameter $L_{A10,T}$.

7.4.7 The adapted CadnaA model used for the calculation of night-time $L_{Aeq,T}$ noise levels (using the substituted BNL method) predicts the L_{night} noise levels at each of the selected receptors, and in grid format across the study area, for each of the scenarios considered.

7.4.8 Noise change contours have been calculated from the absolute noise level contours. The noise change contours are presented in terms of either the short-term or long-term magnitude of change criteria presented below in section 7.5.

7.4.9 The $L_{Amax,F}$ buffer distances (rounded up to the nearest 5m) for each vehicle type and for each link have been used to derive an overall outline buffer zone around the road network for both the do-minimum and do-something scenarios. The buffer zones have been plotted onto base Ordnance Survey mapping enabling scheme-wide property counts.

7.5 Assessment methodology

DMRB

7.5.7 The assessment of road traffic noise has made reference to DMRB methodology [RD24]. It should be noted that DMRB was developed for trunk road works, but it is acknowledged that it is equally applicable in part to other road schemes. It also contains some useful guidance on the perceptibility of changes in traffic noise, which have been used for the Wylfa Newydd Project.

7.5.8 The assessment for the A5025 off-line road improvement scheme has used the DMRB methodology to report the number of dwellings and other sensitive receptors experiencing specific changes in noise level ($L_{A10\ 18hr}$) in the short and long term.

7.5.9 DMRB [RD24] provides guidance on the magnitude of impacts for traffic noise for both the short term and long term. A change in road traffic noise of 1dB in the short term, for example when a project is opened, is the smallest that is considered perceptible. In the long term, a 3dB change is considered perceptible. The classification of noise impact is as detailed in table 7-1 and table 7-2 below.

Table 7-2 Classification of magnitude of noise impacts in the short term

Noise Change dB $L_{A10,18hr}$	Magnitude of Impact
0.0	No change
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
5.0+	Major

Table 7-3 Classification of magnitude of noise impacts in the long term

Noise Change dB $L_{A10,18hr}$	Magnitude of Impact
0.0	No change
0.1 – 2.9	Negligible
3.0 – 4.9	Minor
5.0 – 9.9	Moderate
10+	Major

7.5.10 The number of dwellings experiencing a change in nuisance has also been reported for traffic noise and traffic airborne vibration, using the DMRB-specified banding. The DMRB methodology requires the assessment of noise levels on the façade of each dwelling that shows the least beneficial change.

This approach is acknowledged to highlight the adverse impacts of a road project.

7.5.11 DMRB advises that consideration is given to those receptors that are predicted to experience a noise level change in the long term and which are exposed to an $L_{night,outside}$ noise level of 55dB or greater in any scenario. This approach has been followed and the required information reported.

Project specific assessment criteria

Daytime road traffic noise

Residential receptors

7.5.12 The classification of noise impact, provided by DMRB, has been adapted for direct use within specific significance criteria set out in chapter B1 (introduction to the assessment process) (Application Reference Number: 6.2.1).

7.5.13 The magnitude of daytime noise change criteria used in this assessment, and adapted from the DMRB impact scales, are presented below in table 7-3 and table 7-4 for short-term and long-term assessments respectively.

Table 7-4 Magnitude of daytime noise change in the short term

Magnitude of change	Noise change dB $L_{A10,18hr}$	Significance
Large	>= 5.0	Major (significant)
Medium	3.0 – 4.9	Major (significant)
Small	1.0 – 2.9	Moderate (significant)
Negligible	0.1 – 0.9	Minor (not significant)
No effect	0	Negligible (not significant)

Table 7-5 Magnitude of daytime noise change in the long term

Magnitude of change	Noise change dB $L_{A10,18hr}$	Significance
Large	>= 10.0	Major (significant)
Medium	5.0 – 9.9	Major (significant)
Small	3.0 – 4.9	Moderate (significant)
Negligible	0.1 – 2.9	Minor (not significant)
No effect	0	Negligible (not significant)

7.5.14 The adapted assessment criteria for this project also include consideration of the absolute road traffic noise level when assessing the significance of the effect caused by the magnitude of change. The free-field noise level value of 50dB $L_{Aeq,16hr}$ is based upon guidance presented in the *Guidelines for Community Noise* [RD25] which identifies that 50dB $L_{Aeq,16hr}$ represents the

outside daytime noise level below which the majority of the adult population would be protected from becoming moderately annoyed.

7.5.15 According to the *Guidelines for Community Noise* [RD25], an external incident noise level (free-field) of 50dB $L_{Aeq,16hr}$ would result in a noise level within a property of 35dB $L_{Aeq,16hr}$ when taking into account a typical reduction from a partially open window. A noise level of 35dB $L_{Aeq,16hr}$ inside dwellings is used in the guidelines as a level which is intended to preserve indoor speech intelligibility as well as avoiding moderate annoyance to occupants during daytime and evening.

7.5.16 Where the overall exposure to road traffic noise is less than 50dB $L_{Aeq,16hr}$ the magnitude of change in road traffic noise is assessed to be of negligible significance.

7.5.17 Both adverse and beneficial noise changes have been assessed.

7.5.18 A significant adverse day-time noise effect is identified where the noise increase is predicted to be at least a small magnitude of change, and the overall road traffic noise level is predicted to be equal to or above 50dB $L_{Aeq,16hr}$.

7.5.19 A significant beneficial day-time noise effect is identified where the noise reduction is predicted to be at least a small magnitude of change, but the existing road traffic noise level is already equal to or above 50dB $L_{Aeq,16hr}$.

Non-residential receptors

7.5.20 The DMRB requires that the noise changes applicable for residential receptors are also reported for non-residential receptors in the assessment summary tables.

7.5.21 The daytime noise criteria used in this assessment for non-residential receptors are based upon thresholds for the onset of potential significant effects from road traffic noise, as presented in table 7-5 below. It has therefore not been necessary to attribute receptor sensitivity to non-residential receptors.

Table 7-6 Noise level thresholds for the onset of potential significant adverse effects at non-residential receptors

Receptor Type	External free-field road traffic noise level that relates to the onset of a potential significant adverse effect, dB $L_{Aeq,t}$	Relevant guidance	Description of guideline level
Educational	45	Building bulletin 93 [RD21]	Level below which no special measures likely to be necessary to protect buildings or playing fields from external noise.

Receptor Type	External free-field road traffic noise level that relates to the onset of a potential significant adverse effect, dB $L_{Aeq.t}$	Relevant guidance	Description of guideline level
Places of worship	47	BS8233 [RD18]	Internal acoustic design criteria for new places of worship of 35dB L_{Aeq}.
Commercial	52	BS8233 [RD18]	Internal acoustic design criteria for offices in new buildings of 40dB L_{Aeq}.
Industrial	52	BS8233 [RD18]	Internal acoustic design criteria for offices in new buildings of 40dB L_{Aeq}.
Other	>=3dB change	TAN11 [RD5]	A change of 3dB is the minimum perceptible under normal conditions

7.5.22 Whereas the guidelines published by WHO [RD25] provide specific reference to the appropriate and equivalent external noise levels which are required to protect occupants within residential buildings assuming partially opened windows, similar external guideline values are not available for non-residential receptors in BS8233 [RD18]. To ensure a cautious approach for the derivation of equivalent external free-field noise levels (from published guideline internal levels) a reduction of 12dB in noise has been assumed across a partially opened window for places of worship, commercial and industrial receptors. This is at the conservative end of the range identified by studies into open window sound reduction at Napier University [RD35]. It is also at the lower end of the range of between 10dB and 15dB that is often cited for partially open windows in some WHO guidance and other contemporary European noise guidelines.

7.5.23 Only daytime effects are of relevance to the above non-residential receptor classifications.

7.5.24 A potential significant adverse effect is identified where the road traffic noise is predicted to increase by at least 3dB, and the overall road traffic noise level is predicted to be equal to or above the relevant threshold.

7.5.25 A potential significant beneficial effect is identified where the road traffic noise is predicted to reduce by at least 3dB, but the existing road traffic noise level is already equal to or above the relevant threshold.

7.5.26 For ‘other’ non-residential receptor classifications that do not have directly applicable absolute guideline levels set out in the table above (including Public

Rights of Way, community facilities and other outdoor areas), potential significant adverse or beneficial effects have been identified where the road traffic noise is expected to change by at least 3dB.

Night-time road traffic noise

7.5.27 The DMRB methodology approach has been adapted to take into account the specific considerations associated with the expected night-time movements of public service vehicles and the other changes in traffic composition for the Wylfa Newydd Project.

7.5.28 The development of appropriate assessment criteria for night-time noise is based upon consideration of the potential effects arising from the following:

- magnitude of change in noise levels;
- sleep disturbance from noise; and
- adverse health effects from noise.

7.5.29 Maximum noise levels (using the $L_{Amax,F}$ indicator) have been considered in the assessment of potential sleep disturbance. The lower threshold for the onset of potential sleep disturbance is considered to be a free-field noise level of 60dB $L_{Amax,F}$ at the façade of a property based upon guidance set out in the WHO guidelines [RD25].

7.5.30 An absolute external free-field noise level of 40dB L_{night} is considered a health-based limit value necessary to protect the public, including most of the vulnerable groups such as children, the chronically ill and the elderly, from the adverse health effects of night noise as set out in the WHO *Night Noise Guidelines for Europe* [RD26].

7.5.31 An external free-field noise level of 55dB L_{night} is considered to be a value above which adverse health effects can occur frequently as described in the WHO *Night Noise Guidelines for Europe* [RD26]. The adopted criteria therefore recognise the need to protect the public from increases in existing road traffic noise at and above this level.

7.5.32 In summary, the main features of the adapted night-time noise assessment criteria are described below.

- Night-time road traffic noise has been assessed using both the $L_{Aeq,T}$ and $L_{Amax,F}$ noise indicators.
- Road traffic noise levels at 40dB L_{night} or below are not considered to be significant.
- Night-time magnitudes of noise change are assessed using the free-field $L_{Aeq,8hr}$ (or L_{night}) indicator.
- For those receptors with existing road traffic noise levels at or above 55dB L_{night}, a significant adverse effect (assessed using the short-term magnitude of change criteria from the DMRB) is identified where a night-time noise change of 1dB or more is predicted.
- For those receptors with existing road traffic noise levels below 55dB L_{night}, a significant adverse effect (assessed using the long-term

magnitude of change criteria from DMRB) is identified where a noise change of 3dB or more is predicted.

- Individual road traffic event noise levels below 60dB $L_{Amax,F}$ are unlikely to cause adverse sleep disturbance effects and are therefore not considered to give rise to adverse effects alone.

7.5.33 It should be noted that the above approach is considered to be relevant and proportionate given the specific night-time traffic composition expected to occur once the off-line improvement works become operational and the WNDA Development is under construction. The approach is considerably more cautious than the current DMRB requirement to consider only those receptors where the $L_{night,outside}$ noise level from road traffic in any scenario is greater than 55dB, and considers an effect where a 3dB change occurs in the long term.

7.5.34 The WHO guidelines [RD26] advise that "*for a good sleep"* the appropriate maximum indoor (or outdoor) noise level criterion should not be exceeded "*more than 10–15 times per night*". A qualitative assessment of the number of $L_{Amax,F}$ events has been included, in the context of both the pre-existing road traffic noise and the expected changes associated with the development.

7.5.35 Table 7-6 below presents the night-time noise assessment criteria adopted for the project wide effects.

Table 7-7 Magnitude of change criteria for night-time noise

Magnitude of change	Noise change dB L_{NIGHT}		Significance
	Existing traffic noise level, < 55dB L_{NIGHT}	Existing traffic noise level, >= 55dB L_{NIGHT}	
Large	>=10.0	>=5.0	Major (significant)
Medium	5.0 – 9.9	3.0 – 4.9	Major (significant)
Small	3.0 – 4.9	1.0 – 2.9	Moderate (significant)
Negligible	0.1 – 2.9	0.1 – 0.9	Minor (not significant)
No effect	0	0	Negligible (not significant)

7.5.36 Both adverse and beneficial noise changes are assessed.

7.5.37 A significant adverse night-time noise effect is identified where the noise increase is predicted to be at least a small magnitude of change, and the overall road traffic noise levels are predicted to be above 40dB L_{night} and equal to or above 60dB $L_{Amax,F}$.

7.5.38 A significant beneficial night-time noise effect is identified where the noise reduction is predicted to be at least a small magnitude of change, but the existing road traffic noise levels are already above 40dB L_{night} and already equal to or above 60dB $L_{Amax,F}$.

7.5.39 An appraisal of the quantities of night-time $L_{Amax,F}$ events, and the changes in $L_{Amax,F}$ absolute levels, associated with the operation of the A5025 Highway

Improvements has also been undertaken to provide context to, and complement, the assessment of significant adverse effects.

Noise insulation eligibility

Noise insulation regulations

7.5.40 Under *The Noise Insulation Regulations 1975* (as amended 1988) [RD43], the relevant highways authority has a duty to offer to insulate the habitable rooms (which include dining rooms and studies) and bedrooms of dwellings affected by new or altered roads, if the dwellings satisfy the following criteria:

- the residential premises would be within 300m of the new or altered highway;
- the noise level 15 years after opening would be not less than 68dB $L_{A10,18hr}$;
- the predicted noise level 15 years after opening is calculated to be at least 1dB above the level before work commences; and
- the improved highway would contribute at least 1dB to the final noise level.

Wylfa Newydd Project Local Noise Mitigation Strategy

7.5.41 The following sets out the proposed noise criteria for road traffic noise insulation for all residential properties within the defined study area. The criteria have been developed specifically for the highways improvements and the anticipated changes in traffic composition associated with the Wylfa Newydd Project and are to be published in the scheme's Local Noise Mitigation Strategy.

7.5.42 The Local Noise Mitigation Strategy builds upon the statutory requirements and extends the scope of eligibility in the strategy to meet the specific circumstances associated with the Project.

7.5.43 The daytime criteria refer to façade noise levels which are assessed at 1m from the façade of the building and include the noise contribution from reflected noise from the façade.

7.5.44 The night-time criteria refer to free-field noise levels which are assessed at 1m from the façade of the building and exclude the noise contribution from reflected noise from the façade.

7.5.45 For the purposes of the noise insulation criteria outlined below, eligibility as a result of the Wylfa Newydd Project includes consideration of the associated traffic changes (as a result of both construction and operation of the Wylfa Newydd Project) and the A5025 Off-line Highways Improvements. By identifying eligibility at properties alongside unaltered sections of the existing A5025, as well as those affected by new re-aligned sections introduced under the A5025 Off-line Highway Improvements, the Local Noise Mitigation Strategy goes beyond what would be required under the Noise Insulation Regulations [RD43] alone.

7.5.46 The Relevant Noise Level is the maximum noise level within 15 years caused by the construction or operation of the Wylfa Newydd Project and the Prevailing Noise Level is the noise level just prior to the Wylfa Newydd Project's construction commencing.

7.5.47 The noise insulation criteria are presented in table 7-7 below.

Table 7-8 Noise insulation criteria for Wylfa Newydd Highways Improvements

Time of Day	Condition	Eligibility Criteria
Daytime (06.00 to midnight)	For all highways	To follow the *Noise Insulation Regulations 1975* (as amended 1988) [RD43]: The Relevant Noise Level (after rounding to the nearest whole number) from all road traffic must be at least 68dB $L_{A10,18hr}$ after the Project commences construction or becomes operational; Noise from the Wylfa Newydd Project must contribute 1dB to the Relevant Noise Level; The Relevant Noise Level must have increased by at least 1dB above the Prevailing Noise Level; Property within 300m of the Off-line highway; Façade has window or door of eligible room.
Night-time (23.00 to 07.00)	For all highways	The Relevant Noise Level (after rounding to the nearest whole number) $L_{Amax,F}$ is at least 60dB after scheme opening; Where the Prevailing Noise Level L_{night} is at least 55dB or more, the Relevant Noise Level L_{night} must be at least 1dB higher the Prevailing Noise Level L_{night} Property within 300m of the highway; Façade has window or door of eligible room designated for sleeping at night
The design of the noise insulation package should comply with specification of the insulation works as described in Schedule 1 of *The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996.*		

Initial estimates of noise insulation eligibility

7.5.48 This section is concerned with identifying and assessing the likely noise and vibration significant effects associated with the bringing into use of the project-wide highways improvements. Under the assessment framework applied for the Wylfa Newydd Project the provision of noise insulation is not considered to be a method of reducing or remedying such significant effects at individual properties.

7.5.49 Nevertheless, initial estimates of the quantities of residential receptors potentially eligible for noise insulation under the Local Noise Mitigation Strategy proposals have been made for information in this chapter based upon the following simplified screening criteria.

7.5.50 Daytime:

- Façade noise level from all road traffic is predicted to be at least 68dB $L_{A10,18hr}$ at scheme opening; and
- The road traffic noise level increases by at least 1dB.

7.5.51 Night-time:

- The maximum noise level from road traffic is expected to be 60dB $L_{Amax,F}$ or more; and
- Existing L_{night} => 55dB and change in L_{night} is at least 1dB.

8 Marine vessel noise emissions

8.1 Scope

8.1.6 The assessment of noise from transportation of materials to and from the Power Station Site by sea is subject to the following assessments:

- Construction of the Power Station – construction materials would be imported via vessels using the MOLF when it is completed. There would also be construction vessels such as dredgers and barges (acting as working platforms) associated with construction works within the Wylfa Newydd Development Area; and
- Operation of the Power Station – the MOLF would be retained during the operational phase of the Power Station to allow the very infrequent (less than once per year) import of Abnormal Indivisible Loads via vessels.

8.1.7 Baselines for these assessments have been determined largely by measurements of existing conditions. The development scenarios considered included the periods with the highest levels of ship movements and/or greatest volumes of materials imported/exported.

8.1.8 It is envisaged that vessel movements would be influenced by tides, weather and sea conditions, hence the MOLF may be required to operate during both day and night-time periods.

8.2 Input data

8.2.6 The input data particular to the ship noise emissions assessment included the following:

- noise emission data from the range of vessels likely to use the facilities, moving under full power, manoeuvring and working, based on measurements, manufacturer's details or data taken from published sources (octave band or third octave band data have been used where available); and
- details of vessel offshore movements including numbers and routes.

8.3 Modelling methodology

8.3.6 The modelling of vessel noise emissions from the MOLF area during the construction phase has been undertaken using the CadnaA software, set to implement the BS5228-1 [RD14] prediction methodology, as described in section 4.3. These sources are included in the construction noise models.

8.3.7 Some vessels would obviously travel outside this study area, some to the Holyhead North disposal site, others to the Skerries Traffic Separation Scheme which is approximately four nautical miles offshore, and others closer to the coast. The likely change in noise level due to additional Wylfa Newydd Project-related ship traffic using the Skerries Traffic Separation Scheme or passing closer to the coast has been considered by comparing the numbers of vessel movements. As the additional Project-related shipping traffic is forecast to cause

an increase of less than 25% in the total number of vessels using these routes, the change in magnitude is considered to be negligible (broadly an increase of 25% in ship movements would result in 1dB increase in total ship noise) and no further assessment has been undertaken.

8.4 Model outputs

8.4.6 The construction noise models have been used to predict noise levels at selected representative receptors, and in grid format across the study area, in terms of the parameter $L_{Aeq,T}$, for each of the relevant assessment time periods, as described in section 4.4.

8.5 Assessment methodology

8.5.6 The assessment methodology for construction noise impacts is presented in section 4.5.

9 Other noise sources

9.1 Scope

9.1.6 There are a number of additional noise sources which would be introduced into the area as a direct result of the Associated Development required to build and/or operate the Power Station, which do not fall into any of the topic categories discussed in chapters 4 to 8. The additional noise sources identified by the current development proposals include:

- Off-site Power Station Facilities;
- Park and Ride;
- Logistics Centre;
- mechanical or electrical plant (on Associated Development sites and Off-site Power Station Facilities site) e.g. heating, ventilation, air conditioning plant, substation etc.

9.1.7 Baselines for these assessments have been determined largely by measurements of existing conditions. The development scenarios modelled include periods of maximum activity e.g. maximum number of vehicle movements at the Park and Ride and Logistics Centre.

9.1.8 The Park and Ride and Logistics Centre would operate during the daytime and night-time periods. Assessments have been undertaken for both daytime and night-time periods for this Associated Development. There is a proposed requirement for the Off-site Power Station Facilities to support 24-hour working seven days a week and, as such, the operation of building services (including fixed plant and staff vehicle movements) could potentially occur throughout the daytime and night-time period. Therefore, both daytime and night-time periods have been assessed for the Off-site Power Station Facilities.

9.2 Input data

9.2.6 The source-specific input data used for each of these additional noise sources are detailed below:

- Park and Ride – number of light vehicle and bus movements, noise emission data for vehicle manoeuvres, operational hours;
- Logistics Centre – number of heavy goods vehicle movements with noise emission data for manoeuvres;
- mechanical or electrical plant (on Associated Development sites and Off-site Power Station Facilities site) e.g. heating, ventilation, air conditioning plant, substation etc. – plant list with on-times, locations, noise emission data, operational hours, source-specific mitigation e.g. acoustic enclosures etc. Car movements and associated noise emission data.

9.3 Modelling methodology

9.3.6 The modelling for the operation of the Park and Ride, Logistics Centre and Off-site Power Station Facilities has been undertaken using the CadnaA software, set to adopt the ISO9613-2 noise propagation algorithms [RD30]. The modelling methodology is consistent with that used for the Power Station Site, with further details presented in section 6.3 of this Technical Note.

9.4 Model outputs

9.4.6 Model outputs have been provided in the form of tabulated predicted noise levels at receptors, and noise contour plots in 5dB bands, at a height of 4m above ground level. Model outputs are presented as the $L_{Aeq\ T}$ parameter.

9.5 Assessment methodology

9.5.6 The following guidance documents have been used to form relevant numerical assessment criteria:

- BS4142 [RD13] – as detailed in section 6.5;
- BS8233 [RD18] – as outlined in section 3.5;
- WHO *Guidelines for Community Noise* [RD25] – as outlined in section 3.5.3.2; and
- WHO *Night Noise Guidelines for Europe* [RD26] – as outlined in section 3.5.3.2.

9.5.7 The magnitude of change scale for operational noise effects is based primarily upon the assessment methodology contained in BS4142 [RD13]. The approach is consistent with that adopted for the Power Station Site operational assessment, with further details provided in section 6.5.

10 Cumulative effects

10.1 Scope

10.1.6 Each of the assessments described above considers a particular type of noise source or group of activities and their potential effects on receptors. During both the construction and operational phases of the Power Station, Off-site Power Station Facilities and Associated Development, there is the potential for more than one type of noise source or group of activities to be working at the same time. For example, receptors close to the Power Station Site access may experience simultaneous noise from construction activities at the Power Station Site and traffic noise associated with the Wylfa Newydd Project. It is therefore important to assess whether a number of incremental non-significant effects in noise may give rise to noise effects which would result in significant effects.

10.1.7 Noise from committed developments (or those within the planning system) may have the potential to contribute to local noise levels within the study areas. In particular, decommissioning activities at the Existing Power Station may overlap with some Enabling Works or construction works for the Wylfa Newydd Project.

10.1.8 The nature and number of these cumulative and in-combination assessment scenarios have been determined by considering the potential for both temporal and spatial overlap of the noise effects resulting from different aspects of the Wylfa Newydd Project and committed developments. Reference has been made to the study areas defined for each aspect of the Wylfa Newydd Project in order to identify possible spatial overlaps.

10.1.9 Baselines for these assessments have been determined largely by measurements of existing conditions near the different Wylfa Newydd Project sites. As detailed in Section 6.1 for the Power Station Operations, the baselines take into account the cessation of generation of the existing power station. The modelled traffic noise baselines are also of relevance.

10.1.10 Where sufficient technical information concerning noise effects from committed development is unavailable, quantitative assessments of these cumulative effects has not been possible. In these cases, professional judgement has been used to undertake a qualitative assessment.

10.2 Input data

10.2.6 The input data for the cumulative modelling has comprised the results of the individual models for the relevant assessment scenarios and time periods.

10.2.7 With respect to noise emissions from non-Project related committed developments (or similar), the noise assessments submitted in support of the relevant applications have been analysed to obtain relevant noise immission data.

10.3 Modelling methodology

10.3.6 To enable a direct comparison of noise levels from different sources, the noise indicator has been normalised to $L_{Aeq,T}$ where rating levels are assumed to be equitable with the corresponding $L_{Aeq,T}$ values. Day-time traffic noise levels which are commonly reported as $L_{A10,18hr}$ values, however, the traffic noise assessment also includes levels converted to $L_{Aeq,16hr}$ for the purposes of assessing against relevant benchmark criteria such as the WHO guidelines. Therefore the assessments already have $L_{Aeq,T}$ information available for all sources, albeit that some have acoustic features included, and that there are varying reference time periods (T) across the different assessments.

10.3.7 It was not considered appropriate to attempt to normalise to a reference time period across all $L_{Aeq,T}$ values as this could lead to spreading of noise over considerably longer periods than assessed. The values assessed are directly combined without further correction for the reference time period.

10.4 Model outputs

10.4.6 Model outputs are in the form of tabulated immissions at selected receptors.

10.5 Assessment methodology

10.5.6 To understand whether significant effects have worsened or new effects have arisen, it has been necessary to consider day and night-time separately where this is relevant. For the purposes of concise reporting, any effects that occur separately during day or night, have been combined to provide an overall indication of the total adverse effects.

10.5.7 When assessing the noise levels added together from different sources, it is necessary to establish if there is a dominant source. To establish whether a source is dominant the guidance in TAN11 [RD5] has been used. As part of the guidance on Noise Exposure Categories for new dwellings, TAN11 [RD5] states:

> "Mixed sources: this refers to any combination of road, rail, air and industrial noise sources…To check if any individual noise source is dominant (for the purposes of this assessment) the noise level from the individual sources should be determined and then combined by decibel addition (remembering first to subtract 2dB(A) from any aircraft noise contour values). If the level of any one source then lies within 2dB(A) of the calculated combined value, that source should be taken as the dominant one and the site assessed against the appropriate NEC for that source…"

10.5.8 It is implied in TAN11 [RD5] that it is still the total measured level (not the component source level) that is assessed against the relevant NEC.

10.5.9 For the purposes of identifying dominant noise sources and generating combined noise levels, any correction applied to account for the acoustic characteristics of industrial noise has been retained (i.e. the rating level is used). The primary reason for this is that the need for the acoustic features correction is inherent in the procedure used to determine the presence of 'significant adverse impacts'. It would also be the case that if these corrections were removed and only the specific noise level applied, the cumulative effect assessment would inevitably

lead to fewer or reduced significant effects than reported in the assessments for the individual developments.

10.5.10 If a dominant noise source can be identified at a selected receptor then the criteria typically applied to that source have been used (which follows the principles advised in TAN11 for NECs), and that combined noise level from all sources has been re-assessed against that criterion type. This enables an appreciation of the change in the severity of the effects, or severity of new effects, compared to those already reported for the dominant source. The change in the severity of the effect (cumulative vs dominant source) enables a quantification of whether there are new or worsened effects.

10.5.11 Where there is no single dominant source, then an alternative method is required. No guidance on suitable noise assessment criteria in this situation is provided in IEMA guidelines, nor in other relevant publications. The combined mixed source noise level (in dB $L_{Aeq,T}$) is assessed using the individual assessment criteria for the component sources involved in the interaction. The cumulative effects reported are based upon whichever criterion yields the newest or the most severe worsening of, significant effects (compared to those reported for the individual development assessments).

10.6 Summary

10.6.6 The quantitative cumulative effects assessment process has used the following protocol:

- short listing of interactions based upon spatial and temporal scoping;
- identification of the different Wylfa Newydd noise sources of the interaction(s) at each selected receptor;
- identification of different Wylfa Newydd assessment methods for the sources within the interaction(s);
- normalise all component noise levels to the L_{Aeq} noise indicator;
- sum the component contributions using logarithmic addition to provide a combined noise level in L_{Aeq} at each selected receptor;
- assess where there is a dominant source at each receptor (based upon TAN11 approach [RD5]);
- if there is a dominant source at the particular receptor then assess the combined noise level against the assessment criteria for the dominant source at each receptor;
- if there is no dominant source at the particular receptor, then assess the combined noise level against each individual assessment criteria associated with the component contributions at each receptor. Consider only the highest of the resulting cumulative effects for each receptor; and
- assess whether any effects from the combined noise level assessment are worse than those already reported from the higher of all of the component assessments.

10.6.7 Where a quantitative approach is not possible, a qualitative process has used the following protocol:

- short listing of interactions based upon spatial and temporal scoping;
- identification of the different committed development noise sources at each selected receptor;
- identification of different committed development assessment methods for the different sources;
- apply professional judgement on whether there is likely to be a dominant source at each selected receptor;
- apply professional judgement on whether the effects reported in the individual assessments of committed developments will cause worse, or new, significant effects compared to those from the Wylfa Newydd Project as a whole.

11 Site suitability

11.1 Scope

11.1.6 The Wylfa Newydd Project includes a noise-sensitive development in the form of the Site Campus. In order to assess the potential environmental effects on future occupants of this accommodation, a site suitability assessment has been undertaken.

11.1.7 The existing and future baselines are not strictly relevant to the assessment of site suitability, since it is the future 'with development' noise levels that the occupants of the Site Campus would experience. However, reference has been made to measurements taken in the vicinity, in order to ensure noise from non-development-related sources is fully characterised.

11.1.8 The assessment periods have been selected as appropriate to the operational hours of each noise-sensitive development, and include:

- 16 hours – weekday daytime (07.00–23.00); and
- 8 hours – night-time (23.00–07.00).

11.2 Input data

11.2.6 Realistic worst-case predicted façade noise levels from the construction works were provided for each of the proposed Site Campus units for use in the assessment. Details of the proposed modular building system were provided to enable an assessment of the external noise break-in and internal sound insulation. A Royal Institute of British Architects Stage 2 [RD44] concept design assessment has been undertaken (outlining the acoustic performance criteria for the development, including consideration of the feasibility of ventilating each of the accommodation block units using natural ventilation) and has been referred to in the site suitability assessment.

11.3 Modelling methodology

Consideration has been given to the predicted external noise levels at each of the Site Campus units. Reference has also been made to acoustic performance specifications that have been specified for the various façade elements of the Site Campus, in order to achieve target internal ambient noise criteria. To estimate levels of internal noise, standard calculation methods from BS8233 [RD18] and BS EN ISO 12354-3:2017 [RD19] were used to determine the required sound insulation for the building envelope.

11.4 Model outputs

11.4.6 The model outputs comprised a tabulated range of external and internal noise levels for the Site Campus units. Derived preliminary acoustic performance specifications for the external façades, glazing, roof constructions and ventilation have been referred to in the assessment.

11.5 Assessment methodology

11.5.6 The site suitability assessments have been undertaken by reference to the following benchmark noise criteria:

- TAN11 [RD5] – sets out Noise Exposure Categories which local planning authorities should take into account when assessing residential development applications. The Noise Exposure Categories for road traffic noise and mixed sources are detailed in table 11-1, along with the corresponding advice to local authorities;
- BS8233 [RD18] – as outlined in section 3.5; and
- WHO *Guidelines for Community Noise* [RD25] – as outlined in section 3.5.

11.5.7 The methodology does not consider L_{Amax} internal noise levels, as the information available at this stage of the project is not sufficient to enable such an assessment. However, there will be provision within the application for prior consent under Section 61 of the Control of Pollution Act [RD45] to place controls on L_{Amax} noise levels for specific activities (e.g. noise from percussive piling works), should these be undertaken near the Site Campus.

Table 11-2 TAN11 NECs for road traffic and mixed sources

NEC	DAYTIME NOISE LEVELS ($L_{AEQ07.00\text{-}23.00HRS}$)	NIGHT-TIME NOISE LEVELS ($L_{AEQ23.00\text{-}07.00HRS}$)	ADVICE
A	<55	<45	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.
B	55–63	45–57	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.
C	63–72	57–66	Planning permission should not normally be granted. Where it is considered that permission should be given, for example, because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	>72	>66	Planning permission should normally be refused.

12 Summary

12.1.6 This Technical Note has set out the general approach that has been adopted for the noise and vibration modelling and assessments which are required to support the planning and permitting applications for the development and operation of the Power Station and Associated Development.

12.1.7 The noise modelling has been undertaken using the CadnaA software, supplemented where appropriate by the use of verified spreadsheets, which implemented recognised UK or international calculation standards. The data inputs used include 3-dimensional information on the development and its surrounding area and noise source emission data (including location, on-times, operational hours, numbers of items/movements etc. The data inputs and model outputs for each specialist assessment have been detailed in the relevant sections above.

12.1.8 The vibration modelling has been undertaken using spreadsheets which implemented relevant national calculation standards. The calculation inputs included data describing the development layouts and ground conditions, in addition to source-specific parameters such as hammer energy for piling, and drum width for vibratory compaction.

12.1.9 The calculation methodologies, parameters, and relevant assessment guidance documents for both noise and vibration are summarised below in table 12-1 for ease of reference.

Table 12-2 Summary of calculation methodologies, output parameters and assessment guidance

Topic	Calculation Methodology	Parameter	Relevant Assessment Guidance
Construction and earthworks noise	BS5228-1 [RD14]	$L_{Aeq\ T}$	BS5228-1 [RD14] MTAN1 [RD6] WHO Guidelines [RD25] BS8233 [RD18]
Construction and earthworks vibration	BS5228-2 [RD15]	PPV	BS5228-2 [RD15] MTAN1 [RD6] BS6472-2 [RD16] AS2187.2 [RD46]
Power Station operations	ISO 9613-2 [RD30] BS EN 12354-4 [RD20]	$L_{Aeq\ T}$	BS4142 [RD13] BS8233 [RD18] WHO Guidelines [RD25] NANR45 [RD31]
Road traffic noise	CRTN [RD23] BS5228-1 [RD14]	$L_{A10\ T}$ $L_{Aeq\ T}$	DMRB [RD24]

Topic	CALCULATION METHODOLOGY	PARAMETER	RELEVANT ASSESSMENT GUIDANCE
	ISO 9613-2 [RD30] TRL Report 752 [RD40] NAC guide	L_{Amax}	Noise Insulation Regulations [RD43]
Ship noise emissions	ISO 9613-2 [RD30]	$L_{Aeq\ T}$	BS8233 [RD18] WHO Guidelines [RD25] BS4142 [RD13]
Other noise sources	ISO 9613-2 [RD30]	$L_{Aeq\ T}$	BS4142 [RD13] BS8233 [RD18] WHO Guidelines [RD25]
Cumulative effects	Logarithmic decibel addition	$L_{Aeq\ T}$	BS8233 [RD18] WHO Guidelines RD25]
Site suitability	BS8233 [RD18] and/or BS EN12354-3 [RD19] for internal noise levels	$L_{Aeq\ T}$	TAN11 [RD5] BS8233 [RD18] WHO Guidelines [RD25]

13 References

ID	REFERENCE
RD1	Department of Energy and Climate Change. 2011b. *National Policy Statement for Nuclear Power Generation (EN-6)*. London: The Stationery Office.
RD2	Department of Energy and Climate Change. *2011a. Overarching National Policy Statement for Energy (EN-1)*. London: The Stationery Office.
RD3	Welsh Government. 2016. *Planning Policy Wales (Edition 9).* [Online]. [Accessed: November 2016]. Available from: http://gov.wales/docs/desh/publications/161117planning-policy-wales-edition-9-en.pdf.
RD4	Welsh Government, 2013. *A Noise Action Plan for Wales 2013-2018*. Cardiff: National Assembly for Wales.
RD5	Welsh Office, 1997. *Technical Advice Note 11 (TAN11): Noise*. Cardiff: National Assembly for Wales.
RD6	Welsh Assembly Government. 2004. *Minerals Technical Advice Note (MTAN) Wales 1: Aggregates*. Cardiff: National Assembly for Wales.
RD7	Department of the Environment and the Welsh Office. 1993. *Minerals Planning Guidance 11: The Control of Noise at Surface Mineral Workings*. Cardiff: National Assembly for Wales.
RD8	Isle of Anglesey County Council (IACC) and Gwynedd Council. 2017. Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026, Written Statement, Composite Version incorporating Matters Arising Changes. [Online]. [Accessed: April 2017] Available from: : http://www.anglesey.gov.uk/Journals/z/t/f/Composite-Plan-MACs-2017.pdf
RD9	Isle of Anglesey County Council (IAAC). 2014. *New Nuclear Build at Wylfa: Supplementary Planning Guidance*. [Online]. [Accessed: August 2016]. Available from: http://www.anglesey.gov.uk/download/39341
RD10	Isle of Anglesey County Council (IACC). 1996. *Ynys Môn Local Plan.* Isle of Anglesey.
RD11	Gwynedd County Council. 1993. *Gwynedd Structure Plan*. [Online]. [Accessed: August 2016]. Available from: http://www.anglesey.gov.uk/planning-and-waste/planning-policy/current-plans-and-policies/gwynedd-structure-plan/
RD12	Isle of Anglesey County Council (IAAC). 2005. *Stopped Unitary Development Plan.*

ID	REFERENCE
RD13	British Standards Institution (BSI). 2014. BS4142:2014 Methods for rating and assessing industrial and commercial sound. London: BSI.
RD14	British Standards Institution. 2014. BS5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Noise. London: BSI.
RD15	British Standards Institution. 2014. BS5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Vibration. London: BSI.
RD16	British Standards Institution. 2008. BS6472:2008 Guide to evaluation of human exposure to vibration in buildings, part 1 vibration sources other than blasting and part 2 blast-induced vibration. London: BSI.
RD17	British Standards Institution. 2003. BS7445:2003 *Description and measurement of environmental noise*. London: BSI.
RD18	British Standards Institution. 2014. BS8233:2014 *Guidance on sound insulation and noise reduction for buildings*. London: BSI.
RD19	British Standards Institution. 2017. BS EN 12354-3:2017 – Building acoustics: estimation of acoustic performance in buildings from the performance of elements: Airborne sound insulation against outdoor sound. London: BSI.
RD20	British Standards Institution. 2017. BS EN 12354-4:2017 – Building acoustics: estimation of acoustic performance in buildings from the performance of elements: Transmission of indoor sound to the outside. London: BSI.
RD21	Department for Education and Education Funding Agency. 2015. *Acoustic design of schools: performance standards. Building bulletin 93*. London: The Stationery Office.
RD22	Institute of Acoustics and the Association of Noise Consultants. 2014. *Acoustics of Schools: a design guide.* St Albans.
RD23	Department for Transport and the Welsh Office. 1988. *Calculation of Road Traffic Noise.* Cardiff: National Assembly for Wales.
RD24	Highways Agency. 2011. Design Manual for Roads and Bridges Vol 11 Environmental Assessment Section 3, Part 7 Noise and Vibration (HD213/11 – Revision 1)
RD25	World Health Organization. 2009. *Guidelines for community noise.* Geneva: WHO.
RD26	World Health Organization, 2009. *Night Noise Guidelines for Europe*. Geneva: WHO.

ID	REFERENCE
RD27	Institute of Environmental Management and Assessment. 2014. *Guidelines for Environmental Noise Impact Assessment.* Lincoln: IEMA.
RD28	Environment Agency. 2002. Horizontal Guidance for Noise Part 2 – Noise Assessment and Control. Bristol: EA.
RD29	Environment Agency, 2015. Noise impact assessment – information requirements. Bristol: EA.
RD30	International Organization for Standardisation (ISO). 1996. ISO 9613-2:1996. Acoustics – Attenuation of sound propagation outdoors – Part 2: General method of calculation.
RD31	Moorhouse A.T., Waddington D.C. and Adams M.D. 2011. *Procedure for the assessment of low frequency noise complaints*. NANR45, Revision 1. Report for the Department for Environment, Food and Rural Affairs.
RD32	Horizon Nuclear Power. 2016. Wylfa Newydd Project Pre-Application Consultation Stage 2, Preliminary Environmental Information Report.
RD33	Horizon Nuclear Power. 2014. Baseline Noise Monitoring Plan *Wylfa Newydd main site and surrounds*, DCRM Ref Number: HNP-S5-PAC-REP-00020.
RD34	Magnox. 2008. Wylfa Nuclear Power Station, Environmental Statement.
RD35	Napier University. 2007. *Sound insulation through ventilated domestic windows*. Research project for DEFRA; NANR116: Open/closed window research.
RD36	European Commission. 2016. Best Available Techniques (BAT) Reference Document for Large Combustion Plants. Seville: EC.
RD37	European Commission. 2006. Integrated Pollution Prevention and Control - Reference Document on Best Available Techniques for Large Combustion Plants. Seville: EC.
RD38	Highways Agency. 2015. Interim Advice Note 185/15 - Updated traffic, air quality and noise advice on the assessment of link speeds and generation of vehicle data into 'speed-bands' for users of DMRB Volume 11, Section 3, Part 1 Air Quality and Volume 11, Section 3, Part 7 Noise.
RD39	Noise Advisory Council. 1978. A guide to measurement and prediction of the equivalent continuous sound level. UK: National Advisory Council.
RD40	Transport Research Laboratory. 2015. Laboratory Report 752 - Dutch-style Roundabout Capacity Report.

ID	REFERENCE
RD41	NOISE-CON 2007, Ross and Staiano. 2007. A comparison of green and conventional diesel bus noise levels.
RD42	International Organization for Standardisation (ISO). 1996. *ISO 9613-2:1996* Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation.
RD43	Gov.uk. 1988. Noise Insulation Regulations 1975 (as amended 1988).
RD44	RIBA. 2013. RIBA Plan of Work 2013. *RIBA Stage 2*. [Online]. [Accessed: 09 January 2018]. Available from: https://www.ribaplanofwork.com/PlanOfWork.aspx
RD45	Gov.uk. 1974. *Control of Pollution Act 1974*. London: Her Majesty's Stationary Office.
RD46	Australian Standard ™. Explosives—Storage and use Part 2: Use of explosives. AS2183.2