The Sizewell C Project

9.116 Sizewell C Desalination Plant Greenhouse Gas Emissions Assessment

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None provided.

1 INTRODUCTION

1.1 Project overview

1.1.1 This report provides an addendum to the Sizewell C Project Greenhouse Gas (GHG) assessment with reference to the following documents submitted with the Application:

- **Volume 2, Chapter 26** of the **ES** [APP-342];
- **Volume 1, Chapter 2** of the **First ES Addendum** [AS-181]; and
- **Volume 3, Appendix 9A (Carbon Focused Life Cycle Assessment of the Proposed Sizewell C Nuclear Power Plant Development),** submitted as part of the Responses to the ExA's First Written Questions (ExQ1) [REP2-110] (hereafter referred to as the 'updated Carbon LCA report').

1.1.2 This GHG report sets out to quantify the supplementary carbon impact of a proposed temporary desalination plant in the broader context of the Sizewell C Project's previous GHG assessments listed above. As described briefly below, there are some differences in calculation approach relative to the carbon focused LCA – but these would not be expected to have a material impact on the estimated GHG emissions. The assessment has been undertaken in response to question CC.3.4 of the Examining Authority's third written questions and is indicative based on currently available data.

1.1.3 The proposed desalination plant comprises a temporary modular unit installed at the main development site with intake and outfall connections into the North Sea. For the purposes of this assessment, the plant has been assumed to be operational for approximately 57 months between 2023 and 2028. At the start, the desalination plant has been assumed to be operating from a diesel-fuelled generator for approximately 244 days. The diesel-fuelled generator will then be subsequently replaced by an electrical transmission connection for a forecasted period of 1,461 days.

1.2 Project Scope

1.2.1 The GHG impact assessment includes emissions associated with the following:

- All direct GHG emissions arising from the construction and operation of the temporary desalination plant.
- Indirect emissions associated with electricity use during operation of the temporary desalination plant.
- Indirect emissions embedded within construction materials arising from the energy used in their production.
- Emissions arising from the transportation of materials, waste and operational waste.

a) Eliminated Lifecycle Stages from the Project Scope

1.2.2 Land clearance, worker transport, enabling waste and operational staff have already been accounted for within the scope of the previous GHG assessments [APP-342, AS-181, REP2-110] and, therefore, do not require further quantification as part of this report. Therefore, these aspects of the carbon assessment have been discounted from this assessment.

1.2.3 At the end of the operation of the temporary desalination plant, the intake and outfall tunnels would be grouted and left in-site, and the modular desalination plant would be removed. Hence, the GHG impact of decommissioning is estimated to have negligible GHG implications. Thus, the decommissioning phase of the project has not been included in the carbon assessment in this report.

2 GHG ASSESSMENT METHODOLOGY

2.1 Temporary Desalination Plant GHG Assessment

2.1.1 The GHG impact assessment followed a project lifecycle approach to calculate estimated GHG emissions arising from the construction and operation of the temporary desalination plant. The GHG impact assessment identified GHG 'hotspots' (i.e. emissions sources likely to generate the largest amount of GHG emissions), which enabled the identification of priority areas for mitigation in line with the principles set out in IEMA guidance (Ref.1).

2.1.2 In line with the World Resources Institute (WRI) & World Business Council for Sustainable Development (WBCSD) GHG Protocol (Ref.2), the GHG impact assessment is reported as tonnes of carbon dioxide equivalent (tCO_2e) and includes the seven Kyoto Protocol gases:

- Carbon dioxide (CO_2).
- Methane (CH_4).
- Nitrous oxide (N_2O).
- Sulphur hexafluoride (SF_6).
- Hydrofluorocarbons (HFCs).
- Perfluorocarbons (PFCs).
- Nitrogen trifluoride (NF_3).

2.1.3 Where possible, DEFRA 2021 emissions factors (Ref. 3) and embedded carbon emissions factors from the Inventory of Carbon and Energy (ICE, v3) (Ref.4) were used to estimate the GHG emissions. In circumstances where the DEFRA 2021 or ICE v3 GHG emissions factors were not applicable, other suitable carbon emission factors have been applied, and the emissions factors used are described below.

2.1.4 At this stage, the carbon focused LCA has not been updated to include the desalination plant as the time required to do so (including updating the calculation, report and undergoing the verification process) would not be possible in the short amount of time this addendum has been prepared. As

a result, there are differences in the data sources and calculation method relative to the LCA. These would be expected to give rise to a small difference in the estimated carbon emissions – but would not have a material impact on the outcome. In short, the input data (for materials, energy etc) would be the same and the emissions factors used for each of these inputs would be similar to those provided by the sources above. As the conclusion to this addendum shows, the estimated GHG emissions of the desalination plant are negligible relative to the estimated total construction and lifecycle emissions of Sizewell C.

3 ASSUMPTIONS AND LIMITATIONS

3.1.1 The assumptions made in this assessment are set out in Sections 3.2 to 3.7 by emissions source, including:

- Product carbon emissions
- Transportation of construction materials and equipment
- Waste produced during construction
- Construction Activities
- Operational Energy Usage
- Operational Waste

3.2 Product carbon emissions

3.2.1 The estimated product material data have been used to inform the carbon calculations. The product carbon emissions calculations have made the following assumptions:

- Reusable items and materials were not included in the embodied carbon calculations as it was assumed these are temporary materials and will be reused after construction.
- A market average aggregate emissions factor identified from the ICE Database (v3) has been applied, assuming a mixture of 64.2% land won, 27.5% recycled and secondary, and 8.3% marine aggregates.
- For all concrete, the emissions factor from the ICE Database (v3) for ‘Concrete – General’ has been applied.
- For steel, the world average emissions factor from the ICE Database (v3) for ‘steel sections’ has been applied.
- For the plastic piping, the ICE Database (v3) emissions factor for ‘HDPE pipe’ has been applied.

3.3 Transportation of construction materials and equipment

3.3.1 For the carbon emissions calculations for transportation of construction materials and equipment, the following assumptions have been made:

- For all transportation deliveries, previous assumptions about the distance travelled, type of vehicle, and materials and equipment weight was applied from the updated Carbon LCA report [REP2-110]. for each transport mode.
- For the aggregates material, it was assumed 10,009 tonnes of material was delivered to the site via rail by eight trains travelling a distance of 50km.
- For the concrete material, it was assumed 8 HGVs delivered 352 tonnes of material travelling an individual one-way distance of 70km. Also, it was assumed 880 tonnes of material was delivered by train travelling an assumed distance of 70km.
- For steel, it was assumed 213 tonnes of material was delivered by 9 HGVs travelling a one-way distance of 250km.
- For the HDPE pipes, it was assumed that 137 tonnes of material were delivered by 7 HGVs travelling a one-way distance of 200km.
- The DEFRA 2021 emission factor for diesel articulated lorries >33t + [1]well-to-tank emissions (WTT) emissions was applied for delivering construction materials via HGVs.
- The DEFRA 2021 emission factor for all diesel HGVs was used + WTT emissions for the delivery of equipment via HGVs.
- The DEFRA 2021 emission factor for Freight Train + WTT emissions was used for the delivery of materials via train.

3.4 Waste produced during construction

3.4.1 No waste data was available for the construction period, so the following assumptions have been made:

[1] The Well-to-Tank emissions factor is also known as upstream or indirect emissions, is an average of all the GHG emissions released into the atmosphere from the production, processing and delivery of a fuel or energy vector

- A 5% wastage rate has been applied to construction materials to estimate construction waste quantities.
- Based on the previous GHG assessments (as referenced in Section 1.1.1), it has been assumed that 10% of waste will go to landfill (according to the KPIs), and 90% of the waste will go for recycling.
- DEFRA 2021 carbon emissions factors have been applied for the recycling and landfill calculations.

3.5 Construction Activities

3.5.1 Data on estimated fuel consumption for the construction activities has been used within the assessment. The construction activities assumptions are summarised below:

- The DEFRA 2021 emissions factor for Gas Oil (red diesel) + WTT has been applied for diesel use on site.

3.6 Operational Energy Usage

3.6.1 Data regarding energy usage, fuel usage and substance usage was used to inform the carbon calculations. For the operational energy carbon emissions calculations, the following assumptions have been made:

- The DEFRA 2021 emissions factor for Gas Oil (red diesel) + WTT has been applied for diesel use on site.
- The Green Book Commercial / Public sector projected estimates for electricity usage were used (Ref.5). For phase one, a weighted average projected emissions factor was applied between October 2023 and June 2024. Furthermore, a weighted average projected emissions factor was used for phase two between December 2023 and June 2028.
- For the substances used during the process, carbon emission factors from DEFRA were not available, so other suitable sources were identified, including sodium hydroxide (ASTEE (2011) (Ref. 6), sodium bisulphite (ASTEE (2012) (Ref.7), Ferric Sulphate (University of Manchester (2011) (Ref.8) and Anionic Polyelectrolyte (ASTEE (2012).

- No emissions factors were identified for the following substances sodium hypochlorite, phosphate, citric acid, DBNPA and peracetic acid. Therefore, carbon embodiment calculations were not determined. However, as there are only small quantities of these chemicals, their exclusion is not anticipated to have a material impact on the overall outcome of the assessment.

3.7 Operational Waste

3.7.1 Data relating to estimated operational waste quantities was accounted for within the assessment, including approximately 24,000 tonnes of dewatered cake sludge and 380m^3 of Clean in Place (CIP) hazardous wastewater. For the operational waste carbon emissions calculations, the following assumptions have been made:

- It has been assumed the dewatered cake sludge waste cannot be recycled due to its high saline and mineral content. Since there are no suitable Defra or ICE emissions factors, the 'Water Treatment Works - Sludge to landfill' emissions factor from the UKWIR carbon accounting workbook has been applied (Ref.9).

- It is assumed the hazardous Clean in Place (CIP) wastewater will need to be disposed of offsite. However, since there are no suitable Defra or ICE emissions factors, a fossil liquid waste carbon factor has been calculated using the methodology presented in Chapter 5 of the IPCC Guidelines for National Greenhouse Gas Inventories (vol 5) report (Ref.10). The hazardous CIP wastewater is assumed to be solvent-based with a fossil content of 80%.

4 RESULTS

4.1 Desalination Plant GHG Assessment Results Summary

4.1.1 The temporary desalination plant GHG assessment results are summarised in **Table 4.1**.

Table 4.1: Desalination plant GHG assessment

Lifecycle stage	Project activity/emissions source	tCO_2e	% of total emissions
Construction	Products	877	2%
	Energy consumption/plant fuel use	1,488	3%
	HGV Transport	161	<1%
	Waste	<1	<1%
	Construction Subtotal	2,527	
Operation	Energy consumption / plant fuel use	4,650	9%
	Waste	42,162	85%
	Operation Subtotal	46,813	
	Total	**49,340**	

4.1.2 The carbon hotspots associated with the desalination plant are predominantly concentrated around the operational phase (94% of total emissions). Waste is the most significant contributor to the total emissions (85%). However, it is considered that the waste quantities and associated emissions during the operation of the desalination plant are likely to be an overestimate and present a worst-case assessment. This is because the operation of the desalination plant at full capacity at all times has been assumed for the purposes of this calculation, which will not be the case in practice.

4.1.3 Furthermore, SZC Co. is committed to reviewing options for the re-use of the dewatered sludge cake generated by the desalination plant, in order to reduce GHG emissions.

4.2 Indicative Change to the Overall Sizewell C Project's GHG Construction Emissions

4.2.1 **Table 4.2** presents the GHG emissions from the proposed desalination plant within the context of the construction emissions calculated within the updated Carbon LCA report [REP2-110].

Table 4.2: Indicative change to the Sizewell C Project's GHG assessment with GHG emissions from the desalination plant

	Sizewell C Project GHG Assessment [REP2-110]			
Lifecycle stage	**Desalination Plant total tCO_2e**	**Carbon focused LCA total tCO_2e**	**Revised total tCO_2e with desalination plant**	**Percentage increase**
Construction	49,340	3,830,194	3,879,534	1.3%
Total lifetime	49,340	9,575,486	9,624,826	0.5%

4.2.2 The indicative emissions estimate from the desalination plant represents 1.3% of the total construction GHG emissions from the Sizewell C carbon focused LCA calculation and 0.5% of the total lifetime GHG emissions from the Sizewell C carbon focused LCA calculation. This indicates that the desalination plant has a negligible impact on the overall construction and lifecycle GHG emissions of the Sizewell C Project.

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