THE KENYA POWER AND LIGHTING COMPANY PLC

KENYA OFF-GRID SOLAR ACCESS PROJECT FOR UNDERSERVED COUNTIES (KOSAP)

Volume II (Part 2)

Section VII

Employer's Requirements, Technical Specifications and Drawings

Design, Supply, Installation and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for Community Facilities in Turkana, West Pokot, Marsabit, Isiolo, Samburu, Mandera, Wajir, Garissa, Tana River, Narok, Lamu, Kilifi and Kwale Counties in Kenya with 7 years Operations and Maintenance (O&M) Services

RFB No.: KE-KPLC-417990-CW-RFB

23rd April 2024

Part-2

Employer's Requirements

Section VII

Employer's Requirements and Technical Specifications (ERTS)

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1. SCOPE OF SUPPLY OF PLANT AND INSTALLATION SERVICES

1.1 Introduction

The Government of Kenya has pledged to stimulate economic growth and accelerate job creation to improve the economic wellbeing of Kenyans. Among the many interventions to achieve this is expansion of the power distribution system to be within reach and thus enable more Kenyans connect to the grid at affordable cost and hence initiate economic activities at the micro-economic level. Mini grids and standalone systems are considered as a solution where grid penetration remains limited.

The Kenya Off-grid Solar Access Project for underserved counties (K-OSAP), financed by the World Bank and implemented by the Ministry of Energy, Kenya Power and Lighting Company (KPLC) and Rural Electrification and Renewable Energy Corporation (REREC), aims at providing a comprehensive suite of investments to provide electricity services to households, enterprises, community facilities and boreholes.

KPLC will implement Stand Alone Solar Photovoltaic Systems with Battery Energy Storage to support the provision of electricity services to community facilities in remote areas. The community facilities considered in this component are Health facilities, Educational facilities e.g. Secondary schools and Administrative Offices e.g. Assistant County Commissioner (ACC) offices. A single contractor will be responsible for construction of the solar stand alone systems for each Lot - Supply and Installation (S&I) Phase. The same contractor shall provide Operations and Maintenance (O&M) services for 7 (seven) years. Therefore, two (2) Contracts will be signed between KPLC and the Contractor; one for the S&I Phase and one for O&M Phase.

General Scope

The project scope for this assignment includes Design, Supply, Installation, Metering and Commissioning of 347 No. Stand Alone Solar Photovoltaic Systems with Battery Energy Storage with 7 years Operations and Maintenance (O&M) services in the following 13 Counties: Turkana, West Pokot, Marsabit, Isiolo, Samburu, Mandera, Wajir, Garissa, Tana River, Narok, Lamu, Kilifi and Kwale. The scope includes customer connection and installation of 347 electronic pre-paid energy meters including earthing, cabling to the meterbox, and limited internal wiring (as outlined in Chapter 5) at the customer premise as well as issuing statutory wiring documents. All other associated materials and accessories on turnkey basis for completeness of works to be provided by the contractor.

The project is packaged in Six (6) Lots. Each lot shall be signed as a separate works contract as detailed in Table 1 below:

Table 1: Lots and General Scope of Works

Lot Name	Counties	Scope of Works
KE-KPLC-417990-CW-RFB Lot 1	Turkana	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 86 No. Community Facilities. • O&M services for 7 years
KE-KPLC-417990-CW-RFB Lot 2	West Pokot	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 39 No. Community Facilities. • O&M services for 7 years
KE-KPLC-417990-CW-RFB Lot 3	Marsabit, Isiolo and Samburu	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 43 No. Community Facilities. • O&M services for 7 years
KE-KPLC-417990-CW-RFB Lot 4	Mandera and Wajir	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 63 No. Community Facilities. • O&M services for 7 years
KE-KPLC-417990-CW-RFB Lot 5	Garissa, Tana River and Narok	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 66 No. Community Facilities. • O&M services for 7 years
KE-KPLC-417990-CW-RFB Lot 6	Lamu, Kilifi and Kwale	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 50 No. Community Facilities. • O&M services for 7 years

The Contract shall comprise but is not limited to the clearing of all working areas, quality assurance management, design, manufacture, supply, delivery to site, unloading, erection, setting to work, testing at site, commissioning and trial operation, complete in every respect and suitable for reliable operation in the respective environmental and climatic conditions, including and/or adjustment of defective material and workmanship for duration of the Defects Liability period of the equipment described in detail in the Specifications and Schedules. All works not expressly called for in the Specification and/or Schedules but are necessary for the complete and proper supply, erection, operation and maintenance of the Works shall be performed and furnished by the Contractor at no additional cost to the Employer.

1.2 Scope and characteristics of Stand Alone Solar Photovoltaic (SPV) Systems

1.2.1 Design, supply, installation, testing, metering and commissioning of Stand Alone Solar Power Generation Plants (SPGP) under Lots 1 - 6 for community facilities in various locations in Kenya are as per Tables 2 – 7 below.

1.2.2 Scope and characteristics of Stand Alone SPV systems for community facilities are shown in the Tables 2 - 7 summarizing characteristics of the community facilities including DC Voltage, Nominal AC Voltage and the estimated **minimum capacity** requirements of:

- Solar Power Generation Plant (SPGP) i.e. Solar PV Capacity (in Watt-peak)
- Battery Energy Storage System (BESS) (in Watt-hours)
- Battery Inverter Charger (in Watts[1])
- PV Inverter (in Watts[1]), for systems having 3kWp or more of PV capacity
- Charge Controller (in Amperes), for systems having less than 3kWp PV Capacity

Bidders must meet the minimum capacity requirements or propose a higher capacity.

1.2.3 The winning Bidders shall be responsible for confirming/reviewing demand and sizing data, checking status of electrification of the facility, picking distance of the facility from existing KPLC grid as well as other relevant site data during design stage.

1.2.4 Systems having less than 3kWp PV capacity shall contain a Battery Inverter charger and a Charge Controller. Whilst systems having 3kWp or more of PV capacity shall have a PV Inverter and a Battery Inverter Charger as shown in Tables 2-7. Hybrid inverters can be permitted provided they meet all the requirements stipulated in Clause 4.6.

1.2.5 Systems having less than 3kWp PV capacity shall have a DC System Voltage of 24V; All the equipment i.e. Batteries, Inverters and Charge Controllers must be rated 24VDC.
Conversely, systems having 3kWp or more of PV capacity shall have a DC system voltage of 48V; All the equipment i.e. Batteries and Inverters must be rated 48VDC.

1.2.6 Systems of less than 10kWp PV capacity shall be of Low Voltage Single Phase AC Voltage (240V AC; 345No. sites). Whilst systems of 10kWp and more of PV capacity shall be of Low Voltage Three Phase AC Voltage (415V AC; 2No. sites).
1.2.7 The geographical/locational details of the sites spread across various parts of Kenya including county, coordinates and facility type are contained in Tables 28-33 in **Appendix 3 – Locational Details of Sites**.

1.2.8 Supply of materials necessary for connecting the power generated to the community facility including connection cable and its installation, for providing electricity service connection as per KPLC requirements/specifications.

1.2.9 Installation of the pre-paid energy meter for providing electricity service connection as per KPLC requirements/specifications. The customer prepaid energy meter and MCB for customer metering shall be supplied by KPLC, but installed by contractor. All other meter installation accessories (e.g. meter box, cables etc) shall be provided by the contractor.

1.2.10 Carry out O & M Services on behalf of KPLC for 7 years as per KPLC requirements/specifications.

[1] Note the units of capacity are specified in Watts and not Volt-Ampere. Therefore, proposed inverters must meet the specified capacity requirements in Watts.

1.2.11 Reliable Power supply to community facilities on behalf of KPLC, including timely attendance to complaints/breakdowns to ensure regular supply to customers as per KPLC requirements/specifications.

Table 2: Scope Details - Lot 1 (Turkana County)

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
1	Turkana	Nameyana Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
2	Turkana	Nakaalei Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
3	Turkana	RCEA Kasuroi Boys	1,500	9,379		1,500	60	24V	240V, 1ϕ
4	Turkana	Kodopa Mobile Clinic	1,500	9,379		1,500	60	24V	240V, 1ϕ
5	Turkana	Teremkus dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
6	Turkana	Loche angi-erengo	1,500	9,379		1,500	60	24V	240V, 1ϕ
7	Turkana	Napalatui dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
8	Turkana	Aposta dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
9	Turkana	Narengewoi Health center	1,500	9,379		1,500	60	24V	240V, 1ϕ
10	Turkana	Monti Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
11	Turkana	Loturerei Secondary School	1,500	9,379		1,500	60	24V	240V, 1ϕ
12	Turkana	Kekorisogol Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
13	Turkana	Kapokor Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
14	Turkana	Lokipetot arengan dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
15	Turkana	Meyan Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
16	Turkana	Moru anguibuni	1,500	9,379		1,500	60	24V	240V, 1ϕ
17	Turkana	Chokchok Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
18	Turkana	Kabulokor health center	1,500	9,379		1,500	60	24V	240V, 1ϕ
19	Turkana	Kaenyangaluk dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
20	Turkana	Kakelae Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
21	Turkana	Kakwanyang Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
22	Turkana	Kasuroi Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
23	Turkana	Kenya oil dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
24	Turkana	Kosikiria dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
25	Turkana	Lokamarinyang Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
26	Turkana	Lokipoto dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
27	Turkana	Lokoburu dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
28	Turkana	Losajait dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
29	Turkana	Nakechichok Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
30	Turkana	Sasame Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
31	Turkana	Lomunyakirionok Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
32	Turkana	Loruth dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
33	Turkana	Kaalem	1,500	9,379		1,500	60	24V	240V, 1ϕ
34	Turkana	Nakapelewoi dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
35	Turkana	Nasiger Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
36	Turkana	Epur Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
37	Turkana	Namon Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
38	Turkana	Nakiria Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
39	Turkana	Lochoraikeny Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
40	Turkana	Katiir dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
41	Turkana	Nayanaeangikalalio Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
42	Turkana	Kapua Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
43	Turkana	Atiir Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
44	Turkana	Kaapus dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
45	Turkana	Koyasa Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
46	Turkana	Sopel Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
47	Turkana	Namakat Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
48	Turkana	Lomil Girls Secondary School	2,000	12,505		2,000	75	24V	240V, 1ϕ

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
49	Turkana	Lomii Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
50	Turkana	Louwae Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
51	Turkana	Nakatong'wa Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
52	Turkana	Nakurio Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
53	Turkana	Natuntun Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
54	Turkana	Kangalita Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
55	Turkana	Kanaodon Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
56	Turkana	Lokorkor Health Center	2,000	12,505		2,000	75	24V	240V, 1ϕ
57	Turkana	Lopii Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
58	Turkana	Juluk Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
59	Turkana	Kamuge Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
60	Turkana	Lomelo Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
61	Turkana	Loyapat Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
62	Turkana	Komudei Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
63	Turkana	Kangitankori Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
64	Turkana	Lochor Alomala dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
65	Turkana	Naotin Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
66	Turkana	Riokomor Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
67	Turkana	Long'ech dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
68	Turkana	Loturerei dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
69	Turkana	Parkati dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
70	Turkana	Kalimapus Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
71	Turkana	Nakurio Girls Secondary school	2,000	12,505		2,000	75	24V	240V, 1ϕ
72	Turkana	Lochor Edome Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ

No.	County	Name of Facility	**Minimum PV Capacity** (Wp)	**Minimum Battery Capacity** (Wh)	**Minimum PV Inverter** *(for systems of PV capacity of 3kWp and above)* (W)	**Minimum Battery Inverter Charger** *(for systems of PV capacity below 3kWp)* (W)	**Minimum Charge Controller** *(for systems of PV capacity below 3kWp)* (A)	**DC Voltage** (V)	**Nominal AC Voltage** (V)
73	Turkana	Loperot Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
74	Turkana	Nakoyo Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
75	Turkana	Kaesogol etom Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
76	Turkana	Lokangae Health Centre	2,400	15,006		2,400	90	24V	240V, 1ϕ
77	Turkana	Ngamia one kochodin high school	2,400	15,006		2,400	90	24V	240V, 1ϕ
78	Turkana	Kangirisae dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
79	Turkana	Lokapel Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
80	Turkana	Nadooto dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
81	Turkana	Nanam dispensary	3,500	21,884	3500	3,500		48V	240V, 1ϕ
82	Turkana	Lokwii Health Center	4,000	25,011	4000	4,000		48V	240V, 1ϕ
83	Turkana	Karebur dispensary	4,500	28,137	4500	4,500		48V	240V, 1ϕ
84	Turkana	Loima boys secondary School	5,500	34,389	5500	5,500		48V	240V, 1ϕ
85	Turkana	Aic Songot secondary School	6,000	37,516	6000	6,000		48V	240V, 1ϕ
86	Turkana	Talent high school	6,000	37,516	6000	6,000		48V	240V, 1ϕ

Table 3: Scope Details - Lot 2 (West Pokot County)

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
1	West Pokot	Leng'orok Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
2	West Pokot	Nyangolesinyang dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
3	West Pokot	Cheptiangwa Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
4	West Pokot	Kapkaremba Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
5	West Pokot	Kasitet Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
6	West Pokot	Chemotong Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
7	West Pokot	Kiwakan Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
8	West Pokot	Mading west pokot	1,500	9,379		1,500	60	24V	240V, 1ϕ
9	West Pokot	Nauyapong Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
10	West Pokot	Kapenguria west pokot	1,500	9,379		1,500	60	24V	240V, 1ϕ
11	West Pokot	Nakwijit dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
12	West Pokot	Nasal Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
13	West Pokot	Wonyoi dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
14	West Pokot	St. Marks mixed Day and Boarding Secondary School-Kapkaremba	1,500	9,379		1,500	60	24V	240V, 1ϕ
15	West Pokot	Kisera dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
16	West Pokot	Nyangaita Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
17	West Pokot	Kamanau Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
18	West Pokot	Kesot Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
19	West Pokot	Krich dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
20	West Pokot	Tamarukwa dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
21	West Pokot	Tipet dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
22	West Pokot	Miskwony dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
23	West Pokot	Kalemrekai Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
24	West Pokot	Sostin dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
25	West Pokot	Kataywa dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
26	West Pokot	Cherangan dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
27	West Pokot	Chekomosi location	2,000	12,505		2,000	75	24V	240V, 1ϕ
28	West Pokot	Masol Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
29	West Pokot	Kangoletiang Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
30	West Pokot	Kalemngorok dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
31	West Pokot	Sobukwo secondary School	2,000	12,505		2,000	75	24V	240V, 1ϕ
32	West Pokot	Tamkal dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
33	West Pokot	Nachecheyet Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
34	West Pokot	Kauryong dispensary	3,000	18,758	3,000	3,000		48V	240V, 1ϕ
35	West Pokot	Ptoyo Health Center	3,500	21,884	3,500	3,500		48V	240V, 1ϕ
36	West Pokot	Simpol dispensary	3,500	21,884	3,500	3,500		48V	240V, 1ϕ
37	West Pokot	Salion secondary school	4,000	25,011	4,000	4,000		48V	240V, 1ϕ
38	West Pokot	Kalemnyang Yunhap	4,000	25,011	4,000	4,000		48V	240V, 1ϕ
39	West Pokot	Kanyerus dispensary	4,000	25,011	4,000	4,000		48V	240V, 1ϕ

Table 4: Scope Details - Lot 3 (Marsabit, Isiolo and Samburu Counties)

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
1	Marsabit	Telesgaye Health center	1,500	9,379		1,500	60	24V	240V, 1ϕ
2	Marsabit	Madoadi dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
3	Marsabit	Burgabo dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
4	Marsabit	Qate dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
5	Marsabit	Ell - borr dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
6	Marsabit	El-Molo Bay Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
7	Marsabit	Oltorot Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
8	Marsabit	Waye Godha dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
9	Isiolo	Boji dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
10	Isiolo	Daaba dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
11	Samburu	Oromodei dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
12	Samburu	Sereni dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
13	Samburu	Waso Rongai Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
14	Samburu	Engilai Mixed Secondary	1,500	9,379		1,500	60	24V	240V, 1ϕ
15	Samburu	Loikumkum Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
16	Samburu	Angata Nanyokie Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
17	Samburu	Logetei Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
18	Samburu	Nkaroni dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
19	Samburu	Klitamany dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
20	Samburu	Masikita Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
21	Samburu	Ndonyo Nasipa Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
22	Samburu	Muruankai GOK Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
23	Samburu	Loonjorin Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
24	Marsabit	Korolle Boys' Secondary School	2,000	12,505		2,000	75	24V	240V, 1ϕ
25	Marsabit	Dukana Ward Administrator's Office	2,000	12,505		2,000	75	24V	240V, 1ϕ
26	Marsabit	Badan Rero Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
27	Isiolo	Ntalaby Primay school	2,000	12,505		2,000	75	24V	240V, 1ϕ
28	Isiolo	Kom Acc Office	2,000	12,505		2,000	75	24V	240V, 1ϕ
29	Isiolo	Muchuro dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
30	Samburu	Urra Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
31	Samburu	Ngilai (Saidia) dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
32	Samburu	Donyo-Wasin Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
33	Samburu	Sereolipi mixed day secondary school	2,000	12,505		2,000	75	24V	240V, 1ϕ
34	Samburu	Marti E pareu	2,000	12,505		2,000	75	24V	240V, 1ϕ
35	Marsabit	Arapal Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
36	Marsabit	Dukana Health Center	2,400	15,006		2,400	90	24V	240V, 1ϕ
37	Isiolo	Biliqo Marara dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
38	Marsabit	Godoma Health Centre (Nep)	2,400	15,006		2,400	90	24V	240V, 1ϕ
39	Marsabit	Lontolio Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
40	Marsabit	Kulal Girls Secondary school	2,400	15,006		2,400	90	24V	240V, 1ϕ
41	Marsabit	Karbururi dispensary	3,000	18,758	3,000	3,000		48V	240V, 1ϕ
42	Samburu	Barsoloi arid zone primary school	4,000	25,011	4,000	4,000		48V	240V, 1ϕ
43	Isiolo	Ngaremara secondary-boys	16,500	103,168	16,500	16,500		48V	415V, 3ϕ

Table 5: Scope Details - Lot 4 (Mandera and Wajir Counties)

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
1	Mandera	Olla secondary school	1,500	9,379		1,500	60	24V	240V, 1ϕ
2	Mandera	Burduras secondary School	1,500	9,379		1,500	60	24V	240V, 1ϕ
3	Mandera	Choroko Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
4	Mandera	Burmayo Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
5	Mandera	Burjon Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
6	Mandera	Koromey Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
7	Mandera	Chachabole Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
8	Wajir	Burder Secondary School	1,500	9,379		1,500	60	24V	240V, 1ϕ
9	Wajir	Busbus primary school	1,500	9,379		1,500	60	24V	240V, 1ϕ
10	Wajir	Dureweey dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
11	Wajir	Argane dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
12	Wajir	Burmayo Dispensary Wajir	1,500	9,379		1,500	60	24V	240V, 1ϕ
13	Wajir	Lakole Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
14	Wajir	Wara Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
15	Wajir	Arbajahan mixed/day and boarding secondary Schools	1,500	9,379		1,500	60	24V	240V, 1ϕ
16	Wajir	Wargadud Dispensary(Tarbaj)	1,500	9,379		1,500	60	24V	240V, 1ϕ
17	Wajir	Beramo Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
18	Wajir	Dadhantaly Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
19	Wajir	Dunto Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
20	Wajir	Elben Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
21	Wajir	Ogorji Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
22	Mandera	Fino ACC	2,000	12,505		2,000	75	24V	240V, 1ϕ

No.	County	Name of Facility	**Minimum PV Capacity** (Wp)	**Minimum Battery Capacity** (Wh)	**Minimum PV Inverter** *(for systems of PV capacity of 3kWp and above)* (W)	**Minimum Battery Inverter Charger** *(for systems of PV capacity below 3kWp)* (W)	**Minimum Charge Controller** *(for systems of PV capacity below 3kWp)* (A)	**DC Voltage** (V)	**Nominal AC Voltage** (V)
23	Mandera	Kukub dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
24	Mandera	Tarama Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
25	Mandera	Garsesala Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
26	Mandera	Lagsure dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
27	Mandera	Domal dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
28	Mandera	Kobadadi dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
29	Mandera	Birkan dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
30	Wajir	Bojiyare Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
31	Wajir	Sabuli Nomadic Clinic	2,000	12,505		2,000	75	24V	240V, 1ϕ
32	Wajir	Batalu Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
33	Wajir	Tesorie Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
34	Wajir	Mathow Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
35	Wajir	Hungai Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
36	Mandera	Aresa Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
37	Mandera	Hullow Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
38	Mandera	Alongo Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
39	Mandera	Damasa Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
40	Mandera	El-Golicha Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
41	Mandera	Elram Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
42	Mandera	Falama Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
43	Mandera	Fino Health Centre	2,400	15,006		2,400	90	24V	240V, 1ϕ
44	Mandera	Hareri Hosle Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
45	Mandera	Kabo Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
46	Mandera	Lafey nomadic dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
47	Mandera	Odha Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
48	Mandera	Omar jilaow Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
49	Mandera	Qarsahama Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
50	Wajir	Dugo Health Centre	2,400	15,006		2,400	90	24V	240V, 1ϕ
51	Mandera	Malkamari Boys' Secondary School	3,000	18,758	3,000	3,000		48V	240V, 1ϕ
52	Mandera	Libin Nomadic Girls Secondary School	3,000	18,758	3,000	3,000		48V	240V, 1ϕ
53	Mandera	Gari secondary School	3,500	21,884	3,500	3,500		48V	240V, 1ϕ
54	Mandera	Hareri Mixed Secondary School	3,500	21,884	3,500	3,500		48V	240V, 1ϕ
55	Mandera	Qarsadamu dispensary	4,000	25,011	4,000	4,000		48V	240V, 1ϕ
56	Wajir	Sabuli mixed day secondary School	4,500	28,137	4,500	4,500		48V	240V, 1ϕ
57	Wajir	Lagbogol secondary school	4,500	28,137	4,500	4,500		48V	240V, 1ϕ
58	Mandera	Bolowle dispensary	5,500	34,389	5,500	5,500		48V	240V, 1ϕ
59	Wajir	Baraqwo secondary	5,500	34,389	5,500	5,500		48V	240V, 1ϕ
60	Mandera	Derkale dispensary	6,000	37,516	6,000	6,000		48V	240V, 1ϕ
61	Wajir	KHOrof harar youth polytechnic	6,000	37,516	6,000	6,000		48V	240V, 1ϕ
62	Mandera	El- hagarsu mixed day secondary school	7,500	46,895	7,500	7,500		48V	240V, 1ϕ
63	Wajir	Diif Secondary School	8,500	53,147	8,500	8,500		48V	240V, 1ϕ

Table 6: Scope Details - Lot 5 (Garissa, Tana River and Narok Counties)

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
1	Garissa	Sangole Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
2	Garissa	Afwein Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
3	Garissa	Kotile health center	1,500	9,379		1,500	60	24V	240V, 1ϕ
4	Garissa	ACC office/Residence Galmagala	1,500	9,379		1,500	60	24V	240V, 1ϕ
5	Garissa	ACC office/Residence Jarajilla	1,500	9,379		1,500	60	24V	240V, 1ϕ
6	Garissa	Bodhai ACC office	1,500	9,379		1,500	60	24V	240V, 1ϕ
7	Garissa	Jalish Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
8	Garissa	Korisa Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
9	Garissa	Malaylay Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
10	Garissa	Libahlow dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
11	Garissa	Ruqa Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
12	Tana River	Waldena ACC	1,500	9,379		1,500	60	24V	240V, 1ϕ
13	Tana River	Galili Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
14	Tana River	Mulanjo dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
15	Tana River	Buwa Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
16	Tana River	AIC Titila Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
17	Tana River	Asa Kone Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
18	Tana River	Assa dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
19	Tana River	Boka dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
20	Tana River	Chewele Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
21	Tana River	Haroresa Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
22	Tana River	Meti Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
23	Tana River	Sabukia dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
24	Tana River	Kau Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
25	Tana River	Sombo Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
26	Narok	Roborwo Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
27	Narok	Mausa dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
28	Narok	Kendunywo primary school	1,500	9,379		1,500	60	24V	240V, 1ϕ
29	Narok	Ilkerin -Loita dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
30	Narok	Chemwokter Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
31	Narok	Entotol dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
32	Narok	Olkoroi dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
33	Garissa	Jilango dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
34	Garissa	Amuma Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
35	Garissa	Amuma Mobile Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
36	Garissa	Bodhai Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
37	Garissa	Dekaharjey Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
38	Garissa	El Kambere Nomadic Clinic	2,000	12,505		2,000	75	24V	240V, 1ϕ
39	Garissa	Fafi Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
40	Garissa	Yumbis Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
41	Tana River	Chifiri Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
42	Tana River	Wayu Boru Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
43	Tana River	Mwina Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
44	Tana River	Wayu Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
45	Tana River	Ozi Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
46	Tana River	Sera dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
47	Tana River	Mnazini dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
48	Narok	Ngendalel dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
49	Garissa	Abdisamit Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
50	Garissa	Bultohama Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
51	Garissa	Elan Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
52	Garissa	Danyere Health Centre	2,400	15,006		2,400	90	24V	240V, 1ϕ
53	Tana River	Majengo secondary	2,400	15,006		2,400	90	24V	240V, 1ϕ
54	Tana River	Bilbil dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
55	Tana River	Aic Daba Dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
56	Narok	Chesabuni Primary School	2,400	15,006		2,400	90	24V	240V, 1ϕ
57	Narok	Kamarget dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
58	Garissa	Hagarbul Dispensary	3,000	18,758	3,000	3,000		48V	240V, 1ϕ
59	Tana River	Waldena Dispensary	3,000	18,758	3,000	3,000		48V	240V, 1ϕ
60	Garissa	Kulan secondary School	4,000	25,011	4,000	4,000		48V	240V, 1ϕ
61	Tana River	Kitere secondary school	4,000	25,011	4,000	4,000		48V	240V, 1ϕ
62	Tana River	Mororo mixed day secondary school	4,000	25,011	4,000	4,000		48V	240V, 1ϕ
63	Narok	Losho Dispensary	4,000	25,011	4,000	4,000		48V	240V, 1ϕ
64	Narok	Iltriben primary school	4,500	28,137	4,500	4,500		48V	240V, 1ϕ
65	Garissa	Hara health center	8,500	53,147	8,500	8,500		48V	240V, 1ϕ
66	Garissa	Saretho Dispensary	8,500	53,147	8,500	8,500		48V	240V, 1ϕ

Table 7: Scope Details - Lot 6 (Lamu, Kilifi and Kwale Counties)

No.	County	Name of Facility	Minimum PV Capacity (Wp)	Minimum Battery Capacity (Wh)	Minimum PV Inverter *(for systems of PV capacity of 3kWp and above)* (W)	Minimum Battery Inverter Charger *(for systems of PV capacity below 3kWp)* (W)	Minimum Charge Controller *(for systems of PV capacity below 3kWp)* (A)	DC Voltage (V)	Nominal AC Voltage (V)
1	Lamu	Dide waride dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
2	Lamu	kizuke primary school	1,500	9,379		1,500	60	24V	240V, 1ϕ
3	Lamu	Maisha masha	1,500	9,379		1,500	60	24V	240V, 1ϕ
4	Lamu	Didewaride primary school	1,500	9,379		1,500	60	24V	240V, 1ϕ
5	Lamu	Pangani Secondary School	1,500	9,379		1,500	60	24V	240V, 1ϕ
6	Lamu	Sinambio dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
7	Lamu	Pandanguo primary school	1,500	9,379		1,500	60	24V	240V, 1ϕ
8	Lamu	Manda Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
9	Lamu	Manda Maweri Secondary School	1,500	9,379		1,500	60	24V	240V, 1ϕ
10	Lamu	Chalaluma primary school	1,500	9,379		1,500	60	24V	240V, 1ϕ
11	Lamu	Barigoni Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
12	Lamu	Basuba Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
13	Lamu	Bodhei Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
14	Lamu	Ishakani Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
15	Lamu	Mangai Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
16	Kilifi	Kurawa Secondary school	1,500	9,379		1,500	60	24V	240V, 1ϕ
17	Kilifi	Watala Secondary School	1,500	9,379		1,500	60	24V	240V, 1ϕ
18	Kilifi	Mwangatini Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
19	Kilifi	Gandini Assistant Chief's office	1,500	9,379		1,500	60	24V	240V, 1ϕ
20	Kilifi	Gandini Primary school	1,500	9,379		1,500	60	24V	240V, 1ϕ
21	Kilifi	Viragoni dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
22	Kilifi	Gandini dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
23	Kilifi	Karimboni dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ

No.	County	Name of Facility	**Minimum PV Capacity** (Wp)	**Minimum Battery Capacity** (Wh)	**Minimum PV Inverter** *(for systems of PV capacity of 3kWp and above)* (W)	**Minimum Battery Inverter Charger** *(for systems of PV capacity below 3kWp)* (W)	**Minimum Charge Controller** *(for systems of PV capacity below 3kWp)* (A)	**DC Voltage** (V)	**Nominal AC Voltage** (V)
24	Kilifi	Mulunguni dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
25	Kilifi	Muryachakwe Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
26	Kwale	Mbegani Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
27	Kwale	Chanzou Dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
28	Kwale	Mwachinga dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
29	Kwale	Gozani dispensary	1,500	9,379		1,500	60	24V	240V, 1ϕ
30	Lamu	Acc Kiunga	2,000	12,505		2,000	75	24V	240V, 1ϕ
31	Lamu	Basuba	2,000	12,505		2,000	75	24V	240V, 1ϕ
32	Lamu	Ishakani	2,000	12,505		2,000	75	24V	240V, 1ϕ
33	Lamu	Kiangwi	2,000	12,505		2,000	75	24V	240V, 1ϕ
34	Lamu	Madani	2,000	12,505		2,000	75	24V	240V, 1ϕ
35	Lamu	Mangai	2,000	12,505		2,000	75	24V	240V, 1ϕ
36	Lamu	Marararni	2,000	12,505		2,000	75	24V	240V, 1ϕ
37	Lamu	Pandanguo Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
38	Lamu	Kiangwi Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
39	Lamu	Bahamisi Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
40	Kilifi	Local Chief's Office	2,000	12,505		2,000	75	24V	240V, 1ϕ
41	Kilifi	Waresa Secondary School	2,000	12,505		2,000	75	24V	240V, 1ϕ
42	Kilifi	Kadaina Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
43	Kwale	Mkang'ombe Dispensary	2,000	12,505		2,000	75	24V	240V, 1ϕ
44	Lamu	Maisha Masha secondary	2,400	15,006		2,400	90	24V	240V, 1ϕ
45	Lamu	Majembeni Secondary School	2,400	15,006		2,400	90	24V	240V, 1ϕ
46	Kilifi	Chamari dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ
47	Kilifi	Midoina dispensary	2,400	15,006		2,400	90	24V	240V, 1ϕ

No.	County	Name of Facility	**Minimum PV Capacity** (Wp)	**Minimum Battery Capacity** (Wh)	**Minimum PV Inverter** *(for systems of PV capacity of 3kWp and above)* (W)	**Minimum Battery Inverter Charger** *(for systems of PV capacity below 3kWp)* (W)	**Minimum Charge Controller** *(for systems of PV capacity below 3kWp)* (A)	**DC Voltage** (V)	**Nominal AC Voltage** (V)
48	Kwale	Mbegani secondary	2,400	15,006		2,400	90	24V	240V, 1ϕ
49	Kilifi	Motoloani dispensary	4,000	25,011	4,000	4,000		48V	240V, 1ϕ
50	Kilifi	Shujaa Mekatilili Secondary	16,000	100,042	16,000	16,000		48V	415V, 3ϕ

1.3 Estimated Consumption and PV capacity for SPGP and BESS

1.3.1 The data collection consultant appointed by KOSAP developed details of each community facility taking into account load growth for the next 5 years. These were further revised in line with changing demand. For all sites, it is anticipated that the system will be installed within the community facility's compound and no additional land will need to be acquired or leased by the Contractor.

1.3.2 The bidder shall offer a complete design for each community facility SPGP and BESS based on the technical specification given in the following sections of this document and scope presented in clauses 1.1 and 1.2 above. The design of the Contractor (Successful Bidder) will be approved and the supplies will be made by contractor thereafter as per approved design and scope as per Employer's Requirement and Technical Specification (ERTS).

1.4 General Design Features

1.4.1 During the daytime, the Solar Power Generation Plant (SPGP) should supply power directly to the Loads in online mode, along with charging of the BESS in continuous mode with surplus solar energy, until the batteries are fully charged. On most non-cloudy days during the year ("regular day"), batteries should get fully charged during the day time. In evening or morning (Sun period) battery should support the SPGP to meet the load, if required.

1.4.2 Estimated energy consumption pattern:

i) Estimated energy consumption for health clinics will be weighted 70% during daytime hours (6 AM through 6 PM) and 30% of daytime consumption total during evening hours (6 PM through 6 AM).

ii) Estimated energy consumption for schools and ACC offices shall be weighted 60% during daytime hours (6 AM through 6 PM) and 40% of daytime consumption total during evening hours (6 PM through 6 AM).

1.4.3 During 6 PM to 7 AM, all loads will be powered from BESS as per requirement.

1.4.4 BESS is sized in such a way that it should not go beyond a depth of discharge of 80% for Lithium Ion batteries, considering expected load growth for next 5 years.

1.4.5 The size of the BESS should be dimensioned to allow approximately 1.2 days of autonomy since these systems do not include generators to serve load during periods of high cloud cover.

1.4.6 A properly dimensioned Battery Management System (BMS) should be in place for managing the state of charge and state of health of the BESS.

1.4.7 SPGP and BESS will operate in remote locations where there will be no grid availability in the foreseeable future.

1.4.8 The system should be capable of modular expansion.

1.4.9 All the solar equipment, batteries, charge controllers and inverters should be at minimum height of 300mm from finished floor level so as to ensure safety from flooding. Foundations should be concrete or employer approved alternative such that they can withstand annual low-level flooding for the lifetime of the Stand Alone System. Support structure and foundations shall be designed so as to withstand adverse weather conditions. Balance of system components, including but not limited to underground cables shall be rated for conditions of use, including low-level flooding.

1.4.10 Solar panels shall be ground mounted. Foundations shall be of concrete, steel pile or alternative such that they can withstand annual low-level flooding for the lifetime of the SPGP. In all cases, the land area will be within the compound of the community facility. In the event that ground mounting is not viable, panels shall be mounted on facility roof or other mounting structure or on roof of enclosure to house battery and other equipment; assuming structural engineering calculations are provided to substantiate the safety of the mounting configuration and the proper tilt angle and direction is achieved for optimum generation upon approval of the employer.

1.4.11 All foundations and Steel support structures shall conform to the Contract civil specifications, and relevant associated British Standards for Steel, Concrete and drainage works as well as relevant associated American Standards for roads and earthworks.

1.4.12 The bidder to provide suitable weather proof housing enclosure as detailed in clause 4.14 for holding batteries, inverters, solar energy export meter and other accessories whose design is to be approved by employer.

1.4.13 Metering will be done for every connection of community facility (as per KPLC norms). Customer meters will be supplied by employer. Solar energy export meter to be supplied by the winning bidder.

2. SOLAR POWER GENERATION PLANT

2.1 Scope of Supply & Work of SPGP

2.1.1 Scope of supply & work includes all design, engineering, procurement & supply of equipment, and materials, inspection by third party and witnessed by officers nominated by the Employer, packing and forwarding, supply, unloading at site, associated civil works, services, permits, installation and incidentals, insurance at all stages, erection, metering, testing and commissioning of SPGP with associated equipment and materials on turnkey basis.

2.1.2 The equipment and materials for PV SPGP with associated BESS shall include but not be limited to the supply, erection, testing & commissioning of the following:

2.1.2.1 Solar PV modules (either monocrystalline silicon or polycrystalline silicon), Module Mounting Structures (MMS), that may include piles, foundations, bolts, and nuts for holding structures and module interconnection.

2.1.2.2 Array junction boxes, combiner boxes, and distribution boxes having fuse boxes, MCBs, surge arrestors, earthing, and lightning protection also as per requirement.

2.1.2.3 Inverters with data acquisition capability.

2.1.2.4 Digital voltage meter and ammeter, revenue-grade kWh meters and protection relays along with battery.

2.1.2.5 DC cables including end terminations and other required accessories.

2.1.2.6 Control cables including end terminations and other required accessories.

2.1.2.7 415 V and 240 V AC power cables including end terminations and other required accessories for AC side of plant.

2.1.2.8 BESS Lithium Ion (including battery Inverter and charger) associated with battery system complete with battery racks.

2.1.2.9 Internal 240 volts, 415 volts, interconnection.

2.1.2.10 Early Streamer Emission (ESE) lightning arrestors.

2.1.2.11 Suitable electrical conduit, raceway, cable tray, and/or accessories/trenches.

2.1.2.12 Protection /isolation systems.

2.1.2.13 Earthing system for PV array, DC power system, AC power system and lightning protection system along with firefighting tool kit and first aid tool kit.

2.1.2.14 Security equipment such as a perimeter fence, locked gate, anti-theft mechanisms, and other physical or cybersecurity measures as necessary.

2.1.2.15 Fire protection and firefighting equipment, fire extinguishers, warning signage, danger Plates, name plate etc.

2.1.2.16 Solar meter for recording export of solar energy; meter to record export of energy as applicable per Grid code.

2.1.2.17 Transportation of equipment to site.

2.1.2.18 Loading & unloading of all supplied equipment and installation on foundations at their respective places.

2.1.2.19 Testing, maintenance and monitoring equipment.

2.1.2.20 Mandatory spares & consumable spares for 7 years.

2.1.2.21Any other equipment / material required to complete the SPGP on turnkey Basis.

2.1.2.22 Disposal of solid waste, e-waste etc

2.1.2.23 Receipt, unloading, storage, erection, testing and commissioning of all supplied material.

2.1.2.24 Construction of all necessary civil works, earthworks, foundations, housing enclosures, roof mountings, fencing works and any other works for completion.

2.2 Scope of SPGP and Auxiliary Systems

2.2.1 Bidder's scope includes design of SPGP and its associated electrical & mechanical auxiliary systems including preparation of single line diagrams, electrical lay outs, electrical and physical clearance diagrams, design calculations, indoor and outdoor lighting/illumination, erection key diagrams, installation drawings etc., design memorandum and other relevant drawings and documents required for engineering of all facilities within the fencing to be provided under this contract.

2.2.2 Civil works shall be performed with respect to the following but not limited to:

i) Conducting topographical survey of the SPGP area.

ii) Conducting Geotechnical Investigations

iii) Clearing of vegetation, Earthworks, Site grading, Access roads, Gravel, Drainage, Boundary fencing, site restoration.

iv) Design and construction of module mounting structures.

v) Appropriate well ventilated, suitable housing enclosures for BESS, inverters, charge controllers, solar energy export meters and other equipment.

vi) Appropriate ventilation for BESS thermal performance.

vii) Civil foundation works as required.

2.2.3 Pre-commissioning & commissioning of all supplied equipment. Test running of solar power generation plant as well as load trials at site based on pre-defined commissioning plan, prior to handover and implementation of maintenance contract.

2.2.4 Any other items not specifically mentioned in the specifications but which are required for erection, testing and commissioning in every respect and for safe and efficient operation and guaranteed performance of the SPGP are deemed to be included in the scope of the specification.

2.2.5 Obtaining statutory approvals /clearances from government departments related to Engineering, Procurement and Construction (EPC) work.

2.2.6 The Contractor shall arrange deployment of manpower and required consumables during commissioning.

2.2.7 Total operation & maintenance of solar photovoltaic power plant for the 7-year period including deployment of technical and security personnel full time or part time as necessary.

2.2.8 Submission of the following documents: drawings, data, design and engineering information to Employer or its authorized representative for review and approval in four copies with soft copy.

i) Detailed technical specification of all the equipment being supplied.

ii) Design criteria.

iii) Design calculations for cable size, Module Mounting Structures (MMS), foundations, earthing system, lightning protection zone etc.

iv) General arrangement and assembly drawings.

v) Topographical plan for the area before and after site grading activities.

vi) Solar insolation data and resource assessment.

vii) Schematic diagram for entire electric system.

viii) General Assembly (GA) drawings for all types of structures (including panel mounting structures and battery enclosures).

ix) Quality assurance plans.

x) Test report (Type, Acceptance and Routine tests).

xi) O&M instructions manuals and associated drawings.

xii) And all other necessary drawings

2.2.9 All drawings shall be fully corrected to agree with the actual "as built" site conditions and submitted (4 sets and one soft copy) to Employer after commissioning of the SPGP for record purpose.

2.2.10 The contractor shall generate, forward, or make accessible to the Employer

i) Schedule for various activities in Ms. Projects within a week from the date of detailed work order.
ii) Fortnightly site work progress report during construction period and
iii) Daily generation and weekly O&M reports after commissioning of the SPGP.

2.2.11 Preparation and supply of detailed operation and maintenance manual of SPGP

2.2.12 Establishing a system to maintain an inventory of spare parts and tools, equipment, consumables and supplies for the facilities and operation.

2.2.13 Employ and coordinate the training of personnel who will be qualified and experienced to operate and monitor the facility.

2.2.14 Adequate insurance coverage during EPC and O&M ontracts period.

2.3 Operation and Maintenance of SPGP

2.3.1 The Employer entrusts the total O&M activities of the SPGP (Solar Plant + BESS + Customer Connection) to the Contractor on turnkey basis for the 7 (seven) years O&M period as per Section IV, Schedule 6. The main activities of the contractor shall be:

(i) O&M of Solar Power Generation Plant with associated BESS
(ii) Maintain regular supply to the community facility for 7 years of O&M contract period after commissioning of SPGP

Note: The customers shall be billed on KPLC systems and payments shall be made to KPLC accounts during 7 years of O&M contract period.

2.3.2 The period of Operation and Maintenance of SPGP for 7 years shall be deemed to commence from the date of commissioning of SPGP.

2.3.3 The contractor (Successful Bidder) shall be responsible for all the required activities for the successful running (7 years O&M period), optimum energy generation & maintenance of the Solar Photovoltaic Power Generation Plant and Customer Connection covering:

i. Developing Operations and Maintenance manuals and maintenance schedules to be approved by the employer.

ii. Deployment of technical and supporting personnel as necessary and regulation of their Duties.

iii. Deployment of security personnel, as necessary, and regulation of their duties.

iv. Successful running of SPGP according to best practices for optimum energy generation.

v. Operation and Maintenance including timely supply and installation of all necessary replacement of equipment and materials.

vi. Monitoring, controlling, troubleshooting, maintaining of records, registers.

vii. Supply of all spares, consumables and fixing / application, replacement of damaged modules, inverters, batteries, and other equipment/material etc. required during O&M period of 7 years.

viii. Supply & use of consumables (throughout 7 years O&M period) as per recommendations of the equipment manufacturers.

ix. Conducting periodical checking, testing, overhauling and preventive action.

x. Periodic general up-keeping including cleaning of all equipment, housing enclosures, amenities, SPGP land area etc.

xi. Maintain accurate and up-to-date operating logs, records and reports regarding the operation and maintenance of the Plant which shall include details of power output, other operating data, repairs performed, status of equipment and all other such records to be maintained for the complete O&M period of 7 years. Upon expiry of the O&M term, the Contractor shall hand over such records to the Employer. However, Employer shall have access to all such records at any time during O&M period.

xii. Submission of periodical (monthly, quarterly and annual) reports to Employer on the energy generation (including plant availability details), operating conditions, breakdowns/loss of supply (reported date and start time of breakdown, action taken, resolution time and acknowledgement by the beneficiary of the resolution of the breakdown) of the SPGP.

xiii. Taking care of the full security aspects of the SPGP.

xiv. For all systems, insurance covering all risk (Fire & allied perils, earthquake, terrorist acts, floods, storms and burglary.

xv. Attending to breakdowns on the customer connections

2.3.4 Spare parts during O&M period: the Contractor should ensure sufficient stocks of spare parts of all SPGP equipment including spare parts of major equipment (SPV modules, inverters, batteries, charge controllers and service cables) are always available during the O&M period to be able to promptly attend to breakdowns and meet performance requirements stated in O&M Particular Conditions of Contract (PCC). The cost of spare parts for the 7 year O&M period should be included in the O&M quoted cost.

One year spares of the system should be readily available with Contractor. Stock position of spares / consumable spares shall be reviewed and recouped every quarterly basis so that requisite stock is always available and consumer does not suffer.

2.4 Operation and Maintenance Period

2.4.1 Operation and Maintenance of the Solar Photovoltaic Power Generation Plant is required for a period of 7 (seven) years from the date of commissioning of the SPGP which shall be carried out at quoted O&M services cost as per Section IV, Schedule -6. The cost of Operation and Maintenance includes supply and installation of all necessary replacement equipment and materials, spares & consumable spares and all services detailed in foregoing and following clauses of ERTS. The bidder shall meet the cost of all spares and replacement of the same in the 7-years of the Operation and Maintenance period. The cost of Operation and Maintenance also includes all Environmental, Social, Health and Safety (ESHS) requirements including security requirements during the O&M period.

2.4.2 The bidder should note that the Employer will pay quarterly the O&M cost as per Section IV, respective Schedule -6 of each Community facility.

2.4.3 In the event that a site has to be dropped/ added from the O&M schedule, the O&M cost of that site shall be determined in the ratio of the SPV solar capacity with respect to the O&M contract price.

2.5 Monitoring of SPGP During O&M Period

2.5.1 In order to ensure optimum operation of the SPGP, operation procedures such as preparation to start, routine operations with safety precautions, monitoring of SPGP etc. shall be carried out as per the manufacturer's instructions.

2.5.2 Cleaning of modules, logging of voltage, current, power factor, power and energy output of the SPGP will be the responsibility of the contractor. The SPGP operator shall also note down failures, interruption in supply and tripping of different relays, reason for such tripping, duration of such interruption etc. Another task of the operators is to check battery parameters. The operator shall record monthly energy output, down time etc.

2.6 Maintenance of SPGP Over the O&M Period

2.6.1 The contractor shall carry out the periodical plant maintenance as given in the manufacturer's service manual and perform at least minimum requirement of preventive maintenance of the SPGP plant and the customer connection.

2.6.2 Regular periodic checks of the modules, inverters, BESS, Customer Connection etc, shall be carried out as a part of routine preventive maintenance.

2.6.3 Preventive maintenance shall include checking of all electrical connections, cables etc. wherever required or any other activity that may be required for proper functioning of the installation and Consumer Connections.

2.6.4 In order to meet the maintenance requirements, stock of consumables is to be maintained as well as various recommended spares by the manufacturer.

2.6.5 Particular care shall be taken for outdoor equipment to prevent corrosion. Cleaning of the junction boxes, cable joints, insulators etc. shall also be carried out frequently.

2.6.6 Resistance of the earthing system as well as individual earthing is to be measured and recorded frequently. If the earth resistance is more than 1-ohm, suitable action is to be taken to bring down the same.

2.6.7 According to the recommendations, stock of special tools and tackles shall be maintained for Modules, inverters and other major electrical equipment.

2.6.8 A maintenance record register is to be maintained by the contractor to record the regular maintenance work carried out as well as any breakdown maintenance along with the date of

maintenance, reasons for the breakdowns, steps taken to attend the breakdown, duration of the breakdown etc.

2.6.9 The maintenance schedules will be drawn such that some of the jobs other than breakdown, which may require comparatively long stoppage of the SPGP, shall be carried out preferably during the overnight period.

2.6.10 The Contractor shall deploy enough manpower at solar photovoltaic power generation plant site to carry out work

i) As per O&M manuals and

ii) As specified in preventive maintenance schedules.

2.6.11 The Contractor will attend to any breakdown jobs immediately for repair/replacement /adjustments and complete at the earliest working round the clock. During breakdowns (not attributable to normal wear and tear) at O&M period, the Contractor shall report accidents if any, within 24 hours, to KPLC showing the circumstances under which it happened and the extent of damage and or injury caused. Accident reporting should also be done as per requirements and timelines stipulated in The Energy Act, 2019 and the Occupational Safety and Health Act, 2007. This applies during the Supply and Installation phase and the Operations and Maintenance phase.

2.6.12 If negligence / mal-operation of the contractor's operator results in failure of any equipment then such equipment should be repaired/replaced by contractor at free of cost.

2.6.13 The Contractor shall comply with the provision of all relevant acts of National or Concerned County Governments including Employment Act, Workmen's Compensation Act, Labour Relations Act, Trade Disputes Act, Energy Act 2019 and any other relevant laws.

2.6.14 The contractor shall at their own expense provide all amenities to their workers as per applicable laws and rules.

2.6.15 The Contractor shall ensure that all safety measures are taken at the SPGP to avoid any accident to Contractor’s or sub-contractor’s workers or members of the public.

2.6.16 The Contractor is fully responsible for defects and equipment failure during the 7 years O&M period.

2.6.17 The energy supplied by SPGP shall be recorded by Joint Member Reading Team (comprised of contractor and client) at time intervals as advised by the employer, at Metering Set

located at plant termination Distribution Point.

2.7 Breakdown/Corrective Maintenance of Stand Alone Systems and associated Customer Connection as per Requirements/specifications of KPLC

2.7.1 During the term of the O&M Contract (7 years), the contractor shall ensure that the following requirements are met for maintiaining regular supplies to customers:

a) Ensure electricity supply as per KPLC Requirements.
b) Complaints lodged by consumers to be attended to promptly and as per performance requirements stated in O& M Particular Conditions of Contract (PCC).
c) Maintain sufficient spares to cater for replacement and restore supply to customers within time as per performance requirements stated in O&M Particular Conditions of Contract (PCC).
d) Scheduled outages to be conveyed in advance to the consumer as per KPLC requirements/standards.
e) The Key Performance Indicators in Table 8 below shall apply.

2.7.2 Applicable penalties for failure to meet the stated KPIs shall be as per O&M contract (O&M PCC, Volume 1)

2.8 Key Performance Indicators

Table 8: Key Performance Indicators

	O&M Key Performance Indicator	**Expected value**	**How to measure**
1	Minimum uptime of the SPGP (Plant Availability) and customer connection throughout the quarter per site.	95%	The Plant Availability (PA) will be calculated as a percentage to represent the time that the power plant is available to provide energy.
2	The minimum acceptable Performance Ratio (PR) of the SPGP per site.	0.78	For PR measurement Refer to chapter 12 of this document
3	Quarterly MTTR – Mean Time To Repair power loss/breakdown of the SPGP per lot.	3 days	This will be the average time taken by the Contractor to carry out repairs.

4	Annual MTBF[2] – Mean time between failures/breakdowns per site.	30 days	This is the recorded mean time between system failures/breakdowns of the SPGP and customer connection for each site.

Note: (1) Source of data shall be logs, records and reports referred to in various clauses of Volume 2 ERTS document such as clause 2.3.3 (2) The KPIs shall be revised annually

2.9 Quality Spares and Consumables

2.9.1 In order to ensure longevity & safety of the core equipment and optimum performance of the system the contractor shall use only Original Equipment Manufacturer (OEM) spares.

2.10 Tools and Tackles

2.10.1 The Contractor shall arrange for all the necessary tools for carrying out all the maintenance work. List of such tools to be furnished by the bidder.

[2] This metric represents the reliability of the power plant. This is the mean time between system failures. The MTBF represents the likelihood of failure.

3. STANDARDS AND SPECIFICATIONS

3.1 Standards and Specifications for SPGP and BESS

3.1.1 The standards and specifications to which equipment and material of SPGP and BESS shall comply are given in the table below:

Table 9: List of Standards

For Solar PV Panels	
IEC 61215	Design qualification and type approval for crystalline silicon terrestrial photovoltaic modules
IEC 61701	Salt mist corrosion testing of photovoltaic (PV) modules
IEC 61853- Part 1	Photovoltaic (PV) module performance testing and energy rating: Irradiance and temperature performance measurements, and power rating
IEC 61730-1,2	Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction, part 2: Requirements for testing
IEC 62804	Photovoltaic (PV) modules - Test methods for the detection of Potential-Induced Degradation (PID). IEC TS 62804-1: Part 1: Crystalline silicon (Mandatory for system voltage is more than 600 VDC and advisory for system voltage is less than 600 VDC)
IEC 62759-1	Photovoltaic (PV) modules – Transportation testing, Part 1: Transportation and shipping of module package units
IEC 62716	Photovoltaic (PV) Modules – Ammonia (NH3) Corrosion Testing
For Inverters	
IEC 62109-1, IEC 62109-2	Safety of power converters for use in photovoltaic power systems Safety compliance (Protection degree IP 65 for outdoor mounting, IP 54 for indoor mounting)
IEC/IS 61683 (For stand Alone System)	Photovoltaic Systems – Power conditioners: Procedure for Measuring Efficiency (10%, 25%, 50%, 75% & 90-100% Loading Conditions)
IEC 62891	Overall efficiency of grid-connected photovoltaic inverters:
IEC 62116/ UL 1741/ IEEE 1547	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures

IEC 60255-27	Measuring relays and protection equipment - Part 27: Product safety requirements
IEC 60068-2 (1, 2,14, 27, 30 & 64)	Environmental Testing of PV System – Power conditioners and inverters
IEC 61000- 2,3,5	Electro- magnetic interference (EMI), and Electro-Magnetic Compatibility (EMC) testing of PV inverters (as applicable)
IEC 62909- 1 IEC 62909- 2	Bi-directional grid connected power converters – Part 1: General requirements Bi-directional grid connected power converters - Part 2: Interface of GCPC and distributed energy resources and additional requirements to Part 1
EN 50530	Overall efficiency of grid-connected photovoltaic inverters
IEC 62509	Battery charge controllers for photovoltaic systems - Performance and functioning
For Fuses	
IEC 60947 (Part 1, 2 & 3), EN 50521	General safety requirements for connectors, switches, circuit breakers (AC/DC)
IEC 60269-6	Low-voltage fuses - Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic systems
For Cables	
IEC 60227, IEC 60502	General test and measuring method for PVC (Polyvinyl chloride) insulated cables (for working voltages up to and including 1100 V, and UV resistant for outdoor installation)
BS EN 50618	Electric cables for photovoltaic systems (BT(DE/NOT)258), mainly for DC cables
For Earthing /Lightning	
IEC 62561 Series (Part 1,2 &7) (Chemical earthing)	IEC 62561-1 Lightning Protection System Components (LPSC) - Part 1: Requirements for connection components IEC 62561-2 Lightning Protection System Components (LPSC) - Part 2: Requirements for conductors and earth electrodes IEC 62561-7 Lightning Protection System Components (LPSC) - Part 7: Requirements for earthing enhancing compounds

For Internal wiring	
IEC 60364	Electrical installation guide
For Surge arresters/ Lightning arresters	
NFC17-102	E S E lightning conductor / arrester
IEC 99-4 Part.4	Surge arresters without gap for AC system.
IEC 61643-11:2011	Low-voltage surge protective devices – Part 11: Surge protective devices connected to low voltage power systems – Requirements and test methods
Specification for Steel structure	
ISO 1461	Metallic Coating- Hot dip galvanized coating on fabricated ferrous products-Requirements
BS 5950	Steelworks design guide – Structural use of steelwork in building
BS EN 1011 Part 1	Welding recommendations for welding of metallic of materials. General guidance for arc welding.
BS EN 10056-1	Specification for structural steel equal and unequal angles.
BS EN 10025	Hot rolled products of structural steel
BS 6722	Recommendations for dimensions of metallic materials.
BS 4 Part 1	Structural steel selections. Specification for hot-rolled sections
BS EN 20273	Fasteners. Clearance holes for bolts and screws
BS 4-1:2005	Structural steel sections. Specification for hot rolled section
KS 02-572	Specification for hot-rolled structural steel sections
ENA TS 43-95	Steelwork for Overhead lines
Specification for Fasteners and Washers	
ISO 898-1&-2	Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs with specified properties classes – Part2: Nuts with specified properties classes—Coarse thread and fine pitch.
ISO7094	Plain washers with round holes for wood construction

ISO 965-2	ISO general purpose metric screw threads—Tolerances –Party 2: Limits of sizes for general purposes external and internal screw threads – Medium quality.
ISO 262	ISO general purpose metric screw threads – selected sizes for screws, bolts and nuts
ISO 68-1	ISO general purpose screw threads—Part1: Basic profile
ISO 6157-1&3	Fasteners—Surface discontinuities –Part1: Bolts, Screws and studs for general requirements; screws and studs for special requirement.
ISO 2859-1	Sampling procedures for inspection by attributes—Part 1: Sampling schemes indexed by the Acceptance Quality Limit (AQL) for lot by lot inspection
BS EN 14399-1, 3&6	High strength structural bolting assemblies for preloading. Part 1: General requirements; Part 3: Hexagon bolt and nut assemblies; Part 6: Plain chamfered washers.
BS 4190	ISO metric black hexagonal bolts, screws and nuts
DIN 436	Square washers with round hole for wood construction
ISO 1461	Hot dip galvanized coating on fabricated iron and steel articles specifications and test methods
Specification for civil materials and associated works	
ASTM A 392	Standard Specification for Zinc-Coated Steel Chainlink fence fabric
ASTM A 120	Specification for Pipe, Steel, Black and Hot-Dipped Zinc-coated (Galvanized) welded and seamless
ASTM F 626	Standard Specification for Fence fittings
ASTM A 121	Barbed wire: ASTM A 121, 2.51 mm diameter wire in strand (No.12-1/2 gauge), 2 strands with 4-point barbs spaced at 125 mm, Class 3 zinc coating
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
BS 8301	Code of practice for Building Drainage
BS 6031	Code of practice for Earthworks

BS CP 2005	Sewerage design and Construction
AASHTO T99	Standard Method of Test for moisture-density relations of soils using a 2.5kg rammer and a 305mm drop
BS 1377	Methods of test for soils for civil engineering purposes
AASHTO T180	Standard Method of Test for moisture-density relations of soils using a 5.4kg rammer and a 457mm drop
AASHTO T193	Standard Method of Test for the California Bearing Ratio
BS 882	Specification for aggregates from natural sources for concrete
BS 4449	Specification for the use of Structural steel in building
BS 8110	Structural Use of Concrete
BS 8004	Code of Practice for Foundations
BS 12	Specification for Portland Cement
BS 5950	Structural use of steelwork in building
BS 1490	Aluminium Alloy Specification

3.2 Guidelines and Grid Codes

a) Energy Act 2019

b) Draft Energy Solar Photovoltaic Systems Regulations 2019 or updated draft/ adopted regulations

c) Kenya National Distribution Grid Code (KNDC), April 2017

d) Connection guidelines for small scale renewable generating plant guidelines: Dec 2012

e) BS 7430: 1999: Code of practice for earthing.

f) BS 7354: Code of practice for design of open terminal stations.

g) BS 7671 2008 Requirements for electrical installations IEEE wiring regulations: seventeenth edition.

4. TECHNICAL SPECIFICATIONS FOR SOLAR POWER GENERATION PLANT

4.1 Solar PhotoVoltaic(SPV) Crystalline Modules

4.1.1 SPV Poly / Mono crystalline modules of minimum 60-cell with minimum 18% efficiency.

4.1.2 In picking the capacity of modules ensure they offer high currents in the PV array design to meet battery-charging needs.

4.1.3 Solar modules offered shall be

i) Certified as per IEC 61215 /ISI14286

ii) Qualify IEC 61730- Part -1: PV Module Safety Qualification Part -1 Requirement for Construction.

iii) Qualify IEC 61730- Part -2: PV Module Safety Qualification Part -2 Requirements for Testing.

4.1.4 As SPV modules shall be used in highly corrosive atmosphere throughout their life time so they must qualify IEC 61701.

4.1.5 Solar PV Module design shall conform to following requirement:

i) Weatherproof, DC rated MC4 connector and a lead cable coming out as a part of the module, making connections easier and secure, not allowing any loose connections.

ii) Resistant to water ingress, abrasion, hail impact, humidity, sea water & other harsh environmental factors for the worst situation at site.

4.1.6 Module rating is considered under standard test conditions; however Solar Modules shall be designed to operate and perform under site conditions including high temperature, dusty conditions, high humidity and corrosive atmosphere.

4.1.7 Identification and Traceability

Each PV module shall have Radio Frequency Identification (RFID) tag. The following information must be mentioned in the RFID used on each module. This can be inside or outside the laminate, but must be able to withstand harsh environmental conditions.

i) Name of the manufacturer of SPV module.

ii) Name of the manufacturer of Solar cells.

iii) Month and year of the manufacturer (separately for solar cell and module).

iv) Country of origin (separately for solar cell and module).

v) I-V curve for the module.

vi) Peak wattage, Im, Vm and PF for the module.

vii) Unique Serial No and Model No of the module.

viii) Date and year of obtaining IEC SPV module qualification certificate

ix) Name of the test lab issuing IEC certificate

x) Other relevant information on traceability of solar cell and module as per ISO 9001and ISO14001.

4.1.8 Warranties for Modules

4.1.8.1 Product Warranty

The manufacturer should warrant the solar module(s) to be free from the defects and/or failures specified below for a period not less than ten (10) years from the date of sale to the original customer ("Employer")

i) Defects and /or failures due to manufacturing.

ii) Defects and/or failures due to quality of materials.

iii) Non-conformity to specifications due to faulty manufacturing and/ or inspection processes.

4.1.8.2 Performance Warranty

The predicted electrical degradation of power generated not exceeding 20% of the minimum rated power over the 25-year period and not more than 10% after ten years period of the full rated original output.

Bidder shall provide data sheet for solar PV module (under standard testing condition) along with their offer as per Guaranteed Technical Particulars.

4.1.9 Module Mounting Structure (MMS)

4.1.9.1 The MMS to be used for mounting the SPV modules shall be as under:

i) Fixed-tilt type.

ii) Azimuth: 0º True South/North as per site location.

iii) Tilt angle: 10º- 15º tilt angle shall be provided for all sites with adequate spacing to prevent inter-row shading.

4.1.9.2 Structure shall comply with IEC 61215/61646.

4.1.9.3 The mounting steel structure and its galvanizing shall be as per standards listed above.

4.1.9.4 The mounting structure shall be suitably designed for mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads along with applicable wind loads to the base properly.

4.1.9.5 While designing of MMS additional care is needed to ensure that the material size used is capable to withstand the wind forces generated on account of heavy wind speed of respective sea wind zone. MMS with documented results of wind tunnel testing and resonant frequency dampening are preferred.

4.1.9.6 To reduce the pressure on structure and foundation, clear spacing between two adjacent modules shall be sufficient to allow wind passage.

4.1.9.7 The minimum clearance between the lower edge of the modules and developed ground level shall be adequately elevated above relevant flood plain.Minimum 1000mm and to employers approval

4.1.9.8 For ground-mounted systems, contractor has to choose suitable foundation design(s) depending on soil conditions, geographical condition, regional wind speed, bearing capacity, slope stability etc.

4.1.9.9 The structure shall be designed to allow replacement of any module.

4.1.9.10 The Contractor (successful bidder) shall furnish detailed design calculation.

4.1.9.11 Nuts & bolts, supporting structures including module mounting structures shall have to be adequately protected against all climatic conditions prevailing in the area.

4.1.9.12 All fasteners shall be of stainless steel of grade SS 304 or suitable equivalent.

4.1.9.13 The mounting structure shall be grounded properly using maintenance-free earthing kit.

4.1.9.14 The mounting structure & foundation shall be designed to withstand applicable speed of wind zone of the applicable site as given in relevant International/Kenya wind load codes / standards. Suitable fastening arrangement such as grouting and clamping should be provided to secure the installation against the specific wind speed. The contractor shall ensure that the design has been certified by a recognized lab/ institution in this regard and submit the same to Employer.

4.2 PV Inverter

4.2.1 Systems having 3kWp or more of PV capacity shall have a PV Inverter. The capacity of the PV inverters shall be as per Tables 2-7.

4.2.2 The efficiency of the Inverter shall be more than 93% at full load.

4.2.3 Supply Voltage and Variation

i) Supply voltage Single Phase, 230V AC for systems upto 10kWp; Supply voltage Three phase, 400V AC for systems bigger than 10kWp as shown in Tables 2-7.
ii) Voltage variation (+10% to – 10%),
iii) Frequency variation 50+/-1.5 Hz
iv) Total harmonic voltage distortion less than 3% to synchronize with standard /local grid.

4.2.4 The inverter shall have high overload capacity/ surge capability of at least twice the rated capacity. The Bidder should specify the overload capacity in the bid.

4.2.5 String inverter(s) as per design shall be of requisite numbers to meet the minimum capacity or more as per requirement of each site as given in Tables 2-7; at a suitable DC/AC ratio as specified for the inverter.

4.2.6 A Maximum Power Point Tracker (MPPT) shall be integrated into the inverter to maximize energy drawn from the solar PV array. MPPT shall be microprocessor/micro controller based to minimize power losses and maximize energy utilization. The details of working mechanism of MPPT shall be mentioned by the Bidder in its proposal. The MPPT unit shall be integrated in to the inverter or conform to IEC 62093 for design qualification.

4.2.7 Inverter should comply with IEC 61683 for efficiency and measurements and should comply with IEC 60068-2 for environmental testing.

4.2.8 The inverter shall be capable of controlling power factor dynamically and be equipped with components required to support reactive power.

4.2.9 The Inverters shall be designed for continuous, reliable power supply as per specification and shall have internal protection arrangement against any sustained fault in the feeder line and against lightning strikes in the feeder line.

4.2.10 The inverter shall have the required protection arrangements against earth leakage faults.

Specifically, the inverter shall be singlephase power conditioning unit using static solid-state components.

4.2.11 The inverter shall be suitably designed for parallel operation. Each solid-state electronic device shall have to be protected to ensure long life of the inverter as well as smooth functioning of the inverter.

4.2.12 The inverter must have the feature to work in tandem with other similar inverters and be able to be successively & automatically switched "ON" and "OFF" based on solar radiation variations during the day.

4.2.13 Degree of protection of the indoor inverter shall be at least IP-54 and that of outdoor at least IP-65.

4.2.14 The system should be capable of providing all the data including that of SPV energy meter and inverter to the central software on IEC-104 protocol. All the equipment/hardware /software for complying with the same will be in the Bidder's scope.

4.2.15 Communication interface shall be an integral part of inverter and shall be suitable to be connected to local data monitoring system and also remotely via the web.

4.2.16 The inverter shall have the capability to store data for at least 6 months.

4.2.17 Inverter front panel, supplemental metering, or remote monitoring interface shall be provided with display or remote monitoring of the following:

i) DC power input
ii) DC input voltage
iii) DC current
iv) AC output power
v) AC voltage
vi) AC current

4.2.18 Both AC & DC lines shall have suitable fuses, surge arrestors and contactors to allow safe start up and shut down of the system. Fuses used in the DC circuit should be DC rated.

4.2.19 Protection required in Inverter

i) Input side disconnection switch
ii) Ground fault monitoring

iii) DC reverse polarity protection
iv) DC over voltage / current limitation protection
v) AC short circuit protection
vi) AC over voltage / current limitation protection
vii) DC and AC side surge protection (Metal Oxide Varistor (MOV) built-in)
viii) Any other protection in view of battery.
ix) Anti-islanding protection

4.2.20 The inverter shall include appropriate self-protective and self-diagnostic features to protect itself and the PV array from damage in the event of inverter component failure or from parameters – beyond the inverter's safe operating range due to internal or external causes.

4.2.21 Inverter shall go to shutdown/standby mode, with its contacts open, under the following conditions before attempting an automatic restart after an appropriate time delay.

i) When the power available from the PV array is insufficient to supply the losses of the inverter, the inverter shall go to standby/shutdown mode.
ii) The inverter control shall prevent excessive cycling of shut down during insufficient solar irradiance.

4.2.22 Operation outside the limits of power quality as described in the technical data sheet should cause the inverter to disconnect the system. Additional parameters requiring automatic disconnection are

i) Neutral voltage displacement
ii) Over current
iii) Earth fault
iv) And reverse power

In each of the above cases, tripping time should be low enough to protect the inverter.

4.2.23 Internal surge protection shall consist of three MOV type surge-arrestors connected from positive and negative terminals to earth (via Y arrangement).

4.2.24 The inverter shall be compatible with the Battery Energy Storage System (BESS) as specified in subsection 4.3 below

4.3 Battery Energy Storage System (BESS)

4.3.1 Supply of Battery Energy Storage System (BESS) with Lithium-ion Battery Power Packs,

conforming to IEC standards. No additional / alternative battery chemistries will be considered.

4.3.2 BESS must meet the minimum capacity requirements given in Tables 2-7 for each site and complete in all respects.

4.3.3 The BESS must have minimum 80% Depth of Discharge (DOD).

4.3.4 Warranted number of cycles/ cycle life should be minimum 3,700 cycles at 80% DOD and at a minimum temperature of 25°C.

4.3.5 The Battery Voltage should be 24VDC for sites with less than 3kWp PV capacity and Battery Voltage of 48VDC for sites with 3kWp and above of PV capacity as given in Tables 2-7. Equipment to have matching voltages (Batteries, Battery inverter, Charge Controller). Batteries should achieve specified capacities (Wh) at the stated voltage.

4.3.6 Enclosures should conform to IP54 for Indoor /IP65 or better for outdoor.

4.3.7 All accessories for correct installation, foundation, connection, controls, and operation of BESS should be provided together with BESS.

4.3.8 Batteries are charged by Battery Inverter / Charger. Thus, batteries charging mechanism should be part of the BESS.

4.3.9 A properly dimensioned Battery Management System (BMS) should be in place for managing the state of charge and state of health of the BESS.

4.3.10 Guaranteed minimum service life of Lithium Ion BESS shall be minimum 10 years with Warranty of 10 years. If due to any reason battery requires to be replaced, then the Contractor is to replace the same in warranty period without any extra cost to the Employer.

4.3.11 Load demand requirement of each site, design concept of BESS, Inverter rating, Battery rating etc. elaborated in Tables 2-7. Contractor should submit the detailed drawing for approval demonstrating the meeting of load requirements of consumers for each community facility at design stage.

4.3.12 Suitable number of corrosion resistant and acid-proof storage racks shall be supplied to accommodate the cells, testers and other accessories. The rack design shall be such that minimum space is required, without any way obstructing the maintenance requirements. For metallic racks, standards specified for control panel enclosures and other metallic shall govern.

4.3.13 There shall be no environmental hazards caused due to:

i) Improper use and maintenance of the battery bank.

ii) Improper disposal of batteries at the time of replacement.

iii) Any manufacturing defects.

4.3.14 All technical and other details pertaining to the storage cells shall be supplied including but not limited to the following:

i) Rated voltage and Watt-hour capacity of each storage cell as the rated discharge rate,

ii) Permitted maximum DOD,

iii) Self-discharge rate,

iv) Cycle life of the storage cell and the anticipated life (in years) of the battery bank.

v) Total number of storage cells in use.

vi) Details on cell interconnections, if any

4.3.15 The system should allow for the load current to be supplied at the same time as the battery charging current.

4.3.16 Contractor shall submit (in 4 sets) complete design and expected performance of BESS calculations, drawings, reports and data for approval of the Employer during detailed engineering. The design of BESS with critical parameters such as response time discharge duration, Depth of discharge, frequency of discharge, cycle life, round trip cycle efficiency performance degradation, self-discharge characteristics, short time discharge rating, transient response characteristics, auxiliary system requirement etc. shall be included in the detailed engineering.

4.3.17 Suitable fire protection and suppression system shall be designed for BESS in line with IEC or international requirements/ specifications regulation as applicable for lithium-ion batteries and system requirement considering project site. Detailed hazard analysis and risk mitigation strategy shall be provided along with bid documents.

4.3.18 BESS conforming to International Safety and Electrical Standards shall be Complete in all respect consisting of:

i) Battery inverter/charger for supply voltage as per clause 4.4 below, wave type sinusoidal.

ii) Complete with programmable control and regulation parameters, protection system,

control system, surge protection system etc.

iii) Site Master Controller System. Charge controller for systems with PV capacity below 3kWp.

iv) Requisite numbers of battery pack, the combination of which shall equal or exceed the estimated capacity shown in design characteristics in Tables 2-7, with Minimum 80 % DOD,

v) Enclosures conforming to IP54 for Indoor /IP65 or better for outdoor.

vi) All accessories and connection for correct installation and operation of BESS.

vii) All cables for inter connection with main AC distribution board.

viii) Support structure to keep battery at a suitable clearance level from ground to take care of water flooding etc. The design shall be submitted to the employer before its implementation. Test certificate and test reports as per IEC62133, IEC61959 and IEC 61960 or other international equivalent standard applicable to battery technology shall be submitted for approval of the Employer. All other test certificate and test reports as per international standards and norms for BESS shall be submitted for approval of the Employer during submission of detailed engineering.

4.3.19 Suitable protection/isolation for the battery system should be provided with proper rating of fuses and isolators for DC application. This should be connected between battery bank and battery inverter/charger.

4.3.20 End-of-Life (EOL) plan for all batteries and other potentially hazardous e-waste at the end of its useful life. Bidder shall prepare and submit an EOL recycling and disposal plan for all batteries to be safely processed at a certified facility for the specific battery chemistry being proposed at each facility included in the proposal for each Lot. To the extent that the selected battery chemistry has some residual value as a result of the recycling process, this value can be considered as funds set aside to offset the handling and transport of materials at the end of their useful life. Any remaining cost obligations to ensure compliance with National and International laws and standards, must be set aside in an escrow reserve fund to be established by the Bidder.

4.4 Battery Inverter Charger

4.4.1 All sites shall have Battery Inverter Charger with capacities as specified in Tables 2-7.

4.4.2 The efficiency of the Inverter shall be more than 93% at full load.

4.4.3 The Inverters must be compatible with (able to charge) Lithium-ion Batteries

4.4.4 Supply Voltage and Variation

i) Nominal Input Voltage shall be 24VDC for systems with less than 3kWp PV capacity; Nominal Input Voltage shall be 48VDC for systems having 3kWp or more of PV capacity, as shown in Tables 2-7.
ii) Supply voltage shall be Single Phase, 230V AC for systems upto 10kWp; Supply voltage Three phase, 400V AC for systems bigger than 10kWp as shown in Tables 2-7.
iii) Voltage variation (+5% to – 5%)
iv) Frequency variation 50+/-1.5 Hz
v) Total harmonic voltage distortion less than 3% to synchronize with standard /local grid.

4.4.5 The inverter shall have high overload capacity/ surge capability of at least twice the rated capacity. The Bidder should specify the overload capacity in the bid.

4.4.6 Battery Inverter/charger to be bi-directional with power factor capability of at least 0.80 lagging to 0.80 leading.

4.4.7 Inverters to have pure sinewave output waveform.

4.4.8 Inverter should comply with IEC 61683 for efficiency and measurements and should comply with IEC 60068-2 for environmental testing.

4.4.9 The inverter shall be capable of controlling power factor dynamically and be equipped with components required to support reactive power.

4.4.10 The Inverters shall be designed for continuous, reliable power supply as per specification and shall have internal protection arrangement against any sustained fault in the feeder line and against lightning strikes in the feeder line.

4.4.11 The inverter shall have the required protection arrangements against earth leakage faults. Specifically, the inverter shall be singlephase power conditioning unit using static solid-state components.

4.4.12 The inverter shall be suitably designed for parallel operation. Each solid-state electronic device shall have to be protected to ensure long life of the inverter as well as smooth functioning of the inverter.

4.4.13 Degree of protection of the indoor inverter shall be at least IP-54 and that of outdoor at least IP-65.

4.4.14 The system should be capable of providing all the data including that of SPV energy meter and inverter to the central software on IEC-104 protocol. All the equipment/hardware /software for complying with the same will be in the Bidder's scope.

4.4.15 Communication interface shall be an integral part of inverter and shall be suitable to be connected to local data monitoring system and also remotely via the web.

4.4.16 The inverter shall have the capability to store data for at least 6 months.

4.4.17 Inverter front panel, supplemental metering, or remote monitoring interface shall be provided with display or remote monitoring of the following:

i) DC power input
ii) DC input voltage
iii) DC current
iv) AC output power
v) AC voltage
vi) AC current

4.4.18 Both AC & DC lines shall have suitable fuses, surge arrestors and contactors to allow safe start up and shut down of the system. Fuses used in the DC circuit should be DC rated.

4.4.19 Protection required in Inverter

i) Input side disconnection switch
ii) Ground fault monitoring
iii) DC reverse polarity protection
iv) DC over voltage / current limitation protection
v) AC short circuit protection
vi) AC over voltage / current limitation protection
vii) DC and AC side surge protection (Metal Oxide Varistor (MOV) built-in
viii) Any other protection in view of battery.
ix) Anti-islanding protection

4.4.20 The inverter shall include appropriate self-protective and self-diagnostic features to protect itself from damage in the event of inverter component failure or from parameters beyond the

inverter's safe operating range due to internal or external causes.

4.4.21 Operation outside the limits of power quality as described in the technical data sheet should cause the inverter to disconnect the system. Additional parameters requiring automatic disconnection are

i) Neutral voltage displacement
ii) Over current
iii) Earth fault
iv) And reverse power

In each of the above cases, tripping time should be low enough to protect the inverter.

4.4.22 Internal surge protection shall consist of three MOV type surge-arrestors connected from positive and negative terminals to earth (via Y arrangement).

4.4.23 The inverter shall be compatible with Lithium ion battery technology

4.5 Charge Controller

4.5.1 The bidder shall provide, integrate, install, configure, and commission a Charge Controller to manage and coordinate the performance of SPGP and BESS for all sites with less than 3kWp PV capacity as per Tables 2-7.

4.5.2 The Charge Controllers shall be Maximum Power Point Tracking (MPPT) type.

4.5.3 The Charge Controller input voltage is 24VDC

4.5.4 Output currents for the Charge Controllers for each site are given in Tables 2-7.

4.5.5 The charge Controller should have a display for voltage and current for load and solar. The display should also be able to display other parameters.

4.5.6 The Charge controller should be protected against short circuits, over currents and reverse connection.

4.5.7 The charge controller must have programmable settings for all voltage setpoints. These setpoints must be adjusted by the installer to match the temperature-adjusted battery charging and discharging curves in the anticipated ambient temperatures at the location of the batteries.

4.5.8 The Charge Controller should provide a low voltage disconnect to prevent over-discharging the battery array, and consistent with the settings and specifications of the battery warranty and

prudent operational practices.

4.5.9 The Charge Controller must provide a high voltage disconnect to prevent over-charging the battery array, and consistent with the settings and specifications of the battery warranty and prudent operational practices.

4.5.10 The Charge Controller must have programmable settings for the maximum current for both charging and discharging. These setpoints must be adjusted by the installer to match the temperature-adjusted Rates for charging and discharging within the battery warranty.

4.5.11 The Charge Controller should integrate with the Battery Management System (BMS) to ensure coordinated protection of the battery bank.

4.5.12 The Charge Controller should have multiple operating modes, for example Charge, Discharge, Float, Standby, which can be clearly communicated to the user via a Graphical User Interface (GUI), on-screen display, Bluetooth, wired connection, etc. System voltages, control settings, and setpoints should also be communicated via the on-screent display or equivalent user interface.

4.5.13 The Charge Controller should be protected from the battery system with DC over-current protection, breaker(s) and/or fuse(s).

4.5.14 The Charge Controller shall be accessible and configurable both remotely and on-site.

4.6 Hybrid Inverters

4.6.1 Hybrid Inverter for systems having PV capacity of less than 3kWp:

Systems having less than 3kWp PV capacity shall contain a Battery Inverter Charger and a Charge Controller. A separate Battery Inverter Charger and separate Charge Controller are specified in Tables 2-7. Bidders may propose to use a Hybrid Inverter instead i.e. an Inverter with an inbuilt MPPT Charge Controller, provided the Hybrid Inverter must meet all the below requirements:

- The Inverter meets the capacity requirements of Battery Inverter Charger specified in Tables 2-7 for the site.
- The inbuilt MPPT Charge Controller meets the Charge Controller capacity requirements i.e. Charge Controller charging currents specified in Tables 2-7 for the site.
- Meets the PV array input capacity specified in Tables 2-7. The Hybrid Inverter

documentation i.e. GTP and Technical Data Sheet, must clearly show it's rated for the minimum PV capacity specified.

- Meets all the specifications of Battery Inverter Charger specified in Clause 4.4 above.
- Meets all the specifications of Charge Controllers specified in Clause 4.5 above.
- Is rated for the required System Voltage of 24V.
- Is compatible with Lithium ion battery technology

4.6.2 Hybrid Inverter for systems having PV capacity of 3kWp and above:

Systems having 3kWp or more of PV capacity shall have a PV Inverter and a Battery Inverter Charger. A separate PV Inverter and separate Battery Inverter Charger are specified as per Tables 2-7. Bidders may propose to use a Hybrid Inverter instead, provided the Hybrid Inverter must meet all the below requirements:

- The Inverter meets the capacity requirements of Battery Inverter Charger specified in Tables 2-7 for the site.
- Meets the PV array input capacity specified in Tables 2-7. The Hybrid Inverter documentation i.e. GTP and Technical Data Sheet, must clearly show it's rated for the minimum PV capacity specified.
- Meets all the specifications of PV Inverter specified in Clause 4.2 above.
- Meets all the specifications of Battery Inverter Charger specified in Clause 4.4 above.
- Is rated for the required DC Battery voltage of 48V.
- Has Off-grid Operating Mode
- Is compatible with Lithium ion battery technology

4.7 Lightning & Over Voltage Protection

4.7.1 The SPGP shall be provided with lightning and over voltage protection connected to proper earth pits. Earthing pits shall be measured to have an earthing resistance of 10Ω or less at the time of installation. If this level cannot be obtained with the soil at the facility, then soil conditioning (engineered backfill) shall be implemented to improve the earthing resistance within acceptable

levels.

4.7.2 Lightning protection, placed at strategic locations, shall be used to protect the arrays against lightning protection. The bidder shall give detailed design to the employer, showing location of lightning conductor/masts and the protection coverage on array without causing any shadow on the modules.

4.7.3 All designs shall be submitted to the Employer before its implementation.

4.7.4 Necessary concrete foundation for holding the lightning conductor in position to be made after giving due consideration to maximum wind speed and maintenance requirement at site in future.

4.7.5 The lightning conductor shall be earthed through Copper conductor strips and connected to earth pits per applicable International Standards. Suitable number of earth pits shall be provided for each lightning arrestor. Each lightning conductor shall be fitted with individual earth pit as per required Standards including accessories.

4.7.6 Design calculations, technical specification and requisite test reports of lightning mast conforming to international standards along with detailed write up in 4 sets shall be provided for approval to the Employer.

4.8 Earthing Protection

4.8.1 Earthing system shall be as per KPLC requirements/specifications and as per standards in chapter 3.

4.8.2 Earthing system network / earth mat shall be of interconnected mesh as per KPLC requirements/specifications. The earth conductors shall be free from pitting, laminations, rust, scale and other electrical or mechanical defects.

4.8.3 Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, with the exception of solar panels, for which alternate means of code-compliant earthing shall be admissible if integrated with racking design.

4.8.4 Metallic sheaths / screens, and armor of multi-core cables shall be earthed at both ends. Metallic sheaths and armor of single core cables shall be earthed at switchgear end only unless otherwise approved.

4.8.5 Each continuous laid lengths of cable tray shall be earthed at minimum two places to earthing system, the distance between earthing points shall not exceed 30 meters. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground.

4.8.6 Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing.

4.8.7 Lightning protection system down conductors shall be terminated to separate earth electrodes & not be connected to other earthing conductors.

4.8.8 Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti-corrosive paint / compound.

4.8.9 Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.

4.8.10 Earth pit shall be constructed as per IEC standard specified in Table 9. Minimum spacing between electrodes shall be 2000 mm / as per KPLC requirements/ specifications. Earth pits shall be treated with salt and charcoal/chemical Powder Earthing.

4.8.11 Earth resistance at earth terminations shall be measured and recorded. All equipment required for testing shall be furnished by successful bidder.

4.8.12 Each array structure of the SPGP yard/shed shall be grounded properly as per standard. The Array Structure is to be connected to earth pits as per standards. Junction boxes shall be connected to the main earthing conductor/electrode.

4.8.13 The arrays shall be in protected zone of lightning arrester/spheres by installation of suitable lightning surge diverters/arrestors. The earth electrodes for the same shall have to be completely separate from the plant/array earthing.

4.8.14 All metal casing/shielding of the plant shall be thoroughly grounded in accordance with KPLC requirements/ specifications. Total earthing system installation shall be in strict accordance with KPLC requirements/ specifications.

4.8.15 Necessary test point provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.

4.8.16 All non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode.

4.8.17 Earthing Design and Layout

i) The successful bidder shall submit Design along with drawings showing the location of lightning arresters and protection zones to cover all arrays against lightning for approval from Employer.
ii) The earth mesh system design shall be submitted for approval of Employer.
iii) Total plant earthing system shall be designed to give an earth resistance of less than 1 ohm all along the earth mesh.
iv) Earthing conductors in outdoor areas shall be as per KPLC requirements/standards and as per approvals. The conductiors shall be buried 1.5 to 2M below finished graded level and these buried conductors shall be brought 500 mm above ground level for making tap connections to the equipment.
v) All the electrodes shall be as per KPLC standards/specifications.

4.8.18 Metallic conduits and pipes shall not be used as earth continuity conductor.

4.9 Cables

4.9.1 Cables & Wiring

4.9.1.1 All instruments and panel wiring shall be of heat resisting and self-extinguishing type in compliance with International Standards. Plastic or porcelain cleats of the limited compression type shall be used for holding wiring runs. All wires shall be suitable for bending to meet the terminal studs at right angles.

4.9.1.2 Metal cases of all apparatus mounted on panels shall be separately earthed by means of copper wire or strips.

4.9.1.3 The following color scheme of the wiring shall be used as per standard for three phase systems.

a) AC three phase circuits:
   i) No.1 Phase : Red.
      No.2 Phase : Yellow.
      No.3 Phase : Blue
   ii) Neutral conductor : Black
   iii) Connection to earth : Green
b) D.C. circuits : Brown for positive (+) and Grey for negative (-)

4.9.2 Cables and Accessories

4.9.2.1 Cables of appropriate size to be used in the system shall have the following characteristics:

i) Shall meet IEC 60227/IS 694, IEC 60502/IS1554 standards
ii) Temp. Range: -10^0C to $+80^0$C
iii) Excellent resistance to heat, cold, water, oil, abrasion, Ultraviolet (UV) radiation.
iv) Flexible.
v) Sizes of cables between array interconnections, array to junction boxes, junction boxes to inverter etc. shall be so selected to keep the voltage drop (power loss) of the entire solar system to the minimum. The cables (as per IS) should be insulated with a special grade PVC compound formulated for outdoor use.

4.9.2.2 All the cables shall conform to the requirements of the related standards and codes for:

i) DC cable for photovoltaic system
ii) XLPE / PVC insulated (heavy duty) electric cables for working voltages up to and including 1100V.
iii) Recommended current ratings
iv) Low carbon galvanized steel wires, formed wires and tapes for armoring of cables
v) PVC insulation and sheath
vi) Cross linked polyethylene insulated PVC sheathed cables
vii) Conductors for insulated electrical cables and flexible cords.
viii) Standard test method for density of smoke from the burning or decomposition of plastics.
ix) Tests on gases evolved during combustion of electric cables.
x) Tests on electric cables under fire conditions.

4.9.2.3 Technical Requirements

i) The cables shall be suitable for laying on racks, in ducts, trenches, trestles, conduits and under-ground buried installation with chances of flooding by water.
ii) All cables of module area if laid on cable trays shall be covered. If cables are to be laid underground, laying shall be as per latest relevant code.
iii) Cables with copper conductor on DC side & that with aluminum conductor in AC side to be used as power cables shall have tensile strength as per relevant standards.

Conductors shall be stranded.

iv) Cables with XLPE insulation, PVC sheathed & armored suitable for a continuous conductor temperature of 90^0C and short circuit conductor temperature of 250^0C shall be used.

v) PVC insulation shall be suitable for continuous conductor temperature of 70^0C and short circuit conductor temperature of 160^0C.

vi) Only terminal cable joints shall be accepted. No cable joints to join two cable ends shall be accepted.

vii) Cables inside the control room shall be laid in suitable Cable Trays of approved type.

viii) Cable terminations for LT cables shall be made with suitable cable lugs & sockets etc. crimped properly and passed through brass compression type cable glands at the entry and exit point of the cubicles.

ix) The panels' bottoms shall be properly sealed to prevent entry of snakes / lizard etc. inside the panel.

x) The terminal end of cables and wires are to be fitted with good quality letter and number ferrules of proper sizes so that the cables can be identified easily.

4.9.3 Cable Selection & Sizing

4.9.3.1 All LT power cables of sizes more than 90 sq.mm shall be XLPE insulated, PVC sheathed and armored. Cables shall be sized based on the following considerations:

i) Rated current of the equipment

ii) DC Cable: Minimum voltage drop in the cable during full load running condition, maximum voltage drop shall be limited to 1% of the rated voltage

iii) AC Cable: Minimum voltage drop in the cable during full load running condition, maximum voltage drop shall be limited to 2% of the rated voltage

iv) Short circuit withstand capability.

v) De-rating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:

   a) Variation in ambient temperature for cables laid in air.

   b) Grouping of cables.

   c) Variation in ground temperature and soil resistivity for buried cables.

   d) Cable lengths shall be considered in such a way that straight through cable joints is avoided. Cables shall be armored type if laid in yard area or directly buried.

4.9.3.2 Cable employed for series connection of PV modules through MC4 connectors shall be of 4 / 6 sq mm size subject to voltage drop value within acceptance.

4.9.4 Cable Constructional Features

4.9.4.1 1.1 kV Grade Cables:

i) 1.1 KV grade XLPE power cables on AC side shall have compacted aluminum conductor, XLPE insulated, armored, inner & outer PVC sheathed conforming to KPLC requirements/standards.

ii) Withstanding 90 ^{0}C continuous conductor temperature and 250 ^{0}C during short circuit, inner sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer- sheathed with heat resistant, oil resistant and flame-retardant heavy-duty elastomeric compound conforming to KPLC requirements/ standards.

iii) Cables laid in trenches and using Galvanized Cable trays of adequate strength shall be on structural (Mild Steel) supports.

4.9.4.2 Control Cables

i) 1.1 KV Grade control Cables shall have stranded copper conductor, PVC insulated with appropriate grade shall be used for all control cables required for the SPGP. The cables shall be terminated using Cu. Lugs of adequate cross section area with miller insulation between each pair and tinned copper screening.

ii) Control cables shall have minimum conductor cross-section of 1.5Sq.mm.

4.9.4.3 DC Side Cables

i) DC cables in the plant shall be with Copper conductors to be used between
   a. Module to Modules inter connections
   b. Strings to String Combiner Box
   c. String Combiner Boxes (SCBs) / Array Junction Boxes (AJBs) to DC Distribution Board (DCDB) & or SCBs / AJBs to Inverters

ii) Their guiding factor selected cables shall be the current carrying capacity after the considered reduction factors which shall be higher than 1.25 times of Isc under STC as per IEC 60364-7-712 and the annual energy yield loss is less than 1% as per prevailing norms and to be considered in the Energy Yield Estimation analysis.

iii) The selected cables for the community facility shall be
   a. 1 Core, 4 Sq mm copper conductor (Electrolytic Tinned Copper IEC 60228, Class

5) or higher size, rated 600/1000V AC, as per module manufacturer recommendations for module to module interconnection (normally comes along with modules). The cable shall be solar grade cables with UV and weather resistant protected cables suitable for outdoor applications and confirming to TUV: 2 PfG 1169 / 08.2007.

b. 1 Core, 6 Sq mm copper conductor (Electrolytic Tinned Copper IEC 60228, Class 5) rated 600/1000V AC, solar grade cable with UV and weather resistant protected cables suitable for outdoor application according to TUV: 2 PfG 1169 / 08.2007, Ethylene propylene rubber (EPR) insulation with Ethylene-vinyl acetate (EVA) outer sheath or higher size as per approved design shall be used for cable joining the string to string combiner box (called as Home run cables).

c. 1.1 kV grade, single core with copper conductor, XLPE insulation, armored, with inner & outer PVC sheaths. The cable connecting the SCBs and inverters / DCDB shall be suitable underground laying and shall be 90 -120 sq.mm or more in size.

d. Cables of appropriate size to be used in the system shall have the following characteristics:

i) Temp. Range –10 ^{0}C to +80 ^{0}C.

ii) Excellent resistance to Heat, Fire, oil, cold, water, abrasion, UV radiation.

iii) Flexible Cabling on DC side of the system shall be as short as possible to minimize the voltage drop in the wiring

iv) All parts shall be corrosion resistant.

4.9.4.4 Low Tension (LT) Cables

- 1.1 kV Grade, Aluminium conductor PVC armored cables in AC Side shall be used for all LT power cables between control cubicles, Motor Control Centres (MCC), respective feeders, etc.
- These cables shall be laid on structural supports and using galvanized cable trays of adequate strength. The cable shall be terminated using Al. Lugs of adequate cross section area.

4.10 Solar Export Energy Meter

4.10.1 Export Energy meter system to measure solar generation, complete with CT, PT (where applicable) set shall be as per Requirements/specifications of KPLC (as per clause 5.3.8) and shall

be installed at power plant end, in line with Grid code.

4.11 Danger Boards/Plates

4.11.1 Danger boards/ plates and all other necessary safety signs should be provided as per grid codes and requirements/ specifications of KPLC and must be affixed at various appropriate locations for safety of personnel.

4.12 Construction

4.12.1 The installation shall be carried out by an electrical contractor holding a valid license as required by the Government Authorities.

4.12.2 The contractor shall provide necessary drawings and documents required by statutory authorities and obtain the approval before taking up erection. It shall be the sole responsibility of the contractor to obtain safety certificates / approvals from local statutory authorities.

4.12.3 Any modification in the equipment or installation that may be demanded by the inspecting authorities shall be carried out by the contractor at no additional cost to the Employer.

4.12.4 In accordance with the specific installation instruction as per the manufacturers drawings or as directed by Employer, the successful Bidder shall unload, assemble, erect, install, test, commission and hand over all electrical equipment included in this contract.

4.12.5 Erection materials including all consumables, tools, testing instruments or any other equipment required for successful commissioning shall be arranged by the successful Bidder in a timely manner.

4.12.6 Clearing the site after completion, for ground-mounted systems, of erection as well as regular clearance of unwanted materials from site, returning excess materials supplied by Employer back to Employer's stores shall also be included under this scope of work.

4.12.7 All equipment and instruments, indoor and outdoor, shall be marked with Numbers and provided with suitable danger boards as per local electricity codes and standards before commissioning.

4.12.8 The contractor shall touch up the surface with paint of same shade for equipment, which are scratched and / or damaged during transportation and erection before commissioning.

4.12.9 The contractor shall employ skilled and semi-skilled labourers for erection, testing and commissioning as required. All the electricians, cable jointers, wiremen, welders and others

employed shall posses' valid certificates / licenses recognized by relevant authorities.

4.12.10 The contractor shall set up his own facilities at site at allocated place to undertake fabrication/assembly jobs etc.

4.13 Civil works

The Contractor shall carry out civil works as called for in scope of work:

4.13.1 Pertaining to electrical equipment like foundation for modules structures in ground mounted SPGP or roof support grid for roof mounted SPGP.

4.13.2 Foundations and Structural Support of equipment, AC Distribution Boards (ACDB), DC boards, Inverters and associated trenches etc.

4.13.3 Enclosures for batteries, Inverter and other accessories.

4.13.4 Fencing

4.13.5 All minor civil works such as fixing of foundation bolts, cutting holes in walls, chipping of floor and ceiling etc. and making good the same after installation of the equipment.

4.13.6 All applicable foundations for equipment under scope of work and required to complete the associated work for SPGP only.

4.13.7 During erection, care is to be taken to see that painting does not peel off at any place and if so, it has to be given a 'Touch-up' after erection by the contractor.

4.13.8 Detailed Topographical Survey & Geotechnical Investigation of plant area

The turnkey contractor shall be responsible for detailed geotechnical investigation and topographical survey at required locations for the purposes of foundation design.

4.13.9 Land Development for site activities

The turnkey contractor is responsible for making the site ready by clearing of bushes, felling of trees (if required), leveling of ground and any associated earthworks (wherever required) etc. for commencing the SPGP.

4.13.10 Any other civil works advised by Employer for completion of the work related to SPGP has to be carried out without any extra charges.

4.14 Housing enclosures for equipment

4.14.1 The bidder is to provide suitable well ventilated and weather proof housing enclosures as

per his optimized design for each SPGP to house indoor type equipment – Inverters, batteries, charge controllers, solar energy export meter etc. The housing enclosures shall be designed to the appropriate size as per equipment requirements of each site. Minimum area shall be 6 square metres.

4.14.2 The housing enclosure shall consist of concrete foundation; the walling shall be masonry and have ventilation brick louvres to be used to draw air into the enclosure and circulation of air throughout the enclosure to ensure sufficient cooling as per equipment requirements. The designs shall be subject to employer approval.

4.14.3 The enclosure should contain appropriate indoor lighting.

4.14.4 The enclosure shall have a main door with minimum height of 2100mm and with restricted access. It shall also have aluminium/steel casement windows complete with burglar proof bars.

4.14.5 Suitable fire protection system shall be designed for the enclosure in line with IEC or international norms regulation as applicable and system requirement considering project site. Particularly, suitable fire protection for Lithium–ion batteries to be provided and included in bidder's cost estimates.

4.14.6 The enclosure shall be constructed so such that they can withstand any flooding for the lifetime of the Stand Alone System.

4.14.7 Design of the enclosure shall be subject to employer's approval. The bidder is to supply complete civil lay out plan, elevation, details of each amenity, trenches and structural foundation detailed applicable designs for approval, complete with associated design calculations. Bidders are also required to consider aesthetics while designing. After design review and approval by Employer or his representative, construction shall commence.

4.15 Fencing

4.15.1 The contractor shall provide chain link fencing with concrete posts around the perimeter of the demarcated area (containing the ground mounted PV panels and the housing enclosure for equipment). Warning plates/danger plates etc. shall be provided in sufficient numbers all around the fencing as per safety requirements. The contractor will take prior approval of design from Employer.

4.15.2 Barbed wire shall be installed in 3No. wires above the chainlink fabric on supporting arms facing outwards from site at 45 degree angles.

4.15.3 The fence shall also include a double gate (one leaf for normal traffic, and the other to remain closed by means of a drop bolt locking into centre rest)

4.15.4 Care should be taken during design to ensure no fencing shadows fall on PV modules.

4.15.5 Materials for the chainlink fence

Fabric: ASTM A 392, 2 000 mm high, 3.8 mm diameter (No. 9 gauge) steel wire, 50 mm diamond pattern, twisted and barbed finish at top, knuckled wires at bottom, zinc coated.

Pipes: ASTM A 120, steel pile, hot-dipped zinc coated after welding, diameter and weight size as shown on drawings, unthreaded ends, free from burrs.

Fence fittings: ASTM F 626, hot-dipped zinc coated according to ASTM A 123.

Barbed wire: ASTM A 121, 2.51 mm diameter wire in strand (No.12-1/2 gauge), 2 strands with 4-point barbs spaced at 125 mm, Class 3 zinc coating.

Bottom wires: 5 mm (No. 6 gauge) steel wire, 500 g/m2 zinc coating. This shall be surrounded by a concrete beam (C20) as shown on the drawings.

Fence fittings: ASTM F 626, steel tension bars and bands, nuts and bolts, weather proof tops of commercial aluminium alloy, malleable cast iron, or rolled or pressed steel, cast iron and steel fittings hot-dipped galvanised with 500 g/m2 according to ASTM A123.

4.16 Testing and Commissioning

4.16.1 Earthing Testing after Installation

4.16.1.1 Tests to ensure continuity of all earth connections.

4.16.1.2 Tests to obtain earth resistance of the complete network by using earth tester. The test values obtained shall be within the limits.

4.16.2 Preparation of the Equipment for Commissioning

4.16.2.1 After completion of the installation at site and for the preparation of plant commissioning, the contractor shall check all the equipment and installation in accordance with the agreed standards, latest relevant code of practices of Kenyan Standards and specific instructions furnished by the particular equipment suppliers.

4.16.2.2 Checks required to be made on all equipment and installations at site shall comprise, but

not be limited to the following:

(a) Physical inspection of Modules for removal of any foreign bodies, external defects, such as damaged/ loose connection in Junction Boxes & inverters etc. loose foundation bolts etc.

(b) Check for the free movement of mechanism for the circuit – breaker, rotating parts of the rotating machines and devices.

(c) Check for tightness of all cable joints and bus bar termination ends as well as earth connections in the main earthing network.

(d) Check for clearance of live bus bars and connectors from the metal enclosure.

(e) Check for proper alignment of all the modules etc.

(f) Continuity checks in case of power and control cables.

(g) Checking of all mechanical and electrical interlocks including tripping of breakers using manual operation of relay.

(h) Checking of alarm and annunciation circuits by manual actuation of relevant relays.

(i) Check and calibrate devices requiring field adjustment/calibration like adjustment of relay setting etc.

(j) Check for proper connection to earth network of all non-current carrying parts of the equipment and installation.

4.16.2.3 The relevant tests shall be carried out in accordance with relevant IEC of latest issue.
4.16.2.4 The tests which are to be carried out on the equipment shall include, but not be limited to, the testing of all electrical equipment as well as the system as a whole. This shall be carried out to ensure that the equipment and its components are in satisfactory condition and will successfully perform its functional operations. The inspection of the equipment shall be carried out to ensure that all materials, workmanship and installations conform to the following:

i) Completeness of installation.

ii) Each pole to earth insulation resistance test.

4.16.2.5 Cables

i) Insulation resistance test shall be conducted by megger for cables rated up to 1.1kV grade.

ii) All 1.1 kV cables shall be subjected to high voltage test after joining and terminating but

before commissioning as per relevant standards.

iii) In each test, the metallic sheath/screen/armor should be connected to earth.

iv) Continuity of all the cores, correctness of all connections as per wiring diagram, correctness of polarity and phasing of power cables and proper earth connection of cable glands, cable boxes, armor and metallic sheath, shall be checked.

4.16.3 Tests and Commissioning

4.16.3.1 The testing and commissioning for all electrical equipment at site shall be according to the procedures listed below:

4.16.3.2 All electrical equipment shall be tested, installed and commissioned in accordance with the latest relevant standards and code of practices published by Kenya Bureau of Standards wherever applicable, as per relevant regulations by the Kenyan Energy and Petroleum Regulatory Authority (EPRA) and stipulations made in relevant general specifications.

4.16.3.3 Accepted design, engineering and construction standards, as well as accepted code of practices and stipulations made in the relevant general specifications.

4.16.3.4 The contractor in the presence of representative / Consultant of Employer shall carry out all tests using his own calibrated instruments, testing equipment as well as qualified testing personnel.

4.16.3.5 The contractor shall be expected to carry out all necessary installation and commissioning tests on the installed solar generation plant and internal wiring (as per specifications in Chapter 5) including, but not limited to the following:

i) Earthloop impedance test

ii) Earth resistance test

iii) Insulation resistance test

iv) Continuity test

v) Phase to Earth, Phase to Phase, Neutral to Earth Resistance Tests

vi) Instantenous measurements of Array Voc and Currents, BESS Voltages, Charge cotroller output voltages, functionality of all isolators and breakers, equipment earthing.

4.16.3.6 A commissioning test certificate shall be prepared by the contractor and shall be submitted

to the employer for approval before commencement of commissioning tests of the solar power generation plant. The test certificate should indicate the expected results.

4.16.3.7 Installation test certificates shall be submitted for all sites wiring as per KPLC requirements/specifications and as per requirements outlined in Chapter 5.

4.16.3.8 The results of all tests shall conform to the specification requirements as well as any specific performance data, guaranteed during finalization of the contract.

4.17 Design, Drawings for Electrical & Civil works (Drawing Section)

4.17.1 Submission of Drawings by contractor for Approvals

The Contractor shall submit design /drawings /design Calculations/data Sheets as applicable for each SPGP within 30days from the date of award for approval of Employer. The timely approval of design and drawings are of essence for timely completion of work.

4.18 Warranties of Major Equipment

The warranties of major equipment are found in the table below;

Table 10: Minimum Warranty Requirement for Major Equipment

	Equipment	**Minimum Warranty Requirement**
1.	Solar Photovoltaic Modules	a) Product Warranty: The manufacturer should warrant the Solar Module(s) to be free from the defects and/or failures specified below for a period not less than ten (10) years from the date of sale to the original customer ("KPLC") • Defects and/or failures due to manufacturing. • Defects and/or failures due to quality of materials. • Non conformity to specifications due to faulty manufacturing and/or inspection processes b) Performance Warranty: • The predicted electrical degradation of power generated not exceeding 20% of the minimum rated power over the 25-year period and not more than 10% after ten years period of the full rated original output.
2.	Batteries	Minimum 10 years Warranty

3.	PV Inverter	Minimum 10 years Warranty
4.	Battery Inverter Charger	Minimum 10 years Warranty
5.	Hybrid Inverter	Minimum 10 years Warranty
6.	Charge Controllers	Minimum 10 years Warranty
7.	Service Cables (16 mm^2 Single Phase Concentric Aluminium cables and 25mm^2 4-Core Aluminium cables)	Refer to specification document KP1/3CB/TSP/05/004 and KP1/3CB/TSP/05/001 in Appendix 4 for warranty details

4.19 Fire Safety facilities

4.19.1 Fire protection, firefighting equipment, fire extinguishers, warning signage to be provided.

4.19.2 Suitable fire protection system shall be designed for the housing enclosure to contain equipment, in line with IEC or international norms regulation as applicable and system requirement considering project site. At least 1 No. Portable fire extinguisher to be provided - wall mounted, hand held extinguishers shall be 6kg pressurized control discharge Bromochlorodifluoromethane (BCF) units.

4.19.3 Suitable fire protection and suppression system shall be designed for BESS in line with IEC or international requirements/ specifications regulation as applicable for lithium-ion batteries and system requirement considering project site to employer's approval preferably an automated fire detection, prevention and suppression system fitted with a suitable dry aerosol agent to put-out Lithium-Ion battery fires and all associated accessories.

4.19.4 A minimum of 1 No. Portable fire extinguisher 6 kg pressurized control discharge BCF units shall be provided in the Solar modules (SPGP) area.

4.19.5 The fire safety design shall be subject to approval by the employer. The contractor shall train the local staff on use of the installed system.

5. SERVICE CABLES AND INTERNAL WIRING FOR COMMUNITY FACILITIES

5.1 Scope of Internal Wiring

5.1.1 The bidder's scope includes design, supply, installation and commissioning of limited internal wiring.

5.1.2 Design work shall incorporate all necessary survey work, Customer premises picking, geo-referencing, obtaining & filling customer information as prescribed in a customer information template and updating of KPLC Facility Data Base (FDB) to ensure all additional network is appropriately digitized. At project completion, "As Built Drawings" shall be used to permanently update the FDB.

5.1.3 Designs shall be approved by the employer. Four (4) physical files (one of which will be laminated site file) shall be availed to help in supervision. Soft copies of the designs shall also be submitted to the employer.

5.1.4 Each design file shall bear KPLC's Design & Construction System (DCS) reference number and full costing into a Capital Works Authority (CWA) job to facilitate online tracking and eventual commissioning in FDB and final capitalization into assets.

5.1.5 The contractor shall be expected to be informed by the outcome of the design process of quantities to buy for certain materials that are difficult to predict.

5.1.6 Employer to supply the following goods: Electronic energy meters and MCBs for customer metering. All other meter installation accessories (e.g. meter box, cables etc) shall be provided by the contractor.

5.2 Internal Wiring for Community Facilities

5.2.1 Contractor will carry out internal wiring for the main building of the community facility for 5 lighting points and 2 sockets in compliance with local codes and standards and also provide a wiring certificate for the facility to the employer.

5.2.2 Lighting Fixtures

Type	-	2 ft LED linear tube type with reflector fitted
Power rating	-	11 - 20 watts
Operating Voltage range	-	220-240V AC
Ballast Type	-	Electronic
Power Factor of ballast/light assembly	-	0.8
Colour Rendering Index	-	80 or Better

Start to Full Brightness	-	0 to 5 seconds
Lamp Lumen Maintenance	-	Good
Efficacy (lumens/watt)	-	60
Warranty	-	1 year

NB: Ordinary Tungsten and Compact Fluorescent Lamps will NOT be considered
(Attach detailed technical specifications)

5.2.3 Switched Sockets

These shall be flush pattern in steel/pvc box and shall be of the gang type.

They shall be 13- Amp, 3-pin, shuttered, switched approved as per KS 04 – 246: 1987
For all lighting and sockets wiring shall be carried out in the "looping in" system and there shall be no joints whatsoever

Sub-circuit wiring
(i) Lighting circuits P. V.C. cable 1.5mm² for all lighting circuits

(ii) Power circuits P.V.C cable (minimum sizes): 2.5mm² for all socket wiring.

5.3 Specifications for Service Cables, Meters, Accessories and other items

KPLC specifications are listed below for various tems and attached in **Appendix 4 – KPLC Technical Specifications Documents.**

5.3.1 **16mm^2 Single Phase PVC Insulated Single Phase Concentric Aluminum Cables (Low Voltage)**

The technical specification for PVC insulated single phase concentric aluminum service cables (Low Voltage) shall comply with KPLC standard specification document no. **KP1/3CB/TSP/05/004**

5.3.2 **25mm^2 4C Aluminum cables**

The technical specification for 25mm2 Aluminium 4-Core PVC insulated, Steel Wire Armoured cables shall comply with KPLC standard specification document no. **KP1/3CB/TSP/05/001**

5.3.3 **Earthing Rods and their connectors**

The technical specification for Earth Rods and their connectors shall comply with KPLC standard specification document no. **KP1/3CB/TSP/06/031-1**

5.3.4 **Copper Conductors for earthing (soft drawn)**

The technical specification for Soft Drawn Copper Conductors (Bare & PVC Covered) - for Earthing shall comply with KPLC standard specification document no. **KP1/6C.1/13/TSP/06/026**

5.3.5 **Low Voltage Fuse Cut-Out**

The technical specification for LV fuse cut-out shall comply with KPLC standard specification document no. **KP1/6C.1/13/TSP/11/023**

5.3.6 **Low Voltage Cartridge fuses (fuse links)**

The technical specification for LV cartridge fuses (fuse links) shall comply with KPLC standard specification document no. **KP1/6C.1/13/TSP/11/022**

5.3.7 **Hatari Slabs**

The technical specification for Hatari Slabs shall comply with KPLC standard specification document no. **KP1/6C/13/TSP/07/001**

5.3.8 **Single-Phase Static Meters for Active Energy**

The technical specification for Single Phase Static Meters for active energy (for measuring solar energy generation) shall comply with KPLC standard specification document no. **TSP 14.11**

5.3.9 **PVC Insulated Wiring and Auxilliary Cables** (For 10mm2 Dropper Cable, Red and Black, for customer meter installation)

The technical specification for Specification for PVC Insulated Wiring and Auxilliary Cables shall comply with KPLC standard specification document no. **KP1/6C.1/13/TSP/05/016**

5.3.10 **Meter Box for customer meter**

The Bidder shall provide a Meter box for each installation (Community Faciltiy) suitable for housing the customer energy meter and withstanding climatic conditions. The design (drawings and technical details) of the Meter box shall be submitted to the employer for approval before manufacture commences.

5.4 Customer Meters

5.4.1 The employer will provide approved metering and MCBs for customer metering upon request by contractor, for every connection of community facility consumer.

5.4.2 Customer meters installation shall be done by contractors and shall be as per KPLC requirements/specifications including the following;

5.4.2.1 On site, meter boxes must be sealable as per KPLC standards/specifications.

5.4.2.2 Contractor to collect customers` contracting data and installation certificates and avail to KPLC.

5.4.2.3 After meter installations, all meters and meter boxes must be sealed with serialized twist tights which conforms with KPLC standards.

5.4.2.4 All installed meters must be communicated to KPLC for purposes of validation with their installed locations/meter boxes coordinates.

5.4.2.5 The contractor's meter installation technician to fill and submit to KPLC the Installation Inspection Report (IIR).

5.5 Service cables installation

5.5.1 Installation of service Cables (16mmsq single core cables and 25mmsq 4 core cables) shall be done as per KPLC requirements/ specifications.

5.5.2 When installing cables underground, all KPLC requirements/ specifications shall be followed including covering the cables with Hatari slabs (concrete cable covers).

5.6 Warranties of Service cables

5.6.1 The warranties of low voltage single phase 16mmsq and 3 phase 25mmsq service cables are found in Table 10.

6 PERSONNEL

6.1 Personnel during Supply and Installation Phase

6.1.1 Personnel required during the Supply and Installation phase are listed in the table below (the same is also provided in Volume I, Section VII of the bidding documents). Bidders should provide the names of suitably qualified personnel to meet the specified requirements.

6.1.2 The data on their experience should be supplied using Form PER -1 and Form PER -2 for each candidate. These forms are provided in Volume I, Section IV - bidding forms.

Table 11: Personnel during Supply&Installation phase

Item No.	Position/ specialization	Relevant academic qualifications	Number of Personnel	Minimum General work experience (years)	Minimum Specific work experience (years)
1	Resident Project Manager	*Degree in Electrical or Mechanical Engineering or Renewable Engineering*	*1*	*10*	*5*
2.	Design Engineer	*Degree in Electrical or Mechanical Engineering*	*1*	*7*	*4 (in solar projects)*
3.	Construction Engineer	*Degree in Electrical or Mechanical Engineering*	*1*	*7*	*4*
4.	Technician	*Diploma in Electrical Engineering*	*1*	*5*	*3*
5.	Solar PV Specialist	*Degree in Electrical or Mechanical or Renewable or Energy Engineering and Energy & Petroleum Regulatory Authority (EPRA) Solar PV System Class T3 license or equivalent*	*1*	*5*	*3*
6.	Environmental, Social, Health and Safety (ESHS) Specialist	*Environmental/Social Sciences/Health/Safety Degree or other relevant Degree*	*1*	*5*	*3*

6.2 Personnel during Operations and Maintenance Period

6.2.1 The Contractor shall ensure that he has adequately trained and experienced manpower for carrying out O&M of the SPGP stand alone system.

6.2.2 The Contractor shall deploy the following personnel to meet all the requirements of the O&M activities of the plant in each lot. The Contractor shall ensure that such personnel are available for duty at all times during the O&M period:

Table 12: Personnel during O&M period

Item No.	Position/ specialization	Relevant academic qualifications	Number of Personnel per Lot (Lot 1)	Number of Personnel per Lot (Lot 2-6)	Minimum General work experience (years)	Minimum Specific work experience (years)
1.	O&M Project Manager	Degree in Electrical or Mechanical Engineering or Renewable Engineering	1	1	5	3
2.	O&M Engineer	Degree in Electrical Engineering	2	1	5	3
3.	Technician	Diploma in Electrical Engineering	2	1	5	3
4.	Artisan/ Craftsmen	Certificate in Electrical/Renewable Engineering	4	2	5	3
5.	Environmental, Social, Health and Safety (ESHS) Specialist	Environmental/Social/Health /Safety Degree or other relevant Degree	1	1	5	3

6.2.3 Non-key Staff

- Cleaning Staff: - Contractor may keep Cleaning staff persons on contract to clean modules (on regular basis as needed), cleaning building, wash room and other equipment.
- Security personnel – as may be required

NOTE: The outlined number of staff above are the minimum required to execute the O&M contract. It is therefore upon the bidder to judge and come up with the adequate number of any additional staff that may be required for effective implementation of the O&M Contract.

6.2.4 The Contractor shall ensure that the manpower for carrying out O&M are adequately trained. The man power can also go for training along with KPLC staff at KPLC Training Centre time to time on permission from KPLC.

7. REDRESSAL OF COMPLAINTS DURING O&M PERIOD

7.1 The Contractor shall maintain a public relations office that shall be easily accessible to the users/beneficiaries of the stand alone systems. A register (the "Complaint Register") shall be maintained and opened to public access at all times for recording of complaints by any person (the "Complainant"). Information relating to the availability of and access to the Complaint Register shall be prominently displayed by the Contractor at appropriate places so as to bring it to the attention of all users/beneficiaries of the stand alone system.

7.2 The Complaint Register shall be securely bound and each page thereof shall be duly numbered. It shall have appropriate columns including the complaint number, date, name and address of the Complainant, substance of the complaint and the action taken by the Contractor. Immediately after a complaint is registered, the Contractor shall give a receipt to the Complainant stating the date and complaint number.

7.3 The Contractor shall inspect the Complaint Register every day and take prompt and reasonable action for Redressal of each complaint. The action taken shall be briefly noted in the Complaint Register.

7.4 Within 7 (seven) days of the close of each month, the Contractor shall send to the Employer a copy of each of the pages of the Complaint Register on which any entry has been recorded during the course of such month, and upon perusal thereof, the Employer may, in its discretion, advise the Contractor to take such further action as the Employer may deem appropriate for a fair and just Redressal of any grievance.

7.5 The Contractor shall consider such advice and inform the Employer of its decision thereon, and if the Employer is of the opinion that the Complainant is entitled to further relief, it may refer the matter to the competent forum for its disposal under the Consumer Protection Act, 2012 and advise the Complainant to pursue the complaint at his own risk and cost.

7.6 The Contrator may, in consultation with the Employer, specify the procedure for making complaints in electronic form and for responses there to.

8. SAFETY AND APPLICABLE LAWS

8.1 Safety of contractor staff

8.1.1 The safety of the Contractor's staff is the responsibility of the Contractor . The scope of supply includes supply of adequate and appropriate Personal Protective Equipment (PPE) and all other safety items at each site including first aid kits.

8.2 Safety in O&M period

8.2.1 During O&M Period the replacement of worn out or damaged PPEs shall be the responsibility of the contractor. The site engineer of the Contractor shall take adequate steps to ensure the proper use of the safety equipment by Contractor's staff at all times. The contractor shall be responsible for any accident/incidents that may occur at any site.

8.3 Applicable Safety Regulations

8.3.1 All works shall be executed in accordance with the requirement of the:

a) Occupational Safety and Health Act (OSHA),

b) Factories Act and rules,

c) Energy Act 2019,

d) KPLC safety rules and other applicable acts and rules or codes.

8.4 Accidents and reporting

8.4.1 The Contractor shall ensure that all safety measures are taken to avoid any accident during O&M period to his personnel and to the public.

8.4.2 The Contractor shall report accidents if any, within 24 hours, to KPLC showing the circumstances under which it happened and the extent of damage and/or injury caused as per KPLC requirements. This applies during the Supply and Installation phase and the Operations and Maintenance phase.

8.4.3 Accident reporting should also be done as per requirements and timelines stipulated in The Energy Act, 2019 and the Occupational Safety and Health Act, 2007. This applies during the Supply and Installation phase and the Operations and Maintenance phase.

9. STATUTORY ACTS

9.1 Clearances

9.1.1 All legal formalities/clearances are to be obtained prior to commencement of work by the Contractor regarding the execution of the community facility.

9.2 Applicable laws

9.2.1 The Contractor shall comply with all the Acts, rules and regulations, laws and by-laws framed by the Government of the Republic of Kenya or the County. The Employer shall have no liabilities in this regard.

9.3 Key Obligations of Contractor

9.3.1 The Contractor shall be responsible for implementation of the solar stand alone system as well as O&M of the Stand alone systems together with the associated Customer Connection throughout the Term of the 7 year Contract , subject to the provisions of the Contract, in accordance with the following. It should be clearly understood that in the event of inconsistency between two or more of the following, the order of priority as between them shall be the order in which they are placed, with 'applicable Law' being the first:

a) Applicable Law.
b) The Terms and Conditions of Contract.
c) Technical specifications and
d) Any Approvals and Permits.

9.3.2 The records maintained during the O&M period shall be available from time to time to the Employer.

10. SUPERVISION OF CONSTRUCTION AND COMMISSIONING WORKS

10.1 Completion Time

10.1.1 All community facilities in Lots 1 - 6 shall be completed within twelve (12) months from the Effective Date as described in the Contract Agreement for supply and installation

10.2 Custodian of the SPGP

10.2.1 The Contractor shall be the custodian of the SPGP at all times during the term of the Contracts – S&I and O&M- and shall be responsible for any theft, loss and damage of assets, etc. related to the SPGP. All the recoveries pertaining to any loss of asset due to above reasons shall be on account of Contractor.

10.3 Supervision

10.3.1 Gantt chart/ Time schedule to KPLC

10.3.2 The Contractor shall submit to KPLC, a detailed time schedule in Ms project consisting of adequate number of activities covering various key phases of the SPGP such as design, installation, testing and field erection activities within one (1) month from the date of signing of the Contract for approval.

The contractor to submit Plan for Sequence of construction, to follow the guideline as follows:

- Preliminary Design (Topographical Survey, Geotechnical Investigations, Approval of Statutory Documents, Civil and electrical Works Methodology, Standard Operating Procedures, Quality Management Plan)
- Design Stage (Relevant Standards and Specifications, Drawings and Designs, Revision of Drawings, Statutory Approvals/Requirement)
- Works Program, Reporting System, Security plan.
- Closure (As-built drawings)

10.3.3 The Contractor shall implement the SPGP after Notice to Proceed (NTP) from Employer via formal project communication means.

10.3.4 The details shall include location of the SPGP, approximate capacity of equipment, number and type of consumers, etc.

10.3.5 The Contractor shall generate and supply electricity to consumers in the areas identified in the ICB, conforming to technical standards and all safety measures.

10.3.6 The Contractor shall be required to submit regular monthly progress reports of the SPGP to the Employer. Inability of the Contractor to furnish such progress reports shall be treated as a breach of Contract. For the purpose of information sharing, the format of such progress report shall

be mutually agreed between the Contractor, and the Employer after the Effective Date.

10.3.7 In addition to the progress reports, the Contractor shall inform KPLC within 24 hours, of any allegation, incident or accident in the Site, which has or is likely to have a significant adverse effect on the environment, the affected communities, the public, Employer's Personnel or Contractor's Personnel. This includes, but is not limited to, any incident or accident causing fatality or serious injury; significant adverse effects or damage to private property or any allegation of Sexual Exploitation and Abuse (SEA) and/or Sexual Harassment (SH), incidents of Gender Based Violence(GBV) and insecurity incidents. Accident reporting should also be done as per requirements and timelines stipulated in The Energy Act, 2019 and the Occupational Safety and Health Act, 2007. This applies during the Supply and Installation phase and the Operations and Maintenance phase.

10.3.8 The Contractor shall provide advance notice of at least 15 (Fifteen) days, to the Employer, of its intent of commissioning the SPGP. The Employer shall not delay the commissioning of the SPGP and shall be required to inspect the SPGP within 15 (Fifteen) days period and advice the Contractor of any further measures to be taken prior to the commissioning of the SPGP.

10.3.9 The Contractor shall, during the Construction & Installation period and O&M period, ensure compliance of all statutory and mandatory requirements, including all labor law requirements and shall be responsible for observance of all applicable acts and rules. The Contractor shall also keep the Employer indemnified against any liabilities that may arise on this account. The contractor shall also be required to meet the class registration requirements for the Kenyan Energy and Petroleum Regulatory Authority (EPRA) and National Construction Authority (NCA).

10.3.10 The Contractor shall be required to maintain copies of all insurance covers for inspection by the Employer at any time during the Term of the Contract.

10.3.11 The Contractor is deemed to have visited the Sites and familiarized himself fully. Non-familiarity with the Site conditions will not be acceptable for any type of extra claims or for not carrying out the Construction and Installation of SPGP in strict conformity with the ERTS or for any delay in date of Commissioning.

10.3.12 The Contractor shall, during the Construction and Installation, be guided by and fully adhere to the ERTS. Non-adherence to the ERTS may lead to forfeiture of Performance Security or delay in certification of commissioning of the SPGP of respective stand alone systems for which the Contractor shall be solely responsible and shall have no claim towards the Employer in this

regard.

10.3.13 Failure to meet the timelines as specified in Clause 10.1 above shall cause the Employer to claim liquidated damages from the Contractor.

10.3.14 The employer shall appoint a supervision consultant to oversee the construction and commissioning works of the SPGP.

10.4 Additional Capacity

10.4.1 After meeting the minimum capacity requirement as set out in the Contract , the Employer will be free to integrate the additional generation system (number of plants, capacity of each plant) in existing system in case load demand increases in future years to come.

11. QUALITY ISSUES

11.1 Inspections and tests during manufacture

11.1.1 As far as practicable, quality of material, workmanship and performance of all items of the equipment furnished under the present Contract shall be inspected at the places of manufacture by the Contractor's QC inspectors and the inspectors representing the Employers and the Engineer before shipment.

11.1.2 Equipment shall wherever practical be subject to tests on completion in the Manufacturer's Works to prove that the reliability, operation and performance conforming to the requirements of this Specification and the provisions of the appropriate standards.

11.1.3 Every facility is to be provided by the Contractor to enable the Employers and the Engineer to carry out the necessary inspection of the equipment components and the costs of all tests during manufacture and preparation of test records are to be borne by the Contractor.

11.1.4 The Contractor shall on request submit for approval procedures describing the proposed test methods to be used. Type and layout of test facility, location of instrumentation, formula for calculation of results and correction to Site conditions, etc. shall be included where appropriate.

11.1.5 All instruments and apparatus required for the inspection or used for the performance of tests shall be calibrated to an agreed standard at a laboratory of National standing. The cost of making such calibrations shall be borne by the Contractor in all cases. Records shall be available for examinations by the Employers/Engineer or his Representative.

11.1.6 The passing of the inspection test will not, however, prejudice the right of the Employers/Engineer to reject the equipment components if they do not comply with the Specification when erected, or given complete satisfaction in service.

11.1.7 Where the Contractor desires to use stock material, not manufactured specifically for the work, satisfactory evidence that such material conforms to the requirements of the Contract shall be submitted. In this case tests on these materials may be waived, but certificates are to be submitted. Arrangements shall be made for expediting the shop inspection by having all shop assemblies or pieces covering a single shipment ready at one time. Any packing work as well as transport to the Site of the equipment concerned shall not be started before the approval of the Employers/Engineer has been obtained and all QC certificates due at this time for the equipment concerned have been received and reviewed by the Employers/Engineer.

11.1.8 The Test Objects and the tests to be carried out as detailed in the attached specifications for each item.

11.1.9 Factory Acceptance Tests (FAT) shall be carried out for each of the major equipment at the manufacturer's premises. All routine tests shall be carried out in the presence of employer's representatives. Contractor shall arrange and meet the full costs of local transport and the cost of inspection and test at the manufacturer's premises.

KPLC will bear the cost for air travel & accomodations for its representatives.

11.2 Packing

11.2.1 The Contractor shall prepare, pack, and load all materials and equipment for shipment in such a manner that they are protected from damage during shipment and shall be responsible for and make good any and all damage resulting from improper packing until final acceptance of the Works. Items subject to open storage for several months at the sites shall be suitably protected from weather damage. All electrical parts and mechanical parts subject to damage from moisture shall be packed together with an appropriate quantity of desiccant in hermetically sealed metal containers, plastic envelopes, or other appropriate containers, with all machined surfaces heavily coated with rust preventing compound.

11.2.2 Each case, crate, bundle, or single item shall be marked clearly with the name of the installation for which it is intended. Each container shall be clearly marked and the contents identified for proper warehousing.

11.2.3 The Contractor shall take all necessary precautions to ensure that all materials, which may be subject to deterioration in humid tropical conditions, are packed in such a manner as to prevent such deterioration.

11.2.4 All parts shall be carefully boxed or otherwise suitably prepared for shipment to a tropical climate. All openings shall be tightly closed before shipment. Equipment that will be vulnerable to damage due to seawater or moisture during transportation or storage at the Site shall be protected by a suitable vapour barrier and, if considered necessary by the Engineer, by an internal atmosphere of inert gas or approved desiccant.

11.2.5 All parts exceeding 100 kg gross weight shall be prepared for shipment so that slings for handling by crane may be readily attached while the parts are on railway cars or on board ship. The Contractor shall paint or mark the weight of all pieces in excess of 5 tonnes

11.2.6 The Contractor shall take necessary measures to avoid ingress of moisture during transportation, storage and installation.

11.2.7 The Contractor shall bear the risk of loss or damage to material prior to and including off loading on the dock at the port of entry.

11.3 Markings:

The major equipment (Solar panels, batteries, inverters, charge controllers and cables) shall have the following markings embossed, indented, or otherwise indelibly marked on them in the factory:

i. Name and registered trademark of the manufacturer

ii. Country of Origin

iii. Year of Manufacture

iv. The words “PROPERTY OF KPLC”, at least 4mm high

11.4 Packing List

11.4.1 The contents of each shipping package shall be itemised on a detailed list showing the exact weight, extreme outside dimensions, length, width, and height of each container. If all containers are uniform in size and weight, the dimensions and weight of only one may be shown.

11.4.2 One copy of the detailed packing list shall be enclosed in each package delivered. There shall also be enclosed in one package a master packing list summarizing and identifying each individual package which a part of the shipment is.

11.4.3 The box number in which the master packing list is contained should be shown on each packing list. On barrels, bags, drums, or kegs where it is not feasible to place the packing list inside the container, all pertinent information is to be stenciled on the outside and this will thus constitute a packing list.

11.5 Submission of Drawings

11.5.1 Drawings shall be submitted to the Employers for approval one (1) months prior to the date on which they will be required at the manufacturer's works, to ensure that the work is carried out in compliance with the program of Works.

115.2 The Engineer, for approval of all design calculations and drawings, requires a minimum period of 28 days.

11.5.3 Before commencing the manufacture, the Contractor shall submit to the Employers, for

approval, four copies of prints of drawings in sufficient detail to show:

 The general arrangement and outline of dimensions of the parts to be supplied under the Contract;

 On detail drawings, the weights of components over one tonne to be shipped separately;

 The material specifications from which the various parts are to be made and their machined surface finished;

 The welding details and machining and assembly tolerances of all assemblies;

 The manner in which such parts are designed to function;

 Diagrams, performance curves and catalogue numbers of all electrical and mechanical equipment.

11.5.4 The Contractor shall submit to the Engineer, for approval, all drawings and technical documents as follows:

Table 13: Drawings and technical documents for approval

	Prints	Electronics copy (CD) /USB Stick
For approval		
Calculations and drawings	4	1
As-built drawings	2	1
Other documents	2	1
Supervision formats	2	1
Commissioning procedures	2	1
For Final issue		
Calculations and drawings	3	1
As-built drawings	3	1
Other documents	3	1
Supervision formats	3	1
Commissioning procedures	3	1

11.6 Site Installation and Commissioning

The Contractor shall ensure that all Site installation and commissioning controls, inspections and

tests, are carried out in accordance with the planned program, and that data recorded are adequate to permit the Engineer to verify that the whole of the Contract Works are in full compliance with all Contract requirements.

11.7 Inspection and Testing

The Contractor shall ensure that measures are established for all material and items that will provide the ability, at any point of manufacture, to determine that the manufacturer's planned inspections and tests up to that point have been carried out.

11.8 Measurement and Payment

The quantities in the Schedule of Prices are estimated quantities, and they are not to be considered as limiting or extending the amount of work to be done by the Contractor.

The measured items in the Schedule of Prices are to be accepted as the full interpretation of the requirements of the Technical Specifications and Drawings

12. SPGP PERFORMANCE

12.1 Demonstration of Performance Guarantee of SPGP

12.1.1 The Contractor shall ensure the Performance Guarantee of the installed equipment shall meet the ratings and performance requirements stipulated for various equipment covered in the ERTS/ Supply and Installation Contract.

12.1.2 The contractor shall demonstrate and achieve guaranteed values during the performance guarantee test period (one year), as per details given below, at site in the presence of the Employer for the complete system.

12.1.3 The Contractor shall supervise and direct the operation during performance guarantee test and shall take complete responsibility in this regard. During performance guarantee test, the Contractor shall make available necessary experienced operating & maintenance personnel.

12.1.4 The Contractor shall provide and install all measuring instruments with required calibration for checking the guaranteed generation during performance guarantee test.

12.2 Performance Measurement Procedure for SPGP

12.2.1 The Performance guarantee test of SPGP aims at the comparison of the actual PV plant energy production with the guaranteed value for a limited operation time of the PV plant of 30 consecutive days.

12.2.2 After one-year of correct operation of the plant and after receiving all the satisfactory results for one year there will be continuous monitoring of the performance for 30 days. This monitoring will be performed on the site under the supervision of the Employer / Employer's engineer.

12.2.3 The final tests to prove the guaranteed performance parameters shall be conducted at site by the Contractor in presence of the Employer or his representative. The Performance Guarantee Tests (PG tests) shall be commenced immediately after Date of commissioning of SPGP. These tests shall be binding on both the parties to the contract to determine compliance of the equipment with the guaranteed performance parameters.

12.2.4 The test will consist of guaranteeing the correct operation of each plant individually over 30 days, by the way of the efficiency rate (performance ratio) based on the reading of the energy produced and measured at Solar Meter and the average incident solar radiation.

12.3 The Efficiency or Performance Ratio (PR)

The Efficiency or performance ratio (PR) of the PV Plant is calculated as follows (according to IEC 61724)

Performance Ratio (PR) = $Y_A/Y_R\left[1-\alpha*\left(T_{Cell\ avg}-T_{Cell}\right)\right]$

Where

Y_A = Final PV system yield (representing the number of hours that the system would need to operate at its rated output power PNom to contribute the same energy to the grid as was monitored)

Or $Y_A = E_{ac}/P_{Nom}$

Y_R = Reference yield (representing the number of hours during which the solar radiation would need to be at STC irradiance levels in order to contribute the same incident energy as was monitored)

Or $Y_R = I_{R\ Site}/I_{R\ STC}$

Eac = AC energy injected into the grid during a clearly specified amount of time (kWh)

PNom = Installed nominal peak power of modules (Flash test rating at STC) (kWp)

IR Site = Irradiation on the module plane of array during a clearly specified amount of time (measured with a pyranometer installed on the array plane) (kWh/sq. m)

IR STC = Irradiance at STC (kW/ sq. m)

$T_{cellavg}$ = Average cell/ module temperature (oC)

T_{cell} = STC cell/ module temperature (oC)

α = temperature coefficient of power (negative in sign) corresponds to the installed module (%/oC)

12.4 Plant Performance & CUF

12.4.1 The plant performance will be evaluated through Performance Ratio (PR) test as per IEC 61724 and Capacity Utilization Factor (CUF) calculation as per the formulas and procedures mentioned in Clauses 12.1-12.3 above.

12.4.2 The minimum acceptable PR of the plant is 0.78.

12.4.3 As the PR of the Plant is dependent on the quality of plant equipment and optimum design of the plant, the bidders shall demonstrate the PR of 0.78 as per the procedure mentioned in Clauses 12.1-12.3 above for Operational Acceptance of the plant.

12.4.4 The acceptance of the plant will be evaluated during commissioning by measuring PR for continuous 7 days. However, contractor must demonstrate the PR for a period of 30 days as per the PR test procedure specified in Clauses 12.1-12.3 above.

12.5 Monitoring System for PR Verification

12.5.1 The following instrumentation will be used to determine the SPGP Performance. This equipment shall be provided by bidder during PR verification test

i) Solar Meter at the delivery point of ACDB.
ii) Power Meter for each inverter for reference only.
iii) A calibrated pyranometer to determine irradiance on the plane of array (with a target measurement uncertainty of ± 2).
iv) A calibrated Pyranometer to determine irradiance on horizontal plane (with a target measurement uncertainty of ± 2).
v) Two thermocouples to measure module temperature with a measurement uncertainty of ±1 °C.
vi) Shielded ventilated thermocouple with a measurement accuracy of ±1°C.
vii) An anemometer mounted on a 10m mast to measure wind speed (without additional shadowing on modules).

12.6 Compensation for Shortfall in Performance

12.6.1 During the O&M period of 7 years after the commissioning of the plant, the contractors need to maintain minimum 95% uptime of the plant to achieve the proposed CUF at the end of each year. Any repair, replacement, overhauling of DC area of SPGP etc., are to be performed during times as agreed with the beneficiary so as not to interfere with services.

12.6.2 Bidders are expected to make their own study of solar profile and other related parameters of the area & make sound commercial judgment about the Performance ratio. It shall be the responsibility of the Bidder to access the corresponding solar insolation values and related factors of solar plant.

12.6.3 Remedial Measures to Demonstrate Performance Guarantee after completion of each year of O& M period.

12.6.4 In case of contractor could not demonstrate the Performance Acceptance Test, the contractor will be allowed to relocate the solar modules and install at different places in the same premises at

their own cost ensuring guaranteed PR of plant. The entire cost of dismantling and erection etc, will be borne by the contractor. To ensure PG of plant after first year from Date of commissioning of plant and every year thereafter, the bidder will be allowed to erect additional number of solar modules without extra cost to employer.

12.7 Liquidated Damages for Shortfall in Performance during the Performance Acceptance of Plant

12.7.1 During the Performance Acceptance of plant, any shortfall in the Performance Ratio (PR) as determined through the PR Test Procedure specified above above will attract imposition of liquidated damages. For every 0.01 shortfall in PR below 0.78 by the Contractor, a penalty of 1% of the Prices of Schedules 1, 2, 3, 4 & 5 for SPGP shall be levied and deducted from 5% balance amount.

12.8 Liquidated Damages for Shortfall in Performance during the O&M period of Plant

12.8.1 During the O&M Period of SPGP, any shortfall in the Performance Ratio (PR) as determined through the PR Test Procedure specified above may attract imposition of penalty. For every 0.01 shortfall in PR below 0.78 by the Contractor, a penalty of 1% of the total annual fees of respective year (Schedule 6) shall be levied.

12.9 The Key Performance Indicators detailed in clause 2.8 shall apply during O&M period. Applicable penalties for failure to meet the stated KPIs shall be as per O&M contract (O&M PCC, Volume 1)

13. ENVIRONMENTAL AND SOCIAL SAFEGUARGDS

13.1 Adherence to ESHS Laws and ESMF

13.1.1 The Contractor shall be responsible for adherence to the Environmental and Social Safeguards as provisioned in the Contract and Kenyan Law.

13.1.2 In addition to providing the electricity generation, connection and supply, the Contractor shall at all times – during Supply&Installation phase and Operation&Maintenance phase – be required to adhere to the Environmental and Social Management Framework (ESMF) and Environmental and Social Management Plan (ESMP).

13.1.3 The KOSAP ESMF is available on the KPLC website (www.kplc.co.ke).

13.1.4 The generic Environmental, Social, Health and Safety Management Plan (ESHSMP) has been provided in the Volume 1 bidding document, providing for environmental, social, health and safety aspects that shall affect the entire project. The winning contractor shall be expected to develop the Contractors-ESMP (C-ESMP) for each site, before mobilizing, for the employer's approval.

13.2 Compliance to Environmental and Social Management Framework during SPGP Development

13.2.1 The Contractor shall ensure the following while constructing and developing the SPGP:

i) Aquistion of relevant permits from Local Authority for setting up the SPGP,

ii) Aquistion of requisite approvals from National Environment Management Authority (NEMA), if applicable

iii) Aquistion of permission for Tree cutting (If applicable),

iv) Approval for use of water requirement,

v) Due diligence for waste management system or any pollution which may be generated from the plant or related activities

vi) Due diligence for Ground water usage/availability of water/ Right of way/drainage,

vii) Safe handling and management of E-waste (CFLs, batteries, LEDs, solar panels)

viii) Compliance with Workers Right, Health and Safety requirements as per the applicable local laws and World Bank Group Environmental, Health, and Safety Guidelines (EHSG). This will include conducting due diligence on primary subcontractor and primary suppliers to ensure they are not engaged in forced labor, child labor and

employment of trafficked persons.

13.3 Precautions to be taken during SPGP Development

The Contractor shall ensure that the following precautions are taken during construction, development and O&M phases of the SPGP.

13.3.1 Phase I: Site Identification and Design

All land used for stand alone systems shall be within the compound of the beneficiary. The following activities shall be avoided:

i) Clearing of natural forest or using its resources,
ii) Any type of land acquisition resulting in involuntary resettlements,
iii) Avoidance of Land or any section of land having physical or any other cultural significance to the local community,
iv) Disputed land or have encroachments on them (informal settlers, non-titled entities),
v) Lack of provision for advance notice and lack of due crop compensation for owners and stakeholders.
vi) Adverse impact to any indigenous people (if any) in the community facility area.
vii) Lack of approvals from the Pollution Department/NEMA.

13.3.2 Phase II: SPGP Implementation

The contractor shall avoid the following during implementation

i) Tree cutting without permission,
ii) Use of Chemical Pesticides,
iii) Non-compliance to Kenya Bureau of Standards (KEBS) requirements
iv) Blockage of drainage and consequent flooding or erosion due to cross drainage structures such as new roads or water access,
v) Lack of internal drainage system for the rain fall run off,
vi) Lack of buy back arrangements during the procurement of batteries, solar panels, invertors, LEDs, cables, etc.,
vii) Non-involvement of local labor.

13.3.3 Phase III: SPGP Operation and Maintenance

During O&M period, contractor shall take the following precautions

i) Avoid waste disposal or waste water run off in the nearby fields,

ii) Have a water conservation plan,

iii) Ensure arrangements for safe handling and management of e-waste (CFLs, batteries, LEDs, solar panels),

iv) Avoid Non-compliance with Workers Rights, Health and Safety of the Workers and community at large.

v) Meet all ESHS requirements during O&M period including but not limited to carrying out statutory annual independent EHS audits by an individual expert, that are required of the contractor as well as meeting security requirements. The costs of all ESHS requirements during O&M period should be included in the O&M quoted cost (Price schedule No. 6, Volume III of bidding documents).

13.4 Ground Water Uses/Right of Way

13.4.1 The contractor shall be responsible for provisions for Ground water usage/availability of water/drainage/Right of Way and other approvals, as required to complete the project. In case of difficulty, KPLC will provide recommendation letter to other government departments on request of contractor.

14. ROLE OF KPLC AS EMPLOYER

14.1 The Employer shall endeavor to provide reasonable assistance to the Contractor (Successful Bidder) in obtaining the required approvals and in addressing any key concern/issue pertaining to the involvement of any county government for timely completion of the SPGP for community facilities, provided that, the Employer, at any time, during the term shall not be under any legal obligation to provide such assistance to the Contractor.

14.2 KPLC shall act as Employer through all phases of this contract i.e. Supply and Installation phase as well as the 7-year O&M period for the SPGP and BESS for the community facilities. KPLC as Employer will pay annual fees to the contractor for O&M works as quoted in Price Schedules for O&M period of 7 years on quarterly basis.

14.3 All customers connected to the solar stand alone systems will be KPLC customers. KPLC will charge a tariff to these customers/consumers as per EPRA orders.

14.4 The customers shall be billed on KPLC systems and payments shall be made to KPLC accounts during 7 years of O&M contract period.

15. FACILITIES FOR THE EMPLOYER

15.1 The Contractor shall afford the Employer and his Representatives at a cost deemed to be covered by his Bid price, plant, labour, materials and apparatus as may be required in performing operations in connection with the execution, examination, inspection, and testing of the Works supply:

1. Office facilities including full services at a suitable location to be approved by the Employer. This shall be provided within the contractor's site office for the lot.
2. Transport services shall be provided on a 24 hours basis, 7 days a week, including associated maintenance and repair costs for the vehicles (4X4) double cab provided.
3. Communication facilities for Site Works supervision

15.2 The facilities purchased shall include all local custom duties and charges. The contractor shall provide full/detailed specifications and supporting documents (catalogues, descriptions and technical documentation) with model/type and product for the evaluation of each item. If the specified type/model of items will not be available at the time of supply the contractor will supply the higher model of the concerned item in its range.

15.3 Any equipment provided shall, unless specified to the contrary, become the property of the client, and shall be required for use solely by the Client and/ Engineer's personnel and shall be handed over in good working order and condition upon completion of the Contract.

15.4 The Contractor shall provide all necessary cleaning and maintenance services, including labor, and provide all the required consumable such as, but not limited to water, electricity, cleaning gear and washroom equipment etc.

15.5 **Office facilities requirements**

The Contractor shall provide for the entire duration of the Contract for each lot, contractor's site office for the lot at a localized area as shall be approved by the employer; fully furnished, complete with all electrical fittings, plumbing and sanitary systems clean and provided with windows to give a sufficient supply of natural light and adequate security.

15.6 **Transport**

The Contractor shall provide transport services for use by the employer in site supervision on a 24 hours basis, 7 days a week for the entire contract period with an experienced licensed driver who must be having a certificate of good conduct. The type of vehicle should be a 4X4 double cab suitable for off-road and site conditions.

16. GUARANTEED TECHNICAL PARTICULARS

16.1 Bidders shall submit;

i) Guaranteed Technical Particulars duly filled and signed by manufacturers for equipment being offered as per details in **Appendix 1 – Guaranteed Technical Particulars (GTP).**

ii) The Technical Data sheets of Major equipment as listed in Bid Data sheet, Volume I

iii) Single line diagram of offered SPGP showing modules capacity, String Monitoring Box (SMB), DCDB, Inverters, ACDB, BESS, metering etc.

Note: One (1) design diagram per unique size of PV capacity is required (not per site).

17. CAPACITY FORMS

17.1 Bidders shall indicate capacities and other details of equipment offered per site, by submitting Capacity forms duly filled and signed by the bidder. The capacity forms are provided in **Appendix 2 – Capacity Forms Tables**.

18. END OF LIFE (EOL) PLAN FOR BATTERIES AND E-WASTE

18.1 End-of-Life (EOL) plan for all batteries and other potentially hazardous e-waste at the end of its useful life.

Bidder shall prepare and submit an EOL recycling and disposal plan for all batteries to be safely processed at a certified facility for the Lithium-ion battery chemistry included in the proposal for each Lot. To the extent that the selected battery chemistry has some residual value as a result of the recycling process, this value can be considered as funds set aside to offset the handling and transport of materials at the end of their useful life.

This plan shall also include E-waste equipment that is obsolete/which has reached End-Of-Life for inverters, solar panels etc. for adequate disposal.

19. CODE OF CONDUCT (ESHS) AND IMPLEMENTATION STRATEGY

19.1 The Bidder shall submit its Code of Conduct that will apply to Contractor's and sub-contractor's Personnel (as defined in Sub-clause 22.4 of the GCC and other parts of Bid document Volume 1), to ensure compliance with its Environmental, Social, Health and Safety (ESHS) obligations under the contract.

Note: Complete and include the risks to be addressed by the Code in accordance with Section VII-Works' Requirements

19.2 In addition, the Bidder shall detail how this Code of Conduct will be implemented. This will include: how it will be introduced into conditions of employment/engagement, what training will be provided, how the community shall be sensitised against having sexual relationships with the contractor/sub-contractor personnel, how it will be monitored and how the Contractor proposes to deal with any breaches.

19.3 The Contractor shall be required to implement the agreed Code of Conduct.

20. SITE VISITS

20.1 The Bidders are advised to visit the sites of respective Lots before bidding, to appreciate the site conditions including transportation of material/equipment. The interested Bidders should arrange the site visits of respective Community Facilities at their own cost as per Section II (BDS) so that they can get timely required clarifications. If any assistance is needed, then the bidder representative may contact the Employer as per clause ITB 7.4.

20.2 The locational details including coordinates of the sites are provided in Appendix 3. Bidders should get in touch with KPLC to introduce them to County Renewable Energy Officers (CREOs), who will coordinate the visits to the respective facilities.

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APPENDIX 1 - GUARANTEED TECHNICAL PARTICULARS (GTP)

(i) Bidder is to submit duly filled Guaranteed Technical Particulars (GTP) for each major equipment; duly completed and signed by the Manufacturer of the equipment and submitted together with relevant copies of the Manufacturer's Technical data sheet, catalogues, brochures, drawings, technical data & calculations, documentary evidence indicating manufacturer's supplies record, details of manufacturing capacity, the manufacturer's experience, copies of complete type test reports and accreditation certificate for the testing laboratory for tender evaluation, all in English language.

(ii) The foregoing technical specifications requirements shall guide the filling in of the GTPs.

(iii) Where there is more than one unique capacity/size of an equipment offered, (i.e. where a single unit may have multiple sizes), a separate GTP is to be filled for each different capacity/size. For example, a 1.5kW inverter would have it's own GTP, whereas a 2kW inverter would have it's own separate GTP; a 75A charge controller would have it's own different GTP while a 90A charge controller would have it's own separate GTP and so on, for all different sizes offered, for each equipment.

Table 14: GTP – Solar PV Modules

SOLAR PV MODULES			
No.	**Description**	**KPLC Requirement**	**Bidder's offer**
1	PV Module manufacturer		*State*
	Origin country		*State*
2	Cell manufacturer		*State*
	Origin country		*State*
3	Technology	Monocrystalline or polycrystalline silicon only	*State*
4	Number of cells	Minimum 60 cells	*State*
5	Capacity of each module (Wp) (Capacity of single unit)		*State*[3]
6	Isc - Short Circuit Current (A) (of single module)		*State*
7	Module dimensions		*State*

[3] Fill in a different GTP form for each different capacity module

8	Product Warranty offered	Minimum 10 years	*State*
9	Performance Warranty: Peak Power at year 10	Not less than 90% of rated power	*State*
	Peak Power at year 25	Not less than 80% of rated power	*State*
10	Module efficiency	Minimum 18%	*State*
11	Cell efficiency		*State*
12	Temperature coefficient of power (%/K or %/ deg cell)		*State*
13	Applicable standards	As per Table 9 and clause 4.1	*State*
14	Model No. of offered product		*State*
15	Technical data sheet must be attached to bid (for the Model offered)		*Submit*
	Name of Manufacturer …… ……... Signature of Manufacturer ……		

Table 15: GTP - Batteries

BATTERIES			
No.	**Description**	**KPLC requirement**	**Bidder's offer**
1	Product manufacturer		*State*
2	Origin country		*State*
3	Technology	Lithium ion	*State*
4	Depth of discharge (DOD) of battery	Minimum 80%	*State*
5	Nominal cell voltage (VDC)		*State*
6	Output of voltage of battery bank (system voltage)	24VDC (for sites with less than 3kWp PV capacity) 48VDC (for sites with 3kWp and above of PV capacity)	*State*[4]
7	Capacity of each power pack battery (Wh)		*State*
8	Operation temperature		*State*
9	Maximum Charge Rate (Current) (A)		*State*
10	Maximum Discharge Rate (Current) (A)		*State*
11	Recommended Charge Rate (Current) (A)		*State*
12	Life time in number of cycles (at 80% DOD and at a minimum temperature of 25°C).	Minimum 3,700 cycles (at 80% DOD and at a minimum temperature of 25°C).	*State*
13	Calendar lifetime at recommended operating temperature	10 years minimum	*State*
14	Product Warranty in years	10 years minimum	*State*
15	Is there danger of explosive gas/fumes formation?		*State*
16	Protections provided (List down all protections provided)		*State*

[4] Fill in a different GTP form for each different battery voltage

17	Does the proposed design include a comprehensive Power Management System?		*State*
18	Applicable standards	As per clause 4.3	*State*
19	Model No. of offered product		*State*
20	Technical data sheet must be attached to bid (for the Model offered)		*Submit*
	Name of Manufacturer…… ……... Signature of Manufacturer …….		

Table 16: GTP – PV Inverter

PV INVERTER			
No.	**Description**	**KPLC requirement**	**Bidder's offer**
1	Product manufacturer		*State*
2	Origin Country		*State*
3	MPPT Voltage range		*State*
4	No. of independent MPPT trackers		*State*
5	Capacity of Inverter (W) (Capacity of single unit)		*State*[5]
6	Type of inverters	String Inverters	*State*
7	Product Warranty	Minimum 10 years	*State*
8	Efficiency	More than 93% at full load.	*State*
9	Total harmonic distortion	less than 3%	*State*
10	Overload capacity (Surge capability) (W)	Minimum twice the rated capacity[6]	*State*
11	Power Factor Range		*State*
12	Protections provided (List down all protections provided)	As per clause 4.2	*State*
13	Is the Inverter to be integrated with the power management system in the design?		*State*
14	Applicable standards	As per Table 9 and clause 4.2	*State*
15	Model No. of offered product		*State*
16	Technical data sheet must be attached to bid (for the Model offered)		*Submit*
	Name of Manufacturer…… ……... Signature of Manufacturer …….		

[5] Fill in a different GTP form for each different capacity inverter

[6] The inverter shall have high overload capacity/ surge capability of at least twice the rated capacity.

Table 17: GTP – Battery Inverter Charger

BATTERY INVERTER			
No.	**Description**	**KPLC requirement**	**Bidder's offer**
1	Product manufacturer		*State*
2	Origin Country		*State*
3	DC input voltage	24VDC (for sites with less than 3kWp PV capacity) 48VDC (for sites with 3kWp and above of PV capacity)	*State*[7]
4	Capacity of Inverter (W) (Capacity of single unit)		*State*[8]
5	Output waveform	Pure sinewave	*State*
6	Product Warranty	Minimum 10 years	*State*
7	Efficiency	More than 93% at full load.	*State*
8	Overload capacity (Surge capability) (W)	Minimum twice the rated capacity	*State*
9	Total harmonic distortion	less than 3%	*State*
10	Power Factor Range	0.8 lagging to 0.8 leading	*State*
11	Protections provided (List down all protections provided)	As per clause 4.4	*State*
12	Is the Inverter to be integrated with the power management system in the design?		*State*
13	Applicable standards	As per Table 9 and clause 4.4	*State*
14	Model No. of offered product		*State*
15	Technical data sheet must be attached to bid (for the Model offered)		*Submit*
	Name of Manufacturer…… ……... Signature of Manufacturer …….		

[7] Fill in a different GTP form for each different voltage
[8] Fill in a different GTP form for each different capacity inverter

Table 18: GTP – Charge Controller

CHARGE CONTROLLER			
No.	**Description**	**KPLC requirement**	**Bidder's offer**
1	Product manufacturer		*State*
2	Origin Country		*State*
3	Type of charge controller	MPPT	
4	DC input voltage (battery voltage)	24VDC	*State*
5	Capacity of Charge Controller (A) (Capacity of single unit)		*State*[9]
6	Product Warranty	Minimum 10 years	*State*
7	Efficiency		*State*
8	Protections provided (List down all protections provided)		*State*
9	Is the Charge Controller to be integrated with the power management system in the design?		
10	Applicable standards		*State*
11	Model No. of offered product		*State*
12	Technical data sheet must be attached to bid (for the Model offered)		*Submit*
	Name of Manufacturer…… ……... Signature of Manufacturer …….		

[9] Fill in a different GTP form for each different capacity charge controller

Table 19: GTP – Hybrid Inverter for systems having PV capacity of less than 3kWp

HYBRID INVERTER[10] - For systems having PV capacity of less than 3kWp[11]			
No.	**Description**	**KPLC requirement**	**Bidder's offer**
1	Product manufacturer		*State*
2	Origin Country		*State*
3	DC input voltage (battery voltage)	24VDC	*State*
4	Capacity of Inverter (W) (Capacity of single unit)		*State*[12]
5	PV input maximum power (Wp) (Maximum solar PV array input)		*State*
6	Output waveform	Pure sinewave	*State*
7	Product Warranty	Minimum 10 years	*State*
8	Efficiency	More than 93% at full load.	*State*
9	Overload capacity (Surge capability) (W)	Minimum twice the rated capacity	*State*
10	Total harmonic distortion	less than 3%	*State*
11	Power Factor Range	0.8 lagging to 0.8 leading	*State*
12	Type of integrated charge controller	MPPT	*State*
13	Capacity of integrated Charge Controller (A) (Capacity of single unit)		*State*
14	Protections provided (List down all protections provided)	As per clauses 4.6.1 and 4.4	*State*
15	Is the hybrid Inverter to be integrated with the power management system in the design?		*State*
16	Applicable standards	As per Table 9 and clauses 4.6.1 and 4.4	*State*
17	Model No. of offered product		*State*
18	Technical data sheet must be attached to bid (for the Model offered)		*Submit*
	Name of Manufacturer…… ……... Signature of Manufacturer …….		

[10] The bidder (or Manufacturer) **must** include the heading 'HYBRID INVERTER' to **clearly indicate** intention to offer a Hybrid Inverter.

[11] Refer to Clause 4.6.1 for more details on Hybrid inverter for systems having PV capacity of less than 3kWp

[12] Fill in a different GTP form for each different capacity inverter

Table 20: GTP - Hybrid Inverter for systems having PV capacity of 3kWp and above

HYBRID INVERTER[13] - For systems having PV capacity of 3kWp and above[14]			
No.	**Description**	**KPLC requirement**	**Bidder's offer**
1	Product manufacturer		*State*
2	Origin Country		*State*
3	MPPT Voltage range		*State*
4	No. of independent MPPT trackers		*State*
5	DC input voltage (battery voltage)	48VDC	*State*
6	Capacity of Inverter (W) (Capacity of single unit)		*State*[15]
7	PV input maximum power (Wp) (Maximum solar PV array input)		*State*
8	Output waveform	Pure sinewave	*State*
9	Type of inverters	String Inverters	
10	Product Warranty	Minimum 10 years	*State*
11	Efficiency	More than 93% at full load.	*State*
12	Overload capacity (Surge capability) (W)	Minimum twice the rated capacity	*State*
13	Total harmonic distortion	less than 3%	*State*
14	Power Factor Range	0.8 lagging to 0.8 leading	*State*
15	Protections provided (List down all protections provided)	As per clauses 4.6.2, 4.2 and 4.4	*State*
16	Is the Hybrid Inverter to be integrated with the power management system in the design?		*State*
17	Does the inverter have off-grid operating mode?		*State*
18	Applicable standards	As per Table 9 and clauses 4.6.2, 4.2 and 4.4	*State*
19	Model No. of offered product		*State*
20	Technical data sheet must be attached to bid (for the Model offered)		*Submit*
	Name of Manufacturer…… ……... Signature of Manufacturer …….		

[13] The bidder (or Manufacturer) **must** include the heading 'HYBRID INVERTER' to **clearly indicate** intention to offer a Hybrid Inverter.

[14] Refer to Clause 4.6.2 for more details on Hybrid inverter for systems having PV capacity of 3kWp and above

[15] Fill in a different GTP form for each different capacity inverter

Table 21: GTP – Service Cables

SERVICE CABLES (16 MM² SINGLE PHASE CONCENTRIC ALUMINIUM CABLES AND 25 MM² 4-CORE ALUMINIUM CABLES)	Refer to specification document KP1/3CB/TSP/05/004 and KP1/3CB/TSP/05/001 in Appendix 4 for the GTP

APPENDIX 2 – CAPACITY FORMS TABLES

Table 22: Capacity Form - Lot 1 (Turkana County)

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[16]		Separate or Hybrid equipment[17]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
1	Turkana	Nameyana Dispensary	1,500		9,379				1,500		60		
2	Turkana	Nakaalei Dispensary	1,500		9,379				1,500		60		
3	Turkana	RCEA Kasuroi Boys	1,500		9,379				1,500		60		
4	Turkana	Kodopa Mobile Clinic	1,500		9,379				1,500		60		
5	Turkana	Teremkus dispensary	1,500		9,379				1,500		60		
6	Turkana	Loche angi-erengo	1,500		9,379				1,500		60		
7	Turkana	Napalatui dispensary	1,500		9,379				1,500		60		
8	Turkana	Aposta dispensary	1,500		9,379				1,500		60		
9	Turkana	Narengewoi Health center	1,500		9,379				1,500		60		
10	Turkana	Monti Dispensary	1,500		9,379				1,500		60		
11	Turkana	Loturerei Secondary School	1,500		9,379				1,500		60		

[16] The bidder must fill in the capacity (A) of Charge Controller offered, for systems of PV capacity less than 3kW. This **must** be filled in whether the Charge Controller is a separate equipment or it is integrated within a Hybrid Inverter.

[17] For sites with PV capacity of less than 3kW; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate Charge Controller, other wise state 'HYBRID' if offering a Hybrid Inverter. For sites having PV capacity of 3kWp and above; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate PV Inverter, other wise state 'HYBRID' if offering a Hybrid Inverter.

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[16]		Separate or Hybrid equipment[17]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
12	Turkana	Kekorisogol Dispensary	1,500		9,379				1,500		60		
13	Turkana	Kapokor Dispensary	1,500		9,379				1,500		60		
14	Turkana	Lokipetot arengan dispensary	1,500		9,379				1,500		60		
15	Turkana	Meyan Dispensary	1,500		9,379				1,500		60		
16	Turkana	Moru anguibuni	1,500		9,379				1,500		60		
17	Turkana	Chokchok Dispensary	1,500		9,379				1,500		60		
18	Turkana	Kabulokor health center	1,500		9,379				1,500		60		
19	Turkana	Kaenyangaluk dispensary	1,500		9,379				1,500		60		
20	Turkana	Kakelae Dispensary	1,500		9,379				1,500		60		
21	Turkana	Kakwanyang Dispensary	1,500		9,379				1,500		60		
22	Turkana	Kasuroi Dispensary	1,500		9,379				1,500		60		
23	Turkana	Kenya oil dispensary	1,500		9,379				1,500		60		
24	Turkana	Kosikiria dispensary	1,500		9,379				1,500		60		
25	Turkana	Lokamarinyang Dispensary	1,500		9,379				1,500		60		
26	Turkana	Lokipoto dispensary	1,500		9,379				1,500		60		
27	Turkana	Lokoburu dispensary	1,500		9,379				1,500		60		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[16]		Separate or Hybrid equipment[17]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
28	Turkana	Losajait dispensary	1,500		9,379				1,500		60		
29	Turkana	Nakechichok Dispensary	1,500		9,379				1,500		60		
30	Turkana	Sasame Dispensary	1,500		9,379				1,500		60		
31	Turkana	Lomunyakirionok Dispensary	1,500		9,379				1,500		60		
32	Turkana	Loruth dispensary	1,500		9,379				1,500		60		
33	Turkana	Kaalem	1,500		9,379				1,500		60		
34	Turkana	Nakapelewoi dispensary	1,500		9,379				1,500		60		
35	Turkana	Nasiger Dispensary	1,500		9,379				1,500		60		
36	Turkana	Epur Dispensary	1,500		9,379				1,500		60		
37	Turkana	Namon Dispensary	1,500		9,379				1,500		60		
38	Turkana	Nakiria Dispensary	1,500		9,379				1,500		60		
39	Turkana	Lochoraikeny Dispensary	1,500		9,379				1,500		60		
40	Turkana	Katiir dispensary	1,500		9,379				1,500		60		
41	Turkana	Nayanaeangikalalio Dispensary	1,500		9,379				1,500		60		
42	Turkana	Kapua Dispensary	1,500		9,379				1,500		60		
43	Turkana	Atiir Dispensary	1,500		9,379				1,500		60		
44	Turkana	Kaapus dispensary	1,500		9,379				1,500		60		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[16]		Separate or Hybrid equipment[17]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
45	Turkana	Koyasa Dispensary	1,500		9,379				1,500		60		
46	Turkana	Sopel Dispensary	1,500		9,379				1,500		60		
47	Turkana	Namakat Dispensary	1,500		9,379				1,500		60		
48	Turkana	Lomil Girls Secondary School	2,000		12,505				2,000		75		
49	Turkana	Lomii Dispensary	2,000		12,505				2,000		75		
50	Turkana	Louwae Dispensary	2,000		12,505				2,000		75		
51	Turkana	Nakatong'wa Dispensary	2,000		12,505				2,000		75		
52	Turkana	Nakurio Dispensary	2,000		12,505				2,000		75		
53	Turkana	Natuntun Dispensary	2,000		12,505				2,000		75		
54	Turkana	Kangalita Dispensary	2,000		12,505				2,000		75		
55	Turkana	Kanaodon Dispensary	2,000		12,505				2,000		75		
56	Turkana	Lokorkor Health Center	2,000		12,505				2,000		75		
57	Turkana	Lopii Dispensary	2,000		12,505				2,000		75		
58	Turkana	Juluk Dispensary	2,000		12,505				2,000		75		
59	Turkana	Kamuge Dispensary	2,000		12,505				2,000		75		
60	Turkana	Lomelo Dispensary	2,000		12,505				2,000		75		
61	Turkana	Loyapat Dispensary	2,000		12,505				2,000		75		
62	Turkana	Komudei Dispensary	2,000		12,505				2,000		75		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[16]		Separate or Hybrid equipment[17]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
63	Turkana	Kangitankori Dispensary	2,000		12,505				2,000		75		
64	Turkana	Lochor Alomala dispensary	2,000		12,505				2,000		75		
65	Turkana	Naotin Dispensary	2,000		12,505				2,000		75		
66	Turkana	Riokomor Dispensary	2,000		12,505				2,000		75		
67	Turkana	Long'ech dispensary	2,000		12,505				2,000		75		
68	Turkana	Loturerei dispensary	2,000		12,505				2,000		75		
69	Turkana	Parkati dispensary	2,000		12,505				2,000		75		
70	Turkana	Kalimapus Dispensary	2,000		12,505				2,000		75		
71	Turkana	Nakurio Girls Secondary school	2,000		12,505				2,000		75		
72	Turkana	Lochor Edome Dispensary	2,000		12,505				2,000		75		
73	Turkana	Loperot Dispensary	2,000		12,505				2,000		75		
74	Turkana	Nakoyo Dispensary	2,000		12,505				2,000		75		
75	Turkana	Kaesogol etom Dispensary	2,400		15,006				2,400		90		
76	Turkana	Lokangae Health Centre	2,400		15,006				2,400		90		
77	Turkana	Ngamia one kochodin high school	2,400		15,006				2,400		90		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[16]		Separate or Hybrid equipment[17]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
78	Turkana	Kangirisae dispensary	2,400		15,006				2,400		90		
79	Turkana	Lokapel Dispensary	2,400		15,006				2,400		90		
80	Turkana	Nadooto dispensary	2,400		15,006				2,400		90		
81	Turkana	Nanam dispensary	3,500		21,884		3,500		3,500				
82	Turkana	Lokwii Health Center	4,000		25,011		4,000		4,000				
83	Turkana	Karebur dispensary	4,500		28,137		4,500		4,500				
84	Turkana	Loima boys secondary School	5,500		34,389		5,500		5,500				
85	Turkana	Aic Songot secondary School	6,000		37,516		6,000		6,000				
86	Turkana	Talent high school	6,000		37,516		6,000		6,000				

Name of Bidder ……..

Signature of Bidder ……

Table 23: Capacity Form - Lot 2 (West Pokot County)

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[18]		Separate or Hybrid equipment[19]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
1	West Pokot	Leng'orok Dispensary	1,500		9,379				1,500		60		
2	West Pokot	Nyangolesinyang dispensary	1,500		9,379				1,500		60		
3	West Pokot	Cheptiangwa Dispensary	1,500		9,379				1,500		60		
4	West Pokot	Kapkaremba Dispensary	1,500		9,379				1,500		60		
5	West Pokot	Kasitet Dispensary	1,500		9,379				1,500		60		
6	West Pokot	Chemotong Dispensary	1,500		9,379				1,500		60		
7	West Pokot	Kiwakan Dispensary	1,500		9,379				1,500		60		
8	West Pokot	Mading west pokot	1,500		9,379				1,500		60		
9	West Pokot	Nauyapong Dispensary	1,500		9,379				1,500		60		

[18] The bidder must fill in the capacity (A) of Charge Controller offered, for systems of PV capacity less than 3kW. This **must** be filled in whether the Charge Controller is a separate equipment or it is integrated within a Hybrid Inverter.

[19] For sites with PV capacity of less than 3kW; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate Charge Controller, other wise state 'HYBRID' if offering a Hybrid Inverter. For sites having PV capacity of 3kWp and above; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate PV Inverter, other wise state 'HYBRID' if offering a Hybrid Inverter.

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[18]		Separate or Hybrid equipment[19]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
10	West Pokot	Kapenguria west pokot	1,500		9,379				1,500		60		
11	West Pokot	Nakwijit dispensary	1,500		9,379				1,500		60		
12	West Pokot	Nasal Dispensary	1,500		9,379				1,500		60		
13	West Pokot	Wonyoi dispensary	1,500		9,379				1,500		60		
14	West Pokot	St. Marks mixed Day and Boarding Secondary School-Kapkaremba	1,500		9,379				1,500		60		
15	West Pokot	Kisera dispensary	1,500		9,379				1,500		60		
16	West Pokot	Nyangaita Dispensary	1,500		9,379				1,500		60		
17	West Pokot	Kamanau Dispensary	1,500		9,379				1,500		60		
18	West Pokot	Kesot Dispensary	1,500		9,379				1,500		60		
19	West Pokot	Krich dispensary	1,500		9,379				1,500		60		
20	West Pokot	Tamarukwa dispensary	1,500		9,379				1,500		60		
21	West Pokot	Tipet dispensary	1,500		9,379				1,500		60		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[18]		Separate or Hybrid equipment[19]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
22	West Pokot	Miskwony dispensary	1,500		9,379				1,500		60		
23	West Pokot	Kalemrekai Dispensary	1,500		9,379				1,500		60		
24	West Pokot	Sostin dispensary	1,500		9,379				1,500		60		
25	West Pokot	Kataywa dispensary	1,500		9,379				1,500		60		
26	West Pokot	Cherangan dispensary	2,000		12,505				2,000		75		
27	West Pokot	Chekomosi location	2,000		12,505				2,000		75		
28	West Pokot	Masol Dispensary	2,000		12,505				2,000		75		
29	West Pokot	Kangoletiang Dispensary	2,000		12,505				2,000		75		
30	West Pokot	Kalemngorok dispensary	2,000		12,505				2,000		75		
31	West Pokot	Sobukwo secondary School	2,000		12,505				2,000		75		
32	West Pokot	Tamkal dispensary	2,000		12,505				2,000		75		
33	West Pokot	Nachecheyet Dispensary	2,400		15,006				2,400		90		
34	West Pokot	Kauryong dispensary	3,000		18,758		3,000		3,000				

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[18]		Separate or Hybrid equipment[19]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
35	West Pokot	Ptoyo Health Center	3,500		21,884		3,500		3,500				
36	West Pokot	Simpol dispensary	3,500		21,884		3,500		3,500				
37	West Pokot	Salion secondary school	4,000		25,011		4,000		4,000				
38	West Pokot	Kalemnyang Yunhap	4,000		25,011		4,000		4,000				
39	West Pokot	Kanyerus dispensary	4,000		25,011		4,000		4,000				

Name of Bidder ……..

Signature of Bidder ……

Table 24: Capacity Form - Lot 3 (Marsabit, Isiolo and Samburu Counties)

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[20]		Separate or Hybrid equipment[21]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
1	Marsabit	Telesgaye Health center	1,500		9,379				1,500		60		
2	Marsabit	Madoadi dispensary	1,500		9,379				1,500		60		
3	Marsabit	Burgabo dispensary	1,500		9,379				1,500		60		
4	Marsabit	Qate dispensary	1,500		9,379				1,500		60		
5	Marsabit	Ell - borr dispensary	1,500		9,379				1,500		60		
6	Marsabit	El-Molo Bay Dispensary	1,500		9,379				1,500		60		
7	Marsabit	Oltorot Dispensary	1,500		9,379				1,500		60		
8	Marsabit	Waye Godha dispensary	1,500		9,379				1,500		60		
9	Isiolo	Boji dispensary	1,500		9,379				1,500		60		

[20] The bidder must fill in the capacity (A) of Charge Controller offered, for systems of PV capacity less than 3kW. This must be filled in whether the Charge Controller is a separate equipment or it is integrated within a Hybrid Inverter.

[21] For sites with PV capacity of less than 3kW; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate Charge Controller, other wise state 'HYBRID' if offering a Hybrid Inverter. For sites having PV capacity of 3kWp and above; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate PV Inverter, other wise state 'HYBRID' if offering a Hybrid Inverter.

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[20]		Separate or Hybrid equipment[21]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
10	Isiolo	Daaba dispensary	1,500		9,379				1,500		60		
11	Samburu	Oromodei dispensary	1,500		9,379				1,500		60		
12	Samburu	Sereni dispensary	1,500		9,379				1,500		60		
13	Samburu	Waso Rongai Dispensary	1,500		9,379				1,500		60		
14	Samburu	Engilai Mixed Secondary	1,500		9,379				1,500		60		
15	Samburu	Loikumkum Dispensary	1,500		9,379				1,500		60		
16	Samburu	Angata Nanyokie Dispensary	1,500		9,379				1,500		60		
17	Samburu	Logetei Dispensary	1,500		9,379				1,500		60		
18	Samburu	Nkaroni dispensary	1,500		9,379				1,500		60		
19	Samburu	Klitamany dispensary	1,500		9,379				1,500		60		
20	Samburu	Masikita Dispensary	1,500		9,379				1,500		60		
21	Samburu	Ndonyo Nasipa Dispensary	1,500		9,379				1,500		60		
22	Samburu	Muruankai GOK Dispensary	1,500		9,379				1,500		60		
23	Samburu	Loonjorin Dispensary	1,500		9,379				1,500		60		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[20]		Separate or Hybrid equipment[21]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
24	Marsabit	Korolle Boys' Secondary School	2,000		12,505				2,000		75		
25	Marsabit	Dukana Ward Administrator's Office	2,000		12,505				2,000		75		
26	Marsabit	Badan Rero Dispensary	2,000		12,505				2,000		75		
27	Isiolo	Ntalaby Primay school	2,000		12,505				2,000		75		
28	Isiolo	Kom Acc Office	2,000		12,505				2,000		75		
29	Isiolo	Muchuro dispensary	2,000		12,505				2,000		75		
30	Samburu	Urra Dispensary	2,000		12,505				2,000		75		
31	Samburu	Ngilai (Saidia) dispensary	2,000		12,505				2,000		75		
32	Samburu	Donyo-Wasin Dispensary	2,000		12,505				2,000		75		
33	Samburu	Sereolipi mixed day secondary school	2,000		12,505				2,000		75		
34	Samburu	Marti E pareu	2,000		12,505				2,000		75		
35	Marsabit	Arapal Dispensary	2,400		15,006				2,400		90		
36	Marsabit	Dukana Health Center	2,400		15,006				2,400		90		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[20]		Separate or Hybrid equipment[21]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
37	Isiolo	Biliqo Marara dispensary	2,400		15,006				2,400		90		
38	Marsabit	Godoma Health Centre (Nep)	2,400		15,006				2,400		90		
39	Marsabit	Lontolio Dispensary	2,400		15,006				2,400		90		
40	Marsabit	Kulal Girls Secondary school	2,400		15,006				2,400		90		
41	Marsabit	Karbururi dispensary	3,000		18,758		3,000		3,000				
42	Samburu	Barsoloi arid zone primary school	4,000		25,011		4,000		4,000				
43	Isiolo	Ngaremara secondary-boys	16,500		103,168		16,500		16,500				

Name of Bidder ……..

Signature of Bidder ……

Table 25: Capacity Form - Lot 4 (Mandera and Wajir Counties)

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[22]		Separate or Hybrid equipment[23]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
1	Mandera	Olla secondary school	1,500		9,379				1,500		60		
2	Mandera	Burduras secondary School	1,500		9,379				1,500		60		
3	Mandera	Choroko Dispensary	1,500		9,379				1,500		60		
4	Mandera	Burmayo Dispensary	1,500		9,379				1,500		60		
5	Mandera	Burjon Dispensary	1,500		9,379				1,500		60		
6	Mandera	Koromey Dispensary	1,500		9,379				1,500		60		
7	Mandera	Chachabole Dispensary	1,500		9,379				1,500		60		
8	Wajir	Burder Secondary School	1,500		9,379				1,500		60		
9	Wajir	Busbus primary school	1,500		9,379				1,500		60		
10	Wajir	Dureweey dispensary	1,500		9,379				1,500		60		
11	Wajir	Argane dispensary	1,500		9,379				1,500		60		

[22] The bidder must fill in the capacity (A) of Charge Controller offered, for systems of PV capacity less than 3kW. This must be filled in whether the Charge Controller is a separate equipment or it is integrated within a Hybrid Inverter.

[23] For sites with PV capacity of less than 3kW; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate Charge Controller, other wise state 'HYBRID' if offering a Hybrid Inverter. For sites having PV capacity of 3kWp and above; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate PV Inverter, other wise state 'HYBRID' if offering a Hybrid Inverter.

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[22]		Separate or Hybrid equipment[23]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
12	Wajir	Burmayo Dispensary Wajir	1,500		9,379				1,500		60		
13	Wajir	Lakole Dispensary	1,500		9,379				1,500		60		
14	Wajir	Wara Dispensary	1,500		9,379				1,500		60		
15	Wajir	Arbajahan mixed/day and boarding secondary Schools	1,500		9,379				1,500		60		
16	Wajir	Wargadud Dispensary(Tarbaj)	1,500		9,379				1,500		60		
17	Wajir	Beramo Dispensary	1,500		9,379				1,500		60		
18	Wajir	Dadhantaly Dispensary	1,500		9,379				1,500		60		
19	Wajir	Dunto Dispensary	1,500		9,379				1,500		60		
20	Wajir	Elben Dispensary	1,500		9,379				1,500		60		
21	Wajir	Ogorji Dispensary	1,500		9,379				1,500		60		
22	Mandera	Fino ACC	2,000		12,505				2,000		75		
23	Mandera	Kukub dispensary	2,000		12,505				2,000		75		
24	Mandera	Tarama Dispensary	2,000		12,505				2,000		75		
25	Mandera	Garsesala Dispensary	2,000		12,505				2,000		75		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[22]		Separate or Hybrid equipment[23]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
26	Mandera	Lagsure dispensary	2,000		12,505				2,000		75		
27	Mandera	Domal dispensary	2,000		12,505				2,000		75		
28	Mandera	Kobadadi dispensary	2,000		12,505				2,000		75		
29	Mandera	Birkan dispensary	2,000		12,505				2,000		75		
30	Wajir	Bojiyare Dispensary	2,000		12,505				2,000		75		
31	Wajir	Sabuli Nomadic Clinic	2,000		12,505				2,000		75		
32	Wajir	Batalu Dispensary	2,000		12,505				2,000		75		
33	Wajir	Tesorie Dispensary	2,000		12,505				2,000		75		
34	Wajir	Mathow Dispensary	2,000		12,505				2,000		75		
35	Wajir	Hungai Dispensary	2,000		12,505				2,000		75		
36	Mandera	Aresa Dispensary	2,400		15,006				2,400		90		
37	Mandera	Hullow Dispensary	2,400		15,006				2,400		90		
38	Mandera	Alongo Dispensary	2,400		15,006				2,400		90		
39	Mandera	Damasa Dispensary	2,400		15,006				2,400		90		
40	Mandera	El-Golicha Dispensary	2,400		15,006				2,400		90		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[22]		Separate or Hybrid equipment[23]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
41	Mandera	Elram Dispensary	2,400		15,006				2,400		90		
42	Mandera	Falama Dispensary	2,400		15,006				2,400		90		
43	Mandera	Fino Health Centre	2,400		15,006				2,400		90		
44	Mandera	Hareri Hosle Dispensary	2,400		15,006				2,400		90		
45	Mandera	Kabo Dispensary	2,400		15,006				2,400		90		
46	Mandera	Lafey nomadic dispensary	2,400		15,006				2,400		90		
47	Mandera	Odha Dispensary	2,400		15,006				2,400		90		
48	Mandera	Omar jilaow Dispensary	2,400		15,006				2,400		90		
49	Mandera	Qarsahama Dispensary	2,400		15,006				2,400		90		
50	Wajir	Dugo Health Centre	2,400		15,006				2,400		90		
51	Mandera	Malkamari Boys' Secondary School	3,000		18,758		3,000		3,000				
52	Mandera	Libin Nomadic Girls Secondary School	3,000		18,758		3,000		3,000				
53	Mandera	Gari secondary School	3,500		21,884		3,500		3,500				
54	Mandera	Hareri Mixed Secondary School	3,500		21,884		3,500		3,500				
55	Mandera	Qarsadamu dispensary	4,000		25,011		4,000		4,000				

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[22]		Separate or Hybrid equipment[23]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
56	Wajir	Sabuli mixed day secondary School	4,500		28,137		4,500		4,500				
57	Wajir	Lagbogol secondary school	4,500		28,137		4,500		4,500				
58	Mandera	Bolowle dispensary	5,500		34,389		5,500		5,500				
59	Wajir	Baraqwo secondary	5,500		34,389		5,500		5,500				
60	Mandera	Derkale dispensary	6,000		37,516		6,000		6,000				
61	Wajir	KHOrof harar youth polytechnic	6,000		37,516		6,000		6,000				
62	Mandera	El- hagarsu mixed day secondary school	7,500		46,895		7,500		7,500				
63	Wajir	Diif Secondary School	8,500		53,147		8,500		8,500				

Name of Bidder ……..

Signature of Bidder ……

Table 26: Capacity Form - Lot 5 (Garissa, Tana River and Narok Counties)

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[24]		Separate or Hybrid equipment[25]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
1	Garissa	Sangole Dispensary	1,500		9,379				1,500		60		
2	Garissa	Afwein Dispensary	1,500		9,379				1,500		60		
3	Garissa	Kotile health center	1,500		9,379				1,500		60		
4	Garissa	ACC office/Residence Galmagala	1,500		9,379				1,500		60		
5	Garissa	ACC office/Residence Jarajilla	1,500		9,379				1,500		60		
6	Garissa	Bodhai ACC office	1,500		9,379				1,500		60		
7	Garissa	Jalish Dispensary	1,500		9,379				1,500		60		
8	Garissa	Korisa Dispensary	1,500		9,379				1,500		60		
9	Garissa	Malaylay Dispensary	1,500		9,379				1,500		60		

[24]The bidder must fill in the capacity (A) of Charge Controller offered, for systems of PV capacity less than 3kW. This must be filled in whether the Charge Controller is a separate equipment or it is integrated within a Hybrid Inverter.

[25] For sites with PV capacity of less than 3kW; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate Charge Controller, other wise state 'HYBRID' if offering a Hybrid Inverter. For sites having PV capacity of 3kWp and above; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate PV Inverter, other wise state 'HYBRID' if offering a Hybrid Inverter.

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[24]		Separate or Hybrid equipment[25]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
10	Garissa	Libahlow dispensary	1,500		9,379				1,500		60		
11	Garissa	Ruqa Dispensary	1,500		9,379				1,500		60		
12	Tana River	Waldena ACC	1,500		9,379				1,500		60		
13	Tana River	Galili Dispensary	1,500		9,379				1,500		60		
14	Tana River	Mulanjo dispensary	1,500		9,379				1,500		60		
15	Tana River	Buwa Dispensary	1,500		9,379				1,500		60		
16	Tana River	AIC Titila Dispensary	1,500		9,379				1,500		60		
17	Tana River	Asa Kone Dispensary	1,500		9,379				1,500		60		
18	Tana River	Assa dispensary	1,500		9,379				1,500		60		
19	Tana River	Boka dispensary	1,500		9,379				1,500		60		
20	Tana River	Chewele Dispensary	1,500		9,379				1,500		60		
21	Tana River	Haroresa Dispensary	1,500		9,379				1,500		60		
22	Tana River	Meti Dispensary	1,500		9,379				1,500		60		
23	Tana River	Sabukia dispensary	1,500		9,379				1,500		60		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[24]		Separate or Hybrid equipment[25]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
24	Tana River	Kau Dispensary	1,500		9,379				1,500		60		
25	Tana River	Sombo Dispensary	1,500		9,379				1,500		60		
26	Narok	Roborwo Dispensary	1,500		9,379				1,500		60		
27	Narok	Mausa dispensary	1,500		9,379				1,500		60		
28	Narok	Kendunywo primary school	1,500		9,379				1,500		60		
29	Narok	Ilkerin -Loita dispensary	1,500		9,379				1,500		60		
30	Narok	Chemwokter Dispensary	1,500		9,379				1,500		60		
31	Narok	Entotol dispensary	1,500		9,379				1,500		60		
32	Narok	Olkoroi dispensary	1,500		9,379				1,500		60		
33	Garissa	Jilango dispensary	2,000		12,505				2,000		75		
34	Garissa	Amuma Dispensary	2,000		12,505				2,000		75		
35	Garissa	Amuma Mobile Dispensary	2,000		12,505				2,000		75		
36	Garissa	Bodhai Dispensary	2,000		12,505				2,000		75		
37	Garissa	Dekaharjey Dispensary	2,000		12,505				2,000		75		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[24]		Separate or Hybrid equipment[25]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
38	Garissa	El Kambere Nomadic Clinic	2,000		12,505				2,000		75		
39	Garissa	Fafi Dispensary	2,000		12,505				2,000		75		
40	Garissa	Yumbis Dispensary	2,000		12,505				2,000		75		
41	Tana River	Chifiri Dispensary	2,000		12,505				2,000		75		
42	Tana River	Wayu Boru Dispensary	2,000		12,505				2,000		75		
43	Tana River	Mwina Dispensary	2,000		12,505				2,000		75		
44	Tana River	Wayu Dispensary	2,000		12,505				2,000		75		
45	Tana River	Ozi Dispensary	2,000		12,505				2,000		75		
46	Tana River	Sera dispensary	2,000		12,505				2,000		75		
47	Tana River	Mnazini dispensary	2,000		12,505				2,000		75		
48	Narok	Ngendalel dispensary	2,000		12,505				2,000		75		
49	Garissa	Abdisamit Dispensary	2,400		15,006				2,400		90		
50	Garissa	Bultohama Dispensary	2,400		15,006				2,400		90		
51	Garissa	Elan Dispensary	2,400		15,006				2,400		90		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[24]		Separate or Hybrid equipment[25]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
52	Garissa	Danyere Health Centre	2,400		15,006				2,400		90		
53	Tana River	Majengo secondary	2,400		15,006				2,400		90		
54	Tana River	Bilbil dispensary	2,400		15,006				2,400		90		
55	Tana River	Aic Daba Dispensary	2,400		15,006				2,400		90		
56	Narok	Chesabuni Primary School	2,400		15,006				2,400		90		
57	Narok	Kamarget dispensary	2,400		15,006				2,400		90		
58	Garissa	Hagarbul Dispensary	3,000		18,758		3,000		3,000				
59	Tana River	Waldena Dispensary	3,000		18,758		3,000		3,000				
60	Garissa	Kulan secondary School	4,000		25,011		4,000		4,000				
61	Tana River	Kitere secondary school	4,000		25,011		4,000		4,000				
62	Tana River	Mororo mixed day secondary school	4,000		25,011		4,000		4,000				
63	Narok	Losho Dispensary	4,000		25,011		4,000		4,000				
64	Narok	Iltriben primary school	4,500		28,137		4,500		4,500				
65	Garissa	Hara health center	8,500		53,147		8,500		8,500				

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[24]		Separate or Hybrid equipment[25]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
66	Garissa	Saretho Dispensary	8,500		53,147		8,500		8,500				

Name of Bidder ……..

Signature of Bidder ……

Table 27: Capacity Form - Lot 6 (Lamu, Kilifi and Kwale Counties)

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[26]		Separate or Hybrid equipment[27]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
1	Lamu	Dide waride dispensary	1,500		9,379				1,500		60		
2	Lamu	kizuke primary school	1,500		9,379				1,500		60		
3	Lamu	Maisha masha	1,500		9,379				1,500		60		
4	Lamu	Didewaride primary school	1,500		9,379				1,500		60		
5	Lamu	Pangani Secondary School	1,500		9,379				1,500		60		
6	Lamu	Sinambio dispensary	1,500		9,379				1,500		60		
7	Lamu	Pandanguo primary school	1,500		9,379				1,500		60		
8	Lamu	Manda Dispensary	1,500		9,379				1,500		60		
9	Lamu	Manda Maweri Secondary School	1,500		9,379				1,500		60		
10	Lamu	Chalaluma primary school	1,500		9,379				1,500		60		
11	Lamu	Barigoni Dispensary	1,500		9,379				1,500		60		

[26] The bidder must fill in the capacity (A) of Charge Controller offered, for systems of PV capacity less than 3kW. This must be filled in whether the Charge Controller is a separate equipment or it is integrated within a Hybrid Inverter.

[27] For sites with PV capacity of less than 3kW; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate Charge Controller, other wise state 'HYBRID' if offering a Hybrid Inverter. For sites having PV capacity of 3kWp and above; the bidder to state 'SEPARATE' if offering a separate Battery Inverter/Charger and separate PV Inverter, other wise state 'HYBRID' if offering a Hybrid Inverter.

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[26]		Separate or Hybrid equipment[27]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
12	Lamu	Basuba Dispensary	1,500		9,379				1,500		60		
13	Lamu	Bodhei Dispensary	1,500		9,379				1,500		60		
14	Lamu	Ishakani Dispensary	1,500		9,379				1,500		60		
15	Lamu	Mangai Dispensary	1,500		9,379				1,500		60		
16	Kilifi	Kurawa Secondary school	1,500		9,379				1,500		60		
17	Kilifi	Watala Secondary School	1,500		9,379				1,500		60		
18	Kilifi	Mwangatini Dispensary	1,500		9,379				1,500		60		
19	Kilifi	Gandini Assistant Chief's office	1,500		9,379				1,500		60		
20	Kilifi	Gandini Primary school	1,500		9,379				1,500		60		
21	Kilifi	Viragoni dispensary	1,500		9,379				1,500		60		
22	Kilifi	Gandini dispensary	1,500		9,379				1,500		60		
23	Kilifi	Karimboni dispensary	1,500		9,379				1,500		60		
24	Kilifi	Mulunguni dispensary	1,500		9,379				1,500		60		
25	Kilifi	Muryachakwe Dispensary	1,500		9,379				1,500		60		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[26]		Separate or Hybrid equipment[27]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
26	Kwale	Mbegani Dispensary	1,500		9,379				1,500		60		
27	Kwale	Chanzou Dispensary	1,500		9,379				1,500		60		
28	Kwale	Mwachinga dispensary	1,500		9,379				1,500		60		
29	Kwale	Gozani dispensary	1,500		9,379				1,500		60		
30	Lamu	Acc Kiunga	2,000		12,505				2,000		75		
31	Lamu	Basuba	2,000		12,505				2,000		75		
32	Lamu	Ishakani	2,000		12,505				2,000		75		
33	Lamu	Kiangwi	2,000		12,505				2,000		75		
34	Lamu	Madani	2,000		12,505				2,000		75		
35	Lamu	Mangai	2,000		12,505				2,000		75		
36	Lamu	Marararni	2,000		12,505				2,000		75		
37	Lamu	Pandanguo Dispensary	2,000		12,505				2,000		75		
38	Lamu	Kiangwi Dispensary	2,000		12,505				2,000		75		
39	Lamu	Bahamisi Dispensary	2,000		12,505				2,000		75		

No.	County	Name of Facility	PV Modules		Battery		PV Inverter		Battery Inverter (or Hybrid Inverter if applicable)		Charge Controller (whether separate or within Hybrid Inverter)[26]		Separate or Hybrid equipment[27]
			KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	KPLC requirement	Bidder's offer	Bidder's offer
			Minimum Total Capacity (Wp)	Total Capacity (Wp)	Minimum Total Capacity (Wh)	Total Capacity (Wh)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Total Capacity (W)	Total Capacity (W)	Minimum Capacity (A)	Capacity (A)	Bidder to state 'SEPARATE' or 'HYBRID'
40	Kilifi	Local Chief's Office	2,000		12,505				2,000		75		
41	Kilifi	Waresa Secondary School	2,000		12,505				2,000		75		
42	Kilifi	Kadaina Dispensary	2,000		12,505				2,000		75		
43	Kwale	Mkang'ombe Dispensary	2,000		12,505				2,000		75		
44	Lamu	Maisha Masha secondary	2,400		15,006				2,400		90		
45	Lamu	Majembeni Secondary School	2,400		15,006				2,400		90		
46	Kilifi	Chamari dispensary	2,400		15,006				2,400		90		
47	Kilifi	Midoina dispensary	2,400		15,006				2,400		90		
48	Kwale	Mbegani secondary	2,400		15,006				2,400		90		
49	Kilifi	Motoloani dispensary	4,000		25,011		4,000		4,000				
50	Kilifi	Shujaa Mekatilili Secondary	16,000		100,042		16,000		16,000				

Name of Bidder ……..

Signature of Bidder ……

APPENDIX 3 – LOCATIONAL DETAILS OF SITES

Table 28: Locational Details - Lot 1 (Turkana County)

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
1	Turkana	Loima	Clinic	Nameyana Dispensary	3.50188722, 35.3362795
2	Turkana	Turkana Central	Clinic	Nakaalei Dispensary	2.53896, 36.2165716
3	Turkana	Turkana South	School	RCEA Kasuroi Boys	2.4784238, 35.6547074
4	Turkana	Loima	Clinic	Kodopa Mobile Clinic	2.97147499, 35.4775383
5	Turkana	Turkana West	Clinic	Teremkus dispensary	4.10450555, 34.4673792
6	Turkana	Turkana West	Clinic	Loche angi-erengo	3.57424677, 34.8959665
7	Turkana	Turkana West	Clinic	Napalatui dispensary	3.70118333, 34.4813666
8	Turkana	Turkana West	Clinic	Aposta dispensary	4.05592452, 34.5205341
9	Turkana	Turkana North	Clinic	Narengewoi Health center	4.00742442, 35.8506518
10	Turkana	Turkana Central	Clinic	Monti Dispensary	3.20197166, 35.6425016
11	Turkana	Loima	School	Loturerei Secondary School	2.93398855, 35.6119652
12	Turkana	Turkana South	Clinic	Kekorisogol Dispensary	2.56812261, 35.8269265
13	Turkana	Turkana Central	Clinic	Kapokor Dispensary	3.35276499, 35.6908600
14	Turkana	Loima	Clinic	Lokipetot arengan dispensary	2.60920833, 35.3490383
15	Turkana	Turkana North	Clinic	Meyan Dispensary	4.74946284, 35.6632651
16	Turkana	Turkana West	Clinic	Moru anguibuni	3.79592794, 34.9732170
17	Turkana	Turkana Central	Clinic	Chokchok Dispensary	3.16613999, 35.7286533
18	Turkana	Loima	Clinic	Kabulokor health center	2.81371166, 35.3731466
19	Turkana	Turkana West	Clinic	Kaenyangaluk dispensary	3.72329763, 34.9470260
20	Turkana	Turkana North	Clinic	Kakelae Dispensary	4.52083184, 35.5934130
21	Turkana	Turkana Central	Clinic	Kakwanyang Dispensary	3.15332189, 35.6763457
22	Turkana	Turkana South	Clinic	Kasuroi Dispensary	2.47483833, 35.6517699
23	Turkana	Turkana Central	Clinic	Kenya oil dispensary	3.23001833, 35.9140916
24	Turkana	Turkana Central	Clinic	Kosikiria dispensary	2.922223, 35.9470345

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
25	Turkana	Turkana North	Clinic	Lokamarinyang Dispensary	5.01777772, 35.5945901
26	Turkana	Turkana West	Clinic	Lokipoto dispensary	3.17880379, 34.6664476
27	Turkana	Turkana South	Clinic	Lokoburu dispensary	2.40028876, 35.5586950
28	Turkana	Turkana North	Clinic	Losajait dispensary	3.61926166, 35.3139699
29	Turkana	Turkana Central	Clinic	Nakechichok Dispensary	3.1311331, 35.8576654
30	Turkana	Turkana North	Clinic	Sasame Dispensary	4.50600904, 35.7476656
31	Turkana	Turkana West	Clinic	Lomunyakirionok Dispensary	3.93826818, 34.5607823
32	Turkana	Turkana North	Clinic	Loruth dispensary	4.44922849, 35.3594493
33	Turkana	Turkana North	Clinic	Kaalem	4.30561115, 35.5959481
34	Turkana	Turkana North	Clinic	Nakapelewoi dispensary	4.31790833, 35.4334049
35	Turkana	Loima	Clinic	Nasiger Dispensary	3.36144054, 35.4378960
36	Turkana	Turkana North	Clinic	Epur Dispensary	3.737055, 35.7540633
37	Turkana	Turkana West	Clinic	Namon Dispensary	4.00424333, 34.8733683
38	Turkana	Turkana Central	Clinic	Nakiria Dispensary	3.56012333, 35.8331866
39	Turkana	Turkana Central	Clinic	Lochoraikeny Dispensary	3.34349119, 35.8745542
40	Turkana	Turkana Central	Clinic	Katiir dispensary	2.57512999, 36.0849266
41	Turkana	Loima	Clinic	Nayanaeangikalalio Dispensary	3.16523675, 35.5474844
42	Turkana	Turkana Central	Clinic	Kapua Dispensary	3.42187298, 35.6595539
43	Turkana	Turkana West	Clinic	Atiir Dispensary	4.06144499, 34.8794849
44	Turkana	Loima	Clinic	Kaapus dispensary	3.18065333, 35.3466299
45	Turkana	Turkana North	Clinic	Koyasa Dispensary	4.97006754, 35.4854419
46	Turkana	Turkana South	Clinic	Sopel Dispensary	2.78925499, 35.5214933
47	Turkana	Turkana South	Clinic	Namakat Dispensary	2.162415, 35.4503533
48	Turkana	Loima	School	Lomil Girls Secondary School	3.34983833, 35.2539783
49	Turkana	Turkana North	Clinic	Lomii Dispensary	4.03683000, 35.4777733

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
50	Turkana	Turkana Central	Clinic	Louwae Dispensary	2.82938833, 36.2017333
51	Turkana	Turkana East	Clinic	Nakatong'wa Dispensary	2.31279504, 36.1619125
52	Turkana	Turkana Central	Clinic	Nakurio Dispensary	2.86973251, 36.1645683
53	Turkana	Loima	Clinic	Natuntun Dispensary	2.91833499, 35.4429033
54	Turkana	Loima	Clinic	Kangalita Dispensary	2.74030398, 35.4005127
55	Turkana	Turkana South	Clinic	Kanaodon Dispensary	2.49382917, 35.4096159
56	Turkana	Turkana South	Clinic	Lokorkor Health Center	2.18453166, 36.1141383
57	Turkana	Turkana East	Clinic	Lopii Dispensary	2.06711077, 35.8731322
58	Turkana	Turkana South	Clinic	Juluk Dispensary	2.16349881, 35.4108937
59	Turkana	Turkana East	Clinic	Kamuge Dispensary	1.6704493, 36.2872398
60	Turkana	Turkana East	Clinic	Lomelo Dispensary	1.49915245, 35.9159454
61	Turkana	Turkana East	Clinic	Loyapat Dispensary	1.84259195, 35.7814449
62	Turkana	Turkana West	Clinic	Komudei Dispensary	3.72595434, 34.8818160
63	Turkana	Turkana South	Clinic	Kangitankori Dispensary	2.43394666, 35.4275916
64	Turkana	Loima	Clinic	Lochor Alomala dispensary	2.81210754, 34.8792719
65	Turkana	Loima	Clinic	Naotin Dispensary	3.05095745, 35.5480557
66	Turkana	Turkana North	Clinic	Riokomor Dispensary	4.11611166, 35.7204549
67	Turkana	Turkana Central	Clinic	Long'ech dispensary	3.54710362, 35.9245543
68	Turkana	Loima	Clinic	Loturerei dispensary	2.93430831, 35.6113385
69	Turkana	Turkana East	Clinic	Parkati dispensary	2.24497132, 36.6802469
70	Turkana	Turkana Central	Clinic	Kalimapus Dispensary	3.61444333, 35.8157933
71	Turkana	Turkana Central	Clinic	Nakurio Girls Secondary school	2.86258833, 36.1631216
72	Turkana	Loima	Clinic	Lochor Edome Dispensary	2.75551333, 35.0259149
73	Turkana	Turkana South	Clinic	Loperot Dispensary	2.33485894, 35.8334839
74	Turkana	Turkana West	Clinic	Nakoyo Dispensary	3.71140401, 34.7902586

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
75	Turkana	Loima	Clinic	Kaesogol etom Dispensary	3.49274833, 35.4451999
76	Turkana	Turkana West	Clinic	Lokangae Health Centre	4.10636186, 34.8896621
77	Turkana	Turkana East	School	Ngamia one kochodin high school	2.20457500, 35.7854949
78	Turkana	Turkana Central	Clinic	Kangirisae dispensary	2.6202068, 36.2570047
79	Turkana	Turkana South	Clinic	Lokapel Dispensary	2.36683689, 35.4221972
80	Turkana	Turkana Central	Clinic	Nadooto dispensary	3.0857546, 36.0925348
81	Turkana	Turkana West	Clinic	Nanam dispensary	4.21038869, 34.5624933
82	Turkana	Turkana East	Clinic	Lokwii Health Center	1.97765308, 36.1058718
83	Turkana	Turkana North	Clinic	Karebur dispensary	4.43545816, 35.7229167
84	Turkana	Loima	School	Loima boys secondary School	2.8558834, 35.0795270
85	Turkana	Turkana West	School	Aic Songot secondary School	4.07539506, 34.4841875
86	Turkana	Turkana Central	School	Talent high school	3.19214333, 35.6748883

Table 29: Locational Details - Lot 2 (West Pokot County)

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
1	West Pokot	Kacheliba	Clinic	Leng'orok Dispensary	2.22763419, 35.1008559
2	West Pokot	Kacheliba	Clinic	Nyangolesinyang dispensary	2.09478166, 34.9918183
3	West Pokot	Pokot South	Clinic	Cheptiangwa Dispensary	1.41450768, 35.2452286
4	West Pokot	Pokot South	Clinic	Kapkaremba Dispensary	1.31655279, 35.3632799
5	West Pokot	Kacheliba	Clinic	Kasitet Dispensary	2.19742958, 34.9573879
6	West Pokot	Pokot South	Clinic	Chemotong Dispensary	1.50521592, 35.3227949
7	West Pokot	Sigor	Clinic	Kiwakan Dispensary	1.66435154, 35.4286819
8	West Pokot	Kacheliba	Clinic	Mading west pokot	1.77298083, 35.1499158
9	West Pokot	Kacheliba	Clinic	Nauyapong Dispensary	2.41610809, 34.9561813
10	West Pokot	Kapenguria	Clinic	Kapenguria west pokot	1.60537102, 35.3433267
11	West Pokot	Kacheliba	Clinic	Nakwijit dispensary	1.63883759, 35.1252810
12	West Pokot	Kacheliba	Clinic	Nasal Dispensary	2.33536439, 34.9439058
13	West Pokot	Kapenguria	Clinic	Wonyoi dispensary	1.66003374, 35.1363623
14	West Pokot	Pokot South	Clinic	St. Marks mixed Day and Boarding Secondary School-Kapkaremba	1.31655279, 35.3632799
15	West Pokot	Sigor	Clinic	Kisera dispensary	1.36656598, 35.5273315
16	West Pokot	Sigor	Clinic	Nyangaita Dispensary	1.48327444, 35.6779329
17	West Pokot	Sigor	Clinic	Kamanau Dispensary	1.47617138, 35.5710813
18	West Pokot	Kapenguria	Clinic	Kesot Dispensary	1.76316853, 35.2507890
19	West Pokot	Kapenguria	Clinic	Krich dispensary	1.69660932, 35.3454466
20	West Pokot	Kapenguria	Clinic	Tamarukwa dispensary	1.7630513, 35.1548299
21	West Pokot	Kapenguria	Clinic	Tipet dispensary	1.81748405, 35.2463472
22	West Pokot	Kapenguria	Clinic	Miskwony dispensary	1.58070423, 35.1491633
23	West Pokot	Kapenguria	Clinic	Kalemrekai Dispensary	1.44550027, 34.9636457
24	West Pokot	Sigor	Clinic	Sostin dispensary	1.57319466, 35.4093838
25	West Pokot	Sigor	Clinic	Kataywa dispensary	1.37524711, 35.6930630
26	West Pokot	Kacheliba	Clinic	Cherangan dispensary	1.60288519, 35.1048857
27	West Pokot	Kapenguria	Clinic	Chekomosi location	1.60839328, 35.3426182
28	West Pokot	Sigor	Clinic	Masol Dispensary	1.55933368, 35.5273200
29	West Pokot	Kacheliba	Clinic	Kangoletiang Dispensary	1.83261561, 35.2047652
30	West Pokot	Kacheliba	Clinic	Kalemngorok dispensary	1.55599391, 35.0781208
31	West Pokot	Pokot South	Clinic	Sobukwo secondary School	1.45598349, 35.3366059

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
32	West Pokot	Sigor	Clinic	Tamkal dispensary	1.36586406, 35.4735883
33	West Pokot	Kapenguria	Clinic	Nachecheyet Dispensary	1.49925189, 35.1193349
34	West Pokot	Kacheliba	Clinic	Kauryong dispensary	2.09568784, 35.0949645
35	West Pokot	Kapenguria	Clinic	Ptoyo Health Center	1.65336647, 35.2441830
36	West Pokot	Sigor	Clinic	Simpol dispensary	1.52966637, 35.5613448
37	West Pokot	Sigor	School	Salion secondary school	1.32267656, 35.4734248
38	West Pokot	Kapenguria	Clinic	Kalemnyang Yunhap	1.49993588, 35.1206973
39	West Pokot	Kacheliba	Clinic	Kanyerus dispensary	1.36064206, 34.8054933

Table 30: Locational Details - Lot 3 (Marsabit, Isiolo and Samburu Counties)

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
1	Marsabit	North Horr	Clinic	Telesgaye Health center	4.40306833, 36.2226499
2	Marsabit	Moyale	Clinic	Madoadi dispensary	3.57866726, 38.6932544
3	Marsabit	North Horr	Clinic	Burgabo dispensary	3.17810627, 38.1565715
4	Marsabit	Moyale	Clinic	Qate dispensary	3.4402279, 38.9704884
5	Marsabit	Moyale	Clinic	Ell - borr dispensary	3.4879038, 38.2408051
6	Marsabit	Laisamis	Clinic	El-Molo Bay Dispensary	2.85617864, 36.7001326
7	Marsabit	Laisamis	Clinic	Oltorot Dispensary	2.59311403, 37.0820066
8	Marsabit	Moyale	Clinic	Waye Godha dispensary	3.6060787, 38.6878349
9	Marsabit	Laisamis	Clinic	Korolle Boys' Secondary School	2.51756999, 37.5922233
10	Marsabit	North Horr	Clinic	Dukana Ward Administrator's Office	3.99828537, 37.2702046
11	Marsabit	Moyale	Clinic	Badan Rero Dispensary	2.76020065, 38.9008079
12	Marsabit	Laisamis	Clinic	Arapal Dispensary	2.7867026, 37.0110163
13	Marsabit	North Horr	Clinic	Dukana Health Center	3.99828537, 37.2702046
14	Marsabit	Moyale	Clinic	Godoma Health Centre (Nep)	3.44907123, 39.3003189
15	Marsabit	Laisamis	Clinic	Lontolio Dispensary	1.60780964, 37.6741037
16	Marsabit	Laisamis	School	Kulal Girls Secondary school	2.60254999, 36.9300816
17	Marsabit	Moyale	Clinic	Karbururi dispensary	3.58280215, 38.6054835
18	Isiolo	Isiolo South	Clinic	Boji dispensary	0.56743432, 38.3407678
19	Isiolo	Isiolo North	Clinic	Daaba dispensary	0.54068954, 37.7493017
20	Isiolo	Isiolo North	School	Ntalaby Primay school	0.32802279, 37.4198883
21	Isiolo	Isiolo North	Office	Kom Acc Office	1.07777862, 38.0363963
22	Isiolo	Isiolo South	Clinic	Muchuro dispensary	0.95948207, 38.6297657
23	Isiolo	Isiolo North	Clinic	Biliqo Marara dispensary	0.87681137, 38.3969388
24	Isiolo	Isiolo North	School	Ngaremara secondary-boys	0.50099269, 37.6231892
25	Samburu	Samburu East	Clinic	Oromodei dispensary	1.26980964, 37.2038979
26	Samburu	Samburu North	Clinic	Sereni dispensary	1.87247501, 37.0636394
27	Samburu	Samburu North	Clinic	Waso Rongai Dispensary	2.03772405, 36.8606726
28	Samburu	Samburu North	School	Engilai Mixed Secondary	1.77627711, 36.8528885

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
29	Samburu	Samburu North	Clinic	Loikumkum Dispensary	1.64617591, 37.1099696
30	Samburu	Samburu North	Clinic	Angata Nanyokie Dispensary	1.31796611, 36.6738075
31	Samburu	Samburu North	Clinic	Logetei Dispensary	1.80857999, 36.7401433
32	Samburu	Samburu East	Clinic	Nkaroni dispensary	0.94391437, 37.1927433
33	Samburu	Samburu East	Clinic	Klitamany dispensary	0.64405901, 37.4751024
34	Samburu	Samburu North	Clinic	Masikita Dispensary	1.6072587, 36.9458443
35	Samburu	Samburu East	Clinic	Ndonyo Nasipa Dispensary	1.32684562, 37.1218246
36	Samburu	Samburu North	Clinic	Muruankai GOK Dispensary	1.11107475, 36.9636937
37	Samburu	Samburu North	Clinic	Loonjorin Dispensary	2.25516666, 36.8334049
38	Samburu	Samburu North	Clinic	Urra Dispensary	1.75217617, 37.0761022
39	Samburu	Samburu North	Clinic	Ngilai (Saidia) dispensary	1.77170481, 36.8518876
40	Samburu	Samburu East	Clinic	Donyo-Wasin Dispensary	1.34821964, 37.4368764
41	Samburu	Samburu East	Clinic	Sereolipi mixed day secondary school	1.13931166, 37.6004199
42	Samburu	Samburu East	Clinic	Marti E pareu	1.58159628, 37.2664175
43	Samburu	Samburu North	Clinic	Barsoloi arid zone primary school	1.3323098, 36.8722392

Table 31: Locational Details - Lot 4 (Mandera and Wajir Counties)

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
1	Mandera	Mandera North	School	Olla secondary school	3.90231333, 40.8904866
2	Mandera	Mandera West	School	Burduras secondary School	3.85383833, 39.9019166
3	Mandera	Banissa	Clinic	Choroko Dispensary	3.95492809, 40.5013488
4	Mandera	Mandera South	Clinic	Burmayo Dispensary	2.97804275, 40.2721167
5	Mandera	Banissa	Clinic	Burjon Dispensary	4.08133726, 40.9024159
6	Mandera	Mandera East	Clinic	Koromey Dispensary	3.8973176, 41.7955016
7	Mandera	Mandera South	Clinic	Chachabole Dispensary	3.16314556, 40.6214312
8	Mandera	Lafey	Office	Fino ACC	3.40649327, 41.4231471
9	Mandera	Banissa	Clinic	Kukub dispensary	3.86656999, 40.2060083
10	Mandera	Banissa	Clinic	Tarama Dispensary	3.88812666, 40.2664383
11	Mandera	Mandera South	Clinic	Garsesala Dispensary	2.60507613, 40.8476710
12	Mandera	Mandera West	Clinic	Lagsure dispensary	3.42033495, 40.2666911
13	Mandera	Banissa	Clinic	Domal dispensary	4.04328333, 40.5052899
14	Mandera	Mandera West	Clinic	Kobadadi dispensary	3.20943333, 40.4059499
15	Mandera	Banissa	Clinic	Birkan dispensary	3.95213833, 40.1049250
16	Mandera	Lafey	Clinic	Aresa Dispensary	3.94600671, 41.5408410
17	Mandera	Banissa	Clinic	Hullow Dispensary	4.18371999, 40.8027966
18	Mandera	Mandera South	Clinic	Alongo Dispensary	3.05310395, 41.0577505
19	Mandera	Lafey	Clinic	Damasa Dispensary	3.16082526, 41.3287798
20	Mandera	Mandera South	Clinic	El-Golicha Dispensary	2.83914572, 40.9758715
21	Mandera	Mandera South	Clinic	Elram Dispensary	2.33440911, 40.8882344
22	Mandera	Mandera South	Clinic	Falama Dispensary	2.65619264, 40.9911240
23	Mandera	Lafey	Clinic	Fino Health Centre	3.40655989, 41.4232029
24	Mandera	Mandera East	Clinic	Hareri Hosle Dispensary	3.78178056, 41.7019157
25	Mandera	Lafey	Clinic	Kabo Dispensary	3.15134768, 41.0445533
26	Mandera	Lafey	Clinic	Lafey nomadic dispensary	3.15016113, 41.1848209
27	Mandera	Lafey	Clinic	Odha Dispensary	3.55608768, 41.2818921
28	Mandera	Mandera East	Clinic	Omar jilaow Dispensary	3.75596932, 41.6678855

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
29	Mandera	Mandera West	Clinic	Qarsahama Dispensary	3.43635333, 39.7887849
30	Mandera	Banissa	School	Malkamari Boys' Secondary School	4.225525, 40.7127666
31	Mandera	Mandera North	School	Libin Nomadic Girls Secondary School	4.00699689, 41.0734225
32	Mandera	Lafey	School	Gari secondary School	3.44581268, 40.9716553
33	Mandera	Lafey	School	Hareri Mixed Secondary School	3.9353684, 41.4808896
34	Mandera	Mandera South	Clinic	Qarsadamu dispensary	2.84698539, 40.6819929
35	Mandera	Mandera West	Clinic	Bolowle dispensary	3.25406874, 40.0143378
36	Mandera	Banissa	Clinic	Derkale dispensary	3.83680957, 40.2678955
37	Mandera	Mandera South	School	El- hagarsu mixed day secondary school	2.79346998, 40.9184828
38	Wajir	Wajir South	School	Burder Secondary School	1.19719499, 40.4362366
39	Wajir	Wajir South	School	Busbus primary school	1.28442042, 39.8123283
40	Wajir	Tarbaj	Clinic	Dureweey dispensary	2.47960785, 40.1955713
41	Wajir	Wajir South	Clinic	Argane dispensary	1.66858327, 40.3606016
42	Wajir	Tarbaj	Clinic	Burmayo Dispensary Wajir	2.97804275, 40.2721167
43	Wajir	Eldas	Clinic	Lakole Dispensary	2.51258875, 39.1720354
44	Wajir	Wajir West	Clinic	Wara Dispensary	1.2620245, 39.3670632
45	Wajir	Eldas	School	Arbajahan mixed/day and boarding secondary Schools	2.05332999, 39.0197716
46	Wajir	Tarbaj	Clinic	Wargadud Dispensary(Tarbaj)	2.30589038, 40.3617829
47	Wajir	Wajir North	Clinic	Beramo Dispensary	2.93898069, 39.4896212
48	Wajir	Eldas	Clinic	Dadhantaly Dispensary	2.47141073, 39.4122181
49	Wajir	Wajir North	Clinic	Dunto Dispensary	2.71042516, 39.9862392
50	Wajir	Tarbaj	Clinic	Elben Dispensary	2.30220771, 40.1824036
51	Wajir	Wajir North	Clinic	Ogorji Dispensary	3.19634761, 39.4458052
52	Wajir	Wajir West	Clinic	Bojiyare Dispensary	1.45808822, 39.9034367
53	Wajir	Wajir South	Clinic	Sabuli Nomadic Clinic	0.66447166, 40.1153499
54	Wajir	Wajir North	Clinic	Batalu Dispensary	2.83441863, 39.8503169
55	Wajir	Wajir South	Clinic	Tesorie Dispensary	0.93371833, 39.8884266
56	Wajir	Eldas	Clinic	Mathow Dispensary	2.14573265, 39.6957746
57	Wajir	Tarbaj	Clinic	Hungai Dispensary	2.23758023, 40.1888699

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
58	Wajir	Wajir North	Clinic	Dugo Health Centre	3.45867962, 39.3881008
59	Wajir	Wajir South	School	Sabuli mixed day secondary School	0.34567666, 40.1233849
60	Wajir	Wajir West	School	Lagbogol secondary school	1.28442042, 39.8123283
61	Wajir	Wajir East	School	Baraqwo secondary	1.73212126, 40.0177439
62	Wajir	Wajir East	School	KHOrof harar youth polytechnic	0.97079297, 36.7301659
63	Wajir	Wajir South	School	Diif Secondary School	0.99061982, 40.9479672

Table 32: Locational Details - Lot 5 (Garissa, Tana River and Narok Counties)

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
1	Garissa	Fafi	Clinic	Sangole Dispensary	-1.5043124, 40.5955193
2	Garissa	Lagdera	Clinic	Afwein Dispensary	0.35355399, 39.3560891
3	Garissa	Ijara	Clinic	Kotile health center	-1.9701209, 40.2061624
4	Garissa	Fafi	Office	ACC office/Residence Galmagala	-1.1923259,40.7667853
5	Garissa	Dadaab	Office	ACC office/Residence Jarajilla	-0.3387314, 40.9214334
6	Garissa	Ijara	Office	Bodhai ACC office	-1.8145061,40.6750207
7	Garissa	Ijara	Clinic	Jalish Dispensary	-1.6963833, 40.5091832
8	Garissa	Ijara	Clinic	Korisa Dispensary	-1.8984523, 40.2534382
9	Garissa	Dadaab	Clinic	Malaylay Dispensary	0.20187666, 40.5282433
10	Garissa	Balambala	Clinic	Libahlow dispensary	0.18337128, 38.8965972
11	Garissa	Ijara	Clinic	Ruqa Dispensary	-1.5537857, 40.4508010
12	Garissa	Lagdera	Clinic	Jilango dispensary	0.55365977, 39.2701920
13	Garissa	Fafi	Clinic	Amuma Dispensary	-0.3409754, 40.9151531
14	Garissa	Fafi	Clinic	Amuma Mobile Dispensary	-0.3404122, 40.9188482
15	Garissa	Ijara	Clinic	Bodhai Dispensary	-1.8146037, 40.6750020
16	Garissa	Ijara	Clinic	Dekaharjey Dispensary	-1.2549061, 40.7880504
17	Garissa	Ijara	Clinic	El Kambere Nomadic Clinic	-0.9189342, 40.9409103
18	Garissa	Fafi	Clinic	Fafi Dispensary	-0.3933244, 40.3275014
19	Garissa	Fafi	Clinic	Yumbis Dispensary	-0.1887647, 40.3860735
20	Garissa	Dadaab	Clinic	Abdisamit Dispensary	0.04878167, 39.6549067
21	Garissa	Ijara	Clinic	Bultohama Dispensary	-1.769699, 40.4423831
22	Garissa	Lagdera	Clinic	Elan Dispensary	0.76403094, 39.3096359
23	Garissa	Balambala	Clinic	Danyere Health Centre	0.00684362, 38.7403959
24	Garissa	Fafi	Clinic	Hagarbul Dispensary	-0.0969641, 39.9856997
25	Garissa	Dadaab	School	Kulan secondary School	0.21256925, 40.6268377
26	Garissa	Ijara	Clinic	Hara health center	-1.9701209, 40.2061624
27	Garissa	Dadaab	Clinic	Saretho Dispensary	-0.0230703, 40.1375045
28	Tana River	Galole	Office	Waldena ACC	-1.6111547, 39.0263974

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
29	Tana River	Garsen	Clinic	Galili Dispensary	-2.3359228, 40.2125939
30	Tana River	Bura	Clinic	Mulanjo dispensary	-0.3180033, 39.5158664
31	Tana River	Bura	Clinic	Buwa Dispensary	-0.1491494, 39.1374205
32	Tana River	Galole	Clinic	AIC Titila Dispensary	-1.5320860, 39.2071735
33	Tana River	Garsen	Clinic	Asa Kone Dispensary	-2.3301296, 39.0338378
34	Tana River	Garsen	Clinic	Assa dispensary	-2.0515998, 39.4241546
35	Tana River	Bura	Clinic	Boka dispensary	-0.3402211, 38.7880835
36	Tana River	Bura	Clinic	Chewele Dispensary	-1.1579700, 39.9516811
37	Tana River	Galole	Clinic	Haroresa Dispensary	-1.7225662, 39.8333401
38	Tana River	Bura	Clinic	Meti Dispensary	-1.2101043, 39.9263792
39	Tana River	Bura	Clinic	Sabukia dispensary	-1.0658196, 39.4552889
40	Tana River	Garsen	Clinic	Kau Dispensary	-2.4875972, 40.4385186
41	Tana River	Bura	Clinic	Sombo Dispensary	-0.5930411, 39.6964735
42	Tana River	Galole	Clinic	Chifiri Dispensary	-1.2937710, 39.7085880
43	Tana River	Galole	Clinic	Wayu Boru Dispensary	-1.5260686, 39.5497228
44	Tana River	Garsen	Clinic	Mwina Dispensary	-2.0623810, 40.1761336
45	Tana River	Galole	Clinic	Wayu Dispensary	-1.530799, 39.5838632
46	Tana River	Garsen	Clinic	Ozi Dispensary	-2.5115212, 0.4552452
47	Tana River	Garsen	Clinic	Sera dispensary	-2.1282002, 40.1240506
48	Tana River	Garsen	Clinic	Mnazini dispensary	-1.9782871, 40.1658594
49	Tana River	Galole	School	Majengo secondary	-1.7083452, 40.1474909
50	Tana River	Bura	Clinic	Bilbil dispensary	-1.0178316, 39.7934616
51	Tana River	Galole	Clinic	Aic Daba Dispensary	-1.5806260, 39.4734823
52	Tana River	Galole	Clinic	Waldena Dispensary	-1.6106822, 39.0249161
53	Tana River	Garsen	School	Kitere secondary school	-1.9698850, 40.1628616
54	Tana River	Bura	School	Mororo mixed day secondary school	-0.4918048, 39.6174925
55	Narok	Emurua Dikirr	Clinic	Roborwo Dispensary	-0.9815749, 35.1759265
56	Narok	Narok South	Clinic	Mausa dispensary	-2.0211478, 35.8997029
57	Narok	Emurua Dikirr	Clinic	Kendunywo primary school	-0.9649563, 35.1440398

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
58	Narok	Narok South	Clinic	Ilkerin -Loita dispensary	-1.8049300, 35.7054580
59	Narok	Narok South	Clinic	Chemwokter Dispensary	-0.9291630, 35.5277711
60	Narok	Narok East	Clinic	Entotol dispensary	-0.8707015, 36.0329739
61	Narok	Narok West	Clinic	Olkoroi dispensary	-1.7082108, 35.4608090
62	Narok	Kilgoris	Clinic	Ngendalel dispensary	-1.3438820, 34.7535359
63	Narok	Emurua Dikirr	School	Chesabuni Primary School	-1.0201239, 35.0182652
64	Narok	Emurua Dikirr	Clinic	Kamarget dispensary	-1.0796909, 35.0798192
65	Narok	Narok West	Clinic	Losho Dispensary	-1.6136290, 35.5133179
66	Narok	Narok South	Clinic	Iltriben primary school	-0.9728675, 35.5996153

Table 33: Locational Details - Lot 6 (Lamu, Kilifi and Kwale Counties)

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
1	Lamu	Lamu West	Clinic	Dide waride dispensary	-2.4180981, 40.3978787
2	Lamu	Lamu West	School	kizuke primary school	-2.3322538, 40.7536163
3	Lamu	Lamu West	Clinic	Maisha masha	-2.4088066, 40.5395899
4	Lamu	Lamu West	School	Didewaride primary school	-2.4162367, 40.3978053
5	Lamu	Lamu West	School	Pangani Secondary School	-2.3676549, 40.5517749
6	Lamu	Lamu West	Clinic	Sinambio dispensary	-2.3875231,40.6210803
7	Lamu	Lamu West	School	Pandanguo primary school	-2.2360086, 40.4784391
8	Lamu	Lamu West	Clinic	Manda Dispensary	-2.2487927, 40.9213948
9	Lamu	Lamu West	School	Manda Maweri Secondary School	-2.2469923, 40.9220242
10	Lamu	Lamu West	School	Chalaluma primary school	-2.4081976, 40.3591681
11	Lamu	Lamu West	Clinic	Barigoni Dispensary	-2.0182879, 40.7804149
12	Lamu	Lamu West	Clinic	Basuba Dispensary	-1.7832603, 41.0405094
13	Lamu	Lamu West	Clinic	Bodhei Dispensary	-1.8604266, 40.7129778
14	Lamu	Lamu East	Clinic	Ishakani Dispensary	-1.6861697, 41.5333046
15	Lamu	Lamu East	Clinic	Mangai Dispensary	-1.7505630, 41.1725188
16	Lamu	Lamu East	Office	Acc Kiunga	-1.7439028, 41.4883980
17	Lamu	Lamu East	School	Basuba	-1.7831124, 41.0405374
18	Lamu	Lamu East	School	Ishakani	-1.6862470, 41.5333757
19	Lamu	Lamu East	School	Kiangwi	-1.9310922, 40.9748580
20	Lamu	Lamu East	School	Madani	-1.9711373, 41.2951080
21	Lamu	Lamu East	School	Mangai	-1.7509033, 41.1725635
22	Lamu	Lamu East	School	Marararni	-1.7030879, 41.3027462
23	Lamu	Lamu West	Clinic	Pandanguo Dispensary	-2.2352575, 40.4783403
24	Lamu	Lamu East	Clinic	Kiangwi Dispensary	-1.9315157, 40.9753262
25	Lamu	Lamu West	Clinic	Bahamisi Dispensary	0.97079297, 36.7301659
26	Lamu	Lamu West	School	Maisha Masha secondary	-2.4120711, 40.5400118
27	Lamu	Lamu West	School	Majembeni Secondary School	-2.3246921, 40.6126195
28	Kilifi	Magarini	School	Kurawa Secondary school	-2.7392400, 40.1447716

No.	County	Subcounty	Facility Type	Name of Facility	Coordinates
29	Kilifi	Magarini	School	Watala Secondary School	-2.9332200, 39.9332716
30	Kilifi	Magarini	Clinic	Mwangatini Dispensary	-3.1421577, 40.0431586
31	Kilifi	Magarini	Office	Gandini Assistant Chief's office	-3.0892173, 39.8244143
32	Kilifi	Magarini	School	Gandini Primary school	-3.0881925, 39.8251449
33	Kilifi	Kaloleni	Clinic	Viragoni dispensary	-3.7114658, 39.5152324
34	Kilifi	Magarini	Clinic	Gandini dispensary	-3.0888553, 39.8245840
35	Kilifi	Magarini	Clinic	Karimboni dispensary	-3.1247703, 39.9839678
36	Kilifi	Magarini	Clinic	Mulunguni dispensary	-2.9759336, 39.7722143
37	Kilifi	Ganze	Clinic	Muryachakwe Dispensary	-3.2882985, 39.5764015
38	Kilifi	Magarini	Office	Local Chief's Office	-3.1036819, 39.7842586
39	Kilifi	Magarini	Clinic	Waresa Secondary School	-2.9541527, 40.0087755
40	Kilifi	Kilifi North	Clinic	Kadaina Dispensary	-3.3640887, 39.9511055
41	Kilifi	Magarini	Clinic	Chamari dispensary	-2.9025847, 39.8973541
42	Kilifi	Ganze	Clinic	Midoina dispensary	-3.5621035, 39.3227255
43	Kilifi	Magarini	Clinic	Motoloani dispensary	-3.1017503, 39.6697975
44	Kilifi	Magarini	School	Shujaa Mekatilili Secondary	-3.0186103, 39.8155616
45	Kwale	Matuga	Clinic	Mbegani Dispensary	-4.3574799, 39.1878697
46	Kwale	Kinango	Clinic	Chanzou Dispensary	-3.7255812, 39.3176674
47	Kwale	Kinango	Clinic	Mwachinga dispensary	-4.1286215, 39.4237806
48	Kwale	Kinango	Clinic	Gozani dispensary	-4.0575742, 39.0418475
49	Kwale	Kinango	Clinic	Mkang'ombe Dispensary	-4.1970633, 39.1430666
50	Kwale	Matuga	Clinic	Mbegani secondary	-4.3632716, 39.1975899

APPENDIX 4 – KPLC TECHNICAL SPECIFICATIONS DOCUMENTS

i. Specification for PVC Insulated Single Phase Concentric Aluminium Cables (Low Voltage) – KP1/3CB/TSP/05/004

Kenya Power	TITLE: SPECIFICATION FOR PVC INSULATED SINGLE PHASE CONCENTRIC ALUMINIUM CABLES (LOW VOLTAGE)	Doc. No.	KP1/3CB/TSP/05/004
		Issue No.	2
		Revision No.	2
		Date of Issue	2015-02-18
		Page 1 of 10	

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0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 2 Rev 1	2014-09-23	Included size 10mm^2 Single Core Concentric Aluminium for single phase customers in SWER system	S. Kimitei	
Issue 2 Rev 2	2015-02-18	Included IEC 60502-1, IEC/ISO 17025, ISO 9001		

FOREWORD

This specification has been prepared by the Standards Department in collaboration with The Design Optimization Committee both of The Kenya Power & Lighting Company Ltd (abbreviated as KPLC) and it lays down requirements for PVC Insulated Single Phase Concentric Aluminium Cables (LV). It is intended for use by KPLC in purchasing the cables.

The bid shall be submitted complete with information that confirms satisfactory service experience of the manufacturer with products which fall within the scope of this specification.

1. SCOPE

This specification is for PVC insulated single phase concentric cables with circular stranded aluminium conductors for operation up to and including 1000 Volts between phases and 600 Volts to earth. The cable shall have a central phase stranded aluminium conductor insulated with red PVC and concentric layer comprising bare aluminium wires (combined neutral-earth conductor) and outer sheath in black PVC.

The specification also covers inspection and test of the cables as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted for tender evaluation.

The specification stipulates the minimum requirements for PVC Insulated Single Phase Concentric Aluminium Cables (LV) acceptable for use in the company (KPLC) and it shall be the responsibility of the supplier to ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations in the manufacture of the cables for The Kenya Power & Lighting Company Ltd.

The specification does not purport to include all the necessary provisions of a contract.

2. REFERENCES

The following standard contains provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

ISO 9001: Quality Management System-Requirements

ISO/IEC 17025:	General requirements for the competence of testing and calibration laboratories
IEC 60502-1:	Power Cables with extruded insulation and their accessories for rated voltages from 1kV (Um=1.2kV) up to 30kV (Um=36kV)- Part 1: Cables for rated voltages from 1kV (Um=1.2kV) up to 3kV (Um=3.6kV).
KS 04-1022:	Kenya Standard Specification for 600/1000V PVC-insulated single-phase concentric cables with copper or aluminium conductors for electricity supply

3. TERMS AND DEFINITIONS

For the purpose of this specification the definitions given in the reference standards shall apply.

4. REQUIREMENTS

4.1 SERVICE AND SYSTEM CONDITIONS

a) The cable shall be a service cable for continuous operation outdoors and tropical conditions (temperature range of -1°C to +40°C, humidity of upto 90% and saline conditions along the coast).
b) The cable shall be suitable for laying in cable ducts and in air.
c) Permissible continuous loading operating temperature shall be 70°C.

4.2. MATERIALS AND CONSTRUCTION

4.2.1. The cable shall be designed and manufactured to Kenya Standard KS 04-1022, IEC 60502-1 and the requirements of this specification.

4.2.2. Phase Conductor

4.2.2.1 The phase conductor shall be circular stranded annealed aluminium conductors (class 2) as specified in KS 04-1022. The phase conductor shall have a left-hand direction of lay.

4.2.2.2 The insulation of the phase conductor shall be red PVC compound specified in KS 04-1022. It shall be applied by an extrusion process and shall be spark tested in accordance with KS 04-1022.

4.2.2.3 The thickness of insulation, determined in accordance with KS 04-1022, shall be not less than the value given in Table 1 of this specification and the smallest of the measured values shall not fall below the value given in the said table by more than (10% + 0.1mm).

4.2.3. Concentric Layer

4.2.3.1 The neutral conductor shall be concentric and shall be manufactured from plain annealed aluminium wires in accordance with KS 04-1022. The number of wires and the resistance of the neutral conductor shall comply with Table 1 of this specification.

4.2.3.2 The concentric layer shall be applied with a right hand direction of lay.

4.2.4. Oversheath

4.2.4.1 The oversheath shall be an extruded layer of black PVC compound as specified in KS 04-1022. The oversheath shall be spark tested in accordance with KS 04-1022.

4.2.4.2 The minimum thickness of the oversheath shall not fall below the value given in Table 1 of this specification by an amount more than (15% + 0.1mm).

4.3. STANDARD SIZES AND CHARACTERISTICS

4.3.1 The characteristics of the cables shall comply with Table 1.

Table 1: Characteristics (as per KS 04-1022)

Phase Conductor			*Concentric neutral conductor: number. & approx. diameter of wires No./mm*	Minim-um lay lengths mm	*Thickness of oversheath mm*	*Approxi-mate overall diameter mm*	*Maximum conductor dc resistance per 1000m of cable at 20°C*	
Nominal area mm²	*No. &approx dia. of wires mm*	*Thickness of insulation mm*					*Phase ohms*	*Neutral ohms*
10	7/1.35	1.55	23/1.13	146.5	1.4	12.21	3.08	1.335
16	7/1.70	1.55	26/1.13	155	1.4	13.34	1.91	1.808
25	7/2.14	1.60	29/1.13	165	1.5	14.88	1.20	1.0586
35	19/1.53	1.65	27/1.35	178	1.6	16.75	0.868	0.7966

4.4. EMBOSSING ON CABLE

The cable shall be embossed with the following information throughout the length of the oversheath.

a) 600/1000 VOLTS PVC CABLE PROPERTY OF KPLC
b) Year of Manufacture
c) Size of Cable
d) Name of Manufacturer

(Example: '16 SQ MM 600/1000 VOLTS PVC AL CABLE PROPERTY OF KPLC 2004' xxx)
'xxx' being the manufacturer's name.

Letters and figures shall be raised and consist of upright block characters which shall be legible. Minimum size of characters shall be 3mm. The gap between the end of one inscription and the beginning of the next shall be not greater than 25mm and the gap between each complete set of markings shall be not greater than 500mm.

An indelible length marking shall also be given at every one meter interval to assist field personal in cutting required length.

5. TESTS AND INSPECTION

5.1 The cable shall be inspected and tested in accordance with the requirements of this specification, IEC 60502-1 and KS 04-1022. It shall be the responsibility of the supplier to perform or to have performed the tests specified.

5.2 Copies of previous test certificates and test reports by a third party testing laboratory accredited to ISO/IEC 17025 shall be submitted with the offer for evaluation. A copy of the accreditation certificate for the testing laboratory shall also be submitted with the tender (all in English Language).

5.3 Routine and sample test reports for the cables to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods. KPLC Engineers (2) will witness these tests at the factory before shipment.

5.4 During delivery of the cables, KPLC will inspect them and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The supplier shall replace/rectify without charge to KPLC, cables which upon examination, test or use fail to meet any of the requirements in the specification.

6. MARKING AND PACKING

6.1 The finished cable shall be wound in one continuous length on wooden drum such as to prevent damage during transportation and handling. The drums shall be made from treated timber resistant to termite attack and shall be lagged all round to prevent damage to the cable. There shall be no gaps in the wooden lagging around the drum.

6.2 Each drum shall contain only one continuous length of cable of 2500m nominal length.The actual length of cable shall not be less than the length indicated on the drum.

6.3 Both ends of the cable shall have been sealed to prevent the ingress of water during transportation, storage, handling and installation. The sealing shall enclose the oversheath completely and shall be by close fitting plastic caps. Both ends of the cable shall be secured to the drum to prevent mechanical damage.

6.4 The following information shall be marked legibly and in a permanent manner on the flange of the drum:

a) The manufacturer's name;
b) The type and voltage rating of cable;
c) The conductor cross-sectional area in mm²;
d) The length of the cable, in metres;
e) The year of manufacture;
f) The gross mass and net mass, in kilogram;
g) Arrow indicatingdirection of rotation, the words 'not to be laid flat' (in English Language);
h) The words **"PROPERTY OF THE KENYA POWER & LIGHTING CO."**

Note: The cable shall have been embossed in accordance with clause 4.4

7. DOCUMENTATION

7.1 The bidder shall submit its tender complete with technical documents required by the tender document and Annex A (Guaranteed Technical Particulars) for tender evaluation. The documents to be submitted (all in English language) for tender evaluation shall include the following:

a) Guaranteed Technical Particulars fully filled and signed by the manufacturer;
b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
c) Sales records and customer reference letters;
d) Details of manufacturing capacity and the manufacturer's experience;
e) Copies of required type test certificates and type test reports by a third party testing laboratory accredited to ISO/IEC 17025;

f) Copy of accreditation certificate to ISO/IEC 17025 for the testing laboratory;
g) Manufacturer's warranty and guarantee;
h) Manufacturer's letter of authorization, copy of the manufacturer's ISO 9001:2008/KEBS Diamond Mark certificate and other technical documents required in the tender.

7.2 The successful bidder (supplier) shall submit the following documents/details (from the manufacturer as per tender) to The Kenya Power & Lighting Company for approval before manufacture:

a) Guaranteed Technical Particulars fully filled and signed by the manufacturer,
b) Design drawings and construction details of the cable,
c) Quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation will fulfil the requirements stated in the contract documents, standards, specifications and regulations.
d) Test Program to be used after manufacture,
e) Marking details and method to be used in marking the cables,
f) Manufacturer's undertaking to ensure adequacy of the design, adherence to applicable standards/specification, good workmanship and good engineering practice in the manufacture of the cables for The Kenya Power and Lighting Company Limited,
g) Packaging details (including packaging materials, lagging and length on drum).

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ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED CABLES

(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records, customer reference letters, details of manufacturing capacity, the manufacturer's experience, copies of complete type test reports and accreditation certificate to ISO/IEC 17025 for the testing laboratory for tender evaluation, all in English Language)

TENDER NO. .....BIDDER'S NAME & ADDRESS .....

	Description		Bidder's offer
	Name and address of the Manufacturer		
	Country of manufacture		
	Manufacturer's Letter of Authorization		
	Model/Type Reference No. of the offered cable		
	Manufacturer's warranty and guarantee for the offered cable		
	Service conditions & application		
	Applicable Standard(s)		
	Type and design		
	Phase Conductor (material & construction)	Material of phase conductor	
		No. of wires in phase conductor and diameter of each wire	
	Neutral Conductor (material & construction)	Material of neutral conductor	
		No. of wires in neutral conductor and diameter of each wire	
	Phase Conductor Insulation	Material	
		Colour	
	Oversheath (outer sheath)	Material	
		Colour	
		Marking, embossing	
	RATINGS/CHARACTERISTICS		
	Conductor nominal cross-sectional area		
	Voltage designation Uo/U(Um)		
	Conductor shape		
	Thickness of insulation		
	Thickness of oversheath		

	Description		Bidder's offer
	Maximum phase conductor resistance at 20°C		
	Maximum neutral conductor resistance at 20°C		
	Current carrying capacity	In air at 40°C	
		In duct at 40°C	
	Power frequency withstand voltage		
	List of Type Test Reports submitted with tender (indicate Test Report Numbers)		
	List of Tests to be witnessed by KPLC Engineers at the factory before shipment		
	Embossing on the cable oversheath (parameters to be indicated and method of marking)		
	Marking on cable drum (parameters to be indicated and method of marking)		
	Packaging (wooden drum & lagging)		
	Length of cable on drum		
	Installation and technical manuals to be provided during delivery		
	List of catalogues, brochures, drawings, technical data and customer sales records submitted to support the offer.		
	Statement of compliance to Tender Specifications		
	Deviations from Tender Specifications		
	Inspection/test by KPLC during delivery before acceptance to stores/site		

.....

Manufacturer's Name, Signature, Stamp and Date

ii. Specification for Aluminum 4-Core PVC Insulated, Steelwire Armoured Cable – KP1/3CB/TSP/05/001

Kenya Power	TITLE: SPECIFICATION FOR ALUMINUM 4-CORE PVC INSULATED, STEELWIRE ARMOURED CABLE	Doc. No.	KP1/3CB/TSP/05/001
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0.2 Amendment Record

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Issue 4 Rev 0	2013-04-30	Cancels and replaces 3rd Issue Rev 2 dated 2003-07-02	S. Kimitei	G. Owuor

FOREWORD

This specification has been prepared by the Research and Development Department of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for **Aluminium 4-core, PVC insulated, steel wire armoured cables**. It is intended for use by KPLC in purchasing the cables.

1. SCOPE

1.1 This specification is for four core, stranded and compacted circular aluminium conductors, PVC insulated, galvanized steel wire armoured, PVC outer sheathed power cables for operation at a.c. voltages of 600 Volts to sheath, 1000 Volts between conductors and highest system voltage of 1200 Volts for use in KPLC distribution network.

1.2 This specification covers the following cable sizes:

4 x 25 mm² AL/PVC/SWA/PVC
4 x 70 mm² AL/PVC/SWA/PVC
4 x 120 mm² AL/PVC/SWA/PVC
4 x 185 mm² AL/PVC/SWA/PVC
4 x 300 mm² AL/PVC/SWA/PVC

1.3 The specification also covers inspection and test of the cables as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted for tender evaluation.

The specification stipulates the minimum requirements for Aluminum 4-core PVC insulated, steel wire armoured cables acceptable for use in the company and it shall be the responsibility of the supplier to ensure adequacy of the design, good engineering practice, adherence to the specification, applicable standards and applicable regulations as well as ensuring good workmanship in the manufacture of the cables for The Kenya Power & Lighting Company.

The specification does not purport to include all the necessary provisions of a contract.

2. REFERENCES

The following standards contain provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

BS 6346:	600/1000V and 1900/3300V armoured electric cables having PVC insulation;
IEC 60502-1:	Power cables with extruded insulation and their accessories for rated voltages from 1kV (Um=1.2kV) up to 30kV (Um=36kV) - Part 1: Cables for rated voltages from 1kV (Um=1.2kV) up to 3kV (Um=3.6kV);
IEC 60228:	Conductors for insulated cables;
IEC 60811-1-1:	Common test methods for insulating and sheathing materials of electric cables:– Part 1: Methods for general application; Section 1: Measurements of thickness and overall dimensions – Tests for determining the mechanical properties;
KS 04-187:	Specification for conductors of insulated cables.

3. TERMS AND DEFINITIONS

For the purpose of this specification the definitions given in BS 6346, IEC 60228, IEC 60502-1 and KS 04-187 apply, together with the following:

Al:	Aluminium
PVC:	Polyvinyl Chloride
SWA:	Steel Wire Armour

4. REQUIREMENTS

4.1 SERVICE AND SYSTEM CONDITIONS

4.1.1 Cable Application

a) The cable shall be a distribution cable for use in outdoors installations and tropical conditions (temperature range of -1°C to +40°C, humidity of upto 90% and saline conditions along the coast).

b) The cable shall be suitable for laying in cable ducts and in the ground in power stations and customer installations.
c) The cable shall also be suitable for laying on slopes.
d) Permissible continuous loading operating temperature shall be 70°C.

4.1.2 Operating Voltage

The rated operating voltage (U_o/U), required by this specification is 600/1000 V at 50Hz a.c.

4.2. CABLE CONSTRUCTION

4.2.1. Design

4.2.1.1 The cable shall be designed and manufactured in accordance with requirements of IEC 60228 and IEC 60502-1 and the requirements of this specification.

4.2.1.2 All materials used shall be compatible and suitable for the continuous operating temperature of the cable of 70°C and short circuit temperature of 160°C (5 seconds max duration) as per IEC 60502-1.

4.2.2. Conductors

The cable shall be made from stranded circular compact plain aluminium conductors, class 2 in accordance with IEC 60228 and KS 04-187, and as specified in the table 1 in clause 4.3 of this specification.

4.2.3. Insulation

4.2.3.1 Material

The insulation shall be extruded dielectric of type PVC/A in accordance with the requirements of IEC 60502-1.

The insulation shall be applied by extrusion to form a compact and homogeneous layer.

4.2.3.2 Insulation Thickness

The average thickness of insulation when determined in accordance with IEC 60811-1-1, shall not be less than the nominal values given in table 1 of clause 4.3 as appropriate, and the smallest of the measured values shall not fall below the nominal value by more than (10%+0.1mm).

4.2.3.3 Identification of Cores

Cores shall be identified by colouring throughout the insulation material. Colours of the cores shall be in the following sequence:– Red, Yellow, Blue and Black.

Black colour shall be used only for Neutral.

4.2.4. Laying up

Cores shall be laid up with a right hand direction of lay. Non-hygroscopic fillers shall be applied integrally with the bedding of armoured cable to form a compact and circular cable.

A plastic binder tape shall be applied over the laid up cores of the cable.

There shall be no adhesion between the bedding of armoured cable or the sheath and insulation. Where the bedding or sheath is applied integrally with fillers, it shall be possible to strip it from the cable without damaging the insulation.

4.2.5. Bedding

4.2.5.1 Material

Bedding of four core cables shall comprise of extruded layers of polymeric material compatible with the underlying insulation and suitable for use at the operating temperatures of the cable.

The bedding shall not adhere to the underlying cores.

4.2.5.2 Bedding Thickness

The average thickness of the bedding, when determined in accordance with IEC 60811-1-1 shall not be less than the nominal value given in table 1 of clause 4.3 as

appropriate and the smallest of the measured values shall not fall below the nominal value by more than (20%+0.2mm).

4.2.6. Armour

4.2.6.1 General

Armour for the four core cable shall comprise a single layer of circular galvanized steel wires. The armour wires shall be applied helically with a left hand lay and shall fully comply with the requirements of BS 6346 and IEC 60502-1.

4.2.6.2 Wire diameter

The nominal diameter of the wires shall be as specified in clause 4.3 table 1.

4.2.6.3 Electrical Resistance

When measured and corrected to 20^0 C, the electrical resistance of the armour of the completed cable shall not exceed the appropriate value given in clause 4.3 table 1.

4.2.7. Outer Sheath

4.2.7.1 General

The outer sheath of the cable shall comprise an extruded layer of BLACK PVC in accordance with the requirements of BS 6346. The PVC shall be of type ST1 with maximum conductor temperatures in normal operations of 80^0C as per the requirements of IEC 60502-1.

4.2.7.2 Thickness

The average thickness of the outer sheath, when determined in accordance with IEC 60811-1-1, shall be not less than the nominal value given in table 1 of clause 4.3 as appropriate and the smallest of the measured values shall not fall below the nominal value by more than (20%+0.2mm).

4.2.7.3 Marking

The external surface of the cable shall be legibly embossed with the following information on two lines running parallel to the length of the cable, approximately equally spaced around the circumference of the cable.

Electric Cable 600/1000 V Manufacturers Name Description of Cable **PROPERTY OF KPLC**

For example, for 4-core, 25mm^2, PVC insulated cable manufactured by manufacturer XYZ, the legend would read as follows: Electric Cable 600/1000V XYZ 4x25mm^2 AL PVC/SWA/PVC **PROPERTY OF KPLC**
Note: The bedding material is not included in the PVC/SWA/PVC naming convention.

Letters and figures shall be raised and consist of upright block characters. Minimum size of characters shall be not less than 15% of average overall cable diameter and the distance between one set of markings and the next shall not exceed 500mm. In addition, each cable shall be sequentially marked by indelible printing, indenting or other suitable means, at 1m intervals, to indicate the approximate length of cable remaining on the drum. The numbers shall start with 001, 1m from the inner end of cable and continue every metre to the outer end.

4.3. STANDARD SIZES AND CHARACTERISTICS

Table 1: Mechanical and Electrical characteristics of standard sizes of PVC cables

Conductor nominal sectional area	mm^2	25	70	120	185	300
Number of cores		4	4	4	4	4
Voltage Designation Uo/U (Um)		600/1000 (1200) V				
Conductor shape		Stranded shaped compacted				
Nominal insulation thickness	mm	1.2	1.4	1.6	2.0	2.4
Bedding thickness	mm	1.0	1.2	1.4	1.6	1.6
Average outer sheath thickness	mm	1.8	2.1	2.4	2.6	3.0
Armour wire diameter	mm	1.6	2.0	2.5	2.5	2.5
Armour wire resistance at 20^{0}C	Ω/km	2.1	1.2	0.71	0.59	0.47
Minimum number of wires in the conductor	no	6	12	15	30	30
Minimum diameter of the conductors	mm	5.6	9.3	12.3	15.3	19.7
Maximum diameter of the conductors	mm	6.5	10.2	13.5	16.8	21.6
Outer diameter of cable	mm	27.8	39.2	49.3	59	72
Maximum conductor resistance at 20^{0}C	Ω/km	1.2	0.443	0.253	0.164	0.100
Minimum insulation resistance of cable for 1000m at 20^{0}C	MΩ	10	10	10	10	10
Approximate weight of cable	Kg/Km	1440	2830	4650	6440	9240
Approximate length of cable on drum	m	3000	2000	1000	750	500

Note:

The Current Carrying Capacity of the cable underground, in ducts and in air shall be stated by the manufacturer in the Guaranteed Technical Particulars as per Annex A

Table 2: Mechanical characteristics of Insulating and Sheathing compounds (before and after ageing)

Designation of compound	Unit	PVC/A	ST1
Maximum conductor temperature in normal operation	^{0}C	70	80
Without ageing (IEC 60811-1-2, sub clause 9.1)			
Tensile strength, minimum	N/mm^2	12.5	12.5
Elongation-at-break, minimum	%	150	150
After ageing in air oven IEC 60811-1-2, sub clause 8.1 After ageing without conductor			
Treatment			
➢ Temperature	^{0}C	100	100
➢ Tolerance	^{0}C	±2	±2
➢ Duration	h	168	168
Tensile strength			
➢ Value after ageing, minimum	N/mm^2	12.5	12.5
➢ Variation, maximum	%	±25	±25
Elongation-at-break			
➢ Value after ageing, minimum	%	150	150
➢ Variation, maximum	%	±25	±25

5. TESTS AND INSPECTION

5.1 The cable shall be inspected and tested in accordance with the requirements of this specification, BS 6346, IEC 60811-1-1 and IEC 60502-1. It shall be the responsibility of the supplier to perform or to have performed the tests specified and whatever other tests he normally performs at works.

5.2 Copies of previous Type Tests Reports issued by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. The accreditation certificate to ISO/IEC 17025 for the same third party testing laboratory used shall also be submitted with the tender (all in English Language)

5.2.1 Copies of type test reports to be submitted with the tender (by bidder) for evaluation shall include the following:

5.2.1.1 Electrical Type Tests

a) Insulation resistance measurement at ambient temperature tests.
b) Insulation resistance measurement at maximum conductor temperature test.
c) Voltage test for 4h.
d) Impulse test for completed cable.

5.2.1.2 Non Electrical Type Tests

5.2.1.2.1 Mechanical strength tests for PVC/A insulation and ST1 over sheath.

a) Tensile strength and elongation-at-break tests: without ageing; after ageing in an air, oven and after ageing of pieces of complete cable.

5.2.1.2.2 Thermoplastic properties of insulation and over sheath.

a) Hot pressure tests (indentation) test.
b) Behavior at low temperatures tests.

5.2.1.2.3 Heat shock tests
5.2.1.2.4 Water absorption tests

5.2.2 Routine and sample test reports for the cables to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods. KPLC Engineers will witness tests at the factory before shipment.

5.2.3 Tests to be witnessed by KPLC Engineers at the factory before shipment shall be in accordance with BS 6346, IEC 60228, IEC 60502-1, this specification and shall include the following:

5.2.3.1 Routine Tests

a) Spark test on cores.
b) Spark test on over sheath of armoured cables.
c) Voltage test on completed cables.
d) Insulation resistance tests.

e) Conductor resistance tests.
f) Armour resistance tests.

5.2.3.2 Sample Tests

a) Measurement of insulation thickness
b) Measurement of extruded bedding and over sheath thickness
c) Conductor examination – physical tests and check of dimensions

6. SEALING, PACKING AND MARKING

6.1 Sealing

Before dispatch, the ends of the cable shall be sealed with closing fitting PVC end caps to prevent the ingress of water during transportation and storage.

The sealing shall enclose the oversheath completely.

6.2 Packing

Cables shall be wound on to non-returnable wooden drums, close battened to prevent damage during transportation or storage. The wood shall be treated to resist biological attacks. The drums shall have wooden lagging all round, with no gaps.

Each drum shall contain only one continuous length of cable which shall be of the length indicated in table 1, clause 4.3 above in length. The actual length of cable shall not be less than the length indicated on the drum

Both ends of the cable shall be secured to the drum to prevent mechanical damage

6.3 Marking

6.3.1 Each drum shall be legibly and indelibly marked with the following information on the flange:

a) The manufacturer's trade name;
b) The year of manufacture.
c) The rated voltage of the cable, 600/1000 (1200) V
d) The type of cable. For example AL 4 core PVC/SWA/PVC,
e) The conductor cross-sectional areas in mm²;

f) The length of the cable, in metres;
g) The identifying serial number;
h) The words "NOT TO BE LAID FLAT" or a suitable pictogram;
i) An arrow and words, "ROLL THIS WAY", on each flange of the drum to indicate in which direction the drum shall be rolled in order to prevent the cable from unwinding.
j) A capital letter "T" approximately 50mm high surrounded by a circle with an approximate outside diameter of 65mm, if the wood has been treated to resist biological attack.
k) The gross mass of the drum and net mass cable, in kilogram;
l) The words "PROPERTY OF THE KENYA POWER & LIGHTING CO."

6.3.2 The following information shall be printed on a suitable label. This label shall be firmly attached to one of the flanges of the drum:

a) The year of manufacture;
b) The rated voltage of the cable 600/1000 V;
c) The type of cable. For example 4-core PVC/SWA/PVC;
d) The conductor size in mm^2;
e) The length of the drum in metres;
f) The gross mass of the cable and drum in Kg.
g) An identifying serial number;
h) The purchasers name. For example, **"PROPERTY OF KENYA POWER & LIGHTING CO."**
i) The order number;
j) Any other contract particulars.

Note: The cable shall have been marked in accordance with clause 4.2.7.3

7. DOCUMENTATION

7.1 The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation.

a) Guaranteed Technical Particulars;
b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
c) Sales records for the last five years and at least four customer reference letters;
d) Details of manufacturing capacity and the manufacturer's experience;
e) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025; the Type Test Reports shall not be more than five years old.

f) Copy of accreditation certificate for the testing laboratory.

7.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

a) Guaranteed Technical Particulars,
b) Design drawings and construction details of the cable,
c) Quality Assurance Plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations.
d) Test Program to be used after manufacture,
e) Marking details and method to be used in marking the cables,
f) Manufacturer's undertaking to ensure adequacy of the design, good workmanship, good engineering practice and adherence to applicable standards in the manufacture of the cables for KPLC,
g) Packaging details (including packaging materials, lagging and length on drum).

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ANNEX A: **Guaranteed Technical Particulars** *(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records, four customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test certificates and type test reports for tender evaluation, all in English Language)*

Table 3: Guaranteed Technical Particulars.

1	2		3	4
Item	Description	Units	Schedule 1 (KPLC)	Schedule 2 (Tenderer)
1	Manufacturer		Specify	
2	Country of manufacture		Specify	
3	Name and address of Bidder		Specify	
4	Service conditions			
	a) Cable application		Specify	
	b) Operating voltage	V	Specify	
5	Cable construction			
	a) Design			
	• Standards applicable		Specify	
	• Materials characteristics		Specify	
	b) Conductors types	mm^2	25, 70, 120, 185, 300	
	c) Insulation			
	• Materials		PVC/A	
	• Insulation thickness	mm	Specify	
	• Identification of cores	no	Specify	
	d) Laying up		Specify	
	e) Bedding			
	• Bedding material		Specify	
	• Bedding thickness	m	Specify	
	f) Armour			
	• Armour material		Galvanized steel	
	• Armour wire diameter	mm	Specify	
	• Armour wire electrical resistance at 20°C	Ω/km	Specify	
	g) Outer sheath			

	• Outer sheath material		PVC type ST1	
	• Thickness	mm	Specify	
	• Marking		Specify	
6	Standards and Characteristics			
	a) Conductor nominal x-sectional area	mm^2	Specify	
	b) Number of cores	no	Specify	
	c) Voltage designation $U_o/U(U_m)$	V	Specify	
	d) Conductor shape		Specify	
	e) Nominal insulation thickness	mm	Specify	
	f) Inner sheath thickness	mm	Specify	
	g) Average sheath thickness	m	Specify	
	h) Armour wire thickness	mm	Specify	
	i) Number of wires in the conductor	no	Specify	
	j) Average diameter of the conductors	mm	Specify	
	k) Outer diameter of conductors	mm	Specify	
	l) Maximum conductor resistance at 20^0C	Ω	Specify	
	m) Minimum insulation resistance of cable for 1000m at 20^0C	MΩ	Specify	
	n) Approximate weight of cable	Kg	Specify	
	o) Approximate length of cable on drum	m	Specify	
	p) Current carrying capacity			
	• air	A	Specify	
	• duct	A	Specify	
	• underground	A	Specify	
	q) Power frequency withstand voltage	V	Specify	
7	Copies of type test reports to be submitted with tender for evaluation		As per clauses 5.2.1.1 and 5.2.1.2	
8	List of Tests to be witnessed by KPLC Engineers at the factory before shipment		As per clauses 5.2.3.1 and 5.2.3.2	
9	Embossing of the cable over sheath (parameters to be indicated and method of marking)		Specify	
10	Marking of cable drum (parameters to be indicated and method of marking)		Specify	
11	Packing (treated wooden drum and lagging)		Specify	

12	**Length of cable on the drum (shall be in one continuous length)**		Specify	
13	**Installation and technical manuals to be provided during delivery**		Specify	
14	**List of catalogues, brochures, drawings, technical data and customer sales records submitted to support the offer.**		Specify	
15	**Statement of compliance to tender specifications**		Specify	
16	**Deviations from tender specifications**		Specify	
17	**Inspection/Tests by KPLC during delivery before acceptance to stores/site.**		Specify	

NB: - *This schedule does not in any way substitute for detailed information required elsewhere in the specification.*

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Manufacturer's Name, Signature, Stamp and Date

iii. Specification for Earth Rods and their Connectors – KP1/3CB/TSP/06/031-1

Kenya Power	SPECIFICATION FOR EARTH RODS AND THEIR CONNECTORS Part 1: Copper Clad Earth Rods and their connectors	Doc. No.	KP1/3CB/TSP/06/031-1
		Issue No.	3
		Revision No.	0
		Date of Issue	2014-04-06
		Page 1 of 19	

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Signed:	Signed:
Date: 2014/04/06	Date: 2014/04/06

0.1 Circulation List

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0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
0	2014-04-06	Cancels and replaces issue No. 2 dated 2013/05/13	Michael Apudo	George Owuor

FOREWORD

This specification has been prepared by the Research and Development Department of The Kenya Power and Lighting Company Limited (abbreviated as KPLC). It lays down requirements for Copper Clad Earth Rods and their connectors for use in Kenya Power distribution network and substation earthing. It is intended for use by KPLC in purchasing the items.

This specification supersedes all specifications for earth rods issued before the revision date. The specification for earth rods and their connectors is issued in parts as follows:

Part 1: Copper Clad Earth Rods and their connectors
Part 2: Stainless Steel Earth Rods and their connectors
Part 3: Galvanized Steel Earth Rod and their connectors

1. SCOPE

1.1. This specification is for copper-clad earth rods and the associated connectors. It covers only extensible copper-clad earth rods and connectors which constitute the following items:

a) Copper clad earth rod
b) Connectors which include:
   (i) Couplings,
   (ii) Driving head,
   (iii) Bull-dog grip clamp.

NOTE: The required quantities of the items shall be stated in the tender.

1.2. The specification stipulates the minimum requirements for copper-clad earth rods and the associated connectors acceptable for use in the company and it shall be the responsibility of the supplier to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the items for The Kenya Power & Lighting Company.

1.3. The specification does not purport to include all the necessary provisions of a contract.

2. REFERENCES

The following standards contain provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

ISO 2859-1:	Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
ISO 9001:	Quality management systems -- Requirements
BS 7430:	Code of practice for protective earthing of electrical installations
BS PD 970:	Wrought steels for mechanical and allied ergineering purposes. Requirements for carbon, carbon manganese and alloy hot worked or cold finished steel
BS 2874:	Specification for copper and copper alloy rods and sections (other than forging stock)
BS EN 12163:	Copper and copper alloys. Rod for general purposes
BS 4168-1:	Hexagon socket screws and wrench keys: metric series Specification for hexagon socket head cap screws
BS 3643-2:	ISO metric screw threads — Part 2: Specification for selected limits of size.
UL 1439:	Tests for Sharpness of Edges on Equipment
KS 04 – 744:	Specification for earth rods and their connectors. Part 1: Copper clad earth rods

3. DEFINITIONS

For the purpose of this specification, the definitions given in the reference standards shall apply.

4. REQUIREMENTS

4.1. Service Conditions

4.1.1. The copper-clad earth rods and associated connectors shall be suitable for installation in tropical areas at

(i) Altitudes of up to 2200m above sea level,

(ii) Humidity of up to 90%,

(iii) Ambient temperatures of -1°C to +40°C, average ambient temperature is 30° C. and
(iv) A wide range of soils.

4.1.2. All components shall be manufactured from metal or metals such that when installed under conditions of actual service and exposed to moisture shall not be adversely affected by electrolysis or galvanic corrosion.

4.2. Design and Construction

4.2.1. General

4.2.1.1. To ensure compatibility of component parts of the earth rod and connectors, the items to be supplied under this specification consist of copper-clad earth rod, coupling, driving head and bull dog clamp which form a "total system" conforming to BS 7430: 2011 standard requirements. This will include an assessment of the safety, reliability and long term performance of the items tendered.

4.2.1.2. The design of the earth rod assembly (including couplings, driving head and bull dog clamp) shall be of such mechanical strength that they shall withstand the stresses and abrasions present during installation with either electric/pneumatic hammer or direct hammering.

4.2.1.3. The design of the rods and couplings shall be such that during installation, the connection between the rod and the coupling shall "self-tighten". This self-tightening effect shall improve the electrical and mechanical performances of the rod/coupling combination. The Tenderer shall state the design features of the rod and accessories which verify the following features:

- Self-tightening;
- Improved electrical connection; AND
- No damage to the copper sheath on installation.

4.2.1.4. The rod system shall be extendable by the use of appropriate couplings. All items including rods, couplings, driving points and clamps shall be clean, free of burrs, cracks and sharp edges.

4.2.1.5. Tenderers shall provide the recommended procedure for the correct assembly of the various components of the earthing system including the earth rod, coupling, driving head and clamps.

4.2.2. Threading

4.2.2.1. Threads on the earth rods, couplings and hardware assembly (bull dog clamp bolts and driving heads) shall be formed by roll process ("roll thread" type) giving extra strength to the threads and eliminating the risk of chipping of threads while driving the ground rod in the ground.

4.2.2.2. The earth rods, bull dog clamp bolts and driving heads shall be externally threaded and matched with couplers and bull dog clamp nuts which shall be internally threaded and shall conform to each end of the rod electrode as per Fig. 1 and Table 1.

4.2.2.3. The threading system shall be to BS 3643 for ISO metric screw threads; class 3 (high accuracy, fine fits), with external thread designation of 4h for earth rods and internal thread designation of 5H for couplings as per Table 1; bolts and nuts thread tolerance class shall be standard (general assembly) of 6h and 6g respectively conforming to the values in Table 1 of BS 3643-2.

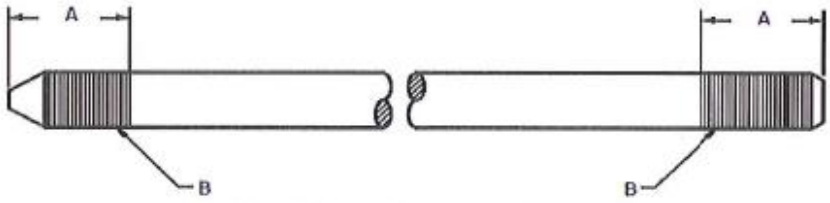

Fig. 1: Threading dimensions

Table 1: Thread dimensions as per BS 3643-2

Nominal diameter, mm			**12.5**	**16**	**20**	**25**
Pitch			1.5	1.0	1.0	1.0
Thread "A" length , mm		min	27.000	30	32	45
		tol.	-1.6; + 3.2			
External threads of the rod; "B"	Tolerance class		4h			
	Fundamental deviation		0.032			0
	Major diameter, mm	max	12.500	16.000	20.000	25.000
		tol.	0.112			
		min	12.388	15.888	19.888	24.888
	Pitch diameter, mm	max	11.850	15.350	19.350	24.350
		tol.	0.075			0.080
		min	11.775	15.275	19.275	24.270
	Minor diameter, mm	min	11.159	14.659	18.659	23.654

Nominal diameter, mm			12.5	16	20	25
Internal threads of the couplers	Tolerance class		5H			
	Fundamental deviation		0			
	Major diameter, mm	min	12.500	16.000	20.000	25.000
	Pitch diameter, mm	max	11.975	15.475	19.475	24.482
		tol.	0.125			0.132
		min	11.850	15.350	19.350	24.350
	Minor diameter, mm	max	11.607	15.107	19.107	24.107
		tol.	0.190			
		min	11.417	14.917	18.917	23.917

4.3. Specific requirements

4.3.1. Copper-Clad Rods

4.3.1.1. The copper clad earth rod shall be manufactured from a steel rod reference symbol P of a grade with tensile strength of 550 MPa to 700 MPa in accordance with BS PD 970: 2005 standard requirements; a Brinell hardness shall be 248 to 302 HBW as recommended by BS 7430:2011 standard.

4.3.1.2. An earth electrode shall be designed to have a loading capacity adequate for the system of which it forms a part, i.e. it shall be capable of dissipating the electrical energy in the earth path at the point at which it is installed under any condition of operation on the system.

4.3.1.3. Copper-clad steel earth rods shall be made by molecularly bonding 99.9% pure copper onto the high carbon, low tensile steel rods to achieve a minimum copper thickness of 0.254 mm (254 µm). The application of the copper sheath shall prevent any electrolytic action to be initiated by moisture ingress between the copper and the steel.

4.3.1.4. Tenderers shall state the method used to apply the copper sheath to the rod together with the design features to verify the prevention of moisture ingress.

4.3.1.5. To prevent oxidation of copper bonding, each rod shall be treated with Benzol Triozole derivatives. A proof of the same shall be provided by the tenderer.

4.3.1.6. Both ends of the rods shall be tapered as per Figure 2. The taper shall be approximately 3:100 on diameter and the minimum dimensions of the taper shall be as per Table 2 (as measured parallel to the axis of the earth rod).

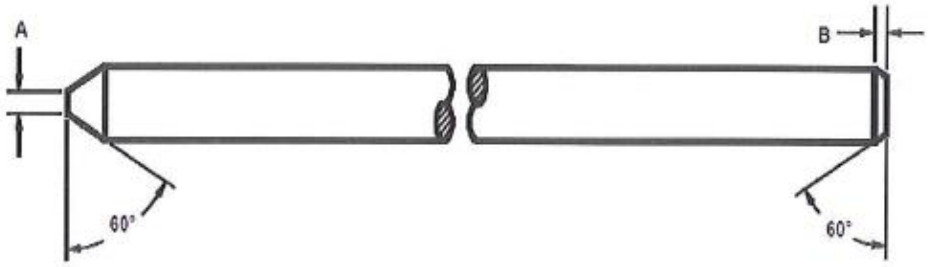

Fig. 2: Earth rod

Table 2: Table of taper lengths

Nominal diameter, mm	Point end "A" (mm)	Chamfer end "B" (mm)
12.5	4.70	2.40
16	4.70	3.20
20	6.35	3.20
25	9.50	5.55

4.3.1.7. The finished product shall have the following sizes as per KS 04 – 744 and Table 3 :

Table 3: Earth rod sizes

Nominal size		Rod length	
mm	Inches*	mm	Feet*
12.5	½ "	1,200	4'
16.0	5/8"	1,500	5'
20.0	¾ "	2,100	7'
25.0	1"	3,000	12'
** The imperial sizes have been replaced by the metric sizes in this specification for clarity.*			

4.3.2. **Connectors**

4.3.2.1. **Couplings**

4.3.2.1.1. The couplings shall be manufactured from phosphor bronze, grade C102 or equivalent in accordance with BS 2874 and shall be suitable for direct burial.

4.3.2.1.2. The coupling shall be a threaded joining device which joins two earth rods together for extending earth rods in an earthing system. The threading system shall be as per clause 4.2.2, Table 1.

4.3.2.1.3. The coupling device shall be designed to ensure that a good permanent electrical conductivity is maintained between the joined earth rods throughout a service life of 35 years for the installed earth rod assembly.

4.3.2.1.4. The couplings in the assembled mode shall exhibit no less than 95% of the conductivity of an unspliced ground rod of equal length.

4.3.2.1.5. The material used shall be selected to ensure that electrolytic action and/or stress corrosion cracking will not occur. In addition, the surfaces of the couplings exposed to the soil, shall be corrosion resistant.

4.3.2.1.6. The couplings design shall be hexagonal in shape as per Fig. 3. The thickness shall be at least 3 mm and lengths of 50, 60 and 70 mm to suit the sizes of the earth rods as per Table 4. Tenderers shall state the material(s) used.

Fig. 3: Hexagonal shape coupling

Table 4: Standard coupling sizes

Nominal size		Coupling length
mm*	Inches	mm
12.5	½ "	50
16.0	5/8"	50
20.0	¾ "	60
25.0	1"	70
* Only the metric system shall be used at tender		

4.3.2.2. **Driving Head**

4.3.2.2.1. Driving heads shall be made of toughened, quenched and tempered stainless steel with reference symbol Z; in accordance with BS PD 970:2005 and as recommended by BS 7430:2011.

4.3.2.2.2. The steel shall have a tensile strength of 1150 MPa to 1300 MPa and shall be able to withstand hammer blows used while hammering an earth rod into ground.

4.3.2.2.3. It shall dimensionally conform to BS 4168-1 (knurled head) and finished standard blue/black.

4.3.2.2.4. The threading system shall match with those of the couplings specified in clause 4.2.2 and shall match with the respective coupling sizes.

4.3.2.2.5. The diameter of the driving head shall NOT be LESS THAN the diameter of the earth rod/coupler assembly.

4.3.2.2.6. The driving head shall be designed to reduce the driving effort on the earth rod and to prevent damage to the copper sheath during the installation process.

Fig. 4: Driving head

4.3.2.3. **Earth Rod Clamps**

4.3.2.3.1. Earth rod clamps shall be of bull dog-type; its material shall be made of phosphor bronze, grade C102 in accordance with BS 2874, and it shall be suitable for direct burial and compatible with the coupling material.

4.3.2.3.2. The surface finish of the completed clamps shall be smooth and free of cracks, burrs and sharp projections. Conformance to no sharp projections shall be tested using a Sharp Edge Tester device calibrated to UL Standard 1439.

4.3.2.3.3. The clamp in the assembled mode shall exhibit no less than 95% of the conductivity of a solid earth conductor.

4.3.2.3.4. The joined clamp/grounding conductor/rod electrode assembly shall withstand a pullout force of no less than 2.0 kN before separation. This test shall be performed by pulling on the grounding conductor with the rod held firmly in place, the clamp providing a securing function only.

4.3.2.3.5. Earth Rod/Conductor clamp shall satisfy the following requirements:

a) Be suitable for direct burial in the ground.

b) Be suitable for connecting the specified rods with one or two stranded copper conductors of the following sizes:
- Minimum conductor size: 50 mm^2 (19/1.80)
- Maximum conductor size: 70 mm^2 (19/2.10)

c) Be of materials which are resistant to corrosion and parts of the connector which are in direct contact with the conductor and earth rod shall be of material which does not cause interface corrosion.

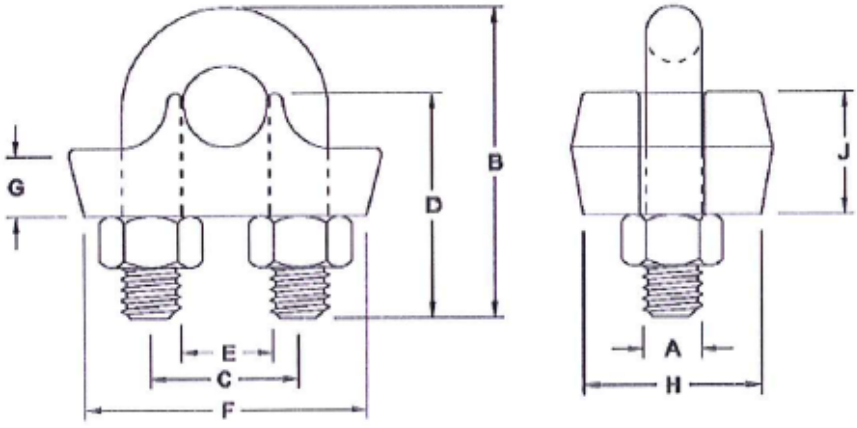

Fig. 5: Bull Dog type connector.

Table 5: Recommended dimensions of bull-dog clamp.

Recommended earth rod size mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	J mm
M12.5	Φ12	64	27	32	15	51	12	28	22
M16, M20, M25	Φ14	82	36	36	40	22	64	32	25

4.3.2.3.6. The U-bolt, nut and washers shall be made from phosphor bronze designation CW451K conforming to BS EN 12163:2011 as recommended by BS 7430:2011 and shall be suitable for direct burial and compatible with the coupling material.

4.3.2.3.7. Assembly torque for bull-dog clamps shall be 70 Nm as the screw thread pitch for the bolts shall be as per clause 4.2.2. The tenderer shall advise the minimum and maximum recommended tightening torques as well as the specified tightening technique/procedure.

4.3.2.3.8. Recommended sizes of the bull dog clamp shall be as per Table 5.

4.4. Sampling for tests

Test specimens shall be selected at random from each inspection lot (or articles) in accordance with ISO 2859-1. The number of samples selected from each lot shall comply with Table 6 of this specification.

Table 6: Number of test samples

Lot size	Sample size	Lot size	Sample size
25 or less	5	501 to 1,200	80
26 to 50	8	1,201 to 3,200	125
51 to 90	13	3,201 to 10,000	200
91 to 150	20	10,000 to 35,000	315
151 to 280	32	35,001 to over	500
281 to 500	50		

4.5. Quality Management System

4.5.1. The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the design, material, workmanship, tests, service capability, maintenance and documentation of the copper-clad earth rod and their connectors, will fulfill the requirements stated in the

contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008.

4.5.2. The Manufacturer's Declaration of Conformity to applicable standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2008 certificate shall be submitted with the tender for evaluation.

4.5.3. The bidder shall indicate the delivery time of the copper-clad earth rod and their connectors, manufacturer's monthly & annual production capacity and experience in the production of the type and size of items being offered.

5.0. TESTS AND INSPECTION

5.1. Performance and Testing

5.1.1. Couplings

5.1.1.1. Two 450 mm rod samples shall be coupled and held vertically in a tubular fixture that is at least 0.25 mm greater than the rod diameter.

5.1.1.2. The penetrating end of the bottom ground rod shall be rested on a fixed plate of a weight sufficient to withstand the impact test, and located in a hole at least 100 mm in depth.

5.1.1.3. The coupling shall not rest on or be contained within the tubular fixture or fixture plate. The top ground rod shall be subjected to an impact force of 55 Nm. After 25 impacts, the couplings shall not break, split, or be subjected to damage that impairs performance.

5.1.1.4. The joined coupling/rod assembly shall be able to withstand a pullout force of no less than 6.5 KN before separation.

5.1.2. Earth rod clamp

5.1.2.1. The clamps shall be installed in accordance with the manufacturer's instructions. The complete test procedure shall be as given below:

a) The earth rod/connector/conductor combination shall be tested in still air. The locations of the connections for injecting the test current shall be positioned not less than twenty (20) times the diameter of the earth rod from the centre of the connector for all tests.

b) Tests shall be carried out on the following connection combinations for the connectors as detailed below:
- 50 mm^2 conductor to earth rod,
- 70 mm^2 conductor to earth rod,
- 50mm^2 conductor to 50 mm^2 conductor,
- 50 mm^2 conductor to 70 mm^2 conductor,
- 50 mm^2 cable conductor to 50 mm^2 cable conductor,
- 50 mm^2 cable conductor to 70 mm^2 cable conductor ,
- 70 mm^2 cable conductor to 70 mm^2 cable conductor.

c) A minimum average test current of 5 kA, 50 Hz for 1 second (I^2t of 25 MA^2/second) shall be used for each test.

d) Visual inspection after the test shall ensure that there is no damage to the connector and there is no severe discolouration to the connector and surrounding areas. There should be no loosening of the connection between the cable and the rod or between the cable and the cable.

5.1.2.2. The successful tenderer shall provide test reports that verify the requirements detailed above before the first deliveries are accepted under the contract.

5.2. The copper-clad earth rod and their connectors shall be inspected and tested in accordance with the requirements of BS PD 970, BS 2874, BS EN 12163, BS 3643-2 and KS 04-744 standards and provisions of this specification. It shall be the responsibility of the supplier to perform or to have performed the tests specified and whatever other tests he normally performs at works.

5.3. Copies of previous Type Tests Reports issued by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. The accreditation certificate to ISO/IEC 17025 for the same third party testing laboratory used shall also be submitted with the tender document (all in English Language)

5.4. Copies of type test reports to be submitted with the tender (by bidder) for evaluation for the copper-clad earth rod and their connectors shall be as stated below:
a) Adherence of copper clad to steel core
b) Current carrying capacity tests
c) Mechanical Strength – ultimate tensile strength tests
d) Chemical composition – Check Analysis
e) Hardness Test

f) Impact Test

5.5. Routine and sample test reports for the copper-clad earth rod and their connectors to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods. KPLC Engineers will witness tests at the factory before shipment.

5.6. Tests to be witnessed by KPLC Engineers at the factory before shipment shall be in accordance with of BS PD 970, BS 2874, BS EN 12163, BS 3643-2 and KS 04-744 standards and provisions of this specification and shall include the following:

a) Verification of dimensions
b) Adherence of copper clad to steel core
c) Current carrying capacity tests
d) Mechanical strength – ultimate tensile strength tests
e) Checking the condition of the threads (earth rod, coupling, driving head and bull dog clamp U-bolt and nut) and copper cladding after performing a driving (in to hard soil) operation.
f) Bending test

5.7. On receipt of the goods KPLC may perform any of the tests specified in order to verify compliance with this specification. The supplier shall replace without charge to KPLC the copper-clad earth rod and their connectors, which upon examination, test or use; fail to meet any of the requirements in the specification.

6.0. MARKING AND PACKING

6.1. Marking

6.1.1. Each copper-clad earth rod shall be indelibly marked with the following information (in English Language):

- Name or trade mark of the manufacturer
- The length of the rod in meters or millimetres,
- The diameter of the rod in millimetres,
- Any information which the manufacturer considers necessary for the correct installation service.
- Letters "**KPLC**"

6.1.2. Couplings and connectors shall be marked with :

- Name or trade mark of the manufacturer
- Trade size

- Letters "**KPLC**"

6.1.3. The driving head shall be marked as per the requirements of BS 4168-1.

6.2. PACKING

6.2.1. The copper clad earth rods, couplings, connectors and driving heads shall be suitably packed separately in reinforced wooden boxes firmly secured with metallic straps and the quantity of items in a package is as in a), b), c), or d) given below.

a) Copper Clad Earth Rods - 50 per box
b) Couplings - 100 per box
c) Connectors - 100 per box
d) Driving Heads - 100 per box

6.2.2. Each Packing shall be clearly and indelibly marked with the following;

a) Name of Item
b) Quantity
c) Gross Weight
d) The boxes shall be marked with manufacturer's identification and property class and the words "**PROPERTY OF KPLC**".

7. DOCUMENTATION

7.1 The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation. The technical documents to be submitted (all in English language) for tender evaluation shall include the following:

a) Fully filled clause by clause description of the item on offer as per Annex A (Guaranteed Technical Particulars) and signed by the manufacturer;
b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data which shall include:
   - Model/Reference number, Code Name,
   - Current carrying capacity and the % of current through the coupling.
   - Constructional features and material used for components, the standards to which the items are manufactured and relevant technical literature.
c) Sales records for the last five years and at least four customer reference letters;
d) Details of manufacturing capacity and the manufacturer's experience;
e) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025;
f) Copy of accreditation certificate to ISO/IEC 17025 for the third party testing laboratory;

g) Manufacturers letter of authorization, ISO 9001:2008 certificate and other technical documents required in the tender.

7.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

a) Guaranteed Technical Particulars signed by the manufacturer;
b) Design Drawings with details of copper-clad earth rod and their connectors to be manufactured for KPLC.
c) Quality assurance plan (QAP) that will be used to ensure that the design, material; workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008
d) Detailed test program to be used during factory testing;
e) Marking details and method to be used in marking of the copper-clad earth rod and their;
f) Manufacturer's undertaking to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the copper-clad earth rod and their connectors for The Kenya Power & Lighting Company;
g) Packaging details (including packaging materials).

7.3 The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during delivery of the copper-clad earth rod and their connectors to KPLC stores.

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ANNEX A: Guaranteed Technical Particulars *(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records, four customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test reports for tender evaluation, all in English Language)*

Tender No. .....

Clause number	**Bidder's offer** (indicate full details of the values offered)
Manufacturer's Name and address	
Country of Manufacture	
Bidder's Name and address	
1. Scope	
1.1-1.4	
2. Applicable Standards	
3. Terms & Definitions	
4. Requirements	
4.1 Service conditions	
4.1.1 – 4.1.2	
4.2 Design and construction	
4.2.1 General	
4.2.1.1 – 4.2.1.3	
Self-tightening	
Improved electrical connections	
No damage to the copper sheath on installation	
4.2.1.4 – 4.2.1.5	
4.2.2 Threading	
4.2.2.1 – 4.2.2.3	
System of threading	
• Earth rods	
• Coupling	
• Connectors	
• Bolts and nuts	
4.3 Specific requirements	
4.3.1 Copper clad earth rods	
4.3.1.1 – 4.3.1.6	
• Taper lengths	
• Earth rod sizes	

Clause number		Bidder's offer (indicate full details of the values offered)
4.3.2 Connectors		
4.3.2.1 Couplings		
4.3.2.1.1 – 4.3.2.1.6		
• Coupling sizes		
4.3.2.2 Driving Head		
4.3.2.2.1 - 4.3.2.2.6		
4.3.2.3 Earth rod clamps		
4.3.2.3.1 – 4.3.2.3.8		
4.4 Sampling		
4.5 Quality Management Systems		
4.5.1 – 4.5.3		
5.0 Tests and Inspection		
5.1 Performance and testing		
5.1.1 Couplings		
5.1.1.1 – 5.1.1.4		
5.1.2 Connectors		
5.1.2.1 – 5.1.2.2		
5.2 – 5.7 Routine and type tests		
6. Marking & Packaging		
6.1. Marking		
6.2 Packaging		
6.2.1 – 6.2.3		
7. Documentation		
7.1 – 7.3		
8.0	Manufacturer's Guarantee and Warranty	
9.0	List catalogues, brochures, technical data and drawings submitted to support the offer.	
10.0	List customer sales records and customer reference letters submitted to support the offer.	
11.0	List Test Reports submitted with tender	
12.0	List test & calibration reports to be submitted to KPLC for approval before shipment	
13.0	Statement of compliance to specification (indicate deviations if any & supporting documents)	

.....

Manufacturer's Name, Signature, Stamp and Date

iv. Specification for Soft Drawn Copper Conductors (Bare & PVC Covered) – for Earthing – KP1/6C.1/13/TSP/06/026

Kenya Power	TITLE: SPECIFICATION FOR SOFT DRAWN COPPER CONDUCTORS (Bare & PVC Covered) – for Earthing	Doc. No.	KP1/6C.1/13/TSP/06/026
		Issue No.	2
		Revision No.	1
		Date of Issue	2016-06-03
		Page 1 of 10	

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Signed:	Signed:
Date: 2016-06-03	Date: 2016-06-03

0.1 Circulation List

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0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 2 Rev 1	2016-04-15	Cancels & replaces KPLC1/3CB/TSP/05/030 Issue 1 Rev 1 of 2007-05-11	S Nguli	Dr. Eng. Kimemia
		1. Foreword; Supplier to submit information on manufacturer's satisfactory experience included		
		2. References: ISO/IEC 17025 Standard included in the list of Standards		
		3. Tests and Inspection: Need for supplier to replace material that fails tests included		

FOREWORD

This specification has been prepared by the Standards Department of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for soft drawn copper conductors for grounding electrical systems. It is intended for use by KPLC in purchasing the conductors.

The supplier shall submit information which confirms the manufacturer's satisfactory service experience with products which fall within the scope of this specification.

1. SCOPE

This specification is for plain bare and PVC covered soft drawn copper conductors for grounding electrical systems.

The specification also covers inspection and test of the conductors as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted for tender evaluation.

The specification stipulates the minimum requirements for soft drawn copper conductors acceptable for use in the company and it shall be the responsibility of the Manufacturer to ensure adequacy of the design, good workmanship and good engineering practice in the manufacture of the conductors for KPLC.

The specification does not purport to include all the necessary provisions of a contract.

2. REFERENCES

The following standards contain provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

IEC 60228: Conductors of insulated cables

IEC 60502-1: Power Cables with extruded insulation and their accessories for rated voltages from 1kV (Um=1.2kV) up to 30kV (Um=36kV)- Part 1: Cables for rated voltages 1kV (Um=1.2kV) and 3kV (Um=3.6kV)

ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories

3. TERMS AND DEFINITIONS

For the purpose of this specification, definitions given in the reference standard shall apply.

4. REQUIREMENTS

4.1 Service Conditions

The conductor shall be suitable for continuous outdoor operation in tropical areas with the following conditions.

a) Altitude: up to 2,200m above sea level;

b) Temperature: average of +30°C with a minimum of -1°C and max +40 °C;

c) Humidity: up to 95%;

d) Pollution: Design pollution level to be taken as "*Heavy*" (Pollution level III) for inland and "*Very Heavy*" (Pollution level IV) for coastal applications in accordance with IEC 60815.

e) Isokeraunic level: 180 thunderstorm days per year

4.2 Materials and Construction

4.2.1 The soft drawn copper conductors shall be suitable for grounding electrical systems where high conductivity and flexibility are required.

4.2.2 The conductors shall be as per IEC 60228. Sizes and electrical characteristics shall be in accordance with Table 1.

4.2.3 PVC covering shall be type PVC/A as per IEC 60502-1. The nominal thickness shall be in accordance with IEC 60502-1 (same values given in Table 1).

Table 1: Characteristics of the soft drawn copper conductors

Nominal cross-sectional area mm²	Number & nominal diameter of wires No x Ø (mm)	Max. DC resistance at 20°C Ohm/km	Approx. overall diameter (uncovered conductor) mm	Nominal thickness of PVC covering mm
16	7x1.68	1.15	5.1	1.0
35	7x2.48	0.524	7.4	1.2
50	19x1.80	0.387	9.0	1.4
70	19x2.10	0.268	10.5	1.4
95	19x2.48	0.193	12.4	1.6
120	37 No. As per IEC 60228	0.153	14.5	1.6
150	37 No. As per IEC 60228	0.124	16.2	1.8

4.3 QUALITY MANAGEMENT SYSTEM

4.3.1 The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the design, material, workmanship, tests, service capability, maintenance and documentation, will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008.

4.3.2 The Manufacturer's Declaration of Conformity to reference standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2008 certificate shall be submitted with the tender for evaluation.

4.3.3 The bidder shall indicate the delivery time of the conductors, manufacturer's monthly and annual production capacity and experience in the production of the type and size of conductors being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers outside the country of manufacture for the conductors sold in the last five years together with reference letters from four of the customers shall be submitted with the tender for evaluation.

5. TESTS AND INSPECTION

5.1 The soft drawn copper conductors shall be tested and inspected in accordance with the requirements of this specification, IEC 60502-1 and IEC 60228. It shall be the responsibility of the manufacturer to perform or to have performed the tests specified.

5.2 Copies of previous Test Reports (in English Language) from the relevant International or National Testing/Standards Authority of the country of manufacture (or ISO/IEC 17025 accredited independent laboratory) shall be submitted with the tender for the purpose of technical evaluation. A copy of accreditation certificate for the laboratory shall also be submitted (all in English Language).

5.3 Routine and sample test reports for the cables to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods.

5.4 During delivery of the conductors, KPLC will inspect them and may perform or have performed any of the relevant tests in order to verify compliance with the specification (including verification of length on drum). The supplier shall replace/rectify without charge to KPLC, conductors which upon examination, test or use fail to meet any or all of the requirements in the specification.

6. MARKING, LABELLING AND PACKING

6.1 Where explicitly requested for, the words "Property of The Kenya Power & Lighting Co. Ltd" shall be marked at intervals of 500mm on the centre strand by laser cutting. The laser cutting shall not change the required mechanical properties of the conductor.

6.2 The finished conductor shall be wound on wooden drum such as to prevent damage during transportation and handling. The drums shall be made from treated timber resistant to termite attack.

6.3 The actual length of conductor shall not be less than the length indicated on the drum.

6.4 The following information shall be marked legibly and in a permanent manner on the flange of the drum.

a) The manufacturer's name.

b) The type of conductor.
c) The conductor cross-sectional areas in mm².
d) The length of the conductor, in metres.
e) The year of manufacture.
f) The gross mass and net mass, in kilogram.
g) Standard of manufacture
h) The instructions for handling and use (in English Language).
i) The words "**Property of The Kenya Power & Lighting Co**. Ltd"

6.5 PVC covered conductors shall be marked with the manufacturer's name, type of conductor, cross-sectional area, year of manufacture and the words "Property of Kenya Power & Lighting Co. Ltd." An indelible marking shall also be given at every one meter interval to assist field personnel in cutting required length.

7. DOCUMENTATION

7.1 The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation. The technical documents to be submitted (all in English language) for tender evaluation shall include the following:

a) Guaranteed Technical Particulars;
b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
c) Sales records for the last five years and at least four customer reference letters;
d) Details of manufacturing capacity and the manufacturer's experience;
e) Copies of required test reports by a third party testing laboratory accredited to ISO/IEC 17025. The test reports shall not be more than five years old.
f) Copy of accreditation certificate for the testing laboratory.

7.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

a) Guaranteed Technical Particulars,
b) Design Drawings with details of conductors to be manufactured for KPLC,
c) Quality assurance plan (QAP) that will be used to ensure that the design, material, workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008
d) Detailed test program to be used during factory testing,

e) Marking details and method to be used in marking the conductor drums
f) Manufacturer's undertaking to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the conductors for The Kenya Power & Lighting Company
g) Packaging details (including packaging materials and their dimensions).

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ANNEX A: **Guaranteed Technical Particulars** *(to be filled and signed by the Manufacturer for all clauses and submitted together with catalogues, brochures, drawings, technical data and test reports for tender evaluation)*

Name of Bidder.....

Clause	Guaranteed Technical Particulars for Conductor		Bidders Offer
1	Name and address of the Manufacturer		
	Country of manufacture		
	Manufacturer's Letter of Authorization		
	Model/Type Reference No. of the offered transformer		
	Drawing Reference Number		
	Manufacturer's warranty and guarantee certificate for the offered conductor		
2	Type and Size		
3.	Reference Standard of manufacture		
4.1	Service Conditions		
4.2	Materials	Copper (condition/grade)	
		PVC Insulation (type and thickness)	
		PVC Sheath (type and thickness)	
4.3.1	Construction & Standard		
4.3.2	Direction of lay		
4.3.3	Inner Insulation and standard of manufacture		
	Oversheath and standard of manufacture		
	Thickness of insulation		
4.4	**Size and ratings**		
	Nominal area of copper, mm²		
	Overall diameter of bare conductor, mm		
	Overall diameter of covered conductor, mm		
	Stranding, No./mm	Copper	
		Tolerance on diameter	
	Maximum d.c. resistance at 20°C, ohm/km		

	Minimum breaking load, kN	
	Approximate mass of conductor, kg/km	
	Current carrying capacity, A (state applicable conditions)	
5.1	Test standard(s) for bare and covered conductors	
5.2	List test reports submitted (indicate test report numbers, date, Testing Institution and their contact addresses)	
5.4	Test reports to be submitted to KPLC before delivery	
5.5	Replacement of non-compliant conductor	
6.1	Mode of Packing, & Length on drum	
6.3	Mode of Sealing of both end of conductor	
6.4	Permanent Marking on the drum	
7.1	Documents submitted with tender	
7.2	Documents to be submitted to KPLC for approval before manufacture	
Other details required with the tender	Manufacturer's Guarantee and Warranty	
	List catalogues, brochures, technical data, drawings and customer sales records submitted to support the offer	
	List Acceptance Tests to be witnessed by KPLC Engineers at the factory	
	Statement of compliance to specification	

NB: - *This schedule does not in any way substitute for detailed information required elsewhere in the specification.*

.....

Manufacturer's Name, Signature, Stamp and Date

v. Specification for Low Voltage Fuse Cut-Out – KP1/6C.1/13/TSP/11/023

Kenya Power	TITLE: LOW VOLTAGE FUSE CUT-OUT – SPECIFICATION	Doc. No.	KP1/6C.1/13/TSP/11/023
		Issue No.	2
		Revision No.	1
		Date of Issue	2016-08-30
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0.1 Circulation List

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0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 2 Revision 1	*2016-08-25*	*Forward:* Amend "manufacturer "to "supplier"	S. Nguli	P. Kimemia
		2. Include ISO/IEC17025 in references		
		3. Clause 5.2: A copy of accreditation certificate for the laboratory shall also be submitted. Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Authority.		
		Change of title to: Low Voltage Fuse Cut-Out – Specification		

FOREWORD

This specification has been prepared by the Research and Development Department of The Kenya Power and Lighting Company Limited (Kenya Power) and it lays down requirements for Low Voltage (LV) Fuse Cut-out. It is intended for use by Kenya Power in purchasing the items.

It shall be the responsibility of the manufacturer to ensure adequacy of the design and good engineering practice in the manufacture of the LV Fuse Cut-outs for Kenya Power. The supplier shall submit information which demonstrates satisfactory service experience of the manufacturer with products which fall within the scope of this specification.

1. SCOPE

1.1 This specification is for low voltage fuse cutouts intended for use at distribution transformer take – off and consumer input terminals.

1.2 The specification covers the following:

(i) House Service Cut-out
(ii) Underground Service Cut-out
(iii) Overhead Service Cut-out (Transformer Fuse Cut-out)

Particular requirements for each fuse cut-out type are given in Clause 4.3

2. REFERENCES

The following standards contain provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

IEC 60269: Low – voltage fuses.

BS 88: Cartridge fuses for voltages up to and including 1000V a.c. and 1500V d.c.

BS 1361: Cartridge fuses for a.c. circuits in domestic and similar premises.

BS 2874: Specification for copper and copper alloy rods and sections(other than forging stock

BS 7657: Specification for cut-out assemblies up to 100A rating, for power supply to buildings

ISO 179-1: Plastics-Determination of Charpy impact properties- Part 1: Non instrumented impact test

ISO 178: Plastics-Determination of flexural properties

ISO 527-2: Plastics-Determination of tensile properties-Part 2: Test conditions for moulding and extrusion plastics

ISO 604: Plastics-Determination of compressive properties

ISO 62: Plastics- Determination of water absorption

ISO 1183-1: Plastics-Methods for determining the density of non-cellular plastics-Part 1: Immersion method, liquid pyknometer method and titration method

ISO 2577: Plastics-thermosetting moulding materials- Determination of shrinkage

ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor

ASTM D1895: Standard Test Method for indentation Hardness of Rigid Plastics by Means of a Barcol Impressor

ISO 243: Turning tools with carbide tips-External tools

ASTM D495: Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation

ISO 75: Determination of temperature of deflection under load

UL 94: The Standard for Safety of Flammability of Plastic Materials for parts in Devices and Appliances testing

ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories

3. TERMS AND DEFINITIONS

For the purposes of this specification the definitions given in the reference standards and the following definition shall apply:

- **Fuse Cut-out** – The combination of the fuse base with its fuse carrier (referred to as fuse-holder in BS 88-1).

4. REQUIREMENTS

4.1 SERVICE CONDITIONS – *applicable to all categories of fuse cut-outs*

The LV Fuse Cut-out shall be insulated type suitable for continuous use indoors and outdoors in tropical areas in humidity of up to 90%, average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C and saline conditions along the coast.

Particular requirements for each fuse cut-out type are given in Clause 4.4.

4.2 MATERIALS AND CONSTRUCTION – *applicable to all fuse cut-outs*

4.2.1. Each fuse cutout shall be supplied as a complete unit incorporating the fuse base and its fuse carrier. It shall be supplied complete with mounting screw.

4.2.2. The fuse base shall be molded in light grey glass reinforced polyester thermoset material. The material shall be DMC type (Dough Molding Compound).

4.2.3. The fuse carrier shall be manufactured from the same materials and color as the fuse base.

4.2.4. The fuse base and the fuse carrier shall interlock fully when fitted to provide weatherproof housing and all live parts fully shielded.

4.2.5. The DMC insulation materials used shall be of characteristics given Table 1 of this specification:

Table 1: Required characteristics of insulating materials (DMC)

	Description	Test Method	Requirements
1	Impact strength	ISO 179	40-50 kJ/m^2
2	Flexural strength	ISO 178	131-152 Mpa
3	Flexural modulus	ISO 178	14 GPa
4	Tensile strength	ISO 527	48 – 62 MPa
5	Compressive strength	ISO 604	159 MPa
6	Water strength	ISO 62	0.15 %
7	Specific gravity	ISO 1183	1.78
8	Shrinkage	ISO 2577	0.10 – 0.30 %
9	Hardness	ASTM D2583	30 – 50 Barcol
10	Bulk factor	ASTM D1895	2
11	Dielectric strength	ISO 243	11 kV/mm
12	Arc resistance	ASTM D495	180+ seconds
13	Heat deflection temperature @264PSI	ISO 75	>260˚C
14	Flame resistance at 1.5mm	UL 94	V-0

4.2.6. The brass used in the manufacture of the brass terminal blocks shall comply with BS 2874 designated CZ12139Pb3 and shall have the following composition:

Table 2: Required composition of brass used in brass terminal blocks

	Metal	**Composition** (content in the brass terminal)
1	Copper	56.5 – 58.5%
2	Lead	2.5 – 3.5%
3	Iron	0.3%
4	Zinc	Balance

4.2.7. The brass used in the manufacture of the brass terminal blocks shall be of the following minimum physical and mechanical properties:

Table 3: Required properties of brass used in brass terminal blocks

	Property	Required Value
1	Density	8.47kg/m^3
2	Melting point	875 ^{0}C
3	Thermal expansion	20.9x10^{-6}/K
4	Modulus of elasticity	97 Gpa

	Property	Required Value
5	Thermal conductivity	123 W/m.K
6	Electrical resistivity	0.062×10^{-6} Ω.m
7	Proof stress	150 – 420 MPa
8	Tensile strength	360 – 580 MPa
9	Elongation	25 – 5%
10	Hardness Vickers	100 to 160 HV

4.2.1. Detailed data sheets and test reports illustrating the composition and the physical, mechanical and electrical properties of the brass used in the terminal blocks shall be submitted with the tender for evaluation and with the cut-outs during delivery to Kenya Power stores.

4.3 PARTICULAR REQUIREMENTS

4.3.1 House Service Cut-out

In addition to the requirements given in clauses 1, 2, 3, 4.1 and 4.2, the House Service Cut-out shall comply with the following:

4.3.1.1 The House Service cut-out shall be of the following types:

(a) Single pole insulated House Service cut-out without neutral link or earthing block (designated SP)

(b) Single pole insulated House Service cut-out with combined neutral & earthing block (designated SPNE or CNE)

Note: ***The SP cutout shall be suitable for use in conjunction with SPNE cutout to make TP+NE sets.***

4.3.1.2 The fuse base shall be complete fitted with solid brass terminal blocks with serrated bores and two pinching brass screws per conductor to suit stranded aluminum and copper phase and neutral conductors of up to 35mm² nominal cross-sectional area. The brass screws shall be size M8.

4.3.1.3 The brass used in the manufacture of the brass terminal blocks shall comply with BS 2874 designated CZ12139Pb3 and shall have the composition and characteristics given in clause 4.2.6 and 4.2.7 of this specification.

4.3.1.4 The fuse base shall incorporate looping facility (on both incoming and outgoing circuits) to connect banks of cutouts. Separate brass serrated bores each with two pinching brass screws shall be provided per phase and neutral incoming, outgoing and looping connections.

4.3.1.5 The incoming phase terminal on the fuse base shall be protected with a hinged nylon shield, red in colour.

4.3.1.6 The fuse carrier shall be suitable for barrel fuse link Type IIa as specified in BS 1361. It shall incorporate copper (tin plated) fuse clips and phosphor bronze insert/spring suitable for intended application, to BS 1361 and in accordance with the general arrangement diagrams in Fig 1 and Fig 2.

4.3.1.7 The phase terminal blocks shall be of the dimensions given in Fig 2. The combined neutral/earth block shall have a minimum length of 42mm, minimum width of 30mm and minimum depth of 15mm.

4.3.1.8 Each fuse clip shall be at least 1.2mm thick and 16mm wide as per BS 1361 (drawing as per BS 1361 is attached in Annex B for reference)

4.3.1.9 Each fuse clip and its insert shall be fixed in position by a suitable screw arrangement.

4.3.1.10 Provision shall be given (on the fuse cutout) for sealing the fuse carrier to the fuse base when fitted.

4.3.1.11 Each fuse base shall be complete with cable entry plugs on all terminals to prevent unauthorised access.

4.3.2 Underground Cable Service Cut-out

In addition to the requirements given in clauses 1, 2, 3, 4.1 and 4.2, the Underground cable Service Cut-out shall comply with the following:

4.3.2.1 The fuse base (for phase and neutral) shall be complete with tunnel connector terminal blocks suitable for stranded aluminum conductors of up to 185mm² nominal area. The terminal blocks shall be in solid brass of electro-tinned finish and have four M8 screws for clamping the conductor.

4.3.2.2 The fuse base shall be suitable for wedge type fuses of 82mm fixing centres as per BS88.

4.3.2.3 The fuse base shall incorporate PVC grommets for cable entry and exit.

4.3.2.4 The fuse carrier shall be fitted with wedge type thumb screw operated contacts for HRC fuse links at 82mm centres and to BS 88.

4.3.2.5 The fuse base and carrier for neutral phase shall be of similar material to the fuse base and carrier of the other phases.

4.3.2.6 The fuse carrier for the neutral phase shall be fitted with distinctive cover embossed 'NEUTRAL' and fitted with solid link, 82mm centres. The cover shall be secured by thumb operated knobs.

4.3.2.7 The solid link shall be fixed by M12 bolts at 82mm centers and have current rating as per clause 4.4.

4.3.3 Overhead Service Cutout

In addition to the requirements given in clauses 1, 2, 3, 4.1 and 4.2, the Overhead Service Cut-out shall comply with the following:

4.3.3.1 The overhead service cutout shall be suitable for terminating aluminum and copper cables.

4.3.3.2 The fuse base shall be suitable for mounting on a wooden or fiberglass reinforced plastic cross arm, outdoors, and shall be fitted with conductor terminals to suit stranded aluminum conductors of up to 300 sq. mm nominal area.

4.3.3.3 The fuse base shall be suitable for wedge type fuses of 82mm fixing centers as per BS88.

4.3.2.4 The fuse carrier shall be fitted with wedge type thumbscrew operated contacts for 82mm centre HRC fuse link to BS 88.

4.4. RATING

The rating of the fuse cut-out assembly shall be as follows:-

4.4.1 House service cutout

Rated Voltage	415 Volts
Rated Current	60/80 A
Rated Frequency	50Hz

4.4.2 Overhead and Underground Service Cut-Outs

Rated Voltage		415 Volts
Rated Current	Overhead Service Cut-out	400 A
	Underground Service Cut-out	300 A
Rated Frequency		50Hz

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ANNEXES

5. TESTS AND INSPECTION

5.1. The fuse cutouts shall be inspected and tested in accordance with the requirements of BS 88 Part 1and Part 5, BS 1361, other standards given in this specification and the requirements of this specification. It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified and those normally performed at works.

5.2. Copies of previous Test Reports from an ISO/IEC 17025 accredited Laboratory shall be submitted with the tender for the purpose of technical evaluation, all in the English Language. The test reports shall include dimensions, insulating properties, temperature rise and power acceptance, breaking capacity, degree of protection, resistance to heat, non-deterioration of contacts, mechanical strength, freedom from season cracking, resistance to abnormal heat and fire and resistance to rusting tests as per BS 88-1 A copy of accreditation certificate for the laboratory shall also be submitted. Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Authority

5.3. Routine and sample test reports for the fuse cutouts to be supplied shall be submitted (by the supplier) to Kenya Power for approval before shipment/delivery of the goods. Kenya Power Engineers will witness acceptance tests at the factory before shipment.

Acceptance tests shall include the following tests as per BS 88 Part 1and Part 5, BS 1361 and applicable latest IEC, ISO and ASTM standards:

5.3.1 Verification of dimensions;
5.3.2 Verification of insulating properties
5.3.3 Temperature rise
5.3.4 Degree of protection
5.3.5 Resistance to heat
5.3.6 Non-deterioration of contacts
5.3.7 Mechanical strength
5.3.8 Resistance to abnormal heat and fire
5.3.9 Resistance to rusting tests.
5.3.10 Verification of the material properties given in this specification

6. MARKING, PACKING AND INSTRUCTIONS

6.1 The following information shall be marked indelibly, legibly and permanently on the fuse cut-out:

i) Manufacturers name or trademark
ii) Type designation and type reference of suitable fuse links
iii) Rated current and rated frequency
iv) Rated voltage
v) Standard to which the fuse cut-out complies
vi) The letters 'PROPERTY OF KPLC"

Both the fuse base and fuse carrier of each cut-out shall be marked with the letters 'PROPERTY OF KPLC' for the purpose of identification.

6.2 The fuse cut-outs shall be packed in such a manner as to protect them from damage during transportation and storage.

The fuse cut-outs shall be packed in wooden crates which are reinforced and held closed by external steel wire bindings. Each crate shall be internally braced to permit stacking and the steel wire bindings shall be designed to keep the crate firmly closed and permit easy and rapid opening at time of issue.

The crates shall then be stacked on sturdy wood pallet. The assembly shall be held tightly in place with steel bands and protected against moisture by a complete covering of heat-shrinkable polyethylene film.

6.3 Instructions for storage, handling and installation shall be provided, all in the English Language. Cut-outs requiring special tools (other than screwdriver) for installation shall be supplied complete with the relevant tools.

7.0 Guaranteed Technical Particulars

(to be filled and signed by the Manufacturer and submitted together with copies of relevant manufacturer's catalogues, brochures, drawings, technical data, sales records and copies of type test certificates and type test reports for tender evaluation)

Clause	Description	KPLC requirement	Bidder's offer
1	Manufacturer's name & address	state	
2	Type Reference Number of insulator offered	state	
3	Service Conditions	state	

4.0	Applicable Standards	Specify as per reference list	
4.2	**MATERIALS AND CONSTRUCTION**		
4.2.1	Complete units	Describe carrier and base	
4.2.2	Material of Mold used	DMC	Specify
4.2.3	Color of base and carrier	Grey	Specify
4.2.4	Interlocking of base and carrier	Specify	Specify
4.2.5	Characteristics of insulating material	As per reference table	Give exact details as per test report
4.2.6	Brass material	As per reference table	Give exact details as per test reports
4.2.7	Physical and mechanical properties of brass	As per reference table	Give exact details as per test reports
4.3.1	**Service cut out**		
4.3.1.1	Designation of cut out	To state as per tender	Specify
4.3.1.2	Complete units , serrated bores, pinching screws and size of cable	As specified	State offered values
4.3.1.3	Brass material	As per reference table	State values as per test reports
4.3.1.4	Looping facility	Provide	State offer
4.3.1.5	Protection of phase terminal	Provide	State offer
4.3.1.6	Type of fuse carrier	Specify	State offer
4.3.1.7	Dimensions of neutral block	As per specification	State offer
4.3.1.8	Dimensions of fuse clip and material of manufacture	As per specification	State offer
4.3.1.9	Means of fixing clips	Provide as per specification	State offer
4.3.1.10	Sealing of cut outs	Provide as per specification	State offer
4.3.2	**Underground Cut Outs**		
4.3.2.1	Complete units	As per specification	State offer
4.3.2.2	Type of fuses and fixing centers	As per specification	State offer
4.3.2.3	Protection of cable entry	Provide as per specification	State offer
4.3.2.4	Fixing of fuse carrier	On either wooden or metallic fuse bars	State offer
4.3.2.5	Material of base and fuse carrier	DMC	State offer

4.3.2.6	Marking of Neutral block	Provide as per specification	State offer
4.3.2.7	Fixing of solid link	Provide as per specification	State offer
4.3.3	**Overhead service cut out**		
4.3.3.1	Applicable cables for use with service cut out	Upto 300MM² cable(Cu/Al)	State offer
4.3.3.2	Mounting positions	Provide as per specification	State offer
4.3.3.3	Applicable Fixing centers	Provide as per specification	State offer
4.3.3.4	Type of fuse	Provide as per specification	State offer
4.4.1	Ratings of house service cut outs	Provide as per specification	State offer
4.4.2	Ratings of overhead and underground service cut outs	Provide as per specification	State offer
5.1	List of copies of Design and Type Test Reports submitted (indicate Test Report Numbers, Testing Authority and contact addresses)	List	List all Test reports
5.2	List Acceptance Tests to be witnessed by KPLC Engineers at the factory	list	List Acceptance Tests to be performed
5.3	List of catalogues, brochures, technical data, drawings and customer sales records submitted to support the offer.	LIST	
6.1	Marking	indicate parameters and method of marking to be used during manufacture	State offer
7.0	Copy of ISO 9001:2008 Certificate submitted (indicate validity)	Attach a copy	
8.0	Quality Assurance Plan	Attach a copy	
9.0	Deviations from tender specifications and supporting data, test reports, technical documents etc.	State ,if any	

Drawings

Fig 1: General Arrangement for Fuse Clips & Terminal Block.

Note: Alternative arrangements for the fuse clip insert will be accepted if supported by copies of test reports from ISO/IEC 17025 accredited laboratory indicating compliance to temperature rise, non-deterioration of contacts, resistance to heat, mechanical strength and other relevant tests as per IEC 60269-1, BS 88-1 and BS 1361

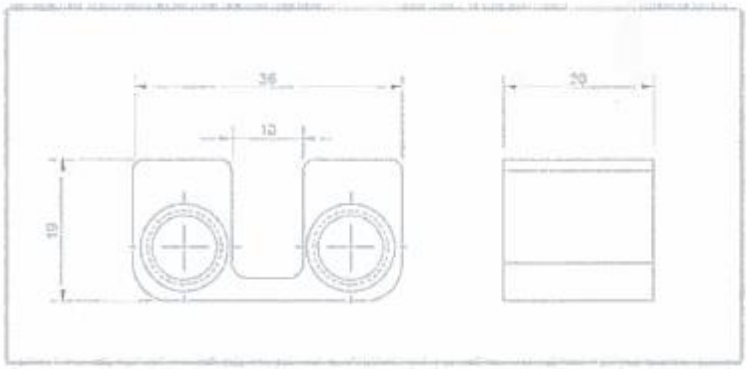

Fig. 2: Dimensions of phase terminal blocks for house service cut-out
(bores shall be suitable for aluminum and copper phase and neutral conductors of up to 35mm² nominal cross-sectional area. The brass screws (not shown) shall be size M8

vi. Specification for Low Voltage Cartridge Fuses (Fuse Links) – KP1/6C.1/13/TSP/11/022

Kenya Power	TITLE: LOW VOLTAGE CARTRIDGE FUSES (FUSE LINKS) – SPECIFICATION	Doc. No.	KP1/6C.1/13/TSP/11/022
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Issue 2 Rev 1	2016-08-22	Cancels and replaces 2nd issue Rev 2 dated July 2004	S. Nguli	Dr. Eng. Kimemia
		1. Tests Clause 5; Rewritten as the current standardized format of ''Tests and Factory Inspection'' 2. Notices Clause 6; Rewritten as the current standardized format of ''Packing and Marking'' 3. Miscellaneous corrections done 4. Changed title		

Issued by: Head of section, standards Development	Authorized by Manager, Standards
Signed:	Signed:
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FOREWORD

This specification has been prepared by the Standards Department of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for Low Voltage Cartridge Fuses (Fuse Links). It is intended for use by KPLC in purchasing of the fuse links.

This specification supersedes all specifications for Low Voltage Cartridge Fuses issued before the revision date. It was prepared to establish and promote uniform requirements for Low Voltage Fuse Links and stipulates the minimum requirements for equipment acceptable for evaluation.

1. SCOPE

1.1. This specification is for Low Voltage cartridge fuses for use in voltages up to and including 1000V a.c. electricity supply network.

1.2. This specification is for the following cartridge fuse links:

(i) Fuse links for use in consumer input terminals in domestic and similar premises.

(ii) Fuse links for use in transformer take – off (Pole mounted cut-out and distribution fuse panel/feeder pillar protection)

Particular requirement for each fuse link is given in section 4.3

1.3. The specification also covers inspection and test of the fuse links as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted for tender evaluation.

1.4. The specification stipulates the minimum requirements for Low Voltage Fuse Links acceptable for use in the company and it shall be the responsibility of the supplier to ensure adequacy of the design, good engineering practice, adherence to the specification, applicable standards and applicable regulations as well as ensuring good workmanship in the manufacture of the Low Voltage Fuse Links for The Kenya Power & Lighting Company.

The specification does not purport to include all the necessary provisions of a contract.

2. REFERENCES

The following standards contain provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

IEC 60269-1, 2 and 3:	Low – voltage fuses
BS 88: Part 1 and 5:	Cartridge fuses for voltages upto and including 1000V ac. and 1500V d.c
BS 1361:	Cartridge fuses for ac. circuits in domestic and similar premises.
IEC 60529:	Degrees of Protection Provided by Enclosures (IP Code)

3. TERMS AND DEFINITIONS

For the purpose of this specification, the definitions given in the reference standard shall apply.

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

4.1.1. The fuse link shall be suitable for continuous operation both indoors and outdoors in tropical areas at altitudes of up to 2200m above sea level, humidity's of up to 95%, average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C and heavy saline conditions along the coast.

4.1.2. The fuse link shall be suitable for an a.c. system with a maximum system voltage of 420 Volts and frequency of 50 Hz.

4.2. DESIGN & CONSTRUCTION

4.2.1. General Requirements

4.2.1.1. The fuse shall be High Rupturing Capacity (HRC) type and constructed as per the requirement of IEC 60269: Part 1 & 2, BS 1361 and BS 88.

4.2.1.2. The fuse shall be suitable for use in distribution pillars, open type substations boards, heavy duty service cut-outs, underground connecting boxes, and house service cut-outs.

4.2.1.3. The fuse links shall be of class 'gG', general purpose fuses as per IEC 60269: Part 1 requirement.

4.2.2. **Mechanical design**

4.2.2.1. **Replacement of fuse-links**

4.2.2.1.1. A fuse-link shall have adequate mechanical strength and its contacts shall be securely fixed. It shall be possible to replace the fuse-links easily and safely.

4.2.3. **Connections, including terminals**

4.2.3.1. The fixed connections shall be such that the necessary contact force is maintained under the conditions of service and operation. No contact force on connections shall be transmitted through insulating material other than ceramic or other material with characteristics not less suitable, unless there is sufficient resilience in the metallic parts to compensate for any possible shrinkage or other deformation of the insulating material.

4.2.3.2. Terminals shall be so arranged that they are readily accessible (after removal of covers, if any) under the intended conditions of installation.

4.2.4. **Fuse-contacts**

4.2.4.1. Fuse-contacts shall be such that the necessary contact force is maintained under the conditions of service and operation, in particular under the conditions corresponding to clause 4.2.9.

4.2.4.2. Contact shall be such that the electromagnetic forces occurring during operation under conditions in accordance with clause 4.2.9 shall not impair the electrical connections between:

i). The fuse-carrier and the fuse-link;
ii). The fuse-link and the fuse-base, or, if applicable, any other support.

4.2.4.3. In addition, fuse contacts shall be so constructed and of such material that, when the fuse is properly installed and service conditions are normal, adequate contact is maintained:

i). After repeated engagement and disengagement;
ii). After being left undisturbed in service for a long period

4.2.4.4. Fuse-contacts of copper alloy shall be free from season cracking.

4.2.5. Mechanical strength of the fuse-link

4.2.5.1. A fuse-link shall have adequate mechanical strength and its contacts shall be securely fixed.

4.2.6. Insulating properties and suitability for isolation

4.2.6.1. The fuses shall be such that they do not lose their insulating properties at the voltages to which they are subjected in normal service.

4.2.6.2. When the equipment is in its normal open position, the fuse-link remaining inside the fuse-carrier, or when the fuse-link, and, where applicable, the fuse-carrier is removed, the fuse shall be suitable for isolation.

4.2.6.3. The minimum creepage distances, clearances and distances through insulating material or sealing compound shall comply with the values of clause 8.2 of IEC 60269-1 requirements.

4.2.7. Temperature rise, power dissipation of the fuse-link and acceptance

4.2.7.1. The fuse-link shall be so designed and proportioned as to carry continuously, under standard conditions of service, its rated current without exceeding the rated power dissipation of the fuse-link as indicated by the manufacturer or otherwise specified in the subsequent parts.

4.2.7.2. In particular, the temperature-rise limits specified in IEC 60269-1 Table 5 shall not be exceeded:

i). When the rated current of the fuse-link is equal to the rated current of the fuse-holder intended to accommodate this fuse-link;

ii). When the power dissipation of the fuse-link is equal to the rated acceptable power dissipation of the fuse-holder.

4.2.7.3. The use of nickel-plated contacts requires, due to its relatively high electrical resistance, certain precautions in the design of the contact, among others the use of a relatively high contact pressure.

4.2.8. **Operation**

4.2.8.1. The fuse-link shall be so designed and proportioned that, when tested as per IEC 60269-1 at rated frequency and an ambient air temperature of (20 ± 5) °C,

i). It is able to carry continuously any current not exceeding its rated current;

ii). It is able to withstand overload conditions as they may occur in normal service;

iii). It's fuse-element does not melt, when it carries any current not exceeding the conventional non-fusing current (I_{nf});

iv). It operates when it carries any current equal to or exceeding the conventional fusing current (I_f).

4.2.9. **Breaking capacity**

4.2.9.1. The fuse shall be capable of breaking, at rated frequency, and at a voltage not exceeding the recovery voltage specified in clause 8.5 of IEC 60269-1, any circuit having a prospective current between,

i). the current If; and
ii). the rated breaking capacity at power factors not lower than those shown in Table 20 of IEC 60269, appropriate to the value of the prospective current;

NOTE:

Where fuse-links are used in circuits with system voltages belonging to a range lower than that corresponding to the rated voltage of the fuse-links, consideration should be given to the arc voltage, which should not exceed the value in Table 6 of IEC 60269-1, corresponding to the system voltage.

4.2.10. **Cut-off current characteristic**

4.2.10.1. The values of cut-off current measured as specified in clause 8.6 of IEC 60269-1, shall be less than, or equal to, the values corresponding to the cut-off current characteristics assigned by the manufacturer

4.2.11. **I^2t characteristics**

4.2.11.1. The pre-arcing I^2t values shall not be less than the characteristics stated by the manufacturer shall lie within the limits given in Tables 1 & 2 as per IEC 60269-1 requirements for "gG" fuse-links.

4.2.11.2. The operating I^2t values shall be less than, or equal to, the characteristics stated by the manufacturer as per Annex C of IEC 60269-1.

4.2.12. **Overcurrent discrimination of fuse-links**

Requirements concerning overcurrent discrimination are dependent upon the fuse system, the rated voltage and the application of the fuse;

4.3. PARTICULAR REQUIREMENTS

4.3.1. Cylindrical House Service Cut-Out Fuse Links

4.3.1.1. The fuse shall be cylindrical type with steatite ceramics body to withstand higher insulating currents, nickel-plated brass end caps and tin-plated copper leads to offer low resistance, for insertion in a fuse carrier.

4.3.1.2. Each end cap shall have a cylindrical contact surface which shall be co-axial with the body of the fuse. End caps shall be suitably protected against corrosion, by silver plating.

4.3.1.3. The maximum diameter (d) of the cartridge between the end caps shall be less than the diameter (D) of the end caps at all times as shown in Fig. 1.

4.3.1.4. The fusing factor shall not exceed 1.5 and shall be determined in accordance with the requirements of IEC 60269: Parts 1 & 2 and BS 1361.

4.3.1.5. The rated minimum fusing current shall be that current corresponding to a time 4h on the time/current characteristics.

4.3.1.6. The fuse link shall be capable of opening any circuit in which the maximum voltage does not exceed 1.1 times the rated voltage.

4.3.1.7. The degree of protection shall be at least IP2X when the fuse is under normal service conditions as per IEC 60529.

4.3.2. Type 'J' Slotted Cylindrical Fuse Links for Utility Applications

4.3.2.1. The 'J' Type Slotted Fuse Links shall comply with the requirements of BS 88: Part 1 & 5 and shall have been ASTA Certified for category of duty 415V ac, i.e. 46,000A r.m.s symmetrical at 415V.

4.3.2.2. They shall be designed for use with wedge type fuse carriers in distribution pillars, open type substation boards, heavy duty service cutouts and underground connecting boxes.

4.3.2.3. The fuse link shall be designed with steatite ceramics body, nickel-plated brass end caps and tin-plated copper leads end caps for use in pole or wall mounted outdoor service fuse units

4.3.2.4. They shall have a fusing factor not exceeding 1.5 times the rated current with category of duty 415AC46 Class Q1 as specified in BS 88: Part 5.

4.3.2.5. The fuse link shall have fixing centers at 82mm and other dimensions as specified in Fig. 2 for fuse-links with 'U' type tags on respective current ratings.

4.3.2.6. The rated minimum fusing current shall be that current corresponding to a time 4h on the time/current characteristics.

4.3.2.7. The degree of protection shall be at least IP2X when the fuse is under normal service conditions.

4.4. RATINGS/ DIMENSIONS

4.4.1 Fuses for domestic and similar premises

4.4.1.1. The ratings and the dimensions of the cylindrical house service cut-out fuses are as shown below as per the requirements of IEC 60269: Parts 1 & 3 and BS 1361.

Table 1: Cylindrical House Service Cut-Out Fuse Links – Rating as per IEC 60269 - 1

Amp. Rating (A)	I^2t (Amp^{2}Seconds)						Nominal Watts Loss (W)	Rated Breaking Capacity (kA), min.	Unit Packing
	Pre-arcing (A)				Total at 240V	Total at 415V			
	I (min) (10s)	I (max) (5s)	I (min) (0.1s)	I (max) (0.1s)					
32	75	150	200	350	2700	5700	3.0	20	10
63	160	320	450	820	25000	52000	5.0		
80	215	425	610	1100	41500	58500	5.4	31.5	
100	290	580	820	1450	73500	10500	6.1		

Tab. 2: Cylindrical House Service Cut-Out Fuse Links – Dimensions as per IEC 60269-2

Size	Amp. Rating (A)	Length (L) (mm)	Length (l) (mm)	Diameter (D) of end caps (mm)
I_c	32	29 ± 0.4	8.0 ± 0.5	12.7 ± 0.1
II_a	63	57 ± 1.0	9.5 ± 0.5	16.6 ± 0.1
II_a	80	57 ± 1.0	16 ± 0.5	22.23 ± 0.1
II_b	100	57 ± 1.0	16 ± 0.5	30.16 ± 0.1

4.4.2 Fuses for transformer take – off as per BS 88: Part 1 & 5

Table 2: Type 'J' Slotted Cylindrical Fuse Links for Utility Applications – Rating

Amp. Rating (A)	I^2t (Amp^{2}Seconds)				Nominal Watts Loss	Rated Breaking Capacity (kA), min.	Unit Packing
	Pre-arcing (A)						
	I (min) (10s)	I (max) (5s)	I (min) (0.1s)	I (max) (0.1s)			
100	290	580	820	1450	10	46	10
125	355	715	1100	1910	12		
160	460	950	1450	2590	14		
200	610	1250	1910	3420	18		
315	1050	2200	3420	6000	29		
400	1420	2840	4500	8060	33		

Table 3: Type 'J' Slotted Cylindrical Fuse Links for Utility Applications- Dimensions

Type	A	B	C	D	E	F	G	H	I	J	K
MJ30-8	110	82	45.2	40.5	30	14.8	17.5	9.8	30.9	2.4	6.45/6.53
MJ30-7 (Up to 200A)	110	82	45.2	40.5	30	14.8	17.5	9.8	30.9	2.4	6.45/6.53
MJ30-7 (315-400A)	110	82	44.8	40	30	14.4	17.5	9.8	38	2.4	6.45/6.53
PJ30-7	110	82	44.8	40	30	14.4	17.5	9.8	38	2.4	6.45/6.53

5. TESTS AND FACTORY INSPECTION

5.1 The fuse links shall be inspected and tested in accordance with the requirements of IEC 60269-1, 2 & 3, BS 88: Part 1& Part 5 and BS 1361. It shall be the responsibility of the supplier to perform or to have performed the tests specified and whatever other tests he normally performs at works.

5.2 Copies of previous Type Tests Reports issued by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. The accreditation certificate to ISO/IEC 17025 for the same third party testing laboratory used shall also be submitted with the tender (all in English Language)

5.2.1 Copies of type test reports to be submitted with the tender (by bidder) for evaluation shall be as stated.

5.2.1.1 Type Tests

a) High voltage or dielectric tests,
b) Temperature rise tests;
c) Breaking capacity tests;
d) Mechanical design strength tests;
e) I^2t characteristics and overcurrent discrimination tests;
f) Cut-off characteristics tests

5.2.2 Routine and sample test reports for the fuse links to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods. KPLC Engineers will witness tests at the factory before shipment.

5.2.3 Tests to be witnessed by KPLC Engineers at the factory before shipment shall be in accordance with IEC 60269-1, 2 & 3, BS 88: Part 1& Part 5 and BS 1361, this specification and shall include the following:

5.2.3.1 Routine Tests

a) Verification of dimensions, material and method of manufacture;
b) Temperature-rise limit, power dissipation and acceptance tests;
c) Non-deterioration of contacts tests;
d) Operation and time/current characteristics tests;
e) Verification of cut-off characteristics;
f) Insulating properties tests;
g) Breaking current capacity tests;
h) I^2t characteristics and overcurrent discrimination tests;
i) Verification of compliance for fuse link at 0.01 seconds;
j) Verification of fuse links of homogeneous series;
k) Verification of degree of protection.

5.2.4 On receipt of the cutouts, KPLC will inspect them and may perform or have performed the relevant tests in order to verify compliance with the specification. The supplier shall replace without charge to KPLC, fuse cutouts which upon examination, test or use fail to meet any or all of the requirements during the inspection.

5.2.5 The cost of inspection and witnessing of tests (except cost of air travel to the nearest International airport) shall be borne by the supplier.

6. PACKING AND MARKING

6.1 Packing

6.1.1 All fuse links shall be supplied separately package in a robust card board boxes.

6.1.2 These boxes shall allow for access (by the KPLC acceptance personnel) so that the fuses may be easily removed for inspection and then be easily repacked and sealed for holding in store.

6.2 Marking

6.2.1 The marking shall be durable and easily legible.

6.2.2 Fuse links shall be clearly marked with the following information:

a) The manufacturer's trade name,
b) The number and appropriate part number of the standard (e.g. BS 88: Part 1)

c) Type reference and designation,
d) Rated voltage and current,
e) Kind of current and rated frequency,
f) Rated power dissipation ,
g) Breaking range and utilization category,
h) Rated breaking capacity ,
i) Dimensions or size,
j) The permanent words "**KPLC.**"

6.2.3 Each packaged lot shall be marked with the following information:

a) The manufacturer's trade name;
b) The manufacturer's identification reference,
c) The number and appropriate part number of the standard (e.g. BS 88: Part 1)
d) The rated voltage,
e) The rated current and frequency,
f) The rated power dissipation,
g) The purchasers name. "**PROPERTY OF KENYA POWER & LIGHTING CO. LTD**"
h) The order number;
i) Any other contract particulars.

6.3.3. Instructions for storage, handling and installation shall be provided, all in English.

7. DOCUMENTATION

7.1 The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation.

7.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

a) Guaranteed Technical Particulars,
b) Design drawings and construction details of the fuse links,
c) Quality Assurance Plan (QAP) that will be used to ensure that the fuse link design, material, workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations.
d) Test Program to be used after manufacture,
e) Marking details and method to be used in marking the fuse links,

f) Manufacturer's undertaking to ensure adequacy of the design, good workmanship, good engineering practice and adherence to applicable standards in the manufacture of the fuse links for KPLC,
g) Packaging details.
h) Year of Manufacturer
i) KPLC PROPERTY

ANNEX

8.0 **Guaranteed Technical Particulars** (to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records, four customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test certificates and type test reports for tender evaluation, all in English Language)

Table 3: Guaranteed Technical Particulars.

1	2		3	4
Item	Description	Units	Schedule 1 (KPLC)	Schedule 2 (Tenderer)
1	**Manufacturer and manufacturer's identification reference,**		Specify	
1.1	**Country of manufacture**		Specify	
1.2	**Name and address of Bidder**		Specify	
2	**Reference standards**		Specify	
3	**Terms and definitions**		Specify	
4	**Requirements**			
4.1	Service conditions			
4.1.1	• Altitude		Specify	
	• Humidity		Specify	
	• Temperature range		Specify	
	• Salinity requirements		Specify	
4.1.2	Voltage and frequency rating		Specify	
4.2	**Design and Construction**			
4.2.1	**General requirements**			
4.2.1.1	Fuse category - HRC		Specify	
4.2.1.2	Applicability		Specify	
4.2.1.3	Class of the fuse – gG class		Specify	
4.2.2	**Mechanical design**			
4.2.2.1	Replacement of fuses		Specify	
4.2.3	**Connections including terminals**			
4.2.3.1	Mode of contacts		Specify	
4.2.3.2	Accessibility to contacts		Specify	
4.2.4	**Fuse-contacts**			
4.2.4.1	Degree of contact		Specify	
4.2.4.2	Electrical connections during contacts		Specify	
4.2.4.3	Materials of contacts		Specify	
4.2.5	**Mechanical strength of fuse links**			
4.2.5.1	Magnitude		Specify	
4.2.6	Insulating properties and isolation		Specify	

4.2.6.1	Insulating properties		Specify	
4.2.6.2	Ease of isolation		Specify	
4.2.6.3	Minimum creepage	mm	Specify	
4.2.7	**Temperature rise and power dissipation**			
4.2.7.1	Power dissipation	W	Specify	
4.2.7.2	Rated temperature rise values	^{0}C	Specify	
4.2.7.3	Contact material		Specify	
4.2.8	**Operation**			
4.2.8.1	Current ratings during operation			
	• Short circuit withstand current	kA	Specify	
	• Non-fusing current, I_{nf}	A	Specify	
	• Fusing current rating, I_f	A	Specify	
4.2.9	**Breaking capacity**			
	• Breaking voltage	V	Specify	
	• Breaking capacity at rated power factor, 0.1-0.2; 0.2-0.3; 0.3-0.5	kA	Specify	
4.2.10	**Cut-off characteristics**			
4.2.10.1	Values as per IEC 60269-1		Specify	
4.2.11	I^2t characteristics		Specify	
4.2.12	Overcurrent discrimination of the fuse link			
4.2.12.1	Requirements		Specify	
4.3	Particular requirements			
4.3.1	**Cylindrical house service fuse link**		Specify	
4.3.1.1	Materials used		Specify	
4.3.1.2	End cap design		Specify	
4.3.1.3	End cap and body diameters	mm	Specify	
4.3.1.4	Fusing factor		Specify	
4.3.1.5	Fusing current		Specify	
4.3.1.6	Voltage at operation	V	Specify	
4.3.1.7	Degree of protection		Specify	
4.3.2	**Type 'J' slotted cylindrical fuse link**			
4.3.1.1	Standards of manufacture		Specify	
4.3.1.2	Fuse type and application		Specify	
4.3.1.3	Material of end cap		Specify	
4.3.1.4	Fusing factor and category class		Specify	
4.3.1.5	End cap and body diameters	mm	Specify	
4.3.1.6	Voltage at operation	V	Specify	
4.3.1.7	Degree of protection		Specify	
4.4				
4.4.1.	Fuse link dimensions			
	L	mm	Specify	
	I	mm	Specify	
	D	mm	Specify	

4.4.2	Dimensions of the fuse link parts	mm	Specify	
	A	mm	Specify	
	B	mm	Specify	
	C	mm	Specify	
	D	mm	Specify	
	E	mm	Specify	
	F	mm	Specify	
	G	mm	Specify	
	H	mm	Specify	
	I	mm	Specify	
	J	mm	Specify	
	K	mm	Specify	
5	List of Tests to be witnessed by KPLC Engineers at the factory before shipment		As per clauses 5.2. 1. and 5.2.3.	
6	Packing and marking (parameters to be indicated and method of marking)		Specify	
7	Installation and technical manuals to be provided during delivery		Specify	
8	List of catalogues, brochures, drawings, technical data and customer sales records submitted to support the offer.		Specify	
9	Statement of compliance to tender specifications		Specify	
10	Deviations from tender specifications		Specify	
11	Inspection/Tests by KPLC during delivery before acceptance to stores/site.		Specify	

NB: - *This schedule does not in any way substitute for detailed information required elsewhere in the specification.*

9.0 Drawings

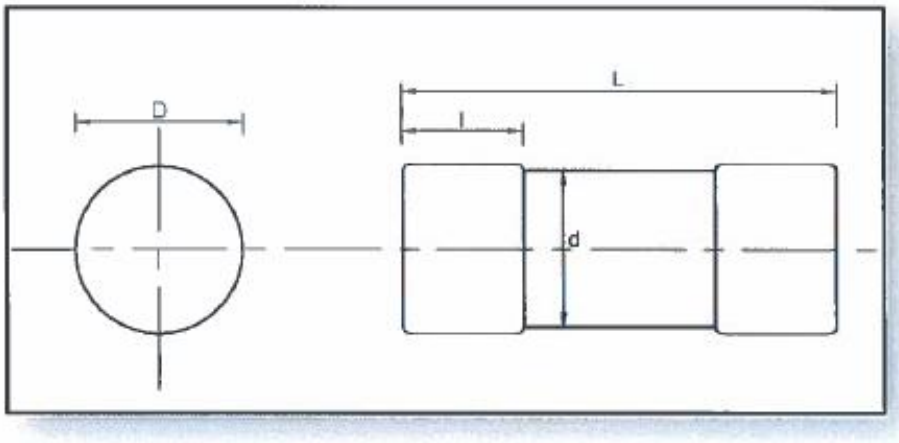

Fig. 1: Cut-out Household fuse

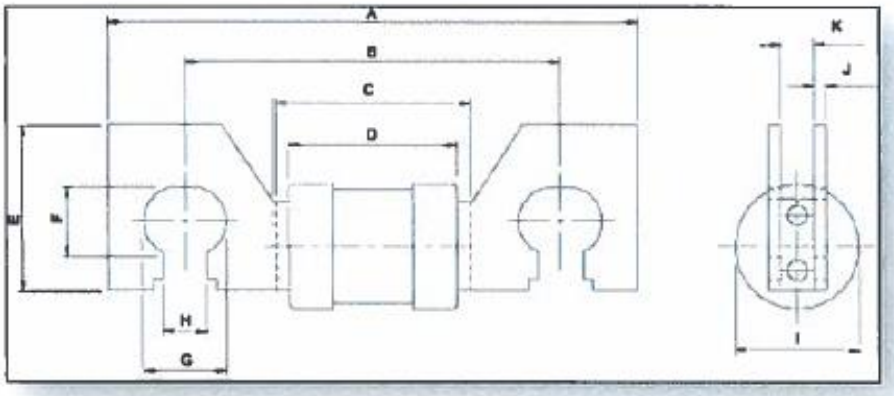

Fig. 2: Cartridge Fuse

vii. Specification for Concrete Products (Hatari Slabs & Stay Blocks) – KP1/6C/13/TSP/07/001

Kenya Power	TITLE: SPECIFICATION FOR CONCRETE PRODUCTS (Hatari Slabs & Stay Blocks)	Doc. No.	KP16C/13/TSP/07/001
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TABLE OF CONTENTS

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Signed:	Signed:
Date: 2016-05-31	Date: 2016-05-31

0.1 Circulation List

COPY NO.	COPY HOLDER
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0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name& Signature)
1	2015-08-12	To include drawings of the products	S Nguli	Dr. Eng. Kimemia

FOREWORD

This specification has been prepared by the Standards Department of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for Concrete Products (Hatari Slabs and Stay Blocks). It is intended for use by Kenya Power in purchasing the concrete products.

It shall be the responsibility of the supplier to ensure adequacy of the design and good engineering practice in the manufacture of the Hatari Slabs and Stay Blocks for KPLC. The supplier shall submit information which confirms satisfactory service experience with products which fall within the scope of this specification.

1. SCOPE

1.1 This specification is for Concrete Products Hatari Slabs (concrete cable covers) and Stay Blocks.

1.2 This specification covers the following sizes:

1.2.1 Hatari slab, LV

1.2.2 Hatari slab, HT

1.2.3 Stay block, 1/2" (12.5mm)

1.2.4 Stay block, 3/4" (19mm)

1.2.5 Stay block, 1" (25mm)

2. REFERENCES

The following documents were referred to during the preparation of this specification. In case of conflict, the requirements of this specification shall take precedence.

ESI 43 – 91	Stay Strands and Stay Fittings for Overhead Lines
BS 2484	British Standard Specification for Straight Concrete and Clayware Cable Covers.
BS 4483	Steel Fabric for the Reinforcement of Concrete
KS 02-95	Kenya Standard Specification for Natural Aggregates for Concrete
KS 1725	Kenya Standard Specification for Cement

Part1: Composition, Specifications and Conformity Criteria for Common Cement

ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories

3. TERMS AND DEFINITIONS

The definitions given in the reference standards shall apply.

4. REQUIREMENTS

4.1 OPERATING CONDITIONS

The concrete products shall be suitable for continuous outdoor operation in tropical areas with the following conditions.

a) Altitude: up to 2,200m above sea level;

b) Temperature: average of +30°C with a minimum of -1°C and max +40 °C;

c) Humidity: up to 95%;

d) Pollution: Design pollution level to be taken as "*Heavy*" (Pollution level III) for inland and "*Very Heavy*" (Pollution level IV) for coastal applications in accordance with IEC 60815.

e) Isokeraunic level: 180 thunderstorm days per year

4.1.1 The stay block shall be buried at depths of up to 2m in soils of various types to act as an anchor for stay wire on overhead lines.

4.1.2 The concrete stay blocks shall be used with stay rod sizes indicated in the table below:

Table 1: Correlating Stay blocks with stay rods

Stay block size	Stay rod	
	Size	Minimum failing load, kN
½''	6ft x ⅝" & 6ft x ½''	52 kN
¾''	8ft x 3/4"	71.3 kN
1"	9ft x 1"	145 kN

4.1.3 The Hatari Slabs (cable covers) shall be laid above power cables buried underground in soils of various types. High voltage cables are buried at depths of up to 1.6m while low voltage cables are buried at depths of 0.5m.

4.1.4 The cable covers designated LV shall be used to cover cables operating at 240/415V (low voltage) while those designated HT shall be used to cover cables operating at higher voltages up to 66kV

4.2. DESIGN AND CONSTRUCTION

4.2.1. General

4.2.1.1 The products shall be made using Portland Cement conforming to KS1725, course aggregates not exceeding 10mm nominal size and conforming to KS02-95, clean river sand and drinking quality water free from any visual contamination.

4.2.1.2 The products shall not contain additional admixtures and pigments. The composition of cement, sand and course aggregates shall be such as to satisfy the requirement for transverse strength and ultimate failing load

4.2.1.3 The concrete stay blocks shall be reinforced while the cable covers shall contain no steel reinforcement

4.2.1.4 Steel moulds shall be used in the manufacture of the products so as to ensure a smooth texture externally. The mould shall be accurately made to produce units of the dimensions, profiles and shapes shown in the drawings.

4.2.1.5 The product shall be vibrated while on moulds to ensure a dense mass free from honeycombs or segregation and fill the forms and spaces between reinforcement (for concrete stay blocks) compactly and without voids. The vibrator used shall have a frequency of not less than 5000 cycles/minute and shall not be attached to or allowed to touch reinforcement during compacting.

4.2.1.6 Lettering shown on the drawings (*for cable covers)* shall be formed using accurately placed formers securely fixed in position. Cutting either uncured or hardened concrete shall not be permitted

4.2.1.7 Freshly placed concrete shall be suitably protected and shall be kept constantly damp for a period of at least four days after concreting. The concrete shall be allowed to dry slowly over a period of at least three days after wet curing is completed and further days to bring the total to twenty one days.

4.2.1.8 Steel reinforcement rods shall be welded at all points of crossing and all dimensions shall be as per the drawings. Alternatively, a welded reinforcing fabric of No. 5 SWG x 75mm square with the wires symmetrically placed about the centre would be accepted.

4.2.1.9 The underside of the cable cover and stay block shall be flat while the upper sides shall be peaked as shown on drawings.

4.2.1.10 The concrete cable cover shall have one end concave, the other convex (as shown in drawings) to provide a concave/convex joint resisting lateral displacement.

4.2.2. Dimensions

4.2.2.1 The cable covers are required in two sizes with dimensions as shown in table 2 and drawing SK No. 08424/1 and 2. Tolerances on length (L), width (W) and thickness at outer edges (H) shall be ±3mm and ±2mm respectively.

4.2.2.2 When tested the Hatari Slabs (concrete cable covers) shall withstand, without breaking, the loads given in table 2 below.

Table 2: Cable Cover Sizes and Transverse Strength

Category	Dimensions (LxWxH) mm	Average Breaking Load (kg)
HT	610 x 230 x 50	750
LV	305 x 150 x 40	300

4.2.2.3 The concrete stay blocks are required in three sizes with dimensions (including hole size) as shown in table 3 and drawing number 3 & 4. Tolerances on length (L), width (W) and thickness at outer edges (H) shall be ±3mm and ±2mm respectively.

4.2.2.4 When tested in accordance with ESI 43 - 91 the concrete stay blocks shall withstand, for a period of 1 minute, the ultimate failing loads given in table 3 below.

Table 3: Concrete Stay Blocks- Sizes and Ultimate Failing Load

Category (size of center hole)	Dimensions(LxWxH) mm	Ultimate failing load (kN)
½'' (12.5mm)	500 x 380 x 50, Drg No. 3	65
3/4" (19mm)	500 x 380 x 50, Drg No. 3	65
1" (25mm)	660 x 480 x 60, Drg No. 4	72

5. TESTS AND INSPECTION

5.1 Type and sample tests for the concrete stay blocks shall be in accordance with ESI 43-91.

5.2 The tests shall include:- dimensional verification,
(i)Porosity Test,
(ii)Crack Test (proof load)
(iii)Quality of finish (straightness)
(iv)Ultimate Failing load

5.3 Copies of previous Test Certificates and Test Reports issued by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation.

5.4 Routine and sample test reports for the concrete products to be supplied shall be submitted to KPLC for approval before delivery of the goods.

6. MARKING AND LABELLING

6.1 The upper side of each cable cover shall be marked longitudinally by means of impression with the words "HATARI KPLC" in accordance with drawing SK No. 08424/1 and 2.

The word 'HATARI' shall be impressed on one inclined face and the name KPLC on the other. The lettering shall be symmetrically spaced, 4mm deep and 20mm minimum height for LV cable covers and 40mm minimum height for HT cable covers.
The stay block shall be marked ½'', ¾'' or 1'' as appropriate on at the top, 4mm deep and 40mm minimum height.
Each cable cover and stay block shall carry an impression or embossment of the manufacturer's name or identifying mark.

6.2 The following information shall be marked on the manufacturer's certificate supplied with the cable covers and stay blocks:

- Name or trademark of manufacturer;
- The number and date of standard to which the concrete product complies;
- Type of binder constituent (s) used;
- Dimensions of the product;
- Property of " Kenya Power"
  (All in English Language)

7. DOCUMENTATION

7.1 The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation. The technical documents to be submitted (all in English language) for tender evaluation shall include the following:

a) Guaranteed Technical Particulars;
b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
c) Sales records for the last five years and at least four customer reference letters;
d) Details of manufacturing capacity and the manufacturer's experience;
e) Copies of required test reports by a third party testing laboratory accredited to ISO/IEC 17025. The test reports shall not be more than five years old and shall include:
   i. Resistance to proof load;
   ii. Verification of dimensions;
   iii. Straightness;
   iv. Ultimate load.
f) Copy of accreditation certificate for the testing laboratory;
g) Copy of the manufacturer's ISO 9001:2008 certificate or for local manufacturer's valid Diamond Mark of Quality Certificate issued by KEBS.

7.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

a) Guaranteed Technical Particulars,
b) Design Drawings with details of the concrete products to be manufactured for KPLC,
c) Quality assurance plan (QAP) that will be used to ensure that the design, materials, workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008 and for local manufacturers the Diamond Mark of Quality (KEBS).
d) Marking details and method to be used in marking the concrete products,

e) Manufacturer's undertaking to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the concrete poles for The Kenya Power & Lighting Company.

f) Packaging details (including packaging materials and their dimensions).

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ANNEX A: Guaranteed Technical Particulars *(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records, four customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test certificates and type test reports for tender evaluation all in English Language)*

Tender No. .....

Clause number	Guaranteed Technical Particulars		Bidder's offer
1	Name and address of the Manufacturer		state
	Country of manufacture		state
	Manufacturer's Letter of Authorization		provide
	Model/Type Reference No. of the offered transformer		state
	Drawing Reference Number		state
	Manufacturer's warranty and guarantee certificate for the offered conductor		provide
2	Type and Size		state
3.	Reference Standard of manufacture		state
4.1	Service Conditions		specify
4.1.1	Design, manufacture and Test Standard		state
4.1.2	Design depth for stay block to buried		state
4.1.3	Size, designation and stay rod size		state
4.1.4	Depth at which cable covers are to laid		state
4.1.5	Voltage rating of cable covers	HT	state
		LV	state
4.2.1.1	Material and Standard of manufacture		state
4.2.1.2	Composition of Concrete mixtures		state
4.2.1.3	Reinforcement of stay block		state
4.2.1.4	Mode of compaction		state
4.2.1.5	Method of Permanent marking		state
4.2.1.6	Method of curing the stay block		specify
4.2.1.7	Material for reinforcement of stay blocks		Specify
4.2.1.8	Design for cable covers and stay block		Specify
4.2.2.1	Sizes and dimensions		Provide drawings
4.2.2.2	Design loads		Specify

4.2.2.3	Concrete stay blocks sizes	Specify
4.2.2.4	Ultimate failing loads	Specify
5.1	Test standards	state
5.2	List of copies of Design and Type Test Reports submitted (indicate Test Report Numbers, Testing Authority and contact addresses)	List
5.3	Copies of previous Test Reports from an ISO/IEC 17025	Specify
5.4	List Acceptance Tests to be witnessed by KPLC Engineers at the factory	List
5.5.	Inspection and Acceptance at KPLC stores	State compliance
	Replacement of rejected poles at no extra cost to KPLC	State compliance
6.1	Marking (indicate parameters and method of marking to be used during manufacture)	Specify
6.2	Packaging (indicate parameters and method of packaging to be used during and after manufacture)	Specify
6.3	Handling and storage instruction to be provided during delivery	Specify
7.1	Documents submitted with tender	list
7.2	Documents to be submitted to KPLC for approval before manufacture	specify
Other details required with the tender	List of catalogues, brochures, technical data, drawings and customer sales records submitted to support the offer.	specify
	Deviations from tender specifications and supporting data, test reports, technical documents etc.	specify

.....

Manufacturer's Name, Signature, Stamp and Date

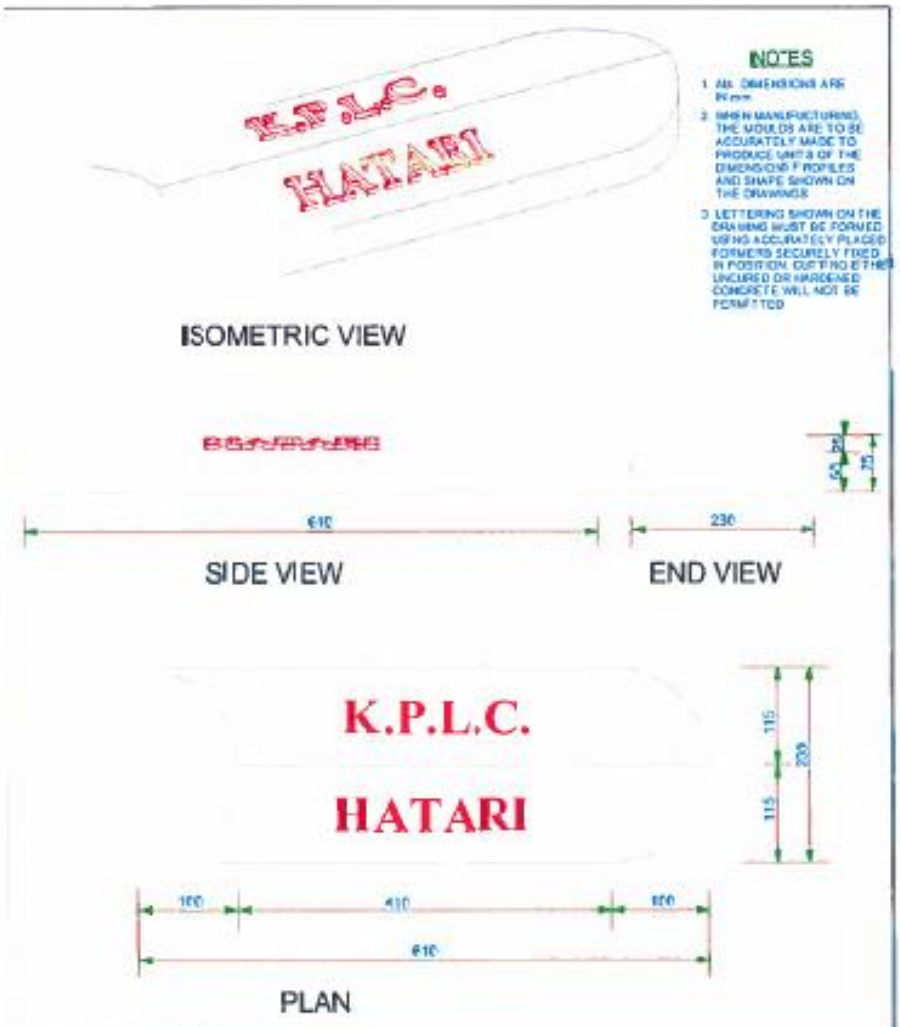


FIG :1 CONCRETE HATARI SLAB TO COVER H.T. CABLES

	DATE	SIGN	ISSUE	DESCRIPTION	DATE	SIGN
APPROVED						
CHECKED	08/03/02	S.K.K.				
DRAWN	07/11/01	J.M.K.				
SCALE						

K. P. & L. Co LTD

SK. NO. 08424 / 1

Issued by: Head of section, standards Development	Authorized by: Manager ,Standards
Signed:	Signed:
Date: 2016-05-31	Date: 2016-05-31

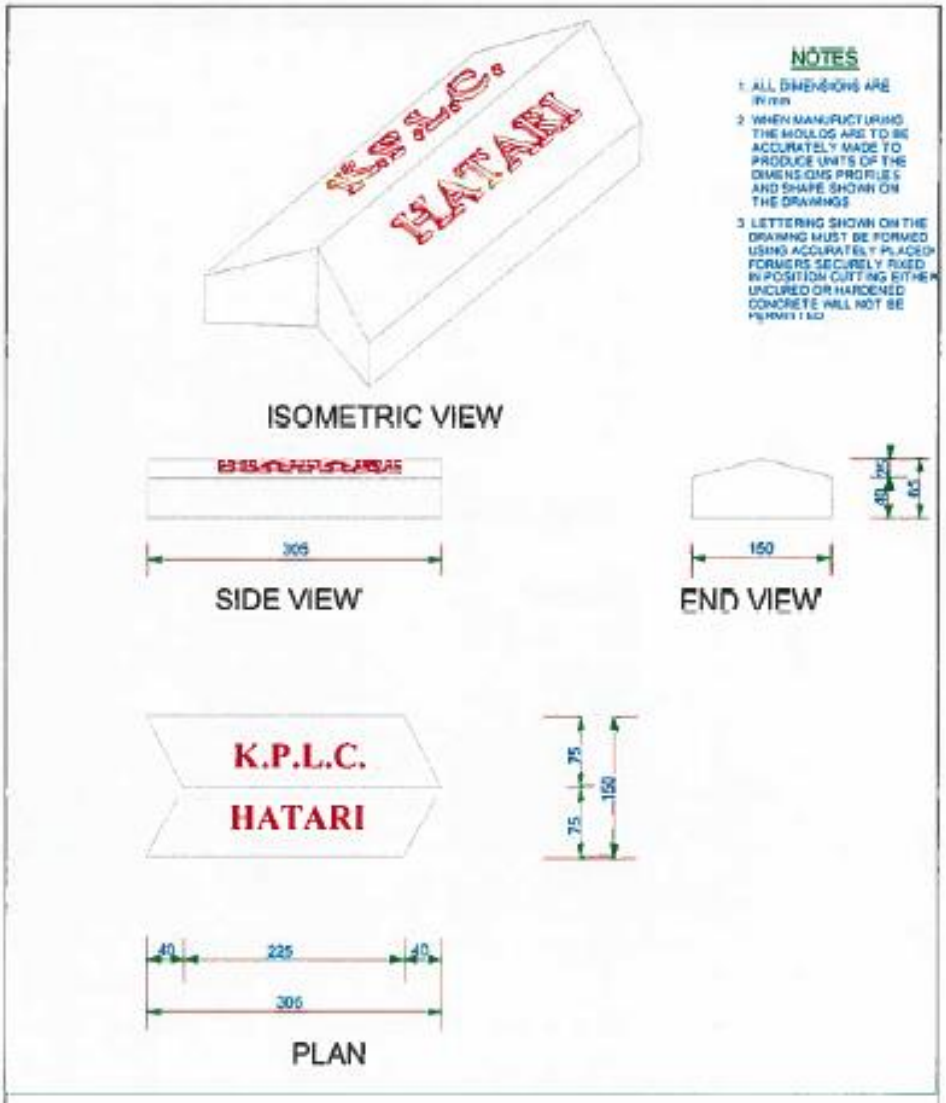


FIG: 2 CONCRETE HATARI SLAB TO COVER L.V. CABLES

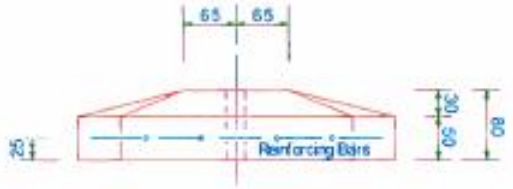
	DATE	SIGN	ISSUE	DESCRIPTION	DATE	SIGN
APPROVED						
CHECKED	25/03/02	S.K.K.				
DRAWN	14/11/01	J.M.K.				
SCALE						

K. P. & L. Co LTD

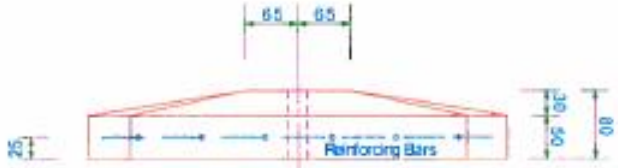
SK. NO. 08424 / 2

Issued by: Head of section, standards Development	Authorized by: Manager ,Standards
Signed:	Signed:
Date: 2016-05-31	Date: 2016-05-31

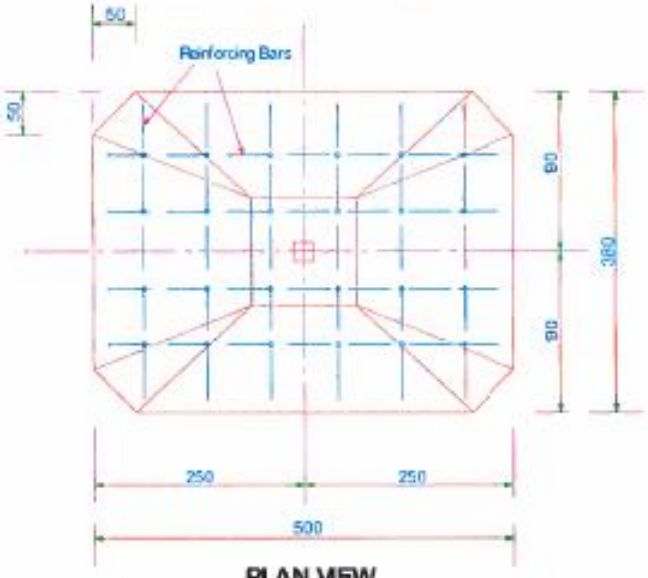
REINFORCED CONCRETE STAY BLOCK FOR M.V. O/H LINE



SIDE ELEVATION



FRONT ELEVATION



PLAN VIEW

SCALE : 1:5

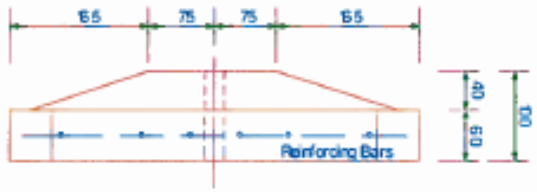
Notes

1. All dimensions are in mm.
2. Reinforcement rods should be welded at all points of points of crossing. Alternatively a welded reinforcing fabric of No. 5 gauge x 3" square would be accepted.
3. Concrete to be vibrated during manufacture.

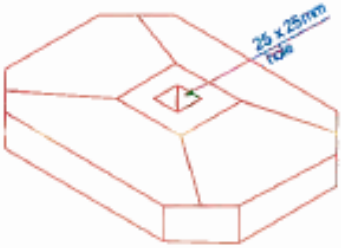
Drg. No. 3			MANUFACTURING FAILING LOAD
REINFORCEMENT			
	NUMBER		
	LENGHT	ACROSS	
¼"	4	4	0.5 KN TO 6

Kenya Power	TITLE: SPECIFICATION FOR CONCRETE PRODUCTS (Hatari Slabs & Stay Blocks)	Doc. No.	KP16C/13/TSP/07/001
		Issue No.	1
		Revision No.	1
		Date of Issue	2016-05-31
		Page 15 of 15	

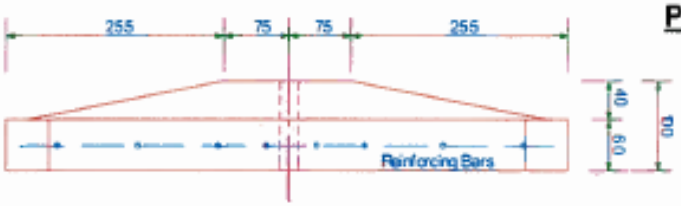
REINFORCED CONCRETE STAY BLOCK FOR H.T. LINE



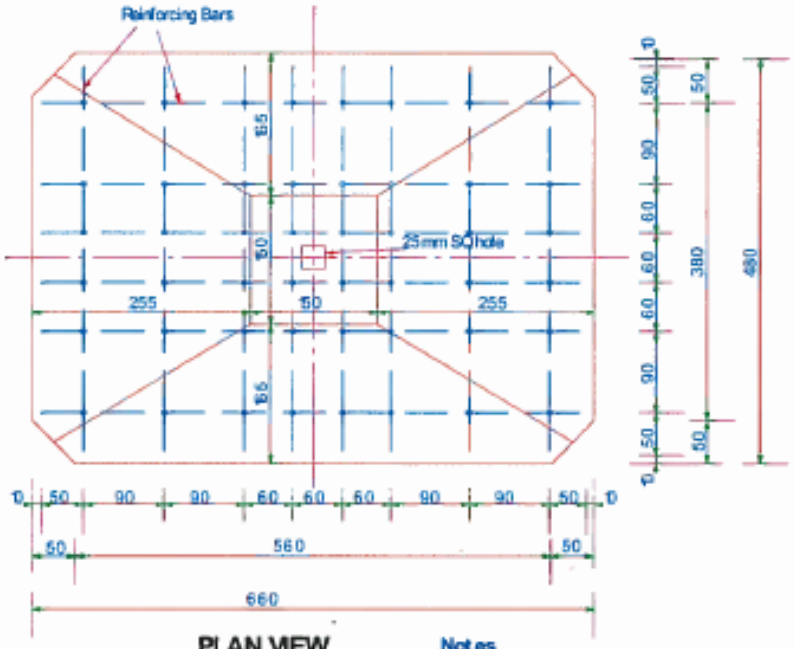
SIDE ELEVATION



PERSPECTIVE VIEW



FRONT ELEVATION



PLAN VIEW

Notes

1. All dimensions are in mm.
2. Reinforcement rods should be welded at all points of crossing. Alternatively a welded reinforcing fabric of No. 5 gauge x 3" square would be accepted.
3. Concrete to be vibrated during manufacture.

SCALE : 1:5

Drg. No. 4

REINFORCEMENT

	NUMBER A	
	LENGHT	ACROSS
¼"	8	6

Issued by: Head of section, standards Development	Authorized by: Manager ,Standards
Signed:	Signed:
Date: 2016-05-31	Date: 2016-05-31

viii. Single-Phase Static Meters for Active Energy – TSP 14.11

TSP 14.11

THE KENYA POWER AND LIGHTING CO. LTD

SPECIFICATION

For

SINGLE-PHASE STATIC METERS FOR ACTIVE ENERGY

REVISION RECORD

REVISION	DESCRIPTION OF REVISION	COMPILED BY	DATE	R&D Approval
1st	1st Issue	W. N. Njaroge	January 2005	24/2/2005

SINGLE-PHASE STATIC METERS FOR ACTIVE ENERGY.

CONTENTS

Foreword

The Meter Central Laboratory and Research and Development Department both of Kenya Power & Lighting Company (KPLC) have prepared this specification. It lays down requirements for single-phase static meters for active energy.

The specification is intended for procurement of equipment and does not include provision of contract.

Introduction

This specification was prepared to establish and promote uniform requirements for single-phase static meters for active energy. The specification lays down the minimum requirements for equipment acceptable for evaluation. It is the responsibility of the Manufacturer to familiarize himself with the standards referred herein.

This specification shall be used in conjunction with the IEC 62053-21 and IEC 62052-11 and the standards referred to therein.

The manufacturer shall stipulate any extra and enhanced features above the IEC Standards' requirements.

1. Scope

This specification is for newly manufactured single-phase static meters for measurement of alternating current active energy in 50 Hz networks.

2. References

The following documents were referred to during the preparation of this specification:

IEC 62052-11:General requirements, tests and test conditions-Metering equipment and IEC 62053- 21: Static meters for active energy (Classes 1 and 2).
In case of conflict, the requirements of this specification take precedence.

3. Terms and definitions

The definitions given in IEC 62052-11 apply.

4. Requirements

In addition to the requirements in IEC 62052-11 and IEC 62053-21, the meters shall fulfill the following requirements.

4.1 Operating Conditions requirements

4.1.1 The meters shall be suitable for operation in tropical climate where temperatures may vary from -1 to 45 degrees Celsius.

4.1.2 Relative humidity reaching 95%.

4.1.3 Operating altitudes ranging from sea level to 2200 m above sea level.

4.1.4 The meters shall be used for measurement of active energy for domestic loads under tropical climate conditions with isokeraunic level of 180 thunderstorm days per year.

4.2 Design and Construction requirements

4.2.1 The meters shall comply fully with the requirements of IEC 62052- 11 and IEC 62053- 21. Where the specifications differ with those of the above IEC standards, these specifications shall apply in respect only of the specific differences.

4.2.2 The meter body shall be of non-metallic and polished material. The material of which the meter body is made shall be capable of passing the tests given in **ISO 75.**

4.2.3 The meters shall conform to the degree of protection **IP 51** as given in **IEC 529.**

4.2.4 The meters shall have a window (clear glass or clear polycarbonate) to enable display reading and observation.

4.2.5 The meters shall be for front projection mounting.

4.2.6 The meters body shall be sealed for life and it shall not be possible to gain access to the meter without permanent damage to the meter. The meters shall be accessible for connection only through the terminals cover.

4.2.7 The meters shall have a sealing provision for terminal cover.

4.2.8 The meter terminal cover shall be of the short-length type, flush to the meter base.

4.2.9 The meters shall have terminals with bottom entry for cables and the arrangement shall be:

L:N:N:L

4.2.10 Terminal holes shall be of sufficient size to accommodate cables of at least 8-mm diameter.

4.2.11 The meters terminal holes and screws shall be made of brass and shall be nickel- plated for high conductivity and strength.

4.2.12 The meters shall have a non-volatile memory capable of data storage and with long-term data retention period for the certified life of the meter.

4.2.13 The certified life of the meter shall not be less than fifteen years

4.2.14 Meters shall have a facility to enable meter reading when mains power fails.

4.2.15 In case where a battery is incorporated in the meter, for either the memory or power fail read facility the battery shall be replaceable without loss of stored data and information or it shall have a certified service life of fifteen years.

4.2.16 The meters shall have facility to indicate reverse connection.

4.2.17 The meters shall continue to register energy forward under reverse connection condition.

4.2.18 The meters shall have a facility to indicate earth loading, a condition where the load is connected to local earth instead of the meter neutral, making neutral current to the meter to be absent.

4.2.19 The meter shall continue to register energy accurately under earth loading conditions even under phase / neutral and Load/supply reversed.

4.2.20 The potential link of the meters shall be internal (inside the sealed part of the meter).

4.2.21 The meters shall be capable of recording mal-functionality status through error codes, which shall be displayed on the LCD.

4.2.22 The meter registers shall not be re-settable to zeros.

4.2.23 The meters shall have a LCD display.

4.2.24 The meters LCD shall have at least 7 digits , and one of which is a tenth for measurement .

4.2.25 The meters shall have LED indicators for testing and indication of kWh- meter operation.

4.2.26 The principal unit for the measured values shall be the kilowatt-hour (kWh).

4.3 Electrical requirements

4.3.1 The meters shall be operated from mains with reference values of: -

240 V, 50 Hz.

4.3.2 The meters shall be connectable for 2 wire systems, **drawing of which shall be printed on the terminal cover or on the meter base (stickers will not be acceptable).**

4.3.3 The meter shall have reference standard currents of: -

$I_b \leq 5A$; $I_{max} \geq 80$ A.

4.3.4 Power consumption

The requirement of IEC 62053-21 applies.

4.3.5 Influence of short-time over-currents

The requirement of IEC 62053-21 applies.

4.3.6 Influence of self-heating

The requirement of IEC 62053-21 applies.

4.3.7 AC voltage test

The requirement of IEC 62053-21 applies.

Requirements 4.3.4 to 4.3.7 shall form part of the type test approval to be issued by an international or the national (of the country of manufacture)) meter certifying body.

4.4 Accuracy requirements

Tests and test conditions given in IEC 62052-11 shall apply.

4.4.1 The meter's accuracy shall be class 1 for active energy.

4.4.2 Limits of errors due to variation of the current.

The requirement of IEC 62053-21 applies.

4.4.3 Limits of error due to influence quantities

The requirement of IEC 62053-21 applies.

4.4.4 Test of starting and no-load condition

The requirement of IEC 62053-21 applies.

4.4.5 Meter constant

The requirement of IEC 62053-21 applies.

4.4.6 Accuracy test conditions

The requirement of IEC 62053-21 applies.

Requirements of clause 4.4 shall form part of the type test approval to be issued by an international or the national (country of manufacture) meter certifying body.

4.5 Instructions and Marking

4.5.1 In addition to IEC 62052- 11 nameplate (Not paper sticker) requirements, each meter shall be marked legibly and indelibly with the following information:

a) Name or trade mark of the manufacturer;
b) Country of origin;
c) Type/model;
d) Meter number up to ten digits;
e) The inscription "Property of K.P. &. L. Co Ltd."
f) Standard to which the meter complies;
g) Year of manufacture.

All markings to be written in English and with at least 4 mm figure height.

4.5.2 In addition, the following drawings and information shall be required with the tender:

(a) Meter drawing giving all the relevant dimensions;
(b) Wiring diagrams;
(c) Description leaflet of the meter being offered;
(d) Users and operational manuals.

4.5.3 Copies of type approval certificate (s) with test and calibration results of the meter being offered obtained from an international or the national meter certification body shall be provided. If type approval certificate (s) is (are) from accredited meter certification laboratories (and not national or international body), then it (they) shall be accompanied with copies of certificates of accreditation from the national or an international certification body.

4.5.4 The Tenderer shall fill the attached matrix to be used as a guideline in accessing the manufacturers' compliance to the requirements of this specification. The tenderers shall indicate the details of their offer where it is different from these requirements. **Insertions such as "noted", "agreed" etc. shall be considered as non-responsive where a specific response is called for.**

4.5.5 The manufacturer shall provide proof of conformance to ISO 9001(2000) standards by attaching copy certificates.

4.5.6 The manufacturer shall provide a list (including contact information) of at least three previous utilities (Export) to which the meter type being offered has been supplied. The number of electronic meters sold over a period of 5 years shall not be less than 250,000 meters.

5 INFORMATION AND WARRANTY *(In case of Tender Award)*

5.1 Drawings and technical details shall be submitted to KPLC for approval before manufacture of the meters commences. KPLC undertakes to submit their comments or approval for the drawings within three weeks of receiving the draft copies.

5.2 The meter shall have a warranty against any defects, which may develop due to faulty material, calibration, transportation or workmanship for a period of thirty-six months from the date of delivery. All defective meters shall be replaced at the supplier's cost.

5.3 The manufacturer shall meet the full costs of two engineers, for meter inspection and acceptance testing at the manufacturer's facility, excepting the cost of engineers' transportation from Kenya to the nearest major airport.

5.4 Where factory visit/ inspection is considered necessary before production of the meter commence, the manufacturer shall meet the full costs of two KPLC representatives, excepting the cost of engineers' transportation from Kenya to the nearest major airport.

5.5 The meters shall be packaged in such a manner as to minimize damage and entry of moisture during transportation and handling.

5.6 The meters shall be packed in suitable groups and / or batches with consecutive serial numbers, provided by KPLC. Packaging shall be done only after the purchaser engineers' visit.

5.7 The supplier shall indicate the delivery time versus quantities of each type of meter and his production capacity.

5.8 Where test and / or calibration certificates/ reports are issued by a laboratory other than the International / National Standards and Testing Authority, a copy of **accreditation certificate** shall be attached together with the tender documents.

5.9 The manufacturer shall provide current e-mail addresses, fax and telephone numbers of the national / international testing / calibration laboratories and meter certification bodies.

5.10 All information supplied to support the tender shall be in the English language. Where any other language is used, a certified English translation shall be attached.

SCHEDULE A: Summary Technical Data

Measurement Base	Active
Network type	2-wire
Connection type	Direct
Accuracy	Class 1
LCD display	7 digits
Voltage measurement (U_n)	240; 50Hz.
Voltage range	0.8 U_n to 1.15 U_n
Voltage circuit burden	≤ 2 W and 10 VA
Bust test	4 kV
Impulse voltage	6 kV, 1.2/50 µs
Current measurement	$I_b \leq 5A$; $I_{max} \geq 80$ A.
Short circuit current	30 I_{max}
Starting current	0.004 I_b
Dielectric strength	4 kV, 50 Hz., 1 min.
Current circuit burden	≤ 4 VA
Ingress protection	IP 51
Temperature	-1 to 45 ^{0}C
Humidity	95 % Non -condensing
Terminal entry diameter	8.0 mm
Indications	Reverse current, Earth load and power on
Calibration output	Pulsating red colour LED (X imp / Wh)
EMC tests	IEC 61000-4-3; EN 55014/55022

SCHEDULE B. Specifications Matrix for Single-phase Static Meters for Active Energy

CLAUSE	KPLC REQUIREMENT	MANUFACTURER'S COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
4.1.1	-1 to 45 °c (operational)		
4.1.2	Humidity: 0-95 %		
4.1.3	Altitude: 0-2200 M		
4.1.4	180 Thunderstorm days per year		
4.2.1	IEC62053-21and IEC62052-11		
4.2.2	ISO 75,non-metallic, etc.		
4.2.3	IP 51		
4.2.4	Clear glass or policarbonate window		
4.2.5	Front projection mounting		
4.2.6	Meter sealed for life		
4.2.7	Terminal cover sealing provision		
4.2.8	Short-length terminal cover ,flush to meter base		
4.2.9	L:N:N:L terminal configuration		
4.2.10	Tenminal holes of 8 mm		
4.2.11	Nickel –plated Brass terminal holes & screws		
4.2.12	Non –volatile data retention period		
4.2.13	Certification life of 15 years.		
4.2.14	Mains power fail reading facility		
4.2.15	Replaceable batteries or 15 years' certification		
4.2.16	Reverse connection indication		
4.2.17	Registration of energy under reverse connection condition		
4.2.18	Earth loading indication		
4.2.19	Registration of energy under Earth loading condition		
4.2.20	Internal potential links		
4.2.21	Fault status recording through error codes display		
4.2.22	Non-resettable meter registers		
4.2.23	LCD display		
4.2.24	7 digit LCD display		
4.2.25	Led indicators for testing and operation		
4.2.26	kWh as the principal unit of measurement		
4.3.1	240 V; 50 Hz.		
4.3.2	2 wire system		
4.3.3	$I_b \leq 5A$; $I_{max} \geq 80A$.		
4.3.4	As per IEC62053-21		
4.3.5	As per IEC62053-21		
4.3.6	As per IEC62053-21		
4.3.7	As per IEC62053-21		
4.4.1	As per IEC62053-21		
4.4.2	As per IEC62053-21		
4.4.3	As per IEC62053-21		
4.4.4	As per IEC62053-21		
4.4.5	As per IEC62053-21		
4.4.6	As per IEC62053-21		
4.5.1	As stated in clause		
4.5.2	As stated in clause		
4.5.3	As stated in clause		
4.5.4	As stated in clause		
4.5.5	As stated in clause		
4.5.6	As stated in clause		

Manufacturer's Declaration: I .....on behalf of.....

Declare that the above specifications matrix conforms to a typical tender meter, type.....

Being offered for this tender.

Signature..... Date.....Stamp/Seal.....

ix. Specification for PVC Insulated Wiring and Auxilliary Cables – KP1/6C.1/13/TSP/05/016

Kenya Power	TITLE: SPECIFICATION FOR PVC INSULATED WIRING AND AUXILLIARY CABLES	Doc. No.	KP1/6C.1/13/TSP/05/016
		Issue No.	2
		Revision No.	1
		Date of Issue	2015-10-21
		Page 1 of 17	

TABLE OF CONTENTS

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date: 2015-10-21	Date: 2015-10-21

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Manager, Standards
Electronic copy (pdf) on Kenya Power server (http://172.16.1.40/dms/browse.php?fFolderId=23)	

0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
0	2015-04-09	Cancels and replaces issue No. 1 dated 2009-05-18	Michael Apudo	Dr. Eng. Peter Kimemia
1	2015-10-21	Harmonized Tables 3, 4, 5, 6a & b to capture all cables applicable in KPLC systems	Michael Apudo	Dr. Eng. Peter Kimemia

FOREWARD

This specification has been prepared by the Standards Department of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for PVC Insulated Wiring and Auxiliary Cables. It is intended for use by KPLC in purchasing the cables.

The manufacturer shall submit information which confirms satisfactory service experience with products which fall within the scope of this specification.

1. SCOPE

1.1. This specification covers requirements for PVC Insulated Wiring and Auxiliary Cables for rated voltage Uo/U of 600/1000V for armoured cables and 450/750V for PVC sheathed/unsheathed and insulated flexible cords. It covers the following:

a) PVC-insulated, non-sheathed cable for internal wiring, single core, copper
b) PVC-insulated, PVC-sheathed cable with or without circuit protective conductor, flat twin, copper
c) PVC-insulated flexible cables and cords, copper
d) Multi-core auxiliary armoured cables with copper conductors

NOTE: *KPLC Stores Codes and Descriptions for the various sizes are in Appendix B attached.*

1.2. The specification stipulates the minimum requirements for PVC Insulated Wiring and Auxiliary Cables in the company and it shall be the responsibility of the supplier to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the cables for The Kenya Power & Lighting Company.

The specification does not purport to include all the necessary provisions of a contract.

2. REFERENCES

The following documents were referred to during the preparation of this specification; in case of conflict the requirements of this specification take precedence.

IEC 60502-1: Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1.2 kV) up to 30 kV (Um = 36 kV) – Part 1: Cables for rated voltages of 1 kV ((Um = 1.2 kV) and 3 kV (Um = 3.6 kV)

IEC 60227-6:	Polyvinyl chloride insulated cables of rated voltages up to and Including 450/750 V – Part 6: Lift cables and cables for flexible connections
IEC 60228.	Conductors of insulated cables.
BS 6346:	Electric cables. PVC insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V
BS 6004:	British Standard Specification for PVC-insulated, non-armoured cables for voltages up to and including 450/750V, for electric power, lighting and internal wiring.
BS EN 50363:	Insulating, sheathing and covering materials for low voltage energy cables — Part 3: PVC insulating compounds- Part 4-1: PVC sheathing compounds
BS 7655-4.2	Specification for insulating and sheathing materials for cables. PVC sheathing compounds. General application.
KS 04-194:	Kenya Standard Specification for PVC insulated cables for electricity supply.
KS 04-192	Kenya Standard Specification for PVC insulated flexible cables and cords of rated voltage Uo/U up to and including 450/750V.
KS 04-453:	Kenya Standard Specification for PVC insulated cables (non-armoured) for electric power & lighting.

3. DEFINITIONS

For the purpose of this specification, the definitions given in the reference standards shall apply

4. REQUIREMENTS

4.1. Service Conditions

The cables shall be suitable for continuous operation in tropical areas:

a) At altitudes of up to 2200m above sea level,
b) Humidity of up to 90%,
c) Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C.

4.2. Design and Construction

4.2.1. Conductors

4.2.1.1. The conductors for the cables in this specification shall consist of plain annealed copper conductors with the conductor classes in accordance with IEC 60228 as follows:

a) PVC-insulated flexible copper cables and cords, (see Table 5) shall be class 5;
b) PVC-insulated, non-sheathed copper cable for internal wiring, single core, (see Table 3) shall be class 2;
c) PVC-insulated, PVC-sheathed copper cable with or without circuit protective conductor, flat twin (see Table 4) shall be class 2;
d) Multi-core auxiliary armoured cables with copper conductors (see Table 6a & b).

4.2.1.2. The wires if not specified in each conductor shall be the same in nominal diameter and shall not exceed the appropriate values given in Tables 2 & 3 of IEC 60228.

4.2.2. Cable design

4.2.2.1. The cables shall be designed as follows:

a) PVC-insulated single core and flat twin cables shall be designed and constructed to IEC 60502-1, KS 04-453 and BS 6004;
b) Flexible cables and cords shall be designed and constructed to IEC 60502-1, IEC 60227-6 and KS 04-192.
c) Multi-core cables (armoured) shall be designed and constructed to IEC 60502-1, BS 6346 and KS 04-194.

4.2.2.2. The cables shall be suitable for wiring, metering, control and other auxiliary applications (including underground) and where the combination of ambient temperature and temperature rise due to load results in a conductor temperature not exceeding 70°C.

4.2.3. Insulation material

4.2.3.1. The insulation material for PVC-insulated single core and flat twin cables in Table 3 & 4 and flexible cables in Table 5 shall be type TI 2, PVC compound as per Table 1.

4.2.3.2. Armoured cables in Table 6a & 6b shall be type TI 1, PVC compound complying with Table 1.

4.2.4. **Armour material**

The armour wire for the cables shall consist of a single layer of galvanized steel. The wire diameters shall be as per Tables 6a & 6b

4.2.5. **Over-sheath material**

4.2.5.1. The oversheath material for PVC-insulated single core and flat twin cables in Table 4 shall be PVC compound Type 6 as specified in BS 6004, BS 7655-4.2 and Table 1.

4.2.5.2. The oversheath for the flexible cables shall be a polyvinyl chloride compound of type PVC/ST5 applied around the cores as per IEC 60502-1 and IEC 60227-6. The sheath shall be applied so as to substantially avoid the formation of cavities, and shall not adhere to the cores. The edges of the cable shall be rounded off.

4.2.5.3. The oversheath armoured cables shall be an extruded layer of black PVC compound – type TM 1 as specified in Table 1 of this specification and shall conform to BS EN 50363-4.1.

4.2.5.4. The oversheath shall be spark tested in accordance with BS EN 50363-3. It shall be applied by an extrusion process and shall form a compact homogeneous body.

4.2.5.5. The PVC compound for PVC-insulated single core and flat twin cables (see Table 3 & 4) and armoured cables (see Table 6a & b) shall be treated with anti-UV chemicals prior to shaping by injection moulding to prevent UV attack by sunlight.

Table 1: Test requirements for insulation and overs-heath PVC compounds as per BS EN 50363: Part 3 and Part 4-1

Test	Test details		Insulation		Sheathing	
			TI 1	TI 2	Type 6	TM 1
Tensile properties	Min. tensile strength, N/mm²		12.5	10.0	6	10.0
	Min. elongation, %		125	125	125	125
Low temperature bend test	Temperature at which specimen shall not crack, °C		-15±2	-15±2	-15±2	-15±2
Low temperature elongation test	Test temperature, °C		-15±2	-15±2	-15±2	-15±2
	Min. elongation, %		20	20	20	20
Low temperature impact test	Temperature at which specimen shall not crack, °C		-15±2	-15±2	-	-15±2
Accelerated ageing for 7 days at 80±20C followed by tensile	Tensile strength after ageing	Min. value, N/mm²	10	10	-	10
		Max. variation, %	20	20	-	20

Test	Test details		Insulation		Sheathing	
			TI 1	TI 2	Type 6	TM 1
strength and elongation at break test and loss of mass test	Elongation at break after ageing	Min. value, %	150	150	-	150
		Max. variation, %	20	20	-	20
	Max. loss of mass after ageing, mg/cm^2		2.0	2.0	-	2.0
Pressure test at high temperatures	Test temperature, ^{0}C		80±2	70±2	80±2	70±2
	Max. indentation, %		50	50	50	50
Resistance to cracking	Temperature at which specimen shall not crack, ^{0}C		150±2	150±2	150±2	150±2
Insulation resistance test	Min. K value at 70^{0}C, MΩ.Km		0.037	0.037	-	-
	Min. K value at 20^{0}C, MΩ.Km		-	-	0.0035	-

4.2.6. Bedding material

The bedding material for all the cables shall be PVC compound compatible with the respective insulating material and shall be suitable for the operating temperature of the cable.

4.2.7. Core identification

The cores of all cables shall be identified by colours or numbers in accordance with BS 6346:1997 and the following sequence in Table 2:

Table 2: Core identification

Type	Colours/Numbers
Single-core	*Red, Black, Blue, Green or Grey*
Twin-core	*Red, Black*
Three-core	*Red, Yellow, Blue*
Four-core	*Red, Yellow, Blue, Black*
Five-core and above (auxiliary cables)	*Numbers 1, 2, 3, 4, 5.....upwards*

NOTE:

1. *The colours Red, Yellow and Blue are intended to indicate phase conductors and Black the neutral conductor.*
2. *The numbers shall be black printed on white cores. The interval between adjacent numbers on the same core shall not exceed 75mm.*

4.2.8. Tolerances

Laying up, bedding, oversheath, armour thicknesses and all tolerances shall be in accordance with design standards given in 4.2.2.1.

4.3. Characteristics

The cables shall be of the following characteristics:

Table 3: PVC insulated, non-sheathed, single-core cable with stranded copper conductors as per IEC 60502-1, KS 04-453 and BS 6004:2012

Nominal conductor area (mm^2)	Number and size of wires (No/mm)	Thickness of insulation (mm)	Nominal overall diameter (mm)	Max d.c. resistance at 20°C Ω/km
1.0	1/1.13	0.6	2.5	18.1
1.5	1/1.38	0.8	2.9	12.1
2.5	7/0.67	0.8	3.8	7.41
4.0	7/0.85	1.0	4.3	4.61
6.0	7/1.04	1.0	4.9	3.08
10	7/1.35	1.0	6.8	1.83
35	19/1.53	1.2	10.3	0.524

Table 4: Twin PVC-insulated, PVC-sheathed cables with copper conductors (with or without circuit protective conductor - CPC) per IEC 60502-1, KS 04-453 and BS 6004:2012

Number & Nominal conductor area (mm^2)	Number and size of wires (No/mm)		Thickness of insulation (mm)	Thickness of sheath (mm)	Nominal overall dimensions (mm)		CPC min. nominal x-sectional area, mm^2	Max resistance at 20°C (Ω/km)	Min insulation resistance at 70°C (Ω/km)
	Phase	Earth - CPC			Lower limit	Upper limit			
2 x 1.5	1/1.38	-	0.7	0.9	4.5x7.2	5.6x8.7	-	12.1	0.011
2 x 1.5	1/1.38	1/1.0	0.7	0.9	4.3x8.3	5.4x10.0	1.0	12.1	0.011
2 x 2.5	7/0.67	-	0.8	1.0	5.2x8.5	6.6x10.5	-	7.41	0.010
2 x 2.5	7/0.67	7/0.46	0.8	1.0	5.2x9.8	6.6x12.5	1.5	7.41	0.010
2 x 4.0	7/0.85	7/0.46	0.8	1.0	5.7x10.8	6.9x13.1	1.5	4.61	0.0077
2 x 6.0	7/1.04	7/0.67	0.8	1.1	6.4x12.4	7.8x15.0	2.5	3.08	0.0065

Table 5: 450/750V, PVC insulated PVC sheathed circular flexible cord cables with copper conductors as per IEC 60502-1, IEC 60227-6 and KS 04-192.

Number of cores & nominal cross sectional area of conductor mm²	Preferred number and size of wires (No)	Thickness of insulation mm	Thickness of outer sheath, mm	Overall diameter (range), mm	Max resistance at 20°C (Ω/km)	Minimum insulation resistance at 70°C MΩ.km
3 x 0.75	6; 9; 12; 18; 24 or 30	0.6	0.8	6.0 – 7.6	26.0	0.011
3 x 1.0		0.6	0.8	6.3 – 8.0	19.5	0.010
3 x 1.5		0.7	0.9	7.4 – 9.4	19.5	0.010
3 x 2.5		0.8	1.1	9.6 – 12.0	7.98	0.0095
3 x 4.0	4 or 5	0.8	1.2	10.5 – 13. 1	-	0.0078

Table 6a: Two-, Three-, Four-core 600/1000V Auxiliary Cables with copper conductors (with steel-wire armour) as per IEC 60502-1, BS 6346 and KS 04-194

No. of cores	Conductor Area mm²	Strand No./Size mm	Insulation thickness mm	Extruded bedding mm	Armour wire diameter mm	Over sheath mm	Overall diameter mm	Max Copper resistance at 20°C (ohm/km	Max. Steel wire armour resistance at 20°C (ohm/km)	Min Insulation Resistance at 20°C Mega ohm.km	Weight kg/km
2	1.5	7/0.53	0.6	0.8	0.9	1.4	12.3	12.1	10.2	10	310
	2.5	7/0.67	0.7	0.8	0.9	1.4	13.6	7.41	8.8	9	368
	4	7/0.85	0.8	0.8	0.9	1.4	15.1	4.61	7.5	8	450
	6	7/1.04	0.8	0.8	0.9	1.5	16.5	3.08	6.8	7	541
3	1.5	7/0.53	0.6	0.8	0.9	1.4	12.8	12.1	9.5	10	321
	2.5	7/0.67	0.7	0.8	0.9	1.4	14.1	7.41	8.2	9	421
	4	7/0.85	0.8	0.8	0.9	1.4	15.8	4.61	7.0	8	533
	6	7/1.04	0.8	0.8	1.25	1.5	18.0	3.08	4.6	7	745
4	1.5	7/0.53	0.6	0.8	0.9	1.4	13.5	12.1	8.8	10	357
	2.5	7/0.67	0.7	0.8	0.9	1.4	15.0	7.41	7.7	9	447
	4	7/0.85	0.8	0.8	1.25	1.5	17.8	4.61	4.6	8	716
	6	7/1.04	0.8	0.8	1.25	1.5	19.2	3.08	4.1	7	855

Table 6b: Multi-core 600/1000V Auxiliary Cables with copper conductors (with steel-wire armour) as per IEC 60502-1, BS 6346 and KS 04-194

No. of cores	Conductor Area mm²	Strand No./ size mm	Insulation thickness mm	Extruded bedding mm	Armour wire diameter mm	Over sheath mm	Approx. overall diameter mm	Max Copper resistance at 20°C (ohm/km	Max. Steel wire armour resistance at 20°C (ohm/km)	Min Insulation Resistance at 20°C Mega ohm.km	Weight kg/km
5	1.5	7/0.53	0.6	0.8	0.9	1.4	14.3	12.1	-	10	436
7				0.8	0.9	1.4	15.2		7.5		515
12				0.8	1.25	1.5	19.4		4.0		839
19				0.8	1.25	1.6	22.2		3.5		1095
5	2.5	7/0.67	0.7	0.8	0.9	1.5	16.3	7.41	-	9	528
7				0.8	1.25	1.5	18.0		4.6		636
12				0.8	1.25	1.6	22.4		3.5		1037
19				1.0	1.6	1.7	26.6		2.3		1628
27				1.0	1.6	1.8	30.2		1.9		2107
5	4.0	7/0.85	0.8	0.8	1.25	1.5	19.0	4.61	-	8	813
7				0.8	1.25	1.6	20.5		3.9		946
12				1.0	1.6	1.7	26.8		2.2		1583
19				1.0	1.6	1.8	30.5		1.9		2123

4.4. EMBOSSING ON CABLE OVERSHEATH

The external surface of all cables conforming to this specification shall be legibly marked with the following elements:

Element Example of marking

a) Cable manufacturer - Manufacturer's name and their unique factory identifier
b) Electric cable ELECTRIC CABLE
c) Voltage designation i.e. 450/750 V or 600/1000V
d) Standard number i.e. KS 04-192 and BS 6004
e) UK cable code 6242Y
f) Number of cores, nominal area of conductor and circuit protective conductor as appropriate e.g.
   (i) 2 × 1.5
   (ii) 2 × 1.5 + 1.0
g) Year of manufacture ZZZZ
h) Standard core colour identifier H

Letters and figures shall be raised and consist of upright block characters which shall be legible. Minimum size of characters shall be 3mm. The gap between the end of one inscription and the beginning of the next shall be not greater than 25mm and the gap between each complete set of markings shall be not greater than 500mm.

An indelible marking shall be given at every one meter interval to assist field personnel in cutting required length.

NOTE:

1. *A simplified version of the manufacturer's name, or a trading name of the manufacturer, may be used in place of the full name.*
2. *Any suitable method may be used to unambiguously identify the manufacturer's factory.*
3. *The manufacturer's own trademark or equivalent may be added but this cannot be used instead of the manufacturer's name or identifier.*
4. *The year of manufacture may take the form of the actual year (e.g. 2015) or a coded year identifier assigned by the manufacturer.*

4.5. QUALITY MANAGEMENT SYSTEM

4.5.1. The bidder shall submit a quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation, will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008.

4.5.2. The Manufacturer's Declaration of Conformity to reference standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2008 certificate shall be submitted with the tender for evaluation.

4.5.3. The bidder shall indicate the delivery time of the cables, manufacturer's monthly & annual production capacity and experience in the production of the type and size of conductor being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar rating of cables sold in the last five years as well as reference letters from at least four of the customers shall be submitted with the tender for evaluation.

5. TESTS AND INSPECTION

5.1. The cable shall be inspected and tested in accordance with IEC 60502-1, IEC 60811-1-1, IEC 60227-6, BS 6346, BS EN 50363-3 & 4-1 , BS 6004, BS 6500, KS 04-191, KS 04-192, KS 04-194 and the requirements of this specification. It shall be the responsibility of the supplier to perform or to have performed all the tests specified.

5.2. Copies of previous Test Reports confirming full conformance to clause 4 requirements for the cable issued by a **third party testing laboratory that is accredited to ISO/IEC 17025** shall be submitted with the tender for the purpose of technical evaluation. The accreditation certificate for the third party testing laboratory shall also be submitted with the tender (all in English Language).

5.3. Test Reports for the cable to be supplied under the contract shall be submitted to The Kenya Power & Lighting Company for approval before shipment/delivery and shall include the following:

a) Power frequency test voltage shall be 2.5 U_0 + 2 kV as per IEC 60502-1.
b) Insulation resistance measurement at ambient temperature and at maximum conductor temperature in normal operation;
c) Voltage test for 4 h - a power frequency voltage equal to $4U_0$ shall then be gradually applied and maintained continuously for 4 h between each conductor and the water as per IEC 60502-1.
d) Insulation material grade test
e) Sheath material grade test
f) Insulation resistance test
g) Long term resistance to d.c. test
h) Compatibility test
i) Flame propagation on single cable
j) Length of lay test
k) Flexing test

5.4. The cable shall be subject to acceptance tests at the manufactures' works before dispatch. Acceptance tests (routine & sample tests) will be witnessed by two Engineers appointed by The Kenya Power and Lighting Company Limited (KPLC).

5.5. Routine and sample test reports for the cable to be supplied shall be submitted to KPLC for approval before shipment of the goods. Tests to be witnessed by KPLC Engineers at the factory before shipment shall be in accordance with KS 04-191, KS 04-192, KS 04-194, BS 6360, BS 6746, BS 6004, BS 6500 and the requirements of this specification and shall include:

a) Conductor material and construction
b) Insulation resistance tests
c) Conductor and armour resistance tests
d) Laid up cores and core identification
e) Dimensional checks
f) Compatibility checks
g) Fire test on single cable
h) Spark resistance tests

5.6. Upon delivery of the cable, KPLC will inspect them and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The supplier shall replace/rectify without extra or additional charge to KPLC, cables which upon examination, test or use fail to meet any of the requirements in the specification.

6.0. MARKING AND PACKING

6.1 The finished cable shall be wound in one continuous length on wooden drum such as to prevent damage during transportation and handling. The drums shall be made from treated timber resistant to termite attack and shall be lagged all round to prevent damage to the cable. There shall be no gaps in the wooden lagging around the drum.

6.2 Each drum shall contain only one continuous length of cable of 2500m in length. The actual length of cable shall not be less than the length indicated on the drum.

6.3 Both ends of the cable shall have been sealed to prevent ingress of water during transportation, storage, handling and installation. The sealing shall enclose the oversheath completely and shall be by close fitting plastic caps. Both ends of the cable shall be secured to the drum to prevent mechanical damage.

6.4 The following information shall be marked legibly and in permanent manner on the flange of the drum:

a) The manufacturer's name
b) The type and rating of cable
c) The conductor cross-sectional area in mm^2
d) The length of cable in metres
e) The year of manufacture
f) The gross mass and net mass in Kilograms
g) The instructions for handling and use (in English language)
h) The words "**PROPERTY OF THE KENYA POWER & LIGHTING CO.**"

NOTE: *The cable shall have been marked in accordance with clause 4.4.*

7.0. DOCUMENTATION

7.1. The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation. The technical documents to be submitted (all in English language) for tender evaluation shall include the following:

a) Guaranteed Technical Particulars fully filled and signed by the manufacturer;
b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;

c) Sales records and customer reference letters;
d) Details of manufacturing capacity and the manufacturer's experience;
e) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025;
f) Copy of accreditation certificate to ISO/IEC 17025 for the testing laboratory.
g) Manufacturer's warranty and guarantee
h) Manufacturer's letter of authorization, copy of the manufacturer's ISO 9001:2008/ KEBS Diamond mark certificate and other technical documents required in the tender.

7.2. The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

a) Guaranteed Technical Particulars,
b) Design Drawings and construction details of the cable,
c) Quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008
d) Detailed test program to be used during factory testing,
e) Marking details and method to be used in marking the cable,
f) Manufacturer's undertaking to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the cables for The Kenya Power & Lighting Company
g) Packaging details (including packaging materials, lagging and length on drum).

7.3. The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during delivery of the cables to KPLC stores.

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ANNEX A: Guaranteed Technical Particulars *(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records, four customer reference letters, the manufacturer's experience and copies of complete type test reports for tender evaluation, all in English Language)*

Tender No. .....

Clause number			KPLC requirement	Bidder's offer
Manufacturer's Name and address				specify
Country of Manufacture				specify
Bidder's Name and address				specify
Type designation of cable				specify
Operating voltage Uo/U				specify
1.	Scope			specify
1.1-1.3				
2.	Applicable Standards			specify
3.	Terms & Definitions			specify
4.	REQUIREMENTS			specify
4.1	Service Conditions			specify
4.2	Design and construction			specify
4.2.1	Conductors	PVC sheathed / unsheathe and flat twin cables	Class 2 as per IEC 60228	Prove compliance by attaching a test report and a drawing
		Flexible cables	Class 5 as per IEC 60228	
		Armoured cables	Class 2 as per IEC 60228	
4.2.2.	Cable design	PVC sheathed / unsheathe and flat twin cables	KS 04-453 or BS 6004	Prove compliance by attaching a test report and a drawing
		Flexible cables	KS 04-192 or BS 6004/BS EN 50525-2-11	
		Armoured cables	KS 04-194/BS 6346	
	Maximum operating temperature		70^{0}C	
4.2.3	Insulating material	PVC sheathed / unsheathed and flat twin cables	TI 2	Prove compliance by attaching a test report and a drawing
		Flexible cables	TI 2	
		Armoured cables	TI 1	
4.2.4	Oversheath material	PVC sheathed / unsheathe and flat	Type 6	

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date: 2015-10-21	Date: 2015-10-21

Clause number			KPLC requirement	Bidder's offer
		twin cables		
		Flexible cables	Type PVC/ST5	
		Armoured cables	TM 1	
4.2.5	Armour material		Galvanized steel	
4.2.6	Bedding material		Compatible with insulating material	
	Compliance to Table 1			
4.3	Standard sizes and characteristics		As per Tables 3, 4, 5, 6, 7 & 8 and the relevant standards	Prove compliance by attaching a test report and a drawing
4.4	Embossing on cable Oversheath (parameters to be indicated and method of marking)			specify
4.5	Quality Management System			Provide
	Quality Assurance Plan			Provide
	Copy of ISO 9001:2008 Certificate			Provide
	Manufacturer's experience			Provide
	Manufacturing Capacity (units per month)			Provide
	List of previous customers			Provide
	Customer reference letters			Provide
5.1	Test standards and responsibility of carrying out tests			Provide
5.2	Copies of Type Test Reports submitted with tender			Provide
5.3	Acceptance tests to be witnessed by KPLC at factory before shipment			Provide
5.4	Test reports to be submitted by supplier to KPLC for approval before shipment			Provide
5.5	Replacement of rejected cables			Provide
6.1	Markings			Provide
6.2	Packing			Provide
7.1	Documents submitted with tender			Provide
7.2	Documents to be submitted by supplier to KPLC for approval before manufacture			Provide
8.0	Statement of compliance to specification			Provide

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Manufacturer's Name, Signature, Stamp and Date

APPENDIX B: KPLC STORES CODES

CODE	DESCRIPTION	Table No. in Specification
108618	CABLE, BLACK/RED, PVC, 7/1.04, 6.0MM², S/C, COPPER	Table 3
108620	CABLE, RED/BLACK, PVC, 19/1.53, 35MM², S/C, COPPER	Table 3
108628	CABLE, PVC, PVC, TWIN WITH EARTH, 1.5MM², COPPER	Table 4
108629	CABLE, PVC, PVC, TWIN, 2.5MM², COPPER	Table 4
108642	CABLE, BLACK, PVC, 7/0.67, 2.5MM², S/C, COPPER	Table 3
108643	CABLE, BLUE, PVC, 7/0.67, 2.5MM², S/C, COPPER	Table 3
108644	CABLE, GREEN, PVC, 7/0.67, 2.5MM², S/C, COPPER	Table 3
108645	CABLE, GREY, PVC, 7/0.67, 2.5MM², S/C, COPPER	Table 3
108646	CABLE, RED, PVC, 7/0.67, 2.5MM², S/C, COPPER	Table 3
108649	CABLE, FLEXIBLE, PVC, PVC, 3/CORE, 1.0MM², COPPER	Table 5
108829	CABLE, PVC, 7/CORE, 7/0.67, 2.5MM², SWA, COPPER	Table 7
108830	CABLE, PVC, 12/CORE, 7/0.67, 2.5MM², SWA, COPPER	Table 7
108840	CABLE, PVC, 2/CORE, 7/0.67, 2.5MM², SWA, COPPER	Table 6
108848	CABLE, PVC, 4/CORE, 7/0.67, 2.5MM², SWA, COPPER	Table 6
108698	CABLE, PVC, 19/CORE, 7/0.67, 2.5MM², SWA, COPPER	Table 7
108907	CABLE, PVC, PVC, S/C, 1.5MM² SOLID, COPPER	Table 3
108920	CABLE, FLEXIBLE, PVC, PVC, 4/CORE, 2.5MM², COPPER	Table 5
108940	CABLE, GREEN, PVC, 7/1.04, 6.0MM², S/C, COPPER	Table 3
108917	CABLE, 10MM² S/C COPPER PVC (Black) LV	Table 3