REPORT

Sizewell B Dry Fuel Store Carbon Footprint Assessment

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HASKONINGDHV NEDERLAND B.V.

Rightwell House
Rightwell East
Bretton
Peterborough
PE3 8DW
United Kingdom
Industry, Energy and Mining
Trade register number: 56515154

+44 1733 334455 **T**
+44 1733 262243 **F**
royalhaskoningdhv.com **W**

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Author(s):	Daniel Beeden and Adam Steele
Drafted by:	Daniel Beeden and Adam Steele
Checked by:	Jon Allen
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Executive Summary

An assessment of the carbon footprint associated with the construction, operation and decommissioning of the Sizewell B Dry Fuel Store (DFS) has been undertaken based upon details provided by EDF Energy of construction, operation and decommissioning related activities, material types, volumes and the associated vehicular transport.

The DFS is situated within the existing Sizewell B nuclear power station site. It is designed to ensure the ongoing safe storage of spent nuclear fuel from Sizewell B throughout the operational life of the nuclear power station and until such time as a national Geological Disposal Facility is available. The DFS will provide a storage solution between the existing facility reaching its capacity (expected to be this year – 2015) and the opening of the GDF towards the end of this century. The facility is assumed to have an operational life, based on current plans, of 84 years.

During operation the DFS will take delivery of casks to house and store the spent nuclear fuel. These casks are manufactured in Pittsburgh and will be shipped to the UK in batches during the operational lifetime of the DFS. There are no ‘active’ elements of the storage process; for example there are no requirements for heating, cooling or other human interventions. The passive storage environment created by the DFS, combined with a small number of annual cask deliveries, means that the energy requirements of the building itself are extremely low. For example lighting within the DFS will be switched on for an average of only 4 hours per week.

To determine a carbon footprint for the construction, operation and decommissioning elements of the DFS, a spreadsheet was created utilising material specifications, volumes and delivery distances as set out by EDF Energy alongside emissions factors as determined by the Environment Agency in their 2014 carbon calculator which is widely considered an industry standard for carbon footprint assessments in the UK.

Based upon the information provided by EDF Energy a total carbon value of 5,426.4 tonnes of embodied CO_2 is attributed to the construction of the DFS, 70,842.09 tonnes of embodied CO_2 is attributed to the operation of the DFS, and 595.8 tonnes of embodied CO_2 is attributed to decommissioning. This gives a total carbon footprint for the construction, operation and decommissioning of the DFS of **76,900.29 tonnes** of $CO_{2.}$

For comparison a typical modern office would have a total carbon footprint in excess of 130,000 tonnes of $C0_2$ based on an 80 year operational life

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1.1 Introduction

This report sets out the results of an assessment of the carbon footprint associated with the construction, operation and decommissioning of the Sizewell B Dry Fuel Store. The aim of the study is to revisit and update the original carbon footprint assessment associated with the development of the Dry Fuel Store, taking account of revised data and methodologies and revisiting the associated calculations.

This document begins by providing an overview of the Sizewell site and the Dry Fuel Store (hereafter referred to as the DFS) specifically, before giving a broad overview of carbon footprints and carbon calculators. Following this the report details the methodology used to calculate the carbon footprint for the DFS and then discusses the results, assumptions, source data and uncertainties.

1.2 Sizewell Site and the Dry Fuel Store

The Sizewell site, located on the Suffolk coast between Dunwich and Thorpeness, is home to two nuclear power stations (Sizewell A and B) with a third (Sizewell C) planned. The DFS is designed to ensure the ongoing safe storage of spent nuclear fuel from Sizewell B throughout the operational life of the nuclear power station and until such time as a national Geological Disposal Facility (GDF) is available. The DFS will therefore provide a storage solution between the existing facility reaching its capacity (expected to be this year – 2015) and the opening of the GDF towards the end of this century. Sizewell B is projected to be operational until 2035 with the DFS designed to accommodate the storage of all associated spent nuclear fuel as well as having capacity for additional material should Sizewell B's operational life be extended.

The DFS is situated within the existing Sizewell B nuclear power station site and is being built on the site of a former car park and substation. As part of the DFS development, a cask haul route has been identified to facilitate the transport of spent fuel from the existing wet storage area to the DFS.

During operation the DFS will take delivery of casks to house and store the spent nuclear fuel. These casks are manufactured in Pittsburgh and will be shipped to the UK in batches during the operational lifetime of the DFS. The casks include stainless steel canisters and carbon steel transport casks. The carbon footprint associated with the manufacture and shipping of these elements is also captured within the carbon calculator and represents the majority of the carbon footprint of the lifecycle of the DFS (approximately 80%).

Operationally, the DFS creates a passive and inert storage environment for spent nuclear fuels. Spent fuel assemblies are stored inside sealed canisters within a concrete cask, sat on a concrete pad. There are no 'active' elements of the storage process; for example there are no requirements for heating, cooling or other human interventions. The passive storage environment created by the DFS, combined with a small number of annual cask deliveries, means that the energy requirements of the building itself are extremely low. For example lighting within the DFS will be switched on for an average of only 4 hours per week.

Current plans will see stored casks begin to be removed from the DFS for transfer the GDF in 2080 with this activity completed by 2099. As the details of the GDF are unknown at this time any attempt to calculate the associated carbon footprint for that activity are beyond the scope of this study.

The construction programme for the DFS lasts 18 months. The facility is assumed to have an operational life, based on current plans, of 84 years. The DFS was one of a small number of short-listed options for the storage of spent fuels, with carbon footprint assessments being undertaken for each of these as part of the selection process.

1.3 Calculating Carbon Footprints

A carbon footprint can be broadly described as an assessment of the total greenhouse gas emissions arising from, or associated with, a given action, item, event, project or individual. Timescales will vary depending upon the nature of the activity and the aim of the assessment. It enables consideration of defined or full-life effects in terms of greenhouse gas emissions and climate impact. In other words, it enables the influence of a development or activity upon climate change to be assessed. They are commonly used as part of the options appraisal process as a measure of the environmental impact of a project or development. At its most basic level, a carbon calculation is a relatively straightforward exercise involving consideration of an emissions source or material, the embodied carbon dioxide (CO_2) emissions and a volume, over a given timescale. The outcome will be a carbon footprint, typically described in tonnes of CO_2e, the 'e' meaning 'equivalent' which is the concentration of CO_2 that would cause the same level of radiative forcing (i.e. extent to which it would influence the climate system) as a given type and concentration of greenhouse gas.

An accurate determination of the carbon footprint is wholly reliant upon good data. In a construction scenario for example this would primarily be a comprehensive bill of quantities, a clear set of assumptions and the use of emissions factors (the determination of carbon intensity associated with a given material or activity) from a recognised source (for example UK Government/Environment Agency material).

1.4 Methodology for the Dry Fuel Store Assessment

This study builds upon the information provided in the 2010 Sizewell B Dry Fuel Store Environmental Statement and the 2012 Sizewell B Dry Fuel Store Further Environmental Information report that set material quantities and vehicle movements associated with the construction of the DFS. Operational quantities and vehicle movements have been provided by EDF Energy and have been used as the basis of the calculations for the operational carbon footprint.

As highlighted above, the passive nature of the DFS as a storage facility means its day to day operation consumes very little energy. Consequently values for energy consumption (lighting, heating etc.) of the DFS building itself are considered to be negligible and are not captured within this study.

At the end of the operational life of the DFS the land will be restored back to greenfield. This will require the removal from site of the above ground structure and the concrete slab and associated parking areas. To inform this part of the assessment it has been assumed that the same volume of materials that were brought to site during construction will need to be removed from site during decommissioning. The carbon calculation therefore assumes the same number of HGV movements will be required to remove this volume of material from site. As part of the decommissioning of the DFS stored casks will be removed from the DFS over a period of 20 years starting in 2080. As details of this activity are currently unknown a calculation of the associated carbon footprint is not included within this study.

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To determine a carbon footprint for the construction, operation and decommissioning elements of the DFS, a spreadsheet was created utilising material specifications, volumes and delivery distances as set out by EDF Energy alongside emissions factors as determined by the Environment Agency in their 2014 carbon calculator which is widely considered an industry standard for carbon footprint assessments in the UK. Construction of a replacement car park (for that lost to make way for the DFS) has not been included in these calculations as while it is associated with the development of the DFS, it is not part of the DFS itself.

The spreadsheet includes separate pages for construction, operation and decommissioning, and these should be read alongside this report with the following subsections detailing how the spreadsheet has been set up by considering each column in turn:

Task

Individual tasks are listed under sub-headings describing key tasks; excavation, concrete, cask assembly, etc. These align with key tasks as set out in the 2012 Sizewell B Dry Fuel Store Further Environmental Information report and those provided separately by EDF Energy associated with operation. Specified material volumes are detailed alongside the key tasks to correlate with those as set out by EDF Energy.

An allowance has been made for generalised construction emissions resulting from staff travel. Given the numerous variables that would need to be taken full account of to determine an accurate value, the Environment Agency's carbon calculator provides an average value based upon project value and the number of staff on site. This value is multiplied by the duration of the project in weeks and is presented as 'Task – Construction Emissions' within the construction spreadsheet.

Volume + unit conversion/density

Capturing the volume of the material to be installed/removed and where relevant a density to determine tonnage, figures in this column are drawn from the principal quantities supplied by EDF Energy. Density conversions are taken either from the existing values as set out in by EDF Energy, or, where they are not specified, from the Environment Agency's 2014 carbon calculator. While values may have been subsequently updated in the 2014 calculator, without details of the precise nature of the material used, the updated assessment uses the conversion factors as set out by EDF Energy in the majority of cases.

In a number of cases, assumptions or inferences have been made where EDF Energy have not specified a particular value. Where this is the case, a 'common sense' approach has been adopted to select an average value, or where additional detail is available, a material from the Environment Agency's carbon calculator that is deemed to be most representative of that which would have been/will be used.

An example is where tarmac surfacing is described. In these cases, an appropriate value from the Environment Agency's carbon calculator has been selected (Asphalt, 6% binder content, 1.7 tonnes/m^3 and an embodied CO_2 value of 0.076 tonnes of CO_2 per tonne of material). Whilst the basis of potential inaccuracies in the assessment, it is important to bear in mind that minor differences in embodied emissions between, for example, asphalt with a 6% versus a 7% binder content, are unlikely to a significant influence on the overall assessment and would commonly be covered by standard margins of error.

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Total delivery size (tonnes)
Corresponding with pre-determined totals, figures in this column set out the total material tonnage related to a given activity.

Load size
Where data was available from EDF Energy, the size of the load (i.e. 20 tonnes per load for excavated surfacing material) for a given material is specified. These values are not utilised in the calculation of associated emissions but are just included for reference.

Associated HGVs (movements)
HGV movements associated with the material movements are detailed and correspond with those specified in EDF's figures.

Calculation
This column confirms the 'logic' behind the associated calculation and clarifies whether the associated carbon footprint is derived purely from transport emissions or transport emissions and production of the material combined. Movements associated with the excavation of a material will exclude emissions associated with the production of that material, as its manufacture is not related to the DFS project.

Material type/specification
Details of the specific construction material selected, as set out in the Environment Agency's carbon calculator (2014), are included in this column. Reference has been made to specifications and material types as set out in construction information provided by EDF Energy. However where more detailed information was required than was available (for example, the Environment Agency's carbon calculator lists multiple concrete specifications with a number of additional variables), a material/value has been selected that was deemed most appropriate given the nature of the development.

Making a significant contribution to the construction carbon footprint of this development is the use of concrete. The available information did not specify the type of concrete that would be used in the construction of the DFS so a specification was chosen based upon a review of materials set out in the Environment Agency's carbon calculator, combined with an understanding of the proposed development. The EA carbon calculator lists eight main concrete types with the associated carbon footprint varying depending upon the type of cement used, the amount of steel reinforcement incorporated, the aggregate source, and so-on. Lacking the specific information about each of these variables related to the construction of the DFS, a best estimate was made based upon what is known about the development and the likely concrete requirements.

There are numerous similar examples where, in the absence of clearly defined values the most appropriate one has been selected with a number of assumptions therefore having to be made. This is applicable to the choice of: surfacing material (asphalt, 6% BC), granular fill (quarried aggregate), concrete (concrete XO), steel reinforcement (steel: bar and rod) and structural steel (steel: sections) with the materials in brackets being those selected from the most recent version of the Environment Agency's carbon calculator.

Making a significant contribution for operation is carbon steel which has been identified as a material associated with the cask assembly. However, this is not present within the EA carbon calculator. In this instance the value for ‘Steel: Plate- UK (EU) Average Recycled Content’ has been adopted in the calculations following advice from EDF Energy. Steel: Plate- UK (EU) Average Recycled Content has the highest material CO_2e of the basic steel options available within the EA spreadsheet. By adopting this value this should ensure that values remain conservative.

Embodied tCO_2e per tonne of material

Taking the value as set out in the Environment Agency’s carbon calculator, this column details the emissions (in terms of CO_2 equivalent) associated with the production of one tonne of a given material. Where no ‘product’ is involved, for example the excavation of existing material, no value is presented here as the emissions arising are solely from vehicular transport, as discussed in the relevant section below.

Material CO_2e

This summary column, shaded green, presents the carbon footprint for the material element of the calculation in terms of tonnes of CO_2 equivalent.

Assumed distance (return km)

The transportation element of the carbon calculator is covered by this and the following two columns. In the absence of specific information detailing journey start and end points for materials being brought into, and taken away from, the DFS site during construction, a broad assumption of trip distance (return) has been made of 100 miles (161km).

Tonnes CO_2e per tonne per kilometre (tCO_2e/t.km)

These metrics are standard values as set out in the Environment Agency’s carbon calculator to determine emissions associated with goods transported by road or by ship. This figure represents the average emissions generated by moving one tonne of material over a distance of one kilometre, standardised across vehicle types and load sizes.

Transport Tonnes CO_2e

This column calculates the emissions associated with the transport of material by multiplying total tonnage (column D) by distance (column K) per tonne/per km emissions (column L) value.

Total CO_2e (tonnes)

The final column presents overall emissions and combines (where relevant) emissions sub-totals from materials and transportation. A final, overall carbon footprint for each phase of the DFS is presented at the bottom. There is one sheet for each of construction, operation and decommissioning.

1.5 Results and Analysis

Uncertainties and assumptions

In addition to those assumptions set out above regarding calculation methodology, some further assumptions have been made that are set out below which should be considered during the review of carbon footprint for the DFS.

- **Pump Trucks & associated emissions**. 45 pours utilising two pumps per pour is the updated value provided by EDF Energy during an initial review of the carbon calculation. The associated number of HGV movements is expected to be 180 however specific details from which a carbon calculation can be derived accurately (for example, vehicle types involved, duration of use, any mileage associated) have not been made available. A nominal value has been calculated based upon a low mileage for each vehicle (appreciating that movements may be entirely contained within the Sizewell site) based upon mileage x HGV movements x the CO_2e/t.km used elsewhere in the spreadsheet.
- **Cladding and roofing**. 80 HGV movements are associated with this element of the construction of the DFS although further information on the type of materials, etc., is not stated. As assumption of the material volumes (in terms of total tonnage) and mileage has been made so that a carbon value can be attributed to the HGV movements specified.
- **West car park surfacing.** Whilst related to the construction of the DFS, emissions associated with the construction of the new west car park are not included in this calculation. This accounts for lower volumes of material removal ('excavation'), surfacing ('tarmac surfacing') and correspondingly, a reduction in the stated number of HGV movements.
- **Total transporter movements.** Whilst relating to the operation of the DFS, total delivery size of a cask has not been provided. Therefore, only Transport Tonnes CO_2e has been calculated.
- **Carbon steel.** Carbon steel is not listed in the Environment Agency's carbon calculator. As Steel: Plate- UK (EU) Average Recycled Content has the highest material CO_2e of the basic steel options this has been used as a proxy following advice from EDF Energy.
- **HD concrete.** Assumptions have been made on the composition of HD concrete and as such it has been inputted into the concrete class with the highest material CO_{2e} (Concrete X0 class).

Based upon the information provided by EDF Energy a total carbon value of 5,426.4 tonnes of embodied CO2 is attributed to the construction of the DFS, 70,842.09 tonnes of embodied CO2 is attributed to the operation of the DFS, and 595.8 tonnes of embodied CO2 is attributed to decommissioning. This gives a total carbon footprint for the construction, operation and decommissioning of the DFS of **76,900.29** tonnes of embodied CO_2.

For comparison a typical modern office would have a total carbon footprint in excess of 130,000 tonnes of $C0_2$ based on an 80 year operational life[1].

[1] Based on a 10 storey modern office. Calculated embedded carbon emissions during construction = 14,937 tonnes CO_2. Calculated embedded carbon emissions during operation = 1,455 tonnes CO_2 per annum. Reported within Pope and Samson (2012) *A comparative embodied carbon assessment of commercial buildings*. The Structural Engineer October 2012.

1.6 Conclusions

This report has sought to provide an update assessment of the carbon footprint associated with the development of a new spent nuclear fuel storage facility for Sizewell B. The Dry Fuel Store is currently being built and is expected to remain operational until the end of the century, pending a long term storage solution for spent nuclear fuels in the UK. Being a passive storage facility, initial estimations suggested that by far the most significant carbon emissions would be associated with its construction and the manufacture and shipping of the associated canisters and casks. The assessment is based upon details provided by EDF Energy of construction, operation and decommissioning related activities, material types, volumes and the associated vehicular transport.

Carbon Calculator Spreadsheet

	Task - **CONSTRUCTION**	Volume + unit conversion/ density	Total delivery size (tonnes)	Load size	Assoc. HGVs (return)	Calculation	Material type/spec	Embodied tCO2e per tonne of material	Material CO2e	Assumed distance (ret) (km)	tCO2e/t.km	Transport Tonnes CO2e	TOTAL CO2e (tonnes)
A	**EXCAVATION**												
1	Removal of south car park surfacing	1875m3 x 2.1	3940	20	394	Vehicle mileage	n/a	n/a	n/a	161	0.00012335	78.25	**78.25**
2	South car park concrete demolition	2221m3 x 2.4	5330	10	532	Vehicle mileage	n/a	n/a	n/a	161	0.00012335	105.85	**105.85**
3	132kV substation compound - removal to formation level	1583m3 x 1.8	2849	15	286	Vehicle mileage	n/a	n/a	n/a	161	0.00012335	56.58	**56.58**
4	Dry store excavation	1017m3 x 1.8	1830	15	182	Vehicle mileage	n/a	n/a	n/a	161	0.00012335	36.34	**36.34**
5	Fab pad & hardstanding tarmac surfacing	300m3 x 1.7	510	20	51	Material x Vehicle mileage	Asphalt, 6% BC	0.076	38.76	161	0.00012335	10.13	**48.89**
6	Fab pad & hardstanding excavation	1490m3 x 1.8	2682	15	262	Vehicle mileage	n/a	n/a	n/a	161	0.00012335	53.26	**53.26**
7	Haul path turning pads	380m3 x 1.7	646	*Not stated*	68	Material x Vehicle mileage	Asphalt, 6% BC	0.076	49.10	161	0.00012335	12.83	**12.83**
8	Haul path road widening	300m3 x 1.7	510	*Not stated*	54	Material x Vehicle mileage	Asphalt, 6% BC	0.076	38.76	161	0.00012335	10.13	**10.13**
B	**GRANULAR FILL (6,793 tonnes)**												
1	Dry store (600mm)	4070m3 x 2	8140	20	814	Material x Vehicle mileage	Quarried aggregate	0.005	40.70	161	0.00012335	161.66	**202.36**
2	Hardstanding	2723m3 x 2	3660	20	544	Material x Vehicle mileage	Quarried aggregate	0.005	18.30	161	0.00012335	72.69	**72.69**
C	**CONCRETE (6,543 tonnes)**												
1	Dry store building	5088m3 x 2.4	12211	6m3 load	1696	Material x Vehicle mileage	Concrete X0	0.083	1013.51	161	0.00012335	242.50	**1256.02**
2	Haul path turning pads	380m3 x 2.4	912	6m3 load	126	Material x Vehicle mileage	Concrete X0	0.083	75.70	161	0.00012335	18.11	**93.81**
3	Fabrication pad & hardstanding	895m3 x 2.4	2148	6m3 load	300	Material x Vehicle mileage	Concrete X0	0.083	178.28	161	0.00012335	42.66	**220.94**
4	Equipment store	180m3 x 2.4	432	6m3 load	60	Material x Vehicle mileage	Concrete X0	0.083	35.86	161	0.00012335	8.58	**44.44**
D	**PUMP TRUCKS**												
1	Dry store building	2 pumps/pour x 16 pumps	320	10	64	On site only	n/a	n/a	n/a	161	0.00012335	6.35	**6.35**
E	**REINFORCEMENT (1,050 tonnes)**												
1	Dry store building	950t	950	28	68	Material x Vehicle mileage	Steel: Bar & Rod	1.4	1330.00	161	0.00012335	18.87	**1348.87**
2	Hardstanding & equipment store	100t	100	28	8	Material x Vehicle mileage	Steel: Bar & Rod	1.4	140.00	161	0.00012335	1.99	**141.99**
F	**STRUCTURAL STEEL (940 tonnes)**												
1	Dry store building	850t	850	*Not stated*	90	Material x Vehicle mileage	Steel: sections	1.53	1300.50	161	0.00012335	16.88	**1317.38**
2	Equipment store building	90t	90	*Not stated*	8	Material x Vehicle mileage	Steel: sections	1.53	137.70	161	0.00012335	1.79	**139.49**
G	**CLADDING & ROOFING**												
1	Standing seam & insulation	*Not stated*	*Not stated*	*10*	40	Vehicle mileage		unspecified		161	unknown		**~**
2	Louvres & ancilliaries	*Not stated*	*Not stated*	*10*	40	Vehicle mileage		unspecified		161	unknown		**~**
H	**TARMAC SURFACING**												
1	Haul path road widening	300m3 x 1.7	510	*Not stated*	60	Material x Vehicle mileage	Asphalt, 6% BC	0.076	38.76	161	0.00012335	10.13	**48.89**

	Task - **CONSTRUCTION EMISSIONS**						Duration of construction (weeks)	kgCO2e per week			Calculation		TOTAL CO2e (tonnes)
1	**PERSONNEL TRAVEL**						75	1748			1748 x (75/1000)		**131.10**
	Large project (16-25 permanent construction workers)												
												TOTAL	**5426.43**

	Task - **OPERATION**	Total delivery size (tonnes)	Load size	Assoc. HGVs (return)	Calculation	Material type/spec	Embodied tCO2e per tonne of material	Material CO2e	Assumed distance (ret) (km)	tCO2e/t.km	Transport Tonnes CO2e	TOTAL CO2e (tonnes)
A	**CASK ASSEMBLY AND TRANSPORT**											
1	Canisters (MPC)	3153.6	n/a	144	Vehicle mileage	Stainless Steel	6.520	20561.47	514	0.00012335	199.94	**20761.42**
2	Canisters (MPC)	3153.6	n/a	n/a	Ship mileage	Stainless Steel	6.520	20561.47	3450	0.00001315	143.07	**20704.54**
3	Concrete casks (HI-STORM)	6435	n/a	143	Vehicle mileage	Carbon Steel	1.660	10682.10	514	0.00012335	407.99	**11090.09**
4	Concrete casks (HI-STORM)	6435	n/a	n/a	Ship mileage	Carbon Steel	1.660	10682.10	3450	0.00001315	291.94	**10974.04**
5	Concrete casks (HI-STORM)	1315.6	n/a	143	Vehicle mileage	Lead	1.670	2197.05	514	0.00012335	83.41	**2280.46**
6	Concrete casks (HI-STORM)	1315.6	n/a	n/a	Ship mileage	Lead	1.670	2197.05	3450	0.00001315	59.69	**2256.74**
7	Concrete casks (HI-STORM)	17875	n/a	n/a	On site only	HD Concrete	0.083	1483.63	0	0.00012335	0.00	**1483.63**
8	Transfer Cask (Hi-TRAC)	100	n/a	2	Vehicle mileage	Carbon Steel	1.660	166.00	827	0.00012335	10.20	**176.20**
9	Transfer Cask (Hi-TRAC)	100	n/a	1	Ship mileage	Carbon Steel	1.660	166.00	5075	0.00001315	6.67	**172.67**
10	Transfer Cask (Hi-TRAC)	33	n/a	2	Vehicle mileage	Lead	1.670	55.11	827	0.00012335	3.37	**58.48**
11	Transfer Cask (Hi-TRAC)	33	n/a	1	Ship mileage	Lead	1.670	55.11	5075	0.00001315	2.20	**57.31**
12	Lifting Transporter	120	n/a	1	Vehicle mileage	Carbon Steel	1.660	199.20	1712	0.00012335	25.35	**224.55**
13	Hauling Transporter	47	n/a	1	Vehicle mileage	Carbon Steel	1.660	78.02	274	0.00012335	1.59	**79.61**
14	HI-STORM Transport Frames	27.6	n/a	2	Vehicle mileage	Carbon Steel	1.660	45.82	274	0.00012335	0.93	**46.75**
15	Hi-TRAC Transport Frames	10.5	n/a	1	Vehicle mileage	Carbon Steel	1.660	17.43	827	0.00012335	1.07	**18.50**
16	Hi-TRAC Transport Frames	10.5	n/a	n/a	Ship mileage	Carbon Steel	1.660	17.43	5075	0.00001315	0.70	**18.13**
17	FHD	7.5	n/a	1	Vehicle mileage	Stainless Steel	6.520	48.90	827	0.00012335	0.77	**49.67**
18	FHD	7.5	n/a	n/a	Ship mileage	Stainless Steel	6.520	48.90	5075	0.00001315	0.50	**49.40**
19	MPCCS	4.8	n/a	1	Vehicle mileage	Stainless Steel	6.520	31.30	827	0.00012335	0.49	**31.79**
20	MPCCS	4.8	n/a	n/a	Ship mileage	Stainless Steel	6.520	31.30	5075	0.00001315	0.32	**31.62**
21	Access Equipment	1	n/a	1	Vehicle mileage	Aluminium	9.160	9.16	827	0.00012335	0.10	**9.26**
22	Access Equipment	1	n/a	n/a	Ship mileage	Aluminium	9.160	9.16	5075	0.00001315	0.07	**9.23**
23	Lifting Assembly	7.2	n/a	1	Vehicle mileage	Stainless Steel	6.520	46.94	827	0.00012335	0.73	**47.68**
24	Lifting Assembly	7.2	n/a	n/a	Ship mileage	Stainless Steel	6.520	46.94	5075	0.00001315	0.48	**47.42**
25	Lifting Equipment stands	2	n/a	1	Vehicle mileage	Stainless Steel	6.520	13.04	827	0.00012335	0.20	**13.24**
26	Lifting Equipment stands	2	n/a	n/a	Ship mileage	Stainless Steel	6.520	13.04	5075	0.00001315	0.13	**13.17**
27	Shield Spacer Assembly	18	n/a	1	Vehicle mileage	Carbon Steel	1.660	29.88	827	0.00012335	1.84	**31.72**
28	Shield Spacer Assembly	18	n/a	n/a	Ship mileage	Carbon Steel	1.660	29.88	5075	0.00001315	1.20	**31.08**
29	Shield Spacer Assembly	18	n/a	1	Vehicle mileage	HD Concrete	0.083	1.49	827	0.00012335	1.84	**3.33**
30	Shield Spacer Assembly	18	n/a	n/a	Ship mileage	HD Concrete	0.083	1.49	5075	0.00001315	1.20	**2.70**
31	Mating Device	8.9	n/a	1	Vehicle mileage	Carbon Steel	1.660	14.77	827	0.00012335	0.91	**15.68**
32	Mating Device	8.9	n/a	n/a	Ship mileage	Carbon Steel	1.660	14.77	5075	0.00001315	0.59	**15.37**
33	CTF Impact Limiter	1.6	n/a	1	Vehicle mileage	Carbon Steel	1.660	2.66	827	0.00012335	0.16	**2.82**
34	CTF Impact Limiter	1.6	n/a	n/a	Ship mileage	Carbon Steel	1.660	2.66	5075	0.00001315	0.11	**2.76**
35	Installed Pipework	1.9	n/a	1	Vehicle mileage	Stainless Steel	6.520	12.39	563	0.00012335	0.13	**12.52**
36	Lid Stands	3.3	n/a	1	Vehicle mileage	Carbon Steel	1.660	5.48	290	0.00012335	0.12	**5.60**
37	Link Stands	7.6	n/a	1	Vehicle mileage	Carbon Steel	1.660	12.62	290	0.00012335	0.27	**12.89**
B	**Fuel/ HLW/ ILW movements**											
38	Total transporter movements	n/a	n/a	143	Cask movement		0.003	n/a	345	0.00012335	0.04	**0.04**
											TOTAL	**70842.09**

NOTES Carbon steel is not idntified within the EA carbon calculator. Instead values for Steel: Plate- UK (EU) Average Recycled Content, have been identified as an apropruiate proxy by EDF Energy

	Task - **DECOMMISSIONING**	Volume + unit conversion/ density	Total delivery size (tonnes)	Load size	Assoc. HGVs (return)	Calculation	Material type/spec	Embodied tCO2e per tonne of material	Material CO2e	Assumed distance (ret) (km)	tCO2e/t.km	Transport Tonnes CO2e	TOTAL CO2e (tonnes)
B	**GRANULAR FILL (6,793 tonnes)**												
1	Dry store (600mm)	4070m3 x 2	8140	20	814	Material x Vehicle mileage	Quarried aggregate	n/a	n/a	161	0.00012335	161.66	**161.66**
2	Hardstanding	2723m3 x 2	3660	20	544	Material x Vehicle mileage	Quarried aggregate	n/a	n/a	161	0.00012335	72.69	**72.69**
C	**CONCRETE (6,543 tonnes)**												
1	Dry store building	5088m3 x 2.4	12211	6m3 load	1696	Material x Vehicle mileage	Concrete X0	n/a	n/a	161	0.00012335	242.50	**242.50**
2	Haul path turning pads	380m3 x 2.4	912	6m3 load	126	Material x Vehicle mileage	Concrete X0	n/a	n/a	161	0.00012335	18.11	**18.11**
3	Fabrication pad & hardstanding	895m3 x 2.4	2148	6m3 load	300	Material x Vehicle mileage	Concrete X0	n/a	n/a	161	0.00012335	42.66	**42.66**
4	Equipment store	180m3 x 2.4	432	6m3 load	60	Material x Vehicle mileage	Concrete X0	n/a	n/a	161	0.00012335	8.58	**8.58**
E	**REINFORCEMENT (1,050 tonnes)**												
1	Dry store building	950t	950	28	68	Material x Vehicle mileage	Steel: Bar & Rod	n/a	n/a	161	0.00012335	18.87	**18.87**
2	Hardstanding & equipment store	100t	100	28	8	Material x Vehicle mileage	Steel: Bar & Rod	n/a	n/a	161	0.00012335	1.99	**1.99**
F	**STRUCTURAL STEEL (940 tonnes)**												
1	Dry store building	850t	850	*Not stated*	90	Material x Vehicle mileage	Steel: sections	n/a	n/a	161	0.00012335	16.88	**16.88**
2	Equipment store building	90t	90	*Not stated*	8	Material x Vehicle mileage	Steel: sections	n/a	n/a	161	0.00012335	1.79	**1.79**
G	**CLADDING & ROOFING**												
1	Standing seam & insulation	*Not stated*	*Not stated*	*Not stated*	40	Vehicle mileage		n/a	n/a	161	unknown		**~**
2	Louvres & ancilliaries	*Not stated*	*Not stated*	*Not stated*	40	Vehicle mileage		n/a	n/a	161	unknown		**~**
H	**TARMAC SURFACING**												
1	Haul path road widening	300m3 x 1.7	510	*Not stated*	60	Material x Vehicle mileage	Asphalt, 6% BC	n/a	n/a	161	0.00012335	10.13	**10.13**
												TOTAL	**595.84**