Fosse Green Energy

Preliminary Environmental Information Report

VOLUME

1

Chapter 3: The Proposed Development

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3.1 Introduction

3.1.1 This chapter provides a description of the physical characteristics of the Proposed Development and the key activities that would be undertaken during the construction, operation, and decommissioning stages. The description contained within this chapter informs each of the technical assessments provided in **Chapters 6** to **14** of this Preliminary Environmental Information (PEI) Report.

3.1.2 In this chapter and throughout the PEI Report the following definitions are used to describe the key areas of the Proposed Development shown in **PEI Report Volume 2, Figure 1-2**:

a. **The Site** – the maximum extent of land required for the construction, operation (including maintenance), and decommissioning of the Proposed Development. The Site comprises the Principal Site and the Cable Corridor. The boundary of the Site is referred to as the Site Boundary. The total area of the Site is 1,426 hectares (ha).

b. **Principal Site** – the area of the Site covered by the ground-mounted solar photovoltaic (PV) panels, Solar Stations, Battery Energy Storage System (BESS), Onsite Substation, planting and mitigation areas, interconnecting cables between solar PV areas, and associated infrastructure. The total area of the Principal Site is approximately 1,065ha.

c. **Cable Corridor** – the area of the Site in which the 400 kilovolt (kV) and associated cables (the Grid Connection Cables) will be installed between the Onsite Substation and the proposed National Grid's Navenby Substation. The proposed Navenby Substation is subject to a separate application and does not form part of the Proposed Development. The Cable Corridor partially overlaps the Principal Site and is approximately 407ha.

3.1.3 This chapter is supported by the following figures in **PEI Report Volume 2**:

a. **Figure 3-1: Construction Compound and Access Locations**;

b. **Figure 3-2A: Indicative South Facing Fixed Site Layout Plan**;

c. **Figure 3-2B: Indicative Single Axis Tracker Site Layout Plan**; and

d. **Figure 3-3: Proposed Permissive Paths**.

3.2 Design Parameters

3.2.1 The Proposed Development will comprise the construction, operation (including maintenance), and decommissioning of a ground-mounted solar PV generating station with battery storage, Onsite Substation, and associated infrastructure to generate and export/import electricity.

3.2.2 The Proposed Development will have the ability to export and import electricity to/from the national electricity transmission network. The associated development to the solar PV generating station (which is a Nationally Significant Infrastructure Project) includes, but is not limited to, access provision, BESS, underground cabling in Interconnecting Cable Corridors between the solar PV array areas, areas of landscaping and biodiversity enhancement, and a 400kV underground Grid Connection Cable of approximately 10km length connecting to the national electricity transmission network at a proposed new National Grid substation near Navenby.

3.2.3 A number of the precise details for design aspects and features of the Proposed Development cannot be confirmed until the tendering process for design and construction has been completed. For example, the enclosure or building sizes may vary, depending on the contractor selected and their specific configuration and selection of plant.

3.2.4 The technology for solar PV and BESS continues to evolve rapidly; for example, solar PV panels are becoming increasingly powerful year on year and better at minimising shading losses, which affects how developers space the rows of solar PV and the amount of land needed to achieve the proposed export capacity. As a result, the design parameters need to be defined and must maintain some degree of flexibility to allow the most appropriate technology to be utilised at the time of construction.

3.2.5 To ensure a robust assessment of the likely significant environmental effects, the Environmental Impact Assessment (EIA) has been undertaken adopting the principles of the ‘Rochdale Envelope’, as described in the Planning Inspectorate Advice Note Nine (Ref 3-1). The Rochdale Envelope involves assessing the maximum (and where relevant, minimum) parameters for the Proposed Development where flexibility needs to be retained. This approach sets worst-case parameters for the purpose of the assessment but does not constrain the Proposed Development from being built in a manner that would lead to lesser environmental and social impacts. The draft Development Consent Order (DCO) will secure these worst-case parameters, providing certainty that the impacts of the Proposed Development will be no worse than those assessed as part of the EIA. The use of ‘design parameters’ is therefore adopted to present a likely worst-case assessment of potential environmental effects of elements of the Proposed Development that require flexibility. Wherever an element of flexibility is maintained, the likely worst-case impacts are reported in this PEI Report and will be reported in the ES.

3.2.6 The design of the Proposed Development is an iterative process, based on preliminary environmental assessments and consultation with statutory and non-statutory consultees. **PEI Report Volume 1 Chapter 4: Alternatives and Design Evolution** describes this process further, including options that have been considered and discounted or amendments made to the Proposed Development design to date.

3.2.7 Each component of the Proposed Development is described in more detail in Section 3.3. Each technical chapter within this PEI Report has assessed the design considered to be the likely worst-case scenario for that discipline to determine the significance of effect. The DCO application would allow for the selection of either south fixed or single axis tracker arrangement panels, and for the selection of either DC-coupled or AC-coupled BESS arrangement, all of which is discussed more in Section 3.3. Where there is a difference between the parameters for these arrangements, this is noted in the section below.

3.3 Components of the Proposed Development

3.3.1 The Proposed Development will consist of the principal infrastructure described in the following sections. To ensure that the likely significant environmental effects of the Proposed Development are not worse than those assessed in the EIA and the effect of the Proposed Development has been robustly assessed, the parameters set out in this chapter are the basis upon which the Proposed Development has been assessed in **Chapters 6** to **14** of this PEI Report.

3.3.2 As the Proposed Development design develops, the configuration of the Proposed Development components will be determined based upon environmental and technical factors. The use of the Rochdale Envelope approach will ensure that the likely significant effects of the Proposed Development do not exceed the reasonable worst-case scenario presented in the Environmental Statement (ES) accompanying the DCO application.

3.3.3 The Proposed Development components comprise:

a. Solar PV panels (also known as ‘modules’);
b. PV panel mounting structures;
c. Battery Energy Storage System (BESS);
d. Inverters;
e. Transformers;
f. Switchgear;
g. An Onsite Substation and control buildings;
h. Onsite cabling;
i. Ancillary infrastructure (e.g. combiner boxes, weather stations);
j. Electricity export and import via high-voltage Grid Connection Cable and connection to the National Electricity Transmission System;
k. Fencing and security;
l. Access tracks; and
m. Landscaping, permissive paths and biodiversity mitigation and enhancement areas.

3.3.4 During the construction phase, one main construction compound and several secondary compounds will be created, as well as temporary roadways to facilitate access to all land within the Principal Site. The construction compounds will be ‘built-out’ being gradually replaced by the solar PV arrays as the construction progresses. The indicative location and maximum footprint of the construction compounds are illustrated on **PEI Report Volume 2 Figure 3-1**. Temporary construction compounds would also be located within the Cable Corridor to enable the construction of the Grid Connection Cable, although their location will be determined at the ES stage.

Solar PV Panels

3.3.5 Solar PV panels (also known as 'modules') convert sunlight into electrical current (as direct current (DC)). Currently individual panels are typically up to 2.4m in height by 1.3m in width and consist of a series of PV cells beneath a layer of toughened glass with an anti-reflective coating (as shown in **Plate 3-1** and **Plate 3-2**, which are two common panel arrangements). Other PV technologies are developing rapidly and may be available at the time of construction, and therefore to allow flexibility for future module technology to be larger, the maximum solar PV table (i.e. solar PV panels fixed to the mounting structures) height parameter considered within this PEI Report is 3.5m above ground level (AGL). The panel frame is typically built from anodised aluminium.

3.3.6 Each panel would likely have a DC generating capacity of between 400 and 850 watts (W), or potentially more depending on advances in technology at the time of construction. The illustrative design currently assumes 670W panels. The panels are fixed to a mounting structure in groups known as 'strings'. Various factors will help to inform the number and arrangement of panels in each string, and it is likely some flexibility will be required to accommodate future technology developments; the illustrative design assumes 30 panels make up each string.

3.3.7 The number of PV panels that will make up each PV table (group of PV panels within a string) is not yet known. Various factors will help to inform the number and arrangement, and it is likely some flexibility will be required to accommodate future technology developments. For this reason, the assessment will be based on the parameters outlined in **Table 3-1**. **Table 3-1** outlines the minimum and maximum parameters that are material to the environmental impact assessment (in line with 'Rochdale Envelope' approach), and also provides indicative parameters which are subject to final design but which are not material to the assessment.

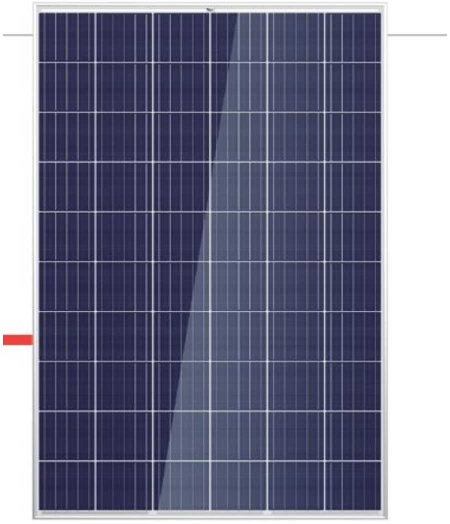

Plate 3-1: 60 Cells Solar Panel

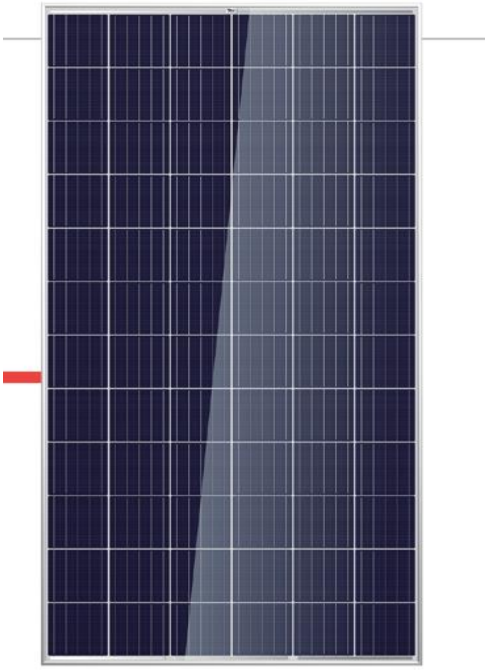

Plate 3-2: 72 Cells Solar Panel

3.3.8 The Proposed Development and this PEI assessment allows for the installation of south facing fixed or single axis tracker configurations, as well as a mixture of the two configurations (although this would be unlikely).

Fixed South Facing Configuration

3.3.9 For a fixed south facing configuration, the PV tables would be aligned east to west with the panels sloping towards the south at a fixed angle of 5 to 45 degrees from horizontal. The preliminary layout shown in **PEI Report Volume 2, Figure 3-2A and Figure 3-2B** is based on the 20 degree tilt as the most likely option. **PEI Report Volume 3, Appendix 14-C: Glint and Glare Assessment** assessed the tilt of 5 and 45 degrees from horizontal.

Single Axis Tracker Configuration

3.3.10 For a single axis tracker configuration, the strings of PV will be secured on single axis tracker mounting structures that are configured in rows generally orientated north-south and which will tilt east to west. The panels will therefore move from east to west during the course of the day operated by a small motor, so that they are most angled (up to 60 degrees) at the start of the day facing east, moving gradually into a flat, horizontal position when the sun is at its highest point in the sky for the day, and then gradually turning to an angle position closer to the vertical (up to 60 degrees) facing west at the end of the day. The panels will then reverse this process at the end of each day, returning to a horizontal position where they remain overnight. Each string of panels is fitted with a light meter which dictates the pace of movement; the strings across the Principal Site therefore move at slightly different times throughout the day. The noise from each string's tracker motor will be less than 40db at a 1m distance. Indicative conservative calculations indicate that a tracker motor operates for a total of 20 minutes during the daytime period, in episodes of 2 minutes, plus 2 episodes of 6 minutes during the early morning and early evening periods to move from and to stow position respectively.

Table 3-1: Design Parameters for the Solar PV Infrastructure

Proposed Development Component	Parameter Type	Applicable Design Parameter
PV tables (i.e. the mounting structure) and PV panels	Maximum height of solar PV panels (also known as modules) above ground level (AGL)	The maximum height of the highest part of the PV panel will be 3.5m AGL.
	Minimum height of the solar PV panels	The minimum height of the lowest part of the PV Panel will be 0.8m AGL.
	Indicative slope and orientation of the PV Tables from the horizontal	Fixed south facing: The PV tables will slope towards the south, at a fixed angle of between 5 and 45 degrees from horizontal. Single axis tracker: The solar PV tables will be secured on single axis trackers that are configured north-south with varying azimuths (azimuth between -40° degrees and 40° degrees) and will track +/-60 degrees from horizontal, where the panels will turn from east to west during the course of the day.
	Indicative number of panels	Fixed south facing: ~620,000 panels Single axis trackers: ~570,000 panels
	Indicative panel dimensions	2.4m x 1.3m
	Indicative panel generating capacity	670W
	Indicative PV panel colour	The PV panels will be dark grey or black in colour.
	Frame type	Typically, anodised aluminium.
	PV mounting structure	Mounting structure will be galvanised steel frames.
	PV foundation	Typically, will be galvanised steel piles driven or screwed into the ground. Indicative maximum depth of 2m for south facing fixed strings and indicative maximum depth

Proposed Development Component	Parameter Type	Applicable Design Parameter
		of 4m for single axis tracker strings depending upon ground conditions and subject to archaeological and geotechnical surveys. In archaeologically sensitive areas solar PV panels may be mounted on concrete blocks, subject to further archaeological investigation and agreement with the relevant stakeholders.
Solar PV Array Area	Location	The proposed area for the Solar PV Array (**PEI Report Volume 2, Figure 3-2A** and **Figure 3-2B**).
	Indicative separation distance between rows of PV Tables	Fixed south facing: 2–7m Single axis tracker: 2.5–5m (see **Table 3-2**)

Panel Mounting Structures

3.3.11 Each string of PV panels will be mounted on an anodised aluminium frame. In all fixed panel options, the frames are usually supported by galvanised steel poles typically driven 1m–2m into the ground, extending up to 4m depth for the single axis tracker configuration depending upon ground conditions and subject to archaeological and geotechnical surveys. This is the most common solution on existing UK solar farms.

3.3.12 In archaeologically sensitive areas solar PV panels may be mounted on concrete blocks, subject to further archaeological investigation and agreement with the relevant stakeholders.

3.3.13 The PV panels across the Principal Site would be mounted on structures with a minimum clearance above ground level of 0.8m. These dimensions are indicative at this stage as the final elevations of the frames will be influenced by various design factors such as local topography, flood risk, drainage design and configuration however they will be no taller than 3.5m AGL as stated in **Table 3-1**.

Fixed South Facing Configuration

3.3.14 The separation distance (inter-row distance) between each row of frames would be a minimum 2m for a fixed south facing configuration, dependent upon angle and length of slope, to allow for appropriate maintenance and to minimise inter-row shading.

3.3.15 A photograph of a typical south facing fixed configuration is provided in **Plate 3-3**.

Plate 3-3: Solar Panels with South Facing Configuration

Single Axis Tracker Configuration

3.3.16 For a single axis tracker arrangement, indicative minimum and maximum design parameters are shown in **Table 3-2** and illustrated on **Plate 3-4** (which identifies each item with the corresponding ID).

Table 3-2: Indicative Parameters for Single Axis Tracker Configuration

ID	Item	Minimum Value	Maximum Value
A	Pitch (m)	4.0	6.0
B	Interrow distance (m)	2.5	5
C	Clearance at maximum tilt (m)	0.8	1.4
D	Height at maximum tilt (m)	2.9	3.5
E	Axis height (m)	1.9	2.5
F	Ground penetration (m)	N/A	4.0
G	Tilt (°)	0° (horizontal)	+/-60° (east and west)

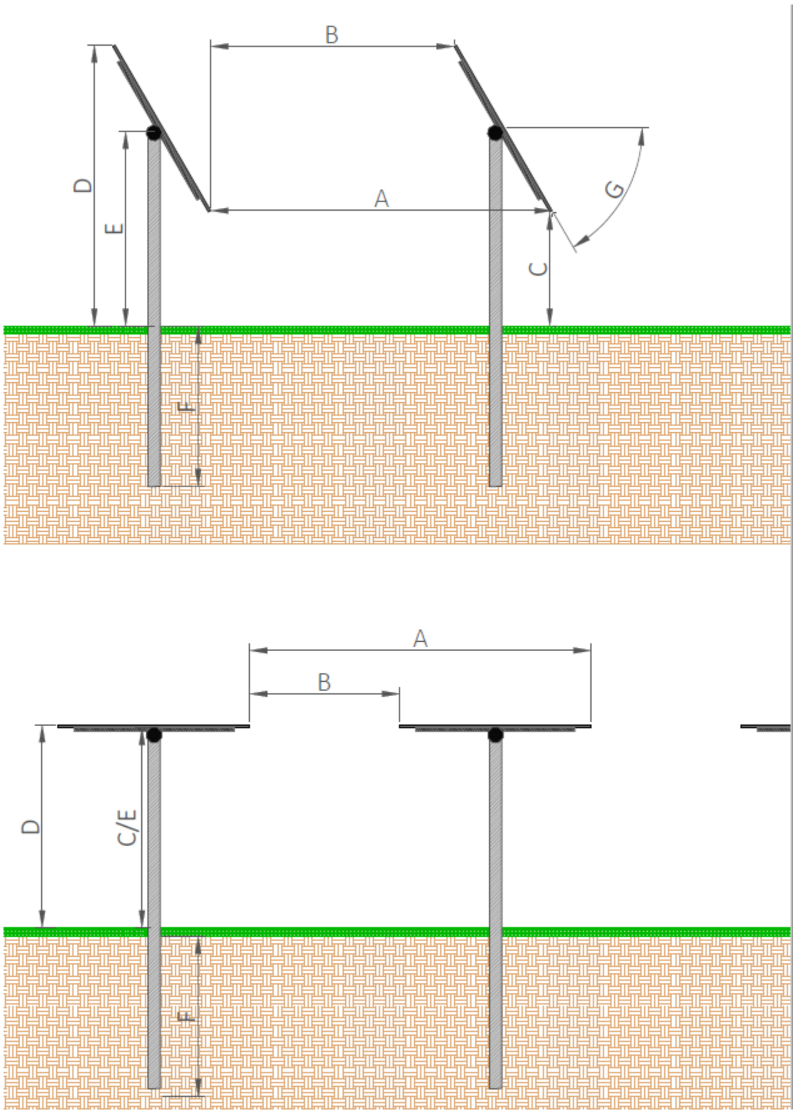

Plate 3-4: Illustrative Section of PV Strings

Supporting Infrastructure (Inverters, Transformers, and Switchgear)

3.3.17 The supporting infrastructure comprises inverters, transformers, and switchgear, which will be mounted on concrete foundations. This infrastructure is commonly grouped together and termed ‘Solar Stations’. They fulfil a number of functions, namely converting the direct current to alternating current (inverters) and stepping up the voltage (transformers), as well as containing isolators (switchgear) and monitoring equipment.

3.3.18 A Solar Station typically comprises the inverter, transformer, and switchgear (although the inverters can alternatively be located at the PV panels rather than in this centralised configuration, as described further below). These components may be located next to one another individually, as illustrated in **Plate 3-5** or enclosed together in a single container, as illustrated in **Plate 3-6**. The containers are typically externally finished in keeping with the prevailing surrounding environment. The containers would typically be mounted on adjustable legs on an area of hardstanding. Areas where Solar Stations will be located within the Principal Site are referred to as Solar Station Compounds.

3.3.19 The illustrative layout (**PEI Report Volume 2, Figure 3-2A and Figure 3-2B**) shows that there would be approximately 84 Solar Station Compounds located throughout the Principal Site. A Solar Station Compound will comprise up to two inverters, a transformer, and switchgear which can be grouped together or distributed throughout the Principal Site.

3.3.20 A reasonable worst-case scenario has been assessed based on the maximum parameters outlined in **Table 3-3**. It is anticipated that Solar Stations would be installed on compacted gravel and concrete bases.

Plate 3-5: Solar Station Compound with Solar Stations Housed in Several Units

Solar Station Housed in One Unit – Exterior

Solar Station Housed in One Unit – Interior

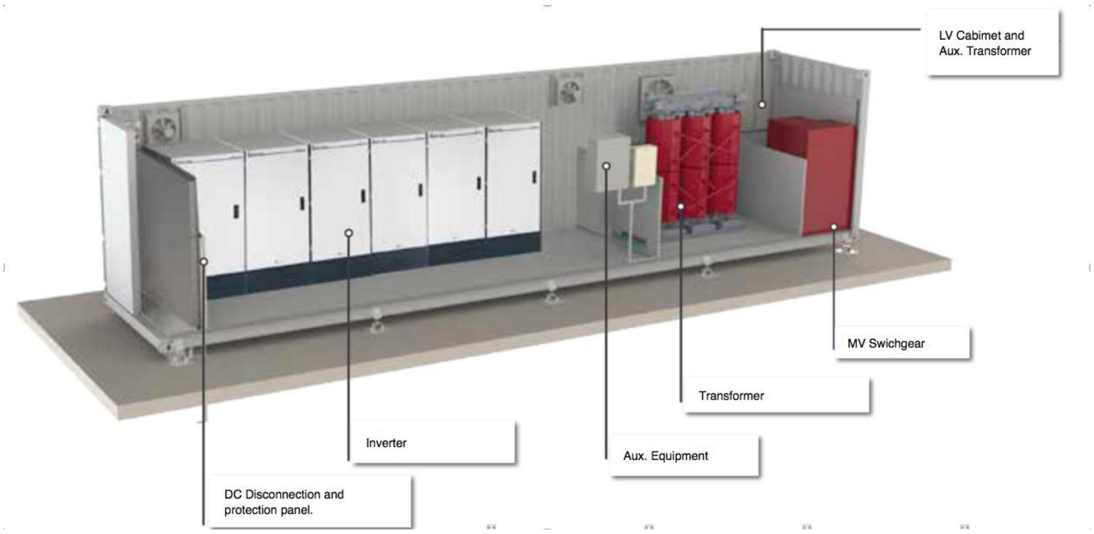

Plate 3-6: Solar Station Housed in One Unit

(Image reproduced courtesy of Power Electronics)

Inverters

3.3.21 The inverters convert the DC current to AC current, which is the format used by the national distribution network. There are two options for solar farms: a central inverter as part of the Solar Station, or string inverters, which are described further below.

3.3.22 String inverters are connected to the rear of the solar PV tables for south facing fixed configurations, as shown on **Plate 3-7**, and may be protected by wire mesh if sheep are grazing in the fields. For single axis tracker panels, the string inverters would be attached to a separate, parallel metal frame located behind each string of panels.

Plate 3-7: Typical string inverter

(Image reproduced courtesy of Huawei)

3.3.23 Where central inverters are used instead, as part of Solar Stations, these are larger and fewer of them are required. They would be located at regular intervals amongst the PV arrays. The Proposed Development will require approximately 170 central inverters (i.e., two at each Solar Station), measuring approximately 6m x 2.5m and up to 3m in height. The containers are typically externally finished in keeping with the prevailing surrounding environment. The containers would typically be mounted on adjustable legs on an area of hardstanding.

3.3.24 The design parameters are outlined in **Table 3-3**.

Transformers

3.3.25 Transformers are required to step up the voltage of the electricity generated before it reaches the Onsite Substation. It is anticipated that there will be approximately 84 transformers.

3.3.26 The footprint of the transformers will typically be 12.5m x 2.5m and 3m in height. An example transformer cabin is shown in **Plate 3-8**, although these are typically externally finished in keeping with the prevailing surrounding environment.

3.3.27 The design parameters are outlined in **Table 3-3**.

Plate 3-8: Typical transformer cabin (including switchgear)

(Image reproduced courtesy of Selma)

Switchgear

3.3.28 Switchgear are the combination of electrical disconnector switches, fuses or circuit breakers used to control, protect and isolate electrical equipment. They are used to de-energise equipment to allow work to be done and to clear faults downstream.

3.3.29 Switchgear are typically housed within a container with a typical footprint of 6.5m x 2.5m and 3m in height. Switchgear containers will be located either adjacent to the transformer containers or contained within the central inverter container. It is anticipated that approximately 300 switchgears could be located within the Principal Site, with two to four switchgear located at each Solar Station.

3.3.30 The design parameters are outlined in **Table 3-3**.

Table 3-3: Design Parameters for the Supporting Infrastructure (Inverters, Transformers, and Switchgear)

Proposed Development Component	Parameter Type	Applicable Design Parameter
Solar Station	Type	A Solar Station will comprise two inverters (unless string inverters are used), a transformer, and several switchgear, which can be grouped together or distributed throughout the Principal Site.
	Indicative number of Solar Stations	Approximately 84, subject to detailed design.
	Indicative dimensions	The Solar Stations as described above will be located within the Solar Station Compounds measuring approximately 33m x 27m to allow for appropriate spacing between components to comply with requirements of the local fire service.
	Colour	Externally finished in a colour in keeping with the prevailing surrounding environment.
Inverters (these convert the direct current electricity collected by the PV panels into alternating current)	Type of inverter	Central or string inverters. The former is located at the Solar Stations, whereas the latter are located next to each PV row or attached to the rear of the PV tables.
	Indicative dimensions of inverters	For central inverters the maximum parameters will be 6m by 2.5m and up to 3m in height. For string inverters, the maximum parameters will be 1.5m length by 0.5m width by 1m in height. For the south facing fixed arrangement these are small enough to be mounted underneath the panels. For the single axis tracker arrangement these would be fitted on a parallel structure behind the panels.
Transformers (these control the voltage of the electricity generated before it reaches the Onsite Substation)	Type of transformer	Transformers may be standalone units or pre-assembled with inverters and switchgear to form a single contained unit (i.e. enclosed).
	Indicative dimensions of transformers	The footprint of the transformers will typically be up to 12.5m x 2.5m and 3m in height.
	Colour of transformers	Typically finished in a colour in keeping with the prevailing surrounding environment, often with a grey or green painted finish

Proposed Development Component	Parameter Type	Applicable Design Parameter
Switchgear (this is a combination of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment)	Type of switchgear	The switchgear may be an individual standalone unit within its own enclosure or may be pre-assembled with transformers and inverters to form a single contained unit.
	Indicative dimensions of switchgear	Maximum footprint of 6.5m x 2.5m and 3m in height.
	Colour of switchgear	Typically finished in grey.

Battery and Energy Storage System

3.3.31 The Proposed Development will include an associated Battery and Energy Storage System (BESS). The BESS will allow the storage of energy generated by the solar panels at times of low demand and release to grid at times when demand is high or when solar irradiance is lower, known as load shifting. The BESS will also have the ability to import power from the grid directly to allow the BESS system to help support the grid through grid balancing mechanisms.

3.3.32 The precise number of individual battery storage containers will depend upon the duration of required energy storage; however, it is expected that there would be approximately 480 megawatt hours (MWh) of BESS capacity, which equates to approximately 300 batteries either distributed throughout the Site (referred to as 'DC-coupled' arrangement) and located alongside the Solar Stations, or located at a single BESS Compound (referred to as 'AC-coupled' arrangement). The 480MWh BESS capacity could be fully charged by only 2 hours of peak production of the Proposed Development.

3.3.33 The typical dimensions of the battery containers would measure approximately 6.5m x 2.5m and 3m in height (same for either AC- or DC-coupled arrangement). The containers would be located on areas of hard standing, with a minimum clearance of 0.1m beneath the container and the hardstanding. The battery containers have been spaced with a minimum 3m clearance from each other. This may be reduced for the DCO application if the National Fire Chief Council safety guidance is updated, as expected.

3.3.34 The BESS switchgear and control room would be located alongside the battery containers and will have a maximum dimension up to 4.5m in height, and 12.5m by 2.5m footprint.

3.3.35 The containers are typically externally finished in keeping with the prevailing surrounding environment, often utilising a green painted finish.

3.3.36 In case of a DC-coupled BESS option, the battery containers will be located within the Solar Station Compounds, up to four BESS container per Solar Station Compound. The BESS Compound area shown on **PEI Report Volume 2, Figure 3-2A** and **Figure 3-2B** in this case will be filled with PV panels.

3.3.37 In case of AC-coupled BESS option, all battery containers and the inverters, transformers, and switchgear associated with the BESS will be located within the BESS Compound, while the inverters, transformers and switchgear associated with the PV panels will be located within the Solar Station Compounds.

3.3.38 It is anticipated that emergency fire water would be stored within onsite water tanks and allowance has been made for fire water storage. The ES will contain details of the water supply (see Utilities below), tank dimensions and storage capacities. A Framework Battery Safety Management Plan will be prepared as part of the DCO application.

3.3.39 The design parameters for the BESS are outlined in **Table 3-4**.

Table 3-4: Design Parameters for the Battery Energy Storage System

Proposed Development Component	Parameter Type	Applicable Design Parameter
Battery Energy Storage System	Type and indicative dimensions	DC-coupled option: the BESS units will be next to the Solar Stations, in a common compound each of which will be approximately 33m by 27m in footprint. AC-coupled option: the BESS containers will be located at a centralised BESS Compound. The BESS Compound footprint will be approximately 400m by 200m.
	Foundations	Concrete base or monolith plinth. Maximum depth of 1m.
Battery Energy Storage System (BESS) Battery Containers	Dimensions	The typical dimensions of the battery containers would measure approximately 6.5m x 2.5m and 3m in height. The containers would be located on areas of hard standing, with a minimum clearance of 0.1m beneath the container and the hardstanding.
	Colour	The containers are typically externally finished in keeping with the prevailing surrounding environment.
	Heating, ventilation, and air conditioning (HVAC)	Integrated into BESS container.
	Fire Management	Integrated into BESS container.
	Foundation	Concrete base or monolith plinth. Maximum depth of 1m.
Battery Energy Storage System (BESS) Switchgear and Control Room	Dimensions	Maximum dimensions: Up to 4.5m in height, 12.5m by 2.5m footprint.
	Colour	Typically finished in white, green or grey.

Onsite Cabling

3.3.40 Low voltage cabling between PV panels and the inverters (typically via 1.5/1.8kV cables) will typically be located above ground level (along a row of racks), fixed to the mounting structure, and then underground (between solar PV array tables and in the central inverter's and or transformer input). Medium voltage cables (around 33kV) are required between the transformers, switchgear and the Onsite Substation. These buried interconnecting cables will be located within the Solar PV Array Areas and within the Interconnecting Cable Corridors between the Solar PV Array Areas. The trench will typically be up to 1m wide with a maximum depth of 1.2m and will be dependent on the method of installation, ground conditions and number of cables laid in parallel. Subject to engagement with utility providers there may be a requirement for horizontal directional drilling (HDD) within the Principal Site to cross beneath some existing buried utilities, watercourses and roads. At this preliminary stage, it is expected that HDD will be required for the onsite cabling to cross under the A46 and the River Witham.

3.3.41 Data cables will be required throughout the Principal Site to allow for the monitoring and control during operation, such as the collection of data on solar irradiance from pyranometers. The data cables would typically be installed within the same trench and alongside the electrical cables.

3.3.42 The existing above ground powerlines across the Principal Site are not proposed to be altered by the Proposed Development, and the appropriate offsets from the above ground powerlines will be maintained.

3.3.43 In identified archaeologically sensitive areas, cables will be installed to avoid or minimise disturbance below ground level.

3.3.44 The design parameters are outlined in **Table 3-5**.

Table 3-5: Design Parameters for the Onsite Cabling

Proposed Development Component	Parameter Type	Applicable Design Parameter
DC cabling	Type	DC cabling connect the panels to the Solar Stations. They will be secured to the back of the PV array tables and will be gathered in DC combiner boards before being routed to the local Solar Stations where they will be connected to the inverters.
Medium Voltage Distribution Cables (Interconnecting cables)	Type	Medium voltage cables, which transmit electricity from the Solar Stations or BESS to the Onsite Substation. All cable circuits will be routed underground in trenches via the interconnecting corridors to the Onsite Substation.

Proposed Development Component	Parameter Type	Applicable Design Parameter
	Indicative cable trench dimensions	Maximum dimensions: 0.8–1.2m depth, and 1.2–5m wide depending on the number of circuits within the trench.

Onsite Substation

3.3.45 A new Onsite Substation will be located within the Principal Site which will include transformers, switchgear and metering equipment required to facilitate the import and export of electricity to the National Grid.

3.3.46 The substation would have up to three transformers. The Onsite Substation compound would have a maximum footprint of up to 140m x 100m in plan and up to 13.5m in height. These maximum dimensions may be refined downwards as design and environmental assessment work continues.

3.3.47 The Onsite Substation compound would also include a warehouse and storage building with a maximum footprint of 36m by 15m and a height of 7.2m and a control building, which would be up to 20m x 20m in plan, and up to 6m in height. This will include office space and welfare facilities as well as operational monitoring and maintenance equipment.

3.3.48 The design parameters are outlined in **Table 3-6**.

Table 3-6: Design parameters for the onsite substation

Proposed Development Component	Parameter Type	Applicable Design Parameter
Onsite Substation	Indicative dimensions	The substation would have up to three transformers and would have a maximum footprint of up to 100m x 140m in plan and up to 13.5m in height.
	Location	As shown in **PEI Report Volume 2, Figure 3-2A and Figure 3-2B**.

3.3.49 The Onsite Substation will be connected to the Solar Stations and BESS via Interconnecting Cables in order to collect electricity (at 33kV) from those components of the Proposed Development. The Onsite Substation will convert the electricity to 400kV for onward transmission to the point of connection at the proposed Navenby Substation via the Grid Connection Cable. The Onsite Substation will also be able to import excess electricity from the grid for storage within the BESS and subsequent export into the grid when there is a need for electricity.

Electricity Export and Point of Connection to the National Electricity Transmission System

3.3.50 The electricity generated by the Proposed Development is expected to be exported via a 400kV Grid Connection Cable between the Onsite Substation and a new National Grid 400kV substation in the Navenby area (not part of this DCO application).

3.3.51 The Grid Connection Cable will be installed using an open trench method requiring a 30m to 40m working width, with trench widths approximately 3m wide and up to 3m deep. Where other specific techniques are required such as micro-tunnelling, boring, or horizontal directional drilling (HDD) wider working areas (up to 60m wide) may be required, for example to avoid a sensitive watercourse, this will be investigated prior to submission of DCO application. At this preliminary stage it is anticipated that the Grid Connection Cable crossing of the River Brant will be implemented using HDD.

3.3.52 The current proposed Cable Corridor is shown in **PEI Report Volume 2, Figure 1-2**. Further studies and assessments will continue to be undertaken prior to the DCO application submission and during the detailed design stage post-consent to refine this corridor and to determine a narrower Cable Corridor that meets the objective of minimising environmental and social impact. The alignment of the connection may be refined following statutory consultation following National Grid's consultation in September 2024 of the precise location of its proposed new substation, into which the Proposed Development will connect.

3.3.53 The design parameters for the Cable Corridor are outlined in **Table 3-7**.

Table 3-7: Design parameters for the Cable Corridor

Proposed Development Component	Parameter Type	Applicable Design Parameter
Grid Connection (from Onsite Substation to National Grid Connection at Navenby substation)	Max width (construction)	The approximately 10km cable corridor is expected to require a 30m to 40m wide working area for the purposes of construction with a small number of wider areas up to 60m width for example at the location of any required HDD entry and exit pits. The cable route will be located within the Cable Corridor described below.
	Max depth (construction)	For open trench excavation, up to 3m below ground level subject to design and ground conditions, with a minimum cover of 0.9m for the cable. For horizontal directional drilling, a minimum 5m depth under watercourses subject to design and ground conditions.

Proposed Development Component	Parameter Type	Applicable Design Parameter
National Grid Connection	Point of Connection	At the National Grid Substation proposed in the Navenby area.

Fencing, Security, Lighting and Ancillary Infrastructure

3.3.54 A fence will enclose the operational areas of the Proposed Development – the Solar PV Array Areas, the Onsite Substation and the BESS Compound.

3.3.55 The fence is likely to be a stock proof mesh-type security fence with wooden posts and approximately 2m in height. Pole mounted closed circuit television (CCTV) systems installed at a height of up to 3.5m are also likely to be deployed around the perimeter of the operational areas facing along the fence line and into the Site, as illustrated in **Plate 3-9**. Access gates will be of similar construction and height as the perimeter fencing. Clearances above ground or mammal gates will be included to permit the passage of wildlife.

3.3.56 To comply with British Standard (BS) EN 62271-1:2017 (Ref 3-2) applicable to the Proposed Development, if outdoor transformers are used, they will be surrounded by a secure wire mesh fence or metal palisade fence. These will only be located in Solar Station Compounds. This fence is likely to be 1.8m to 2.5m in height. In addition, the Onsite Substation and the BESS Compound would be surrounded by a secure metal palisade fence up to 2.5m in height.

3.3.57 The inward facing CCTV cameras would typically use night-vision technology with a 50m range, which would be monitored remotely and minimise the need for night-time lighting. No areas of the Proposed Development are proposed to be continuously lit. For security requirements, operational lighting would include Passive Infra-red Detector (PID) systems which would be installed around the perimeter of the Proposed Development.

Plate 3-9: Example of mesh stockproof fencing and a metal perimeter CCTV pole

3.3.58 The lighting of the primary substation would be in accordance with health and safety requirements, particularly around any emergency exits where there would be motion sensor triggered lighting, similar to street lighting, that would operate from dusk. There would be low level lighting on specific operational units that would operate, when triggered by motion sensors, from dusk. All lighting would seek to limit any impact on sensitive receptors following guidance from the Bat Conservation Trust among others.

3.3.59 Lighting sensors for security purposes would be implemented on other critical electrical infrastructure. No areas are proposed to be permanently lit.

3.3.60 The design parameters are outlined in **Table 3-8**.

Table 3-8: Design Parameters for the Fencing, Security and Ancillary Infrastructure

Proposed Development Component	Parameter Type	Applicable Design Parameter
Fencing and security	Maximum Height	Maximum fence height will be 2.5m
	Dimensions	Maximum parameters: 20m by 20m footprint and 6m in height, within the

Proposed Development Component	Parameter Type	Applicable Design Parameter
Control building and Office		footprints of the Onsite Substation and BESS Compound.
	Materials	It is assumed the control building and office would be constructed with brick facades.
	Foundations	<2m below ground level
Warehouse and storage building	Dimensions	Maximum parameters: 36m by 15m and 7.2m in height.
	Materials	It is considered these buildings could have brick of sheet metal facades.
	Foundations	<2m below ground level

Site Access and Access Tracks

3.3.61 Site access optioneering is ongoing. At this preliminary stage it is anticipated that during construction there will be approximately 19 site access points which would provide access to an internal network of access tracks enabling access to each field parcel. During operation some of these accesses will remain in use, or will be replaced by operational access points in different locations. In addition, during operation there will be three dedicated emergency accesses into the Principal Site. Currently considered access proposals are shown on **PEI Report Volume 2, Figure 3-1**, and further described in **PEI Report Volume 3, Appendix 13-E: Access Appraisal Report**.

3.3.62 The internal access tracks would be constructed across the Principal Site and are shown on **PEI Report Volume 2, Figure 3-2A** and **Figure 3-2B**. These would typically be 5m wide with passing bays provided as required. Initially at each of the main access points, access tracks would be required to be 6m wide on approach to the construction compounds to facilitate two-way Heavy Goods Vehicle (HGV) traffic. The internal access tracks will likely be constructed of compacted stone or gravel with excavation kept to a minimum, or for secondary tracks left as grass. Where drainage is required a ditch or a swale may be located downhill of the internal access track to control any potential for surface water run-off.

Surface Water Drainage

3.3.63 A Framework Drainage Strategy will be developed alongside the impact assessment outlining how surface water will be managed during operation of the Principal Site in order to prevent any increase in flood risk. This will be developed into a detailed drainage strategy prior to construction. It will provide measures to manage drainage from new infrastructure required by the Proposed Development (e.g. PV panel arrays, access tracks and areas of hardstanding across the Principal Site) and manage any required changes to existing land drainage arrangements. As an additional mitigation measure, edge swales will be provided to capture excess runoff from the neighbouring PV areas. The existing surface water flood risk to properties along the Avenue will be reduced by the drainage proposals, thereby providing betterment. Preliminary Drainage Strategy is provided in **PEI Report Volume 3, Appendix 9-D**.

3.3.64 The design of new drainage systems will be based on the Flood Risk Assessment (FRA), the preliminary results of which are provided within **PEI Report Volume 1, Chapter 9: Water Environment**.

3.3.65 Infiltration drainage design will be in accordance with Building Research Establishment (BRE) Digest 365: Soakaway Design (Ref 3-3).

3.3.66 During construction, an adequate temporary drainage system will be in place and maintained throughout the construction phase, as described in **PEI Report Volume 3, Appendix 3-A: Framework CEMP**.

Biodiversity and Landscaping

3.3.67 The Proposed Development will involve new planting, field boundary enhancement and planting of seed mixes within the Solar PV Array Areas and within the wider Principal Site. Planting will also be used to provide screening, mitigation for wildlife, and habitat enhancement, as illustrated in **Plate 3-10**. The planting would increase biodiversity and contribute to the Proposed Development achieving Biodiversity Net Gain (BNG) in line with the principles in the Environment Act 2021, National Planning Policy Framework and local planning policy: Central Lincolnshire Local Plan (Ref 3-9). Further information is provided within **PEI Report Volume 1, Chapter 8: Ecology and Nature Conservation** and **Chapter 10: Landscape and Visual Amenity**.

3.3.68 The Principal Site has been designed to fit within the network of Public Rights of Way (PRoW) and existing permissive paths in the area, with additional permissive paths proposed to further enhance the local connectivity. It is anticipated that sections of three permissive paths (LL|TOTH|13/1, LL|Aubo|12/2 and LL|Aubo|10/1) will require minor permanent diversion around the PV areas. PRoW and PRoW diversions, existing and proposed permissive paths are shown in **PEI Report Volume 2, Figure 3-3: Proposed Permissive Paths**.

Plate 3-10: Image showing enhanced planting surrounding the boundary of a solar PV farm

(AECOM, 2021)

3.4 Construction

Construction Programme

3.4.1 The construction phase is anticipated to take 24 months if multiple construction teams are mobilised simultaneously, or 30 months if it is built out sequentially. Subject to being granted consent, construction is anticipated to start in 2031 to enable completion for the agreed connection date, 2033.

3.4.2 The potential for an earlier start date would be discussed with National Grid following receipt of any DCO consent, in the event National Grid can facilitate connection earlier than currently offered date.

3.4.3 The construction period could be longer in duration however these timings have been used within the PEI Report where they allow for worst-case assumptions in the technical assessments presented in **Chapters 6** to **15, PEI Report Volume 1**, for example by maximising predicted daily traffic flows and the amount of construction activity occurring at any given time. An exception to this is where the use of a shorter-duration construction period may over-estimate the number of jobs during peak construction; however, as explained in **PEI Report Volume 1, Chapter 12: Socio-Economics and Land Use**, the overall amount of construction activity over the construction period and therefore the associated employment and spending benefits of the Proposed Development overall would remain unchanged. The chapters of the PEI Report each provide clarification of whether delaying or extending the construction period (and knock-on changes to the decommissioning date) would lead to changes in the outcome of the assessment provided.

Construction Activities

3.4.4 The types of construction activities that are anticipated to be required include:

a. Site preparation:
   i. Delivery of construction materials, plant and equipment;
   ii. The establishment of the temporary construction compound(s);
   iii. The upgrade of existing tracks and access roads and construction of new tracks required;
   iv. The upgrade or construction of crossing points (bridges/culverts) over drainage ditches; and
   v. Marking out location of the infrastructure.

b. Principal Site construction:
   i. Delivery of construction materials, PV panels, BESS, cabling, plant and equipment;
   ii. Erection of panel mounting structures;
   iii. Mounting of panels;
   iv. Installation of electric cabling;
   v. Installation of transformer containers;
   vi. Installation of battery storage units;
   vii. Construction of substation compound; and
   viii. Construction of onsite electrical infrastructure to facilitate the import and export of generated electricity.

c. Testing and commissioning; and

d. Reinstatement, landscaping, planting and habitat creation.

3.4.5 The Environmental Statement (ES) to be submitted with the DCO application will provide further details of the proposed construction activities, their anticipated duration, along with an indicative programme.

Principal Site Construction

3.4.6 The following activities will be undertaken to install the solar PV panels:

a. Import of components to site;

b. Piling and erection of panel mounting structures (some panels may be mounted on concrete blocks subject to archaeological survey and agreement with the relevant stakeholders);

c. Mounting of panels (this will be undertaken by hand);

d. Installation of Solar Stations and BESS (DC-coupled option) (cranes will be used to lift equipment into position);

e. Trenching and installation of Interconnecting Cables; and

f. Site reinstatement, mitigation planting and habitat creation.

400kV Cable Connection to Navenby Substation

3.4.7 The following activities will be undertaken to construct the 400kV cable connection:

a. The establishment of mobilisation areas and running tracks;

b. Temporary construction compounds (to be located on or near the cable route, which are yet to be finalised);

c. Stripping of topsoil in sections;

d. Trenching in sections;

e. Appropriate storage and capping of soil;

f. Appropriate construction drainage with pumping where necessary;

g. Sectionalised approach of duct installation;

h. Excavation and installation of jointing pits (areas where sections of cable are joined together);

i. Cable joint installation;

j. Cable pulling;

k. Implementation of crossing methodologies for watercourses, infrastructure (including roads and rail), and sensitive habitats (e.g. Horizontal directional drilling, cable bridging);

l. Testing and commissioning; and

m. Site reinstatement.

Onsite Substation and **BESS Compound**

3.4.8 The following activities will be undertaken to construct the Onsite Substation and BESS Compound (AC-coupled option):

a. Topsoil strip and ground levelling;

b. Groundworks including piling and drainage installation;

c. Construction of foundations;

d. Installation of electric cabling;

e. Import of components to site;

f. Installation of busbar, circuit breaker, isolators, earthing switch and transformers at the Onsite Substation;

g. Installation of batteries, transformers, inverters and switchgear at the BESS Compound;

h. Installation of office, storage areas and warehouse; and

i. Site reinstatement and mitigation planting.

Testing and Commissioning

3.4.9 Commissioning of the Proposed Development will include testing and commissioning of the process equipment. Commissioning of the solar PV infrastructure will involve mechanical and visual inspection, electrical and equipment testing, followed by commencement of electricity supply into the grid. Individual sub-systems will be commissioned separately, with each having its own procedures and prerequisite lines, and it may be necessary to commission these elements separately or at the same time, depending on the end technology utilised at the time of construction.

3.4.10 This process will take place prior to operation of the Proposed Development which is anticipated to commence in 2033.

Construction Staff

3.4.11 At the peak of construction, which is currently expected to be during 2032, it is estimated that a maximum of up to 600 workers will be required on site per day. On average the construction is anticipated to require 350 workers per day, with 25 allocated to the works on the Grid Connection Cable. This number will be less at other times of the construction phase and if construction is carried out over a slightly longer period than the anticipated 24 months.

Construction Hours of Work

3.4.12 The core working hours will be 07:00 to 19:00 Monday to Friday, and 07:00 to 13:00 on Saturday, year-round, although there is the possibility of shorter hours in the months with reduced daylight hours. There will be no works on Sundays and Bank Holidays. Some works activities may need to occur out of these hours/times due to activities requiring to be undertaken continuously (such as HDD and cable jointing). Where work outside of times is necessary prior notification will be provided to the relevant planning authority.

3.4.13 Additionally, quiet non-intrusive works such as the installation of PV panels may take place over longer periods during the high summer and other quiet non-intrusive works such as electrical testing, commissioning and inspection may take place over longer periods throughout the year.

Security

3.4.14 Site security during construction will be managed by the contractor(s). A security perimeter fence will be implemented early in the construction phase to secure the Site. The site security fencing will remain in place throughout the duration of the construction period. Any storage of materials will be kept secure to prevent theft of vandalism. A safe system for accessing the materials storage areas would be implemented by the contractor(s).

3.4.15 There will be designated security staff during construction who will manage the Site Boundary and patrol the perimeter.

Construction Traffic

3.4.16 An access strategy will be prepared as part of the DCO application to determine appropriate access during construction, operation, and decommissioning. Currently considered access proposals are shown on **PEI Report Volume 2, Figure 3-1**, and further described in **PEI Report Volume 3, Appendix 13-E: Access Appraisal Report**. At this stage it is anticipated that there will be 12 access points for the Principal Site, and additional seven access points for the Cable Corridor.

3.4.17 It is expected that during construction phase there will be a peak of around 50 HGV deliveries per day (100 HGV movements per day) across the regional road network attributed to the Principal Site, with an average of 35 HGV deliveries per day (70 HGV movements per day) throughout the duration of the construction phase. For the Grid Connection Cable, there is anticipated to be eight HGV deliveries per day (16 HGV movements per day), occurring at the same time as the deliveries for the Principal Site. It is also anticipated that there would be two to three abnormal indivisible loads deliveries in total to deliver the transformers for the Onsite Substation. These vehicles will be distributed across the local road network. Construction traffic predictions will be further refined and confirmed in the ES.

3.4.18 Temporary car parks will be provided within the proposed construction compound areas. Construction workers will then be transported around site via mini-bus, or similar.

3.4.19 A Framework Construction Traffic Management Plan (CTMP) will be developed as part of the DCO application and will contain mitigation to avoid and/or reduce impacts relating to construction traffic including the delivery of materials and transport of staff during the construction phase.

Wheel Wash Facilities

3.4.20 A self-contained wheel wash will be installed near the site exits onsite to be used by vehicles prior to exiting the site onto the public highway. For loads unable to use the fixed wheel wash, localised wheel washing would be set up to cater for these individually and as required to prevent detrimental effect to the highway.

Construction Compounds

3.4.21 There will be one main construction compound and several secondary compounds shown in **PEI Report Volume 2, Figure 3-1**. The main compound would be approximately 100m x 200m and the secondary compounds will be approximately up to 100m x 100m and will contain a site office, mobile welfare units, canteen facility, a fenced area for storage and waste skips and space for short-term parking, storage, download and a turning area. The compounds will be converted to solar PV or landscaping and mitigation/enhancement planting at the end of their use.

3.4.22 In addition to the main compound and the secondary compounds, smaller short-term use construction compounds will be located across the Site including the Cable Corridor. The location of the temporary construction compounds for the Cable Corridor will be determined at the ES stage.

3.4.23 Design parameters for the construction compounds are shown in **Table 3-9**.

Table 3-9: Design parameters for the construction compounds

Proposed Development Component	Parameter Type	Applicable Design Parameter
Construction compounds within the Principal Site	Number of compounds	There is proposed to be one main construction compound near the main trunk road the A46, there will be several smaller construction compounds around the Principal Site that would be intended to be temporary laydown areas for the construction of the solar array in that area.
Construction compounds within the Cable Corridor	Number of compounds	To be determined at the ES stage.

Storage of Plant and Materials

3.4.24 No long-term onsite storage of materials is required during the construction phase. Materials will be delivered via HGVs at regular intervals to the construction compounds and transported directly to where it is required within the Site using smaller LGVs.

3.4.25 Short term storage of materials and plant will be accommodated within the construction compounds until required.

3.4.26 Topsoil, spoil, and other construction materials will be stored outside of the 1 in 100-year floodplain extent and only moved to the temporary works area immediately prior to use.

Spoil Management

3.4.27 There will be no site wide reprofiling required; however, there will be a need to level areas in a number of locations including the Onsite Substation and BESS Compound. This is unlikely to create excess spoil and it is not expected that this would need to be removed from the Site. Spoil material is only expected to be generated from cable trenches, temporary construction compounds, internal roads, BESS, and the Onsite Substation. This will be minimal relative to the size of the Site and will be distributed over a wide area to avoid substantial local changes in topography.

3.4.28 During construction of the Grid Connection Cable, spoil will be stored temporarily within designated areas adjacent to the cable route and within the construction compounds. The spoil will be utilised to backfill the cable trenches, reinstate the temporary construction compounds and any temporary access roads. Any excess spoil will be utilised or distributed across the Site without creating substantial changes in local topography. It is not anticipated that any spoil will be removed from the Site.

Construction Lighting

3.4.29 During winter months, mobile lighting towers with a power output of 8kVA may be used during construction in isolated work areas. There will also be lighting at the main construction compounds while construction is underway.

Onsite Fuel

3.4.30 Fuel for machinery and generators will be delivered to site by a fuel truck and stored in above ground fuel storage tanks of 10–36 m^3 capacity. The fuel storage tank will be sheltered, secured from unauthorised access, and equipped with a spill protection bund capable of holding 110% of the volume of the tank. Spill kits will be available at the fuelling point and other strategic locations of the construction site to allow for prompt clean up to limit soil and water contamination. Construction workers will be trained in spill kit use.

Utilities

3.4.31 It is expected that an electricity connection to the local electrical distribution network can be obtained for the temporary construction compounds to avoid the requirement for diesel generators. The connection options will be set out and assessed within the ES.

3.4.32 Based on the assumption that each construction worker would require eight litres of water per day, a total of 1,500m^3 would be required over the construction period. Other sources of water use include wheel washers (assumed to be 500m^3 in total) and to support the preparation of concrete for use across the Site (assumed to be 25,000m^3 in total). The water will either be transported to the Site by road from an existing nearby licenced water abstraction source and stored on site in tanks of up to 10m^3 (10,000 litres) capacity or supplied through a mains connection.

Waste

3.4.33 Solid waste materials generated during construction will be segregated and stored onsite in containers of up to 30m^3 capacity prior to transport to approved, licensed third party landfill and recycling facilities. During construction, removal of waste is estimated to require up to a maximum of 400 HGV loads over a period of 12 months, which equates to an average of just over 1 HGV load per day (2 HGV movements). This will fluctuate with the largest waste numbers being the removal of pallets and recyclable cardboard during delivery of the PV panels.

Construction Environmental Management Plan

3.4.34 A Framework Construction Environmental Management Plan (CEMP) is provided in **PEI Report Volume 3, Appendix 3-A**. This describes the framework of mitigation measures to be followed, to be carried forward to a detailed CEMP to be approved under the DCO prior to construction. The aim of the CEMP is to avoid and/or reduce environmental impacts from:

a. Use of land for compounds;
b. Construction traffic (including parking and access requirements) and changes to access and temporary road or footpath diversions (if required);
c. Noise and vibration;
d. Utilities diversion;
e. Dust generation;
f. Soil removal;
g. Lighting; and
h. Waste generation.

3.4.35 The (detailed) CEMP will be produced by the Applicant following granting of the DCO and prior to the start of construction. It is expected the production of a detailed CEMP will be a Requirement attached to the DCO. The CEMP will identify the procedures to be adhered to and managed by the Applicant and its contractors throughout construction.

3.4.36 Contracts with companies involved in the construction works will incorporate environmental control, health and safety regulations, and current guidance and will ensure that construction activities maximise opportunities for the incorporation of sustainability principles and that all contractors involved with the construction stages are committed to agreed best practice and meet all relevant environmental legislation including: Control of Pollution Act 1974 (COPA) (Ref 3-5, Environment Act 1995 (Ref 3-6), Hazardous Waste (England and Wales) Regulations 2005 (Ref 3-7) and the Waste (England and Wales) Regulations 2011 (Ref 3-8).

3.4.37 Records will be kept and updated regularly, ensuring that all waste transferred or disposed of has been correctly processed with evidence of signed Waste Transfer Notes (WTNs) that will be kept onsite for inspection whenever requested. Furthermore, all construction works will adhere to the Construction (Design and Management) Regulations 2015 (CDM) (Ref 3-4).

Site Reinstatement and Habitat Creation

3.4.38 Prior to and during the construction phase, and following construction, a programme of site reinstatement and habitat creation will be implemented.

3.4.39 The Proposed Development has been designed to integrate with and, where practicable, enhance the local green infrastructure network, improving ecological connectivity across the Site. The initial proposed planting design shown in **PEI Report Volume 2, Figure 3-2A** and **Figure 3-2B** has responded to the varied character by allowing views to remain open, where tall screening would not be appropriate. Based on the preliminary layout of the Principal Site, new planting would include approximately 13km of new native hedgerows, 1.5ha of new native tree belts, and 3.1ha of orchard, in addition to hedgerow enhancement, gapping up and infill planting, and grassland under the panels and along perimeter buffers. Planting proposals will be reviewed following statutory consultation and updated for the DCO application.

3.4.40 A Framework Landscape and Ecological Management Plan (LEMP) will be prepared to accompany the ES. This document will set out the principles for how the land will be managed throughout the operational phase, following the completion of construction. The detailed Landscape and Ecological Management Plan will be produced following the granting of the DCO and prior to the start of construction and will be secured as a Requirement attached to the DCO.

3.5 Operational Activities

3.5.1 During the operational phase, activity on the Principal Site will be limited and would be restricted principally to vegetation management, equipment maintenance and servicing, periodic replacement of components, periodic fence inspection, and monitoring to ensure the continued effective operation of the Proposed Development.

3.5.2 Given the proposed 60-year operational life of the Proposed Development, there will be requirement for periodic replacement of some or all of the Principal Site elements. **Table 3-10** summarises the indicative design life of the key equipment of the Principal Site. The ES will include an assessment of the likely impact of component replacement (e.g. panels, batteries, inverters, transformers) and outline what measures will be put in place to ensure that these components are able to be diverted from the waste chain.

Table 3-10: Indicative Design Life of the Key Equipment of the Proposed Development

Equipment	Indicative design life
Solar PV panels and mounting structures	25–40 years
Inverters	10–20 years
Transformers	25–30 years
Batteries	5–15 years
Onsite Substation equipment	25–30 years

3.5.3 During operation, some of the construction access points will continue to be used in addition to the dedicated operational accesses. Furthermore there will be tree separate accesses for emergency services. Access proposals are shown in **PEI Report Volume 2, Figure 3-2A** and **Figure 3-2B**, and further described in **PEI Report Volume 3, Appendix 13-E: Access Appraisal Report**.

3.5.4 Fire suppression water at the BESS will be provided from water storage tanks on site. The DCO application will include the Framework Battery Safety Management Plan and the Framework Drainage Strategy describing the management of firefighting water.

3.5.5 During the operational phase, the Proposed Development will be serviced by a nominal number of staff (up to four permanent staff per day), predominantly undertaking day-to-day maintenance tasks. In addition, there is expected to be around two visitors per week. Staff vehicles and those used for maintenance will primarily be four wheeled drive vehicles and vans, with HGVs rarely accessing the site during the majority of the operational phase.

3.5.6 Furthermore, it is anticipated there will be additional staff attending the Principal Site when required for maintenance, the replacement of solar infrastructure and cleaning; up to a total of 20 staff per day (in addition to the four permanent staff undertaking day-to-day maintenance). Maintenance and equipment replacement activities are expected to generate in the order of 20 HGV deliveries (or 40 two-way HGV movements) per day and up to 20 staff car trips (40 two-way movements) per day. It is not anticipated that any AILs will be required during operation.

Cleaning of Panels

3.5.7 In the UK climate solar panels are largely self-cleaning and deterioration in PV system output due to dust or dirt is generally low. The requirement for, and the frequency of, cleaning of the solar PV panels due to the build-up of dust and dirt varies depending upon site specific conditions.

3.5.8 The cleaning requirements for the Proposed Development can only be accurately determined once operational, therefore, to present a worst case for the assessments presented in this PEI Report, a two-year cleaning cycle is assumed.

3.5.9 This PEI Report assumes that a tractor mounted system (currently the system typically used on UK solar farms) will be used. This also allows the water usage to be determined based on current schemes using this technology (**Chapter 9: Flood Risk, Drainage and Water Environment, PEI Report Volume 1**).

3.5.10 A tractor mounted cleaning system uses a rotating ‘car-wash’ type brush. It is anticipated that water would be brought to site in 1 m^3 (one tonne/1,000 litres (l)) intermediate bulk containers (IBCs). Individual IBCs would be mounted on the rear of the tractor to provide water supply during cleaning. Based upon cleaning water usage on similar schemes it is estimated that the cleaning of each panel will require 250 millilitres (ml) of water and that, assuming cleaning of all panels is required, the total volume of cleaning water per cleaning cycle would be 200,000 litres (200 m^3).

3.5.11 Panels would be cleaned at night when they are cool, as applying cold water to warm panels can lead to thermal shock and the risk of micro-cracks to the panel surface. Cleaning operations typically commence at sunset (after the panels have stopped tracking and have returned to their night-time horizontal position) and finish prior to the panels recommencing tracking in the morning. The cleaning operations would be lit by tractor mounted lighting which is akin to that used during night-time arable harvesting operations currently undertaken within the Principal Site. As the use of cleaning products (chemicals) can damage panels and void manufacturer's warranties, no cleaning products would be used, only water. If required, a water softener would be added to prevent wash-residue forming on the panels, this would be biodegradable and would have no impact to the environment.

3.5.12 Dry-cleaning would not be employed as the action of the dry brush and any dust present on the panel surface would likely result in the formation of micro-scratches. Such scratches would likely attract/harbour more dirt on the panel surface decreasing efficiency and also potentially voiding manufacturer's warranties.

Grazing

3.5.13 Grazing by sheep is the Applicant's preferred option for the management of the grassland created within the Solar PV Array Areas of the Principal Site. This option is therefore being explored and there are no known landowner restrictive covenants or other reasons that would prevent such use. Should grazing not be possible in some or all areas of the Solar PV Array Areas, grassland will instead be mowed.

3.5.14 Sheep grazing on solar PV facilities is successfully used in the UK and carries with it multiple benefits such as soil health improvement and biodiversity enhancement. Sheep can move safely between and under the PV panels, and shelter under the PV panels from sun or rain.

3.5.15 As grazing achieves an essential maintenance function (maintaining the grass at a low level) without the need for/cost of machinery, it is possible for solar farms to use less agriculturally productive breeds (such as heritage breeds) and to graze at a lower density than might be required if the sole aim of grazing was a high level of agricultural productivity/revenue.

3.5.16 Any potential adverse impacts of grazing will be assessed in the ES if they are considered likely to occur. However, the flock would be of a suitable size for the land available, rotated as required to ensure that no areas were overgrazed and that the land being currently grazed was sufficiently dry to support them thereby avoiding potential damage to soil structure.

3.6 Decommissioning

Design Life and Decommissioning Activities

3.6.1 The operational life of the Proposed Development is 60 years with decommissioning to start 60 years after commercial operation date; the operational life of the Proposed Development is currently anticipated to be 2033 to 2093. Decommissioning is expected to take between 24 and 30 months and would be undertaken in phases.

3.6.2 When the operational phase ends, the Principal Site will require decommissioning. All PV panels, Onsite Substation, mounting structures, inverters, transformers and BESS would be removed and recycled or disposed of in accordance with good practice and market conditions at the time. Buried cables would either be removed or left in situ.

3.6.3 The majority of the Principal Site would be returned to the landowner after decommissioning and will be available for its original use and any planting would be retained as far as practicable. Areas of landscape and biodiversity mitigation and enhancement, as well as permissive paths delivered as part of the Proposed Development, would remain up until the land is returned to the previous landowners. Following this, the landowners would choose how the land is to be used and managed.

3.6.4 The drainage of the land within the Principal Site will be checked after decommissioning. Should any agricultural drains be altered or removed, they will be restored such that agricultural activities could continue after decommissioning of the Proposed Development.

3.6.5 A Framework Decommissioning Environmental Management Plan (DEMP) will be prepared as part of the EIA and submitted with the DCO application. This will set out the general principles to be followed in the decommissioning of the Proposed Development. A detailed DEMP be prepared and agreed with the relevant authorities at that time of decommissioning, in advance of the commencement of decommissioning works, and would include timescales and transportation methods.

3.6.6 The effects of decommissioning are usually like or of a lesser magnitude than construction effects and will be considered in the relevant sections of the ES. The specific method of decommissioning the project at the end of its operational life is uncertain at present as the engineering approaches to decommissioning will evolve over the operational life of the Proposed Development.

Waste

3.6.7 The wastes generated at decommissioning will primarily be the electrical components of the Principal Site, the solar PV frames, and fencing. Wastes will be managed, recycled or disposed of in accordance with the relevant legislation and guidance at the time. Current UK-based recycling technology allows for 90% of the glass and 95% of the semiconductor materials to be extracted from waste solar PV panels for use in new solar PV panels. Wastes will be safely and securely stored at all times.

3.6.8 Removal of waste is estimated to require approximately 1,300 HGV loads over a period of 12 months, which equates to an average of eight HGV loads per day.

3.6.9 At this time, it is not possible to identify either the waste management routes or specific facilities that would be used, as these are liable to change over such a timescale. The waste types generated, and effects of decommissioning are likely to be similar or of a lesser magnitude than the construction effects.

Solar PV Array Areas

3.6.10 It is anticipated that some areas of habitat and biodiversity mitigation and enhancement within the Solar PV Array Areas may be left in-situ given they could contain protected species and so relevant licences at the time would need to be obtained for any changes.

3.6.11 It is anticipated, however, that the majority of the Solar PV Array Areas will be returned to their original use and condition after decommissioning. This would include the removal of hard standing and reinstatement of the soil profile in areas where topsoil was removed. Application of measures set out in Defra's code of practice (Ref 3-10) will ensure that the restored soils are appropriately managed allowing their quality and function to be retained upon reinstatement and that any agricultural land is restored to the same quality (ALC grade) as prior to construction. The undisturbed soils within the Solar PV Array Areas will have been removed from intensive agriculture for a long period and are expected to have achieved improvements in soil structure and carbon sequestration over that time.

Cables

3.6.12 The mode of cable decommissioning for the Grid Connection and Interconnecting Cables will be dependent upon government policy and best practice at that time. Currently, the most environmentally acceptable option is considered to be leaving the cables in situ, as this avoids disturbance to overlying land and habitats and to neighbouring communities. Alternatively, the cables can be removed by opening up the ground at regular intervals and pulling the cable through to the extraction point, avoiding the need to open up the entire length of the cable route. The impact assessment will be based on the worst-case parameters for each technical topic.

3.7 References

Ref 3-1 Planning Inspectorate (2018). Nationally Significant Infrastructure Projects - Advice Note Nine: Rochdale Envelope. Available at: https://www.gov.uk/government/publications/nationally-significant-infrastructure-projects-advice-note-nine-rochdale-envelope/nationally-significant-infrastructure-projects-advice-note-nine-rochdale-envelope

Ref 3-2 British Standards Institute (BSI) (2017) BS EN 62271-1:2017 High-voltage switchgear and controlgear. Common specifications for alternating current switchgear and controlgear. Brussels: BSI.

Ref 3-3 Building Research Establishment (BRE) (2012) Digest 365: Soakaway Design and Sewers for Adoption (7th Edition). Watford: BRE.

Ref 3-4 HMSO (2015) Construction (Design and Management) Regulations 2015. Available at: http://www.legislation.gov.uk/uksi/2015/51/pdfs/uksi_20150051_en.pdf

Ref 3-5 HMSO (1974); Control of Pollution Act 1974. Available at: https://www.legislation.gov.uk/ukpga/1974/40/pdfs/ukpga_19740040_en.pdf

Ref 3-6 HMSO (1995); Environment Act 1995. Available at: https://www.legislation.gov.uk/ukpga/1995/25/pdfs/ukpga_19950025_en.pdf.

Ref 3-7 HMSO (2016); The Hazardous Waste (Amendment) Regulations 2016. Available at: http://www.legislation.gov.uk/uksi/2016/336/made

Ref 3-8 HMSO (2014); Waste (England and Wales) (Amendment) Regulations 2014. Available at: https://www.legislation.gov.uk/uksi/2014/656/contents/made

Ref 3-9 Lincolnshire County Council, “Central Lincolnshire Local Plan 2012-2036,” Lincolnshire County Council, Lincoln, 2017.

Ref 3-10 DEFRA (2009) Construction Code of Practice for the Sustainable Use of Soils on Construction Sites. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/716510/pb13298-code-of-practice-090910.pdf