Technical note:
Wylfa Newydd Standby Combustion Plant Environmental Permit Application: Building Sensitivity Analysis Method Statement

1. Introduction

1.1.1 This technical note has been produced by Wood Environment & Infrastructure Solutions UK Limited in response to further information requested by Natural Resources Wales (NRW), in addition to the initial Schedule 5 request for more information, following submission of the environmental permit application for the standby combustion plant installation forming a component part of the Wylfa Newydd Project.

1.1.2 NRW's latest request, received by email on 08/01/19, states:

"We appreciate that building downwash effects are a complex issue here and a lot work has been done by Horizon to address that. However, based on the information submitted as part of Horizon's schedule 5 response, the conclusion cannot be reached that the modelled scenario has reflected a possible worst-case scenario.

Horizon's Response to NRW requirements 1, 3, 4, 5, 8

Please provide a detailed and complete quantitative sensitivity analysis to demonstrate that the modelled setup represents a worst-case scenario. To ensure a worst-case scenario (therefore worst-case ground level concentrations) is represented the sensitivity analysis should consider all influencing factors, including but not limited to:

- *Different stack locations relative to reactor buildings (1-101 and 2-101) and receptors;*
- *Varying wind direction to the receptors;*
- *Nearby taller buildings;*
- *Distance and location of modelled stacks to buildings – the shift in stack location may affect the extent of plume entrained in the cavity region which will significantly change the predicted ground level concentration; and*
- *Dimensions of buildings."*

1.1.3 This technical note discusses the complexity in undertaking a "*detailed and complete quantitative sensitivity analysis*" and proposes a method for a focussed sensitivity study subject to further discussion and agreement with NRW.

2. Complexity of building sensitivity analysis applied to the Wylfa Newydd Project

2.1.1 Sensitivity analysis with respect to modelled buildings can be a complex matter even for the simplest site layout incorporating fixed building dimensions. For the Wylfa Newydd Project, building sensitivity analysis is further complicated by the number of buildings which may influence dispersion and the fact that, at the current stage of design, the building dimensions are not fixed.

2.1.2 The initial Schedule 5 response by HNP clarified that, at this stage of the design, building dimensions are specified as part of a buildings parameter plan, rather than as fixed dimensions. Effectively, the length, width and height of each individual building could be any value between a specified minimum and maximum dimension, although a central or nominal dimension is also specified as part of this parameter plan.

2.1.3 With 21 modelled buildings in the input files upon which the air quality modelling has been based, there would be more than $1x10^{19}$ different combinations of building lengths, widths and heights under the parameter plan. Modelling this number of combinations would be a practical impossibility. Consequently, the building sensitivity analyses undertaken as part of the initial modelling report and Schedule 5 response represented a combination of quantitative, and considered qualitative analyses, drawing upon fundamental dispersion modelling theory. Data from the quantitative sensitivity analysis and, based on the balance of probability for the qualitative analyses, supports the justification that the modelled approach represents a worst-case assessment, or that any assessment adopting a different approach to the treatment of modelled buildings would not significantly affect the conclusions of the assessment.

2.1.4 The analyses conducted to date indicate that changes in building dimensions will slightly increase concentrations of emitted pollutants at some receptors and slightly decrease them at others, but that the base approach adopted is likely to result in returning the maximum concentration at any receptor. A fundamental sensitivity test, involving "switching off" the buildings module in ADMS, revealed that concentrations were approximately 20% lower at the worst affected receptors than if the buildings module was used. Further permutations and combinations of building dimensions are considered to lie within this envelope.

3. Proposed method for further building sensitivity analysis

3.1.1 As explained in Section 2, upwards of $1x10^{19}$ individual model input files would be required to undertake a "*detailed and complete quantitative sensitivity analysis*". This equates to approximately 200,000 billion years of model run time alone. Consequently, any further sensitivity analysis to provide quantitative data should be focussed and consider the most important factors only.

3.1.2 Table 1 presents the proposed additional building sensitivity tests to be performed. These cases result in the requirement to produce 80 individual model input files, or approximately 440 hours of model run time.

3.1.3 The results from these cases will be compared against a base-case scenario, which reflects the current approach adopted in the Appendix H modelling report supporting the environmental permit application. Results from the various sensitivity analyses will be presented on a non-dimensional basis, as per the existing format presented in the Appendix H modelling report and

Table 2 of the Schedule 5 response. Commissioning Scenario A will be used as a proxy for the sensitivity analysis, since this scenario has all EDGs for an individual Unit operational concurrently, thereby allowing a thorough analysis of the sensitivity to movement in the location of multiple stacks.

3.1.4 Reference is made in Table 1 to various options representing the tiered, curved roof reactor building. These are consistent with the visualisations provided in Figure 2 within the initial Schedule 5 response and have been replicated in Figure 1 of this technical note for ease of reference. Figure 2 provides a visualisation of the current modelled building and emission point layout and identification of building IDs.

Figure 1 Visualisation of various modelled reactor building and discharge location options

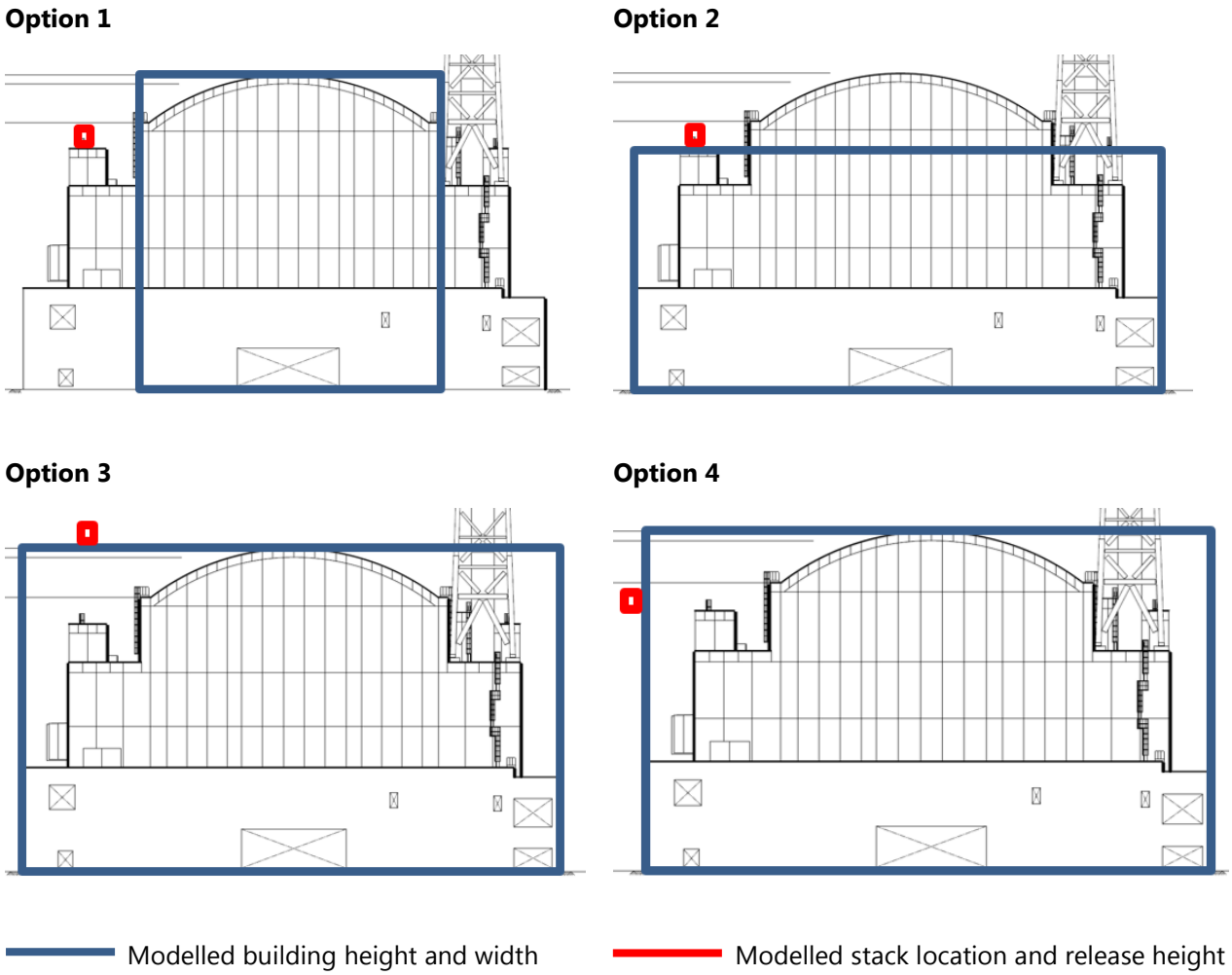

Figure 2 Building and emission point visualisation

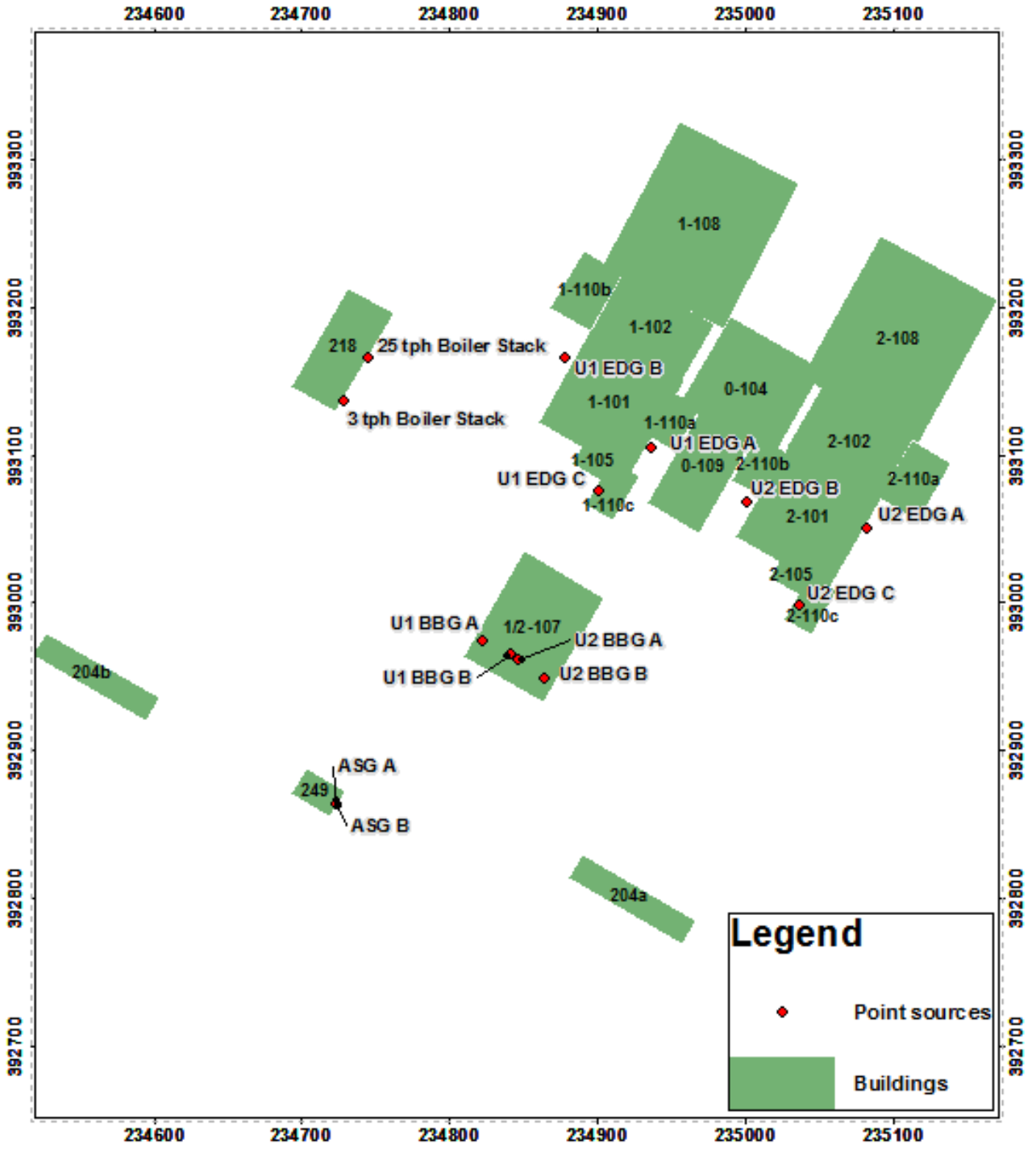

Table 1 Proposed building sensitivity analysis scenarios

Scenario name	Description
Base-case	The existing modelled scenario presented in Appendix H to the permit application. The reactor buildings are represented in the model as per Option 4 in Figure 1 with the reactor buildings (1-101 and 2-101) specified as the 'Main' building for the EDGs. Building lengths and widths modelled at the nominal dimensions in the building parameter plan. Buildings where stacks discharge from, or adjacent to, are modelled at the minimum height of the parameter plan (results in the lowest stack height estimate) whilst all other buildings are modelled at their maximum height. The scenario is modelled using 10 years of hourly sequential meteorological data
Cases to determine sensitivity to different stack locations and distance and location of modelled stacks to buildings	
Sensitivity Case 1	As per the base-case scenario but with the reactor buildings represented by Option 1 in Figure 1
Sensitivity Case 2	As per the base-case scenario but with the reactor buildings represented by Option 2 in Figure 1
Sensitivity Case 3	As per the base-case scenario but with the reactor buildings represented by Option 3 in Figure 1
Cases to determine sensitivity to nearby taller buildings	
Sensitivity Case 4	As per the base-case scenario but with Building 1-102 specified as the 'Main' building for Unit 1 EDGs and Building 2-102 specified as the 'Main' building for Unit 2 EDGs
Sensitivity Case 5	As per the base-case scenario but with Building 0-104 specified as the 'Main' building for Unit 1 and Unit 2 EDGs
Sensitivity Case 6	As per the base-case scenario but with Building 0-109 specified as the 'Main' building for Unit 1 and Unit 2 EDGs
Sensitivity Case 7	As per the base-case scenario but with Building 1-108 specified as the 'Main' building for Unit 1 EDGs and Building 2-108 specified as the 'Main' building for Unit 2 EDGs
Cases to determine sensitivity to different building dimensions	
Sensitivity Case 8	As per the base-case scenario but with building lengths and widths increased to their maximum values under the parameter plan, or the maximum extent which prevents overlap of the building footprint or overlap of modelled buildings on emission point locations

3.1.5 It is not considered that separate, explicit consideration of varying wind direction to the receptors is required, since the sensitivity analyses use 10 years of hourly sequential meteorological data, allowing all possible combinations of wind directions to be considered, and their influence on building downwash to be evaluated.

3.1.6 Similarly, it is not considered necessary to undertake sensitivity analysis of different building heights under the parameter plan. Table 2 in the initial response to the Schedule 5 notice already includes quantitative analysis of the current model basis and the maximum building heights for all buildings in the parameter plan. This analysis demonstrates the current modelled basis presents a more conservative approach with respect to ground level concentrations.

3.1.7 Based on quantitative studies undertaken to date, supported by further considered qualitative analysis detailed in the initial Schedule 5 response, it is expected that any effect on modelled ground level concentrations associated with further sensitivity analysis would not be sufficient to affect the conclusions of the existing air quality assessment. The focussed sensitivity cases presented in this method statement are considered to provide a sufficient quantitative knowledge base to enable NRW to complete its evaluation of the potential impacts of operational combustion plant emissions associated with the Wylfa Newydd project.

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