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CALL-DOWN CONTRACT

Framework Agreement with:	**AECOM Ltd ("Supplier" or "AECOM")**
Framework Agreement for:	**DFID Goods & Equipment Procurement Supplier**
Framework Agreement Purchase Order Number:	**PO 7387**
Call-down Contract For:	**Procurement of Goods and Equipment for the Solar Nigeria Borno Phase 2 expansion project ("SNB") ("Project")**
Contract Purchase Order Number:	**PO 8080**

I refer to the following:

1. The above-mentioned Framework Agreement dated 29th March 2016

2. Your proposal of 14th September 2017

and I confirm that the Department for International Development ("DFID") requires AECOM to provide the Services (as set out in Annex A), under the Terms and Conditions of the Framework Agreement which shall apply to this Call-down Contract as if expressly incorporated herein and unless expressly amended otherwise herein.

1. Commencement and Duration of the Services

1.1 The Supplier shall start the Services no later than 18th September 2017 ("the Start Date") and the Services shall be completed by 30th April 2018 ("the End Date") unless the Call-down Contract is terminated earlier in accordance with the Terms and Conditions of the Framework Agreement.

2. Recipient

2.1 DFID requires the Supplier to provide the Services to the Borno State Government, Nigeria on behalf of DFID Nigeria (the "Recipient") at the bonded warehouse Port of Lagos, Nigeria (the "Port"),

3. Financial Limit

3.1 Payments under this Call-down Contract shall not, exceed **£4,172,787.15** ("the Financial Limit") and is exclusive of any government tax, if applicable as detailed in Annex D**.**

4. DFID Officials

4.1 The Project Officer is:

[redacted], Solar Nigeria Programme Manager and Infrastructure Advisor, DFID Nigeria

4.2 The Contract Officer is:

[redacted], Procurement Officer, DFID East Kilbride

5. Key Personnel

Not used

6. Reports

6.1 The Supplier shall submit project reports in accordance with the Terms of Reference/Scope of Work at Annex A.

7. Duty of Care

All Supplier Personnel (as defined in Section 2 of the Framework Agreement) engaged under this Call-down Contract will come under the duty of care of the Supplier:

I. The Supplier will be responsible for all security arrangements and Her Majesty's Government accepts no responsibility for the health, safety and security of the Supplier's employees or property whilst travelling.

II. The Supplier will be responsible for taking out insurance in respect of death or personal injury, damage to or loss of property, and will indemnify and keep indemnified DFID in respect of:

1. Any loss, damage or claim, howsoever arising out of, or relating to negligence by the Supplier, the Supplier's Personnel, or by any person employed or otherwise engaged by the Supplier, in connection with the performance of the Call-down Contract.
2. Any claim, howsoever arising, by the Supplier's Personnel or any person employed or otherwise engaged by the Supplier, in connection with their performance under this Call-down Contract.

III. The Supplier will ensure that such insurance arrangements as are made in respect of the Supplier's Personnel, or any person employed or otherwise engaged by the Supplier are reasonable and prudent in all circumstances, including in respect of death, injury or disablement, and emergency medical expenses.

IV. The costs of any insurance specifically taken out by the Supplier to support the performance of this Call-down Contract in relation to Duty of Care may be included as part of the management costs of the project, and must be separately identified in all financial reporting relating to the project.

V. Where DFID is providing any specific security arrangements for Suppliers in relation to the Call-down Contract, these will be detailed in the Terms of Reference in Annex A.

8. Call-down Contract Signature

8.1 If the original Form of Call-down Contract is not returned to the Contract Officer (as identified at clause 4 above) duly completed, signed and dated on behalf of the Supplier within 15 working days of the date of signature on behalf of DFID, DFID will be entitled, at its sole discretion, to declare this Call-down Contract void.

For and on behalf of The Secretary of State for International Development	Name: Position: Signature: Date:
For and on behalf of AECOM Limited St George's House 5, Wimbledon, London, England, SW19 4DRT	Name: Position: Signature: Date:

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ANNEX A
Terms of Reference

Procurement of Goods and Equipment for the Solar Nigeria Borno Phase 2 expansion project

1. Introduction

The Solar Nigeria Programme (SN), funded by the UK Department for International Development (DFID), is part of DFID's strategy for North East Nigeria which has been developed in coordination with other UK Government departments. This strategy includes a focus on solar systems to supply critical power needs for health facilities, including water pumping requirements.

Borno State is suffering a major IDP crisis and its hospitals and education centres outside of the capital have very limited access to power, reducing the efficacy of health service provision. This intervention aims to provide reliable and renewable power to hospitals in locations serving large numbers of people in need of medical care.

In 2016 and early 2017, DFID, through the Solar Nigeria programme, completed work at three second tier hospitals in Borno where works finished in late-April/early-May 2017. Given the success of this initial phase of work in Borno, DFID Nigeria have received Ministerial approval for a second phase of work to include additional works in medical facilities as well as an extension of work into training institutes and village clusters.

This Call Down Contract covers the procurement for goods and equipment for medical facilities and village clusters only, covering up to 8 locations in total to be made up from the following:

- Up to six hospitals

OR

- Up to five hospitals and the teaching areas of the School of Nursing and the School of Midwifery in Maiduguri

AND

- Two village clusters

As per those listed in Table 2 of Annex B herein.

In seeking approval for funds to undertake this programme of work, DFID commissioned a suite of designs and indicative costings for solar installations at these medical facilities in December 2016. These designs are based on a modular system that can be scaled up or down to meet the required power need. These costings and designs were prepared by a contractor EmOne Energy Solutions (EmOne). Updated versions of these designs and costings form the specifications for and cost base of this call down contract. These costings and designs have been further updated in June and July 2017 following analysis and monitoring of existing installations from phase 1.

DFID Nigeria has requested AECOM to engineer, procure and install solar equipment and provide ancillary services and works in various hospital and village locations in Borno employing EmOne as subcontractor. There will be two contracts for this work as follows:

Contract 1: This Call-Down Contract under the DFID Goods and Equipment Framework agreement dated 29th March 2016 between AECOM Limited and DFID. To cover the procurement of the agreed goods and equipment, which includes delivery to the bonded warehouse where clearance is to be carried out at the Port and the provision of relevant goods insurance and associated warranties as detailed in Section 4 of this Terms of Reference.

Contract 2: Foreign and Commonwealth Office Framework 'Lot 1 – Architectural & Lead Design Consultancy' ("The Works Contracts"). To cover the scope of professional services associated with project management, inland freight and logistics, warehousing of goods, detailed design, works and quality assurance and the installation of the goods and equipment supplied under Contract 1 including associated civil and electrical engineering works. The scope and details for this are covered in a separate ToR.

Given the current levels of insecurity in the region, and the potential for a rapid change in the security and operational environment, provision will be made through this call down contract – to provide contingency planning and fall-back options for project delivery which will be agreed with DFID and any necessary changes shall be made accordingly.

2. Objective

This Terms of Reference covers procurement and delivery of goods and equipment to the bonded warehouse in order for clearance to be carried out at the Port of Lagos ("Port").

3. Recipient

The primary recipient is the Borno State Government ("the Recipient").

4. Scope of work

AECOM's role under this Call-Down Contract, together with its supply chain, will include procurement and delivery of the goods and equipment to the agreed end destination, i.e. the bonded warehouse at the Port.

4.1 Project management and quality assurance

i. Project management and oversight including development of a workplan for project delivery.

ii. Participation in site selection as far as commenting on the practicality and security of sites proposed by DFID and Borno State Government.

iii. Engagement with government, NGO, humanitarian and security services stakeholders to work to harmonise the security protocols, information and arrangements for the project delivery.

iv. Scenario planning for different combinations of health facility and village clusters to meet the potential changes required as they relate to the goods and equipment.

v. Duty of Care plan for the project; including providing project team details.

vi. Price checking and oversight of the procurement standards and processes of its supplier(s).

vii. At least monthly progress meetings with EmOne Solar

viii. Monthly progress reports to DFID

ix. Financial reporting, forecasting and billing for goods and equipment

x. Due diligence on its supplier(s) for the programme.

xi. Certain quality assurance of the plans, designs and costings provided by EmOne as part of the business case approval and any reversions thereafter as far as they relate to bills of quantities for goods and equipment, with the objective of meeting the requirements of this terms of reference.

xii. Provision of reports and documents to DFID to enable final decisions about the technical details and options for the solar installations to be made as far as they relate to bills of quantities for goods and equipment to be purchased and delivered under this Call Down Contract and to agree whether changes are necessitated.

xiii. Certain quality assurance of the detailed designs, implementation plans, bills of materials and costings for final installation at the selected sites as far as they relate to bills of quantities for the goods.

4.2 Critical Review of Technical Designs

i. Critically review the technical designs, plans and costings submitted by the EPC contractor EmOne Energy Solutions for solar installations in Borno State.

ii. Consider the suitability of these designs for their intended purpose, the installation of solar energy in remote locations in North East Nigeria.

iii. Comment on the suitability of technical options such as the battery choice, PV panel and other component choices, warranty coverage and any other relevant factors.

4.3 Design, engineering, procurement, logistics and construction

i. Negotiation of a contract with EmOne pursuant to the objectives set out by DFID for the procurement as specified in Annex D. Indicative specifications and bills of materials are attached in Annex B based on initial design work commissioned by DFID and updated in July 2017. Final designs and bills of materials are subject to change. Where the final design or bill of materials exceeds the tolerance levels outlined in the proposal in Annex D, DFID shall agree with AECOM a suitable course of action.

ii. DFID shall be responsible for the correctness of the following data and information provided by (or on behalf of) the Employer:

(a) definitions of intended purposes of the Goods or any parts thereof; and

(b) Portions, data and information which cannot be verified by AECOM or its supplier(s).

iii. Oversight of the work of its supplier, Em-One Energy Solutions Canada Inc. with respect to the procurement and delivery of goods to the bonded warehouse where clearance is due to take place at Port.

iv. Engagement with the British High Commission in Lagos for duty waiver processing and port clearance as required.

4.4 Procurement

AECOM and its supply chain will be responsible for:

i. Procuring all approved equipment and materials based on agreed designs and bills of materials, including taking responsibility for transportation and secure delivery to Port for acceptance by DFID or its nominated representative, i.e. to the bonded warehouse

where clearance of the goods is due to take place at. Dealing with any issues arising with respect to its supplier(s).

ii. Certain pre and post shipment inspection and testing of the goods to ensure they arrive in good, working condition to be carried out as per industry standards.

iii. Title/ownership of the goods will pass to DFID upon full payment by DFID of the goods, which is due when the Supplier and/or its supply chain provide the relevant shipping documentation for said goods. The risk of loss and insurable risk for said goods shall transfer to DFID at the point of delivery of the goods at the Port.

iv. Arrangements for pre-fabrication of any solar modules or systems against agreed designs and plans, as needed.

4.5 Contingency planning

It may be necessary to alter, modify, amend or makes changes to the quantity and types of goods, etc. required for this project due to the fluid security situation in Borno, Nigeria and the various ancillary circumstances involved.

If such circumstances necessitate this, AECOM and its supply chain can consider and prepare fallback contingency plans to enable the project to continue. Should this affect bills of quantities, the goods or any other element of this Call-Down Contact, AECOM and DFID shall agree (by way of contract variation) a mutually acceptable revised course of action.

In the event of additional cost being incurred on the overall contract envelope, which results from either a change in location or a change in the security environment, DFID Nigeria will be notified at the earliest possible opportunity and work will not proceed without the written approval from DFID Nigeria to a contract variation.

Duty waiver
DFID will ensure that the British High Commission in Lagos will provide any duty exemption certificates necessary for all imports. The responsibility of DFID or its nominated representative is to provide duty exemption certificates from the relevant authority of Nigeria on a timely and efficient basis. The provision of these certificates is subject to the provision, by AECOM or its supply chain of the appropriate shipping documents as outlined below:

2 Original copies of the Bill of Lading
Commercial Invoice
Detailed Packing Lists
Original copy of the goods insurance

All Bills of Lading (BL) and Air Waybills (AWBs) must be consigned to:

BRITISH DEPUTY HIGH COMMISSION, DEPT. FOR INTERNATIONAL DEVELOPMENT, [redacted].

Draft copies of Bills of Lading or Air Waybills must be submitted to [redacted] ([redacted]) by email before shipment takes place for checking and approval. After issuance of original documents, original copies must be couriered to [redacted] at the above address. In the review of draft documents, the British High Commission will advise on whether any changes are required to the description of the cargo and whether any additional or amended wording should be contained within the Bills of Lading or Air Waybills along with the provision of the reference number which shall be indicated for the duty waiver.

If accurate and complete duty exemption certificates are not provided on a timely basis by DFID or its representatives, AECOM or its supplier(s) shall be compensated for the costs of any import duties which may be payable, fines, expenses, penalties and charges arising as a result thereof.

5. Outputs / Deliverables

The following will be required from AECOM and its supply chain:

5.1. Project management

Project work plan

Evidence of due diligence of EmOne

Logistics plan and logistics updates

Shipping documentation to assist with duty waiver

Detailed costings and bill of materials for each site

5.2. Technical designs and plans

Solar system designs and plans:

A written summary of the findings and any recommendations arising from the review as detailed at 4.2.

Manufacturers' technical specification for each of the proposed goods.

Pre-shipment inspection/test reports on critical equipment such as solar panels, inverters, and batteries.

Warranty statements for all equipment

6. DFID commitments

DFID representatives will assist in brokering agreements for Borno State Government to ensure their support and engagement throughout the course of the project. This will include:

Final site selections on a timely basis (within 4 weeks of contract signature) in conjunction with the Borno State Government, AECOM and its supply chain. If any party deems a site to be unsuitable from a security or duty of care perspective, that site will be reconsidered.

Adequate budget and timely funding/payments to be made.

Provision of adequate and authorised personnel to be available, as and when required.

DFID – including representatives from health, North East and security – to attend a monthly situation update meeting, covering progress and any security and operational issues affecting the project.

DFID shall upon full payment, in accordance with paragraph 12, take ownership of goods at the point of shipment (as demonstrated by shipping documentation provided by the Supplier) and will be responsible for duty waiver and clearance accordingly. Risk of loss and insurable risk in the goods will remain with the Supplier until they are delivered to the Port of Lagos.

7. Method

AECOM will provide the Services in line with the Proposal as detailed in Annex C.

8. Coordination

Clear communication channels and/or approval processes will be established between AECOM, its supply chain and DFID. A communication matrix is attached at Annex G and is subject to amendment.

9. Reporting

Monthly progress reporting is required.

A final report will be submitted to DFID by AECOM providing details of the deliverables achieved during the programme period. This would also include a breakdown of costs for the equipment, logistics, insurance (if any) and procurement fee to DFID in a format as detailed in Annex F

The report will be submitted to the DFID Programme Manager

10. Timeframe

AECOM will be contracted for the period 18th September 2017 – 30th April 2018 inclusive.

11. Duty of Care (DoC)

AECOM are responsible for the safety and well-being of their personnel (as defined in the Framework Agreement) and appropriate security arrangements. They will also be responsible for the provision of suitable security arrangements.

AECOM is responsible for ensuring appropriate safety and security briefings for all their personnel working under the Call-down Contract and ensuring that their personnel register and receive appropriate briefing. Travel advice is also available on the FCO website and the supplier must ensure they (and their personnel) are up to date with the latest position.

AECOM is fully responsible for Duty of Care in line with the details provided above and the initial risk assessment matrix developed by DFID as detailed in Annex H. AECOM confirms that:

They fully accept responsibility for Security and Duty of Care.

They understand the potential risks and have the knowledge and experience to develop an effective risk plan.

They have the capability to manage their Duty of Care responsibilities throughout the life of the contract.

The inland transportation, installation, etc. of the goods shall be governed by a separate contract. Please refer to Contract 2 for site-specific requirements.

12. Payment

Payments for the goods and equipment will be made by DFID in accordance with the milestone

payment drawdown schedule in Annex D below. The first payment shall be due upon AECOM submitting to DFID an invoice together with shipping documents for the goods, subsequent payments will be due upon completion of each stipulated milestone and AECOM submitting its invoice to DFID.

AECOM's Fees will be a percentage of the value of the procured goods and equipment plus daily rate inputs as detailed in Annex D.

AECOM will be required to maintain a record of any relevant expenditure incurred in the programme activities and keep original copies for the record for the entire duration of the programme.

An inventory of all assets procured under the programme will be maintained by AECOM and its' supply chain. At the end of the programme period or once the contract has been completed, DFID will decide in consultation with key stakeholders how best to dispose of assets acquired with DFID funding, or transfer title to the Borno State Government.

13. Additional terms and conditions

13.1. Insurance of the Goods and Equipment

AECOM shall provide insurance to the extent herein agreed.

The insurances obtained by AECOM or its supplier(s) in relation to this Call-Down Contract shall be subject to certain limitations and exclusions; including but not limited to it, not applying in event of an act of terrorism or event akin to this; hence, in the event that any such event arises, this shall be the responsibility of DFID.

The entire liability period of the Supplier, its agents and servants under this Call-Down Contact shall be no longer than twelve (12) months from the End Date.

13.2. Risk of Loss or Damage

For the purposes of clarity and in accordance with clause 43 of the Framework Agreement, neither AECOM or its supplier(s) shall be liable or responsible for any loss, expenses, charges, penalties or damages arising in relation to or in connection with the Services or the goods and equipment in question or a suspension of the Services or the supply of the goods and equipment as a result of any of the following actual or anticipated force majeure events (including not limited to):

Losses caused by force majeure including ionising radiations or contamination by radioactivity; pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds; any act of terrorism; act of God; war, invasion, act of foreign enemy, hostilities (whether war be declared or not), civil war, rebellion, revolution, insurrection, military or usurped power, confiscation, commandeering, nationalisation or requisition, the order of any government de jure or de facto or public, municipal or local authority

Notwithstanding any provision in this Call-Down Contract to the contrary, neither AECOM or its supplier(s) (which includes any agents, servants and employees) shall be liable in the event that any loss or damages arises as a result of the acts or omissions of a third party and/or DFID or its nominated representative(s).

ANNEX B
Specifications

Specification summary

The purchase, supply and logistics of equipment to the Port of Lagos, Nigeria. Details of the system sizes and related specifications of the systems being purchased are provided in the tables below.

Final sites are still to be selected and final designs confirmed, therefore this contract includes some flexibility in the specifications that can only be finalised once detailed designs are complete for the systems in each site. The specifications and prices are presented on a fixed priced basis for the size of system for each installation type as detailed in Table 1 below

Table 1: Sites and system sizes covered by this contract

Site	Size of system
Hospital site 1	H2: 102.4KW
Hospital site 2	H2: 102.4KW
Hospital site 3	H2: 102.4KW
Hospital site 4	H1: 76.8KW
Hospital site 5	H1: 76.8KW
School of Nursing and Midwifery teaching areas	SoNMW: 122.8KW
Village cluster 1	Village day School: 15.36KW Primary Health Clinic PHC1 size: 20.48 KW Solar Bore Hole 1: 4.8 KW Solar Bore Hole 2: 4.8 KW
Village cluster 2	Village day School: 15.36KW Primary Health Clinic PHC1 size: 20.48 KW Solar Bore Hole 1: 4.8 KW Solar Bore Hole 2: 4.8 KW

Notes on Table 1:

[1] Final sites still to be selected and will be confirmed in writing by DFID although indicative shortlist is as follows: Damasak – H2, Monguno – H2, Damboa – H2, Uba – H1, Konduga – H1, School of Nursing and Midwifery, Mandaragirau village in Iu LGA and Ngwom village in Mafa LGA.
[2] Detailed specifications for each system are provided below. If sites require different sized systems than detailed above after detailed design work then prices will change.

Table 2: List of potential hospital sites and their system sizes

For detailed specifications, see Table 3 below

Hospital Name	Standard system size applicable
Konduga General Hospital	H1
Monguno General Hospital	H2
Gubio General Hospital	H1
Damasak General Hospital	H2
Mafa General Hospital	H1
Ngwom Health Care Centre	PHC1
Gajiram General Hospital	NA [1]
Chibok General Hospital	H1+ [2]
Bama General Hospital	H3
Baga General Hospital	H1
Damboa General Hospital	H2
Gwoza General Hospital	H2
Ngala General Hospital	H2
Uba General Hospital	H1

Notes on Table 2:
[1] A new hospital is currently being built by Borno State Government. This may be an H2 or H3 system as yet unknown.
[2] Additional load is coming from a primary health clinic operating in the same compound. As such an H2 system would be preferable to cover both operations.

Table 3: Technical system specifications for General Hospitals: H1, H2 and H3 sizes

This call down covers equipment supply for: Three (03) H2-size systems and Two (02) H1-size systems as per the below system specifications.

		H1	H2	H3
1	Solar PV installed capacity	76.80KW	102.4KW	204.80KW
2	Suitable Battery Inverter	1	1	1
3	Battery Capacity	170 kWh	420 kWh	840 kWh
4	Diesel Generator Rated Power	60KW	80KW	130KW
5	AC Distribution System	1000 meters (Max)	1000 meters (Max)	1500 meters (Max)
6	Suitable PV Mounting System	1	1	1
7	Cloud based data monitoring system	1	1	1

Table 4: Technical system specification for School of Nursing and Midwifery teaching areas

This contract covers equipment supply for One (01) system for the School of Nursing and Midwifery teaching areas as per the below system specifications:

		School of Nursing and Midwifery
1	Solar PV installed capacity	122.8KW
2	Suitable Battery Inverter	1
3	Battery Capacity	420 kWh
4	Diesel Generator Rated Power	80KW
5	AC Distribution System	500 meters (Max)
6	Suitable PV Mounting System	1
7	Cloud based data monitoring system	1

Tables 5a and 5b: Technical system specification for village clusters
This contract covers equipment supply for Two (02) village clusters each to include: Two (02) solar bore holes, One (01) primary health clinic (PHC1 size) and One (01) village day school (SCH1 size) as per the below system specifications:

Table 5a: Specifications for village day school and primary health clinics

Each village cluster will have One (01) Primary health clinic (PH1) and One (01) village day school (SCH1). Other larger primary health clinic sizes (PHC2 and PHC3) are included for reference purposes only.

		PHC0/SCH1	PHC1	PHC2	PHC3
1	Solar PV installed capacity	15.36KW	20.48KW	30.72KW	46.08KW
2	Suitable Battery Inverter	1	1	1	1
3	Battery Capacity	86.49KWh	111.22 KWh	172.99 KWh	259.49 KWh
4	AC Distribution System	100 meters (Max)	100 meters (Max)	100 meters (Max)	100 meters (Max)
5	Suitable PV Mounting System	1	1	1	1
6	Cloud based data monitoring system	1	1	1	1
7	Enclosure housing 20/10 feet ISO insulated and modified shipping container with cooling and ventilation	1	1	1	1

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Table 5b: Specifications for One (01) solar bore hole

Each village cluster will have two solar bore holes so the coverage of this contract is for Four (04) solar bore holes in total.

Water Borehole		
1	Solar PV installed capacity	4.80KWp
2	Solar Borehole controller	1
3	Suitable PV Mounting System	1
4	Enclosure (controller)	1
5	Submersible Pump	1

Table 6: Indicative technical specifications for major solar system components for General Hospitals and School of Nursing and Midwifery

System Component	Details
PV Generator	315Watt PV modules Warranty: 25 years performance warranty, 10 years product warranty Manufacturer: Canadian Solar
Battery Invertor	SMA Sunny Tripower 25000TL (STP 25000TL-30) Warranty: 5 years factory warranty Manufacturer: SMA
Battery Storage	Tesla Powerpack at the required modular size for each system as specified above including self-contained thermal management system, communications and monitoring, mechanical and electrical safety features in a NEMA 3R (IP35) enclosure Battery Management System via Powerpack Controller Management Warranty: 10 years. Manufacturer: Tesla
Diesel generator	60 KVA - 130 KVA depending on system size Diesel fuel Automatic or Manual start Warranty:2 years Manufacturer: Cummins
Data Monitoring System	SMA Cluster Controller (CLCON-S-10) Device for monitoring and controlling SMA inverters in decentralized large-scale PV power plants with Speedwire network Warranty: 5 years Manufacturer: SMA Sunny Cloud Portal, data plan, GPRS/GNM Modem for Remote Assess
Electrical Balance of System	Complete Electrical Balance of System (BOS), including: Wiring system and connectors Fuses and breakers Energy meters Load limiting devices AC distribution panel Earthing systems Ground fault protection Surge protection devices

Solar Mounting Structures	As per final designs Warranty: 5-10 years warranty for different components Manufacturer: Schletter
Palisade fencing	Palisade Fencing 2.0 M high, with Double Leaf Gates 6m wide x 2m high and Single Leaf Gates 1m wide x 2m high PALES: 2.5mm W, 1.95m. overall, 17 per 2.75m. panel, with triple pointed tops. POSTS: 100x55x6.72kg/m RSJ, 2.725m, overall without baseplates and complete with loose fishplates HORIZONTALS 2 No. 50x50x6 RSA. FIXINGS: M12 cup square bolts with permacone type nuts. SUPPORT LEGS: 40x8 RSF 2 per standard panel. PALE FIXINGS 8mm galvanised T - head bolt with Permacone nuts. FINISH: Galvanised - BS EN ISO1461

Table 7: Indicative technical specifications for major solar system components for village clusters

System Component	Details
PV Generator	315Watt PV modules Warranty: 25 years performance warranty, 10 years product warranty Manufacturer: Canadian Solar
Battery Invertor	Conext™ MPPT 80 600 Solar Charge Controller Warranty: 5 years Manufacturer: Schneider
Battery Storage	Lead acid OPZV VRLA 2V , 48V Batteries battery connectors & cables and battery racks Warranty: 2 years Manufacturer: Hoppecke
Container/ Battery enclosure	20 feet/10 feet ISO Containers Warranty: 5 years
Data Monitoring System	Conext combox with Conext Insight PV Monitoring Software/Web Portal for hybrid PV monitoring 2 years warranty Manufacturer: Schnieder Cloud Portal, data plan, GPRS/GNM Modem for Remote Assess
Electrical Balance of System	Complete Electrical Balance of System (BOS), including: Wiring system and connectors AC and DC Overvoltage protection Fuses and breakers for isolation and protections Energy meters Load limiting devices AC distribution panel Earthing systems Ground fault protection (RCD) Surge protection devices
Solar Mounting Structures	As per final designs Warranty: 5-10 years warranty for different components Manufacturer: Schletter

Solar Borehole Controller	Warranty: 2 years Manufacturer: Lorentz / Groundfus
Water pump	4 feet high efficiency ECDRIVE brushless DC motor EN 1.4301/AISI 304 cast stainless steel stator housing solid stainless steel rotor 600 to 3,300rpm-depending on pump end Multi-stage centrifugal-premium materials, EN 1.4301/AISI304 stainless steel Warranty: 2 years Manufacturer: Lorentz

Full and detailed bills of materials for each site and packing lists will be provided after the design stage.

The above specifications in tables 6 and 7 are indicative. Should final designs or availability of certain brands mean than certain components need to change, items can be substituted for other equivalent items of the same quality in line with delivering the system specifications in tables 2, 3, 4, 5a and 5b.

Table 8: Solar system standards and codes to which the systems will comply

Category	Standard
Characteristics	IEC 61194 ed1.0: Characteristic parameters of stand-alone photovoltaic (PV) systems
Crystalline	IEC 61215 ed2.0: Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval
Test	IEC 61701 ed2.0: Salt mist corrosion testing of photovoltaic (PV) modules
Li-Ion Battery	IEC 62109,UL9540,UL1741,IEC60068-2-52 Security level 6
Monitoring	IEC 61724 ed1.0: Photovoltaic system performance monitoring - Guidelines for measurement, data exchange and analysis
Safety	IEC 61730-1 ed1.0: Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction
Safety	IEC 61730-2 ed1.0: Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing
Balance of System	IEC 62109-1 ed1.0: Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
Balance of System	IEC 62109-2 ed1.0: Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters
Design	IEC 62124 ed1.0: Photovoltaic (PV) standalone systems - Design verification
Commissioning	IEC 62446 ed1.0: Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection
Performance	IEC 62509 ed1.0: Battery charge controllers for photovoltaic systems - Performance and functioning
Steel Chain-link Fencing	A53, A90, A153, A653, A824, A585, F626, F1183,
PV Mounting Structure: Rack Support Structural Steel	ASTM, A36/A36M, A123, A143, A153, A239, A325, A384, A394, A500, A 563, A572/A572M, B201, AISC, ASCE 10-90, AWS, ISO 9001
PV Mounting Racks	ASTM B308 / B308M, ASTM B221, ASTM B429, American Welding Society.

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Table 9: Technical assistance

A critical review was required of the technical designs, plans and costings provided by DFID from the EPC contractor, EmOne Energy Solutions for the solar installations items.

The intended objectives of the review are as follows:

- Provide feedback on the suitability of these designs and the installation of solar energy in remote locations in North East Nigeria.
- Report on particular findings or concerns with respect to the designs, plans or costings.
- Comment on the suitability of technical options such as the battery choice, PV panel and other component choices, warranty coverage and any other relevant factors.