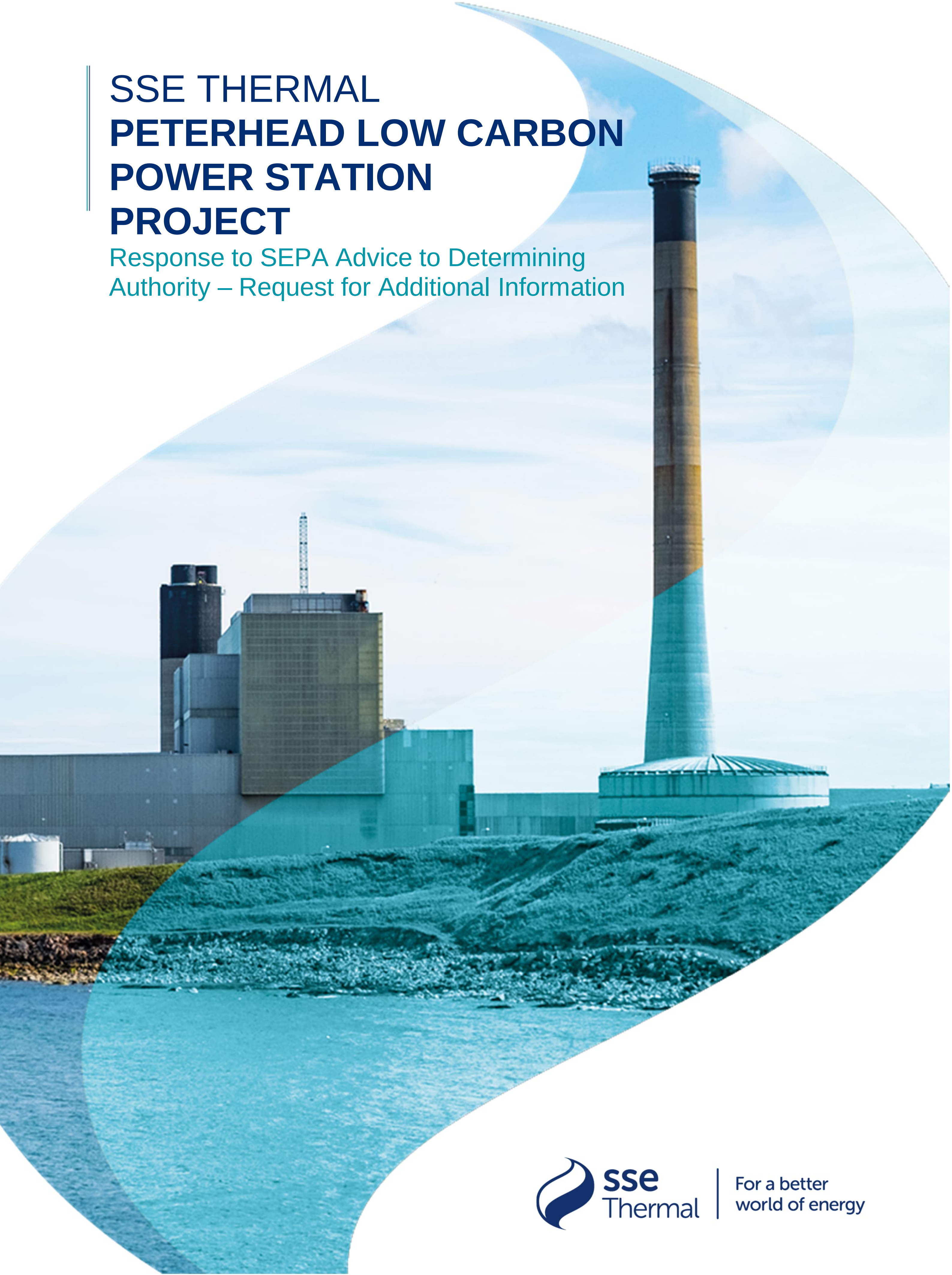
SSE THERMAL

PETERHEAD LOW CARBON POWER STATION PROJECT

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



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1. Introduction

Following your response dated 1st July 2022 to the application for consent for the Peterhead Low Carbon CCGT Power Station, and our further engagement on the points raised, SSE Thermal (hereafter referred to as 'the Applicant') have set out the below responses to closing out these comments. It is noted that SEPA requested additional information to remove a holding objection to the application, with clarity required on matters associated with the assessment of air quality and emissions and the management of firewater.

In the interim period of submitting the application for consent for the Peterhead Low Carbon CCGT Power Station and present, a number of external factors have resulted in the need to consider the operational future of the existing Peterhead Power Station. This has resulted in re-modelling future baseline scenarios to ensure the appropriate worst-case scenario is considered in the Environmental Impact Assessment (EIA).

1.1. REVISION OF THE ASSUMED OPERATIONAL REGIME OF THE EXISTING PETERHEAD POWER STATION

At the time of submission it was assumed that the operation of the existing Peterhead Power Station would be reduced to operating only one of the three gas turbines, in line with SSE's Net Zero Acceleration Programme and associated science-based targets to cut Scope 1 emissions by 80% by 2030[1]. The approach and commitment to close the existing Peterhead Power Station is well documented by SSE in their Annual Report(s) noting that the power station along with other SSE-owned CCGTs are projected to cease operations before 2030 (with the exception of Keadby 2).

As a result of recent energy security issues, largely as a result of geo-political factors, it has been considered that the existing Peterhead Power Station may operate at a higher capacity when the Peterhead Low Carbon CCGT Power Station comes online to increase the availability of dispatchable power to the UK electricity transmission network where necessary. For the purposes of the application for consent for the Peterhead Low Carbon CCGT Power Station the air quality modelling and associated assessments have therefore been reviewed to reflect this potential worst-case scenario (the three gas turbines operating concurrently with the proposed Peterhead Low Carbon CCGT Power Station in both abated and unabated operation) to ensure timely and appropriate consideration of the potential environmental impacts associated with this scenario.

1.2. STRUCTURE OF THIS RESPONSE DOCUMENT

Table 1 sets out the structure of this response related to addressing the additional information requested of SEPA to remove their holding objection.

Table 1. structure of response to the request for additional information

SEPA Response Section of response	Matter raised	Where this is addressed in our response
Appendix 1A – Section 1	Air quality – approach to assessment and emissions	Appendix A of this document includes the response to SEPA's questions regarding the approach to the assessment, modelling and emissions.

[1] Compared to 2017/18 levels, to a target of 61gCO2e/kWh. Source: https://www.sse.com/sustainability/

SEPA Response Section of response	Matter raised	Where this is addressed in our response
		This response includes SEPA's original comments for ease of review against the relevant response and where action has been taken in regard to further modelling. To keep relevant comments and responses together for ease of review, Appendix A continues with other air quality-related comments raised by SEPA in Appendix 1B of their comments.
Appendix 1A – Section 2	Water environment – firewater management	Appendix B of this response document includes further detail on the proposed approach to the management of firewater at the Peterhead Low Carbon Power Station site.
Appendix 1B – Section 1	Air quality – technical assessment	Appendix A of this document includes the response to SEPA's questions regarding the air quality technical assessment. As noted above this follows on from the response to comments made in regard to the approach and emissions as raised in Appendix 1A Section 1 of SEPA's comments. Response directly relevant to Appendix 1B Section 1 start on page 8 of Appendix A.

It is noted that there are a number of other comments that are included in the response, although not the subject of the holding objection or requiring additional information at this stage of the Section 36 consent application. The Applicant has summarised these comments in **Table 2** in recognition and understanding of the points raised, acknowledging that further consideration of these matters in many cases will be necessary through subsequent stages of the consenting process (namely the Pollution Prevention and Control (PPC) permit application process), should the application for Section 36 consent be approved.

Table 2 – Other SEPA Comments not subject to Holding Objection

SEPA Comment Document Paragraph Reference	Comment Summary and Applicant Response
2.3 Cooling Water	Three main points are raised by SEPA in this section: • Will the operation of the new plant impact on the existing cooling water intake from Boddam Harbour – noting that the water consumption of the proposed power station is close to the existing station (and therefore there may be a need to reconsider the current Controlled Activities Regulations (CAR) abstraction registration). • No information has been presented in regard to the existing cooling water discharge quality – specifically noting that the discharge of chlorine, and the potential formation of chloroform and other halogenated compounds. SEPA note that an indication of the technologies to be adopted to minimise emissions will be required at the PCC permit application stage. • SEPA highlight that there is no consideration within the application material of the sustainability of the existing extraction location over the lifespan of the development noting that the location may need to be relocated should the temperature of water in the current location be too susceptible to temperature change. These comments are noted by the Applicant and further work is ongoing to support the PCC permit application to address or add certainty around the Development's position on these points.

SEPA Comment Document Paragraph Reference	Comment Summary and Applicant Response
2.4 Drainage (inc. surface water)	Noted that SEPA are satisfied that plans of the drainage system will be provided at the PCC permit application stage.
2.5 Effluent	It is noted that the design of the effluent treatment plant for the discharge of pollutants that could be emitted from the new power station and associated CCP will need to provided as part of a PPC permit application.
2.6 Domestic Effluent	It is noted that SEPAs preference would be for the development to connect to the public sewer system – and this will be investigated further. However given the relatively small volumes of domestic effluent involved there is capacity to discharge within the current PPC Permit standards.
3. Water Environment – Engineering	The Applicant welcomes the confirmation that the preferred replacement culvert option of the Den of Boddam Burn is likely to be authorised under The Water Environment (Controlled Activities) (Scotland) Regulations (CAR).
4. Flood Risk	Comments agree with the assessment and no objection on flood risk matters have been raised.
5. Noise	The Applicant welcomes the conclusion that noise impacts can be adequately controlled through best practice design and operating procedures. It is also acknowledged that differing design criteria will be applied at PPC permit application. The Applicant notes has no objection to planning conditions being applied for noise management during construction, and that no condition is applied to operational noise.
6. Energy Efficiency	The Applicant notes the requirement to provide a cost benefit analysis as per Article 14 EU Energy Efficiency Directive (2012/27/EU) as part of the PPC permit application.
7. Carbon Capture Readiness	Two points are raised by SEPA in this section: • Comments have been raised by SEPA regarding the transport of carbon dioxide between the power station and the St Fergus Gas Terminal, with reference made to the potential use of existing, currently decommissioned, pipelines. This is noted and accepted by the Applicant as work continues to assess the viability of the existing pipework, which is the preferred transport solution, the existing pipeline corridor presents a feasible option for CO_2 transportation. • The assessment is noted to be undertaken using a revised space requirement calculation (instead of the area per MW value set out in the DECC 2009 Carbon Capture Readiness guidance) – however SEPA note that there is sufficient space available on site. This is noted and the
8. Other Planning Matters	No comments from the Applicant.
Appendix 2 – Matters Relating to the Climate Change (Scotland) Act 2009	SEPA has asked for clarification on the following matters to enable determination with respect to the Climate Change Duties: • As the life span of the Proposed Development goes beyond the 2009 Act's 2045 Net Zero emissions target and UK-wide target to decarbonise the electricity system by 2035, with continued operation of the existing site, SEPA requests additional specificity regarding overall emission from the operation of both sites. o As set out above, given that the closure of the existing station relies on dynamic external factors, including governmental policy, it is not

SEPA Comment Document Paragraph Reference	Comment Summary and Applicant Response
	possible to know with certainty when the existing station will cease operations, or what its exact running pattern will be between now and then. SSE does not expect the existing station to continue generation into the 2030s. o The potential impact of the Proposed Development to climate change and its carbon emissions are clearly set out in Chapter 18: Climate Change and Sustainability within the Environmental Impact Assessment Report. • Efficiency of carbon capture systems, greenhouse gas emissions over its lifespan and potential opportunities for mitigation. How residual emissions are compatible with Net Zero. o As stated within the planning application (see EIAR Volume 2, Chapter 4: The Proposed Development, Section4.3.4.2) that a capture efficiency of between 90-95% is expected to be achieved, with relevant assessments assuming the conservative 90% efficiency rating for a realistic worst-case scenario. 100% capture efficiency is technically not achievable. o As set out in SSE's Net Zero Transition Plan, SSE aims to assist the development of policy to deliver an orderly transition from unabated gas generation whilst ensuring security of supply. SSE's science-based targets are described above, as is its aim to achieve net zero Scope 1 emissions by 2040; this would likely include the use of negative emissions technologies to offset any residual emissions. o SEPA will be aware that further detail from the UK Government on the aim of decarbonising the electricity system by 2035 are awaited, and achievement is subject to security of supply. As outlined above, a degree of residual emissions is inevitable for CCS systems. BEIS is currently consulting on changes to the Capacity Mechanism to better align it with the 2035 power system decarbonisation target. Proposals include significantly reducing emissions limits as 2035 approaches, making allowances for residual emissions from CCS and Hydrogen power generation. Likewise, the market design and support contracts for Power CCS projects currently in development by BEIS, allows for residual emissions. • Proposed Development's reliance on shared carbon transport and storage infrastructure, which is yet to obtain consent. o The Applicant agrees with this analysis, the proposed development as outlined does rely on shared infrastructure. o As stated within EIAR Volume 2, Chapter 1 – Introduction, Section 1.3.2.2 the Applicant has confirmed that the Proposed Development would not be progressed without the CCP as the Applicant is fully committed to building a generating station which has a clear route to decarbonisation.

SEPA Comment Document Paragraph Reference	Comment Summary and Applicant Response

	• Use of cooling water in Boddam Harbour and associated climate change adaptation measures.
	  o There are not envisaged to be any performance issues associated with the projected rise in sea water temperatures and the existing infrastructure. The Applicant will continue to work together with SEPA to provide sufficient evidence to support the future Pollution Prevention Control (PPC) Permit. It is noted that the existing permit is based on current sea water temperatures of 4-16°C, and allows for a 10°C rise or maximum of 32°C.
	  o The future climatic baseline is further described in EIAR Volume 2, Chapter 18: Climate Change and Sustainability, section 18.1.6.

APPENDIX A – DETAILED SEPA RESPONSE TO ECU00003433 (APPENDIX 1A)

The below technical note provides responses to the Scottish Environment Protection Agency (SEPA) in regard to the comments raised to the application for consent of the Peterhead Low Carbon CCGT Power Station under Section 36 of the Electricity Act 1989. SEPA submitted a holding objection to the application on grounds of air quality and firewater management.

SSE Thermal ('the Applicant') has since been engaged with SEPA to discuss the comments and agree the relevant work.

The section number in the note below is replicated from the SEPA holding objection, and wording taken directly from the holding objection is shown in bold, with the SSE responses provided in normal text.

2. AIR QUALITY

2.1. OVERALL APPROACH TO AIR EMISSIONS ASSESSMENT

2.1.1. THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) NEEDS EXPANSION TO REFLECT THE LEVEL OF DETAIL THAT WOULD BE EXPECTED FOR A LARGE POWER STATION. IT IS IMPORTANT THAT THE RISK OF EXCEEDANCES IS REDUCED AS MUCH AS POSSIBLE TO REDUCE THE LIKELIHOOD OF NEEDING TO RETROFIT THE PROPOSED POWER STATION WITH FURTHER IMPROVEMENTS AT THE POLLUTION PREVENTION CONTROL (PPC) PERMITTING STAGE. THERE ARE ALSO LARGE UNCERTAINTIES IN THE AMINES MODELLING AND THEREFORE ADDITIONAL SENSITIVITY TESTS ARE NEEDED TO SHOW THE RISK HAS BEEN MINIMISED AS MUCH AS POSSIBLE USING MODELLING TECHNIQUES. ALL THESE CONSIDERATIONS COULD RESULT IN A GREATER STACK HEIGHT OR HIGHER STANDARD OF EMISSIONS TREATMENT BEING NECESSARY.

The purpose of the Air Quality assessment carried out for the EIAR was to determine the worst-case impacts of the operation, based on the information available from a number of CCGT manufacturers and CCP licensors that were being consulted on for the Proposed Development. As such, it is considered appropriate that the worst case CCGT operational parameters (e.g. highest airflow volumes from all CCGT manufacturers) and CCP operational parameters (e.g. highest emission concentrations of amines) were applied in the EIAR assessment to create an "envelope" into which the actual Proposed Development's impacts and effects will fall within. This is the approach used on numerous consent applications for power stations and is the only way to practically assess environmental effects of a Proposed Development at this early stage in the development's design. Developers typically need certainty that a project can be consented before investing significant funds in progressing detailed design.

At the time the assessment was carried out for the EIA, it was envisaged that only one PH1 GT would remain operational, however SSE have confirmed that it may now be the case that all three PH1 GTs are retained for future operation, and therefore this required further consideration.

An engineering consortium has now been selected to carry out a full Front-End Engineering and Design (FEED) of the project, therefore more detailed and specific information is becoming available on the plant operating parameters, and it is envisaged that further information will be available at the PPC variation application stage. For example, MHI have provided some information that indicates that the CCGT airflows will be lower than those assessed for the EIAR, therefore resulting in lower mass emission rates and therefore potentially impacts. In addition, the MHI layout indicates a different shape to the absorber which would reduce the downwash effects for the abated operation. Emission concentrations, specifically for amines are also considered to be much lower than those assessed in the EIAR. If appropriate, further dispersion modelling will be carried out at the PPC application stage taking into account any updated information that is available from the FEED process when the application is prepared.

Updated dispersion modelling has been carried out to take account of the PH1 operation with three GTs and the MHI layout, and this is provided in a separate Memo. The further assessment demonstrates that the abated operation of PH2, together with the operation of the three PH1 GTs remains within the envelope presented in the EIAR.

The key points following the outcome of SEPA's review of the Air Quality Impact Assessment (AQIA) are:

- **As noted in our covering letter, the EIAR has not outlined the worst-case scenarios for the operation of the proposed plant and when operating in conjunction with the existing power station. The applicant needs to provide an outline of the potential operating scenarios for the development during the commissioning and operational phases for both the existing station and the new plant. This should clearly outline the emission limits and pollutant release rates for these scenarios to show how the worst-case scenarios have been determined. This should cover air and any associated water emissions.**

The Air Quality assessment did include the combined operation of the existing power station based on the expected operational profile of it, comprising the running of a single GT and the Proposed Development in-combination.

However, SSE have now confirmed that they may retain all three existing GTs, and therefore additional modelling has been carried out to determine the impacts of this scenario, and the results are presented in a separate Memo. There was an error in the original modelled data for the single GT, which meant that the mass emissions of pollutants assessed for the single GT was actually equivalent to two GTs, and therefore the additional impacts of this mode of operation are not as marked as may be expected. In addition, updates to the Proposed Developments design (mainly the change in the shape of the absorber) has meant that the impacts of the Proposed Development itself are reduced. As such, the overall outcome of the assessment demonstrates that current predicted impacts are lower than those presented in the EIAR.

Information on the peak emissions from start-up operations of the Proposed Development are not available, and will not be available until further into the FEED process. It is considered that additional modelling, which will include consideration of commissioning and start-up operations will be completed as a requirement of the PPC Permit following completion of FEED.

- **A human health risk assessment (HHRA) has not been provided as the applicant believes, for the single stack option, it is not required as it is within the Air Quality Standards/Environmental Assessment Levels (ASLs/EALs). Nitrosamines are highly carcinogenic compounds. Therefore, consideration should be given to their potential impact due to the scale of the project and the uncertainty associated with the capture solvent composition not being provided (due to understandable commercial considerations). We believe the best risk management approach is that a HHRA is considered to enable the determination of the Application. The applicant should propose an approach to this assessment using the methodology outlined in available guidance that takes into** consideration the potential nitrosamine exposure routes for human populations. This should consider exposure from air, land and water ingestion for adult and juveniles.**

For a HHRA assessment to be informative, it would need to be carried out for the specific amine/ amines and degradation products that are relevant for chosen licensors solvent, and until FEED has been carried out, this information will not be available.

Additionally, there is limited data available on the carcinogenicity of different nitrosamines compared to N-Nitrosodimethylamine (NDMA). NDMA will not be present as a result of degradation of all licensors solvents and therefore it would not be appropriate to assume that this nitrosamine, which is considered to be the most toxic, is the case at this stage. As a result, an assessment has been conducted considering the worst case concentrations of NDMA predicted to occur in the environment and assessing those against its published EAL to demonstrate compliance with that EAL.

- **Emissions rates and limits**
- **The flow and emission rates for the new single stack need to be rechecked by the applicant as SEPA has not be able to replicate these. It appears that the flow rate could have been overestimated using the data provided.**

The flow rates for both the single stack and the twin stack were calculated in the same way. It is considered that any difference in the numbers calculated could be due to the rounding used in the report and therefore would only constitute 0.1m/s difference between calculated values, which would not affect the assessment result.

Area of the stack (= $A=\pi r^{\wedge 2}$)	3.1412 x 3.52 = 38.48m^2	
Efflux velocity	$\frac{\text{Actual flow rate } Am^3/s}{\text{Area of stack } m^2}$	
	$\frac{906.375}{38.48}$	= 23.55m/s, rounded to 23.6m/s

- **The assessments undertaken in the application have been based on the best available techniques associated emission levels (BAT-AELs) set out in the Large Combustion Plant BAT Conclusions. 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. This could result in a potential underestimation of the short-term impacts from the operation of the new plant and therefore we request this is undertaken.**

BAT for Large Combustion Plant is to meet the annual and daily BAT-AELs as presented in the BAT Conclusions, and therefore these have been used in the assessment. It is assumed that the PPC Permit will require these BAT-AELs to be met. It is also our understanding from equipment suppliers that these BAT-AELs can be met by modern CCGT equipment, and therefore there is no need to assess the higher IED limits, which have been superseded by the BAT-AELs in the LCP BAT Conclusions.

It is recognised that SEPA have requested that an assessment including the unabated operation of the CCGT without SCR. Information on the potential NOx emissions without SCR has yet to be provided, however this will be assessed for the PPC variation application.

- **The basis for the energy efficiency for the new plant as a whole should be outlined and clearly state how the additional energy penalty from operating the Carbon Capture Plant (CCP) has impacted on its efficiency. These values should then be translated across to the determination of energy efficiency-based limits.**

It is considered that this is a matter for the PPC permit, rather than planning, and as such an Energy Efficiency BAT study will be carried out as part of the PPC Permit application.

- **The lowest end of BAT-AEL range has been used for ammonia and therefore is not worst-case. Plant will have to operate to this emission limit value (ELV) or will need reassessed if higher value is proposed in PPC application.**

The BAT-AEL for ammonia from the use of SCR and/or SNCR is < 3–10 mg/Nm3 as a yearly average, with the lower end of the range being achievable when using SCR and the upper end being achievable when using SNCR. As SCR is the proposed technology, the lower end of the range is considered appropriate for the assessment. Note that if SCR technology is applied, the Direct Contact Cooler will remove the majority of the ammonia slip from the SCR in any case and therefore the ammonia emission from the absorber stack would be only that associated with the CCP. It is envisaged by the Applicant that the ELV set in the PPC permit will reflect the emission level achievable by the plant design and will therefore be lower than the upper limit of the BAT-AEL range in this case.

- **Amines**
- **Amines data is presented individually for direct and indirect concentrations and the two are not summed. The Environment Agency's Air Quality Modelling and Assessment Unit recommendations for the assessment of amine based post-combustion capture plants notes that the EAL for nitrosamines (as N-Nitrosodimethylamine (NDMA)) is on a total basis. This should be clarified, and the development may need to be revised as a greater stack height could be necessary.**

The text below Table 6 in Appendix 8C considers the direct and indirect amine emission together, using the in-direct screening assessment results:

"The [in-direct N-amine] screening assessment results indicate that at the receptor experiencing the maximum impact, the PC represents 49% (at OR11) of the AQAL for NDMA. This is therefore well below the AQAL and demonstrates that based on the screening criteria applied, an exceedance of the AQAL would be unlikely at receptor locations as a result of the atmospheric degradation of amines.

Together with the direct ammine release PC at OR10 provided in Table 6, the combined PC would remain within the AQAL for NDMA (31% + 49% = 80%.)"

There is a slight error in the text in the final sentence - OR9 should have been referenced as the worst-case receptor for direct amines based on the results in Table 5. This is conservative at it takes the worst case for direct and indirect at the worst-case receptor for each, which is not the same receptor.

As the in-direct impacts results using the ADMS Amines module are lower than the screening assessment results presented above, which demonstrated no exceedance, then it was not considered necessary to provide additional interpretation.

- **The amine release rates are assumed to be worst-case, but this may need to be changed depending on which capture solvent is utilised. Further details of this solvent will need to be provided at the PPC application stage and it may be necessary to amend the proposal if there are any increases in emission rates. This would be at the applicant's own commercial risk if the PPC application is not twin tracked with the Energy consent application.**

The amine concentration used in the modelling was the highest provided by the CCP licensors under consideration, and therefore it is considered highly unlikely that an increase in the emission rate will occur, and a decrease is considered more likely. Indeed, information provided by MHI suggests that the amine emission concentration will be <1mg/Nm3 compared to the 5.5mg/Nm3 modelled for the EIAR. In addition, the twin absorber design that is also still under consideration has amine emissions much lower than 5.5mg/Nm3 used for the EIAR.

Post FEED additional modelling will be carried out on the final design to ensure that the impacts are no worse than presented in the EIAR assessment. It was the Applicant's intention to submit the PPC Permit at the same time as the Section 36 Application, however SEPA requested that the submission was delayed.

- **Stack height**
- **Section 8.5.2.7 of the EIAR suggests the stack heights and design can be addressed by condition as worst-case scenarios have been assessed. However, considering the above review and the following points we do consider the worst-case scenario has yet been assessed.**

  – **Optimisation has only been undertaken for the CCP single stack option and not for the Heat Recovery Steam Generator (HRSG) or CCP twin stack option.**

The proposed stack height for the twin absorber scenario was considered appropriate given that the results for the single and twin absorbers were largely comparable. Following FEED, optimisation of the stack height for the preferred option will be carried out to ensure that the predicted impacts remain within those presented in the EIAR.

  – **It should be carried out for all pollutants of concern and not solely NO2 (e.g. amines) and for all the applicable averaging periods.**

The optimisation of the stack height has been based on NO2 only, as all other species are below the criteria to determine insignificance at receptor locations, or are unaffected by background concentrations. The stack height at which the building downwash effects are reduced will be the same for all pollutants, and therefore there is considered to be no additional benefit in assessing each pollutant species.

  – **The uncertainties associated with the model, particularly those around amine emissions, suggest that a greater release height may be necessary.**

The stack height(s) reported in the Air Quality assessment are the lowest that is considered to lead to acceptable impacts on the basis of the assessment carried out at the time of the EIAR, and a higher stack has not been discounted for the final design, should this be required. It should be noted that a higher stack height would be subject to the height assessed in the landscape and visual impact assessment and also dependent on any Ministry of Defence (MOD) requirements. Based on the reassessment presented in the accompanying Memo however, it is not considered that a higher stack will be necessary.

- **There has been no assessment for odour potential for the release of potentially odorous compounds (e.g., ammonia, aldehydes and ketones) and detail regarding the significance of the emissions for offensive odour needs to be provided.**

It is recognised that some amines have potential to generate odour, depending on their volatility, and therefore if required for the selected solvent, appropriate controls will be put in place to minimise the potential for fugitive odours, based on the final licensor selection. It is therefore considered that this will be controlled through the PPC Permit.

In terms of stack emissions of amines, ammonia, aldehydes and ketones, odour thresholds for a whole range of chemicals are provided in Odour Measurement and Control – An Update" (AEA Technology, 1994). These have been reviewed and those relating to amines/ amino alcohols are detailed below:

- Monoethanolamine: 5mg/m^3
- Diethyl monoethanolamine: 0.054mg/m^3
- Dimethyl monoethanolamine: 0.12mg/m^3
- Diethanolamine: 5.3mg/m^3

The maximum hourly PC (as a 100th percentile) for amines in the EIAR was 30.8µg/m3 occurring anywhere and 4.1µg/m^3 occurring at a receptor and therefore well below the lowest of the odour thresholds shown above. Odour from the amines from the stack is therefore considered highly unlikely.

The ammonia odour threshold is reported between 0.1mg/m^3 and 11.6mg/m^3. The maximum hourly PC was 19.7µg/m^3 and the maximum at receptor is 3.1 µg/m^3 and therefore these concentrations are again well below odour thresholds.

Any degradation products, such as ketones and aldehydes will be licensor specific and therefore any further consideration of odour from these species should be given post-FEED.

- **Further guidance on the technical requirements that need to be considered in the modelling assessment is provided in Appendix 1B.**

Further responses provided to Appendix 1B requirements below.

2.2. CARBON CAPTURE PLANT OPERATION AND EMISSIONS

2.2.1. TWIN STACK OPTION

- **Table 3 of Appendix 8B sets out the emission concentrations and release rates for both single and twin stack options. It is noted that the release rates for two stack option when combined are significantly higher than the single stack. These pollutants are also being released at a lower temperature and stack height, so the potential impact is likely to have been underestimated.**

As the twin absorbers have much smaller dimensions than the single large absorber assessed for the EIAR, the building downwash effects were significantly less. This is why the results for both scenarios were broadly comparable. The worst-case results from either the single or twin absorber were reported in the main assessment results. However, the reassessment carried out and provided in the accompanying Memo shows reduced downwash impacts for the single absorber scenario, and therefore the twin absorbers are now the worst case for the majority of pollutant species.

- **The applicant should provide an amines assessment for the twin stack option as there is the potential that the impact may be close to, or above, the EALs for n-amines. It is feasible to model each stack individually and then aggregate the impact as it is an annual EAL.**

The twin absorber design is specific to a single licensor, which has a much lower amine release than that included in the assessment, and therefore it is considered that this is not a risk. However, once the final licensor is selected, post-FEED amine modelling of the final design would be carried out to ensure the results are no worse than present in the EIAR.

2.2.2. HRSG STACK OPERATION AND EMISSIONS

- **The application notes that further assessment of the operation of the HRSG stack is required and could result in the consent needing modified. It also indicates that some assessment has been undertaken but not provided in the application. We request several aspects relating to the operation of this stack are clarified before the Application is determined:**
  - **The additional assessment for the HRSG stack includes ammonia and this indicates that Selective Catalytic Reduction to reduce NOx emissions will be utilised. This needs to be confirmed.**

Dependent on the NOx emissions from the CCGT SCR will be applied if required to meet BAT-AELS for NOx and to ensure that NOx emissions meet the required levels at the inlet of the CCP. This has been detailed in both Chapter 4 'Proposed Development' and Appendix 8B. It has therefore been assumed it will be included for the purpose of assessment, but this will only be confirmed post-FEED.

- **The EIAR indicates that the HRSG stack will have similar emissions to the twin stack CCP option, but the HRSG assessment has the same flow rate as the single stack option. The EIAR also notes that there is a potential operation where the generating plant will be operating above the maximum capacity of the CCP. The applicant should clarify if this operation is with or without the CCP operating and provide an impact assessment for its operation in this mode for the station as a whole (i.e., if GT11 is also operating).**

Appendix 8B states that *"initial modelling showed that emissions from the HRSG stack will lead to lower maximum impacts, and impacts at receptor locations that emissions from the CCP absorber(s)".* It doesn't specify the single or the twin absorber scenario, but the worst case of either of these scenarios is presented in the assessment. For clarity, the HRSG stack and CCP stack will not operate concurrently.

We are not aware of making a statement regarding potential operation where the generating plant will be operating above the maximum capacity of the CCP; the generation plant will not exceed the CCP capacity and it will be appropriately rated for maximum generation capacity.

- **The HRSG assessment should also be undertaken against long term Air Quality Standards (AQS) and EALs to establish the impact of the plant if there are any prolonged issues with the carbon capture plant or the downstream geological storage chain. Consideration should also be given to assessing the impact of the HRSG stack operating in conjunction with the existing plant.**

The additional modelling now carried out, and provided in a separate Memo, details the long-term impacts associated with operation of the HRSG stack.

2.3. HABITATS

2.3.1. THE HABITATS IMPACT ASSESSMENTS WILL NEED TO BE UPDATED TO ACCOUNT FOR THE AIR QUALITY MODELLING REVISIONS THAT ARE HIGHLIGHTED IN SECTION 1 ABOVE; MOST NOTABLY, ANY HIGHER RATE OF AMMONIA EMISSION FROM THE HRSG STACK IF IT IS EMITTING ABOVE THE CCP OPERATIONAL RANGE.

It is considered that ammonia has been assessed at an appropriate level as described above.

APPENDIX B – SEPA RESPONSE – TECHNICAL ASSESSMENTS (APPENDIX 1B)

Only points that have not already been addressed in the responses above have been discussed in this section.

1. AIR QUALITY MODELLING

AMBIENT AIR CONCENTRATIONS

Para 1.5 of SEPA response: **Higher background concentrations in the Peterhead area have not been used and is therefore not worst case (using background maps). This is linked to the limited grid domain that has been used for the assessment of air quality impacts.**

We have already responded to previous questions on the background concentration selected for the assessment. Whilst it is recognised that the value of 26.3ug/m^3 is from the Scottish background maps at grid square 413500, 845500, and the value of 19.3ug/m^3 proposed for the assessment is for 412500, 844500 (i.e. the adjacent 1km grid square), the area covered by Grid square 413500, 845500 is predominantly offshore (Peterhead Bay), and therefore applying this value as a background concentration for the assessment would seem overly conservative as there would be very few receptors within this area. In addition, the value of 19.3ug/m^3 used in the assessment is in line with the actual monitoring data collected by Aberdeenshire Council in 2019 for Peterhead, rather than the modelled background mapping data, and therefore is considered more appropriate for use in the assessment. It is also considered that the modelled background data will take into account emissions from the existing Peterhead power station and therefore there will be some degree of double counting. Also, taking the average concentration from the background map for all grid squares over the area covered by Peterhead actually provides an average concentration of approx. 16ug/m^3, which is lower than the value proposed for use in the assessment. The peak impact occurs in an area where the background is less than 19 ug/m^3.

We have presented the worst-case effect at any receptor in the assessment, and these can be shown to be not significant.

Para 1.6 of SEPA response: **Although there is limited hourly data suitable for the amines module, Fort William (being located far from Peterhead) is not suitable on its own. A site on the east coast should also be included. Although Aberdeen Errol Place is 'urban background', it is the closest to Peterhead with the required data and should be considered for a sensitivity test.**

The Aberdeen Erroll Park monitoring station only became operational in October 2021, and therefore data for the relevant periods of met data used in the assessment are not available for this site. There are no monitoring sites on the east coast of Scotland that have the necessary background pollutants (NO2, NOx and ozone) for inclusion in the amine module.

Sensitivity testing carried out on the model has shown that the ambient NO2/ NOx concentrations do not have a large impact on the model output. The amine constant rates are of much more significance. For example, for sites with an annual average difference of NOx 7.2µg/m^3 and a 3µg/m^3 difference in NO2, the modelled PCs only varied for the nitramine component, and only then by less than 1%. It is therefore considered that for the purpose of the assessment carried out, the data that has been used is adequate.

MODEL DESCRIPTION AND JUSTIFICATION

Para 1.7of SEPA response: **The AERMOD version within ADMS has been used, which is reasonably suitable for an initial check. It is recommended that for an application of this size, detailed AERMOD modelling is carried out, so as the full functionality of AERMOD can be utilised. This could also include stack height assessment.**

This will be considered for the post-FEED reassessment, although as the ADMS AERMOD version results are lower than those presented in the assessment, it is considered that the assessment carried out in ADMS presents the worst-case impacts. As the worst-case impacts are shown to be acceptable it is considered that additional modelling using AERMOD would be of limited benefit.

SPECIAL MODEL TREATMENTS

Para 1.8 of SEPA Response: **The use of mid-point values for the amines module rate constant and branching ratio values, as presented in the main application, do not represent worst case. If the worst-case values were used, the data indicates that there would be an exceedance of the MEA/DMA EALs.**

It is considered that to use all the worst-case values for every rate constant would be unrepresentative, as the more likely scenario is that some values will be higher and some will be lower.

Additional work on the constants used in the model has been carried out by the Carbon Capture and Storage Association and AECOM since the application was made and as a result it is considered that some of the constants could be updated. The constants used in the main assessment are shown below.

Table 4: MEA and DMA ADMS model set-up

Parameter	Units	MEA Constant Range	DMA Constant Range	Source
Ratio of NO_X to NO_2 in the exhaust gas	%	5 – 10%	5 – 10%	Typical values for the combustion of natural gas
k1 = Amine/OH• reaction rate constant	ppb/s	1.87 – 2.26 Mid-point = 2.07	1.54 – 1.63 Mid-point = 1.59	CERC (2012) Lee & Wexler (2013)
k2 = Amino•/O_2 reaction rate constant	ppb/s	3.1e-9* - 9.5e-8* Mid-point = 4.91e-8	3.1e-9* - 8.9e-8* Mid-point = 4.61e-8	CERC (2012) Manzoor (2014)
k3 = Rate constant for formation of nitrosamine	ppb/s	1.4e-3 – 6.0e-3 Mid-point = 3.7e-3	2.06e-3 – 2.13e-3 Mid-point = 2.1e-3	CERC (2012) Manzoor (2014)
k4a = Rate constant for formation of nitramine	ppb/s	2.1e-4 - 7.8e-3 Mid-point = 4.0e-3	7.75e-3 - 7.80e-3 Mid-point = 7.78e-3	CERC (2012) Manzoor (2014)

k4b = Amino•/NO_2 reaction rate constant	ppb/s	3.1e-4 - 8.8e-3 Mid-point = 4.45e-3	8.0e-3 – 9.7e-3 Mid-point = 8.85e-3	CERC (2012) Manzoor (2014)
Branching Ratio	dimensionless	0.05 – 0.15 Mid-point = 0.10	0.38 – 0.42 Mid-point = 0.40	CERC (2012) Manzoor (2014) Lee & Wexler (2013)
Ratio of J (nitrosamine) to NO_2	dimensionless	-	0.53* - 0.25* Mid-point = 0.39	Nielson (2010)
OH concentration constant c	Seconds	7.1e-4 – 3.9e-3 Mid-point = 2.31e-3	7.1e-4 – 3.9e-3 Mid-point = 2.31e-3	CERC (2012) Jackson *et al.* (2009)

On 21st February, the CCSA issued a position statement that was developed by Dr Chris Hazell-Marshall and Professor Claus Nielsen containing recommended constants for MEA, EA, DMA and MEA.

The k1 constant recommended for DMA was in line with the mid-point presented in Table 4 above, however for MEA a much lower value was recommended. This would have the effect of lowering the predicted PCs.

The k2 constant recommended for all amine species was $3.05e^{-9}$, which is lower than the mid-point value presented in Table 4. This would have the effect of increasing the predicted PCs.

All the other DMA constants recommended are in line with the mid-point values presented in Table 4, however the MEA ones differ.

K3, K4a and K4b are higher, however the branching ratio is lower.

Our sensitivity testing for the EIAR showed that the main constants for affecting the results were K2 and the c constant. We have carried out additional work on the c constant, developing a value that is specific to the site, in the region of $1.107e^{-3}$ which is approximately half the value shown as the mid-point in Table 4. This would have the effect of lowering the predicted PCs.

The reassessment carried out and provided in the accompanying memo includes modelling amines with the CCSA recommended rate constants. When modelled as MEA, the predicted impacts are significantly lower than those presented in the EIAR, however when modelled as DMA there is an increase in the predicted impacts. That said, the majority of the resulting N-amines for the DMA modelling are nitramines, rather than nitrosamines, and nitramines are considered to be less toxic than nitrosamines.

In addition, the amines reassessment presented in the accompanying Memo still assumed the 5.5mg/m^3 emission concentration from the absorber stack, as per the EIAR, however both MHI and the twin absorber option have confirmed a much lower amine emission concentration.

It is therefore recommended that additional modelling is carried out once more detail is known on the chosen licensors amine solvent, however it is considered that the conservative assumptions used in the assessment to date are likely to represent a worst case assessment of the potential for N-amine impacts.

EMISSION SOURCE/ PARAMETERS

Para 1.9 of SEPA response: **There are several areas where further information/clarification is required regarding the emission sources:**

- **The AQIA has mainly focussed on the single absorber and stack option for estimating the impact on air quality however, this does not correspond to the worst-case option set out within the document. The use of two absorbers with supporting stacks has a potentially higher pollutant release rate at a lower height and temperature which could result in greater impact.**

The results presented in the assessment were the worst case of the single or twin absorber scenario, as stated in Appendix 8B para 1.3.2 *"Impacts reported as either those from the single CCP absorber stack scenario, assuming a release height of 105m AGL, or the 77m AGL twin stack option, whichever is the worst case as the main reported assessment results."*

- **Paragraph 4.2.3.5 of the main report notes that there is a potential operating scenario where the generating plant will be operating above the maximum capacity of the CCP in unabated mode. The applicant should clarify if this operation is in conjunction with the existing station and provide an impact assessment for its operation in this mode for the station as a whole (i.e. if GT11 is also operating).**

We are not aware of making a statement regarding potential operation where the generating plant will be operating above the maximum capacity of the CCP; the generation plant will not exceed the CCP capacity and it will be appropriately rated for maximum generation capacity.

- **The Ketone emission concentrations differ for each stack (whereas all other pollutants have the same emission concentration).**

This is typo in the report; however the emissions concentrations only vary by 0.3mg/m^3 and the impacts of ketones are considered to be insignificant in any case.

MODEL DOMAIN, GRID AND RECEPTORS

Para 1.10 of SEPA Response: **A larger domain is needed to include the whole town of Peterhead. If contour plots are need for habitats, then a significantly larger domain is also needed.**

A previous response to SEPA on this point stated that the grid domain and resolution does not affect the predicted concentrations at receptors points defined as specific points within the model itself. As the results in the EAIR are presented based on the receptor locations defined within the model the grid resolution is only relevant for the isopleths. A larger grid size would not affect the conclusions of the assessment.

The habitats included in the assessment again have been considered at specific points, which it the closest point to the stack location. As the results at these closest and therefore worst-case locations are acceptable, then no further assessment is considered to be necessary.

METEOROLOGICAL DATA

Para 1.11 of SEPA response: **The following areas should be amended/clarified regarding the meteorological data used in the impact assessment:**

- **Inverbervie has been used in the assessment with 1 year from Peterhead, but no wind-rose for Peterhead is presented. For an application of this size, it is recommended that 5 years of Peterhead data is used (given its close proximity).**

A previous response to SEPA on this point stated at the time we commenced our assessment we had been told that only wind data for 2020 for Peterhead Harbour was available, and therefore this was discounted in favour of 5 full years of data from another suitable site. We have studied the wind roses for Peterhead and consider that Peterhead and Inverbervie do show similar wind distributions, with the main wind directions being from the southwest therefore sending the majority of the plume offshore (and therefore away from receptors). The assessment was therefore presented using the Inverbervie data, and a sensitivity test with the 2020 Peterhead Harbour data was carried out.

Peterhead Harbour meteorological data has now been obtained and has been used in the reassessment presented in the accompanying Memo.

- **Confirm that each meteorological year is run separately.**

Yes, this was the case.

- **The minimum Monin-Obhukov length used in ADMS needs to be given.**

This was the model default value.

- **Further consideration of coastal effects is needed (e.g. use of spatially varying roughness length); including to what extent such effects may be included in the selected met data set.**

A detailed terrain file was used in the sensitivity testing which included surface roughness of:

- 0.5m for Peterhead
- 0.3 for the area surrounding the site
- 0.001m for sea

This was found to result in slightly lower annual average impacts at the worst-case human health receptor and slightly higher hourly impacts.

- **A justification for not using Aberdeen Dyce (e.g., as presentation of wind roses) should be included. This is the minimum sensitivity test we would expect.**

A previous response to SEPA on this point stated that the wind rose from Dyce shows a strong south-southeast influence, and therefore does not show the same wind distribution as Peterhead Harbour and Inverbervie, it was therefore discounted for use in the assessment.

TERRAIN

Para 1.12 of SEPA response: **Terrain has been used in sensitivity test, but limited details on results has been provided and this should be expanded.**

This can be expanded upon during the post-FEED modelling for the PPC variation application.

STACK HEIGHT ASSESSMENT

Para 1.16 of SEPA response: **There appears to be discrepancy between the stack height optimisation chart (Appendix 8B, Plate 2) and the data presented in Tables 13 and 14 of the same Appendix. The chart quotes process contribution but the Tables suggest this data is predicted environmental concentration.**

Plate 2 shows the annual average PC as 9% for the 105m stack and the hourly PC as 50% for the 105m stack. Tables 13 and 14 show corresponding PC values of 7% and 50%. The slight difference in the annual average value is due to the stack height assessment being completed prior to the modelled emission parameters being finalised. However, the purpose of Plate 2 is show where the elbow of the curve occurs, rather than to show the specific PC concentrations and that will be determined by the absorber height and stack height not the specific emission parameters.

IMPACT ASSESSMENT

Para 1.17 of SEPA response: **The following should be added/ clarified to improve the output results of the impact assessment:**

- **The results for each years modelled should be presented to demonstrate that the maximum year is given.**

The worst case from all 5 years has been presented in the assessment. It is considered that provision of results for all 5 years would distract the reader from the results that are most important. However, these can be provided to SEPA for the PPC permit variation application if that would be beneficial.

- **The contour plots should provide predicted environmental concentration not process contribution.**

Background concentrations vary over the modelled domain, and therefore it is considered more appropriate to present contour plots as PCs only. The PCs for both annual and hourly NO2 impacts are largely below the thresholds of insignificance, without the requirement to consider the background concentrations in any case.

- **Contour plots need to be provided for the amine screening scenario.**

When post-FEED modelling is carried out, N-amine contour plots can be produced.

- **The analysis looks at uncertainty for each parameter, but it does not consider combinations of these variables (e.g., Terrain and Peterhead data change the conclusion)**

When post-FEED modelling is carried out, this can be looked at, however model uncertainty is inherent in the process. Best estimates to some parameters have to be applied, based on modelling experience and reasonable uncertainties predicted. Generating more results, does not necessarily increase the certainty in the model output.

- **The cumulative impact assessment for the existing power station operating in conjunction with the new CCP station shows little change in impact which is not what would be expected. The older station is operated at a higher mass release rate and so there it would have been expected to see a step change in impact. The basis for the cumulative impact assessment should be given in terms of the variables used to determine the release rate for the existing station.**

This was not found to be the case in the EIAR model output which will be determined by the absorber height and stack height as the absorber impacts dominate the PCs due to the building downwash caused by the absorber, the lower temperature of the absorber emissions and the much higher efflux velocity of the GT releases.

SSE have now confirmed that they wish to retain all three existing GTs and therefore the reassessment presented in the accompanying Memo has modelled this scenario and includes the modelled emission parameters from the three GTs.

MODEL INPUT FILES

Para 1.18 of SEPA response: **Model Input files should be provided so that SEPA can verify the assessment which is an appropriate measure to consider for a development of this significance.**

This will be provided with the PPC application submission as normal.

UNCERTAINTY CONSIDERATIONS

Para 1.19 of SEPA response: **There has been a limited uncertainty analysis and the following outline the aspects that need further clarification:**

- **Table A1 reports sensitivity analysis results, but only the percentage of the modelled concentrations and is not easy to interpret. It would be expected that the absolute values of each model run are presented so that that the variance can be assessed (for example is the lowest short term model result of 18% of the maximum an outlier, or are 4 of the 5 years modelled only 18% of the max concentration)**

Further information on the sensitivity can be provided in the post-FEED modelling.

APPENDIX C – POST-SUBMISSION AIR QUALITY MODELLING TECHNICAL NOTE

1.1. INTRODUCTION

The Air Quality Assessment for the Environmental Impact Assessment Report (EIAR) detailed the impacts associated with the operation of one retained Peterhead 1 (PH1) Gas Turbine (GT) together with the abated operation of the Peterhead 2 Low Carbon Power Station (PH2). The PH2 plant assessment included a single absorber layout scenario and a twin absorber layout scenario.

Since submission of the Section 36 application, SEPA have requested additional information on the unabated operation of the PH2 plant, and this was provided to them in May 2022.

It is now recognised that SSE would like to retain all three of the PH1 GTs for future operation if required and therefore the impacts associated with their operation together with the PH2 plant needs to be assessed, for both abated and unabated operation.

In addition, SSE have now appointed a contractor to carry out Front-end Engineering and Design (FEED). As such, a new layout plan for the PH2 plant has been provided, which is based on a single absorber, however it is recognised that the twin absorber option is still under consideration.

This memo details the dispersion modelling that has been carried out to assess the operation of three PH1 GTs together with the PH2 plant in abated and unabated mode. The new layout plan has been used for the single absorber assessment.

The model results have been compared to those that were presented in the submitted EIAR.

1.2. MODELLED EMISSIONS

The model inputs are provided in Table 1. Data for the three PH1 GTs was provided by Ronnie Glen of SSE (email dated 6th September 2022 PEHE L3 16-06-22 Rev 5_0).

The data for the unabated operation of the PH2 CCGT has been based on a Siemens 9000HL. Although this is not the proposed CCGT unit, it is a larger unit than the proposed unit, and therefore is considered to represent a worst case for the assessment. Emissions data for the CCGT has now been received and the air flows are up to 500,000Nm3/hr lower than those assessed (although the normalisation parameters require confirmation) and therefore the mass emissions for both the abated and unabated operation of the proposed CCGT are anticipated to be lower than those assessed in this Memo.

The PH2 abated and unabated modelled NOx concentration is based on the annual mean Large Combustion Plant (LCP) Best Available Technique (BAT) achievable emission level (BAT-AEL), taking into account the likely CCGT efficiency correction. It is not known whether this correction can be made for plant when operating in carbon capture mode, and this requires confirmation from SEPA, however using this higher value again ensures that the assessment is conservative at this stage.

It is assumed that SCR will be employed to minimise NOx concentrations on PH2 and therefore ammonia slip is included in the emissions.

The operational scenarios that have been assessed for this memo are shown in Table 1, and the emission parameters modelled are shown in Table 2.

Table 3: Modelled Scenarios

Scenario	NO of PH 1 GTs	PH2	Notes
1	1	Unabated – CCGT Stack	Redundant (superseded by scenario 2) but requested by SEPA
2	3	Unabated – CCGT Stack	New layout applied for the single absorber Scenario 3.
3	3	Abated - 1 absorber stack	New layout applied, including the updated absorber length and width. Absorber height as per the EIA, as no new information provided.
4	3	Abated - 2 absorber stack	Assessed as per Keadby height AGL for absorbers and no change to location since EIA.

Other building parameters, specifically the HRSG building, have remained as in the original EIA assessment, however it is considered that the HRSG for the updated design will be smaller than that used in the assessment, although this is awaiting confirmation.

Meteorological data for Peterhead Harbour for the years 2017 – 2021 has now been obtained and has been used in this reassessment.

Table 4: Modelled emissions data

Parameter	PH1 GT11	PH1 GT12	PH1 GT13	PH2 Unabated	PH2 Abated (single absorber)	PH2 Abated (twin absorber, per stack)
OS Grid Coordinates (x,y)	412845, 842940	412849, 842933	412839, 842935	412546, 843246	412538, 843315	412532, 843195 412547, 843157
Stack height (m)		90		85	105	76
Stack internal diameter (m)		6.2		8.0	7.0	5.4
Temperature (°C)	96.5	98.0	93.8	74.1	48.4	30
Flow rate (Am^3/s) (at release conditions)	716.1 (12.8% O_2, 8.3% H_2O)	718.5 (12.7% O_2, 8.4% H_2O)	710.9 (12.8% O_2, 8.3% H_2O)	1029.7 (10.2% O_2, 11.4% H_2O)	906.4 (12% O_2, 10.7% H_2O)	471.6 (11.0% O_2, 7.7% H_2O)
Flow rate (Nm^3/s) (15% O_2, dry, 273K)	485.3	484.4	485.0	1,162	1,037	651.4
Efflux velocity (m/s)	23.7	23.8	23.5	20.5	23.6	20.6

Substance	PH1 Concentration (mg/Nm^3)	PH1 Emission Rate (g/s) GT11	PH1 Emission Rate (g/s) GT12	PH1 Emission Rate (g/s) GT13	PH2 Unabated Concentration (mg/Nm^3)	PH2 Unabated Emission Rate (g/s)	PH2 Abated (single) Concentration (mg/Nm^3)	PH2 Abated (single) Emission Rate (g/s)	PH2 Abated (twin) Concentration (mg/Nm^3)	PH2 Abated (twin) Emission Rate (g/s)
NOx (annual average)	50	24.3	24.2	24.3	-	-	34	35.3	34	21.2
NOx (daily average)	50	24.3	24.2	24.3	45	52.3	45	46.0	45	29.3
CO	100	48.5	48.4	48.5	100	116.2	100	104	100	65.1
NH_3	-	-	-	-	3.8	4.4	3.0	3.1	3.0	2.0
Amines	-	-	-	-	-	-	5.5	5.7	0.4	0.3
N-Amines (direct release)	-	-	-	-	-	-	0.002	0.002	0.001	0.00007
Ketones	-	-	-	-	-	-	5.3	5.5	5.3	3.5
Acetaldehyde	-	-	-	-	-	-	5.3	5.5	4.0	2.6
Formaldehyde					-	-	2.0	2.1	2.0	1.3

The amine and amine breakdown products for the twin absorber scenario are as per those that had been provided for the original EIA assessment. The Single absorber scenario has also been modelled at the same concentrations as the original EIA assessment, however data now provided by the contractor suggests that the concentration of amine and breakdown products will be lower than those assessed for the EIA. In particular, the concentration of the amine release from the design is <1mg/Nm3, and therefore considerably lower than that used in this assessment.

The modelled layouts of the site are shown in Figures 1 and 2.

Figure 1. Scenario 2 and 3 layouts

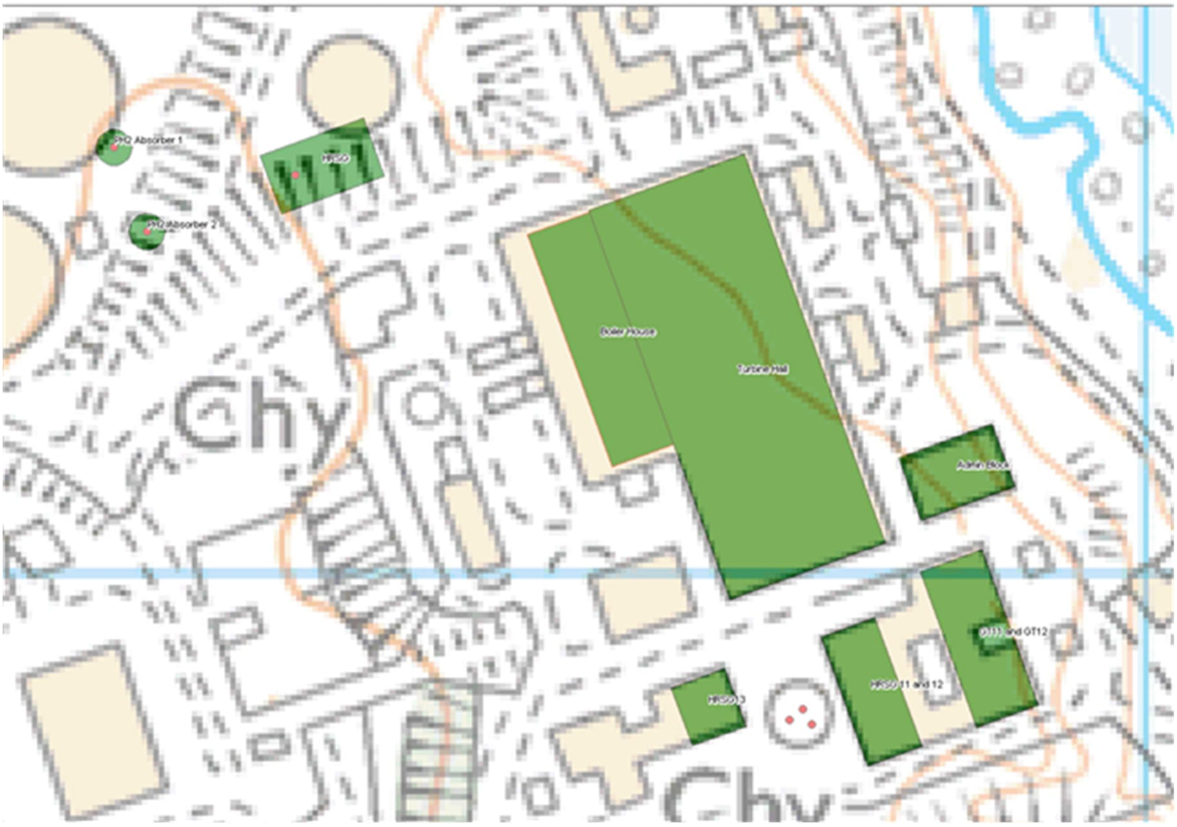

Figure 2. Scenario 4 layout

1.3. MODEL RESULTS – HUMAN HEALTH

The results in Table 3 are presented against those provided in the original EIA assessment. Green shading indicates results that are lower than those presented in the original EIA.

The N-amine assessment presented in Table 3 has used the rate constants advised by the Carbon Capture and Storage Associated (CCSA) for MEA and DMA. It should be noted that the actual amine (or amines) present in the solvents are not known, and therefore the results presented are indicative, and further assessment will be required once further information on the solvent to be used is provided, likely to be at the PPC permit variation stage.

Table 5. Results at maximum receptor – abated operation

Pollutant	Air Quality Standard (AQS) µg/m³	As Presented in ES Abated Operation		Scenario 3 PH2 Abated Single Absorber		Scenario 4 PH2 Abated Twin Absorber	
		Process Contribution (PC) µg/m³	PC/AQS	Process Contribution (PC) µg/m³	PC/AQS	Process Contribution (PC) µg/m³	PC/AQS
NO_2 - hourly average (99.8th %ile)	200	21.0	11%	15.4	7%	28.6	14%
NO_2 - annual average	40	1.7	4%	1.3	2.9%	2.8	7%
Carbon monoxide - hourly average (100th %ile)	30,000	216	1%	98.7	0%	268	1%
Carbon monoxide 8-hour average	10,000	126	1%	90.7	1%	171	2%
NH_3 - hourly average (100th %ile)	2500	6.5	0.3%	2.3	0.1%	8.2	0.3%
NH_3 - annual average	180	0.2	0.1%	0.11	0.0%	0.3	0.2%
Amines (as MEA) – hourly average (100th %ile)	400	5.3	1%	4.3	1%	1.1	0.3%
Amines – daily mean	100	4.1	4%	2.9	3%	0.5	0.5%
N-amines – Annual mean (direct release)	0.2 ng/m³	0.06 ng/m³	31%	0.08 ng/m³	38%	0.01	5%
Annual mean (in-direct release ADMS Chemistry MEA Results)	0.2 ng/m³	0.02 ng/m³	9%	0.00063	0.3%	-	-
Annual mean (in-direct release ADMS Chemistry DMA Results)	0.2 ng/m³	0.06 ng/m³	29%	0.22	112%	-	-
Acetaldehyde - hourly average (100th %ile)	9,200	11.4	0.1%	4.1	0.0%	13.7	0.1%
Acetaldehyde - annual average	370	0.4	0.1%	0.2	0.1%	0.5	0.1%
Formaldehyde - hourly average (100th %ile)	10	4.3	4%	1.6	2%	5.3	5%
Formaldehyde - annual average	5	0.1	3%	0.08	2%	0.2	4%
Ketones - hourly average (100th %ile)	89,500	11.4	0.01%	4.1	0.00%	13.7	0.02%
Ketones - annual average	6,000	0.4	0.01%	0.2	0.00%	0.5	0.01%

Table 6. Results at maximum receptor – unabated operation

Pollutant	Air Quality Standard (AQS) µg/m³	Values Provided to SEPA		Scenario 2 PH2 Unabated Single Absorber		Scenario 4 PH2 Unabated Twin Absorber	
		Process Contribution (PC) µg/m³	PC/AQS	Process Contribution (PC) µg/m³	PC/AQS	Process Contribution (PC) µg/m³	PC/AQS
NO_2 - hourly average (99.8th %ile)	200	46.1	23%	47.3	24%	23.0	11%
NO_2 - annual average	40			1.4	4%	1.4	3%
Carbon monoxide hour average (100th %ile)	30,000			351	1%	173	1%
Carbon monoxide 8-hour average	10,000			196	2%	146	2%
NH_3 - hourly average	2500	6.5	0.3%	13.4	0.5%	4.9	0.2%
NH_3 - annual average	180	0.2	0.1%	0.17	0.1%	0.15	0.1%

Greyed out cells indicated values that had not been provided to SEPA previously, as it was considered that unabated operation would not occur for long periods, and therefore that annual average impacts were not relevant.

1.4. MODEL RESULTS – ECOLOGICAL RECEPTORS

The results in Table 5, 6 and 7 are presented against those provided in the original EIA assessment for ecological receptors.

Green shading indicates results that are lower than those presented in the original EIA, or where results are not lower, green shading has been used to demonstrate the results are considered to be insignificant in accordance with the H1 screening methodology.

In Table 6, an exceedance of the daily NOx critical level is shown at the E1 receptor. The Habitats Risk Assessment considered that NOx impacts at this receptor were not a concern due to the open sea habitat that is present at the location of maximum impact (i.e. adjacent to the Development Site), and also the prevalence of coastal rock on which the birds nest. It is therefore considered that the habitat types present are not vulnerable to NOx.

Table 7. Results at ecological receptors – annual average NOx

Pollutant	Critical Level (CL) µg/m³	As Presented in ES		Scenario 2 PH2 Unabated		Scenario 3 PH2 Abated Single Absorber		Scenario 4 PH2 Abated Twin Absorber		Scenario 4 PH2 Unabated Twin Absorber	
		Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL
E1- Buchan Ness SPA	30	2.5	8.4%	2.6	8.8%	0.6	2.1%	4.5	15.0%	3.0	9.8%
E2- Buller of Buchan SSSI		1.3	4.2%	0.5%	1.6%	0.4	1.5%	1.2	3.9%	0.6	2.1%
E3- Loch of Strathbeg SPA/SSSI		0.10	0.3%	0.20	0.7%	0.19	0.6%	0.28	0.9%	0.23	0.8%
E4- Ythan Estuary, Sands of Forvie and Meikle Loch SPA		0.09	0.3%	0.17	0.6%	0.18	0.6%	0.35	1.2%	0.27	0.9%
E5- Rora Moss SSSI		0.08	0.3%	0.10	0.3%	0.10	0.3%	0.16	0.5%	0.13	0.4%
E6- Collieston to Whinnyfold Coast SSSI		0.06	0.2%	0.15	0.5%	0.15	0.5%	0.27	0.9%	0.21	0.7%
E7- Meikle Loch and Kippet Hills SSSI		0.04	0.1%	0.13	0.4%	0.12	0.4%	0.19	0.6%	0.16	0.5%

Table 8. Results at ecological receptors – daily average NOx

Pollutant	Critical Level (CL) µg/m³	As Presented in ES		Scenario 2 PH2 Unabated		Scenario 3 PH2 Abated Single Absorber		Scenario 4 PH2 Abated Twin Absorber		Scenario 4 PH2 Unabated Twin Absorber	
		Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL
E1- Buchan Ness SPA	75	45.1	60%	83.5	111%	34.3	46%	47.4	63%	57.2	76%
E2- Buller of Buchan SSSI		27.7	37%	14.3	19%	14.4	19%	31.3	42%	20.0	27%
E3- Loch of Strathbeg SPA/SSSI		2.2	3.0%	2.6	3.5%	2.5	3.4%	3.9	5.2%	4.3	5.7%
E4- Ythan Estuary, Sands of Forvie and Meikle Loch SPA		3.0	4.1%	4.3	5.8%	4.3	5.7%	7.9	10.6%	5.9	7.9%
E5- Rora Moss SSSI		3.2	4.3%	2.8	3.8%	2.7	3.6%	4.1	5.4%	3.4	4.5%
E6- Collieston to Whinnyfold Coast SSSI		2.4	3.2%	3.2	4.2%	2.9	3.9%	5.5	7.3%	4.0	5.3%
E7- Meikle Loch and Kippet Hills SSSI		1.7	2.2%	3.0	4.1%	2.8	3.8%	4.3	5.8%	3.8	5.0%

Table 9. Results at ecological receptors – annual average NH_3

Pollutant	Critical Level (CL) µg/m³	As Presented in ES		Scenario 2 PH2 Unabated		Scenario 3 PH2 Abated Single Absorber		Scenario 4 PH2 Abated Twin Absorber		Scenario 4 PH2 Unabated Twin Absorber	
		Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL	Process Contribution (PC) µg/m³	PC/CL
E1- Buchan Ness SPA	3	0.22	7.4%	0.28	9.3%	0.054	1.8%	0.35	11.8%	0.27	8.8%
E2- Buller of Buchan SSSI		0.11	3.7%	0.041	1.4%	0.030	1.0%	0.071	2.4%	0.028	0.9%
E3- Loch of Strathbeg SPA/SSSI		0.009	0.3%	0.010	0.3%	0.007	0.2%	0.012	0.4%	0.010	0.3%
E4- Ythan Estuary, Sands of Forvie and Meikle Loch SPA		0.008	0.3%	0.010	0.3%	0.008	0.3%	0.017	0.6%	0.011	0.4%
E5- Rora Moss SSSI		0.007	0.2%	0.005	0.2%	0.004	0.1%	0.007	0.2%	0.006	0.2%
E6- Collieston to Whinnyfold Coast SSSI		0.005	0.2%	0.009	0.3%	0.006	0.2%	0.013	0.4%	0.009	0.3%
E7- Meikle Loch and Kippet Hills SSSI		0.004	0.1%	0.006	0.2%	0.005	0.2%	0.008	0.3%	0.006	0.2%

APPENDIX D – FIREWATER MANAGEMENT (APPENDIX 1A)

The section below outlines the comments made by SEPA regarding the lack of information presented within the application material for the management of firewater.

1.1. SEPA COMMENTS – APPENDIX 1A, SECTION 2, WATER ENVIRONMENT – DRAINAGE

"2.2 Accidental releases

2.2.1 The application indicates that the new station has the potential to be covered by the Control of Major Accident Hazard (COMAH) Regulations and could need to apply for Hazardous Substances Consent. Section 19 of the EIAR outlines its consideration of major accident risk and the measures that could be employed.

2.2.2 However, there is a lack of detail regarding how firewater will be managed, in part due to the lack of drainage plans, but also the techniques described appear to be largely designed to control spillages. The application identifies a need to design for firewater management system but there is little information about how the proposed infrastructure will address the potential volume and constituents that could need retention. It is noted that an isolation tank will be employed to mitigate chemical spillages, but it is not clear whether it will have sufficient capacity for firewater and that all appropriate areas of the site are connected to it. Whilst we accept matters including siting, layout, scale and external appearance, including the colour, materials and surface finishes of all new permanent buildings and structures could be secured by condition (as proposed in section 16.7.1.1 of the EIA), we request the matter of how firewater will be managed is clarified to ascertain whether additional storage facilities are required as these requirements may have significant impact on land take and/or site layout."

1.2. RESPONSE

The site drainage system shall provide a safe drainage system that protects the local environment and water bodies from accidental discharges of oil or other chemicals (e.g. fire-fighting foam). As referenced within Chapter 12 Water Environment, Environmental Impact Assessment Report, Volume 2, Appendix 12A Water Framework Directive Assessment (EIAR Volume 4) and Appendix 13B Sustainable Urban Drainage Strategy (EIAR Volume 4), Tthe design of the site drainage system shall include:

- Segregating clean water, rainwater and firewater drains from potentially contaminated water by separating paved areas and use of rain shelters above outdoor equipment in line with sustainable drainage systems good practices. Bunding, kerbing, oil interceptors, pollution control valves (or similar) and appropriate sampling shall be provided where appropriate.
- Deployment of passive gravity drainage where practicable, maximising reliability through minimum use of rotating equipment for drainage.
- Areas at most risk of frequent spills will be isolated using bunds (or other physical barriers) to prevent spread of spills across the Proposed Development Site and towards watercourses, and then would be disposed of appropriately. Penstocks, booms or absorbent systems will also be used to ensure accidental fuel/ chemical spills and fire control do not enter the surface water network.

- Areas where chemicals and substances that could be harmful or toxic in the water environment (including where they exert a Biochemical Oxygen Demand) are stored, and thus spillages are possible, will be bunded, and oil interceptors will be fitted with alarms. Delivery areas would be kerbed and sloped to runoff into a catchment sump. Penstocks will be provided to isolate any spills or firewater in the surface water drainage system and prevent its discharge to the environment. Should any spillage occur then SEPA would immediately be informed.

The conceptual drainage strategy allows for inclusion of isolation/ sluice valves in the drainage network to allow any unplanned chemical spills or firewater from chemical fires to be safely removed for treatment. At detailed design stage, a surface water drainage strategy will be developed through the PPC Permit which will include firewater drainage, using relevant British Standards and realistic worst-case antecedent conditions such that in the event of an incident occurring, contaminated fire water would not enter the surface water drainage system or process water system, but rather be retained on-Site for a period and be disposed of safely.

Limited impact on the site layout is anticipated from development of the firewater management systems during detailed design. Primary containment and retention of firewater will be provided by localised bunding in areas at risk of chemical contamination, with isolation shut-off valves or equivalent provided to prevent discharge to the sea water. Bunding will be sized appropriately for the reasonable worst-case firewater volume scenario. The system will be designed to serve the equipment and their chosen sitings, with gravity drainage relying on sub surface systems that will limit additional land usage where practicable. Retained firewater will be sampled for contamination and dependant on the results will either be tankered and taken off-site for suitable treatment and disposal or will be treated on-site and then discharged safely to the clean water outfall.

Flammable inventories will be segregated from the rest of the chemical inventory, the majority of flammable inventory on site is the natural gas for the CCGT. The remaining flammable inventory is anticipated to consist of relatively small volumes of:

- hydrogen for deoxygenation of the CO2 and cooling of electrical generator,
- transformer oil,
- diesel for back-up generators and firewater pump,
- 25% ammonia for the SCR,
- amine solvent in the reclaimation and
- various lubricant and sealing oils.

The vast majority of the CCP chemicals inventory are diluted aqueous based operating under their high flash points, thus fire-fighting requirements are not expected to be greatly more onerous than those for the existing power plant.

During detailed design consideration will be given to firefighting strategies and possible methods of reducing the amount of firewater run-off generated, for example by the use of sprays rather than jets, controlled burn, and the possible re-cycling of fire-fighting water, where safe and practicable to do so. Advice on this will be sought from the Fire Service, based on best fire-fighting practice.

The fire-fighting and firewater management strategy will be further developed in detailed design in accordance with guidance in PPG-18 (Managing Fire Water & Major Spillages), CIRIA C736 (Containment systems for the prevention of pollution) and ISO 26368:2012.