HORIZON NUCLEAR POWER

ENERGY WORKING FOR BRITAIN

Response to Environmental Permitting Regulations 2016 Schedule 5 Notice, Issued 17/10/2018

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Introduction

This document provides Horizon's response to the Schedule 5 Notice issued by NRW on 17/10/2018 under paragraph 4 of Part 1 of Schedule 5 of the Environmental Permitting Regulations (England and Wales) 2016. The Notice requires further information on Horizon's Combustion Activity Environmental Permit application PAN-002429.

NRW's requests for information are reproduced in the tables below (shown in bold text), together with Horizon's response.

Air Dispersion Modelling & Assessment

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NRW requirement 1: Section 2.3, p9. "EDG A and EDG B have their stacks routed up the sides of the reactor building, the first configuration assumes the stacks are 3m above the reactor building's parapet, which in turn is 7m lower than the reactor building dome." Please provide evidence that this configuration represents a worst-case scenario in terms of building downwash effects.

NRW requirement 5: Table 2.4, p20. Please state how many building roofs associated with stack emissions are not flat but modelled as flat roofs. Please provide detailed information of building roof features (i.e., dome, slope) and any sensitivity analysis that has been undertaken to consider the impact of these roof features in terms of building downwash effect.

NRW requirement 8: Table 2.2, p10. Please provide the detailed information of the shape and dome features on the roof of 1-101 and 2-101 buildings. Please provide any sensitive analyses undertaken in terms of the selection of roof height (from parapet to apex), selection of main buildings (i.e., 49 m buildings). Please provide evidence that the proposed approach (moving stack away from the wall) would not affect plume-trapping in the building downwash. Also, please provide evidence that the selected scenario (i.e. main building, building height and moving stack) has reflected a worst-case prediction in terms of building downwash effect.

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<tr><td>Horizon's Response</td></tr>
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The reactor buildings (1-101 and 2-101) are the only modelled buildings which do not have flat roofs. The reactor building is a tiered building arrangement with a domed roof. EDGs A and B are installed in buildings immediately adjacent to the reactor building. However, due to this proximity, it is possible to route their stacks up the side of the reactor building, using the reactor building walls as support. It is not possible to do so for Unit 1 and Unit 2 EDG C since these EDGs are installed in a building which is a greater distance from the reactor building.

The stacks for EDGs A and B discharge 3 m above a parapet on the second tier of the reactor building, resulting in the stacks discharging approximately 4 m below the apex of the reactor dome (the top of the parapet is 7 m below the apex of the dome). Figure 1 visually depicts the tiered structure of the reactor building and the location of the stacks for EDGs A and B.

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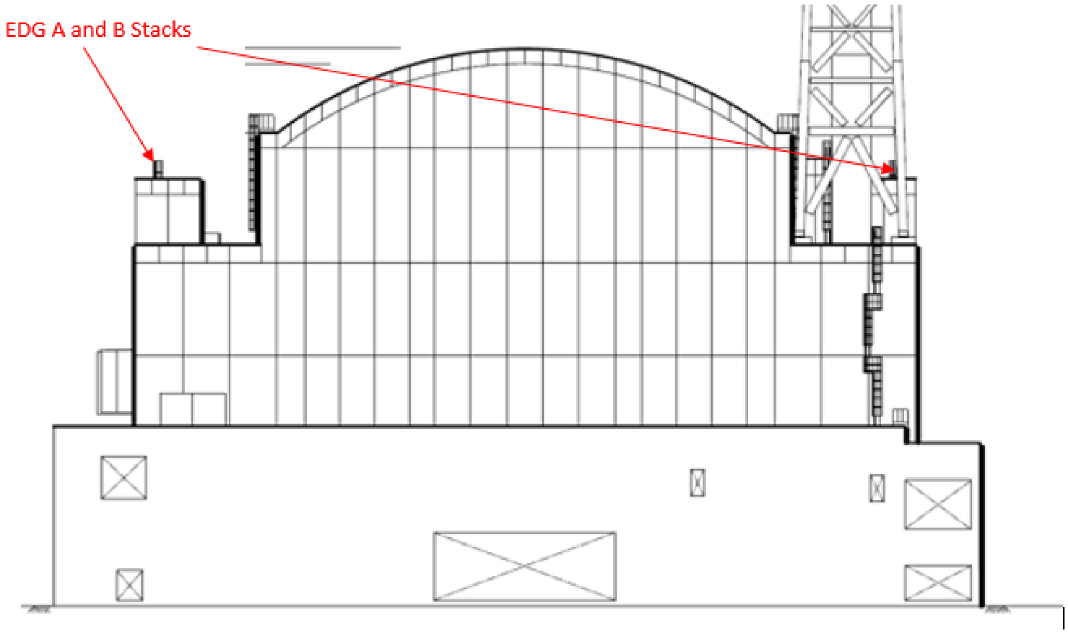
Figure 1 Reactor building profile



This arrangement does present certain challenges for the modelling assessment since, due to the number of other buildings included in the model, it is not possible to model each tier of the reactor building without exceeding the maximum number of buildings allowed by the model. Furthermore, the dispersion model can only model flat roofs. Consequently, certain simplifications to the building and stack representation in the model have been made by necessity, such as modelling the reactor building as a single tiered, flat roof building. However, where simplifications have been made, these aim to produce a more conservative estimate of the resulting impact.

With the assumption of a single tiered building, a scenario needs to be avoided whereby the stack(s) discharge within the building itself, since the model will not run where this is the case. Consequently, various options were considered to represent the reactor building and discharge points for EDGs A and B in the model. These options can be visualised in Figure 2.

- Option 1: EDGs discharge from their actual stack location and height, reactor building height modelled as the dome apex height, reactor building width taken as the width of the third tier;
- Option 2: EDGs discharge from their actual stack location and height, reactor building height modelled as the height of parapet, reactor building width taken as the width of the bottom tier;
- Option 3: EDGs discharge from their actual stack location but at a height 3 m above the height of the apex of the dome, reactor building height modelled as the dome apex height, reactor building width taken as the width of the bottom tier; and
- Option 4: EDG discharge location moved such that it is immediately adjacent to the modelled building, EDG discharge height modelled as 3 m above the parapet level, reactor building height modelled as the dome apex height, reactor building width taken as the width of the bottom tier.

Figure 2 Visualisation of various modelled reactor building and discharge location options

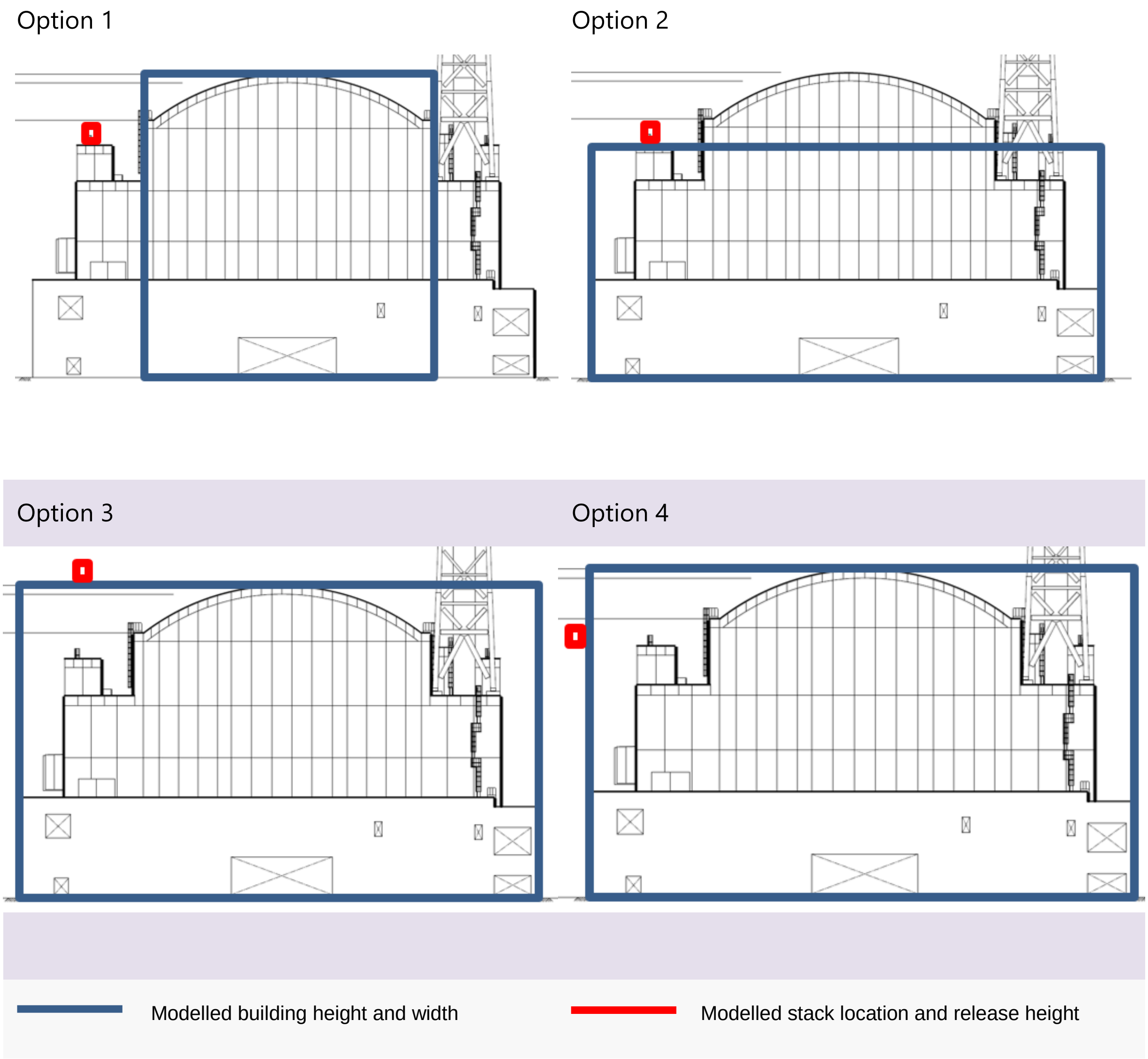
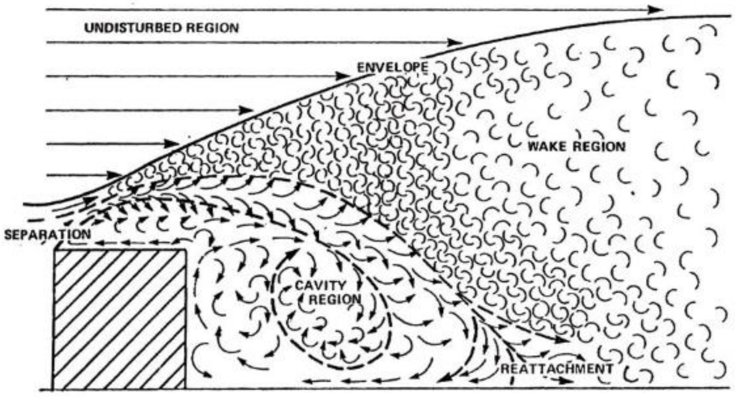


Figure 3 presents the predominant flow characteristics near a building. The flow regime primarily consists of a recirculating flow region (‘cavity’) in the immediate lee of the building and a turbulent wake further downwind. The largest impact on ground level concentrations occurs when a plume is fully entrained within the cavity region, as the plume is rapidly advected towards ground level in this recirculation zone. The residence time in the cavity determines the ground level concentration.

Figure 3 Flow regions in the vicinity of a building



In terms of building downwash, such effects will be enhanced with:

- Increasing building height for a fixed stack height;
- Increasing proximity of the stack to the building;
- Increasing building 'bulk'/projected width; and
- Emissions being discharged directly within the cavity zone.

Option 1 would contribute to enhancement of building downwash due to the height of the modelled building relative to the release height and due to the stack discharging directly within the modelled building cavity region with a high likelihood that a significant proportion of the plume will become entrained. However, the cavity length and mean residence time within the cavity will be reduced as a result of a smaller building 'bulk'/projected width.

Option 2 increases the building bulk, but the stack no longer discharges directly within the cavity, so the fraction of material entrained will reduce, whilst the reduced building height compared to Option 1 also reduces the cavity residence time.

Option 3 increases the building height and would result in a larger cavity length, but the release is unlikely to be fully entrained, since it no longer discharges directly within the cavity. Furthermore, the actual height of the release has been artificially increased, which will result in lower model predictions outwith the building effects zone.

Option 4 maximises the building height and bulk such that it is considerably greater than the actual building volume and any of the other options considered. Whilst the stack location has been artificially moved by a small distance, its height remains consistent with the actual discharge height. Furthermore, the initial release occurs within the building cavity, which will result in near full entrainment in the cavity, whilst the residence time in the cavity is increased due to the larger than actual building dimensions. From a building downwash/plume trapping perspective, this option represents the worst-case option of any option considered and would exaggerate the actual downwash effects of the reactor building.

The shift in the stack location is negligible compared to the distance to the nearest receptor, notwithstanding the fact that the stacks are moved closer to the nearest receptor (in the order of ~5%) so, therefore, present a more conservative estimate of impact. Artificially increasing the stack height as per Option 3 represents a 19% increase in stack height from the actual case and would have a much larger influence (reduction) on the predicted ground level concentration.

Consequently, for the factors discussed above, Option 4 is considered to represent the most conservative representation of the reactor building in terms of potential downwash effects. This is the option used in the modelling assessment.

ADMS itself includes further simplification of the modelled buildings. The model does not explicitly model the effects on atmospheric flow from each individual building. Rather, it agglomerates all modelled buildings in to a single, effective building. The length and width of this effective building changes for each source and for each hour of meteorological data, whilst its height is based on the height of the user-defined ‘main’ building.

The selection of the main building should not be based solely on whichever building is tallest. For example, a tall, narrow building is unlikely to have considerable effects on an emission source a significant distance away compared to a slightly shorter, but wider building located immediately adjacent to the emission source.

Based on **nominal dimensions** the reactor building is the tallest on-site building and one of the largest in terms of overall building footprint. As the EDGs discharge adjacent to the reactor building, this building will have the greatest actual influence on downwash effects. Consequently, the reactor building was defined as the ‘main’ building for all EDG stacks.

It should, however, be highlighted that the model is not based solely on nominal dimensions but a combination of minimum, nominal and maximum dimensions as dictated by the parameter plan (further discussion on nominal, minimum and maximum dimensions of the parameter plan is provided in paragraph 2.1.22). Consequently, the tallest and largest footprint modelled building, other than the reactor building, is the turbine building (1-108 and 2-108) which is 49 m tall based on maximum dimensions (it is shorter than the reactor building based on nominal dimensions and has the same height of the reactor building based on maximum dimensions). There are also other buildings located closer to the EDG stacks which have the same height as the turbine building but a smaller footprint.

These buildings have not been defined as the ‘main’ building for the simple reason that they only appear to be taller than the reactor building in the model because the reactor building has been modelled at its minimum height, whereas the other buildings have been included in the model based on their maximum height. The reactor building has been modelled at is minimum height, since the height of the EDG A and B stacks is directly related to the height of this building i.e., the design basis is that they discharge 3 m above the parapet so a lower height for the reactor building produces a lower release height for the EDG stacks. Consequently, modelling the minimum reactor building height results in a lower stack height and, hence, higher predicted impact (paragraph 2.1.29 demonstrates this is the case).

In an actual scenario where the turbine building is constructed based on its maximum height, it would be highly likely that the reactor building would also be constructed based on its own maximum height, since the parameter plan assigns a maximum height of 49 m to the entire reactor island polygon. The maximum height of the reactor building is also 49 m and it would once more be the dominant building influencing building downwash. Hence, it is a simple artefact of the model that other buildings appear taller than the reactor building, whilst conservatism has already been introduced in the model by defining the EDG stack heights based on the minimum reactor building height.

Notwithstanding any of the factors previously discussed, the buildings sensitivity analysis in Section 2.15 of the air dispersion modelling report demonstrates that, whilst long-term and short-term process contributions do increase when buildings are introduced to the model set up, the model itself is relatively insensitive to such considerations. This is likely to be due to the distance to the receptors, with the receptors located outside the building cavity zone where the largest impact on ground level concentrations will occur.

Despite the above, additional sensitivity analysis has been undertaken to ascertain how assumptions on assignment of the ‘main’ building might affect the conclusions of the assessment. The Commissioning Scenario A model was re-run with the turbine buildings defined as the main building for the EDGs instead of the reactor building. This was found to have a negligible effect on the maximum predicted 99.9th percentile hourly mean concentration at any receptor, with the modelled result changing by just 1.6%. The maximum impact at any receptor was actually found to decrease in the sensitivity case, reflecting the fact that it is not simply building height, but location relative to the stack and overall dimensions which affects how assumptions on the main building influences an assessment.

NRW requirement 2: Section 2.4, second bullet point, p10. Scenario B; emissions from three EDGs have different building-association and height, please provide evidence that the combination with the highest prediction was properly assessed.

Horizon’s Response

Two separate source groups have been defined for Commissioning Scenario B – one source group for commissioning of the Unit 1 EDGs and a second for commissioning of the Unit 2 EDGs. The results reported in the assessment are the highest prediction from either source group for each individual receptor, i.e., one receptor result may be based on the Unit 1 source group result, whilst another receptor result may be based on the Unit 2 source group result.

With respect to which two of the three EDGs in each source group are modelled as being operational during Commissioning Scenario B, EDG C has been included in each source group, since this EDG has a stack height of 20 m compared to 37 m for EDG stacks A and B and, consequently, produces higher ground level impacts than a scenario where EDGs A and B are considered. The remaining choice between EDG A and EDG B has been made following analysis of which EDG contributes to the maximum predicted impact at any receptor in the routine testing scenario – that scenario includes each EDG as an individual source group and allows contributions from individual EDGs to be identified.

NRW requirement 3: Section 2.9, p18. Please provide more detailed information regarding the 'parameter plan' and provide evidence why, as the submitted report claimed, "it was considered that it was most appropriate to use the nominal lengths and widths for each building."

Horizon's Response

At DCO and EP application stage, the design of the plant is not fixed. In particular, building dimensions have been specified as nominal dimensions but, theoretically, could ultimately be constructed to any size between a defined minimum and maximum envelope. This is known as the 'parameter plan'. Table 1 presents how these parameters are defined with respect to building heights as an example.

Table 1 Parameter plan for building heights

Name	Nominal height (m)	Minimum height (m)	Maximum height (m)
1-101	44	41	49
1-102	25	20	49
0-104	42	35	49
1-105	14	9	49
1/2-107	33	27	38
1-108	42	37	49
0-109	21	20	49
1-110a	23	17	49
1-110b	23	17	49
1-110c	23	17	49
2-101	44	41	49
2-102	25	20	49
2-108	42	37	49
2-105	14	9	49
2-110a	23	17	49
2-110b	23	17	49
2-110c	23	17	49
218	20	17	25
249	20	18	22
204a	9	9	14
204b	9	9	14

It is not plausible to include the maximum lengths and widths of the buildings defined by the parameter plan in the model, since this results in buildings overlapping each other and, in some cases, results in stacks discharging within a building; such a scenario could, quite evidently, not occur in reality.

Consequently, the model was based on the nominal building length and widths of the parameter plan, since this would produce a more conservative estimate of building induced effects than modelling based on the minimum dimensions.

In most cases, the difference between the nominal and maximum building length and width is negligible. For example, there is only a difference of 5 m between the maximum building length and width and the nominal building length and width of the reactor building.

Furthermore, it is important to realise that, as previously discussed, the dispersion model does not explicitly model the effects of each individual building, with the model only considering the effects of a single, effective building on its predictions. Due to the modelled buildings covering a large geographic area, the modelled effective building is very large; in some cases, this has dimensions of ~ 200 m x 350 m. Consequently, changes to individual buildings in the order of ~5 m are likely to be within the footprint of the modelled effective building and would have minimal effect on the model prediction.

NRW requirement 4: Section 2.9, p18. Please provide evidence supporting the following statements. "Similarly, taller buildings will tend to produce higher ground-level concentrations from elevated sources, so the maximum height was used for buildings which act purely as obstacles. However, for buildings which are associated with sources, the first stack configuration has the stacks 3m above the top of the building, so in these cases the minimum building height was used. This is because having the emission at a lower height will have a greater impact on ground-level concentrations than the building height. This building configuration is therefore judged to be most likely to produce the highest ground-level concentrations, within the bounds of the provided parameter plan". Please also provide evidence that the adopted approach represents a worst-case.

Horizon's Response

It is fundamental dispersion theory that:

- Reducing stack height results in an increase in maximum ground level concentrations, since the plume has less time to mix with ambient air before reaching ground level; and
- For a fixed stack height, increasing building height increases maximum ground level concentrations since it results in a larger cavity zone and longer residence time in the cavity.

Hence, adopting the minimum building height (and hence lowest stack height) for those buildings where stacks discharge from/adjacent to and which define the minimum acceptable stack height, whilst adopting the maximum building height for other buildings which act purely as obstacles and do not define the minimum stack height, would produce the most conservative estimate of impact of the various possibilities under the parameter plan.

To illustrate this quantitatively, the original model has been re-run for Commissioning Scenario A with all buildings and stack heights set to their maximum values under the parameter plan. The results of this additional sensitivity analysis are presented in Table 2. Results have been normalised by the value obtained from the scenario resulting in the highest ground level concentration. For example, a value of 0.85 would indicate the prediction from that scenario is 15% lower than the maximum prediction from any scenario.

Table 2 Model sensitivity to alternative parameter plan basis

Scenario	Normalised 99.79 Percentile 1-hour Mean NO_2 PC
As reported (minimum height for buildings where stacks discharge from or adjacent to, maximum height for all other buildings acting purely as obstacles)	**1.00**
Sensitivity case (maximum height for all buildings and stacks in the parameter plan)	0.77

Table 2 demonstrates that the original model scenario represents a considerably more conservative case with maximum 99.79 percentile hourly mean NO2 process contributions at any receptor 23% lower in the sensitivity case. This is a consequence of the model being more sensitive to changes in release height than to changes in building height. As such, whilst the building heights have increased, which would enhance downwash, the increase in stack height more than off-sets this effect.

NRW requirement 6: Section 2.13, p25. Appendix H used the Jacobs 2017 report; however, Jacobs 2015 was used for this section. Please provide a reason for this.

Horizon’s Response

The stack height assessment preceded the full dispersion modelling report and was produced at an earlier stage of the assessment process. The stack height assessment simply forms the basis for defining the stack heights and does not represent a full assessment of operational emissions. Appendix H is the full dispersion modelling report produced after completion of the stack height assessment and represents the full, final modelling report and that upon which the air quality impact assessment in Appendix I has been made.

NRW requirement 7: p33-35. In the commissioning scenario the number of hourly exceedances modelled was 182 (which was the same as Appendix H). In the LOOP/LOCA scenario the number of hourly exceedances modelled was 1833, but Appendix H was 1651. Please explain why different hourly exceedances were predicted for the LOOP/LOCA scenario but not for the commissioning scenario.
Horizon's Response
This is an error in the Stack Height Assessment report. We have reviewed the model outputs and reports, and this appears to be due to a track change from an earlier version of the stack height assessment being inadvertently rejected in the final report during the document production process. The actual number of modelled exceedances from the LOOP/LOCA scenario is 1,651, consistent with the output from the full modelling in Appendix H.

NRW requirement 9: Figure 2.1, p17. There are discrepancies between Figure 2.1 – Locations of modelled receptor locations in Appendix G and Appendix H. Please clarify why some receptors are missing from the (north) Wylfa Newydd Development Zone in Appendix H.
Horizon's Response
These are the North Wales Coast Path seaward option receptors, an option that was initially considered when the stack height assessment model was being developed. However, the seaward option was not being taken forward when the full modelling report was produced and, consequently, these receptors were removed. The footnote to Figure 2.1 in Appendix G clarifies that, whilst these receptors are included in the stack height assessment models, they do not actually form part of the stack height assessment and full air quality impact assessment.

NRW requirement 10: Appendix A Section 3.1.1, paragraphs 2-4, p8 of 40. Please confirm that there will be no overlap between different testing scenarios.
Horizon's Response
This is confirmed.

NRW requirement 11: Appendix A, Section 3.1.2, paragraph 2, p9 of 40. Please confirm if there are any exceedances from individual runs of the EDG, BBG and ASG.
Horizon's Response
This type of operation reflects the routine testing scenario, where each individual EDG, BBG and ASG has been modelled as an individual source group, with the maximum result from any individual source group at each receptor location reported in the assessment. These results confirm there are no exceedances in the routine testing scenario and, hence, there are no exceedances from individual runs of the EDGs, BBGs and ASGs.

Noise Modelling & Assessment

NRW requirement 12: Source terms. Please explain why there are discrepancies between the noise and air quality modelling regarding source locations and heights

Horizon's Response

In order to address inevitable changes to the site design through its development process, a parameter-based approach has been used for the environmental modelling and assessments presented in the DCO and EP applications. To keep the development within a flexible defined envelope that can accommodate a reasonable level of change, maximum and minimum parameters (such as limits on height and location of buildings) have been set out for key buildings.

For each assessed environmental topic, parameters have been selected within the parameter envelope that are judged to represent a conservative assessment approach for that topic. For air quality and noise modelling, these parameters in relation to source height and building height are not identical. The effect of this is that the heights and locations of sources are different in the noise and air quality models.

The considerations relevant to selection of the most conservative parameters for air quality modelling are set out in the responses to questions 1-3, 5 and 8 above.

The noise modelling has represented a conservative assessment by using the following approach:

- When calculating noise break-out levels for the buildings containing noise sources, the maximum dimensions from the parameter envelope for each building have been used. This results in the highest potential sound value being used to represent the break-out levels for each building.
- Only the screening associated with the following buildings has been accounted for in the model: Reactor Buildings, Control Buildings, Turbine Buildings, Heat Exchanger Buildings and Service Building. As screening provided by all other buildings is not accounted for in the model, the calculated noise levels at receptors are higher than those that would be expected in practice.
- The screening associated with the Reactor Buildings, Control Buildings, Heat Exchanger Buildings and Service Buildings has been minimised by using the minimum dimensions from the parameter envelope for each building. This results in a lower degree of screening in the model than would be expected in practice, leading to an overestimate of noise levels at receptors.
- All rooftop point noise sources (e.g. the exhaust stacks, air intakes, cooling fans and AHUs) are modelled as being located at or above the maximum roof height. The adoption of the maximum roof height results in a marginally greater spatial separation between rooftop sources and receiver points, leading to marginally greater distance attenuation. However, it also results in a lower degree of screening in the model for these sources than would be expected in practice. As the reduction in screening has a greater effect on noise levels at nearby receivers than the change in distance attenuation, the adopted approach is conservative.

The northing and easting co-ordinates used for the rooftop point noise sources (e.g. the exhaust stacks, air intakes, cooling fans and AHUs) in the noise modelling are the nominal locations from the design, rather the absolute 'worst case' for any particular receptor group. A model specific to each receptor group (i.e. with all point noise sources located at the closest point on the building roof to that receptor group) results in a negligible (i.e. less than 0.2 dB) difference in overall noise level when compared to the case using the nominal locations from the design. It was therefore considered proportionate to base the assessment on the point sources at the nominal locations for the following reasons:

- The scenario where all point noise sources are located at the closest point on any building roof to any particular receptor group is sufficiently far from any realistic design scenario to be discounted.
- The differences in overall noise level at receptors associated with the 'micro-siting' of all point sources around the building roofs are considered negligible, particularly in the context of the other conservative modelling approaches (e.g. the deliberate absence of screening associated with site buildings).
- The development of seven separate noise models was judged likely to introduce a disproportionate level of complexity into the assessment process.

NRW requirement 13: Table 4.6, p17. Please provide further detail as to how Receptor Group G is "linked to development". Please provide clarification regarding the status of the receptor when assessing the impact.

Horizon's Response

Receptor Group G represents Caerdegog Isaf, which comprises two properties, one of which is habitable, the other of which is not in a habitable condition (and is uninhabited).

Horizon has an 18-year lease on the inhabited property and will either rent the property to an Horizon employee or leave the property vacant for some or all of the lease period. The status of the property after the 18-year lease period has not currently been determined.

In the noise assessment that supports the EP Application, Receptor Group G is considered as a normal residential property with no commercial connection to the project.

NRW requirement 14: Appendix 2 – Source noise levels used in calculations. Please supply references or further explanation as supporting evidence for the reverberant level within the building, stack and intake source levels.

Horizon's Response

1. Reverberant noise level within Back-up Buildings and EDG Buildings

The dominant noise source within these buildings is expected to be the casing of the diesel generator in the case of the EDG Buildings, and the casing of the back-up generator in the case of the Back-up Buildings.

Data obtained from a leading manufacturer of generators* with similar electrical output rating, indicate that sound pressure levels at 1m from these casings are expected to be approximately

110 dB(A) without an engineered noise enclosure. This also corresponds with professional experience of measurements undertaken around similar units.

Using this level, the calculation sheets (in Appendix 1) based on BS12354-4 present the calculation of the reverberant sound pressure level within the EDG Building and Backup Buildings.

2. Reverberant noise level within Auxiliary Boiler Building

The dominant noise source within the boiler room is expected to be the forced draft fan providing combustion air to the boiler, as the combustion aspect of modern industrial boilers is known to not give rise to significant levels of noise. Sound pressure levels at 1m from fan casings are expected to be less than 80 dB(A), based on information contained in CIBSE HVAC Guide B5[1]. Therefore, the assumption that 80dB(A) would be incident upon the entire internal envelope of the building is a conservative assumption.

3. Reverberant noise level within ASG Building

ASGs are to be located within high performance acoustic enclosures such that 85dB(A) is met internally at building walls. High performance acoustic enclosures on power generation projects are typically specified to achieve a sound pressure level of 80-85 dB(A) at 1m to control the noise exposure of employees working in their vicinity. This provides a strong indication that achieving this level is feasible using standard noise enclosure design techniques.

4. Stack sound power values

The design includes silencers in all exhaust systems. Data obtained from a leading manufacturer* of similar diesel generators to the proposed EDGs (i.e. those with similar electrical output rating) indicate that a stack sound power level of 95 dB(A) is achievable with high performance exhaust stack silencers. This is based on the following manufacturers data for the unsilenced exhaust sound power and exhaust silencer transmission loss.

	Octave band centre frequency, Hz									dB(A)
	31.5	63	125	250	500	1000	2000	4000	8000	
Exhaust gas sound power	132	143	140	133	122	126	135	132	132	139
Stack silencer transmission loss	13	35	39	41	40	48	48	45	41	-
Silenced exhaust sound power	119	108	101	92	82	78	87	87	91	95

To account for potential variability of noise performance between commercial suppliers, a factor of +4dB has been added to the overall level. This factor has been selected based on professional experience of the variability of noise output between commercial suppliers. The EDG stack sound power level of 99 dB(A) used in the noise model should therefore be regarded as a conservative assumption.

[1] Noise and vibration control for HVAC : CIBSE guide B5. Chartered Institution of Buildings Services Engineers (CIBSE), London, 2002

Sound power levels for the stacks of the ASGs and BBGs have been derived by correcting the EDG stack sound power value using the relationship between stack sound power and electrical output (i.e. $L_w \propto 10 \log_{10} MW$) set out in *Engineering Noise Control* by Bies & Hansen[2].

5. Air intake aperture sound power values

The design includes acoustic attenuators in all combustion air intake duct systems. Data obtained from a leading manufacturer* of similar diesel generators to the proposed EDGs (i.e. those with similar electrical output rating) indicate that an air intake sound power level of 94 dB(A) is achievable with standard acoustic attenuators. This is based on the following manufacturers data for the unsilenced air intake sound power and attenuator transmission loss.

	Octave band centre frequency, Hz									dB(A)
	31.5	63	125	250	500	1000	2000	4000	8000	
Combustion air intake sound power	117	112	111	111	112	125	129	133	127	136
Attenuator transmission loss	2	6	14	19	28	47	54	46	35	-
Silenced intake sound power	115	106	97	92	84	78	75	87	92	94

To account for potential variability of noise performance between commercial suppliers, a factor of +4dB has been added to the overall level. This factor has been selected based on professional experience of the variability of noise output between commercial suppliers. Therefore, the EDG air intake sound power level of 98 dB(A) used in the noise model should be regarded as a conservative assumption.

Sound power levels for the air intakes of the ASGs and BBGs have been derived by correcting the EDG air intake sound power value using the relationship between air intake sound power and electrical output (i.e. $L_w \propto 5 \log_{10} MW$) set out in *Engineering Noise Control* by Bies & Hansen.

* *As the manufacturer's data was provided in commercial confidence on other projects, Jacobs are not in a position to be able to identify the specific manufacturer / model.*

NRW requirement 15: Appendix 2 – Source noise levels used in calculations. The noise modelling input files show EDG stacks located 3m above the EDG building roofs (49m + 3m, total height 52m). This is contradictory to the air quality model where the stacks are located next to the EDG buildings and at a height of 37m. Please clarify and justify that this does not change predicted noise levels.

Horizon's Response

The response to Question 12 provides a general explanation of why point sources are located differently in the air quality and noise models.

To specifically answer this query, if the EDG stacks were modelled as being next to the EDG buildings in the direction of a particular receptor group at a height of 37m, the maximum

[2] D. A. Bies and C. H. Hansen, "Engineering Noise Control: Theory and Practice," 4th Edition, Spon Press, London, 2009

increase in overall noise level at the receptor group would be less than 0.1 dB, which is considered a negligible difference.

Shadow Habitats Regulations Assessment

NRW requirement 16: Please provide an up to date National Vegetation Classification (NVC) map of the habitats present within the Shingle ridge community interest feature of Cemlyn Bay SAC.
Horizon's Response
The NVC survey report and mapping [Wallace, H. & Jones, L. (2018). National Vegetation Classification mapping of Cemlyn Bay Shingle Bar. Final report to Royal Haskoning DHV] accompanies this Schedule 5 Response; this document has previously been informally shared with NRW.

NRW requirement 17: Please provide justification for the use of the less precautionary critical load for Nitrogen deposition at Cemlyn Bay SAC of 20KgN/ha/year used in table 7-26 p371 of the Shadow HRA (Appendix L) instead of the 8KgN/ha/year used in Table 26 of Appendix I, p79.
Horizon's Response
A technical note [Wylfa Newydd Power Station – Case Work towards the Shadow HRA Review of case work, literature, and critical load assessment, Jones & Bealy 2018] explaining the reasoning behind using the 20KgN/ha/year was included as Appendix G of the Shadow HRA (Appendix L, Volume B to the Combustion Activity Environmental Permit Application) and has been shared with NRW informally for comment. This report accompanies this Schedule 5 response. The 8 KgN/ha/yr value was used in Appendix I as this was the Critical Load (CL) value provided by NRW that was initially used, on a precautionary basis, before the assessment which lead to the adoption of the 20kgN/ha/yr value. The assessment in Appendix I was not revised after the adoption of the 20kgN/ha/yr value as the nitrogen deposition screened out as not significant based on the lower CL value. A further note [Nitrogen Inputs from Marine Sources (Jones & Bealey 2018)] accompanies this Schedule 5 response, this document has previously been informally shared with NRW.

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Appendix 1 – Calculation Sheets of the reverberant sound pressure level within the EDG Building and Backup Buildings

EDG Building Noise Calculation - BS12354-4

Calculation of SWL within EDG Building

Average Free field SPL at 1m from EDG (L_{Aeq}, dB)	110.0		
	Length L	Width W	Height H
Estimated dimensions of turbine (m)	12	4	5
Measurement distance (m)	1	1	1
Dimensions of measurment surface (m)	13	6	7
Surface area of measurement surface (m^2)	380.0		
Conformal surface area correction (dB)	25.8		
Sound power of unit (L_{WA}, dB)	135.8		

	Octave Band Centre Frequency, Hz								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Example spectrum given in Bies and Hansen Table 11.17	-7	-6	-9	-10	-10	-12	-13	-17	**-4.8**
Spectrum scaled up to meet SWL value calculated above	133.6	134.6	131.6	130.6	130.6	128.6	127.6	123.6	**135.8**

Consideration of Reverberant Properties of EDG Building

				63	125	250	500	1000	2000	4000	8000
Wall α	6003	Block, 'Breeze' or 'Cinder'	8526m²	0.10	0.20	0.45	0.60	0.40	0.45	0.40	0.40
Open Area	-	-	0m²	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Floor α	5017	Concrete	1872m²	0.00	0.02	0.02	0.02	0.03	0.03	0.04	0.00
Ceiling α	2092	Plain steel ceiling planks	1872m²	0.00	0.25	0.15	0.10	0.08	0.05	0.05	0.00

Dimensions of turbine hall

Area S_{total}	12270m²									
Length L	48m	Mean absorption coefficient α	0.07	0.18	0.34	0.44	0.29	0.32	0.29	0.28
Width W	39m	Room constant R_c	916	2696	6282	9455	5127	5904	5052	4723
Height H	49m	Turbine Hall $K_{(rev)}$	-23	-28	-31	-33	-31	-31	-31	-30

Calculation of reverberant sound pressure level within EDG Building

	Octave Band Centre Frequency, Hz								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Turbine SWL	133.6	134.6	131.6	130.6	130.6	128.6	127.6	123.6	**135.8**
Reverberant SPL within Turbine Hall (diffuse)	110.6	106.6	100.6	97.6	99.6	97.6	96.6	93.6	**104.7**

Backup Building Noise Calculation - BS12354-4

Calculation of Backup generator SWL

Average Free field SPL at 1m from Backup generator (L_{Aeq}, dB)	110.0		
	Length L	Width W	Height H
Estimated dimensions of turbine (m)	12	4	5
Measurement distance (m)	1	1	1
Dimensions of measurment surface (m)	13	6	7
Surface area of measurement surface (m^2)	380.0		
Conformal surface area correction (dB)	25.8		
Sound power of unit (L_{WA}, dB)	135.8		

	Octave Band Centre Frequency, Hz								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Example spectrum given in Bies and Hansen Table 11.11	12	11	9	9	6	9	13	19	**20.3**
Spectrum scaled up to meet SWL value calculated above	127.5	126.5	124.5	124.5	121.5	124.5	128.5	134.5	**135.8**

Consideration of Reverberant Properties of Backup Building

				63	125	250	500	1000	2000	4000	8000
Wall α	6003	Block, 'Breeze' or 'Cinder'	11322m²	0.10	0.20	0.45	0.60	0.40	0.45	0.40	0.40
Open Area	-	-	90m²	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Floor α	5017	Concrete	5762m²	0.00	0.02	0.02	0.02	0.03	0.03	0.04	0.00
Ceiling α	2092	Plain steel ceiling planks	5762m²	0.00	0.25	0.15	0.10	0.08	0.05	0.05	0.00

Dimensions of EDG Building

Area S_{total}	22846m²
Length L	86m
Width W	67m
Height H	37m

	63	125	250	500	1000	2000	4000	8000
Mean absorption coefficient α	0.05	0.17	0.27	0.33	0.23	0.25	0.22	0.20
Room constant R_c	1285	4695	8397	11265	6786	7460	6594	5760
$K_{(rev)}$	-25	-30	-33	-34	-32	-32	-32	-31

Calculation of reverberant sound pressure level within Backup Building

	Octave Band Centre Frequency, Hz								dB(A)
	63	125	250	500	1000	2000	4000	8000	
SWL within hall	127.5	126.5	124.5	124.5	121.5	124.5	128.5	134.5	**135.8**
Reverberant SPL within Hall (diffuse)	102.5	96.5	91.5	90.5	89.5	92.5	96.5	103.5	**104.4**

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