TECHNICAL NOTE

IQE 80 GAN PERMITTING

SUBJECT	PROJECT NO.	DATE
Severn Estuary Air Quality Assessment	5222164	02 October 2024

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Introduction

This Technical Note addresses Item 1 of the Schedule 5 notice, dated 19/09/2024 (PAN-024249 Schedule 5 Notice final.pdf), issued by Natural Resources Wales (NRW) for the permit variation application for the next phase of development of the IQE (Europe) Plc semiconductor facility (application number PAN-024249). Item 1 states,

- ***You need to provide additional information assessing impact upon the Severn Estuary SAC / SPA / Ramsar Site / SSSI.***

  The Air Quality Modelling (document reference: Air Quality Assessment IQE 80 GAN PERMITTING included in the revised submission in January 2024) does not assess the impact of nitrogen deposition at the Severn Estuary SAC / SPA / Ramsar Site / SSSI. This site is within the relevant screening distance of your site and it's features have critical load values which you need to assess your proposal against.

  You need to complete this assessment and provide us with an updated report (or an addendum to the report) including any additional modelling files or calculations.

Approach

The Severn Estuary SAC / SPA / Ramsar / SSSI is approximately 3.5 km south east of the IQE facility, represented by receptor I in the air quality assessment report (grid reference 331044, 183950)[1]. Deposition calculations were omitted from the environmental permit variation application air quality assessment report due to the extremely low process contributions (PCs) made by the expanded facility to the critical levels for oxides of nitrogen (NOx) and ammonia (NH_3) under the scenarios considered. It was thus not deemed necessary to consider in detail the effects of deposition on vegetation at this site as the contribution to critical loads (CLs) would be just a fraction of a percent.

This technical note presents the calculation of nitrogen and acid deposition at the Severn Estuary SAC / SPA / Ramsar / SSSI for the operation of the facility under normal and emergency regimes as was modelled in the air quality assessment for the permit variation.

The air dispersion modelling study undertaken in support of the permit variation application considered two operational scenarios, Scenario 1a and Scenario 1b, as detailed in section 2.1.6 of the air quality assessment report. Scenario 1a is relevant to the assessment of impacts at the ecological sites, since the number of reactor tools emitting oxides of nitrogen is higher compared to Scenario 1b (82 versus 72). The emission sources included in Scenario 1a are:

- 10 existing G4 reactors (1-10) emitting arsine and phosphine, and the oxidation furnace, emitting arsine only (emission point A1);
- 82 new GaN reactors, comprising 10 reactors (11-20) considered within the existing R&D exclusion (emission point A4) plus residual chlorine emissions from the tool cleaning cycle gases from A4a, and 72 new reactors (21-92), emitting traces of plasma abated ammonia, oxides of nitrogen and carbon monoxide (emission points A5 to A8);
- Auxiliary boilers emitting oxides of nitrogen and carbon monoxide, four existing (emission point A11) and four new (A12 to A15).

[1] IQE_80GaN Permit Variation_AQ_v1_ISSUE.docx, January 2024

Two operating regimes were investigated for Scenario 1a: the normal operation of the facility where all the emission sources listed above are assumed as operating concurrently, 24 hours a day seven days a week, and an emergency scenario with operation of two emergency standby diesel generators up to 50 hours per year, concurrent with all of the above listed sources.

Section 2 “Methodology” of the air quality assessment report contains full details on the model scenarios, source characteristics and emission inventory embedded in the air dispersion study undertaken for the IQE facility.

Model outputs

The process contributions of oxides of nitrogen and ammonia to nitrogen and acid deposition have been estimated following the procedure in AQTAG06 Technical Guidance[2] and the relevant critical loads obtained from the Air Pollution Information System (APIS) website[3].

To calculate nitrogen deposition, the modelled PCs (in µg/m^3) at receptor I (representative of Severn Estuary SAC / SPA / Ramsar / SSSI at its closest point) have been converted to a dry deposition flux (in µg/m^2/s) using the deposition velocities for grassland habitat (0.0015 m/s for NO_2, 0.02 m/s for NH_3). These were converted into units of kg N/ha/year using the factors of 96 for NO_2 and 260 for NH_3. This enables comparison with the relevant critical load (Atlantic salt meadows and shifting sand dunes, with range of 10-20 kg N/ha/year). For a conservative approach all NO_x was assumed to convert to NO_2.

The conversion factor of 0.071428 has then been applied to the combined nitrogen deposition rate to estimate the acid deposition (units of keq/ha/year), however, no acidity critical load (referred as “CLMaxN”) is available on APIS for the features at this site.

Ecological results

The modelled nitrogen and acid deposition rates at the Severn Estuary SAC / SPA / Ramsar / SSSI (receptor I) for Scenario 1a under the normal and emergency operations are shown in Table 1 .

Table 1 - Nitrogen and Acid Deposition, Scenario 1a, Normal and Emergency Operation

ID	NOx PC, µg/m^3	NH_3 PC, µg/m^3	N dep, kg N/ha/yr	Lower CL, kg N/ha/yr	PC/ Lower CL, %	Acid dep, keq/ha/yr	CLMaxN keq/ha/yr
Normal	0.004	$1.7x10^{-6}$	$6.0x10^{-4}$	10	0.006	$4.3x10^{-5}$	N/A
Emergency	0.007	$1.7x10^{-6}$	$9.8x10^{-4}$	10	0.010	$7.0x10^{-5}$	N/A

The results show that, for both normal and emergency operation under Scenario 1a, the additional nitrogen deposition rate due to the operation of the IQE facility is only 0.01% or less of the lower critical load of 10 kg/ha/year for this location. The APIS website does not provide any value for the acidity critical load, however, given that the average

[2] Air Quality Advisory Group, 2014, AQTAG06 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air.
[3]: https://www.apis.ac.uk/srcl

background acid deposition for moorland (short vegetation) at this location is 1 keq/ha/yr, the estimated N derived acid deposition is 0.004% and 0.007% of background for the normal and emergency operation, respectively.

It should be noted that these results are based on very conservative assumptions embedded in the air dispersion study; for example, it was assumed that the sources would emit continuously throughout the 24 hour production cycle (although the semiconductor production methods are batch processes during the normal operation of the reactors) and the standby diesel generators would run 50 hours per year (in reality, the generators are not expected to run more than two hours per year in an emergency, plus half an hour per month for maintenance). Further details on the conservative assumptions used in the study are provided in the air quality assessment report submitted with the permit variation application.

Conclusions

A calculation of nitrogen and acid deposition at the Severn Estuary SAC / SPA / Ramsar / SSSI due to the operation of the IQE facility has been undertaken, for Scenario 1a (82 GAN tools) under normal and emergency operation. Based on the very low results of just a fraction of a percent of the relevant critical loads, and given the conservative nature of the assessment, the ecological impacts are deemed to be insignificant. This reinforces the conclusion of the air quality assessment report.