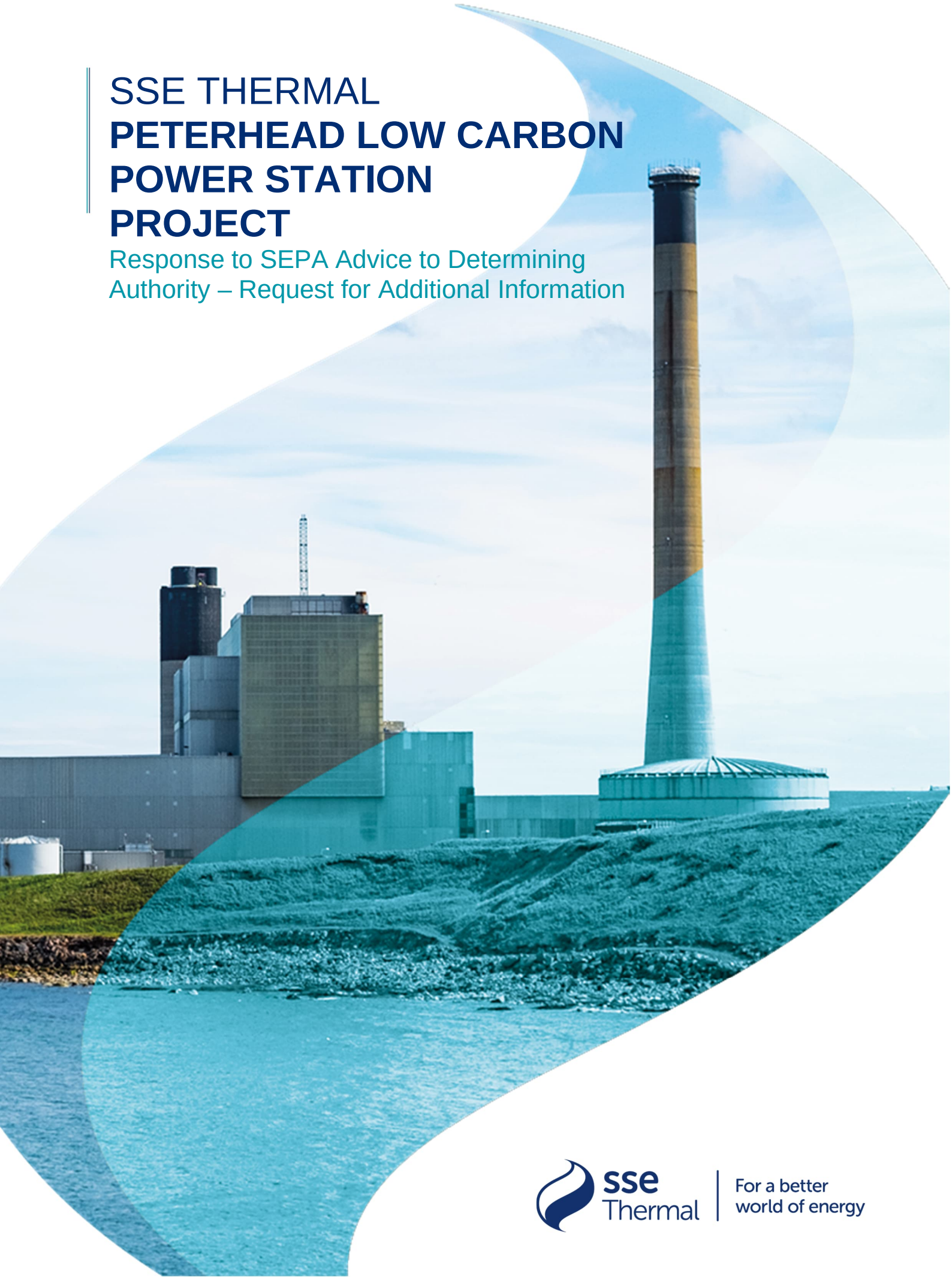
SSE THERMAL

PETERHEAD LOW CARBON POWER STATION PROJECT

Response to SEPA Advice to Determining Authority – Request for Additional Information



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1. Introduction

On the 10th February 2023 SSE Thermal (hereafter referred to as the 'Applicant') submitted additional information to the Energy Consents Unit (ECU) to respond to comments and a request from SEPA for additional information to make an informed decision (dated 1st July 2022). Following the submission of this information, whilst some of the points have been closed, SEPA provided a further response dated 28th March 2023 requesting that further information relating to air quality and emissions was required for an informed decision to be made. SEPA maintained their holding objection until the additional information is provided.

The Applicant has continued to engage with SEPA on the points raised and the discussion has informed the development of this technical note. Appropriate cross-referencing is made within this technical note to the Environmental Impact Assessment Report (EIAR) and the prior response dated 10th February. The Applicant believes that the information presented in the response below suitably addresses the requests made by SEPA to make an informed decision on the Section 36 application.

For clarity and ease of cross-referencing against the comments raised by SEPA this response is structured in line with SEPA's comments.

2. Overview of Additional Information Provided

In the Applicant's response to SEPA's request for additional information dated 1st July, and in the current response provided below the Applicant has responded directly to comments raised. It is recognised that as part of these responses separate technical notes have been provided. In setting out the additional information the Applicant has checked and confirm that the realistic worst-case scenario has been accounted for regarding air quality and emissions in the EIAR primary findings. The additional information has provided further clarification and greater resolution of the assessment however the main findings of the EIAR remain unchanged and as such no revision of the Air Quality EIAR Chapter or the supporting appendices is proposed.

The EIAR findings were based on broad parameters to cover a number of potential final design scenarios as a contractor was not appointed to provide specific design-related information at the time. This is a common approach implemented for consenting of new power generation as utilised by the Applicant elsewhere in the UK. Subsequent to the submission of the Section 36 application, the Applicant has engaged with the industry and appointed a Front-End Engineering Design (FEED) Contractor. Through the early FEED process the emerging design details have enabled the Applicant to add further resolution of emissions details and further validate the EIAR assessment findings, as presented in the response to SEPA in February 2023 and the responses included within this technical note.

In line with some of the responses presented in Section 3 below the Applicant recognises that the additional information provided will feed in to, and will be further updated, based on details provided by the appointed Contractor to progress the Pollution Prevention and Control (PPC) Permit application. The confirmed design for construction will be utilised to formally update the air quality assessment as part of this process. Therefore, whilst a final design is not known the results presented provide confidence in the EIAR assessment and prospective compliance with relative emissions limits. The Applicant acknowledges that suitable conditions would need to apply to the consent granted for the Section 36 application to secure the refinement of the air quality emissions based on the finalised design through the PPC Permitting process.

3. The Applicant's response to SEPA comments

The Applicant's responses to comments raised by SEPA are detailed in the table below, with cross-references to the figures presented in Appendix A where appropriate.

AECOMs response to SEPA comments

SEPA Comment	AECOM Response
Air Quality Impact Assessment	
We note the dispersion modelling has now been revised and carried out to assess the operation of three Peterhead Gas Turbines with it being confirmed that the existing power station could potentially be operating at full capacity up to 2030 in conjunction with the new station. We provide comments below to the AECOM response from their Appendix B (SEPA Response Technical Assessments) and on the new air-quality modelling results that are given in their Appendix C (Post-Submission Air Quality Modelling Technical Note). The revised assessment has not presented the cumulative impact of the proposal on the surrounding area and so it is not possible to determine whether air quality standards or environmental assessment levels have been compromised and we highlight the key points to be clarified or where further information is required in the following sections.	The original holding objection related to SEPA's concerns that a worst-case assessment had not been carried out. The purpose of the remodelling provided for the original holding objection was to evidence that the effects of the Peterhead Low Carbon CCGT Power Station together with the operation of the three existing Peterhead Gas Turbines were no worse than those that were presented in the EIAR, thus demonstrating that the EIAR remained a worst-case assessment. To simplify the demonstration, the process contributions (PCs) of the original EIAR assessment were compared to the PCs for the new scenarios modelled in Table 5 of the original holding response, with Red/ Amber/ Green colouring to show where the impacts were lower or no worse than those presented in the EIAR. It was therefore considered that the information provided gave a simplified demonstration that the original EIAR assessment had considered a worst-case assessment. For all scenarios assessed in the remodelling, the impacts at the worst-case human health receptor were demonstrated to be lower than those presented in the EIAR (except for NO_2), which were slightly higher for the twin absorber scenario only. This was also the case for habitat receptors. The EIAR concluded that the NO_2 impacts for annual averages and hourly averages were negligible adverse and **not significant**, consequently, as the remodelling demonstrated that (on the whole) NO_2 PCs were lower than the EIAR, no further consideration of the cumulative impacts (i.e. the PC plus the background concentration) was deemed necessary in the original holding response. In terms of the ecological receptors the EIAR results clearly showed that all receptors experienced effects which were assessed as **not significant** (or insignificant for annual average impacts either at the PC level or at the PEC levels in terms of the H1 Guidance screening thresholds). Therefore again as the remodelling demonstrated lower impacts, no further consideration of the PECs was deemed necessary in the original holding response as the effects would remain not significant (or insignificant). AECOM consider that the information presented in the first holding objection response adequately addressed the concerns raised, however where SEPA have requested further information regarding the demonstration of impacts to receptors this information has been presented in the detailed responses below.

Appendix B

(SEPA Response – Technical Assessments)

In relation to Ambient Air Concentrations, we **request** the following further information and analysis:

- For NO_2, the higher 1x1km gridded background concentration of 26ug/m^3 is to be used to provide a worst-case Predicted Environmental Concentration (PEC).

The background NO_2 concentrations for the Scottish Air Quality Background maps are shown in the figure below. The location of SEPAs proposed background concentration is shown in the red circle. This can clearly be seen to be an outlier result, over an area where there would be limited annual exposure for human receptors from the Proposed Development. Additionally, this area does not correspond spatially to the point of maximum modelled impact from the Proposed Development.

However, this background concentration has been utilised in the additional information provided within this response, at the request of SEPA.

- It should be possible to do a comparison using the Errol Place monitor for the period 2015-2020 rather than solely rely on the Fort William data. Although the Aberdeen Errol Park monitor only became operational in October 2021, this monitor replaced the one at Aberdeen Errol Place which has suitable measurements (NO_2, NOx and ozone) up to 2020. We request this is attempted.

The Errol Place monitoring data has been processed for the modelling period 2017 – 2021, and a comparison of the results with those presented in the EIAR Appendix 8C (Tables 7 and 8) is provided in Table 1 and Table 2 below. The updated N-amines modelling includes the use of the Errol Place backgrounds, and the use of the CCSA constant values that were employed in the remodelling carried out for the original holding objection response.

Table 1: Predicated change in annual average N-amine concentrations as a result of the indirect amine releases – when modelled as MEA

Rec	Air Quality Standard (AQS) ng/m^3	As Presented in EIAR				Remodelling Indirect Releases MEA			
		Nitrosamine PC ng/m^3	Nitramine PC ng/m^3	Combined PC ng/m^3	Combined PC/ AQS	Nitrosamine PC ng/m^3	Nitramine PC ng/m^3	Combined PC ng/m^3	Combined PC/ AQS
Max	0.2	**0.015**	**0.006**	**0.021**	**10.4%**	**0.0004**	**0.00001**	**0.0004**	**0.2%**
OR1		0.0023	0.001	0.003	1.5%	0.00003	0.000001	0.00003	0.0%
OR2		0.0010	0.0002	0.001	0.6%	0.0002	0.000003	0.0002	0.1%
OR3		0.0063	0.0016	0.008	4.0%	0.0002	0.000004	0.0002	0.1%
OR4		0.0013	0.0002	0.002	0.8%	0.00004	0.000001	0.00004	0.0%
OR5		0.0032	0.0006	0.004	1.9%	0.00007	0.000001	0.00007	0.0%
OR6		0.0058	0.0012	0.007	3.5%	0.00006	0.000001	0.00006	0.0%
OR7		0.0067	0.0013	0.008	4.0%	0.00005	0.000001	0.00005	0.0%
OR8		0.0072	0.0017	0.009	4.4%	0.0003	0.000005	0.0003	0.1%
OR9		0.012	0.0042	0.016	8.2%	0.0003	0.000007	0.0003	0.2%
OR10		0.013	0.0044	0.017	8.7%	0.0004	0.00001	0.0004	0.2%
OR11		0.011	0.0056	0.017	8.4%	0.0004	0.00001	0.0004	0.2%
OR12		0.010	0.0053	0.015	7.6%	0.0002	0.00001	0.0003	0.1%

Table 2: Predicated change in annual average N-amine concentrations as a result of the indirect amine releases – when modelled as DMA

Rec	Air Quality Standard (AQS) ng/m^3	As Presented in EIAR				Remodelling Indirect Releases DMA			
		Nitrosamine PC ng/m^3	Nitramine PC ng/m^3	Combined PC ng/m^3	Combined PC/ AQS	Nitrosamine PC ng/m^3	Nitramine PC ng/m^3	Combined PC ng/m^3	Combined PC/ AQS
Max		**0.029**	**0.044**	**0.073**	**36.7%**	**0.095**	**0.36**	**0.46**	**228%**
OR1		0.0045	0.0054	0.010	5.0%	0.005	0.01	0.02	8.1%
OR2		0.0022	0.0017	0.004	1.9%	0.003	0.01	0.01	5.2%
OR3		0.013	0.013	0.025	12.6%	0.028	0.08	0.11	56.4%
OR4		0.0026	0.0018	0.004	2.2%	0.006	0.02	0.02	10.8%
OR5		0.0067	0.0047	0.011	5.7%	0.008	0.01	0.02	11.5%
OR6	0.2	0.012	0.0090	0.021	10.5%	0.014	0.03	0.04	20.3%
OR7		0.014	0.0096	0.024	11.8%	0.014	0.02	0.03	17.5%
OR8		0.015	0.013	0.028	13.9%	0.013	0.02	0.04	18.9%
OR9		0.022	0.032	0.054	27.1%	0.060	0.18	0.24	120.7%
OR10		0.024	0.033	0.057	28.4%	0.074	0.20	0.27	137.1%
OR11		0.015	0.043	0.058	28.8%	0.044	0.24	0.28	140.5%
OR12		0.012	0.041	0.052	26.1%	0.023	0.17	0.19	94.3%

The results for MEA show a marked reduction from those presented in the EIAR due to the use of the CCSA constants. The difference in the results run with Fort William background data and the Aberdeen Errol Place background data was only -0.1% of the indirect MEA PCs at the maximum receptor location (i.e. compared to the PC/ AQS of 0.3% presented in the original holding objection response).

The results for DMA show an increase over those presented in the EIAR due to the use of the CCSA constants. The difference in the Fort William background data and the Aberdeen Errol Place background data was +28% of the indirect DMA PCs at the maximum receptor location (i.e. compared to the PC/ AQS of 112% presented in the original holding objection response).

Whilst the DMA impacts show an increase in the PC over those presented in the EIAR, and also a potential exceedance of the AQS, it is important to consider the results in context. The ADMS amines module has not been validated and there are numerous recognised limitations with the model, which were detailed in Appendix 8C of the EIAR. The results should therefore not be viewed as definitive values, but rather an indication of the potential impact.

The indirect amine impacts have been modelled both as MEA and DMA assuming that the total amine emission is either MEA or DMA. This was done to provide a range of the potential impacts based on publicly available rate constants for amines. Neither MEA nor DMA have been confirmed as amines that are present in the solvent that will be used in the Peterhead Low Carbon CCGT Power Station carbon capture plant and therefore these results are indicative only.

The variation in the N-amine impacts caused by the use of different rate constants were demonstrated in the EIAR Appendix 8C to be between -7% and +299% of the AQS when modelled as MEA and -21% and +536% of the AQS when modelled as DMA, and therefore the results presented above remain within this range.

In addition, the greater proportion of the combined N-amine impacts shown in Table 2 are from nitramines, which are understood to be less toxic than nitrosamines by at least 6 times, as detailed and discussed in the EIAR Appendix 8C. Taking this into account for the maximum nitramine concentration presented in Table 2, the maximum PC for DMA N-amines for comparison with the NDMA AQS that occurs anywhere would be:

$$\text{nitrosamine } (0.095 ng/m^3) + \text{nitramine } (0.36 ng/m^3 / 6) = 0.16 \text{ ng/m}^3$$

This would represent 78% of the AQS for NDMA at the maximum location, rather than the 228% detailed in Table 2, and therefore demonstrate that an exceedance of the NDMA AQS was unlikely.

Additional modelling will be carried out once more detail is known on the chosen licensor's amine solvent, and it is considered that this can be carried out as part of the PPC Permitting process. Initial indications are that there is a mix of primary and secondary amines in the solvent with a ratio of approximately 1:3 primary amine to secondary amine, which would therefore reduce the current modelled DMA PCs by a quarter. Further, it is understood that the relative molecular mass (RMM) of the amines present in the solvent are different to MEA and DMA, and initial model runs with this data have indicated that using these RMMs would also lead to a reduction in the predicted PCs over those presented in Tables 1 and 2 above.

	The comparison of the Errol Place monitoring data (as presented above) and the original EIAR results based on the Fort William data shows varied results across MEA and DMA. As documented above, and within Appendix 8C of the original EIAR, this is a factor of modelling limitations in use of the CCSA constants values. The values presented above demonstrate a range of potential N-amine concentrations to be emitted from the Proposed Development, however the results from using the Errol Place monitoring data do not change the findings of the EIAR results. As described in Appendix 8C, the previous additional information submitted in February 2022 and above, the PPC Permit application will include further details that demonstrate the projects compliance with AQS based on the final design and modelling guidance available at the time.
In relation to the model description and justification and sensitivity assessment, we **request** the following clarification: • It is unclear what accounts for the large (factor of three) difference in results between advanced dispersion modelling system (ADMS) and AERMOD modelling system. This should be clarified. (We note our comments regarding uncertainty analysis have not been addressed as the applicant wishes to defer this to the PPC application stage and **highlight** this is at their commercial risk.)	The absorber modelled for the EIAR had a very large height and massing, and the difference in the ADMS and AERMOD results are, in our experience, likely to be due to the way that downwash effects are modelled between the two models. ADMS includes a specific module for modelling downwash, which takes into account the effects of buoyancy, momentum, and heat transfer on the dispersion of emissions, and allows for the inclusion of site-specific data such as building geometry and surface roughness. A 'main building' is selected for each source (in this case the absorber building for the absorber stack), then for each wind direction, the buildings included in the model set-up are reduced to a single cuboidal effective wind-aligned building, the height of which is that of the 'main building'. Given the 91m height of the absorber building, when all buildings included in the model are encompassed in the effective modelled building, it is not unreasonable to conclude that the downwash effects will be overestimated by the ADMS model, resulting in the increased process contributions in the vicinity of the stack. In contrast, AERMOD uses an algorithm to calculate the reduction in effective stack height due to the presence of nearby buildings and modifies the dispersion calculations accordingly. From our experience, ADMS gives much higher values closer to a source than AERMOD when large building impacts are influencing the dispersion, and there are model comparison papers around on this topic which support this. It is therefore considered to be a known difference. As the AERMOD results are lower, it is considered that the use of ADMS represents the worst case, and therefore that the modelling is precautionary.
In relation to the model domain, grid and receptors, we **request** the following information: • The model grid domain is expanded so that isopleths can be produced for the habitats.	Example isopleth figures have been produced (see Figures 1 - 4, Appendix A), which correspond to the Scenarios modelled for the original holding objection response. Those scenarios were abated and unabated operation of single stack and twin stack designs. The figures presented represent the worst-case single absorber scenario, which was for unabated operation (modelled Scenario 2) and the worst-case twin absorber scenario which was for abated operation (modelled Scenario 4).

It should be noted that the impacts at all but the closest habitat receptors were shown to be **not significant** in the EIAR (and insignificant at the first level of screening applied in the H1 Guidance), and therefore the lower results modelled for the original holding objection response are also insignificant. The PCs are so low at habitat sites at distance from the site, that it is difficult to produce an isopleth figure which will show isopleth lines at the furthest habitat sites. All areas beyond the 0.3µg/m^3 isopleth line have impacts that are less than 1% of the annual average Critical Level and therefore are insignificant in terms of the H1 screening criteria, and all areas beyond the 7.5µg/m^3 isopleth line have impacts that are less than 10% for the daily average Critical Level.

In relation to the impact assessment, the summary tables only provide process contribution (PC) from the stations and not predicted environmental concentration (PEC) which combines this with background levels. The applicant has argued that background concentrations vary over the modelled domain and that this justifies the use of PCs in the contour plots, however this is not consistent with the stated fixed background concentration that has been used. We therefore **request** the following:

- Contour plots to show the PEC rather than the PC with the model run with the highest and other background levels.

Table 13 and 14 (Appendix 8B) from the EIAR are replicated below. The figures reported in the EIAR are shown in grey, with the new figures for the single absorber scenario (abated) shown in **black bold**. The background concentration (BC) for the maximum location anywhere has been assumed to be 26.3µg/m^3 in line with SEPA's request for this to be used as the worst-case background in the area.

All other receptors have BCs that correspond to the background map concentration for the relevant 1km grid square.

The EIAR concluded that the NO_2 impacts for annual averages and hourly averages were negligible adverse and **not significant**, the new PC impacts are lower than those presented in EIAR.

Table 13: Predicted change in annual mean NO_2 concentrations at all receptors

Receptor I.D.	AQS (µg/m^3)	PC (µg/m^3)	PC/ AQS %	BC (µg/m^3)	PEC (µg/m^3)	PEC/ AQS %
Maximum anywhere	40	2.7 **1.8**	7% **5%**	**26.3** 19.3	22.0 **28.1**	55% **70%**
OR1		0.57 **0.04**	1% **0.1%**	**8.4**	19.9 **8.4**	50% **21%**
OR2		0.69 **0.2**	2% **0.5%**	**8.4**	20.0 **5.8**	50% **21%**
OR3		0.57 **0.08**	1% **0.2%**	**8.4**	19.9 **8.4**	50% **21%**
OR4		0.44 **0.3**	1% **0.7%**	**5.8**	19.7 **6.1**	49% **15%**
OR5		0.74 **0.08**	2% **0.2%**	**6.4**	20.0 **6.4**	50% **16%**
OR6		0.93 **0.1**	2% **0.3%**	**6.4**	20.2 **6.5**	51% **16%**
OR7		0.90 **0.2**	2% **0.4%**	**6.4**	20.2 **6.5**	50% **16%**

OR8	1.10 **0.2**	3% **0.4%**	**6.4**	20.4 **6.5**	51% **16%**
OR9	1.63 **0.11**	4% **0.3%**	**7.1**	20.9 **7.2**	52% **18%**
OR10	1.75 **1.3**	4% **3%**	**19.3**	21.0 **20.5**	53% **51%**

PC = Process Contribution, AQS = Air Quality Standard, BC = Background Concentration, PEC = Predicted Environmental Concentration

Table 14: Predicted change in hourly mean NO_2 concentrations (as the 99.79th Percentile of Hourly Averages) at all receptors

Receptor I.D.	AQS ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC/ AQS %	BC ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PEC/ AQS %
Maximum anywhere	200	98.4 **23.3**	49% **12%**	**52.6** 38.6	137.0 **75.9**	68% **38%**
OR1		21.0 **3.0**	11% **2%**	**16.7**	59.6 **19.7**	30% **10%**
OR2		19.7 **8.6**	10% **4%**	**16.7**	58.2 **25.3**	29% **13%**
OR3		16.9 **5.4**	8% **3%**	**16.7**	55.5 **22.1**	28% **11%**
OR4		19.3 **8.2**	10% **4%**	**11.6**	57.9 **19.9**	29% **10%**
OR5		20.1 **4.7**	10% **2%**	**12.7**	58.7 **17.4**	29% **9%**
OR6		19.1 **7.3**	10% **4%**	**12.7**	57.7 **20.0**	29% **10%**
OR7		20.7 **8.4**	10% **4%**	**12.7**	59.3 **21.2**	30% **11%**
OR8		19.3 **8.7**	10% **4%**	**12.7**	57.9 **21.4**	29% **11%**
OR9		19.0 **7.2**	10% **4%**	**14.2**	57.6 **21.5**	29% **11%**
OR10		19.1 **15.4**	10% **8%**	**38.6**	57.6 **54.0**	29% **27%**

PC = Process Contribution, AQS = Air Quality Standard, BC = Background Concentration, PEC = Predicted Environmental Concentration

Tables 13 and 14 show that even when the worst-case background concentration is used to assess the impacts at the location of maximum impact (which do not correspond spatially), the annual average impacts remain below the 70% threshold for PEC values.

Example isopleth figures of the PECs have been produced (see Figures 5 - 8, Appendix A), which correspond to the Scenarios modelled for the original holding objection response. The figures presented represent the PECs for the worst-case single absorber scenario, which was for unabated operation (modelled Scenario 2) and the worst-case twin absorber scenario which was for abated operation (modelled Scenario 4).

At the request of SEPA, the PECs have been produced assuming the worst-case background concentration of 26.3µg/m^3, which as shown and discussed previously in this response, is representative of a 1km grid square that is predominantly located over Peterhead Harbour and therefore not representative of human health receptors. The isopleths provided with this response clearly show that the worst-case PCs from the Proposed Development do not correspond with this grid square.

In relation to emissions limits we note the applicant has not taken on board our previous comments regarding potential effects higher short-term Large Combustion Plant emission limits (NOx and CO) could have on short-term air quality. The modelling shows that there may be sufficient capacity for emissions at these higher rates, but we wish to **highlight** it is at their risk to solely base environmental capacity on some of the averaging criteria but not all.

The original holding objection stated *"It has not taken into consideration the higher daily and hourly emission limits required by Chapter III, Annex V, Part 2 of the Industrial Emissions."*

A comparison of the LCP BAT and the IED limits provided in Chapter III, Annex V, Part 2 are provided in the table below, together with the concentrations that have been modelled.

Source	**Pollutant**	**Averaging Period**	**Concentration (mg/Nm^3)**	**Modelled Concentration (mg/Nm^3)**
LCP BAT Conclusions New CCGT	Oxides of Nitrogen	Daily average	15-40	45
		Yearly average	10-30	34
	Carbon monoxide	Yearly average	5-30	100
Industrial Emissions Directive (IED) LCP	Oxides of Nitrogen	Not stated	50	34
	Carbon monoxide	Not stated	100	100

It is considered that the wording in the original objection perhaps should have referenced Chapter III, Annex V, Part 4 on compliance with emission limits, whereby:

- no validated monthly average value exceeds the relevant emission limit values set out in Part 2;
- no validated daily average value exceeds 110% of the relevant emission limit values set out in Parts 2
- 95% of all the validated hourly average values over the year do not exceed 200% of the relevant emission limit values set out in Part 2.

As such, emission limits that could be applied are shown below.

Source	**Pollutant**	**Averaging Period**	**Concentration (mg/Nm^3)**	**Modelled Concentration (mg/Nm^3)**
Industrial Emissions Directive (IED) LCP	Oxides of Nitrogen	Monthly	50	No air quality standard for NO_2 or NOx for monthly averaging periods.
		Daily	55	45mg/Nm^3 modelled for ecological impacts only.
		Hourly (95% of all the validated hourly average values per year)	100	45
	Carbon monoxide	Monthly	100	No air quality standards for CO for monthly averaging periods.
		Daily	110	No air quality standard for CO for daily averaging periods.
		Hourly (95% of all the validated hourly average values per year)	200	100mg/m^3 modelled and impacts demonstrated to be insignificant. Doubling the hourly limit would also result in impacts that would be not significant.

The concentrations modelled have been based on the BAT-AELs with the net electrical efficiency correction factor applied, and are considered to be achievable by the technology licensors. The NOx emissions from the CCGT need to be controlled to these levels to ensure that solvent degradation is limited, and therefore emissions at these levels are not only for regulatory compliance, but to optimise the carbon capture plant performance.

In addition, it is considered that the Chapter III, Annex V, Part 4 provisions are in place to assist compliance with emission limits based on CEMS monitoring results. For example, to account for potential infrequent and short-term process upset (e.g. load swing) and to prevent penalisation of otherwise well performing assets (on average hourly values and on a daily basis), rather than determining suitable emission limits for modelling purposes, which in AECOM's experience have always been carried out at BAT-AEL concentrations.

The remodelled hourly NO_2 results presented in Table 13 above show a significant reduction from those assessed for EIAR, with hourly PCs representing 12% of the AQS at the maximum location, compared to the 49% reported in the EIAR. Therefore, it is considered that if the NOx emissions were modelled at the IED hourly limit of 100mg/Nm^3 the hourly PCs would still be less than the 49% presented in the EIAR. It should be noted that a number of Large Combustion Plant permits including the current Peterhead Power Station PPC permit do not apply the IED Chapter III, Annex V, Part 4 provisions exactly as stated, with the 95% of validated hourly NOx emissions being less than the 200% of the applied emission limit, and therefore if necessary to reduce the predicted impacts of the Proposed Development, a lower limit could be considered.

In the EIAR, the maximum hourly and 8-hour running mean CO PCs that occur anywhere as a result of the Proposed Development represent less than 2% and 6% of the relevant AQS. The remodelled CO results are of similar magnitude, with the 1-hour being 1.5% of the relevant AQS and the 8h running being 2.1% of the relevant AQS. Both were modelled with an emission rate of 100 mg/Nm^3 but doubling the hourly limit is expected to also result in impacts that would be **not significant**.

It is therefore proposed that the modelling to be carried out for the PPC Permit application will use the IED NOx and CO concentrations of 100mg/Nm^3 and 200mg/Nm^3 respectively for hourly averaging periods, in the first instance, and if the results are higher than those detailed in the EIAR report, a lower limit will be proposed (for example 150% of the IED limit as per SSE's Keadby 2 station, or 120% of the IED limit as per the existing Peterhead Power Station).

In relation to the meteorological data from Peterhead Harbour being used: • We **request** wind rose plots are included for each year of this data.	Windrose plots for all years of Peterhead Harbour meteorological data have been provided in Figure 9 (Appendix A).

Appendix C (Post-Submission Air Quality Modelling Technical Note)

The model reassessment results in Appendix C indicate a high risk that the Air Quality Standard (AQS) for amines will be exceeded. In-direct concentrations of N-amines exceed the AQS (112%) at the maximum receptor before the addition of direct concentrations. These results are higher than those previously presented in Appendix 8C of the EIA report volume 4.	The remodelling presented in Appendix C of the original holding objection response assessed the in-direct impact of amines released as both MEA and DMA as in the EIAR assessment. The impacts when assessed as MEA were much lower (at 0.3%) than the 9% reported in the EIAR. When assessed as DMA, the impacts increased from those presented in the EIAR from 29% to 112%. It is therefore only the results when assessed with the rate constants for DMA that were higher. Additional detail on these impacts are provided in Table 1 and 2 of this response, with further discussion of the relevance and potential impact of the predicted PCs. The variation in the N-amine impacts caused by the use of different rate constants were shown in the EIAR Appendix 8C to be between -7% and +299% of the AQS when modelled as MEA and -21% and +536% of the AQS when modelled as DMA and therefore the SEPA statement that *"In-direct concentrations of N-amines exceed the AQS (112%) at the maximum receptors"* needs to be considered in context of the great variance in the amine model results as presented and discussed in the EIAR Appendix 8C. Additional modelling will be carried out once more detail is known on the chosen licensor's amine solvent, and it is considered that this can be carried out as part of the PPC Permitting process. As stated earlier, initial indications are that licensor specific modelling will lead to a reduction in the predicted PCs. As per the response to the request for a comparison with the Errol Place monitoring data there are no proposed changes to the EIAR as a result of the uncertainty caused by the rates constants. The Applicant believes sufficient information has been provided for SEPA's confidence that N-amine concentrations will be lower based on the final design and appropriate modelling will accompany the PPC Permit application to support this prior to Permit approval and construction of the Proposed Development.
We would therefore **request** the following information and analyses: • The Normal flow rates for Peterhead 2 in Table 4 are higher than the Actual flow rates, (e.g., Abated single absorber actual flow rate of 906 Am^3/s and Normal of 1037 Nm^3/s. These calculations should be clarified to ensure there are no errors in the calculated emission rates. Due to the high risk of the N-amine Environmental Assessment Levels (EALs) being compromised, we request the applicant provides	The data required to calculate the normalised flow rates is provided in Table 4 of the original holding objection response. Due to the actual oxygen concentration of the stack gas being 12% and the normalisation correction to 15% oxygen, this increases the volume for the normalised flow rate. Flows normalised to dry, 0ºC, 15% O_2, based on O_2 (dry) 12% H_2O 10.7% using calculation: $906.4m^3/s \times 273/(273+48.4) \times (20.9-12)/(20.9-15) \times ((100-10.7)/100) = 1{,}037m^3/s$ Following discussions with SEPA on 4th April 2023, it was highlighted that it was the existing Peterhead Power Station flow rates that were also under question, as it appears that the normalised flow rates provided had not been corrected for oxygen. This is correct, and therefore the release rates remodelled for Peterhead 1 NOx and CO emissions are potentially

the model input files to SEPA so that it can verify the assessment findings using its own modelling software.

lower than they should be. However, the comment was made in relation to N-amine impacts being underestimated, and therefore as N-amines are not released from Peterhead 1 their impacts will not be affected by this error.

In terms of the underestimating of the normalised flow rates for Peterhead 1 potentially affecting the impacts of NO_2, NOx and CO these results are dominated by the impacts from the Peterhead Low Carbon CCGT Power Station emissions due to the higher release rate, greater building downwash and lower emission temperature. Check modelling has been carried out to determine the impact on NO_2 emissions at human health receptors and it was found that for the single absorber scenario (Scenario 3) the annual average impacts were increased at the maximum location by <0.5% of the AQS, and the hourly impacts remained the same. For the unabated operational scenario (Scenario 2) the annual average impacts were increased at the maximum location by <1.1% of the AQS, and again the hourly impacts remained the same.

As stated previously, the model files will be provided to SEPA on submission of the PPC variation application, when the model will be refined for the specifics of the plant design following the Front-End Engineering Design (FEED) that has been carried out since the Section 36 application was submitted.

- It is normal practice to include the results for each receptor for each of the 5 years considered to show that the maximum has been appropriately established. Results are only given for an undisclosed maximum receptor, but we request data is presented for all receptors, including contour plots. A cumulative total (direct and in-direct) amine concentrations should be included.

Results were provided for the worst-case year only to help focus the results on the important issues for the lay person. Given the very technical nature of the assessment, and the potential target audience, it was considered appropriate to simplify the information provided.

Table 3 below presents the remodelled MEA and DMA results for all 5 met years modelled. The PCs presented are the combined nitramine and nitrosamine PCs at the worst-case location, corresponding to the modelling used to generate the results that were presented in Tables 1 and 2 above of this response.

Table 3: Remodelled MEA and DMA PC Results for all 5 Peterhead Met Years

Amine Species Modelled	2017	2018	2019	2020	2021	Max	Variance between the min and the max
MEA	0.00024	0.00038	0.00031	0.00030	0.00032	0.00038 (rounded to 0.0004 in Table 2 above)	64%
DMA	0.27	0.46	0.36	0.33	0.35	0.46	60%

Results for all receptors for the worst-case year have been provided in Tables 1 and 2 above.

An example of the Contour plots for the N-amines modelling have been provided in Figures 10 to 16 (Appendix A), on the understanding that further modelling will be carried out when additional detail on the amine emissions and the appropriate reaction rate constants for the amines within the solvent becomes available during FEED and further contour plots

	provided at this time. The example figures relate to the CCSA rate constants for DMA, as per the results presented in Table 2 of this response. It should also be noted that a new version of the ADMS amines module is due to be released, and also that the UK EA are due to release a consultation on proposed additional EALs for amines and their degradation species. It is therefore considered that the assessment would need to be revised when this information becomes available in any case, and that more appropriate AQS may be available for the amines and nitrosamines within the solvent to be used may be available, therefore refining the assessment results. Given that the current N-amine AQS is based on what is accepted to be one of the most toxic nitrosamines NDMA, it is considered that AQSs for the actual nitrosamines involved are likely to be higher, and therefore the impacts would be lower.
• In-direct concentrations of N-amines for the twin stack option needs to be given.	The emerging design from the supplier indicates the preference of a single-stack option. The twin stack design assessed for the EIAR related to a different licensor, and therefore is not applicable to the chosen supplier. However, the Applicant would like the option for a twin stack option to remain in the planning consent, in the event that this is required as a result of concerns raised by the Defence Infrastructure Organisation over stack height. In order to provide SEPA with assurance that the N-amine impacts are no worse for the twin stack option than the results presented in the EIAR, indicative modelling of this scenario has been carried out. As it is not possible to model two emission points when using the ADMS amines module, the g/s release rate for the two stacks needs to be combined and modelled as a single emission point. This has been carried out, assuming that the absorber and stack location is in the middle of the absorber location defined for the twin stack option. It is understood that the licensor with the twin stack option may commit to a lower amine emission concentration than the single absorber and stack, and consequently, when modelled the N-amine impacts are lower than the single absorber scenario. As in the assessment carried out for the Environment Agency (EA) for another similar SSE project, a range of rate constants were used in the modelling and provided PCs that were between 0.5% of the NDMA EAL at the lower end and 105% of the NDMA EAL at the upper end at the worst-case receptor for the in-direct amine impacts. For direct nitrosamine impacts the PCs were between 4% - 108% of the of the NDMA EAL for the lower and upper point respectively. The mid-point rate constant provided EALs that were 16% and 19% of the NDMA EAL respectively, therefore representing 35% of the EAL when considered together. Given the emerging design and the requirement to revisit the amines modelling based on further Contractor design information for the PPC Permit, and the impending additional EALs for amines and their degradation species from UK EA, modelling of the twin stack option will be carried out and presented in full for the PPC permit variation, should the twin absorber scenario option still be applicable when the application is submitted. However preliminary assessment based on the Applicant's knowledge of contractor solutions note that twin stack emissions would be within, or less than, the

	impacts that have been assessed and reported within the EIAR and therefore no further amendments to the assessment are deemed to be necessary at this time.
• Given the risk of high amine concentrations and the modelling uncertainties, we **request** a stack height assessment for amines be included to show the benefit of increasing stack height. This may indicate that the stack height may need to be raised.	As stated previously, additional modelling will need to be carried out once further detail on the amine emissions becomes available during FEED, when the updated ADMS amines module is released and then additional AQS have been made available. Based on the information provided to date, it is considered that further modelling will be able to refine the amines assessment, such that the results are within the PCs already modelled. As such, it is considered that the proposed stack height is suitable and that limited benefit would be provided by increasing the stack further. Any increase in stack height must also be considered with the potential adverse effects to other environmental topics – namely landscape and visual amenity, as well as defence infrastructure (i.e. radar). The lower stack height, where suitable for emissions, is the preferred solution on balance across all environmental topics. It is therefore considered that the worst-case assumptions used in the assessment of amines carried out to date are appropriately conservative for the stage at which the project is at, to demonstrate that impacts are unlikely at human health receptors.
• Stack height assessment has not been undertaken for Peterhead 2 operating in unabated mode via the Heat Recovery Steam Generator (HRSG) stack. Considering this could be operated for a prolonged period of time if the capture plant be out of operation, this needs to be undertaken.	The impacts for the HRSG stack height assessed can be seen to be largely comparable to the abated operational scenario, which has negligible adverse impacts that are **not significant** and therefore is considered to be appropriate. However, at the request of SEPA a stack height assessment for the unabated operation has been carried out and graphs showing the impacts of NO_2 have been produced for annual average and hourly Process Contributions at the point of maximum impact and at the worst-case receptor (see Figure 17, Appendix A). The purpose of the graphs is to identify the elbow of the curve where the reduction in PC becomes less marked with increasing stack height. It can be seen from the graphs that there is no distinct elbow for either the impacts at the worst-case location or the worst-case receptor. It is therefore considered that the proposed HRSG stack height is 85m, with its comparable impacts to the abated operational scenario is appropriate for the HRSG.
Further SEPA Advise for the Determining Authority	
Human Health Risk Assessment We highlight that a human health risk assessment has not been considered with the applicant taking position that a vendor has to be agreed prior to the identifying any nitrosamines (N-amines) of concern. Environment Assessment Levels used in air emissions risk	Given the location of the site, on the east coast of Scotland, and the prevailing wind direction (from the southwest), the emissions from the site are dispersed out over the North Sea, which can be clearly seen from the isopleths provided in Appendix A. It is therefore considered that potential exposure through ingestion either from deposition on agricultural land or drinking water supplies is highly unlikely to occur for this location.

assessments only assess inhalation, not ingestion and N-amines have been identified as a possible concern in drinking water supplies. The applicant believes that the highest risk N-amine (N-DMA) will not be formed but it could be used for a worst-case assessment in the absence of known pollutant data. The determining authority needs to satisfy itself it happy to proceed with this gap in impact assessment.	In addition, it is understood that the Derived Minimal Effect Level of 0.03ng/m^3 set by the Norwegian Institute of Public Health and was based on drinking water studies and this has been taken into account in the derivation of the UK EAL of 0.2ng/m^3, therefore it is considered that the EAL has been set with other potential exposure routes in mind.
Cooling Waters We are disappointed to note the applicant has not provided any further information on the potential location of any change in water supply. We highlight this is at the developer's future risk should a new location be required and is found not to be consentable.	The Applicant is confident that the existing Peterhead cooling water supply is appropriate for use for the Peterhead Low Carbon CCGT Power Station, however it is noted that the risk remains with the Applicant for appropriate evidence to be shared with SEPA to confirm and agree this position.
Carbon Capture Readiness We **highlight** no further information has been provided on the possible use of existing pipelines to transport CO_2 to the St Fergus Terminal. It does not confirm whether the pipeline has the capacity to handle the throughput of CO_2 expected when the station is operating. We **highlight** the applicant has not clarified whether the footprint calculations include the existing power station. We **recommend** clarification is sought on this matter, with it included if it has not been.	This is noted and accepted by the Applicant. Work is ongoing to assess the viability of the existing pipework, which is the preferred transport solution, alternatively the existing pipeline corridor presents a feasible option for CO_2 transportation. This will be delivered as part of the Acorn project and is separate to the current application. Regarding the footprint calculations for the CCR Assessment, the Applicant can confirm that this does not include the existing Peterhead Power Station. The CCR requirements apply only to new combustion plant and therefore are not applicable to the existing operational site. Furthermore, the Applicant reiterates its position that it does not envisage the existing Peterhead Power Station to continue operations into the 2030s as the company transitions to low carbon flexible thermal generation as per annual statements. It is recognised and accepted that the short-term future of the existing units at Peterhead will be influenced by a number of factors, including the date at which the new generating station comes online, delivery of new capacity across the system by that date, system needs, levels of electricity demand, policy, and market signals. On this basis, it is uncertain whether any or all of the existing gas turbines will be required to operate alongside the Proposed Development for any period of time, it is therefore disproportionate to account for the existing power station in the CCR Assessment.
Visual Assessment	The shape, scale and massing of the absorber has overall been reduced and is within the Envelope presented in the EIAR. The design amendments are a positive change in the parameters however these do not amend the findings of

In addition to the confirmation the existing power station will be retained, we **highlight** the shape of the proposed absorber tower has also been changed. Whilst these changes are welcome, particularly in relation to the shape of the absorber tower which has affected dispersion in a positive way, we highlight to the determining authority there appears to be no reassessment of the visual/landscape aspects of these revisions.	the worst-case assessment undertaken to inform the EIAR and the original application. As a result, no further landscape or visual assessment is deemed necessary.
Firewater We confirm the response adequately addresses our previous concern regarding firewater and the need for any additional storage and we remove our objection in this regard.	This is noted and welcomed by the Applicant.