Immingham Green Energy Terminal
Green Hydrogen Production Facility

EPR/VP3425SV/A001

Environmental Permit Application

Noise Impact Assessment

Environmental Permitting (England and Wales) Regulations 2016

Applicant: Air Products (BR) Ltd

May 2024

Environmental Permitting (England and Wales) Regulations 2016

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Appendix E - Noise Impact Assessment

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GLOSSARY

Abbreviation	Definition
APBRL	Air Products (BR) Limited
ABP	Associated British Ports
BAT	Best Available Techniques
DCO	Development Consent Order
EA	Environment Agency
EIA	Environmental Impact Assessment
EP	Environmental Permit
H_2	Hydrogen
HPU	Hydrogen Production Unit
IGET	Immingham Green Energy Terminal
ISO	International Standards Organization
Km	kilometre
NIA	Noise Impact Assessment
NH3	Ammonia
NMP	Noise Management Plan
NSIP	Nationally Significant Infrastructure Project
NSR	Noise Sensitive Receptors
OS	Ordnance Survey
UK	United Kingdom

1 Synopsis

This Noise Impact Assessment (NIA) has been prepared by AECOM on behalf of Air Products (BR) Limited (APBRL), referred to as 'the Operator', in support an Environmental Permit application for the proposed Green Hydrogen (H_2) Production Facility ('proposed installation'). The proposed installation forms part of the wider Immingham Green Energy Terminal ('IGET') Nationally Significant Infrastructure Project (NSIP) being developed by Associated British Ports ('ABP') on the eastern side of the Port of Immingham, situated in northeast Lincolnshire on the south bank of the Humber Estuary.

It should be noted that the Environmental Permit application and consequently this NIA is being carried out prior to completion of detailed design of the plant. As such, some worst-case assumptions have been applied to the assessment, which may lead to an over-prediction of the potential impacts. At the detailed design stage, opportunities to reduce the predicted *specific sound levels* further will be explored and APBRL will continue to ensure that Best Available Techniques (BAT) mitigation is applied to the plant design. Following detailed design, it is proposed that this NIA assessment be reviewed, updated, and resubmitted to the Environment Agency, if required, through a pre-operational condition to be included in the Environmental Permit.

The NIA has been prepared following the Environment Agency's Noise and Vibration Management: Environmental Permits[1] guidance.

The focus of the NIA has been on the potential effects of operational sound upon the nearest residential Noise Sensitive Receptors (NSRs) to the proposed installation.

The assessment comprises the following:

- Review of baseline surveys undertaken as part of the Environmental Impact Assessment (EIA) to support the Development Consent Order (DCO) for IGET (Immingham Green Energy Terminal - Project information (planninginspectorate.gov.uk).
- BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'[2], assessment of the proposed plant.
- Proposal of options to prevent or reduce noise impact, in line with BAT or appropriate measures.

A sound propagation model has been created using the noise modelling software CadnaA to provide a 3D representation of the proposed installation.

[1] Noise and vibration management: environmental permits - GOV.UK (www.gov.uk)
[2] British Standards Institute (BSI). (2019). BS 4142:2014+A1:2019: 'Methods for rating and assessing industrial and commercial sound'.

In accordance with BS 4142 the representative *background sound levels* at NSRs have been compared against the predicted operational *rating levels* (the *specific sound levels* with character correction).

The initial BS 4142 assessment identifies that based on the worst-case scenario, there is the potential for adverse/ significant adverse impacts at the nearest NSRs. The context of the existing industrial and commercial operations in the area, which all contribute to the overall acoustic environment, is also taken into consideration.

Additional mitigation is proposed in Section 7 of this report, following the principles of BAT. With the additional mitigation measures incorporated into the design, the proposed installation would have a low impact on the NSRs.

APBRL will continue to follow appropriate BAT, and during the detailed design stage opportunities to reduce the *specific sound levels* further will be explored.

This NIA has been used to develop a Noise Management Plan (NMP) for the proposed installation.

2 Introduction

2.1 Background

AECOM has been commissioned by Air Products (BR) Limited (APBRL) to undertake a Noise Impact Assessment (NIA) to support an Environmental Permit application for the proposed Green Hydrogen (H_2) Production Facility ('proposed installation'). The proposed installation forms part of the wider Immingham Green Energy Terminal ('IGET') Nationally Significant Infrastructure Project (NSIP) being developed by Associated British Ports ('ABP') on the eastern side of the Port of Immingham, situated in northeast Lincolnshire on the south bank of the Humber Estuary.

This report presents the results of the NIA, comprising a BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' (BS 4142) assessment at nearest noise sensitive receptors (NSR).

The proposed installation will provide capacity to produce green hydrogen to help decarbonise the United Kingdom's (UK) transport sector and ultimately assist transition towards net zero.

The Environment Agency (EA) is a statutory consultee to the DCO application and must provide assurance to the Planning Inspectorate that the proposed installation would be granted a permit to operate, in order that the Examining Authority gains confidence that there is no impediment to the granting of the DCO. It is recognised that the permit application is being submitted prior to the detailed design of the project has been completed and that further information may need to be provided to the EA following completion of the detailed design process, in order to reflect design changes that may have occurred post-application submission. Where possible, conservative or worst-case assumptions have been used in this application to potentially minimise any updates required.

2.2 Proposed Installation

The proposed installation comprises the development of a green H2 production facility which includes infrastructure for the offloading and transfer of green ammonia (NH3) from ships to ammonia storage facilities, the main H2 production facility and vehicle and trailer H2 refuelling facilities.

The proposed installation will be located in North East Lincolnshire on the south bank of the Humber Estuary on the eastern side of the Port of Immingham. The installation location will be approximately centred on National Grid Reference (NGR) E520783 N415271.

The environmental permit application is therefore for an H2 production facility which comprises the following within the installation boundary:

- NH_3 ship offloading infrastructure to facilitate the receipt of NH_3 for H_2 production. The offloading infrastructure will be located on a new jetty being constructed by Associated British Ports (ABP). Only the offloading infrastructure is incorporated in the application and the jetty itself remains outside the installation boundary.
- NH_3 transfer pipeline which links the ship offloading infrastructure with the NH_3 storage tanks located on the east site.
- East site which comprises:

    a. NH_3 storage tank and related plant including an NH_3 tank flare stack and boil-off gas compression system to liquefy the generated boil-off gas during offloading from Ship and static boil-off from Ammonia Tank.
    b. H_2 production facility comprising up to three H_2 production units including associated flue gas and flare stacks.
    c. Power distribution buildings for NH_3 and H_2 production plant~~H2~~.
    d. Instrumentation buildings for NH_3 and H_2 processes.
    e. Analyser shelters for the H_2 production plant.
    f. Pipe-racks, pipelines, pipes, utilities and other infrastructure associated with both NH_3 and H_2 equipment.
    g. Welfare facility.
- West site which comprises:
    a. H_2 production facility comprising up to three H_2 production units including associated flue gas and flare stacks.
    b. Up to four liquefier units.
    c. H_2 storage tanks.
    d. H_2 trailer filling stations.
    e. H_2 vent stack and associated process equipment.
    f. H_2 vehicle and trailer filling stations.
    g. H_2 compressors and associated process equipment.
    h. Control room and workshop building.
    i. Security and visitor building.
    j. Contractor building.
    k. Warehouse.
    l. Driver administration building.
    m. Safe haven building.
    n. Electrical substation and metering station.
    o. Power distribution buildings.
    p. Process instrumentation buildings.
    q. Analyser buildings.
    r. Process and utility plant including cooling towers and pumps, fire water tank, instrument air equipment, pipe racks, pipelines, pipes, cable racks, utilities and other infrastructure nitrogen generation package (HPN) with LIN Tank and LIN Vaporizers and steam generation package.
- Pipeline corridor for underground pipelines, pipes, cables and other conducting media for the transfer of NH_3, H_2, nitrogen (N_2) and utilities, with cathodic protection against saline corrosion.

The Operator and ABP together have made an application to the Secretary of State for Business, Energy and Industrial, under section 37 of the Planning Act 2008, for a development consent order (DCO) for the construction, operation and maintenance of a multi-user liquid bulk terminal and its associated green hydrogen facility for the production of green hydrogen.

Subject to the DCO being granted, there would be a phased approach to the construction of the project over a period of six years. The construction of the terminal and the first phase of the hydrogen production facility would comprise the first phase of the development and following completion, a further five phases of hydrogen production would be constructed incrementally to increase the processing capacity as

the market for green hydrogen increases. There would be six development phases in total.

2.3 Scope of Assessment

The assessment comprises the following items:

- Review of baseline surveys undertaken as part of the EIA to support the DCO for IGET.
- BS 4142 assessment of the proposed plant in operation.
- Presentation of options to prevent or reduce noise impact, in line with BAT or appropriate measures.
- Provision of a report detailing the baseline sound measurements, acoustic modelling, calculations and assessment work, suitable for submission to the EA as part of the Environmental Permit application.

3 Assessment Locations

The installation is situated to the east of the Port of Immingham and largely outside of the operational area of the Port. The area surrounding the Port is industrial in nature, being dominated by chemical manufacturing, oil processing and power generation facilities. Residential and commercial properties are present to the south of the Port on Queens Road, some of which lie within the proposed installation site boundary. Beyond the industrial facilities, the wider area is largely agricultural. The nearest major residential area is on the eastern edge of the town of Immingham approximately 460 m from the western edge of the proposed West Site installation boundary.

Key NSR locations, which are considered representative of the nearest and potentially most sensitive existing receptors to the proposed installation, have been identified based upon knowledge of the local area and professional judgement. It is considered that if noise and vibration levels are suitably controlled at these receptors, then noise and vibration levels will be suitably controlled at other more distant sensitive receptors in the surrounding area. The NSRs are described in Table 3-1.

With respect to the residential and part residential properties within the installation boundary along Queens Road, given their proximity to the hydrogen production facility on the West Site, their acquisition is proposed in order to secure cessation of the residential use before operation of the West Site. Therefore, the residential properties on Queens Road (known as NSR 1 and NSR 2 in the DCO ES Chapter 7 Noise and Vibration) have not been included in this noise impact assessment of the operation of the proposed development.

On the basis of the above, the nearest identified NSRs during operation of the installation are listed in Table 3-1 and are shown in Figure A1 in Appendix A. For the purposes of this assessment the NSR numbering from the DCO ES Chapter 7 Noise and Vibration have been retained.

Table 3-1: Identified nearest NSRs

NSR ID	Location	Approx. distance and direction from installation boundary (m)
NSR 3	Residential properties at Chestnut Avenue, Waterworks Street and Spring Street (eastern extent of Immingham's residential urban area). Properties in this area are grouped together with the above and later referred to as NSR3 for the purpose of this assessment.	480 m north-west of the Site Boundary
NSR 4	Residential properties at Somerton Road, Worsley Road, Dunster Walk, Ings Lane, Oakham Walk, Talbot Road and Kendal Road (eastern extent of Immingham's residential urban area). Properties in this area are later referred to as NSR4 for the purpose of this assessment.	460 m west of the Site Boundary

At NSRs to the west of the proposed installation on the eastern edge of Immingham (represented by NSR3 and NSR4 in the DCO ES Chapter 7 Noise and Vibration) the typical sources of sound likely to influence/dominate the baseline sound environment are the road traffic on the A1173 and A180, more distant industrial/commercial premises to the east of the A1173 (associated with power production, manufacturing, waste and port facilities) and occasional distant aircraft. The land between the NSRs (NSR 3 and NSR 4) and the proposed development is open fields.

4 Methodology

4.1 Baseline Sound Surveys

A range of sound surveys were undertaken as part of the EIA carried out to support the DCO application for the proposed installation, at locations representative of the nearest NSRs.

Sound level monitoring was undertaken to the requirements of BS 7445-1:2003 'Description and measurement of environmental noise. Guide to quantities and procedures'[3] (BS 7445) and BS 4142, regarding instrumentation and monitoring methodology. This comprised unattended and attended measurements with observations made on set up, and collection of unattended equipment.

All measurements were taken at approximately 1.5 m above ground level and were positioned at least 3.5 m from any acoustically reflecting surface, other than the ground (i.e. free-field measurements). Each sound level meter was set to log the $L_{AF10,15mins}$, $L_{Aeq15mins}$, $L_{AF90,mins}$ and L_{AFmax} parameters. The weather conditions during the survey periods were all within the parameters set out in the relevant guidance documents including BS 7445 and BS 4142.

Attended sound measurements were undertaken in October 2022 representative residential location in the vicinity of the Site, as follows:

- ML1 – outside 31 Queens Road, Immingham (representing NSR1 at the eastern end of Queens Road, however data from this location has not been used in this assessment as Queen Roads Receptors (NSR1 and NSR2 excluded as stated in Section 3).
- ML2 – on land off Worsley Road (representing NSR4 on the eastern edge of Immingham. However, the data at this location has not been used in this assessment as it has been superseded by the long term unattended monitoring at ML4)

In addition, unattended sound measurements surveys were undertaken in April 2023 at two further representative residential locations in the vicinity of the Site. The unattended sound monitoring locations are as follows:

- ML3 – inside garden of 17 Spring Street, Immingham (representing NSR3 on the eastern edge of Immingham).
- ML4 – inside garden of 29 Talbot Road, Immingham (representing NSR4 on the eastern edge of Immingham).

[3] British Standards Institute (BSI). (2003). BS 7445-1 – Description and measurement of environmental noise. Guide to quantities and procedures

.All monitoring locations are presented on Figure A1 in Appendix A. The survey at ML2 included a minimum of one-hour measurements during the daytime (between the hours 07:00 to 23:00) and 30-minutes during the night-time (between the hours of 23:00 to 07:00). The surveys at ML3 and ML4 included a minimum of seven days of baseline sound level data collection.

4.2 Operational Noise Prediction and Assessment

The predictions of operational sound from the proposed installation have been based on information provided by Air Products engineering design team. This information has included sound power levels for the major sound sources and details of the acoustic performance of noise mitigation measures already embedded into the designs such as siting of equipment away from site boundaries and NSRs. During detailed design stage, where necessary, industrial sound will be mitigated further as discussed in DCO ES Chapter 7 Noise and Vibration. The predictions also take into account the distance between the proposed plant and NSRs and the acoustic screening offered by existing topography and existing and proposed new buildings.

The proposed plant sound power levels and the assumptions applied to the prediction methodology are detailed in Appendix B.

A three-dimensional sound propagation model has been developed using the modelling software CadnaA® Version 2023 MR1 to predict the levels of sound generated by the mechanical and process plant on site. CadnaA® implements the prediction method ISO 9613-2:1996 ‘Attenuation of sound during propagation outdoors’[4], which has been employed to calculate sound levels at surrounding NSRs due to the proposed installation.

A digital terrain model created using publicly available ground elevation spot height data has been used to position buildings and other noise sources at the proposed heights relative to ground. Areas of acoustically soft (e.g. vegetation) and hard (e.g. concrete) ground have been identified from the Ordnance Survey (OS) MasterMap Topographic Layer and modelled accordingly.

The following sources of information have been reviewed and form the basis of the assessment:

- Indicative Layout and Zoning Plan for the Proposed Development as provided by Air Products;
- Items of plant including sound power level data for Proposed Development as provided by Air Products;

[4] International Standards Organization (Part 1: 1993, Part 2: 1996) ISO 9613 – Acoustics – Attenuation of sound during propagation outdoors, ISO.

- OS MasterMap mapping, topographical data (LiDAR data) and aerial photography of the site and surrounding area.

The prediction method assumes that the prevailing wind direction is always from source to receiver, which is likely to overestimate sound from the plant for much of the time at NSRs at the eastern edge of Immingham (represented by NSR3 and NSR4), given the predominant wind direction in the UK is from the south-west.

Based upon the predicted sound levels from the model, an assessment of potential impacts at nearby NSR has been undertaken using the guidance in BS 4142.

A key aspect of the BS 4142 assessment procedure is a comparison between the '*background sound level*' in the vicinity of residential locations and the '*rating level*' of the sound source under consideration. The relevant parameters in this instance are as follows:

- *background sound level* – $L_{A90,T}$ – defined in the Standard as the "A-weighted sound pressure level that is exceeded by the residual sound for 90% of a given time interval, *T*, measured using time weighting F and quoted to the nearest whole number of decibels";
- *specific sound level* – *L*s ($L_{Aeq,Tr}$) – the "equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, *T*r"; and
- *rating level* – $L_{Ar,Tr}$ – the "specific sound level plus any adjustment made for the characteristic features of the sound".

BS 4142 requires that a one-hour assessment period is considered during the day (07:00 to 23:00) and a 15-minute assessment period at night (23:00 to 07:00). When in operation the sound produced by the proposed installation will be constant in nature. As the proposed installation may operate at any time of day or night, the predicted *specific sound levels* will be the same for both day and night. The predicted free-field operational *specific sound levels* at the NSRs during the daytime have been predicted at the ground floor and the night-time levels have been predicted at the upper floor.

BS 4142 also allows for corrections to be applied based upon the presence or expected presence of the following at the receptor location:

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

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

> *"Typically, the greater the difference, the greater the magnitude of impact. A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context. A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context. The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound*

level, this is an indication of the specific sound source having a low impact, depending on the context."

BS 4142 requires that the *rating level* of the sound source under assessment be considered in the context of the environment when defining the overall significance of the impact.

The potential for sound of a tonal, impulsive or intermittent nature will be designed out of the proposed installation during the detailed design phase by the selection of appropriate plant, building cladding, louvres and silencers/attenuators as necessary. However, inclusion of a +3 dB correction for other distinctive character has been included at this stage as a conservative approach for NSR with the potential to identify the new sound source in their existing acoustic environment.

The operational facilities and equipment associated with the proposed installation are located within the West Site and East Site, as shown in Figure A1 in Appendix A

5 Baseline Sound Surveys and Operational Sound Level Predictions

5.1 Baseline Sound Surveys

Sound level monitoring was undertaken at the locations as described in Section 4. Details of ongoing activities and noise sources in the area were recorded whilst in attendance at the monitoring locations and around the Site.

The weather conditions during the attended survey periods were all within the parameters set out in the relevant guidance documents including BS 7445. During the unattended survey period, some meteorological conditions fell outside the acceptable range and therefore baseline data collected at these times have been excluded from this assessment.

The sound level meters and associated microphones were field calibrated at the beginning and end of their respective measurement periods in accordance with recommended practice. No significant drift in calibration was observed. The accuracy of the calibrator can be traced to the National Physical Laboratory Standards.

Details of the survey locations, equipment used and conditions recorded at the NSRs can be found in Appendix A.

Descriptions of noise sources observed on site during the measurements for the Project at ML3 and ML4 during the daytime are included in Table 5-1 and night-time noise sources are included in Table 5-2.

Table 5-1: Daytime measurement details

Location	Date	Time of day	Description of sound environment
ML3	19/04/2023 – 26/04/2023	15.45-14.00	A180 road noise, alarm from east Port, Port noise, neighbouring dogs, birdsong.
ML4	19/04/2023 – 27/04/2023	14.00-11.45	A180 road noise, alarm from east Port, occasional noise from footpath, birdsong.

Table 5-2: Night-time measurement details

Location	Date	Time of day	Description of sound environment
ML3	19/04/2023 – 26/04/2023	23.00-07.00	Unattended monitoring, but expected to be A180 road noise, distant port noise and general residential area activities.
ML4	19/04/2023 – 27/04/2023	23.00-07.00	Unattended monitoring, but expected to be A180 road noise, distant port noise and general residential area activities.

A summary of the daytime sound levels for monitoring locations ML3 and ML4 are presented in Table 5-3.

Table 5-3: Summary of measured daytime sound levels

Measurement Location	Start Time	Duration/ End Time	Measured sound levels			
			dB $L_{Aeq,T}$	dB $L_{AF90,T}$	dB $L_{AFmax,T}$	dB $L_{AF10,T}$
ML3	07:00 (20/4/23)	23:00	66	45	83	52
	07:00 (21/4/23)	23:00	50	45	75	50

Measurement Location	Start Time	Duration/ End Time	Measured sound levels			
			dB $L_{Aeq,T}$	dB $L_{AF90,T}$	dB $L_{AFmax,T}$	dB $L_{AF10,T}$
	07:00 (22/4/23)	23:00	48	43	79	50
	07:00 (23/4/23)	23:00	47	40	73	49
	07:00 (24/4/23)	23:00	48	42	82	49
	07:00 (25/4/23)	23:00	47	41	76	48
ML4	07:00 (20/4/23)	23:00	62	45	83	50
	07:00 (21/4/23)	23:00	49	45	72	49
	07:00 (22/4/23)	23:00	46	38	75	47
	07:00 (23/4/23)	23:00	45	40	78	46
	07:00 (24/4/23)	23:00	48	43	80	48
	07:00 (25/4/23)	23:00	47	41	76	48

All values are in A-weighted dB re 20 µPa, Free-field

A summary of the night-time sound levels for monitoring locations ML3 and ML4 are presented in Table 5-4.

Table 5-4: Summary of measured night-time sound levels

Measurement Location	Start Time	Duration/ End Time	Measured sound levels			
			dB $L_{Aeq,T}$	dB $L_{AF90,T}$	dB $L_{AFmax,T}$	dB $L_{AF10,T}$
ML3	23:00 (19/4/23)	07:00	55	44	67	48
	23:00 (20/4/23)	07:00	45	41	70	45
	23:00 (21/4/23)	07:00	43	37	69	43
	23:00 (22/4/23)	07:00	43	38	67	45
	23:00 (23/4/23)	07:00	41	36	76	41
	23:00 (24/4/23)	07:00	41	38	71	41
	23:00 (25/4/23)	07:00	49	43	74	48
ML4	23:00 (19/4/23)	07:00	57	44	71	48
	23:00 (20/4/23)	07:00	47	41	70	46
	23:00 (21/4/23)	07:00	44	36	69	43
	23:00 (22/4/23)	07:00	45	36	69	44
	23:00 (23/4/23)	07:00	44	38	71	43
	23:00 (24/4/23)	07:00	46	40	73	45
	23:00 (25/4/23)	07:00	49	40	74	47

All values are in A-weighted dB re 20 µPa, Free-field

5.2 Representative Baseline Sound Levels

Representative baseline sound levels have been established for daytime and night-time periods. Table 5-5 summarises the defined *ambient sound levels* and *background sound levels* taken forward within this assessment for the NSRs on the eastern edge of Immingham, in the vicinity of each noise monitoring location.

Table 5-5: Representative *ambient sound levels* (L_{Aeq}) and *background sound levels* (L_{A90})

Assessment Period	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML4
Daytime L_{Aeq} dB (07.00 – 23.00)	58	55
Night-time L_{Aeq} dB (23.00 – 07.00)	48	50
Daytime L_{A90} dB (07.00 – 23.00)	41	39
Night-time L_{A90} dB (23.00 – 07.00)	39	37

5.3 Operational Sound Level Predictions

As stated in Section 4, sound models have been created to predict the operational *specific sound levels* from the Proposed Installation. The Proposed Installation plant has been modelled as part of a "reasonable worst case" scenario based on different site layout configurations of HPUs and Hydrogen Liquefiers, as described below.

Several models have been produced to identify the potential worst-case scenario and highest noise levels at NSR. This has been through modelling different layouts of HPUs and Hydrogen Liquefier units across the West Site and East Site, and changes in unit orientation.

In analysing the different model variations that have been produced, the highest predicted sound levels at NSRs have been used within the assessment.

There is limited scope for substantive change in layout of plant items within the HPUs and Hydrogen Liquefier areas across the west and East Sites due to the necessary process function.

The operational sound modelling comprises two main scenarios: Phase 1 operation of the proposed installation, potentially representative of the first three years after opening, and then full operation of Phases 1-6 thereafter.

Further details of the sound source sound power level data, the settings used in the sound modelling software and the list of assumptions used are presented in Appendix B.

A 'reasonable worst case' operational layout has been assessed which is defined as follows:

- The operational layout of West Site and East Site are configured such that the noisiest possible configuration of HPUs and Hydrogen Liquefiers has been assessed, in the context of the NSRs at the eastern edge of Immingham. The HPUs have a higher sound power level, therefore this configuration assumes the HPUs are located at the western edge of the installation area of West Site.
- The HPUs and Hydrogen Liquefiers are themselves comprised of a number of individual plant elements, some of which generate noise. The items of plant are spatially separated as determined by their process function. The assessment assumes the noisiest possible configuration for an individual HPU or Hydrogen Liquefier in the context of the NSRs at the eastern edge of Immingham. The plant elements with the higher sound power levels are the "Flue Stack (ID Fan)" for a HPU and the Two "N2 Companders" for a Hydrogen Liquefier.

- This approach means that in future a different configuration could be brought forward and the noise effects at the NSRs on the Eastern edge of Immingham would be no worse than that assessed.

It should be noted that within this reasonable worst-case assessment, acoustic benefits of embedded mitigation (i.e. features that are inherently part of the design of the proposed installation) not specifically included for noise reduction purposes, have been included in the modelling (See Section 7 of this report for details).

However, in the absence of additional specific noise mitigation measures, the predicted free-field operational *specific sound levels* at the NSRs around the Site Boundary are presented in Table 5-6.

Table 5-6: Predicted worst-case operational *specific sound levels* (without additional specific noise mitigation measures)

Phase	Predicted operational *specific sound level* $L_{Aeq,Tr}$ dB free-field	
	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4
Phase 1 Only	43-47	44-47
Phases 1-6 (full operation)	46-49	47-50

Given that the plant on-site could operate 24/7, the above predicted sound levels could apply to both the 1-hour daytime or 15-minute night-time BS 4142 assessment periods.

6 Sound Impact Assessment

The following tables present the BS 4142 assessment summary during the daytime and night-time for NSR 3 and NSR 4 without additional specific noise mitigation measures. The predicted *specific sound levels* are rounded to the nearest whole decibel. The assessment is based on the difference between the representative *background sound level* ($L_{A90,T}$) and the predicted *rating level* ($L_{Ar,Tr}$) dB (i.e. the *specific sound level* $L_{Aeq,Tr}$ plus any character correction) at the NSR. Positive values in the table indicate an excess of the *rating level* over the *background sound level*.

Table 6-1 shows the daytime initial BS 4142 assessment for the proposed installation.

Table 6-1: Initial Daytime BS4142 assessment (without additional specific noise mitigation measures)

Receptor	Phase 1 only		Phase 1-6 (Full Operation)	
	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4
Specific sound level L_s ($L_{Aeq,Tr}$), dB	43-47	44-47	46-49	47-50
Acoustic feature correction, dB	+3	+3	+3	+3
Rating level ($L_{Ar,Tr}$), dB	46-50	47-50	49-52	50-53
Representative *background sound level* ($L_{A90,T}$), dB	41	39	41	39
Excess of *rating level* over *background sound level* ($L_{Ar,Tr}$ - $L_{A90,T}$), dB	+5 - +9	+8 - +11	+8- +11	+11 - +14
BS 4142:2014 impact category	An indication of an adverse/ significant adverse impact, depending on the context	An indication of a significant adverse impact, depending on the context	An indication of a significant adverse impact, depending on the context	An indication of a significant adverse impact, depending on the context

Table 6-2 shows the night-time initial BS 4142 assessment for the proposed installation.

Table 6-2: Initial Night-time BS4142 assessment (without additional specific noise mitigation measures)

Receptor	Phase 1 only		Phase 1-6 (Full Operation)	
	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4
Specific sound level L_s ($L_{Aeq,Tr}$), dB	43-47	44-47	46-49	47-50

Receptor	Phase 1 only		Phase 1-6 (Full Operation)	
	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4
Acoustic feature correction, dB	+3	+3	+3	+3
Rating level ($L_{Ar,Tr}$), dB	46-50	47-50	49-52	50-53
Representative *background sound level* ($L_{A90,T}$), dB	39	37	39	37
Excess of *rating level* over *background sound level* ($L_{Ar,Tr}$ - $L_{A90,T}$), dB	+7 - +11	+10 - +13	+10 - +13	+13 - +16
BS 4142:2014 impact category	An indication of a significant adverse impact, depending on the context	An indication of a significant adverse impact, depending on the context	An indication of a significant adverse impact, depending on the context	An indication of a significant adverse impact, depending on the context

The results in Tables 6.1 and 6.2 indicate that there is the potential for an adverse to significant adverse impact when the *rating level* is compared to the *background sound level* at each NSR location. However, the context of the area and the existing sound climate should be taken into consideration when determining the overall impact.

6.1 Consideration of Context

The proposed installation is adjacent to the operational area of the Port of Immingham, one of the busiest ports in the UK, operating 24 hours a day, 365 days a year. The area surrounding the Port is also primarily industrial in nature, being dominated by chemical manufacturing, oil processing and power generation facilities. Beyond the industrial facilities, the wider area is largely agricultural.

The proposed installation will replace some temporary storage activities currently operating on parts of the proposed installation site and also use areas zoned for future employment enterprise zone. This, as well as the existing operational port traffic using Queens Road, Laporte Road and other nearby access routes is likely to mean that many residents in the local communities are already accustomed to an industrial sound environment.

Table 6-3 presents existing and future predicted *ambient sound levels* (assuming constant operation of the Project) and compares them to the BS8233:2014 and WHO 'Guidelines for Community Noise' recommended indoor *ambient sound level* for sleeping. The recommended internal criterion is 30 dB $L_{Aeq,8h}$, which would be equivalent to an external criterion of 45 dB $L_{Aeq,8h}$ assuming a reduction through a façade with the windows partially open for ventilation of 15 dB.

Table 6-3: Comparison of *ambient sound levels* (without additional specific noise mitigation measures)

Receptor	Time Period	Existing *ambient sound level* $L_{Aeq,T}$, dB	Predicted *specific sound level*, $L_{Aeq,Tr}$, dB	Sum of existing *ambient sound level* and predicted *specific sound level* $L_{Aeq,Tr}$, dB	Predicted increase in existing *ambient sound level* due to the proposed installation, $L_{Aeq,Tr}$ dB
NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue)	Daytime (16 hour)	58	46 – 49	58-59	0 - +1
	Night-time (8 hour)	48	46 – 49	50-52	+2 - +4
NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road)	Daytime (16 hour)	55	47 – 50	56	+1
	Night-time (8 hour)	40	47 – 50	47-50	+8 -+10

As shown in Table 6-3, *ambient sound levels* at NSRs are predicted to increase when the predicted *specific sound levels* from the proposed installation are added, and all are above the BS8233:2014/WHO external criterion of 45 dB $L_{Aeq,8h}$.

The WHO Night Noise Guidelines (WHO, 2009) for Europe consider the long-term effect of night-time noise on the population. The requirement for health-based guidelines originated from the European Union Directive 2002/49/EC relating to the assessment and management of environmental noise (known as the Environmental Noise Directive). The 2009 Night Noise WHO Guidelines are intended to complement rather than replace the 1999 WHO Guidelines for Community Noise.

The 2009 Night Noise WHO Guidelines assess the effect of noise during the night-time using the $L_{night,outside}$ parameter. This considers the external noise level averaged over a complete year for the 8-hour night time period. The Guidelines state:

> *"There is no sufficient evidence that the biological effects observed at the level below 40 dB $L_{night,outside}$ are harmful to health. However, adverse health effects are observed at the level above 40 dB $L_{night,outside}$, such as self-reported sleep disturbance, environmental insomnia, and increased use of somnifacient drugs and sedatives. Therefore, 40 dB $L_{night,outside}$ is equivalent to the lowest observed adverse effect level (LOAEL) for night noise."*

The 2009 WHO Night Noise Guidelines suggest a night-time noise guideline of 40 dB $L_{night,outside}$ and an interim target of 55 dB $L_{night,outside}$ in situations where the achievement of the night-time noise guideline is not feasible in the short-term. With regard to the suggested night-time noise guideline of 40 dB $L_{night,outside}$ the guidance states:

> *"The LOAEL of night noise, 40 dB $L_{night,outside}$, can be considered a health-based limit value of the night noise guidelines 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."*

Given that the operational sound emissions from the proposed installation could occur at any time of day/ night, provided that sound levels are acceptable during night-time hours, they will automatically be acceptable during daytime period when existing *ambient sound levels* are higher. The noise survey results used within this assessment

confirm that existing night-time *ambient sound levels* exceed the 40 dB $L_{night,outside}$ recommendation at NSR3. When existing baseline night-time *ambient sound levels* and predicted *specific sound levels* from the proposed installation are combined, all values are equal to or less than the interim target of 55 dB $L_{night,outside}$.

Nevertheless, on this basis of the above BS 4142 assessment, potential additional mitigation options to reduce noise levels are discussed in Section 7 of this report.

7 Noise Control

7.1 Embedded Mitigation

As part of the operational assessment for the EIA, the proposed installation was modelled based upon plant data provided by the project design team. Embedded mitigation was incorporated into the noise model including (but not limited to) features on site that are required for the operation of the site but are not explicitly used for acoustic attenuation/insulation. Examples include concrete flood walls, which will provide a level of screening of plant noise from different areas on site, such as from HPUs, Hydrogen Liquefiers and utility areas.

Design decisions, such as the lagging of pipework for on-site plant have also been applied within the operational noise model and form part of embedded mitigation.

Table 7-1 describes the items of plant within the operational noise model that have embedded mitigation attenuation values assigned to them.

Table 7-1: List of embedded mitigation used within the initial operational noise model.

Embedded Mitigation	Item of Plant attenuated by embedded mitigation	Level of attenuation provided (dB)
Concrete Fire Walls	H2 Refuelling Station – Reciprocating Pumps (West Site)	10
Lagging of pipework in accordance with ISO 15665	Intercooler Skids/Oil Removal Skids (all) (West Site)	5
Concrete Fire Walls/Blast Walls surrounding the "Compression Area"	All items in the "Compression Area" including LP and Bulk Hydrogen High Pressure Compressors, and Air-Cooled Intercooler (West Site)	10
Concrete Flood Walls/Blast Walls	Boil Off Gas Compressor Package (@ 50%) – w/Enclosure (East Site)	10

Details of the operational plant sound power level data and building material sound insulation performance can be found in Appendix B Operational Sound Information.

As stated in Section 4 the operational noise assessment has assumed that potential sound of a tonal, impulsive or intermittent nature (according to BS4142: 2014) will be designed out of the Project during the detailed design phase through the selection of appropriate plant, building cladding, louvres and silencers/ attenuators as necessary. Based on the worst-case results presented in Section 6, additional mitigation would be required to achieve a BS 4142 outcome of no greater than +5 dB excess of rating level over background sound level, or lower, at nearby NSRs.

7.2 Additional Specific Noise Mitigation Measures

The contribution at each NSR from each modelled sound source across the proposed installation has been ranked. The potential attenuation required from the source sound power levels of the key noise emitting plant is listed in Table 7-2. These reductions could be achieved either through reduction of sound power level at source or by application of the mitigation measures listed below.

During the detailed design stage it may be more practical to apply higher attenuation to some plant items/buildings than the attenuation levels listed in Table 7-2 in order to reduce the attenuation applied to other plant items/ buildings and still achieve the same overall level of reduction (i.e. to achieve a *rating level* no greater than +5 dB above defined *background sound level*). It is also possible that changes will be proposed to plant specifications, or the number of plant required on-site for normal process function, during the detailed design of the proposed installation. The Operational Noise Management Plan would set out the appropriate mitigation.

Table 7-2: Attenuation required (dB) from individual plant items

Plant	Location	Quantity	Required attenuation to achieve a *rating level* no greater than +5 dB above defined *background sound level*
Individual Items of Plant			
H2 Refuelling Station - Reciprocating Pumps	West Site Hydrogen Refuelling Station	2	30* (10 dB embedded, 20 dB additional)
Two N2 Companders + Lube Oil System	West Site (LHY35) Hydrogen Liquefiers Areas	4	20
Bulk Hydrogen High Pressure Fill Compressor – Glycol Circuit Air Cooler	West Site Compression Area	6	25* (10 dB embedded, 15 dB additional)
Bulk Hydrogen High Pressure Fill Compressor – Hydraulic Oil Pump Motor	West Site Compression Area	6	25* (10 dB embedded, 15 dB additional)
LP Tube Fill Compressor	West Site Compression Area	2	25* (10 dB embedded, 15 dB additional)
LP Tube Fill Compressor Motor	West Site Compression Area	2	25* (10 dB embedded, 15 dB additional)
Cooling Tower - Cooling Water Motor Pump	West Site	6	15
Cooling Tower - Cooling Water Pump Motor	West Site	6	15
Cooling Tower Fan Air Outlet	West Site	6	5
Air-Cooled Intercooler	West Site Compression Area	8	10
Chiller for K400A/B/C/D Aftercooler	West Site Compression Area	1	10
Common Air-Cooled Cylinder Jacket Water Cooler	West Site Compression Area	1	10
Intercooler Skids/Oil Removal Skids	West Site Hydrogen Liquefiers Areas	18 x 4 Liquefier Areas	10* (5 dB embedded, 5 dB additional)
Common Air-Cooled Cylinder Jacket Water Cooler	West Site Compression Area	1	10

Plant	Location	Quantity	Required attenuation to achieve a *rating level* no greater than +5 dB above defined *background sound level*
Intercooler Skids/Oil Removal Skids	West Site Hydrogen Liquefiers Areas	18 x 4 Liquefier Areas	10* (5 dB embedded, 5 dB additional)
Nitrogen Generator (24HPN) Package Expanders Vacuum Can S218 Compressor Inlet Filter Compressor with on skid close-fit enclosure Tepsa Skid C182A/B U004 Process Container U004 Vent	West Site	1 of each item as part of the 24HPN package	10
H2 PSA (West Site Only)	West Site HPU Area	3 x West Site	10
Air Inlet – FD Fan	West and East Site HPU Area	3 x West Site 3 x East Site	10
Flue Stack (ID Fan)	West and East Site HPU Area	3 x West Site 3 x East Site	10
ID Fan	West and East Site HPU Area	3 x West Site 3 x East Site	5
FD Fan	West and East Site HPU Area	3 x West Site 3 x East Site	5
FD Fan Motor	West and East Site HPU Area	3 x West Site 3 x East Site	5
ID Fan Motor	West and East Site HPU Area	3 x West Site 3 x East Site	5
ID Fan Inlet Ducting (Insulated)	West and East Site HPU Area	3 x West Site 3 x East Site	5
FD Fan Inlet Ducting (Insulated)	West and East Site HPU Area	3 x West Site 3 x East Site	5
NH3 Hydrogen Production Unit – (Work Area No. 7 Only) Burner Pipes: West Wall Only	West Site HPU Area	3 x West Site	5
East Ammonia Storage	East Site	2	10

Plant	Location	Quantity	Required attenuation to achieve a *rating level* no greater than +5 dB above defined *background sound level*
Boil Off Gas Compressor Package with Enclosure			
Buildings			
LHY35 Compressor Building - 4 Walls and Roof	LHY35 Compressor Building - 4 Walls and Roof	4 x West site	10
Cooling Tower Air Inlet Face Side A	Cooling Tower Air Inlet Face Side A	1 x West Site	10
Cooling Tower Air Inlet Face Side B	Cooling Tower Air Inlet Face Side B	1 x West Site	10

**The level of attenuation includes "embedded mitigation" which takes into account attenuation that has been already considered and implemented during the initial design phases of the Project.*

These reductions could be achieved either through reduction of sound power levels at source or by application of BAT, and general principles include, but are not limited to, the measures set out in Table 7-3.

Table 7-3: Best Available Techniques

Technique	Description	Applicability
Operational Measures	These include: • Inspection and maintenance of equipment; • Closing of doors and windows of buildings and enclosed areas, where possible; • Plant operated by experienced staff; • Avoidance of noisy activities at night, if possible.	These are part of good working practices at the installation.
Low-noise equipment	Select low noise equipment where possible.	When equipment is new or being replaced. Where practicable low noise equipment will be procured for the installation.
Noise Attenuation	These include: • Use of screening or bunding to shield receptors from noise sources; • Reducing the breakout noise from plant through the use of enhanced enclosures, or potentially containing them within a building.	This has been considered during the development of the proposed installation and will continue to be considered during the detailed design.
Noise Control Equipment	This includes: • Reducing air inlet noise emissions by the addition of further in-line attenuation; • Reducing stack outlet noise emissions by the addition of silencers or sound proofing panels; • Reducing fan cooler emissions by screening, re-sizing, fitting low noise fans or attenuation; • Use of anti-vibration supports and interconnections for equipment.	To be considered during the detailed design of the installation
Appropriate Location of Equipment and buildings	Orientation of plant within the site to provide screening of low-level noise sources by other buildings and structures, or orientating fans and the air inlets away from sensitive receptors	This has been considered during the development of the proposed installation and will continue to be considered during the detailed design.

The operational assessment has assumed that potential sound of a tonal, impulsive or intermittent nature (according to BS4142: 2014) will be designed out of the plant during the detailed design phase through the selection of appropriate plant, building cladding, louvres and silencers/ attenuators as necessary.

Throughout the development of the proposed installation, practical measures to mitigate noise will be incorporated into the design as detailed above and the implementation of further mitigation on proposed plan may be prohibitive, and use of BAT will be taken in to account. In addition, a Noise Management Plan has been prepared to support the Environmental Permit application.

With the above additional specific noise mitigation measures included in the noise models, the predicted free-field operational *specific sound levels* at the NSRs around the Site Boundary are presented in Table 7-4.

Table 7-4: Predicted worst-case operational *specific sound levels* with additional specific noise mitigation measures

Phase	Predicted operational *specific sound level* $L_{Aeq,Tr}$ dB free-field	
	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4
Phase 1 Only	33-36	33-36
Phases 1-6 (full operation)	36-39	37-38

Table 7-5 shows the daytime BS 4142 assessment with additional mitigation.

Table 7-5: Daytime BS4142 assessment with additional specific noise mitigation measures

Receptor	Phase 1 only		Phase 1-6 (Full Operation)	
	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4
Specific sound level L_s ($L_{Aeq,Tr}$), dB	33-36	33-36	36-39	37-38
Acoustic feature correction, dB	+3	+3	+3	+3
Rating level ($L_{Ar,Tr}$), dB	36-39	36-39	39-42	40-41
Representative *background sound level* ($L_{A90,T}$), dB	41	39	41	39
Excess of *rating level* over *background sound level* ($L_{Ar,Tr}$ - $L_{A90,T}$), dB	-5 - -2	-3 - 0	-2- +1	+1 - +2
BS 4142:2014 impact category (including consideration of context in Section 6)	Indication of low impact	Indication of low impact	Indication of low impact	Indication of low impact

Table 7-6 shows the night-time BS 4142 assessment with additional mitigation.

Table 7-6: Night-time BS4142 assessment with additional specific noise mitigation measures

Receptor	Phase 1 only		Phase 1-6 (Full Operation)	
	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4	NSR3 (vicinity of Spring Street, Waterworks Street & Chestnut Avenue) / ML3	NSR4 (vicinity of Talbot Road, Worsley Road & Somerton Road) / ML2, ML4
Specific sound level L_s ($L_{Aeq,Tr}$), dB	33-36	33-36	36-39	37-38
Acoustic feature correction, dB	+3	+3	+3	+3
Rating level ($L_{Ar,Tr}$), dB	36-39	36-39	39-42	40-41
Representative *background sound level* ($L_{A90,T}$), dB	39	37	39	37
Excess of *rating level* over *background sound level* ($L_{Ar,Tr}$ - $L_{A90,T}$), dB	-3 - 0	-2 - +2	0 - +3	+3 - +4
BS 4142:2014 impact category (including consideration of context in Section 6)	Indication of low impact	Indication of low impact	Indication of low impact	Indication of low impact

Based on the BS 4142 assessment with additional specific noise mitigation measures and considering the context of the existing industrial sound environment, noise impacts from the proposed installation on the nearest NSRs would be considered likely to have a low impact.

8 Assessment Uncertainty

As outlined previously, the operational noise is assessed against the *background sound levels* obtained during daytime and night-time surveys undertaken in 2022 and 2023 as part of the DCO EIA. There are inherent uncertainties involved with the use of any measurement survey data, due to the general variation in area activities on different occasions. However, given the extended duration of the surveys in 2023, the nature of the area and the monitoring locations selected, uncertainty will have been reduced.

Sound emission data for key sound emitting plant/buildings within the West and East Sites have been based on data provided by APBRL. These data are assumed to be representative of the proposed plant, although the precise methodology by which these data were gathered by third parties, and hence the uncertainty associated with these, is not known.

Predictions of sound pressure levels according to ISO 9613 are based on an assumption of moderate downwind propagation, and hence could be considered as a worst-case calculation. However, the standard also indicates an estimated accuracy of ±3 dB in predicted levels at the heights and distances relevant to this assessment.

Although the proposed plant will operate 24 hours a day, 7 days a week, not all of the plant will operate all of the time, as operation is dependent upon demand and ambient temperatures. For example, a key source of noise from the plant is associated with cooling, which would only be in full operation in the highest anticipated ambient air temperatures. Therefore, the assessment of all plant operating at full power at the same time is considered a robust worst-case scenario, and in reality, operational noise levels will be lower for much of the year as cooling is only required during periods of warm/ hot weather.

9 Conclusions

This noise assessment has been prepared by AECOM on behalf of APBRL to support an Environmental Permit application (Permit number EPR/VP3425SV/A001) for the proposed Green Hydrogen (H_2) Production Facility ('proposed installation') which forms part of the wider Immingham Green Energy Terminal ('IGET') Nationally Significant Infrastructure Project (NSIP) being developed by Associated British Ports ('ABP') at the eastern end of the Port of Immingham.

The focus of the assessment has been on operational sound level impacts upon the nearest residential NSR to the proposed installation.

The baseline sound surveys undertaken as part of the DCO application for IGET have been used to determine the existing representative *background sound levels* and *ambient sound levels* at the NSRs.

A sound propagation model has been created using the sound modelling software CadnaA to provide a 3D representation of the proposed installation and to predict sound levels at NSRs in accordance with ISO 9613.

In accordance with BS 4142, the defined representative *background sound levels* at the NSRs have been compared against the predicted operational *rating levels* (the *specific sound levels* plus appropriate character corrections).

An initial BS 4142 assessment identifies that based on the worst-case scenario, with no additional specific noise mitigation measures incorporated into the project design, there is the potential for adverse/ significant adverse impacts at the nearest NSRs.

Additional mitigation is proposed in Section 7, following the principles of BAT. With the additional specific noise mitigation measures incorporated into the design, sound emissions from the proposed installation are predicted to achieve *rating levels of* no greater than +5 dB above defined *background sound level,* and would be considered to have a low impact at the nearest NSRs when considering the context of the existing environment.

APBRL will continue to follow appropriate BAT and during the detailed design stage opportunities to reduce the *specific sound levels* further will be undertaken.

This NIA has been used to develop a Noise Management Plan (NMP) for the proposed installation.

Appendix A Baseline Monitoring Locations and Survey Data

Monitoring Locations

The monitoring and assessment locations are shown on Figure 7.1. The drawing focuses on the West Site where receptors are more abundant.

Revision: 1 Drawn: EB Checked: DF Approved: DP Date: 2024-03-05

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AECOM

PROJECT

Immingham Green Energy Terminal

CLIENT

Associated British Ports
Air Products (BR) Limited

CONSULTANT

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5th Floor
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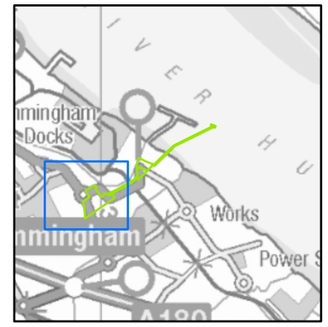
LEGEND

- Permit Installation Boundary
- Sound Monitoring Location

NSR Assessment Location

- NSR1
- NSR2
- NSR3
- NSR4



NOTES

ISSUE PURPOSE

Environmental Statement

PROJECT NUMBER

60673509

DEVELOPMENT CONSENT ORDER NO

TR030008

FIGURE TITLE

Sound Monitoring Locations

FIGURE NUMBER

Figure 7.1

Survey Data/ Reports

The following reports have been used to determine the representative *background sound levels* and existing *specific sound levels*.

1. AECOM (2023) environmental Statement Appendix 7A Sound Survey Information.

Appendix B Sound Modelling Data and Assumptions

Noise Model Settings

An operational sound model covering the west and East Site has been constructed in CadnaA (version 2023 MR1) acoustic modelling software. This software implements the sound propagation calculation methodology set out in ISO 9613-2:1996: Attenuation of Sound during Propagation Outdoors.

Noise Model Input Data

The data sources presented in Table 9-1 to Table 9-3 below have been used to construct the sound model.

Table 9-1: Noise Model Input Data – Individual Items of Plant

Equipment Number	Source	Linear sound power levels for each frequency band (dB)									Number in model	LWA (dB)
		31.5	63	125	250	500	1k	2k	4k	8k		
West Site Utilities – Low Noise Cooling Tower												
607-U901	Cooling Tower Air Inlet Face (Side A & Side B)	105	107	107	103	100	98	96	96	95	2	105
	Cooling Tower Fan Air Outlet	100	102	102	98	95	93	89	86	82	6	98
600-G901 (A to F)	Cooling Water Pump	89	90	91	93	93	96	93	89	83	6	100
600-D901 (A to F)	Cooling Water Pump Motor	85	87	89	90	90	93	93	85	78	6	98
West Site Utilities – Nitrogen Generator (24 HPN)												
607-U923	Compressor with On-Skid Close-Fit Enclosure	96	97	95	90	91	93	86	85	79	1	96
	Compressor Inlet filter	86	87	90	89	97	99	90	88	81	1	101
	U004 Process Container	97	96	98	92	89	91	92	93	89	1	99
	U004 Vent	84	91	3	85	81	55	94	100	98	1	103
	Tepsa Skid C182A/B	92	92	90	85	85	88	89	91	87	1	96
	Expanders	80	78	75	71	73	75	84	81	82	1	88
	Vacuum Can S218	90	92	85	81	87	86	89	92	89	1	96
600 West Site Utilities – Other												
602-K922A 602-K922B	Instrument Air Compressor	92	87	87	86	89	92	92	90	87	2	97
N/A	H2 Refueling Station Reciprocating pumps									N/A	2	121

383-K300 (A & B)	LP Tube Fill Compressor		107	109	107	105	104	102	98	93	2	109
383-D300A (A & B)	LP Tube Compressor Motor	90	92	94	94	94	94	94	91	84	2	100
N/A	Air-cooled Intercooler	83	86	86	83	80	78	75	70	67	8	83
N/A	Common Air-cooled Cylinder Jacket Water Cooler	83	86	86	83	80	78	75	70	67	1	83
383-D450 (A, B, C, E, F, G)	Bulk Hydrogen High Pressure Fill Comp. Hydraulic Oil Pump Motor	94	96	98	98	98	98	98	95	88	6	104
383-D462 (A1/A2, B1/B2, C1/C2, E1/E2, F1/F2, G1/G2)	Bulk Hydrogen High Pressure Fill Comp. Glycol Circuit Air Cooler	83	86	86	83	80	78	75	70	67	6	83
383-U650 A	Chiller for K400A/B/C/D Aftercooler	83	86	86	83	80	78	75	70	67	1	83
741 East Site Utilities – Other												
740-K922 A&B	Instrument Air Compressor	93	88	88	87	90	93	93	91	88	2	99
741 East Site – Storage Area												
741-D3811 A, B, C, D	NH3 Transfer Pump	82	84	86	86	86	86	86	83	76	3	92
N/A	Boil Off Gas Compressor Package (@ 50%) – w/Enclosure	101	104	108	117	109	93	77	68	62	2	110
231 LHY1 (Liquifier Areas)												
231-K271-281	Two N2 Companders + Lube Oil System	105	107	108	98	108	105	107	116	112	4	119

N/A	Intercooler Skids/Oil Removal Skids	Linear frequency data unavailable 18 per each Liquifier area (72 altogether across the model)										90
271 NH3 Dissociator (Hydrogen Production Unit Area)												
271-U501	H2 PSA	63	78	81	89	102	106	107	109	104	6	114
271-F217	Flue Stack (ID Fan)	**112**	**112**	**112**	**108**	**103**	**97**	**87**	**82**	**75**	6	105
271-K211	ID Fan	**104**	**101**	**96**	**89**	**86**	**80**	**77**	**75**	**73**	6	88
271-D211	ID Fan Motor	**103**	**102**	**101**	**95**	**91**	**89**	**86**	**83**	**81**	6	95
N/A	Air Inlet (FD Fan)	**113**	**111**	**109**	**104**	**100**	**99**	**96**	**91**	**88**	6	104
271-K212	FD Fan	**104**	**103**	**100**	**95**	**93**	**89**	**85**	**80**	**75**	6	95
271-D212	FD Fan Motor	**96**	**95**	**94**	**88**	**86**	**82**	**79**	**76**	**74**	6	88
N/A	ID Fan Inlet Ducting (Insulated)**	112	109	104	95	90	84	81	79	78	6	94
N/A	FD Fan Inlet Ducting (Insulated)**	110	109	106	99	95	91	87	82	77	6	98
271-F201	NH3 Hydrogen production unit – North Wall	81	88	95	93	88	77	67	52	37	6 buildings radiating these noise sources	89
	NH3 Hydrogen production unit – South Wall	81	88	95	93	88	77	67	52	37		89
	NH3 Hydrogen production unit – East Wall	80	87	95	92	87	76	66	52	36		88
	NH3 Hydrogen production unit – West Wall	80	87	95	92	87	76	66	52	36		88
	NH3 Hydrogen production unit – Vent Gril – North	89	86	90	84	82	81	80	75	71	6	87
	NH3 Hydrogen production unit – Vent Gril – South	89	86	90	84	82	81	80	75	71	6	87
	NH3 Hydrogen production unit – Vent Gril – East	89	86	90	84	82	81	80	75	71	6	87
	NH3 Hydrogen production unit – Vent Gril – West	89	86	90	84	82	81	80	75	71	6	87

	NH3 Hydrogen production unit – Burn Pipes – East	92	92	98	90	90	87	87	83	83	6	94
	NH3 Hydrogen production unit – Burn Pipes – West	92	92	98	90	90	87	87	83	83	6	94

Table 9-2 presents the full list of sound power level data used for each item of plant that modelled within a building as part of the IGET Operational Noise model.

Table 9-2: Noise Model Input Data – Building Sound Sources

Equipment number	Sources within Buildings	Linear sound power levels for each frequency band (dB)									Number in model	LWA
		31	63	125	250	500	1k	2k	4k	8k		
LHY35 Compressor Building (Dimensions – 36 m x 24 m x 15 m)												
231-K221/231/241	H2 Recycle Compressor + Lube Oil system	N/A	112	113	111	109	107	106	101	96	4 Buildings across the full site	113
231-D240	H2 Recycle Compressor Motor	N/A	89	96	97	101	108	108	98	91		112
231-K251/261	N2 Recycle Compressor + Lube Oil System	N/A	124	128	129	123	127	128	126	115		133
231-D260	N2 Recycle Compressor Motor	N/A	103	108	100	100	97	105	85	76		107
Combined Sound Power Level of All Equipment		***N/A***	***124***	***128***	***129***	***123***	***127***	***128***	***126***	***115***		--
Hydrogen Production Unit Building (Dimensions – 14 m x 18 m x 15 m)												
271-K681	Tail Gas Compressor	N/A	104	105	103	101	99	98	93	88	6 Buildings across the full site	105
271-D681	Tail Gas Compressor Motor	56	71	83	91	96	99	101	97	88		105
Combined Sound Power Level of All Equipment		***N/A***	***104***	***105***	***103***	***102***	***102***	***102***	***99***	***91***		--

The following items of plant, although containing noise source information, were deemed as being “emergency items” only and were not modelled as part of the operational noise model.

a) 600 West Utilities
   - Diesel Generator Sets and Diesel Generator Set Exhausts
   - Diesel Drivers and Diesel Driver Exhausts
   - Firewater Pumps, Firewater Pump Motors and Firewater Jockey Pump Motors

b) 741 East Utilities
   - Diesel Drivers and Diesel Driver Exhausts
   - Firewater Pumps, Firewater Pump Motors, Firewater Jockey Pump and Firewater Jockey Pump Motor

c) 231 LHY1 Area
   - Diesel Generator Sets and Diesel Generator Set Exhausts

d) 741 Storage Area
   - Flare

Where possible the duration of the emergency plant will be kept to a minimum through prompt attention to resolving power outages or plant failure.

Building Material Sound Insulation Performance Data

For items of plant that are located within buildings, the internal reverberant sound pressure level is first calculated from the combined items of plant before the sound insulation performance of the wall panel systems and internal linings is taken into account in order to predict sound levels outside the buildings.

Table 9-3 shows the embedded mitigation that is applied to both the LHY35 Compressor Buildings and the Tail Gas Compressor buildings as standard. Discussions were held with Air Products across various meetings to discuss potential noise mitigation measures in order that the calculated internal reverberant sound pressure level within each compressor building was no greater than the Control of Noise at Work Regulations (2005) upper exposure action value of 85 dB(A). Following this, noise breakout from each compressor building was calculated using the data in Table 9-3

Table 9-3: Noise Model Input Data – Building Material Sound Insulation Performance

Façade or Wall	Embedded Mitigation Item	Attenuation provided by each item for each frequency band (dB)								Total R_w
		63	125	250	500	1k	2k	4k	8k	
Internal Wall/Panel System										
Façade (4 Walls)	Kingspan AWP60 Composite Wall Panel System w/ No internal lining	15	16	19	23	26	22	39	39	-25
Roof	Kingspan KS1000 Composite Roof Panel System w/ No internal lining	20	18	20	24	20	29	39	47	-25
Internal Acoustic Lining		**Absorption coefficient for each frequency band**								
Facade (4 walls)	Mineral Wool – Flakt Woods (150mm Glass or Rockwool Blanket)	0.35	0.55	0.90	0.90	0.85	0.90	0.95	0.35	N/A
Roof	Mineral Wool – Flakt Woods (150mm Glass or Rockwool Blanket)	0.35	0.55	0.90	0.90	0.85	0.90	0.95	0.35	N/A
Floor	Smooth concrete, painted or glazed	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	N/A