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, Isiolo, Marsabit, Samburu, Mandera, Wajir, Garissa, Lamu, Tana River, Kilifi, Kwale, Taita Taveta and Narok Counties in Kenya with 7 years O&M Services

RFB: KP1/6A.1/PT/2/21/A76

Credit No. 6135: Project ID No P160009

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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 (schools, health centres and ACC offices) in remote areas. A single private sector contractor for each lot will be competitively selected to supply and install the systems as well as be responsible for Operations and Maintenance (O&M) of the systems for 7 years.

General Scope

The project scope for this assignment includes Design, Supply, Installation, Metering and Commissioning of 473 No. Stand Alone Solar Photovoltaic Systems with Battery Energy Storage with 7 years Operations and Maintenance services in the following 14 Counties: Turkana, West Pokot, Isiolo, Marsabit, Samburu, Mandera, Wajir, Garissa, Lamu, Tana River, Kilifi, Kwale, Taita Taveta and Narok. The scope includes customer connection and installation of 473 electronic pre-paid energy meters including earthing, cabling to the meterbox, and limited internal wiring (as outlined in clauses 5.1 and 5.2) 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.

The project is packaged in Eleven (11) Lots. Each lot shall be signed as a separate works contract as detailed in Table 1 below:

Table 1

Lot Name	Counties	Scope of Works
KP1/6A.1/PT/2/21/A76Lot 1	Turkana	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 96 No. Community Facilities. • O&M services for 7 years
KP1/6A.1/PT/2/21/A76Lot 2	West Pokot	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 44 No. Community Facilities. • O&M services for 7 years

Lot Name	Counties	Scope of Works
KP1/6A.1/PT/2/21/A76Lot 3	Isiolo and Marsabit	• 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
KP1/6A.1/PT/2/21/A76Lot 4	Samburu	• 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
KP1/6A.1/PT/2/21/A76Lot 5	Mandera	• 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
KP1/6A.1/PT/2/21/A76Lot 6	Wajir	• 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
KP1/6A.1/PT/2/21/A76Lot 7	Garissa	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 32 No. Community Facilities. • O&M services for 7 years
KP1/6A.1/PT/2/21/A76Lot 8	Lamu	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 27 No. Community Facilities. • O&M services for 7 years
KP1/6A.1/PT/2/21/A76Lot 9	Tana River	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 32 No. Community Facilities. • O&M services for 7 years
KP1/6A.1/PT/2/21/A76 Lot 10	Kilifi, Kwale and Taita Taveta	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 37 No. Community Facilities. • O&M services for 7 years
KP1/6A.1/PT/2/21/A76 Lot 11	Narok	• Design, Supply, Installation, Metering and Commissioning of Stand Alone Solar Photovoltaic Systems with Battery Energy Storage for 34 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 Employers.

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

Scope and characteristics of Stand Alone SPV systems for community facilities are shown in Tables 2A through 2K below. These tables summarize characteristics including the evaluated Solar Power Generation Plant (SPGP) size in W, the evaluated size of the Battery Energy Storage System (BESS) in Wh, the evaluated minimum inverters capability in W and Charge Controllers. The size of the BESS is dimensioned to allow two days of autonomy since these systems do not include generators to serve load during periods of high cloud cover. In the KPLC website (www.kplc.co.ke), bidders can download the 'KOSAP Community Facilities System Profiles' document containing location of the Community Facilities (co-ordinates; other data provided in the system profiles shall not be used for the purposes of bidding). The scope details are as summarized as follows.

1.2.1 Design, supply, installation, testing, metering and commissioning of Solar Power Generation Plants (SPGP) under Lots 1 - 11 for community facilities in various locations in Kenya are as per Tables 2A through 2K. The systems will contain both AC- and DC-coupled inverter topologies.

Table 2A: Lot 1 (Turkana County)

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
1	1	Turkana	Loima	Clinic	Nameyana Dispensary	1200	9240		1000	30
2	1	Turkana	Turkana Central	Clinic	Nakaalei Dispensary	1200	9240		1000	30
3	1	Turkana	Turkana South	School	RCEA Kasuroi Boys	1200	9240		1000	30
4	1	Turkana	Loima	Clinic	Kodopa Mobile Clinic	1200	9240		1000	30
5	1	Turkana	Turkana West	Clinic	Teremkus dispensary	1200	9240		1000	30
6	1	Turkana	Turkana West	Clinic	Loche angi-erengo	1200	9240		1000	30
7	1	Turkana	Turkana West	Clinic	Napalatui dispensary	1200	9240		1000	30
8	1	Turkana	Turkana West	Clinic	Aposta dispensary	1200	9240		1000	30
9	1	Turkana	Turkana North	Clinic	Narengewoi Health center	1200	9240		1000	30
10	1	Turkana	Turkana Central	Clinic	Monti Dispensary	1200	9240		1000	30
11	1	Turkana	Loima	School	Loturerei Secondary School	1200	9240		1000	30
12	1	Turkana	Turkana South	Clinic	Kekorisogol Dispensary	1200	9240		1000	30
13	1	Turkana	Turkana Central	Clinic	Kapokor Dispensary	1200	9240		1000	30

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
14	1	Turkana	Loima	Clinic	Lokipetot arengan dispensary	1200	9240		1000	30
15	1	Turkana	Turkana North	Clinic	Meyan Dispensary	1200	9240		1000	30
16	1	Turkana	Turkana West	Clinic	Moru anguibuni	1200	9240		1000	30
17	1	Turkana	Turkana Central	Clinic	Chokchok Dispensary	1200	9240		1000	30
18	1	Turkana	Loima	Clinic	Kabulokor health center	1200	9240		1000	30
19	1	Turkana	Turkana West	Clinic	Kaenyangaluk dispensary	1200	9240		1000	30
20	1	Turkana	Turkana North	Clinic	Kakelae Dispensary	1200	9240		1000	30
21	1	Turkana	Turkana Central	Clinic	Kakwanyang Dispensary	1200	9240		1000	30
22	1	Turkana	Turkana South	Clinic	Kasuroi Dispensary	1200	9240		1000	30
23	1	Turkana	Turkana Central	Clinic	Kenya oil dispensary	1200	9240		1000	30
24	1	Turkana	Turkana Central	Clinic	Kosikiria dispensary	1200	9240		1000	30
25	1	Turkana	Turkana South	Clinic	Locheremoit dispensary	1200	9240		1000	30
26	1	Turkana	Turkana North	Clinic	Lokamarinyang Dispensary	1200	9240		1000	30
27	1	Turkana	Turkana West	Clinic	Lokipoto dispensary	1200	9240		1000	30
28	1	Turkana	Turkana South	Clinic	Lokoburu dispensary	1200	9240		1000	30
29	1	Turkana	Turkana East	Clinic	Lokwamosing' Dispensary	1200	9240		1000	30
30	1	Turkana	Turkana North	Clinic	Losajait dispensary	1200	9240		1000	30
31	1	Turkana	Turkana Central	Clinic	Nakechichok Dispensary	1200	9240		1000	30
32	1	Turkana	Turkana North	Clinic	Sasame Dispensary	1200	9240		1000	30
33	1	Turkana	Turkana North	Clinic	Kaeris Dispensary	1200	9240		1000	30
34	1	Turkana	Turkana East	Clinic	Katilia dispensary	1200	9240		1000	30
35	1	Turkana	Turkana West	Clinic	Lomunyakirionok Dispensary	1200	9240		1000	30
36	1	Turkana	Turkana North	Clinic	Loruth dispensary	1200	9240		1000	30
37	1	Turkana	Turkana North	Clinic	Kaalem	1200	9240		1000	30
38	1	Turkana	Turkana North	Clinic	Nakapelewoi dispensary	1200	9240		1000	30
39	1	Turkana	Loima	Clinic	Nasiger Dispensary	1200	9240		1000	30
40	1	Turkana	Turkana North	Clinic	Epur Dispensary	1200	9240		1000	30
41	1	Turkana	Turkana West	Clinic	Namon Dispensary	1200	9240		1000	30
42	1	Turkana	Turkana Central	Clinic	Nakiria Dispensary	1200	9240		1000	30
43	1	Turkana	Turkana North	Clinic	Lomekwi Dispensary	1200	9240		1000	30
44	1	Turkana	Turkana Central	Clinic	Lochoraikeny Dispensary	1200	9240		1000	30

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
45	1	Turkana	Turkana Central	Clinic	Katiir dispensary	1200	9240		1000	30
46	1	Turkana	Loima	Clinic	Nayanaeangikalalio Dispensary	1200	9240		1000	30
47	1	Turkana	Turkana Central	Clinic	Kapua Dispensary	1200	9240		1000	30
48	1	Turkana	Turkana West	Clinic	Atiir Dispensary	1200	9240		1000	30
49	1	Turkana	Turkana East	Clinic	Nakukulas dispensary	1200	9240		1000	30
50	1	Turkana	Loima	Clinic	Kaapus dispensary	1200	9240		1000	30
51	1	Turkana	Turkana North	Clinic	Koyasa Dispensary	1200	9240		1000	30
52	1	Turkana	Turkana North	Clinic	Koyasa Dispensary	1200	9240		1000	30
53	1	Turkana	Turkana South	Clinic	Sopel Dispensary	1200	9240		1000	30
54	1	Turkana	Turkana South	Clinic	Namakat Dispensary	1200	9240		1000	30
55	1	Turkana	Loima	School	Lomil Girls Secondary School	1500	11550		1000	37.5
56	1	Turkana	Turkana North	Clinic	Lomii Dispensary	1500	11550		1000	37.5
57	1	Turkana	Turkana Central	Clinic	Louwae Dispensary	1500	11550		1000	37.5
58	1	Turkana	Turkana East	Clinic	Nakatong'wa Dispensary	1500	11550		1000	37.5
59	1	Turkana	Turkana Central	Clinic	Nakurio Dispensary	1500	11550		1000	37.5
60	1	Turkana	Loima	Clinic	Natuntun Dispensary	1500	11550		1000	37.5
61	1	Turkana	Loima	Clinic	Kangalita Dispensary	1500	11550		1000	37.5
62	1	Turkana	Turkana South	Clinic	Kanaodon Dispensary	1500	11550		1000	37.5
63	1	Turkana	Turkana South	Clinic	Lokorkor Health Center	1500	11550		1000	37.5
64	1	Turkana	Turkana East	Clinic	Lopii Dispensary	1500	11550		1000	37.5
65	1	Turkana	Turkana South	Clinic	Juluk Dispensary	1500	11550		1000	37.5
66	1	Turkana	Turkana East	Clinic	Kamuge Dispensary	1500	11550		1000	37.5
67	1	Turkana	Turkana East	Clinic	Lomelo Dispensary	1500	11550		1000	37.5
68	1	Turkana	Turkana East	Clinic	Loyapat Dispensary	1500	11550		1000	37.5
69	1	Turkana	Turkana West	Clinic	Komudei Dispensary	1500	11550		1000	37.5
70	1	Turkana	Turkana South	Clinic	Kangitankori Dispensary	1500	11550		1000	37.5
71	1	Turkana	Turkana East	Clinic	Parkati dispensary	1800	13860		1000	45
72	1	Turkana	Turkana Central	Clinic	Kalimapus Dispensary	1800	13860		1000	45
73	1	Turkana	Turkana Central	Clinic	Nakurio Girls Secondary school	1800	13860		1000	45
74	1	Turkana	Loima	Clinic	Lochor Edome Dispensary	1800	13860		1000	45
75	1	Turkana	Turkana West	School	Kalobeyei secondary School	2100	16170		1000	52.5

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
76	1	Turkana	Loima	Clinic	Kaesogol etom Dispensary	2100	16170		1000	52.5
77	1	Turkana	Turkana East	School	Ngamia one kochodin high school	2400	18480		1000	60
78	1	Turkana	Loima	Clinic	Lochor Alomala dispensary	1500	11550		1500	37.5
79	1	Turkana	Loima	Clinic	Naotin Dispensary	1500	11550		1500	37.5
80	1	Turkana	Turkana North	Clinic	Riokomor Dispensary	1500	11550		1500	37.5
81	1	Turkana	Turkana Central	Clinic	Long'ech dispensary	1500	11550		1500	37.5
82	1	Turkana	Loima	Clinic	Loturerei dispensary	1500	11550		1500	37.5
83	1	Turkana	Turkana South	Clinic	Loperot Dispensary	1800	13860		1500	45
84	1	Turkana	Turkana West	Clinic	Nakoyo Dispensary	1800	13860		1500	45
85	1	Turkana	Turkana West	Clinic	Lokangae Health Centre	2100	16170		1500	52.5
86	1	Turkana	Turkana Central	Clinic	Kangirisae dispensary	2400	18480		1500	60
87	1	Turkana	Turkana South	Clinic	Lokapel Dispensary	2400	18480		1500	60
88	1	Turkana	Turkana Central	Clinic	Nadooto dispensary	2400	18480		1500	60
89	1	Turkana	Turkana West	Clinic	Nanam dispensary	3300	25410	4125	2500	
90	1	Turkana	Turkana East	Clinic	Lokwii Health Center	3600	27720	4500	2500	
91	1	Turkana	Turkana North	Clinic	Karebur dispensary	4200	32340	5250	2500	
92	1	Turkana	Loima	School	Loima boys secondary School	5100	39270	6375	2500	
93	1	Turkana	Turkana East	Clinic	Elelea sub-county hospital	4200	32340	5250	4000	
94	1	Turkana	Turkana East	School	A.I.C Katilia Boys Secondary School	4500	34650	5625	4000	
95	1	Turkana	Turkana West	School	Aic Songot secondary School	5700	43890	7125	4000	
96	1	Turkana	Turkana Central	School	Talent high school	5700	43890	7125	4000	

Table 2B: Lot 2 (West Pokot Counties)

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
1	2	West Pokot	Kacheliba	Clinic	Leng'orok Dispensary	1200	9240		1000	30
2	2	West Pokot	Kacheliba	Clinic	Kamketo Dispensary	1200	9240		1000	30

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
3	2	West Pokot	Kacheliba	Clinic	Nyangolesinyang dispensary	1200	9240		1000	30
4	2	West Pokot	Pokot South	Clinic	Cheptiangwa Dispensary	1200	9240		1000	30
5	2	West Pokot	Pokot South	Clinic	Kapkaremba Dispensary	1200	9240		1000	30
6	2	West Pokot	Kacheliba	Clinic	Kasitet Dispensary	1200	9240		1000	30
7	2	West Pokot	Pokot South	Clinic	Chemotong Dispensary	1200	9240		1000	30
8	2	West Pokot	Sigor	Clinic	Kiwakan Dispensary	1200	9240		1000	30
9	2	West Pokot	Kacheliba	Clinic	Kasei Assistant county commissioner's office	1200	9240		1000	30
10	2	West Pokot	Kacheliba	Clinic	Mading west pokot	1200	9240		1000	30
11	2	West Pokot	Kacheliba	Clinic	Nauyapong Dispensary	1200	9240		1000	30
12	2	West Pokot	Kacheliba	Clinic	Kamila GOK dispensary	1200	9240		1000	30
13	2	West Pokot	Kapenguria	Clinic	Kapenguria west pokot	1200	9240		1000	30
14	2	West Pokot	Kacheliba	Clinic	Nakwijit dispensary	1200	9240		1000	30
15	2	West Pokot	Kacheliba	Clinic	Nasal Dispensary	1200	9240		1000	30
16	2	West Pokot	Kapenguria	Clinic	Wonyoi dispensary	1200	9240		1000	30
17	2	West Pokot	Pokot South	Clinic	St. Marks mixed Day and Boarding Secondary School-Kapkaremba	1200	9240		1000	30
18	2	West Pokot	Sigor	Clinic	Kisera dispensary	1200	9240		1000	30
19	2	West Pokot	Sigor	Clinic	Nyangaita Dispensary	1200	9240		1000	30
20	2	West Pokot	Sigor	Clinic	Kamanau Dispensary	1200	9240		1000	30
21	2	West Pokot	Kapenguria	Clinic	Kesot Dispensary	1200	9240		1000	30
22	2	West Pokot	Kapenguria	Clinic	Krich dispensary	1200	9240		1000	30
23	2	West Pokot	Kapenguria	Clinic	Tamarukwa dispensary	1200	9240		1000	30
24	2	West Pokot	Kapenguria	Clinic	Tipet dispensary	1200	9240		1000	30
25	2	West Pokot	Kapenguria	Clinic	Miskwony dispensary	1200	9240		1000	30

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
26	2	West Pokot	Kapenguria	Clinic	Kalemrekai Dispensary	1200	9240		1000	30
27	2	West Pokot	Sigor	Clinic	Sostin dispensary	1200	9240		1000	30
28	2	West Pokot	Sigor	Clinic	Kataywa dispensary	1200	9240		1000	30
29	2	West Pokot	Kacheliba	Clinic	Cherangan dispensary	1500	11550		1000	37.5
30	2	West Pokot	Kapenguria	Clinic	Chekomosi location	1500	11550		1000	37.5
31	2	West Pokot	Sigor	Clinic	Masol Dispensary	1500	11550		1500	37.5
32	2	West Pokot	Kacheliba	Clinic	Kangoletiang Dispensary	1500	11550		1500	37.5
33	2	West Pokot	Kacheliba	Clinic	Kalemngorok dispensary	1800	13860		1000	45
34	2	West Pokot	Pokot South	Clinic	Sobukwo secondary School	1800	13860		1000	45
35	2	West Pokot	Kacheliba	Clinic	Kasei dispensary	1800	13860		1500	45
36	2	West Pokot	Sigor	Clinic	Tamkal dispensary	1800	13860		1500	45
37	2	West Pokot	Kacheliba	Clinic	Kamketo Trinity Girls Secondary School	2100	16170		1000	52.5
38	2	West Pokot	Kapenguria	Clinic	Nachecheyet Dispensary	2100	16170		2500	52.5
39	2	West Pokot	Kacheliba	Clinic	Kauryong dispensary	3000	23100	3750	2500	
40	2	West Pokot	Kapenguria	Clinic	Ptoyo Health Center	3300	25410	4125	1000	
41	2	West Pokot	Sigor	Clinic	Simpol dispensary	3300	25410	4125	2500	
42	2	West Pokot	Sigor	School	Salion secondary school	3600	27720	4500	1000	
43	2	West Pokot	Kapenguria	Clinic	Kalemnyang Yunhap	3600	27720	4500	2500	
44	2	West Pokot	Kacheliba	Clinic	Kanyerus dispensary	3900	30030	4875	5000	

Table 2C: Lot 3 (Isiolo and Marsabit)

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
1	3	Marsabit	Laisamis	Clinic	Arge Dispensary	1200	9240		1000	30
2	3	Isiolo	Isiolo North	Clinic	Korbesa mixed/secondary school	1200	9240		1000	30

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
3	3	Marsabit	Moyale	Clinic	Dabel Health Center	1200	9240		1000	30
4	3	Marsabit	North Horr	Clinic	Telesgaye Health center	1200	9240		1000	30
5	3	Marsabit	Moyale	Clinic	Madoadi dispensary	1200	9240		1000	30
6	3	Isiolo	Isiolo North	School	Armiet Mixed Secondary	1200	9240		1000	30
7	3	Marsabit	Laisamis	School	Loiyangalani vocational training polytechnic	1200	9240		1000	30
8	3	Isiolo	Isiolo North	Clinic	Oldonyiro girls	1200	9240		1000	30
9	3	Marsabit	Moyale	School	Dabel Secondary School	1200	9240		1000	30
10	3	Isiolo	Isiolo South	School	Kula Mawe Secondary School	1200	9240		1000	30
11	3	Isiolo	Isiolo North	Clinic	Lolkuta North Dispensary	1200	9240		1000	30
12	3	Isiolo	Isiolo South	Clinic	Boji dispensary	1200	9240		1000	30
13	3	Marsabit	North Horr	Clinic	Burgabo dispensary	1200	9240		1000	30
14	3	Isiolo	Isiolo North	Clinic	Daaba dispensary	1200	9240		1000	30
15	3	Isiolo	Isiolo North	Clinic	Matar-arba dispensary	1200	9240		1000	30
16	3	Marsabit	Moyale	Clinic	Qate dispensary	1200	9240		1000	30
17	3	Marsabit	Moyale	Clinic	Ell - borr dispensary	1200	9240		1000	30
18	3	Marsabit	Laisamis	Clinic	El-Molo Bay Dispensary	1200	9240		1000	30
19	3	Marsabit	Laisamis	Clinic	Oltorot Dispensary	1200	9240		1000	30
20	3	Isiolo	Isiolo South	Clinic	Barambate dispensary	1200	9240		1000	30
21	3	Marsabit	Moyale	Clinic	Waye Godha dispensary	1200	9240		1000	30
22	3	Isiolo	Isiolo South	Clinic	Janju Dispensary	1200	9240		1000	30
23	3	Marsabit	North Horr	Clinic	Ileret Health center	1200	9240		1000	30
24	3	Marsabit	Saku	Clinic	Segel Dispensary	1200	9240		1000	30
25	3	Marsabit	Moyale	Clinic	Nana Health Center	1500	11550		1000	37.5
26	3	Isiolo	Isiolo North	Clinic	Ntalaby Primay school	1500	11550		1000	37.5
27	3	Marsabit	Laisamis	Clinic	Korolle Boys' Secondary School	1500	11550		1000	37.5

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
28	3	Marsabit	North Horr	Clinic	Dukana Ward Administrator's Office	1500	11550		1000	37.5
29	3	Marsabit	Moyale	Clinic	Badan Rero Dispensary	1500	11550		1500	37.5
30	3	Isiolo	Isiolo North	Office	Kom Acc Office	1800	13860		1000	45
31	3	Isiolo	Isiolo South	Clinic	Muchuro dispensary	1800	13860		1000	45
32	3	Isiolo	Isiolo North	Clinic	Biliqo Marara dispensary	2100	16170		1000	52.5
33	3	Marsabit	Laisamis	Clinic	Arapal Dispensary	2100	16170		1500	52.5
34	3	Isiolo	Isiolo North	Clinic	Korbesa Dispensary	2100	16170		1500	52.5
35	3	Marsabit	North Horr	Clinic	Dukana Health Center	2100	16170		2500	52.5
36	3	Marsabit	North Horr	Clinic	Hurri Hills dispensary	2100	16170		2500	52.5
37	3	Marsabit	Laisamis	Clinic	Namarei Borehole Pumphouse	2400	18480		1500	60
38	3	Marsabit	Moyale	Clinic	Godoma Health Centre (Nep)	2400	18480		2500	60
39	3	Marsabit	Laisamis	Clinic	Lontolio Dispensary	2400	18480		3000	60
40	3	Marsabit	Laisamis	School	Kulal Girls Secondary school	2450	18865		1000	61.25
41	3	Marsabit	Moyale	Clinic	Karbururi dispensary	3000	23100	3750	1500	
42	3	Marsabit	Saku	Clinic	Kituruni Dispensary	3300	25410	4125	1500	
43	3	Isiolo	Isiolo North	School	Ngaremara secondary-boys	16450	126665	20563	15000	

Table 2D: Lot 4 (Samburu County)

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
1	4	Samburu	Samburu East	Clinic	Oromodei dispensary	1200	9240		1000	30
2	4	Samburu	Samburu West	School	Ledero Mixed Secondary School	1200	9240		1000	30
3	4	Samburu	Samburu North	Clinic	Sereni dispensary	1200	9240		1000	30

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
4	4	Samburu	Samburu North	Clinic	Waso Rongai Dispensary	1200	9240		1000	30
5	4	Samburu	Samburu North	School	Engilai Mixed Secondary	1200	9240		1000	30
6	4	Samburu	Samburu North	Clinic	Loikumkum Dispensary	1200	9240		1000	30
7	4	Samburu	Samburu North	Clinic	Angata Nanyokie Dispensary	1200	9240		1000	30
8	4	Samburu	Samburu West	School	Kirimon mixed day secondary	1200	9240		1000	30
9	4	Samburu	Samburu North	Clinic	Logetei Dispensary	1200	9240		1000	30
10	4	Samburu	Samburu West	Clinic	Lolmolog Mixed Day Secondary school	1200	9240		1000	30
11	4	Samburu	Samburu East	Clinic	Nkaroni dispensary	1200	9240		1000	30
12	4	Samburu	Samburu East	Clinic	Klitamany dispensary	1200	9240		1000	30
13	4	Samburu	Samburu East	Clinic	Laresolo dispensary	1200	9240		1000	30
14	4	Samburu	Samburu North	Clinic	Marti dispensary	1200	9240		1000	30
15	4	Samburu	Samburu North	Clinic	Masikita Dispensary	1200	9240		1000	30
16	4	Samburu	Samburu North	Clinic	Nachola Dispensary	1200	9240		1000	30
17	4	Samburu	Samburu East	Clinic	Ndonyo Nasipa Dispensary	1200	9240		1000	30
18	4	Samburu	Samburu North	Clinic	Muruankai GOK Dispensary	1200	9240		1000	30
19	4	Samburu	Samburu West	Clinic	Longewan Dispensary	1200	9240		1000	30
20	4	Samburu	Samburu North	Clinic	Loonjorin Dispensary	1200	9240		1000	30
21	4	Samburu	Samburu West	Clinic	Naborkeju Dispensary	1200	9240		1000	30
22	4	Samburu	Samburu West	Clinic	Lkiloriti dispensary	1500	11550		1000	37.5
23	4	Samburu	Samburu North	Clinic	Urra Dispensary	1500	11550		1000	37.5
24	4	Samburu	Samburu North	Clinic	Ngilai (Saidia) dispensary	1500	11550		1000	37.5
25	4	Samburu	Samburu East	Clinic	Donyo-Wasin Dispensary	1500	11550		1500	37.5
26	4	Samburu	Samburu East	Clinic	Sereolipi mixed day secondary school	1800	13860		1000	45

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
27	4	Samburu	Samburu West	School	Longewan Mixed Day Secondary school	1800	13860		1000	45
28	4	Samburu	Samburu West	Clinic	Lolngese Dispensary	1800	13860		1000	45
29	4	Samburu	Samburu East	School	Wamba mixed secondary school	1800	13860		1000	45
30	4	Samburu	Samburu East	Clinic	Marti E pareu	1800	13860		1000	45
31	4	Samburu	Samburu West	Clinic	Nauneri Dispensary	1800	13860		1000	45
32	4	Samburu	Samburu North	School	Ngurunit Mixed Secondary School	1800	13860		1500	45
33	4	Samburu	Samburu West	Clinic	Ledero dispensary	2100	16170		1000	52.5
34	4	Samburu	Samburu West	School	Suguta Mar Mar Mixed Day Secondary School	2400	18480		1000	60
35	4	Samburu	Samburu West	Clinic	Lolmolog Dispensary	3300	25410	4125	1500	
36	4	Samburu	Samburu North	Clinic	Barsoloi arid zone primary school	3900	30030	4875	1000	
37	4	Samburu	Samburu West	School	Maralal Day Mixed Secondary School	5100	39270	6375	1000	
38	4	Samburu	Samburu West	School	Kisima mixed secondary school	5400	41580	6750	4000	
39	4	Samburu	Samburu West	Clinic	Seketet dispensary	5700	43890	7125	3000	

Table 2E: Lot 5 (Mandera County)

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
1	5	Mandera	Mandera North	Clinic	Olla secondary school	1200	9240		1000	30
2	5	Mandera	Mandera West	Clinic	Gither Mixed Day/Boarding Secondary school	1200	9240		1000	30

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
3	5	Mandera	Mandera West	School	Burduras secondary School	1200	9240		1000	30
4	5	Mandera	Banissa	Clinic	Choroko Dispensary	1200	9240		1000	30
5	5	Mandera	Mandera South	Clinic	Burmayo Dispensary	1200	9240		1000	30
6	5	Mandera	Banissa	Clinic	Burjon Dispensary	1200	9240		1000	30
7	5	Mandera	Mandera East	Clinic	Koromey Dispensary	1200	9240		1000	30
8	5	Mandera	Mandera South	Clinic	Chachabole Dispensary	1200	9240		1000	30
9	5	Mandera	Lafey	Office	Fino ACC	1500	11550		1000	37.5
10	5	Mandera	Lafey	Office	Lafey ACC	1500	11550		1000	37.5
11	5	Mandera	Mandera South	Clinic	Kutayu dispensary	1500	11550		1000	37.5
12	5	Mandera	Banissa	Clinic	Kukub dispensary	1500	11550		1000	37.5
13	5	Mandera	Banissa	Clinic	Tarama Dispensary	1500	11550		1000	37.5
14	5	Mandera	Mandera South	Clinic	Garsesala Dispensary	1500	11550		1000	37.5
15	5	Mandera	Mandera West	Clinic	Lagsure dispensary	1500	11550		1000	37.5
16	5	Mandera	Banissa	Clinic	Domal dispensary	1500	11550		1500	37.5
17	5	Mandera	Lafey	School	Aresa girls secondary	1800	13860		1000	45
18	5	Mandera	Mandera West	Clinic	Kobadadi dispensary	1800	13860		1500	45
19	5	Mandera	Banissa	Clinic	Birkan dispensary	1800	13860		1500	45
20	5	Mandera	Mandera North	Clinic	Kalicha Dispensary	2100	16170		1000	52.5
21	5	Mandera	Lafey	Clinic	Aresa Dispensary	2100	16170		1000	52.5
22	5	Mandera	Banissa	Clinic	Hullow Dispensary	2100	16170		1500	52.5
23	5	Mandera	Mandera East	Clinic	BP1 Dispensary	2100	16170		2500	52.5
24	5	Mandera	Mandera South	Clinic	Alongo Dispensary	2400	18480		2500	60
25	5	Mandera	Mandera East	Clinic	Arabia Health Centre	2400	18480		2500	60
26	5	Mandera	Lafey	Clinic	Damasa Dispensary	2400	18480		2500	60
27	5	Mandera	Mandera South	Clinic	El-Golicha Dispensary	2400	18480		2500	60
28	5	Mandera	Mandera South	Clinic	Elram Dispensary	2400	18480		2500	60
29	5	Mandera	Mandera South	Clinic	Elram Dispensary	2400	18480		2500	60

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
30	5	Mandera	Mandera South	Clinic	Falama Dispensary	2400	18480		2500	60
31	5	Mandera	Lafey	Clinic	Fino Health Centre	2400	18480		2500	60
32	5	Mandera	Mandera East	Clinic	Hareri Hosle Dispensary	2400	18480		2500	60
33	5	Mandera	Lafey	Clinic	Kabo Dispensary	2400	18480		2500	60
34	5	Mandera	Lafey	Clinic	Lafey nomadic dispensary	2400	18480		2500	60
35	5	Mandera	Lafey	Clinic	Odha Dispensary	2400	18480		2500	60
36	5	Mandera	Mandera East	Clinic	Omar jilaow Dispensary	2400	18480		2500	60
37	5	Mandera	Mandera West	Clinic	Qarsahama Dispensary	2400	18480		2500	60
38	5	Mandera	Banissa	Clinic	Malkamari Boys' Secondary School	3000	23100	3750	1500	
39	5	Mandera	Mandera North	School	Libin Nomadic Girls Secondary School	3000	23100	3750	1500	
40	5	Mandera	Lafey	Clinic	Gari secondary School	3300	25410	4125	3000	
41	5	Mandera	Lafey	Clinic	Hareri Mixed Secondary School	3400	26180	4250	1000	
42	5	Mandera	Mandera North	Clinic	Rhamu Dimtu Health Centre	3600	27720	4500	2500	
43	5	Mandera	Mandera North	Office	Rhamu Dimtu Chief's Office	3900	30030	4875	1000	
44	5	Mandera	Mandera South	Clinic	Qarsadamu dispensary	3900	30030	4875	3000	
45	5	Mandera	Mandera West	School	Dandu Secondary School	4200	32340	5250	2500	
46	5	Mandera	Mandera West	Clinic	Bolowle dispensary	5400	41580	6750	5000	
47	5	Mandera	Banissa	Clinic	Derkale dispensary	5700	43890	7125	2500	
48	5	Mandera	Mandera West	Office	Dandu ACC Office	6600	50820	8250	1000	
49	5	Mandera	Mandera South	School	El- hagarsu mixed day secondary school	7200	55440	9000	5000	
50	5	Mandera	Mandera West	Clinic	Dandu Health Centre	23700	182490	29625	15000	

Table 2F: Lot 6(Wajir Counties)

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
1	6	Wajir	Eldas	Office	Anole ACCsOffice	1200	9240		1000	30
2	6	Wajir	Wajir South	Clinic	Burder Secondary School	1200	9240		1000	30
3	6	Wajir	Wajir South	Office	Busbus primary school	1200	9240		1000	30
4	6	Wajir	Tarbaj	Clinic	Dureweey dispensary	1200	9240		1000	30
5	6	Wajir	Wajir South	Clinic	Argane dispensary	1200	9240		1000	30
6	6	Wajir	Tarbaj	Clinic	Burmayo Dispensary Wajir	1200	9240		1000	30
7	6	Wajir	Eldas	Clinic	Lakole Dispensary	1200	9240		1000	30
8	6	Wajir	Wajir West	Clinic	Wara Dispensary	1200	9240		1000	30
9	6	Wajir	Eldas	Clinic	Arbajahan mixed/day and boarding secondary Schools	1200	9240		1000	30
10	6	Wajir	Tarbaj	Clinic	Wargadud Dispensary(Tarbaj)	1200	9240		1000	30
11	6	Wajir	Wajir North	Clinic	Malkagufu Dispensary	1200	9240		1000	30
12	6	Wajir	Wajir North	Clinic	Beramo Dispensary	1200	9240		1000	30
13	6	Wajir	Eldas	Clinic	Dadhantaly Dispensary	1200	9240		1000	30
14	6	Wajir	Wajir North	Clinic	Dunto Dispensary	1200	9240		1000	30
15	6	Wajir	Tarbaj	Clinic	Elben Dispensary	1200	9240		1000	30
16	6	Wajir	Wajir North	Clinic	Ogorji Dispensary	1200	9240		1000	30
17	6	Wajir	Wajir West	Clinic	Bojiyare Dispensary	1500	11550		1000	37.5
18	6	Wajir	Wajir South	Clinic	Sabuli Nomadic Clinic	1500	11550		1000	37.5
19	6	Wajir	Eldas	Clinic	Anole Dispensary	1500	11550		1000	37.5
20	6	Wajir	Wajir South	Clinic	Kursin Health Centre	1500	11550		1000	37.5
21	6	Wajir	Wajir North	Clinic	Batalu Dispensary	1500	11550		1000	37.5
22	6	Wajir	Tarbaj	Clinic	Hargal Dispensary	1500	11550		1000	37.5
23	6	Wajir	Wajir North	Clinic	Malkagufu Primary School	1800	13860		1000	45
24	6	Wajir	Wajir South	Clinic	Tesorie Dispensary	1800	13860		1000	45
25	6	Wajir	Eldas	Clinic	Mathow Dispensary	1800	13860		1000	45
26	6	Wajir	Wajir West	Clinic	Ganyure dispensary	1800	13860		1500	45
27	6	Wajir	Tarbaj	Clinic	Hungai Dispensary	1800	13860		1500	45

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
28	6	Wajir	Wajir West	Clinic	Shanta Abaq Dispensary (Wajir West)	2100	16170		1000	52.5
29	6	Wajir	Eldas	Office	Anole APs Camp	2400	18480		1000	60
30	6	Wajir	Wajir East	Clinic	Wajir bor Boys secondary School	2400	18480		1000	60
31	6	Wajir	Wajir North	Clinic	Dugo Health Centre	2400	18480		2500	60
32	6	Wajir	Eldas	Clinic	Tula tula Secondary	3000	23100	3750	1000	
33	6	Wajir	Wajir South	Clinic	Sabuli mixed day secondary School	4200	32340	5250	4000	
34	6	Wajir	Wajir West	Office	Lagbogol secondary school	4500	34650	5625	3000	
35	6	Wajir	Wajir East	School	Baraqwo secondary	5200	40040	6500	2500	
36	6	Wajir	Wajir North	School	Buna girls secondary	5400	41580	6750	1500	
37	6	Wajir	Wajir North	School	buna boys Secondary	5400	41580	6750	2500	
38	6	Wajir	Wajir East	School	KHOrof harar youth polytechnic	5700	43890	7125	4000	
39	6	Wajir	Wajir South	School	Diif Secondary School	8100	62370	10125	5000	

Table 2G: Lot 7(Garissa County)

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
1	7	Garissa	Ijara	Clinic	Mohammed Dahir	1200	9240		1000	30
2	7	Garissa	Fafi	Clinic	Sangole Dispensary	1200	9240		1000	30
3	7	Garissa	Dadaab	Office	IFO 1 AP camp	1200	9240		1000	30
4	7	Garissa	Lagdera	Clinic	Afwein Dispensary	1200	9240		1000	30
5	7	Garissa	Ijara	Clinic	Township primary school	1200	9240		1000	30
6	7	Garissa	Ijara	Clinic	Kotile health center	1200	9240		1000	30
7	7	Garissa	Fafi	Office	ACC office/Residence Galmagala	1200	9240		1000	30

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
8	7	Garissa	Dadaab	Office	ACC office/Residence Jarajilla	1200	9240		1000	30
9	7	Garissa	Ijara	Office	Bodhai ACC office	1200	9240		1000	30
10	7	Garissa	Ijara	Clinic	Jalish Dispensary	1200	9240		1000	30
11	7	Garissa	Ijara	Clinic	Korisa Dispensary	1200	9240		1000	30
12	7	Garissa	Dadaab	Clinic	Malaylay Dispensary	1200	9240		1000	30
13	7	Garissa	Balambala	Clinic	Libahlow dispensary	1200	9240		1000	30
14	7	Garissa	Ijara	Clinic	Ruqa Dispensary	1200	9240		1000	30
15	7	Garissa	Fafi	Office	Sanguilu ACC office	1500	11550		1000	37.5
16	7	Garissa	Lagdera	Clinic	Jilango dispensary	1500	11550		1500	37.5
17	7	Garissa	Fafi	Clinic	Amuma Dispensary	1800	13860		1500	45
18	7	Garissa	Fafi	Clinic	Amuma Mobile Dispensary	1800	13860		1500	45
19	7	Garissa	Ijara	Clinic	Bodhai Dispensary	1800	13860		1500	45
20	7	Garissa	Ijara	Clinic	Dekaharjey Dispensary	1800	13860		1500	45
21	7	Garissa	Ijara	Clinic	El Kambere Nomadic Clinic	1800	13860		1500	45
22	7	Garissa	Fafi	Clinic	Fafi Dispensary	1800	13860		1500	45
23	7	Garissa	Fafi	Clinic	Yumbis Dispensary	1800	13860		1500	45
24	7	Garissa	Dadaab	Clinic	Abdisamit Dispensary	2100	16170		1000	52.5
25	7	Garissa	Ijara	Clinic	Bultohama Dispensary	2100	16170		1000	52.5
26	7	Garissa	Lagdera	Clinic	Elan Dispensary	2100	16170		1500	52.5
27	7	Garissa	Balambala	Clinic	Danyere Health Centre	2100	16170		2500	52.5
28	7	Garissa	Dadaab	Clinic	Bogyar dispensary	2400	18480		1000	60
29	7	Garissa	Fafi	Clinic	Hagarbul Dispensary	2800	21560		1500	70
30	7	Garissa	Dadaab	School	Kulan secondary School	3900	30030	4875	2500	
31	7	Garissa	Ijara	Clinic	Hara health center	8100	62370	10125	4000	
32	7	Garissa	Dadaab	Clinic	Saretho Dispensary	8400	64680	10500	5000	

Table 2H: Lot 8(Lamu County)

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
1	8	Lamu	Lamu West	Clinic	Dide waride dispensary	1200	9240		1000	30
2	8	Lamu	Lamu West	School	kizuke primary school	1200	9240		1000	30
3	8	Lamu	Lamu West	Clinic	Maisha masha	1200	9240		1000	30
4	8	Lamu	Lamu West	Clinic	Didewaride primary school	1200	9240		1000	30
5	8	Lamu	Lamu West	School	Pangani Secondary School	1200	9240		1000	30
6	8	Lamu	Lamu West	Clinic	Sinambio dispensary	1200	9240		1000	30
7	8	Lamu	Lamu West	Clinic	Pandanguo primary school	1200	9240		1000	30
8	8	Lamu	Lamu West	Clinic	Manda Dispensary	1200	9240		1000	30
9	8	Lamu	Lamu West	School	Manda Maweri Secondary School	1200	9240		1000	30
10	8	Lamu	Lamu West	School	Chalaluma primary school	1200	9240		1000	30
11	8	Lamu	Lamu West	Clinic	Barigoni Dispensary	1200	9240		1000	30
12	8	Lamu	Lamu West	Clinic	Basuba Dispensary	1200	9240		1000	30
13	8	Lamu	Lamu West	Clinic	Bodhei Dispensary	1200	9240		1000	30
14	8	Lamu	Lamu East	Clinic	Ishakani Dispensary	1200	9240		1000	30
15	8	Lamu	Lamu East	Clinic	Mangai Dispensary	1200	9240		1000	30
16	8	Lamu	Lamu East	Office	Acc Kiunga	1500	11550		1000	37.5
17	8	Lamu	Lamu East	School	Basuba	1500	11550		1000	37.5
18	8	Lamu	Lamu East	School	Ishakani	1500	11550		1000	37.5
19	8	Lamu	Lamu East	School	Kiangwi	1500	11550		1000	37.5
20	8	Lamu	Lamu East	School	Madani	1500	11550		1000	37.5
21	8	Lamu	Lamu East	School	Mangai	1500	11550		1000	37.5
22	8	Lamu	Lamu East	School	Marararni	1500	11550		1000	37.5
23	8	Lamu	Lamu West	Clinic	Pandanguo Dispensary	1500	11550		1000	37.5
24	8	Lamu	Lamu East	Clinic	Kiangwi Dispensary	1500	11550		1000	37.5
25	8	Lamu	Lamu West	Clinic	Bahamisi Dispensary	1500	11550		1000	37.5
26	8	Lamu	Lamu West	School	Maisha Masha secondary	2100	16170		1000	52.5
27	8	Lamu	Lamu West	School	Majembeni Secondary School	2100	16170		1000	52.5

Table 2I: Lot 9(Tana River County)

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
1	9	Tana River	Garsen	School	Mandingo Dispensary	1200	9240		1000	30
2	9	Tana River	Galole	Office	Waldena ACC	1200	9240		1000	30
3	9	Tana River	Garsen	Clinic	Galili Dispensary	1200	9240		1000	30
4	9	Tana River	Bura	Clinic	Mulanjo dispensary	1200	9240		1000	30
5	9	Tana River	Bura	Clinic	Buwa Dispensary	1200	9240		1000	30
6	9	Tana River	Galole	Clinic	AIC Titila Dispensary	1200	9240		1000	30
7	9	Tana River	Garsen	Clinic	Asa Kone Dispensary	1200	9240		1000	30
8	9	Tana River	Garsen	Clinic	Assa dispensary	1200	9240		1000	30
9	9	Tana River	Bura	Clinic	Boka dispensary	1200	9240		1000	30
10	9	Tana River	Bura	Clinic	Chewele Dispensary	1200	9240		1000	30
11	9	Tana River	Galole	Clinic	Haroresa Dispensary	1200	9240		1000	30
12	9	Tana River	Bura	Clinic	Meti Dispensary	1200	9240		1000	30
13	9	Tana River	Bura	Clinic	Sabukia dispensary	1200	9240		1000	30
14	9	Tana River	Garsen	Clinic	Kau Dispensary	1200	9240		1000	30
15	9	Tana River	Bura	Clinic	Sombo Dispensary	1200	9240		1000	30
16	9	Tana River	Galole	Clinic	Chifiri Dispensary	1500	11550		1000	37.5
17	9	Tana River	Galole	Clinic	Wayu Boru Dispensary	1500	11550		1000	37.5
18	9	Tana River	Garsen	Clinic	Mwina Dispensary	1500	11550		1000	37.5
19	9	Tana River	Galole	Clinic	Wayu Dispensary	1500	11550		1000	37.5
20	9	Tana River	Garsen	Clinic	Ozi Dispensary	1500	11550		1500	37.5
21	9	Tana River	Bura	Clinic	Bangale Chiefs office	1800	13860		1500	45
22	9	Tana River	Bura	Clinic	Bangali Dispensary	1800	13860		1500	45
23	9	Tana River	Garsen	Clinic	Sera dispensary	1800	13860		1500	45
24	9	Tana River	Garsen	Clinic	Mnazini dispensary	1800	13860		1500	45
25	9	Tana River	Galole	School	Majengo secondary	2100	16170		1000	52.5
26	9	Tana River	Bura	Clinic	Bilbil dispensary	2100	16170		2500	52.5

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
27	9	Tana River	Galole	Clinic	Aic Daba Dispensary	2400	18480		1500	60
28	9	Tana River	Galole	Clinic	Waldena Dispensary	3000	23100	3750	3000	
29	9	Tana River	Garsen	Clinic	Kitere secondary school	3600	27720	4500	3000	
30	9	Tana River	Bura	Clinic	Mororo mixed day secondary school	3900	30030	4875	3000	
31	9	Tana River	Garsen	Clinic	Semikaro Dispensary	5100	39270	6375	5000	
32	9	Tana River	Galole	Clinic	Huruma mixed day secondary School	5700	43890	7125	4000	

Table 2J: Lot 10 (Kilifi, Kwale and Taita Taveta)

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
1	10	Taita Taveta	Voi	Clinic	Gimba Dispensary	1200	9240		1000	30
2	10	Taita Taveta	Voi	Clinic	Mwangea Dispensary	1200	9240		1000	30
3	10	Kilifi	Rabai	School	Kawala girls secondary school	1200	9240		1000	30
4	10	Kilifi	Magarini	School	Kurawa Secondary school	1200	9240		1000	30
5	10	Kwale	Matuga	Clinic	Mbegani Dispensary	1200	9240		1000	30
6	10	Kwale	Kinango	School	Bang'a secondary school	1200	9240		1000	30
7	10	Kilifi	Magarini	School	Watala Secondary School	1200	9240		1000	30
8	10	Kilifi	Magarini	Clinic	Mwangatini Dispensary	1200	9240		1000	30
9	10	Kilifi	Magarini	School	Baricho Secondary School	1200	9240		1000	30
10	10	Kilifi	Magarini	Office	Gandini Assistant Chief's office	1200	9240		1000	30
11	10	Taita Taveta	Voi	Clinic	Bamako dispensary	1200	9240		1000	30
12	10	Kwale	Kinango	Clinic	Chanzou Dispensary	1200	9240		1000	30

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
13	10	Kilifi	Kaloleni	Clinic	Kasemeni dispensary	1200	9240		1000	30
14	10	Kilifi	Magarini	School	Gandini Primary school	1200	9240		1000	30
15	10	Kilifi	Magarini	School	Adu secondary	1200	9240		1000	30
16	10	Kilifi	Kaloleni	Clinic	Viragoni dispensary	1200	9240		1000	30
17	10	Kilifi	Magarini	Clinic	Gandini dispensary	1200	9240		1000	30
18	10	Kilifi	Magarini	Clinic	Karimboni dispensary	1200	9240		1000	30
19	10	Kilifi	Magarini	Clinic	Mulunguni dispensary	1200	9240		1000	30
20	10	Kilifi	Ganze	Clinic	Muryachakwe Dispensary	1200	9240		1000	30
21	10	Kwale	Kinango	Clinic	Mwachinga dispensary	1200	9240		1000	30
22	10	Kwale	Kinango	Clinic	Gozani dispensary	1200	9240		1000	30
23	10	Kwale	Lunga Lunga	Clinic	Mkwiro Dispensary	1200	9240		1000	30
24	10	Kilifi	Magarini	Office	Local Chief's Office	1500	11550		1000	37.5
25	10	Kilifi	Magarini	Clinic	Waresa Secondary School	1500	11550		1000	37.5
26	10	Kwale	Kinango	Clinic	Mkang'ombe Dispensary	1500	11550		1000	37.5
27	10	Kilifi	Ganze	Clinic	Sokoke Health dispensary	1500	11550		1000	37.5
28	10	Taita Taveta	Wundanyi	Clinic	Sengeroko Dispensary	1500	11550		1000	37.5
29	10	Kwale	Lunga Lunga	Clinic	Wasini Dispensary	1500	11550		1000	37.5
30	10	Kilifi	Kilifi North	Clinic	Kadaina Dispensary	1500	11550		1500	37.5
31	10	Kwale	Matuga	Clinic	Mbegani secondary	2100	16170		1000	52.5
32	10	Kilifi	Magarini	Clinic	Baricho Dispensary	2100	16170		1500	52.5
33	10	Kilifi	Magarini	Clinic	Chamari dispensary	2100	16170		2500	52.5
34	10	Kilifi	Ganze	Clinic	Midoina dispensary	2100	16170		2500	52.5
35	10	Kilifi	Rabai	School	Bwagamoyo Secondary School	3300	25410	4125	2500	
36	10	Kilifi	Magarini	Clinic	Motoloani dispensary	3900	30030	4875	2500	
37	10	Kilifi	Magarini	School	Shujaa Mekatilili Secondary	15900	122430	19875	15000	

Table 2K: Lot 11 (Narok County)

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
1	11	Narok	Kilgoris	Clinic	Kapune. Trans Mara west	1200	9240		1000	30
2	11	Narok	Narok South	Clinic	Masese secondary	1200	9240		1000	30
3	11	Narok	Emurua Dikirr	Clinic	Roborwo Dispensary	1200	9240		1000	30
4	11	Narok	Narok South	Clinic	Mausa dispensary	1200	9240		1000	30
5	11	Narok	Narok South	Clinic	Olmesutie Dispensary	1200	9240		1000	30
6	11	Narok	Narok West	Clinic	Leshuta Dispensary	1200	9240		1000	30
7	11	Narok	Emurua Dikirr	Clinic	Kendunywo primary school	1200	9240		1000	30
8	11	Narok	Narok South	Clinic	Ilkerin -Loita dispensary	1200	9240		1000	30
9	11	Narok	Narok West	School	Aganga Mixed Day Secondary	1200	9240		1000	30
10	11	Narok	Emurua Dikirr	Clinic	Chebara primary school	1200	9240		1000	30
11	11	Narok	Narok South	Clinic	Chemwokter Dispensary	1200	9240		1000	30
12	11	Narok	Narok East	Clinic	Entotol dispensary	1200	9240		1000	30
13	11	Narok	Emurua Dikirr	Clinic	Kuresiet health center	1200	9240		1000	30
14	11	Narok	Kilgoris	Clinic	Meguarra dispensary	1200	9240		1000	30
15	11	Narok	Kilgoris	Clinic	Shankoe Dispensary	1200	9240		1000	30
16	11	Narok	Narok West	Clinic	Olkoroi dispensary	1200	9240		1000	30
17	11	Narok	Narok South	School	Saire day mixed secondary	1500	11550		1000	37.5
18	11	Narok	Narok West	Clinic	Sekenani Community Health Centre	1500	11550		1000	37.5
19	11	Narok	Kilgoris	Clinic	Ngendalel dispensary	1500	11550		1000	37.5
20	11	Narok	Kilgoris	Clinic	Sosiana Dispensary	1500	11550		1000	37.5
21	11	Narok	Narok West	Clinic	Endoinyo Narasha	1500	11550		1500	37.5
22	11	Narok	Narok South	Clinic	Enaramatishoreki health center	1800	13860		1000	45
23	11	Narok	Narok West	Clinic	Olderkesi dispensary	1800	13860		1500	45
24	11	Narok	Emurua Dikirr	School	Kuresiet Secondary School	2100	16170		1000	52.5

No.	Lot	County	Subcounty	Facility Type	Name	PV Capacity (Wp)	Battery Capacity (Wh)	PV Inverter for AC Coupled systems (W)	Battery Inverter charger (W)	Charge Controller for DC Coupled systems (A)
25	11	Narok	Emurua Dikirr	School	Chesabuni Primary School	2100	16170		1000	52.5
26	11	Narok	Emurua Dikirr	Clinic	Kamarget dispensary	2100	16170		1500	52.5
27	11	Narok	Narok South	Clinic	Enkutoto Dispensary	2100	16170		2500	52.5
28	11	Narok	Narok West	Clinic	Endoinyo Erinka Dispensary	2400	18480		3000	60
29	11	Narok	Narok West	Clinic	Megwara Dispensary	3300	25410	4125	4000	
30	11	Narok	Narok West	Clinic	Losho Dispensary	3600	27720	4500	3000	
31	11	Narok	Narok North	School	Enakishomi mixed secondary school	3900	30030	4875	1000	
32	11	Narok	Narok South	Clinic	Tengecha Esoit Secondary School	4200	32340	5250	1000	
33	11	Narok	Narok South	Clinic	Iltriben primary school	4500	34650	5625	4000	
34	11	Narok	Narok West	Office	ACC's office, Assistant Chief Office, Tourist Police	6300	48510	7875	3000	

1.2.2 Supply of materials necessary for connecting the community facility including connection cable, its installation, together with the energy meter (the customer energy meter to be supplied by KPLC) for providing electricity service connection as per KPLC requirements/specifications.

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

1.2.4 Reliable Power supply to community facilities on behalf of KPLC, including timely attending to complaints/Breakdowns to ensure regular supply.

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. 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 1.1-1.2 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 BESS should have two days' autonomy for designed demand for community facilities.

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 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 enclosures 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 System (DAS)

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, capable of at least C/4 charge/discharge rate.

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.

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 Bidder 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) 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 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

2.4 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 clauses of ERTS.

2.4.2 The bidder should note that 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 repsect to the 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 are 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 promptly report accidents, if any, to KPLC showing the circumstances under which it happened and the extent of damage and or injury caused.

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) every month 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(7yrs), 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) Minimum availability of 95% (time the system is operational)
c) Complaints lodged by consumers to be attended within 2 days.
d) Maintain spares to cater replacement within 5 days of complaint.
e) Scheduled outages to be conveyed 24 hours in advance to the consumer.

2.8 Quality Spares and Consumables

2.8.1 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.

2.9 Tools and Tackles

2.9.1 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.

3. STANDARDS AND SPECIFICATIONS

3.1 Standards and Specifications for SPGP and BESS

3.1.1 The standards & specifications to which equipment and material of SPGP and BESS shall comply are given in the Table 3 below:

Table 3

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 Solar PV 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)
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

3.2 Guidelines and Grid Codes

3.2.1 Energy Act 2019.

3.2.2 Draft Energy Solar Photovoltaic Systems Regulations 2019

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

3.2.4 Connection guidelines for small scale renewable generating plant guidelines: Dec 2012

3.2.5 BS 7430: 1999: Code of practice for earthing.

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

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

4. TECHNICAL SPECIFICATIONS FOR SOLAR POWER GENERATION PLANT

4.1 SPV Crystalline Modules

4.1.1 SPV Poly / Mono crystalline modules of 72- or 60-cell with minimum 16.3% efficiency.

Solar modules offered shall be

i) Tier-1 Manufacturer of Kenya or international company.
ii) Certified as per IEC 61215 /ISI14286
iii) Qualify IEC 61730- Part -1: PV Module Safety Qualification Part -1 Requirement for Construction.
iv) Qualify IEC 61730- Part -2: PV Module Safety Qualification Part -2 Requirements for Testing.

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

4.1.3 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.

4.1.4 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.

4.2 Identification and Traceability

4.2.1 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.

4.3 Warranties for Modules

4.3.1 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.

4.3.2 Performance Warranty

i) 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.

ii) Bidder shall provide data sheet for solar PV module (under standard testing condition) along with their offer as per guaranteed technical particular (Bid Response sheet -1).

4.4 Module Mounting Structure (MMS)

4.4.1 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: 5º tilt angle shall be provided for all sites with adequate spacing to prevent inter-row shading.

4.4.2 Structure shall comply with IEC 61215/61646.

4.4.3 The mounting steel structure and its galvanizing shall be as per standards listed in Table 2 above

4.4.4 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.

4.4.5 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.

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

4.4.7 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

4.4.8 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.

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

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

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

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

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

4.4.14 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.

4.5 PV Inverter

4.5.1 SPGP shall be either DC- or AC-coupled as per the lists provided in Tables 2A-2K.

4.5.2 The efficiency of the Inverter shall be more than 97% at full load.

4.5.3 Supply Voltage and Variation

i) Supply voltage Single phase, 230V AC
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.

4.5.4 The inverter shall have high overload capacity. The Bidder should specify the overload capacity in the bid.

4.5.5 String inverter(s)/ Central inverter(s) as per design shall be of requisite numbers having equal to total AC capacity as per requirement of each site at a suitable DC/AC ratio as specified for the inverter.

4.5.6 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.

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

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

4.5.9 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.

4.5.10 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.

4.5.11 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.

4.5.12 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.

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

4.5.14 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.

4.5.15 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.

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

4.5.17 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

4.5.18 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.

4.5.19 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

4.5.20 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.

4.5.21 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.

4.5.22 Operation outside the limits of power quality as described in the technical data sheet should cause the inverter to disconnect the grid. 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.

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

4.6 Battery Inverter/ Charger

4.6.1 SPGP shall be either DC- or AC-coupled as per the lists provided in Tables 2A-2K.

4.6.2 The efficiency of the Inverter shall be more than 95% at full load.

4.6.3 Supply Voltage and Variation

i) Nominal Input VDC 48 V
ii) Supply voltage Single phase, 230V AC
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.

4.6.4 The inverter shall have high overload capacity. The Bidder should specify the overload capacity in the bid.

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

4.6.6 Inverters to have pure sinewave output waveform.

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

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

4.6.9 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.

4.6.10 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.

4.6.11 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.

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

4.6.13 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.

4.6.14 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.

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

4.6.16 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

4.6.17 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.

4.6.18 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

4.6.19 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.

4.6.20 Operation outside the limits of power quality as described in the technical data sheet should cause the inverter to disconnect the grid. 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.

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

4.7 Battery Energy Storage System (BESS)

4.7.1 Supply of Battery Energy Storage System (BESS) with Lithium-ion Battery pack conforming to IEC standards with warranty of 10 years, 3000 cycles minimum. Complete in all respects as under and confirming to Employer's Requirement & technical specification, consisting of

i) Lithium-ion Battery Power Packs for required energy capacity, or equivalent as per approved design, minimum 80% Depth of Discharge (DOD). Batteries should be capable of at least C/4 charge and discharge rate.

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

iii) All accessories for correct installation, foundation, connection, controls, and operation of BESS.

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

4.7.3 The BESS must allow minimum 80% of Depth of Discharge in all installations as Lithium ion shall be used.

4.7.4 Warranted number of cycles for the BESS for lithium Ion battery systems at the supplier recommended depth of discharge should not be less than 3,000 cycles at 80% DOD.

4.7.5 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.

4.7.6 Load demand requirement of each site, design concept of BESS, Inverter rating, Battery rating etc. elaborated in Tables 2A to 2K. Contractor should submit the detailed drawing for approval demonstrating the meeting of load requirements of consumers for each community facility.

4.7.7 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.

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

i) Rated voltage and ampere-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

vii) Charging system used for battery

4.7.9 The system should allow for the load current to be supplied at the same time as the battery charging current, whether AC- or DC- coupled.

4.7.10 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.

4.7.11 Suitable fire protection system shall be designed for BESS in line with IEC or international norms regulation as applicable and system requirement considering project site. Detailed hazard analysis and risk mitigation strategy shall be provided along with bid documents.

4.7.12 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 4.6 above, 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 DC coupled systems.

iv) Requisite numbers of battery pack, the combination of which shall equal or exceed the estimated capacity shown in design characteristics in this document, with Min. 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.

4.8 Lightning & Over Voltage Protection

4.8.1 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 1Ω 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.

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

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

4.8.4 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.

4.8.5 The lightning conductor shall be earthed through Galvanized Iron (GI) flat strips and connected to earth pits per applicable International Standards. Each lightning conductor shall be fitted with individual earth pit as per required Standards including accessories.

4.8.6 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.

4.9 Earthing Protection

4.9.1 Earthing system shall be in strict accordance with IEC specified in Table 3 and applicable Electricity Rules / Acts and Guidelines for connections.

4.9.2 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.

4.9.3 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.

4.9.4 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.

4.9.5 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.

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

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

4.9.8 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.

4.9.9 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.

4.9.10 Earth pit shall be constructed as per IEC standard specified in Table 3. Minimum spacing between electrodes shall be 2000 mm. Earth pits shall be treated with salt and charcoal/chemical Powder Earthing.

4.9.11 Earth resistance at earth terminations shall be measured and recorded. All equipment

required for testing shall be furnished by successful bidder.

4.9.12 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.

4.9.13 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.

4.9.14 All metal casing/shielding of the plant shall be thoroughly grounded in accordance with applicable electricity act/rules/guidelines. Total earthing system installation shall be in strict accordance with the latest editions of Electricity Rules, relevant Standards and code of practices and the local statutory authority regulations.

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

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

4.9.17 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 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.

4.10 Charge Controller

4.10.1 The bidder shall provide, integrate, install, configure, and commission a Charge Controller to manage and coordinate the performance of SPGP and BESS.

4.10.2 The Charge Controllers shall be MPPT.

4.10.3 The Charge Controller input voltage is 48VDC

4.10.4 Output currents for the Charge Controllers for each site are given in Tables 2A-2K

4.10.5 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.

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

4.10.7 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.

4.10.8 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.

4.10.9 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.

4.10.10 The Charge Controller should either have an automated equalization charge cycle or should allow for manual override by the operator for the ability to perform periodic equalization charge cycles

4.10.11 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 C-Rates for charging and discharging within the battery warranty.

4.10.12 If the battery array has its own protection system or Battery Management System (BMS), then the Charge Controller should integrate with the BMS to ensure coordinated protection of the battery array.

4.10.13 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.

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

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

4.11 Cables

4.11.1 Cables & Wiring

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

4.11.1.2 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 : Grey

4.11.2 Cables and Accessories

4.11.2.1 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.

4.11.2.2 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.

4.11.2.3 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.

4.11.3 Cable Selection & Sizing

4.11.3.1 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.

4.11.3.2 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.

4.11.4 Cable Constructional Features

4.11.4.1 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.

4.11.4.2 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.

4.11.4.3 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.

4.11.4.4 Low Tension (LT) Cables

1.1 kV Grade, Al. 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.

4.12 Danger Boards/Plates

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

4.13 Construction

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

4.13.2 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.

4.13.3 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.

4.13.4 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.

4.13.5 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.

4.13.6 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.

4.13.7 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.

4.13.8 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.

4.13.9 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.

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

4.14 Civil works

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

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

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

4.14.3 Enclosures for batteries, Inverter and other accessories.

4.14.4 Fencing

4.14.5 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.

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

4.14.7 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.

4.14.8 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.

4.14.9 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.

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

4.15 Earthing Testing after Installation

4.15.1 Tests to ensure cont inuity of all earth connections.

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

4.16 Preparation of the Equipment for Commissioning

4.16.1 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 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.

4.16.3 The relevant tests shall be carried out in accordance with relevant IEC of latest issue.

4.16.4 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.

4.16.5 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.

4.17 Testing & Commissioning

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

4.17.2 All electrical equipment shall be tested, installed and commissioned in accordance with the latest relevant standards and code of practices published by Kenyan Standards wherever applicable and stipulations made in relevant general specifications.

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

4.17.4 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.

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

4.18 Housing enclosures for equipment

4.18.1 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. Minimum area shall be 6 square metres.

4.18.2 It shall consist of concrete foundation; the walling shall be masonry or pre-fabricated steel panels. The designs shall be subject to employer approval.

4.18.3 The enclosure should contain appropriate indoor lighting.

4.18.4 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.

4.18.5 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.

4.18.6 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.

4.19 Fencing

4.19.1 The contractor shall provide chain link fencing with concrete posts around the perimeter

of the demarcated area. 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.

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

4.19.3 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)

4.19.4 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.

4.20 Solar Export Energy Meter

4.20.1 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 5.3.7 and 5.3.8) and shall be installed at power plant end, in line with Grid code.

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

4.21.1 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.

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 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.

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.

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 itemss

5.3.1 **25mm² 4C Aluminum cables**

The technical specification for 25mm² 4C Aluminum cables shall comply with KPLC standard specification document no. KP1/3CB/TSP/05/001 (Attached as Appendix 3)

5.3.2 **16mm² Single Phase PVC Insulated Single Phase Concentric Aluminum Cables (Low Voltage)**

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

5.3.3 **Earthing Rods**

The technical specification for Earthing Rods and their connectors shall comply with KPLC standard specification document no. KP1/3CB/TSP/06/031-1 (Attached as Appendix 3)

5.3.4 **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 and KP1/6C.1/13/TSP/11/022 (Attached as Appendix 3)

5.3.5 **Meter Box**

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.

5.3.6 **Metering system**

For customer meters:

i) On site, meter boxes must be sealable-KPLC standard.

ii) Customers` contracting data and installation certificates to be availed to KPLC.

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

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

v) Meter installation technician to fill and submit IIR – Installation inspection report.

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

The technical specification for Single Phase Static Meters for active energy shall comply with KPLC standard specification document no. TSP 14.11 (Attached as Appendix 3)

5.3.8 **Current and Potential Transformer Connected Meters**

The technical specification for Current and Potential Transformer Connected Meters shall comply with KPLC standard specification document no. KP1/6C/4/1/TSP/14/020 (Attached as Appendix 3)

6 PERSONNEL DURING O&M PERIOD

6.1 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 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 4

Item No.	Position/ specialization	Relevant academic qualifications	Number of Personnel per Lot (Lot 1)	Number of Personnel per Lot (Lot 2-11)	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	10	5
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

6.3 **Additional Staff**

i. Cleaning Staff: - Contractor may keep Cleaning staff persons on contract to clean modules (on regular10 day's interval basis), Sweeping building, wash room and other equipment.

ii. Security personnel – at least 1 No. per site

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.

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 adequate supply of Personal Protective Equipment (PPE) at each site.

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.

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 County or the Government of the Republic of Kenya. The Employer shall have no liabilities in this regard.

9.3 Key Obligations of Contractor

9.3.1 The Contractor shall be responsible for 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.

10. SUPERVISION OF CONSTRUCTION AND COMMISSIONING WORKS

10.1 Completion Time

10.1.1 All community facilities in Lots 1 - 11 shall be completed within eighteen (18) 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 this Contract 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, capacity, 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 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 for any further measures to be taken prior to the commissioning of the SPGP.

10.3.8 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. The Contractor shall also keep the Employer indemnified against any liabilities that may arise on this account.

10.3.9 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.

10.3.10 The Contractor is deemed to have visited the Site 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.

10.3.11 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.

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

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, provided that systems are compliant with the minimum requirements in this document.

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.

11.2 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 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

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)

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

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 bidders 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 Bidder could not demonstrate the Performance Acceptance Test, the bidder 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 bidder. 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 at Clauses 12.1-12.3 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 at Clauses 12.1-12.3 above will 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.

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 be required to adhere to the Environmental and Social Management Framework (ESMF) and Environmental and Social Management Plan (ESMP).

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).

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.

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) Blockage of drainage and consequent flooding or erosion due to cross drainage structures such as new roads or water access,

iv) Lack of internal drainage system for the rain fall run off,

v) 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.

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 including installation, commissioning and 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.

15. FACILITIES FOR THE CLIENT/ENGINEER

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 including full services at a location directed by the Employer/Engineer
2. Transport shall be provided, including associated maintenance and repair costs for the vehicles (4X4) provided.
3. Communication facilities for Site Works

15.2 The facilities will be purchased from local authorized distributor of the concerned item and the cost 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 plant, equipment or facilities 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 **Site Office**

The Contractor shall provide for the entire duration of the Contract for the sole use of the Client and Engineer for each lot and at localized area as directed by the Client/ Engineer, fully furnished, complete with all electrical fittings, plumbing and sanitary systems clean and provided with windows to give a sufficient supply of natural light.

The Contractor shall provide for each lot, an office of at least $12m^2$ in the location advised by the client. Each office block shall accommodate at least 2 persons. The office blocks shall be subject to the approval of the Client/ Engineer.

The Contractor shall provide 24hour security to the office facilities for the entire duration of the Contract.

15.6 **Transport**

The Contractor shall provide transport services for use by the employer in site supervision on a need basis, 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. BID RESPONSE SHEET NO.1 (GUARANTEED TECHNICAL PARTICULARS)

16.1 Bidders are requested to submit for each community facility.

i) Bid response Sheet No-1 (Guaranteed Technical Particulars) duly filled for equipment being offered.

ii) The Data sheets of Modules, PV Inverters, BESS, Battery Inverters, Charge controllers and cables as mentioned in Bid response sheet.

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

Bid Response Sheet No. 1 (Guaranteed Technical Particulars) is contained in Appendix 1.

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

17.1 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 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.

18. CODE OF CONDUCT (ESHS) AND IMPLEMENTATION STRATEGY

18.1 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), 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

18.2 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.

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

19. SITE VISITS

19.1 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 cost as per Section II of ICB. If any assistance is needed, then the bidder representative may contact the Employer as per clause ITB 7.4.

19.2 The Contractor is deemed to have visited the Site 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.

19.3 The bidder will furnish details of site visit in Bid Response Sheet No-2 (contained in Appendix 2) with bid for information.

APPENDIX 1 - BID RESPONSE SHEET NO.1 (GUARANTEED TECHNICAL PARTICULARS)

(Bidder is to submit duly filled Bid Response Sheets (Guaranteed Technical Particulars)

separately for each Community facility of Respective Lot along with Bid)

Community Facility No: _____ Lot: _____ County: _____

Community Facility Name: _____ SPGP AC Capacity: _____ kW

Table 5

BASIC COMPLIANCE & PRODUCT EVALUATION		
Sr.	**Particulars**	**Description**
SOLAR PV MODULES		
1	Module manufacturer:	
	Origin country:	
2	Cell manufacturer:	
	Origin country:	
3	Module Manufacturer Tier / Ranking (Tier-1 Required)	
4	Technology (Monocrystalline or polycrystalline silicon only)	
5	Wattage of each module Wp (Capacity of single unit)	
6	Number of cells	
7	Number of Bus in Cell 5 or less	
8	Module dimensions	
9	Initial degradation (%)	
10	Per year degradation (%)	
11	Degradation in first ten years (%)	
12	Degradation in 16 -25 years	

BASIC COMPLIANCE & PRODUCT EVALUATION		
13	Product Certification/ Standard confirmation	
14	Module efficiency: Cell efficiency:	
15	Potential Induced Degradation (PID) resistant	
16	Temperature coefficient of power (%/K)	
17	Stacking range of offered modules	
18	Product warranty offered: Manufacturing defect warrantee: Performance warrantee:	
19	IEC Tolerance	
20	Positive tolerance in offered stack	
21	Number (quantity) of modules	
22	Detailed data sheet enclosed	
Battery Energy Storage System		
1	Product manufacturer	
2	Origin country	
3	Manufacturer Tier / Ranking	
4	Technology (Lithium Ion)	
5	Depth of discharge (DOD) of battery	
6	Product Certification /Standard Confirming to	
7	Nominal cell voltage	
8	Capacity of each power pack battery	
9	Number of power pack battery	
10	Operation temperature	

BASIC COMPLIANCE & PRODUCT EVALUATION		
11	Maximum charge/discharge Rate (C rating)	Must be at least C/4
11	Lifetime in number of cycles at the recommended DOD	Must be at least 3,000 or include replacement costs to achieve 3,000 cycles
12	Lifetime in years (Lifetime in cycles divided by 365 days)	Must be at least 10 years or include replacement costs to achieve 10 years
13	Calendar lifetime at recommended operating temperature	
14	Product warranty in years	
15	Danger of explosive gas/fumes formation?	
16	Output of voltage of battery bank	
17	Technical data Sheet of offered BESS enclosed	
18	Details of associated battery inverter/battery charger & its make	
19	Capacity	
20	Protection provided	
21	Minimum required/recommended charging time in hours?	
22	Minimum required/recommended discharging time in hours?	
POWER MANAGEMENT SYSTEM		
1	SPGP design been provided in the bid?	
2	Does the proposed design include a comprehensive Power Management System?	
3	Offered SPGP design have all the features of Solar plant + BESS as per requirement and detailed in design attached	
PV INVERTERS		
1	Product manufacturer: Origin Country:	
2	Manufacturer Tier / ranking	
3	Product size (kW)	

BASIC COMPLIANCE & PRODUCT EVALUATION		
	(Capacity of single unit)	
4	MPPT voltage range	
5	No. of independent MPPT trackers	
6	The proposal includes inverter management system for all inverters?	
7	Are the Inverters integrated with the power management system in the design?	
8	Type of inverters	Central / String Inverters
9	Number (quantity) of inverters	
10	Product Certification / standard	
11	Product warranty offered	
12	Efficiency	
13	Total harmonic distortion	
14	Protections provided	
15	Details of System integration & power management	
16	Power Factor Range	
17	Detailed data sheet enclosed	
BATTERY INVERTERS/CHARGERS		
1	Product manufacturer: Origin Country:	
2	Manufacturer Tier / ranking	
3	Product size (kW) (Capacity of single unit)	
4	The proposal includes inverter management system for all inverters?	
5	Are the Inverters integrated with the power management system in the design?	
6	Type of inverters	
7	Number (quantity) of inverters	
8	Product Certification / standard	
9	Product warranty offered	
10	Efficiency	
11	Total harmonic distortion	
12	Protections provided	
13	Details of System integration & power management	
14	Power Factor Range	
15	Detailed data sheet enclosed	

BASIC COMPLIANCE & PRODUCT EVALUATION		
CHARGE CONTROLLERS		
1	Product manufacturer: Origin Country:	
2	Manufacturer Tier / ranking	
3	Product capacity (A)	
4	Type of charge controller (MPPT required)	
5	Voltage of charge controller	
6	Number (quantity) of charge controllers	
7	Product Certification / standard	
8	Product warranty offered	
9	Efficiency	
10	Detailed data sheet enclosed	

Name of Bidder ……..

Signature of Bidder ……

NOTE: Guaranteed Technical Particulars of cables and meters are contained within the KPLC Technical Specifications in Appendix 3.

APPENDIX 2 - BID RESPONSE SHEET NO.2

(Bidder is to submit duly filled Bid Response Sheet No-2 for respective Lot along with Bid)

DETAILS OF VISIT TO SITE PERFORMED BY BIDDER'S REPRESENTATIVE

Table 6A: Lot 1 (Turkana County)

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
1	1	Turkana	Loima	Clinic	Nameyana Dispensary			
2	1	Turkana	Turkana Central	Clinic	Nakaalei Dispensary			
3	1	Turkana	Turkana South	School	RCEA Kasuroi Boys			
4	1	Turkana	Loima	Clinic	Kodopa Mobile Clinic			
5	1	Turkana	Turkana West	Clinic	Teremkus dispensary			
6	1	Turkana	Turkana West	Clinic	Loche angi-erengo			
7	1	Turkana	Turkana West	Clinic	Napalatui dispensary			
8	1	Turkana	Turkana West	Clinic	Aposta dispensary			
9	1	Turkana	Turkana North	Clinic	Narengewoi Health center			
10	1	Turkana	Turkana Central	Clinic	Monti Dispensary			
11	1	Turkana	Loima	School	Loturerei Secondary School			
12	1	Turkana	Turkana South	Clinic	Kekorisogol Dispensary			
13	1	Turkana	Turkana Central	Clinic	Kapokor Dispensary			
14	1	Turkana	Loima	Clinic	Lokipetot arengan dispensary			
15	1	Turkana	Turkana North	Clinic	Meyan Dispensary			
16	1	Turkana	Turkana West	Clinic	Moru anguibuni			
17	1	Turkana	Turkana Central	Clinic	Chokchok Dispensary			
18	1	Turkana	Loima	Clinic	Kabulokor health center			
19	1	Turkana	Turkana West	Clinic	Kaenyangaluk dispensary			
20	1	Turkana	Turkana North	Clinic	Kakelae Dispensary			
21	1	Turkana	Turkana Central	Clinic	Kakwanyang Dispensary			
22	1	Turkana	Turkana South	Clinic	Kasuroi Dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
23	1	Turkana	Turkana Central	Clinic	Kenya oil dispensary			
24	1	Turkana	Turkana Central	Clinic	Kosikiria dispensary			
25	1	Turkana	Turkana South	Clinic	Locheremoit dispensary			
26	1	Turkana	Turkana North	Clinic	Lokamarinyang Dispensary			
27	1	Turkana	Turkana West	Clinic	Lokipoto dispensary			
28	1	Turkana	Turkana South	Clinic	Lokoburu dispensary			
29	1	Turkana	Turkana East	Clinic	Lokwamosing' Dispensary			
30	1	Turkana	Turkana North	Clinic	Losajait dispensary			
31	1	Turkana	Turkana Central	Clinic	Nakechichok Dispensary			
32	1	Turkana	Turkana North	Clinic	Sasame Dispensary			
33	1	Turkana	Turkana North	Clinic	Kaeris Dispensary			
34	1	Turkana	Turkana East	Clinic	Katilia dispensary			
35	1	Turkana	Turkana West	Clinic	Lomunyakirionok Dispensary			
36	1	Turkana	Turkana North	Clinic	Loruth dispensary			
37	1	Turkana	Turkana North	Clinic	Kaalem			
38	1	Turkana	Turkana North	Clinic	Nakapelewoi dispensary			
39	1	Turkana	Loima	Clinic	Nasiger Dispensary			
40	1	Turkana	Turkana North	Clinic	Epur Dispensary			
41	1	Turkana	Turkana West	Clinic	Namon Dispensary			
42	1	Turkana	Turkana Central	Clinic	Nakiria Dispensary			
43	1	Turkana	Turkana North	Clinic	Lomekwi Dispensary			
44	1	Turkana	Turkana Central	Clinic	Lochoraikeny Dispensary			
45	1	Turkana	Turkana Central	Clinic	Katiir dispensary			
46	1	Turkana	Loima	Clinic	Nayanaeangikalalio Dispensary			
47	1	Turkana	Turkana Central	Clinic	Kapua Dispensary			
48	1	Turkana	Turkana West	Clinic	Atiir Dispensary			
49	1	Turkana	Turkana East	Clinic	Nakukulas dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
50	1	Turkana	Loima	Clinic	Kaapus dispensary			
51	1	Turkana	Turkana North	Clinic	Koyasa Dispensary			
52	1	Turkana	Turkana North	Clinic	Koyasa Dispensary			
53	1	Turkana	Turkana South	Clinic	Sopel Dispensary			
54	1	Turkana	Turkana South	Clinic	Namakat Dispensary			
55	1	Turkana	Loima	School	Lomil Girls Secondary School			
56	1	Turkana	Turkana North	Clinic	Lomii Dispensary			
57	1	Turkana	Turkana Central	Clinic	Louwae Dispensary			
58	1	Turkana	Turkana East	Clinic	Nakatong'wa Dispensary			
59	1	Turkana	Turkana Central	Clinic	Nakurio Dispensary			
60	1	Turkana	Loima	Clinic	Natuntun Dispensary			
61	1	Turkana	Loima	Clinic	Kangalita Dispensary			
62	1	Turkana	Turkana South	Clinic	Kanaodon Dispensary			
63	1	Turkana	Turkana South	Clinic	Lokorkor Health Center			
64	1	Turkana	Turkana East	Clinic	Lopii Dispensary			
65	1	Turkana	Turkana South	Clinic	Juluk Dispensary			
66	1	Turkana	Turkana East	Clinic	Kamuge Dispensary			
67	1	Turkana	Turkana East	Clinic	Lomelo Dispensary			
68	1	Turkana	Turkana East	Clinic	Loyapat Dispensary			
69	1	Turkana	Turkana West	Clinic	Komudei Dispensary			
70	1	Turkana	Turkana South	Clinic	Kangitankori Dispensary			
71	1	Turkana	Loima	Clinic	Lochor Alomala dispensary			
72	1	Turkana	Loima	Clinic	Naotin Dispensary			
73	1	Turkana	Turkana North	Clinic	Riokomor Dispensary			
74	1	Turkana	Turkana Central	Clinic	Long'ech dispensary			
75	1	Turkana	Loima	Clinic	Loturerei dispensary			
76	1	Turkana	Turkana East	Clinic	Parkati dispensary			
77	1	Turkana	Turkana Central	Clinic	Kalimapus Dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
78	1	Turkana	Turkana Central	Clinic	Nakurio Girls Secondary school			
79	1	Turkana	Loima	Clinic	Lochor Edome Dispensary			
80	1	Turkana	Turkana South	Clinic	Loperot Dispensary			
81	1	Turkana	Turkana West	Clinic	Nakoyo Dispensary			
82	1	Turkana	Turkana West	School	Kalobeyei secondary School			
83	1	Turkana	Loima	Clinic	Kaesogol etom Dispensary			
84	1	Turkana	Turkana West	Clinic	Lokangae Health Centre			
85	1	Turkana	Turkana East	School	Ngamia one kochodin high school			
86	1	Turkana	Turkana Central	Clinic	Kangirisae dispensary			
87	1	Turkana	Turkana South	Clinic	Lokapel Dispensary			
88	1	Turkana	Turkana Central	Clinic	Nadooto dispensary			
89	1	Turkana	Turkana West	Clinic	Nanam dispensary			
90	1	Turkana	Turkana East	Clinic	Lokwii Health Center			
91	1	Turkana	Turkana North	Clinic	Karebur dispensary			
92	1	Turkana	Turkana East	Clinic	Elelea sub-county hospital			
93	1	Turkana	Turkana East	School	A.I.C Katilia Boys Secondary School			
94	1	Turkana	Loima	School	Loima boys secondary School			
95	1	Turkana	Turkana West	School	Aic Songot secondary School			
96	1	Turkana	Turkana Central	School	Talent high school			

Table 6B: Lot 2 (West Pokot County)

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
1	2	West Pokot	Kacheliba	Clinic	Leng'orok Dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
2	2	West Pokot	Kacheliba	Clinic	Kamketo Dispensary			
3	2	West Pokot	Kacheliba	Clinic	Nyangolesinyang dispensary			
4	2	West Pokot	Pokot South	Clinic	Cheptiangwa Dispensary			
5	2	West Pokot	Pokot South	Clinic	Kapkaremba Dispensary			
6	2	West Pokot	Kacheliba	Clinic	Kasitet Dispensary			
7	2	West Pokot	Pokot South	Clinic	Chemotong Dispensary			
8	2	West Pokot	Sigor	Clinic	Kiwakan Dispensary			
9	2	West Pokot	Kacheliba	Clinic	Kasei Assistant county commissioner's office			
10	2	West Pokot	Kacheliba	Clinic	Mading west pokot			
11	2	West Pokot	Kacheliba	Clinic	Nauyapong Dispensary			
12	2	West Pokot	Kacheliba	Clinic	Kamila GOK dispensary			
13	2	West Pokot	Kapenguria	Clinic	Kapenguria west pokot			
14	2	West Pokot	Kacheliba	Clinic	Nakwijit dispensary			
15	2	West Pokot	Kacheliba	Clinic	Nasal Dispensary			
16	2	West Pokot	Kapenguria	Clinic	Wonyoi dispensary			
17	2	West Pokot	Pokot South	Clinic	St. Marks mixed Day and Boarding Secondary School-Kapkaremba			
18	2	West Pokot	Sigor	Clinic	Kisera dispensary			
19	2	West Pokot	Sigor	Clinic	Nyangaita Dispensary			
20	2	West Pokot	Sigor	Clinic	Kamanau Dispensary			
21	2	West Pokot	Kapenguria	Clinic	Kesot Dispensary			
22	2	West Pokot	Kapenguria	Clinic	Krich dispensary			
23	2	West Pokot	Kapenguria	Clinic	Tamarukwa dispensary			
24	2	West Pokot	Kapenguria	Clinic	Tipet dispensary			
25	2	West Pokot	Kapenguria	Clinic	Miskwony dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
26	2	West Pokot	Kapenguria	Clinic	Kalemrekai Dispensary			
27	2	West Pokot	Sigor	Clinic	Sostin dispensary			
28	2	West Pokot	Sigor	Clinic	Kataywa dispensary			
29	2	West Pokot	Kacheliba	Clinic	Cherangan dispensary			
30	2	West Pokot	Kapenguria	Clinic	Chekomosi location			
31	2	West Pokot	Sigor	Clinic	Masol Dispensary			
32	2	West Pokot	Kacheliba	Clinic	Kangoletiang Dispensary			
33	2	West Pokot	Kacheliba	Clinic	Kalemngorok dispensary			
34	2	West Pokot	Pokot South	Clinic	Sobukwo secondary School			
35	2	West Pokot	Kacheliba	Clinic	Kasei dispensary			
36	2	West Pokot	Sigor	Clinic	Tamkal dispensary			
37	2	West Pokot	Kacheliba	Clinic	Kamketo Trinity Girls Secondary School			
38	2	West Pokot	Kapenguria	Clinic	Nachecheyet Dispensary			
39	2	West Pokot	Kacheliba	Clinic	Kauryong dispensary			
40	2	West Pokot	Kapenguria	Clinic	Ptoyo Health Center			
41	2	West Pokot	Sigor	Clinic	Simpol dispensary			
42	2	West Pokot	Sigor	School	Salion secondary school			
43	2	West Pokot	Kapenguria	Clinic	Kalemnyang Yunhap			
44	2	West Pokot	Kacheliba	Clinic	Kanyerus dispensary			

Table 6C: Lot 3 (Isiolo and Marsabit Counties)

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
1	3	Marsabit	Laisamis	Clinic	Arge Dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
2	3	Isiolo	Isiolo North	Clinic	Korbesa mixed/secondary school			
3	3	Marsabit	Moyale	Clinic	Dabel Health Center			
4	3	Marsabit	North Horr	Clinic	Telesgaye Health center			
5	3	Marsabit	Moyale	Clinic	Madoadi dispensary			
6	3	Isiolo	Isiolo North	School	Armiet Mixed Secondary			
7	3	Marsabit	Laisamis	School	Loiyangalani vocational training polytechnic			
8	3	Isiolo	Isiolo North	Clinic	Oldonyiro girls			
9	3	Marsabit	Moyale	School	Dabel Secondary School			
10	3	Isiolo	Isiolo South	School	Kula Mawe Secondary School			
11	3	Isiolo	Isiolo North	Clinic	Lolkuta North Dispensary			
12	3	Isiolo	Isiolo South	Clinic	Boji dispensary			
13	3	Marsabit	North Horr	Clinic	Burgabo dispensary			
14	3	Isiolo	Isiolo North	Clinic	Daaba dispensary			
15	3	Isiolo	Isiolo North	Clinic	Matar-arba dispensary			
16	3	Marsabit	Moyale	Clinic	Qate dispensary			
17	3	Marsabit	Moyale	Clinic	Ell - borr dispensary			
18	3	Marsabit	Laisamis	Clinic	El-Molo Bay Dispensary			
19	3	Marsabit	Laisamis	Clinic	Oltorot Dispensary			
20	3	Isiolo	Isiolo South	Clinic	Barambate dispensary			
21	3	Marsabit	Moyale	Clinic	Waye Godha dispensary			
22	3	Isiolo	Isiolo South	Clinic	Janju Dispensary			
23	3	Marsabit	North Horr	Clinic	Ileret Health center			
24	3	Marsabit	Saku	Clinic	Segel Dispensary			
25	3	Marsabit	Moyale	Clinic	Nana Health Center			
26	3	Isiolo	Isiolo North	Clinic	Ntalaby Primay school			
27	3	Marsabit	Laisamis	Clinic	Korolle Boys' Secondary School			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
28	3	Marsabit	North Horr	Clinic	Dukana Ward Administrator's Office			
29	3	Marsabit	Moyale	Clinic	Badan Rero Dispensary			
30	3	Isiolo	Isiolo North	Office	Kom Acc Office			
31	3	Isiolo	Isiolo South	Clinic	Muchuro dispensary			
32	3	Isiolo	Isiolo North	Clinic	Biliqo Marara dispensary			
33	3	Marsabit	Laisamis	Clinic	Arapal Dispensary			
34	3	Isiolo	Isiolo North	Clinic	Korbesa Dispensary			
35	3	Marsabit	North Horr	Clinic	Dukana Health Center			
36	3	Marsabit	North Horr	Clinic	Hurri Hills dispensary			
37	3	Marsabit	Laisamis	Clinic	Namarei Borehole Pumphouse			
38	3	Marsabit	Moyale	Clinic	Godoma Health Centre (Nep)			
39	3	Marsabit	Laisamis	Clinic	Lontolio Dispensary			
40	3	Marsabit	Laisamis	School	Kulal Girls Secondary school			
41	3	Marsabit	Moyale	Clinic	Karbururi dispensary			
42	3	Marsabit	Saku	Clinic	Kituruni Dispensary			
43	3	Isiolo	Isiolo North	School	Ngaremara secondary-boys			

Table 6D: Lot 4(Samburu County)

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
1	4	Samburu	Samburu East	Clinic	Oromodei dispensary			
2	4	Samburu	Samburu West	School	Ledero Mixed Secondary School			
3	4	Samburu	Samburu North	Clinic	Sereni dispensary			
4	4	Samburu	Samburu North	Clinic	Waso Rongai Dispensary			
5	4	Samburu	Samburu North	School	Engilai Mixed Secondary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
6	4	Samburu	Samburu North	Clinic	Loikumkum Dispensary			
7	4	Samburu	Samburu North	Clinic	Angata Nanyokie Dispensary			
8	4	Samburu	Samburu West	School	Kirimon mixed day secondary			
9	4	Samburu	Samburu North	Clinic	Logetei Dispensary			
10	4	Samburu	Samburu West	Clinic	Lolmolog Mixed Day Secondary school			
11	4	Samburu	Samburu East	Clinic	Nkaroni dispensary			
12	4	Samburu	Samburu East	Clinic	Klitamany dispensary			
13	4	Samburu	Samburu East	Clinic	Laresolo dispensary			
14	4	Samburu	Samburu North	Clinic	Marti dispensary			
15	4	Samburu	Samburu North	Clinic	Masikita Dispensary			
16	4	Samburu	Samburu North	Clinic	Nachola Dispensary			
17	4	Samburu	Samburu East	Clinic	Ndonyo Nasipa Dispensary			
18	4	Samburu	Samburu North	Clinic	Muruankai GOK Dispensary			
19	4	Samburu	Samburu West	Clinic	Longewan Dispensary			
20	4	Samburu	Samburu North	Clinic	Loonjorin Dispensary			
21	4	Samburu	Samburu West	Clinic	Naborkeju Dispensary			
22	4	Samburu	Samburu West	Clinic	Lkiloriti dispensary			
23	4	Samburu	Samburu North	Clinic	Urra Dispensary			
24	4	Samburu	Samburu North	Clinic	Ngilai (Saidia) dispensary			
25	4	Samburu	Samburu East	Clinic	Donyo-Wasin Dispensary			
26	4	Samburu	Samburu East	Clinic	Sereolipi mixed day secondary school			
27	4	Samburu	Samburu West	School	Longewan Mixed Day Secondary school			
28	4	Samburu	Samburu West	Clinic	Lolngese Dispensary			
29	4	Samburu	Samburu East	School	Wamba mixed secondary school			
30	4	Samburu	Samburu East	Clinic	Marti E pareu			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
31	4	Samburu	Samburu West	Clinic	Nauneri Dispensary			
32	4	Samburu	Samburu North	School	Ngurunit Mixed Secondary School			
33	4	Samburu	Samburu West	Clinic	Ledero dispensary			
34	4	Samburu	Samburu West	School	Suguta Mar Mar Mixed Day Secondary School			
35	4	Samburu	Samburu West	Clinic	Lolmolog Dispensary			
36	4	Samburu	Samburu North	Clinic	Barsoloi arid zone primary school			
37	4	Samburu	Samburu West	School	Maralal Day Mixed Secondary School			
38	4	Samburu	Samburu West	School	Kisima mixed secondary school			
39	4	Samburu	Samburu West	Clinic	Seketet dispensary			

Table 6E: Lot 5 (Mandera County)

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
1	5	Mandera	Mandera North	Clinic	Olla secondary school			
2	5	Mandera	Mandera West	Clinic	Gither Mixed Day/Boarding Secondary school			
3	5	Mandera	Mandera West	School	Burduras secondary School			
4	5	Mandera	Banissa	Clinic	Choroko Dispensary			
5	5	Mandera	Mandera South	Clinic	Burmayo Dispensary			
6	5	Mandera	Banissa	Clinic	Burjon Dispensary			
7	5	Mandera	Mandera East	Clinic	Koromey Dispensary			
8	5	Mandera	Mandera South	Clinic	Chachabole Dispensary			
9	5	Mandera	Lafey	Office	Fino ACC			
10	5	Mandera	Lafey	Office	Lafey ACC			
11	5	Mandera	Mandera South	Clinic	Kutayu dispensary			
12	5	Mandera	Banissa	Clinic	Kukub dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
13	5	Mandera	Banissa	Clinic	Tarama Dispensary			
14	5	Mandera	Mandera South	Clinic	Garsesala Dispensary			
15	5	Mandera	Mandera West	Clinic	Lagsure dispensary			
16	5	Mandera	Banissa	Clinic	Domal dispensary			
17	5	Mandera	Lafey	School	Aresa girls secondary			
18	5	Mandera	Mandera West	Clinic	Kobadadi dispensary			
19	5	Mandera	Banissa	Clinic	Birkan dispensary			
20	5	Mandera	Mandera North	Clinic	Kalicha Dispensary			
21	5	Mandera	Lafey	Clinic	Aresa Dispensary			
22	5	Mandera	Banissa	Clinic	Hullow Dispensary			
23	5	Mandera	Mandera East	Clinic	BP1 Dispensary			
24	5	Mandera	Mandera South	Clinic	Alongo Dispensary			
25	5	Mandera	Mandera East	Clinic	Arabia Health Centre			
26	5	Mandera	Lafey	Clinic	Damasa Dispensary			
27	5	Mandera	Mandera South	Clinic	El-Golicha Dispensary			
28	5	Mandera	Mandera South	Clinic	Elram Dispensary			
29	5	Mandera	Mandera South	Clinic	Elram Dispensary			
30	5	Mandera	Mandera South	Clinic	Falama Dispensary			
31	5	Mandera	Lafey	Clinic	Fino Health Centre			
32	5	Mandera	Mandera East	Clinic	Hareri Hosle Dispensary			
33	5	Mandera	Lafey	Clinic	Kabo Dispensary			
34	5	Mandera	Lafey	Clinic	Lafey nomadic dispensary			
35	5	Mandera	Lafey	Clinic	Odha Dispensary			
36	5	Mandera	Mandera East	Clinic	Omar jilaow Dispensary			
37	5	Mandera	Mandera West	Clinic	Qarsahama Dispensary			
38	5	Mandera	Banissa	Clinic	Malkamari Boys' Secondary School			
39	5	Mandera	Mandera North	School	Libin Nomadic Girls Secondary School			
40	5	Mandera	Lafey	Clinic	Gari secondary School			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
41	5	Mandera	Lafey	Clinic	Hareri Mixed Secondary School			
42	5	Mandera	Mandera North	Clinic	Rhamu Dimtu Health Centre			
43	5	Mandera	Mandera North	Office	Rhamu Dimtu Chief's Office			
44	5	Mandera	Mandera South	Clinic	Qarsadamu dispensary			
45	5	Mandera	Mandera West	School	Dandu Secondary School			
46	5	Mandera	Mandera West	Clinic	Bolowle dispensary			
47	5	Mandera	Banissa	Clinic	Derkale dispensary			
48	5	Mandera	Mandera West	Office	Dandu ACC Office			
49	5	Mandera	Mandera South	School	El- hagarsu mixed day secondary school			
50	5	Mandera	Mandera West	Clinic	Dandu Health Centre			

Table 6F: Lot 6 (Wajir County)

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
1	6	Wajir	Eldas	Office	Anole ACCsOffice			
2	6	Wajir	Wajir South	Clinic	Burder Secondary School			
3	6	Wajir	Wajir South	Office	Busbus primary school			
4	6	Wajir	Tarbaj	Clinic	Dureweey dispensary			
5	6	Wajir	Wajir South	Clinic	Argane dispensary			
6	6	Wajir	Tarbaj	Clinic	Burmayo Dispensary Wajir			
7	6	Wajir	Eldas	Clinic	Lakole Dispensary			
8	6	Wajir	Wajir West	Clinic	Wara Dispensary			
9	6	Wajir	Eldas	Clinic	Arbajahan mixed/day and boarding secondary Schools			
10	6	Wajir	Tarbaj	Clinic	Wargadud Dispensary(Tarbaj)			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
11	6	Wajir	Wajir North	Clinic	Malkagufu Dispensary			
12	6	Wajir	Wajir North	Clinic	Beramo Dispensary			
13	6	Wajir	Eldas	Clinic	Dadhantaly Dispensary			
14	6	Wajir	Wajir North	Clinic	Dunto Dispensary			
15	6	Wajir	Tarbaj	Clinic	Elben Dispensary			
16	6	Wajir	Wajir North	Clinic	Ogorji Dispensary			
17	6	Wajir	Wajir West	Clinic	Bojiyare Dispensary			
18	6	Wajir	Wajir South	Clinic	Sabuli Nomadic Clinic			
19	6	Wajir	Eldas	Clinic	Anole Dispensary			
20	6	Wajir	Wajir South	Clinic	Kursin Health Centre			
21	6	Wajir	Wajir North	Clinic	Batalu Dispensary			
22	6	Wajir	Tarbaj	Clinic	Hargal Dispensary			
23	6	Wajir	Wajir North	Clinic	Malkagufu Primary School			
24	6	Wajir	Wajir South	Clinic	Tesorie Dispensary			
25	6	Wajir	Eldas	Clinic	Mathow Dispensary			
26	6	Wajir	Wajir West	Clinic	Ganyure dispensary			
27	6	Wajir	Tarbaj	Clinic	Hungai Dispensary			
28	6	Wajir	Wajir West	Clinic	Shanta Abaq Dispensary (Wajir West)			
29	6	Wajir	Eldas	Office	Anole APs Camp			
30	6	Wajir	Wajir East	Clinic	Wajir bor Boys secondary School			
31	6	Wajir	Wajir North	Clinic	Dugo Health Centre			
32	6	Wajir	Eldas	Clinic	Tula tula Secondary			
33	6	Wajir	Wajir South	Clinic	Sabuli mixed day secondary School			
34	6	Wajir	Wajir West	Office	Lagbogol secondary school			
35	6	Wajir	Wajir East	School	Baraqwo secondary			
36	6	Wajir	Wajir North	School	Buna girls secondary			
37	6	Wajir	Wajir North	School	buna boys Secondary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
38	6	Wajir	Wajir East	School	KHOrof harar youth polytechnic			
39	6	Wajir	Wajir South	School	Diif Secondary School			

Table 6G: Lot 7(Garissa County)

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
1	7	Garissa	Ijara	Clinic	Mohammed Dahir			
2	7	Garissa	Fafi	Clinic	Sangole Dispensary			
3	7	Garissa	Dadaab	Office	IFO 1 AP camp			
4	7	Garissa	Lagdera	Clinic	Afwein Dispensary			
5	7	Garissa	Ijara	Clinic	Township primary school			
6	7	Garissa	Ijara	Clinic	Kotile health center			
7	7	Garissa	Fafi	Office	ACC office/Residence Galmagala			
8	7	Garissa	Dadaab	Office	ACC office/Residence Jarajilla			
9	7	Garissa	Ijara	Office	Bodhai ACC office			
10	7	Garissa	Ijara	Clinic	Jalish Dispensary			
11	7	Garissa	Ijara	Clinic	Korisa Dispensary			
12	7	Garissa	Dadaab	Clinic	Malaylay Dispensary			
13	7	Garissa	Balambala	Clinic	Libahlow dispensary			
14	7	Garissa	Ijara	Clinic	Ruqa Dispensary			
15	7	Garissa	Fafi	Office	Sanguilu ACC office			
16	7	Garissa	Lagdera	Clinic	Jilango dispensary			
17	7	Garissa	Fafi	Clinic	Amuma Dispensary			
18	7	Garissa	Fafi	Clinic	Amuma Mobile Dispensary			
19	7	Garissa	Ijara	Clinic	Bodhai Dispensary			
20	7	Garissa	Ijara	Clinic	Dekaharjey Dispensary			
21	7	Garissa	Ijara	Clinic	El Kambere Nomadic Clinic			
22	7	Garissa	Fafi	Clinic	Fafi Dispensary			
23	7	Garissa	Fafi	Clinic	Yumbis Dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
24	7	Garissa	Dadaab	Clinic	Abdisamit Dispensary			
25	7	Garissa	Ijara	Clinic	Bultohama Dispensary			
26	7	Garissa	Lagdera	Clinic	Elan Dispensary			
27	7	Garissa	Balambala	Clinic	Danyere Health Centre			
28	7	Garissa	Dadaab	Clinic	Bogyar dispensary			
29	7	Garissa	Fafi	Clinic	Hagarbul Dispensary			
30	7	Garissa	Dadaab	School	Kulan secondary School			
31	7	Garissa	Ijara	Clinic	Hara health center			
32	7	Garissa	Dadaab	Clinic	Saretho Dispensary			

Table 6H: Lot 8 (Lamu County)

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
1	8	Lamu	Lamu West	Clinic	Dide waride dispensary			
2	8	Lamu	Lamu West	School	kizuke primary school			
3	8	Lamu	Lamu West	Clinic	Maisha masha			
4	8	Lamu	Lamu West	Clinic	Didewaride primary school			
5	8	Lamu	Lamu West	School	Pangani Secondary School			
6	8	Lamu	Lamu West	Clinic	Sinambio dispensary			
7	8	Lamu	Lamu West	Clinic	Pandanguo primary school			
8	8	Lamu	Lamu West	Clinic	Manda Dispensary			
9	8	Lamu	Lamu West	School	Manda Maweri Secondary School			
10	8	Lamu	Lamu West	School	Chalaluma primary school			
11	8	Lamu	Lamu West	Clinic	Barigoni Dispensary			
12	8	Lamu	Lamu West	Clinic	Basuba Dispensary			
13	8	Lamu	Lamu West	Clinic	Bodhei Dispensary			
14	8	Lamu	Lamu East	Clinic	Ishakani Dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
15	8	Lamu	Lamu East	Clinic	Mangai Dispensary			
16	8	Lamu	Lamu East	Office	Acc Kiunga			
17	8	Lamu	Lamu East	School	Basuba			
18	8	Lamu	Lamu East	School	Ishakani			
19	8	Lamu	Lamu East	School	Kiangwi			
20	8	Lamu	Lamu East	School	Madani			
21	8	Lamu	Lamu East	School	Mangai			
22	8	Lamu	Lamu East	School	Marararni			
23	8	Lamu	Lamu West	Clinic	Pandanguo Dispensary			
24	8	Lamu	Lamu East	Clinic	Kiangwi Dispensary			
25	8	Lamu	Lamu West	Clinic	Bahamisi Dispensary			
26	8	Lamu	Lamu West	School	Maisha Masha secondary			
27	8	Lamu	Lamu West	School	Majembeni Secondary School			

Table 6I: Lot 9 (Tana River)

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
1	9	Tana River	Garsen	School	Mandingo Dispensary			
2	9	Tana River	Galole	Office	Waldena ACC			
3	9	Tana River	Garsen	Clinic	Galili Dispensary			
4	9	Tana River	Bura	Clinic	Mulanjo dispensary			
5	9	Tana River	Bura	Clinic	Buwa Dispensary			
6	9	Tana River	Galole	Clinic	AIC Titila Dispensary			
7	9	Tana River	Garsen	Clinic	Asa Kone Dispensary			
8	9	Tana River	Garsen	Clinic	Assa dispensary			
9	9	Tana River	Bura	Clinic	Boka dispensary			
10	9	Tana River	Bura	Clinic	Chewele Dispensary			
11	9	Tana River	Galole	Clinic	Haroresa Dispensary			
12	9	Tana River	Bura	Clinic	Meti Dispensary			
13	9	Tana River	Bura	Clinic	Sabukia dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
14	9	Tana River	Garsen	Clinic	Kau Dispensary			
15	9	Tana River	Bura	Clinic	Sombo Dispensary			
16	9	Tana River	Galole	Clinic	Chifiri Dispensary			
17	9	Tana River	Galole	Clinic	Wayu Boru Dispensary			
18	9	Tana River	Garsen	Clinic	Mwina Dispensary			
19	9	Tana River	Galole	Clinic	Wayu Dispensary			
20	9	Tana River	Garsen	Clinic	Ozi Dispensary			
21	9	Tana River	Bura	Clinic	Bangale Chiefs office			
22	9	Tana River	Bura	Clinic	Bangali Dispensary			
23	9	Tana River	Garsen	Clinic	Sera dispensary			
24	9	Tana River	Garsen	Clinic	Mnazini dispensary			
25	9	Tana River	Galole	School	Majengo secondary			
26	9	Tana River	Bura	Clinic	Bilbil dispensary			
27	9	Tana River	Galole	Clinic	Aic Daba Dispensary			
28	9	Tana River	Galole	Clinic	Waldena Dispensary			
29	9	Tana River	Garsen	Clinic	Kitere secondary school			
30	9	Tana River	Bura	Clinic	Mororo mixed day secondary school			
31	9	Tana River	Garsen	Clinic	Semikaro Dispensary			
32	9	Tana River	Galole	Clinic	Huruma mixed day secondary School			

Table 6J: Lot 10 (Kilifi, Kwale and Taita Taveta)

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
1	10	Taita Taveta	Voi	Clinic	Gimba Dispensary			
2	10	Taita Taveta	Voi	Clinic	Mwangea Dispensary			
3	10	Kilifi	Rabai	School	Kawala girls secondary school			
4	10	Kilifi	Magarini	School	Kurawa Secondary school			
5	10	Kwale	Matuga	Clinic	Mbegani Dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
6	10	Kwale	Kinango	School	Bang'a secondary school			
7	10	Kilifi	Magarini	School	Watala Secondary School			
8	10	Kilifi	Magarini	Clinic	Mwangatini Dispensary			
9	10	Kilifi	Magarini	School	Baricho Secondary School			
10	10	Kilifi	Magarini	Office	Gandini Assistant Chief's office			
11	10	Taita Taveta	Voi	Clinic	Bamako dispensary			
12	10	Kwale	Kinango	Clinic	Chanzou Dispensary			
13	10	Kilifi	Kaloleni	Clinic	Kasemeni dispensary			
14	10	Kilifi	Magarini	School	Gandini Primary school			
15	10	Kilifi	Magarini	School	Adu secondary			
16	10	Kilifi	Kaloleni	Clinic	Viragoni dispensary			
17	10	Kilifi	Magarini	Clinic	Gandini dispensary			
18	10	Kilifi	Magarini	Clinic	Karimboni dispensary			
19	10	Kilifi	Magarini	Clinic	Mulunguni dispensary			
20	10	Kilifi	Ganze	Clinic	Muryachakwe Dispensary			
21	10	Kwale	Kinango	Clinic	Mwachinga dispensary			
22	10	Kwale	Kinango	Clinic	Gozani dispensary			
23	10	Kwale	Lunga Lunga	Clinic	Mkwiro Dispensary			
24	10	Kilifi	Magarini	Office	Local Chief's Office			
25	10	Kilifi	Magarini	Clinic	Waresa Secondary School			
26	10	Kwale	Kinango	Clinic	Mkang'ombe Dispensary			
27	10	Kilifi	Ganze	Clinic	Sokoke Health dispensary			
28	10	Taita Taveta	Wundanyi	Clinic	Sengeroko Dispensary			
29	10	Kwale	Lunga Lunga	Clinic	Wasini Dispensary			
30	10	Kilifi	Kilifi North	Clinic	Kadaina Dispensary			
31	10	Kwale	Matuga	Clinic	Mbegani secondary			
32	10	Kilifi	Magarini	Clinic	Baricho Dispensary			
33	10	Kilifi	Magarini	Clinic	Chamari dispensary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
34	10	Kilifi	Ganze	Clinic	Midoina dispensary			
35	10	Kilifi	Rabai	School	Bwagamoyo Secondary School			
36	10	Kilifi	Magarini	Clinic	Motoloani dispensary			
37	10	Kilifi	Magarini	School	Shujaa Mekatilili Secondary			

Table 6K: Lot 11 (Narok)

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
1	11	Narok	Kilgoris	Clinic	Kapune. Trans Mara west			
2	11	Narok	Narok South	Clinic	Masese secondary			
3	11	Narok	Emurua Dikirr	Clinic	Roborwo Dispensary			
4	11	Narok	Narok South	Clinic	Mausa dispensary			
5	11	Narok	Narok South	Clinic	Olmesutie Dispensary			
6	11	Narok	Narok West	Clinic	Leshuta Dispensary			
7	11	Narok	Emurua Dikirr	Clinic	Kendunywo primary school			
8	11	Narok	Narok South	Clinic	Ilkerin -Loita dispensary			
9	11	Narok	Narok West	School	Aganga Mixed Day Secondary			
10	11	Narok	Emurua Dikirr	Clinic	Chebara primary school			
11	11	Narok	Narok South	Clinic	Chemwokter Dispensary			
12	11	Narok	Narok East	Clinic	Entotol dispensary			
13	11	Narok	Emurua Dikirr	Clinic	Kuresiet health center			
14	11	Narok	Kilgoris	Clinic	Meguarra dispensary			
15	11	Narok	Kilgoris	Clinic	Shankoe Dispensary			
16	11	Narok	Narok West	Clinic	Olkoroi dispensary			
17	11	Narok	Narok South	School	Saire day mixed secondary			

No.	Lot	County	Subcounty	Facility Type	Name	Site visit by Bidder's Representative		
						Date of Visit	Representative Name and signature	Facility's representative name and signature
18	11	Narok	Narok West	Clinic	Sekenani Community Health Centre			
19	11	Narok	Kilgoris	Clinic	Ngendalel dispensary			
20	11	Narok	Kilgoris	Clinic	Sosiana Dispensary			
21	11	Narok	Narok West	Clinic	Endoinyo Narasha			
22	11	Narok	Narok South	Clinic	Enaramatishoreki health center			
23	11	Narok	Narok West	Clinic	Olderkesi dispensary			
24	11	Narok	Emurua Dikirr	School	Kuresiet Secondary School			
25	11	Narok	Emurua Dikirr	School	Chesabuni Primary School			
26	11	Narok	Emurua Dikirr	Clinic	Kamarget dispensary			
27	11	Narok	Narok South	Clinic	Enkutoto Dispensary			
28	11	Narok	Narok West	Clinic	Endoinyo Erinka Dispensary			
29	11	Narok	Narok West	Clinic	Megwara Dispensary			
30	11	Narok	Narok West	Clinic	Losho Dispensary			
31	11	Narok	Narok North	School	Enakishomi mixed secondary school			
32	11	Narok	Narok South	Clinic	Tengecha Esoit Secondary School			
33	11	Narok	Narok South	Clinic	Iltriben primary school			
34	11	Narok	Narok West	Office	ACC's office, Assistant Chief Office, Tourist Police			

APPENDIX 3 – KPLC TECHNICAL SPECIFICATIONS

3A. Specification for Aluminum 4-Core PVC Insulated, Steelwire Armoured Cable

Kenya Power	TITLE: SPECIFICATION FOR ALUMINUM 4-CORE PVC INSULATED, STEELWIRE ARMOURED CABLE	Doc. No.	KP1/3CB/TSP/05/001
		Issue No.	4
		Revision No.	0
		Date of Issue	2013-04-30
		Page 1 of 16	

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Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
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

3B. Specification for PVC Insulated Single Phase Concentric Aluminium Cables (Low Voltage)

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		

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date:2015-02-18	Date:2015-02-18

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		

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Manufacturer's Name, Signature, Stamp and Date

3C. Specification for Earth Rods and their Connectors

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
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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

Issued by: Head of Section, Technical Standards and Specifications	Authorized by: Head of Department, R&D
Signed:	Signed:
Date: 2014/04/06	Date: 2014/04/06

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 safely, 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.

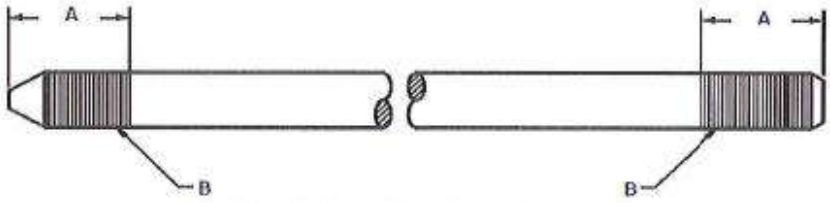

Fig. 1: Threading dimensions

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).

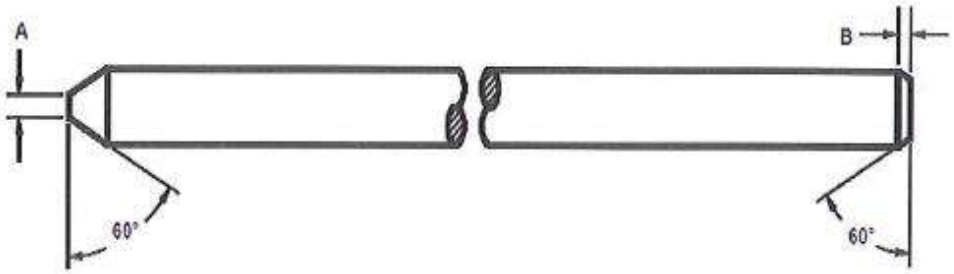

Fig. 2: Earth rod

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.

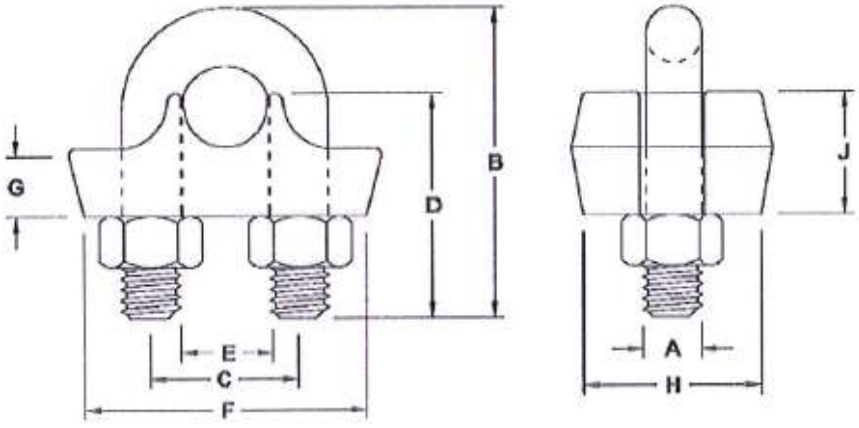

Fig. 5: Bull Dog type connector.

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 900': 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 manufacture'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 recuirements 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

Issued by: Head of Section, Technical Standards and Specifications	Authorized by: Head of Department, R&D
Signed:	Signed:
Date: 2014/04/06	Date: 2014/04/06

3D. Specification for Low Voltage Fuse Cut-Out

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
		Page 1 of 15	

TABLE OF CONTENTS

Issued by: Head of Section, standards Development	Authorized by: Manager ,Standards
Signed:	Signed:
Date: 2016-08-30	Date: 2016-08-30

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Manager ,Standards
Electronic copy (pdf) on Kenya Power server (currently: Network→stima-fprnt-001→techstd&specs)	

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		

Issued by: Head of Section, standards Development	Authorized by: Manager ,Standards
Signed:	Signed:
Date: 2016-08-30	Date: 2016-08-30

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

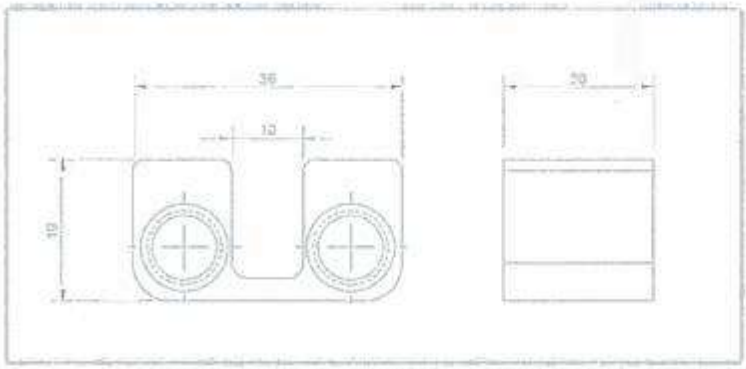

Fig. 2: Dimensions of phase terminal blocks for house service cut-out
(bores shall be suitable for aluminum and copper phase and neutral conductors of up to 35mm² nominal cross-sectional area. The brass screws (not shown) shall be size M8

Issued by: Head of Section, standards Development	Authorized by: Manager ,Standards
Signed:	Signed:
Date: 2016-08-30	Date: 2016-08-30

4E. Specification for Low Voltage Cartridge Fuses (Fuse Links)

Kenya Power	TITLE: LOW VOLTAGE CARTRIDGE FUSES (FUSE LINKS) – SPECIFICATION	Doc. No.	KP1/6C.1/13/TSP/11/022
		Issue No.	2
		Revision No.	1
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		Page 1 of 18	

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0.1 Circulation List

COPY NO.	COPY HOLDER
1	Manager Standards
Electronic copy (pdf) on Kenya Power server (currently: Network→stima-fpnt-001→techstd&specs)	

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	2016-08-22	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
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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) Pre-arcing (A)				Total at 240V	Total at 415V	Nominal Watts Loss (W)	Rated Breaking Capacity (kA), min.	Unit Packing
	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) Pre-arcing (A)				Nominal Watts Loss	Rated Breaking Capacity (kA), min.	Unit Packing
	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

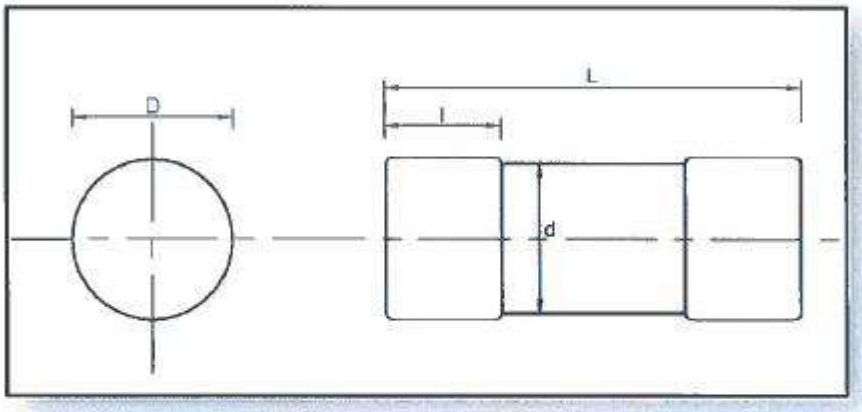

Fig. 1: Cut-out Household fuse

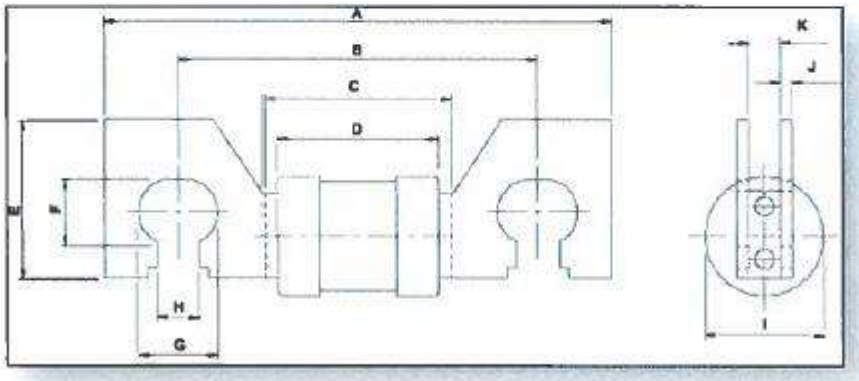

Fig. 2: Cartridge Fuse

Issued by: Head of section, standards Development	Authorized by Manager, Standards
Signed:	Signed:
Date: 2016-08-30	Date: 2016-08-30

3E. Single-Phase Static Meters for Active Energy

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	Terminal 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.....

3F. Current and Potential Transformer Connected Meters

DOCUMENT NO. : KP1/6C/4/1/TSP/14/020

Kenya Power

CURRENT AND POTENTIAL TRANSFORMER CONNECTED METERS - SPECIFICATION

A Document of the Kenya Power & Lighting Co. Ltd
December 2017

Table of Contents

0.1 CIRCULATION LIST

COPY NO.	COPY HOLDER
1	Manager, Standards
2	Electronic copy (pdf) on Kenya Power server (http://172.16.1.40/dms/browse.php?fFolderId=23)

REVISION OF KPLC STANDARDS

To keep abreast of progress in the industry, KPLC Standards shall be regularly reviewed. Suggestions for improvements to approved standards, addressed to the Manager, Standards Department, are welcome.

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date: 2017-12-15	Date: 2017-12-15

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	2017-12-15	Cancels and replaces KP1/10A.2B/3/3/01 dated … and all other previous issues	John Ng'ang'a Patricia Ngaaga	Dr. Eng. Peter Kimemia

FOREWORD

This specification has been prepared by the Standards Department in collaboration with Energy Management, both of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for current and voltage connected static meters, for use in Advanced Metering Infrastructure (AMI) system for large industrial and commercial loads including metering for power generating stations. It is intended for use by KPLC in purchasing these items.

In preparation of this specification, reference was made to IEC 62053-22:2003. A new format of writing specifications as guided by KEBS was also adopted

Customer service division has previously kept their own specifications. The company is however in the process of standardizing all specifications through the Standards Department. This therefore serves to promote standardization.

This specification stipulates the minimum requirements for the meters acceptable for use in the company and it shall be the responsibility of the supplier and manufacturer to ensure that the offered design is of the highest quality and guarantees excellent service to KPLC, and exhibit good workmanship and good engineering practice in the manufacture.

The following are members of the team that developed this specification:

Name	Division
Peter Wanyonyi	Customer Service
Patricia Ngaanga	Customer Service
Felix Juma Saidi	Customer Service
James Ndegwa	Customer Service
John Ng'ang'a	Infrastructure Development

1. SCOPE

1.1. This specification is for current and potential transformer connected static meters for measurement of alternating current active energy in 50Hz networks.

1.2. The specification stipulates minimum requirements, inspection and tests of the meters as well as schedule of Guaranteed Technical Particulars.

2. NORMATIVE REFERENCES

The following standards contain provisions which through reference in this text constitute provisions of this specification. For dated editions the cited edition will apply; for undated editions the latest edition of the referenced document shall apply.

IEC 60529:1989.	Degrees of protection provided by enclosures (IP Code).
IEC 62052-11:2003	Electricity Metering equipment (a.c.) – General Requirements, Tests and Test Conditions - PART 11: Metering equipment.
IEC 62053-22:2003	Electricity metering equipment (a.c.) – Particular Requirements - Part 21: Static meters for active energy (Classes 0.2s and 0.5s).
IEC 62054-21:2004	Electricity metering (a.c) – Tariff and Load Control- part 21: Particular requirements for time switches.
IEC TR 62055-21:2005	Electricity metering – Payment systems – Part 21: Framework for Standardization.
IEC 62055-31:2005	Electricity metering – Payment systems – Part 31: Particular requirements – Static payment meters for active energy (classes 1 and 2).
IEC 62055-41	Electricity metering-Payment systems-Part 41: Standard transfer specification (STS) - Application layer protocol for one - way token carrier systems.
IEC 62056-21:2002	Electricity Metering – Data exchange for meter reading, tariff, and load control – Part 21: Direct local data exchange.
IEC 62056-46:2006	Electricity metering – Data exchange for meter reading, tariff and load control – Part 46: Data link layer using HDLC protocol.
IEC 62056-53:2006	Electricity metering – Data exchange for meter reading, tariff and load control – Part 53: COSEM Application layer.

IEC 62056-61:2006	Electricity metering – Data exchange for meter reading, tariff and load control – Part 61: OBIS object identification system.
IEC 62056-62:2006	Electricity metering – Data exchange for meter reading, tariff and load control – Part 62: Interface classes.

3. DEFINITIONS AND ABBREVIATIONS

For the purpose of this specification the definitions given in the reference standards shall apply and the following abbreviations:

CIU:	Customer Interface Unit
COSEM:	Companion Specification for Energy Metering
DLMS:	Device Language Message Specification
EDIS:	Energy Data Identification System
EMC:	Electromagnetic Compatibility
GPRS:	General Packets Radio Service
GSM:	Global System for Mobile communications
I_b:	Basic current of an electric meter
I_{max}:	Maximum current of an electricity meter
I_n:	Nominal current of a transformer coupled electricity meter
IEC:	International Electro-Technical Commission
ISO:	International Organization for Standardization
LED:	Light Emitting Diode
LCD:	Liquid Crystal Display
KP:	Kenya Power
PLC:	Power Line Communication
RF:	Radio Frequency
TCP/IP:	Transmission Control Protocol/Internet Protocol
kWh:	Kilowatt hour
kVARh:	Kilovolt ampere reactive hour
AMI:	Advanced Metering Infrastructure

USSD:	Unstructured Supplementary Service Data
CSD:	Circuit Switched Data
GMAC:	Galois Message Authentication Code

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

The meters shall be suitable for use outdoors in tropical areas and harsh climatic conditions including areas exposed to:

a) At altitudes of up to 2200m above sea level and humidity of up to 95%,

b) Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C, in direct sunlight,

c) 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.

d) Isokeraunic levels of up to 180 thunderstorm days per year.

4.2. METER COVER, BASE AND TERMINALS

4.2.1. The meters shall be constructed as 3 phase 4-wire meters.

4.2.2. The meters shall be of the relevant British Standard (BS) 5685-foot print for standardized mounting for asymmetrical (BS) wiring.

4.2.3. The meters shall be of front projection mounting.

4.2.4. The meters shall have terminals with bottom entry for cables and the arrangement shall be L1V1L1: L2V2L2: L3V3L3: NN.

4.2.5. The meters' front cover may be of translucent material but shall have a window (clear glass or polycarbonate) for reading the display and for observation.

4.2.6. The terminal cover shall be of transparent material. The external communication modem/module shall be equipped under the terminal cover.

4.2.7. The meters shall be ultrasonically sealed for life and there should be no screws on the body except for the termination of cables.

4.2.8. The meters shall be equipped with lockable / sealable push buttons where such buttons are used to change some meter parameters.

4.2.9. The meters' terminal cover shall be of the long type with cable entry knock-offs.

4.2.10. The meters potential links shall be inside the meter body and shall only be accessed by opening the meter body cover.

4.2.11. Terminal holes shall be of sufficient size to accommodate cables of at least 6mm diameter and depth of 15mm

4.2.12. The meters terminal holes and screws shall be made of brass or nickel-plated brass for high strength and high conductivity.

4.2.13. The meters shall have a sealing provision for terminal cover that is sealable with utility wire seals. The meter shall have terminal cover open detection. Once the terminal cover is opened, the load shall be disconnected.

4.2.14. The meters shall conform to the degree of protection IP54 as given in IEC 60529.

4.2.15. The dimensions of the meter must not exceed the following values:

Width : 180 mm, Length : 300 mm, Height : 90 mm

4.3. COMMUNICATIONS

4.3.1 The meters shall have integrated GPS module for use in locating of the meter.

4.3.2 The meters shall have two separate pulse outputs (LED) indicators for testing and indication of kWh and KVARh meter measurement.

4.3.3 The meters shall be compliant with the DLMS/COSEM or equivalent communication protocol

4.3.4 The Meter shall be able to communicate with a remote central system using a plug in modem/module, through the GSM/GPRS, dual band for operation in the 3G networks.

4.3.5 The modem shall support meter communication protocols as per DLMS/COSEM standards. DLMS certificate and KEMA certificate shall be provided.

4.3.6 The meters shall be equipped with one RS485 port (with terminals A and B) for communication. The meters support remote reading via AMI system existing in Kenya Power. The remote Communication protocol shall be compliant with DLMS/COSEM, IEC62056.

4.3.7 The meters shall support two-way communication.

4.3.8 The meters shall be equipped with RF port to support communication with the hand held unit on site for a distance not less than 50 meters. The hand held units to be used in data reading shall meet all the requirements in clause 4.16

4.3.9 The meter shall be designed with a plug and play communication module that can be replaced at site without powering off the meter.

4.3.10 The communication module shall support USSD, CSD communication.

4.3.11 The manufacturer shall facilitate interfacing of the meters communication with the existing AMI System.

4.3.12 The meters shall be equipped with an infrared optical port with baud rate of 1200 - 9600 for meter programming and data downloading, according to IEC62056 -21.

4.3.13 The data communication shall have encryption and authentication, mechanism is method 5 (GMAC).

4.3.14 The meter shall report to the AMI system when it is power on or off.

4.3.15 The meters shall have the relevant software for programming and reading out data.

4.3.16 The meters shall be programmable to allow the user to change parameters on the installation configuration and in particular the voltage and current transformation ratios. The transformation factor shall be greater or equal to 4000(≥4000).

4.3.17 Access to meter parameters and programming information shall only be through user-level password(s).

4.3.18 The meters software shall support 3 access levels:

a) No security - The lowest level of security would allow users to read specified data fields without password

b) Low level security - The level of security would allow users with the appropriate password to read specified data fields in the meter.

c) High level security - The highest level of security would allow users with the appropriate password to reconfigure the meter with a new program.

4.3.19 The meter program shall be capable of tracking user access to the meter.

4.3.20 Two laptop computers and two optical probes, (see Appendix G for the Laptop computer specifications), for programming and down-loading the meter data shall be provided at no extra cost.

4.3.21 10 hand held units (see clause 4.16 for the Hand held units requirements) shall be supplied for every 600 meters. For meter supplies less than or greater than 600 a simple ratio shall be applied to establish the number of HHUs to be supplied.

4.4. METER DISPLAY

4.4.1 The meters shall have a backlight seven-segment Liquid Crystal Display (LCD) for displaying parameters and measured values.

4.4.2 The meters shall have a backlight-LCD with at least ten (10) numerical characters comprising of selectable integers and No decimal points for energy measurement. Individual digit size shall be minimum 4 mm wide x 8 mm high.

4.4.3 The meters LCD shall have 6-digit ID codes that are OBIS compliant. In addition, the meters shall be DLMS/COSEM protocol compliant (IEC 62056).

4.4.4 The display must be associated with push buttons for parameter scrolling. LCD is to be clearly readable within a viewing angle ±15° in either the horizontal or vertical direction. Nominal diminutions of the display shall be 75 mm X 23 mm.

4.4.5 Meters shall support information reading via optical communication port at site even when mains power supply fails.

4.4.6 The meters shall be capable of continuous display of the presence or absence of individual phase voltages.

4.4.7 The meters LCD shall be capable of displaying various tampering conditions of the meter.

4.4.8 The display parameters shall be configurable by software action.

4.4.9 The LCD display shall operate in at least two modes, namely, basic and extended data list display using push buttons on meter front.

4.4.10 Meters shall have provision for reading the meter at site even when mains power supply fails.

4.5. REAL TIME CLOCK AND MEMORY

4.5.1 The meters shall have a real-time clock controlled by a quartz crystal oscillator. It shall be possible to reset the clock without loss of billing data.

4.5.2 The accuracy of the clock shall be maximum 0.5s and shall meet the requirements of IEC 62054-21.

4.5.3 The meters shall have remote and local synchronization capability.

4.5.4 The Clock shall have a configurable calendar type either as MMDDYY, DDMMYY or YYMMDD.

4.5.5 The meters shall have a backup power supply to run the calendar clock for a minimum of 1 year without mains supply.

4.5.6 If the backup is by means of Lithium battery it shall have a shelf life of ten (10) years.

4.5.7 The meters shall have a non-volatile memory capable of data storage and with long-term data retention for the certified life of the meter or 15 years, whichever is greater without an electrical supply being supplied to the meter.

4.6. FUNCTIONALITY AND LOAD CONTROL

4.6.1 The meters shall be equipped with auxiliary terminals for inputs and outputs.

4.6.2 For inputs, it shall be equipped with:

a) At least 2 control signal inputs, the voltage signal can be 230VAC.

b) At least 4 Impulse signal inputs, the Impulse signal shall be an open/close signal.

4.6.3 For outputs, it shall be equipped with:

a) At least 4 control signal outputs, the control signal shall be an open/close signal, with maximum 400VAC/DC, 100mA.

b) At least 4 Impulse signal outputs, the Impulse signal shall be an open/close signal, with Maximum 250VDC, 27mA.

4.6.4 The meters shall detect significant reverse energy (SRE) when the line and load wires are swapped.

4.6.5 The meters shall continue to operate correctly and record in forward register during SRE detection.

4.7. TIME-OF-USE TARIFF MEASUREMENTS

4.7.1 The meter shall support main tariff table and passive tariff table, with the following parameters:

a) Up to 4 seasons, 4 weekend table,

b) 8 daily tables,

c) Up to 8 divisions per day,

d) Up to 4 tariffs.

4.7.2 The meters shall have four day types namely weekday, Saturday, Sunday and Special/Holiday with switching times set independently.

4.7.3 The meters shall have at least forty (40) special days to take care of national holidays, world days and Easter holidays.

4.7.4 The meters shall be capable of measuring and displaying time-of-day demand (kW and kVA) consumption up to four tariff registers.

4.7.5 The meter shall have at least eight (8) registers for energy

4.7.6 The meters shall have at least six (6) registers for maximum demand.

4.7.7 Each tariff register shall be set to operate over defined time periods during a 24-hour day.

4.8. ENERGY MEASUREMENTS

4.8.1 The meters shall be capable of measuring and displaying active, reactive and apparent energy consumption in both import and export modes.

4.8.2 The meters shall measure demand in two flow directions, namely; import and export.

4.8.3 The meters principal unit for measurement of energy shall be the kilowatt-hour (kWh). The meter shall be capable of measuring demand in kvar, kVA and kW.

4.8.4 The meters shall measure reactive energy and demands in four quadrants up to 4 tariffs.

4.8.5 The energy registers shall be capable of displaying these measured parameters in either kilo-, Mega- or Giga-.

4.8.6 The meters shall be capable of measuring energy in security mode and also record reversed units in forward register.

4.8.7 The meters shall have a facility to indicate reverse connection and reversed units.

4.8.8 The meters shall have a capability of closing end of billing period on any selected date and time of the month selectable by software.

4.8.9 The meter's billing registers shall not be re-settable to zero readings.

4.8.10 The meters shall have at least eighteen (18) billing historical data stored in memory and retrievable by software action. The current billing/historical data shall be available on meter display for reading and billing purposes.

4.9. DEMAND MEASUREMENTS

4.9.1 The meters shall be capable of measuring and displaying active, reactive and apparent demand consumption in both import and export modes.

4.9.2 The meters shall display demand values and their time and date stamps.

4.9.3 The meters shall measure demand correctly even when the phase rotation/sequence is incorrect.

4.9.4 The meters shall have a capability of closing end of billing period on any selected date of the month selectable by software.

4.9.5 The meters shall have at least eighteen (18) billing historical data stored in memory and retrievable by software action. The current and billing/historical data shall be available on meter display for reading and billing purposes.

4.9.6 The meters shall be able to measure, display and store average power factor (PF) in independent import and export registers. The average PF is defined as the ratio of kWh to kVAh over a billing period/ over one month.

4.9.7 The demands registers shall be capable of displaying these measured parameters in either kilo-, Mega- or Giga-.

4.10. INSTRUMENTATION DATA MEASUREMENTS

4.10.1 The meters shall be capable of displaying instrumentation data namely instantaneous phase voltages and currents, phase angles, and power factor.

4.10.2 The meters shall be capable of measuring and displaying instantaneous power (active, reactive and apparent).

4.10.3 The meters shall be capable of measuring and displaying average power factor for the current and the previous billing months.

4.10.4 The meters shall be capable of continuous display of the presence or absence of individual phase voltages.

4.11. LOAD PROFILING

4.11.1 The meters shall be capable of storing load profiles for at least 180 days on 25 channels with 20 minutes integration.

4.11.2 The channels available for load profiling shall be as follows: +kWh, -kWh, +kVARh, -kVARh, +kVAh, -kVAh, +P, -P, +Q, -Q, +S, -S, QI, QII, QIII, QIV, V1, V2, V3, I1, I2, I3 & PF.

4.11.3 The load profile integration period shall be programmable from one (1) minute up to a maximum of sixty (60) minutes.

4.12. POWER QUALITY ANALYSIS

4.12.1 The meter shall collect and record basic power quality information – overcurrent, total no. of alarms, power outages, voltage and current, average power factor and line frequency, etc.

4.12.2 The meter shall measure total harmonic distortion (THD). Meters shall support wave capture function, capture data and can be read via software

4.12.3 Meter shall support up to 32 times odd harmonic voltage and current measurement

4.12.4 The meter shall be able to provide voltage sag and swell detection.

4.13. SECURITY FEATURES

4.13.1 The meters shall be capable of event recording and the event can be read remotely via system, which shall include but not be limited to:

a) Power ups and power downs with date and time stamp;

b) Individual Phase failure, with date and time stamps;

c) Over and under voltages based on a pre-set threshold with date and time stamp;

d) Battery voltage status;

e) Memory status;

f) Meter Errors,

g) Date and time of last programming/parameterization;

h) Date and time of the last billing period;

i) Firmware upgrades

j) Terminal and Meter cover removal even during a power failure

k) Main meter cover removal, even during a power failure

l) Communications removal

m) Magnetic detection, at least 0.5 mT

n) Existence of current, despite absence of one or two phases

o) Current imbalance, over 30% in one phase or two phases (compared with other phase) should be detected

p) Tariff change

q) Time and Date change.

4.13.2 The LCD shall display events that have occurred. The events displayed shall include but not be limited to the following:

a) Meter errors;

b) Individual Phase failure;

c) Battery voltage status;

d) Alarms

e) Warning messages etc.

f) Terminal cover

g) Communications removal

h) Magnetic detection, at least 0.5 mT

4.14. ELECTRICAL REQUIREMENTS

4.14.1 The meters shall be operated from main power with reference values of: 3×57.7/100V to 230 V/400V, 3 x 1 (10) A at 50 Hz.

4.14.2 Primary currents and voltages for the meters shall be programmable through the software thus allowing primary metering of Demand and Energy.

4.14.3 The meters shall be connectable as three phase four wire systems drawing of which shall be printed on the terminal cover.

4.14.4 The meter shall have reference standard currents of: In= 1 A; I max = 10 A for the operating conditions stated in clause 4.14.1.

4.14.5 The meters Power consumption shall meet IEC 62053-22 7.1-7.4

4.14.6 Influence of short-time over-currents shall meet IEC 62053-22 7.1-7.4

4.14.7 Influence of self-heating shall meet IEC 62053-22 7.1-7.4

4.14.8 AC voltage test shall meet IEC 62053-22 7.1-7.4

Requirements 4.14.4 to 4.14.8 shall form part of the type test approval to be issued by an international/ national (of the country of manufacture) meter certifying body.

4.15. ACCURACY REQUIREMENTS

4.15.1 The meter's accuracy shall be class 0.2s for active energy and class 2 for reactive energy measurements as per accuracy requirements such that it meets IEC 62053-22 8.1-8.6.

4.15.2 Limits of errors due to variation of the current shall meet requirement IEC 62053-22 8.1-8.6.

4.15.3 Limits of error due to influence quantities shall meet IEC 62053-22 8.1-8.6 requirements.

4.15.4 Test of starting and no-load condition shall meet IEC 62053-22 8.1-8.6 requirements.

4.15.5 Meter constant shall meet IEC 62053-22 8.1-8.6 requirements.

4.15.6 Accuracy test conditions shall meet IEC 62053-22 8.1-8.6 requirements.

4.16. HAND HELD UNIT (HHU) REQUIREMENTS

4.16.1 The handheld unit shall be used to read meter data and parameters at site which include

a) Meter consumption reading

b) Instantaneous data reading

c) Billing information reading

d) Event information reading. Phase loss, over-current, over-voltage, open box and other relevant data

e) Basic parameter reading, e.g. meter number, software version no, assets number etc

4.16.2 The handheld unit shall be used to read longitude and latitude information of the installation site and report to data center with the GIS information and the meter information after the installation.

4.16.3 The handheld unit shall at least have one USB 2.0 port and a compatible data cable to download the task from data center (KP AMI) as well as uploading data to the data center.

4.16.4 The handheld unit with wireless communication shall be able to acquire data from the meter at least 50m from the intended meter/s enclosure/s.

4.16.5 The handheld unit shall have a high precision GPS location module.

4.16.6 The handheld unit shall have Microsoft Windows as the operating system.

4.16.7 The handheld unit shall have LCD display: TFT-LCD，320x240 pixel with touch screen

4.16.8 The handheld unit shall have a power supply with minimum 4000mAh battery with up to 100 hours of standby time

4.16.9 The handheld unit shall meet IP65 protection requirements

4.16.10 The handheld unit shall have working temperature of 0°C to 60°C

4.16.11 The handheld unit shall be able to withstand the drop impact of vertical height 1.5 meters

4.16.12 The handheld unit shall be able to configure the following on the meter:

a) Set the time and date

b) Set the communication parameter

c) GPS code reading and match the GPS code with meter Number.

d) Import /Export meter information in batch

4.16.13 The handheld unit shall be complete with a charger for charging at 230Vac

4.16.14 The internal memory shall be at least 4GB

4.16.15 Supports up to 32GB micro SD card

4.16.16 The CPU shall be at least 800MHz

5. TESTS REQUIREMENTS

The meters shall be inspected and tested in accordance with the requirements of IEC 62053-22, IEC 62052-11, IEC 62056 and other relevant standards and provisions of this specification.

6. MARKING, LABELLING AND PACKING

6.1. In addition to IEC 62052-11:2003 nameplate requirements, each meter shall be marked legibly and indelibly with the following information:

a) Name and trade mark of the manufacturer;

b) Country of origin;

c) Type/model;

d) Meter number up to twelve digits;

e) Barcode comprising of meter serial no;

f) The inscription "Property of KPLC"

g) Standard(s) to which the meter complies;

h) Year of manufacture.

i) Every meter shall be indelibly marked with connections diagrams

All markings to be written in English and with c), d) and e) at least 4 mm figure height.

6.2. The meters shall be packaged in such a manner as to minimize damage and entry of moisture during transportation and handling.

6.3. The meters shall be packed in suitable groups and / or batches with consecutive serial numbers provided by Kenya Power. The range of meter serial numbers including the barcode information for each meter shall be indicated on the outside of the packaging material.

6.4. The number of meters packaged in a group and/or batch for handling/lifting/carrying by an operator manually shall be such that their weight does not exceed 15 kg.

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APPENDICES

A. TESTS AND INSPECTION (Normative)

A.1 It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified. Tenderers shall confirm the manufacturer's capabilities in this regard when submitting tenders. Any limitations shall be clearly specified.

A.2 Copies of Type Test Certificates and Type 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. A copy of the accreditation certificate to ISO/IEC 17025 for the testing laboratory shall also be submitted. Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Laboratory that carried out the tests.

A.3 The meters shall be subject to acceptance tests at the manufacturer's works before dispatch. Acceptance tests shall be witnessed by two Engineers appointed by The Kenya Power & Lighting Co. Ltd. (KPLC) and shall include the following:

A.3.1 Tests and test conditions given in IEC 62052-11:2003

A.3.2 Acceptance tests as per the requirements of IEC 62053-22:2003

A.4 **Testing Facility**

A.4.1 The bidder shall provide current e-mail address, fax and telephone numbers and contact person at the Testing Laboratory where Type Tests and Special Tests were carried out.

A.4.2 All test and measuring equipment to be used during acceptance testing shall have been calibrated and copies of valid calibration certificates shall be provided to KPLC Engineers. A detailed list of workshop tools, test/measuring equipment and list of tests that can be carried out by the manufacturer shall be submitted with the tender for evaluation.

A.5 Test reports for each meter shall be submitted to The Kenya Power and Lighting Company for approval before shipment.

A.6 During delivery of the meters, 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, meters which upon examination, test or use fail to meet any or all of the requirements in the specification.

B. QUALITY MANAGEMENT SYSTEM (Normative)

B.1 The bidder shall submit a quality assurance plan (QAP) that will be used to ensure that the meter design, material, workmanship, tests, service capability, maintenance and documentation, shall fulfil the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2008 or later.

B.2 The Manufacturer's Declaration of Conformity to applicable standards, this specification and copies of quality management certifications including copy of valid and relevant ISO 9001 certificate shall be submitted with the tender for evaluation.

B.3 The bidder shall indicate the delivery time of each type of meter, manufacturer's monthly and annual production capacity and experience in the production of the type of meter being offered. A detailed list and contact addresses (including e-mail) of the manufacturer's previous customers outside the country of manufacture for exact or similar rating of meters sold in the last five years shall be submitted with the tender for evaluation.

C. DOCUMENTATION AND DEMONSTRATION (Normative)

C.1 The bidder shall submit its tender complete with technical documents required by Appendix F (Guaranteed Technical Particulars) for tender evaluation. The documents to be submitted (all in English language) for tender evaluation shall include the following:

a) Fully filled clause by clause Guaranteed Technical Particulars (GTP) stamped and signed by the manufacturer,

b) Copies of the manufacturer's catalogues, brochures, meter drawings and wiring diagrams and technical data showing description leaflet, programming details and manuals,

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. The Number of electronic meters sold over a period of five years shall not be less than 150,000 meters.

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 third party testing laboratory,

g) Manufacturer's warranty and guarantee; subject to 36 months from date of delivery to KPLC stores,

h) Manufacturer's letter of authorization, copy of the manufacturer's ISO 9001:2008 or later certificate, ISO 17025(2005) certificate.

C.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

a) Fully filled clause by clause Guaranteed Technical Particulars (GTP) stamped and signed by the manufacturer,

b) Design drawings and wiring diagrams of the meters,

c) Original software, software manuals and operation manuals,

d) List of registers to be displayed and sequence of display as per appendix E,

e) 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 or later,

f) Detailed test program to be used during factory testing,

g) Marking details and method to be used in marking the meters,

h) 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 meters for The Kenya Power & Lighting Company,

i) Packaging details (including packaging materials and marking and identification of batches).

C.3 The bidder shall submit with the tender, a sample meter, meter software, operating manual(s), and an optical interface for interrogating the meter.

C.4 The sample meter submitted shall have basic and extended data display sequences as specified in appendix E of this document. The submitted meter samples shall be subjected to accuracy tests at KPLC's Meter Central Laboratory to verify the requirements of IEC 62053-22:2003 clause7.1-7.4 and 8.1 and to verify responsiveness to other clauses of this specification. Sample meters shall not be returned to the bidders.

C.5 The successful bidder and manufacturer shall demonstrate at their cost (excluding costs to be incurred by KPLC staff) to at least twenty KPLC staff (in Nairobi) after delivery of meters to KPLC stores, for at least 3 days, the following;

a) Meter features,

b) Meter metrology,

c) Meter installation,

d) Meter software,

e) Meter programming and data downloading,

f) Other relevant information

C.6 **Samples**

Bidders are advised that the Laws of Kenya require that the Kenya Bureau of Standards must approve any new meter being introduced in the country. To this end Bidders shall furnish the Bureau with 4 (four) samples of each meter type to be supplied. The successful Bidder shall submit this approval before the signing of the supply contract. Bidders may communicate directly with the Kenya Bureau of Standards on this matter through the following address:

The Managing Director
Kenya Bureau of Standards,
P.O. Box 54974, 00200 Nairobi
Kenya.
Tel: (+254 020) 605490, 602350
Fax: (+254 020) 604031
Email: info@kebs.org
Web: http://www.kebs.org

D. SCHEDULE OF TECHNICAL DATA

Standard and type tests	
General requirements, tests and test conditions	IEC 62052-11:2003
Particular requirements for static meters for active energy	IEC 62053-22:2003
Power consumption and voltage requirements	IEC 62053-22:2003
Shock test	IEC 62052-11:2003
Plastic-determination of temperature	IEC 62052-11:2003
Degree of protection	IP54
Measurement Base	Active / Reactive energy, 3 element, 4 quadrant
Network type	3phase 3 or 3 phase 4-wire
Connection type	VT and CT connected
Accuracy	kWh Class 0.2s (IEC 62053-22:2003); kvarh class 2 (IEC 62053-23:2003)
Humidity:	Reaching 95%
Altitude	Up to 2,600m
Temperature range (operating)	-1 to+60 0 C
Voltage measurement (Un)	3x 63.5/110 V 50Hz, 3 phase 4 wire
Voltage range	0.8 Un to 1.15 Un

Standard and type tests	
Voltage circuit burden	2 W and 10 VA
Burst test	4 kV
Impulse voltage	6 kV, 1.2/50 s
Current measurement	In =1 A; Imax ≥ 6 A
Short circuit current	20 Imax for 0.5 s
Starting current	0.001In
Current circuit burden	≤1 VA
LCD	7 Measurement and 5 ID (EDIS) digits
Load profile	180 day-4-channel capacity at 20 minute intervals
Dielectric strength	4 kV, 50 Hz, 1 min.

E. LIST OF REGISTERS TO BE DISPLAYED AND SEQUENCE OF DISPLAY

No.	Category/Sequence of Display	Data Item	OBIS Code
1	LCD Automatic Display List	Current Month Import Active +kWh Sum Energy	1-1:1.8.0
2	LCD Automatic Display List	Last month 1 Import Active +kWh Sum Energy	1-1:1.8.0*1
3	LCD Automatic Display List	Current Month Export Active -kWh Sum Energy	1-1:2.8.0
4	LCD Automatic Display List	Last month 1 Export Active -kWh Sum Energy	1-1:2.8.0*1
5	LCD Button Display List	ERR 0	0-0:F.F.0
6	LCD Button Display List	User No. High 6 digits	1-0:0.0.1
7	LCD Button Display List	User No. Low 6 digits	1-0:0.0.1
8	LCD Button Display List	Meter No. High 6 digits	1-0:0.0.0
9	LCD Button Display List	Meter No. Low 6 digits	1-0:0.0.0
10	LCD Button Display List	Time	1-0:0.9.1
11	LCD Button Display List	Date	1-0:0.9.2
12	LCD Button Display List	Current Month Import Active +kWh Sum Energy	1-1:1.8.0
13	LCD Button Display List	Last month 1 Import Active +kWh Sum Energy	1-1:1.8.0*1
14	LCD Button Display List	Current Month Export Active -kWh Sum Energy	1-1:2.8.0
15	LCD Button Display List	Last month 1 Export Active -kWh Sum Energy	1-1:2.8.0*1
16	LCD Button Display List	Current Month Import Apparent +kVA Sum Max Demand	1-1:9.6.0

No.	Category/Sequence of Display	Data Item	OBIS Code
17	LCD Button Display List	Current Month Import Apparent +kVA Sum Max Demand Date	1-1:9.6.0
18	LCD Button Display List	Current Month Import Apparent +kVA Sum Max Demand Time	1-1:9.6.0
19	LCD Button Display List	Last month 1 Import Apparent +kVA Sum Max Demand	1-1:9.6.0*1
20	LCD Button Display List	Last month 1 Import Apparent +kVA Sum Max Demand Date	1-1:9.6.0*1
21	LCD Button Display List	Last month 1 Import Apparent +kVA Sum Max Demand Time	1-1:9.6.0*1
22	LCD Button Display List	Current Month Import Apparent +kVA Sum Concurrent Active Power	1-1:1.5.0
23	LCD Button Display List	Current Month Import Apparent +kVA Sum Active Power Occur Date	1-1:1.5.0
24	LCD Button Display List	Current Month Import Apparent +kVA Sum Active Power Occur Time	1-1:1.5.0
25	LCD Button Display List	Last month 1 Import Apparent +kVA Sum Concurrent Active Power	1-1:1.5.0*1
26	LCD Button Display List	Last month 1 Import Apparent +kVA Sum Active Power Occur Date	1-1:1.5.0*1
27	LCD Button Display List	Last month 1 Import Apparent +kVA Sum Active Power Occur Time	1-1:1.5.0*1
28	LCD Button Display List	Current Month Import Active +kWh Tariff 1 Energy	1-1:1.8.1
29	LCD Button Display List	Last month 1 Import Active +kWh Tariff 1 Energy	1-1:1.8.1*1
30	LCD Button Display List	Current Month Import Active +kWh Tariff 2 Energy	1-1:1.8.2
31	LCD Button Display List	Last month 1 Import Active +kWh Tariff 2 Energy	1-1:1.8.2*1
32	LCD Button Display List	Current Month Import Apparent +kVA Tariff 1Max Demand	1-1:9.6.1
33	LCD Button Display List	Current Month Import Apparent +kVA Tariff 1Max Demand Date	1-1:9.6.1
34	LCD Button Display List	Current Month Import Apparent +kVA Tariff 1Max Demand Time	1-1:9.6.1
35	LCD Button Display List	Last month 1 Import Apparent +kVA Tariff 1Max Demand	1-1:9.6.1*1
36	LCD Button Display List	Last month 1 Import Apparent +kVA Tariff 1Max Demand Date	1-1:9.6.1*1
37	LCD Button Display List	Last month 1 Import Apparent +kVA Tariff 1Max Demand Time	1-1:9.6.1*1

No.	Category/Sequence of Display	Data Item	OBIS Code
38	LCD Button Display List	Current Month Import Apparent +kVA Tariff 1Concurrent Active Power	1-1:1.5.1
39	LCD Button Display List	Current Month Import Apparent +kVA Tariff 1Active Power Occur	1-1:1.5.1
40	LCD Button Display List	Current Month Import Apparent +kVA Tariff 1Active Power Occur	1-1:1.5.1
41	LCD Button Display List	Last month 1 Import Apparent +kVA Tariff 1Concurrent Active Power	1-1:1.5.1*1
42	LCD Button Display List	Last month 1 Import Apparent +kVA Tariff 1Active Power Occur	1-1:1.5.1*1
43	LCD Button Display List	Last month 1 Import Apparent +kVA Tariff 1Active Power Occur	1-1:1.5.1*1
44	LCD Button Display List	Current Month Import Reactive +kvarh Sum Energy	1-1:3.8.0
45	LCD Button Display List	Last month 1 Import Reactive +kvarh Sum Energy	1-1:3.8.0*1
46	LCD Button Display List	Current Month Import Apparent +kVAh Sum Energy	1-1:9.8.0
47	LCD Button Display List	Last month 1 Import Apparent +kVAh Sum Energy	1-1:9.8.0*1
48	LCD Button Display List	Sum Instant Power factor	1-1:13.7.0
49	LCD Button Display List	CT Ratio	1-0:0.4.2
50	LCD Button Display List	VT Ratio	1-0:0.4.3
51	LCD Button Display List	Phase A Instant Voltage	1-1:32.7.0
52	LCD Button Display List	Phase B Instant Voltage	1-1:52.7.0
53	LCD Button Display List	Phase C Instant Voltage	1-1:72.7.0
54	LCD Button Display List	Phase A Instant Current	1-1:31.7.0
55	LCD Button Display List	Phase B Instant Current	1-1:51.7.0
56	LCD Button Display List	Phase C Instant Current	1-1:71.7.0
57	LCD Button Display List	Frequency	1-1:14.7.0
58	LCD Button Display List	Sum Import Instant Active power kW	1-1:1.7.0
59	LCD Button Display List	Sum Import Instant Reactive power kvar	1-1:3.7.0
60	LCD Button Display List	Sum Import Instant Apparent power kVA	1-1:9.7.0
61	LCD Button Display List	Current Month Import Sum Monthly average power factor	1-1:13.15.0
62	LCD Button Display List	Last month Import 1 Sum Monthly average power factor	1-1:13.15.0*1
63	LCD Button Display List	Current Month Export Sum Monthly average power factor	1-1:14.15.0
64	LCD Button Display List	Last month Export 1 Sum Monthly average power factor	1-1:14.15.0*1

F. GUARANTEED TECHNICAL PARTICULARS (Normative)

To be filled and signed by the Supplier and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records for previous five years, four customer reference letters, details of suppliers' capacity and experience; and copies of complete type test certificates and test reports for tender evaluation, all in English Language)

Tender No. .....

Bidder's name and Address.....

Clause number	KPLC requirement	Bidder's offer
Manufacturer's Name and address		Specify
Country of Manufacture		Specify
Bidder's Name and address		Specify
1.	**Scope**	Specify
1.1-1.2		
2.	Applicable Standards	Specify
3.	Terms & Definitions	Specify
4.	**Requirements**	
4.1	Operating Conditions	Specify
4.2	**Meter cover, base and Terminals**	
4.2.1	3 phase 4 wire configuration	Specify
4.2.2	BS 5685 footprint	Specify
4.2.3	The meters shall be of front projection mounting	Specify
4.2.4	Bottom entry terminals with arrangement $L_1V_1L_1$: $L_2V_2L_2$: $L_3V_3L_3$:NN	Specify
4.2.5	The meter's front cover may be of translucent material but shall have a window (clear glass or polycarbonate) for reading the display and for observation	Specify
4.2.6	The terminal cover shall be of transparent material	Specify
	The modem shall be equipped under the terminal cover	Specify
4.2.7	The meters shall be ultrasonically sealed for life	Specify
4.2.8	The meters shall be equipped with lockable / sealable push buttons where such buttons are used to change some meter parameters.	Specify
4.2.9	Terminal cover long type with cable entry knock-offs	Specify
4.2.10	The meter potential links shall be inside the meter body and shall only be accessed by opening the meter body cover	Specify

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date: 2017-12-15	Date: 2017-12-15

Clause number	KPLC requirement	Bidder's offer
4.2.11	Terminal holes shall at be of sufficient size to accommodate the cables of at least 6mm diameter	Specify
4.2.12	The meters terminal holes and screws shall be made of brass or nickel-plated brass for high strength and high conductivity	Specify
4.2.13	Sealing provisions for terminal cover, back –up battery and reset button	Specify
	Meter to have terminal cover open detection	Specify
	Load to be disconnected once the terminal cover is opened	Specify
4.2.14	Conforms to IP54 degree of protection	Specify
4.2.15	Dimensions WxLxH of 180mmx300mmx90mm	Specify
4.3	**Communications**	Specify
4.3.1	The meters shall have integrated GPS module for use in meter location.	Specify
4.3.2	KWh and KVARh LED indicators for testing and indication	Specify
4.3.3	Compliant with DLMS/COSEM or equivalent protocol	Specify
4.3.4	The Meter shall be able to communicate with a remote central system using a plug in modem/module, through the GSM/GPRS, dual band for operation in the 3G networks.	Specify
4.3.5	The meter shall support DLMS/COSEM communication protocols	Provide DLMS and KEMA certificates
4.3.6	The meters shall be equipped with one RS485 port (with terminals A and B) for communication. The meters support remote reading via AMI system existing in Kenya Power. The remote Communication protocol shall be compliant with DLMS/COSEM, IEC62056.	Specify
4.3.7	Shall support two way communication	Specify
4.3.8	The meters shall be equipped with RF port to support communication with HAND HELD UNIT on site for a distance not less than 50 meters. The Hand held Units to be used in data reading shall meet all the requirements in clause 4.16	Specify
4.3.9	The modem shall be replaced at site without powering off the meter	Specify
4.3.10	Communication module shall support USSD, CSD communication	Specify
4.3.11	Manufacturer to facilitate interfacing of the meters communication with existing AMI system	Specify
4.3.12	Infrared optical port with baud rate 1200-9600 for programming and data downloading provided.	Specify

Clause number	KPLC requirement	Bidder's offer
4.3.13	Communication with encryption and authentication	Specify
4.3.14	Reports to AMI system when Powered on or off	Specify
4.3.15	Relevant software and hardware for programming and data reading	Specify
4.3.16	The meters shall be programmable to allow the user to change parameters on the installation configuration and in particular the voltage and current transformation ratios. The transformation factor shall be greater or equal to 4000(≥4000).	Specify
4.3.17	Access and programming through user level passwords	Specify
4.3.18	Supports 3 access levels	Specify
4.3.19	Software capable of tracking user access	Specify
4.3.20	Two Laptops and two optical probes at no extra cost	Specify
	Laptop requirements shall be fully provided as per appendix G	Specify
4.3.21	10 HHU (see clause 4.17 for the Hand held units specifications) be supplied for every 600 meters	specify
4.4	**Meter display**	
4.4.1	The meter shall have a backlight seven segment LCD	Specify
4.4.2	The LCD shall have at least 10 numerical characters without decimal points. Digits shall be at least 4mm wide by 8mm high	Specify
4.4.3	LCD with 6-digit ID codes that are Obis compliant	Specify
4.4.4	Display associated with push buttons for scrolling.	Specify
	LCD to be clearly readable at ±15° horizontally or vertically.	Specify
	Nominal diminutions shall be 75mm x 23mm	Specify
4.4.5	Supports reading even when power supply fails	Specify
4.4.6	Display continuously presence or absence of individual phase voltages	Specify
4.4.7	Shall display various tampering conditions of the meter	Specify
4.4.8	Display parameters configurable by software action	Specify
4.4.9	LCD display operates in at least two modes, basic and extended data list display using push buttons on meter front	Specify
4.4.10	Supports reading even when mains power fails.	Specify
4.5	**Real time clock and memory**	
4.5.1	With real time clock controlled by a quartz crystal oscillator that shall be reset without loss of billing data	Specify
4.5.2	Clock accurate to 0.5s max	Specify
4.5.3	Meters with remote and local synchronization capability	Specify
4.5.4	Clock with configurable calendar type	Specify

Clause number	KPLC requirement	Bidder's offer
4.5.5	Meters with a backup power supply to run the calendar clock for a minimum of 1 year without mains supply	Specify
4.5.6	For lithium battery, it shall have a shelf life of 10 years	Specify
4.5.7	Non-volatile memory data retention period equivalent to meter certified period or 15years, whichever is greater, without electrical supply.	Specify
4.6	**Functionality and load control**	
4.6.1	Equipped with auxiliary terminals for inputs and outputs	Specify
4.6.2	2 control signal inputs	Specify and state signal type
	4 impulse signal inputs	
4.6.3	4 control signal outputs	Specify and state signal type
	4 impulse signal outputs	
4.6.4	Meters shall detect significant reverse energy when line and load wire are swapped	Specify
4.6.5	Meters shall operate correctly and record in forward register during SRE detection	Specify
4.7	**Time-of-use tariff measurements**	Specify
4.7.1	The meter shall support main tariff table and passive tariff table, with a) Up to 4 seasons, 4 weekend table, b) 8 daily tables, c) Up to 8 divisions per day, d)Up to 4 tariffs .	Specify
4.7.2	Meters shall have four day types namely weekday, Saturday, Sunday and Special/Holiday with switching times set independently.	Specify
4.7.3	Meters shall have at least forty (40) special days	Specify
4.7.4	Capable of measuring and displaying time-of-day demand (kW and kVA) consumption up to four tariff registers.	Specify
4.7.5	The meter shall have at least eight (8) registers for energy	Specify
4.7.6	Meters shall have at least six (6) registers for maximum demand.	Specify
4.7.7	Each tariff register shall be set to operate over defined time periods during a 24-hour day	Specify
4.8	**Energy Measurements**	
4.8.1	Can measure and display active, reactive and apparent energy in both import and export modes	Specify
4.8.2	Shall measure demand in import and export flows	Specify
4.8.3	Main measurement unit shall be kilowatt-hour. It shall also measure in kvar, kVA and kW	Specify

Clause number	KPLC requirement	Bidder's offer
4.8.4	Meters shall measure reactive energy and demands in four quadrants up to 4 tariffs	Specify
4.8.5	Energy registers shall be able to display measured parameters in either kilo, mega or giga	Specify
4.8.6	The meters shall be capable of measuring energy in security mode and also record reversed units in forward register.	Specify
4.8.7	Meters shall have a facility to indicate reverse connection and reversed units	Specify
4.8.8	Meters shall have a capability of closing end of billing period on any selected date and time of the month selectable by software	Specify
4.8.9	The meter's billing registers shall NOT be re-settable to zero readings	Specify
4.8.10	The meters shall have at least eighteen (18) billing historical data stored in memory and retrievable by software action. The current billing/historical data shall be available on meter display for reading and billing purposes.	Specify
4.9	**Demand Measurements**	
4.9.1	Can measure and display active, reactive and apparent demand in both import and export modes	Specify
4.9.2	Meters shall display demand values and their time and date stamps	Specify
4.9.3	Meters shall measure demand correctly when phase rotation/sequence is incorrect	Specify
4.9.4	Meters shall have a capability of closing end of billing period on any selected date and time of the month selectable by software	Specify
4.9.5	Meters shall have at least eighteen (18) billing historical data stored in memory and retrievable by software action. The current and billing/historical data shall be available on meter display for reading and billing purposes	Specify
4.9.6	Meters shall be able to measure, display and store average PF in independent import and export registers. The average PF is defined as the ratio of kWh to kVAh over a billing period/ over one month.	Specify
4.9.7	Demand registers shall be able to display measured parameters in either kilo, mega or giga	Specify
4.10	**Instrumentation data measurements**	
4.10.1	Shall display instantaneous phase voltages, phase currents, phase angles and power factors	Specify

Clause number	KPLC requirement	Bidder's offer
4.10.2	Shall measure and display instantaneous power (active, reactive and apparent)	Specify
4.10.3	Shall measure and display average power factor for the current and previous billing months	Specify
4.10.4	Shall continuously display presence or absence of individual phase voltages	Specify
4.11	**Load profiling**	
4.11.1	Meters shall be capable of storing load profiles for at least 180 days on 25 channels with 20 minutes integration	Specify
4.11.2	The channels available for load profiling shall be as follows: +kWh, -kWh, +Kvarh, -kvarh, +kVAh, -kVAh, +P, -P, +Q, -Q, +S, -S, QI, QII, QIII, QIV, V1, V2, V3, I1, I2, I3 & PF.	Specify
4.11.3	The load profile integration period shall be programmable from one (1) minute up to a maximum of sixty (60) minutes.	Specify
4.12	**Power Quality Analysis**	
4.12.1	Meters shall collect and record basic power quality information – overcurrent, total no. of alarms, power outages, voltage and current, average power factor and line frequency, etc.	Specify
4.12.2	Shall measure THD. Meters shall support wave capture function, data capture and can be read via software	Specify
4.12.3	Meters shall support up to 32 times odd harmonic voltage and current measurements	Specify
4.12.4	Meters shall be able to provide voltage sag and swell detection	Specify
4.13	**Security Features**	
4.13.1	The meters shall be capable of event recording and the event can be read remotely via system, which shall include but not be limited to: a) Power ups and power downs with date and time stamp; b) Individual Phase failure, with date and time stamps; c) Over and under voltages based on a pre-set threshold with date and time stamp; d) Battery voltage status; e) Memory status; f) Meter Errors, g) Date and time of last programming/parameterization;	Specify

Clause number	KPLC requirement	Bidder's offer
	h) Date and time of the last billing period; i) Firmware upgrades j) Terminal and Meter cover removal even during a power failure k) Main meter cover removal, even during a power failure l) Communications removal m) Magnetic detection, at least 0.5 mT n) Existence of current, despite absence of one or two phases o) Current imbalance, over 30% in one phase or two phases (compare with other phase) should be detected p) Tariff change q) Time and Date change.	
4.13.2	The LCD shall display events that have occurred. The events displayed shall include but not be limited to the following: a) Meter errors; b) Individual Phase failure; c) Battery voltage status; d) Alarms e) Warning messages etc. f) Terminal cover g) Communications removal h) Magnetic detection, at least 0.5 mT	Specify
4.14	**Electrical Requirements**	
4.14.1	Mains reference: - 3×57.7/100V to 230 V/400V, 3 x 1 (10) A , 50 Hz.	Specify
4.14.2	Primary currents and voltages programmable through software	Specify
4.14.3	Three phase four wire connection. Drawing printed on terminal cover	Provide drawing
4.14.4	In= 1 A; I max = 10 A	Provide test reports
4.14.5	The meters Power consumption shall meet IEC 62053-22 7.1-7.4	Provide test reports
4.14.6	Influence of short-time over-currents shall meet IEC 62053-22 7.1-7.4	Provide test reports
4.14.7	Influence of self-heating shall meet IEC 62053-22 7.1-7.4	Provide test reports
4.14.8	AC voltage test shall meet IEC 62053-22 7.1-7.4	Provide test reports
4.15	**Accuracy requirements**	
4.15.1	Accuracy class 0.2s for active energy and class 2 for reactive energy	Provide test reports

Clause number	KPLC requirement	Bidder's offer
	as per IEC 62053-22 8.1-8.6	
4.15.2	Limits of errors due to variation of the current shall meet requirement IEC 62053-22 8.1-8.6.	Provide test reports
4.15.3	Limits of error due to influence quantities shall meet IEC 62053-22 8.1-8.6 requirements	Provide test reports
4.15.4	Test of starting and no-load condition shall meet IEC 62053-22 8.1-8.6 requirements	Provide test reports
4.15.5	Meter constant shall meet IEC 62053-22 8.1-8.6 requirements	Provide test reports
4.15.6	Accuracy test conditions shall meet IEC 62053-22 8.1-8.6 requirements	Provide test reports
4.16	**Hand Held Unit Requirements**	
4.16.1	The handheld unit shall be used to read meter data and parameters at site which include a) Meter consumption reading b) Instantaneous data reading c) Billing information reading d) Event information reading. Phase loss, over-current, over-voltage, open box and other relevant data e) Basic parameter reading, e.g. meter number, software version no, assets number etc	Specify
4.16.2	The handheld unit shall be used to read longitude and latitude information of the installation site and report to the data center with the GIS information and the meter information after the installation.	Specify
4.16.3	The handheld unit shall at least have one USB 2.0 port and compatible data cable to download the task from data center (KP AMI) as well as uploading data to the data center.	Specify
4.16.4	The handheld unit with wireless communication shall be able to acquire data from the meter at least 50m from the intended meter/s enclosure/s.	Specify
4.16.5	The handheld unit shall have a high precision GPS location module	Specify
4.16.6	The handheld unit shall have Microsoft Windows as the operating system	Specify
4.16.7	The handheld unit shall have LCD display: TFT-LCD, 320x240 pixel with touch screen	Specify
4.16.8	The handheld unit shall have a power supply with minimum 4000mAh	Specify

Clause number	KPLC requirement	Bidder's offer
	battery with up to 100 hours of standby time	
4.16.9	The handheld unit shall have IP65 requirements	Specify
4.16.10	The handheld unit shall have working temperature of 0°C to 60°C	Specify
4.16.11	The handheld unit shall be able to withstand the drop impact of vertical height 1.5 meters	Specify
4.16.12	The handheld unit shall be able to configure the following on the meter: a) Set the time and date b) Set the communication parameter c) GPS code reading and match the GPS code with meter Number. d) Import /Export meter information in batch	Specify
4.16.13	The handheld unit shall be complete with a charger for charging at 230Vac	Specify
4.16.14	The internal memory shall be at least 4GB	Specify
4.16.15	Supports up to 32GB micro SD card	Specify
4.16.16	The CPU shall be at least 800MHz	Specify
5	**Test Requirements**	State
6	**Marking and Packing**	
6.1	Marking	Provide with drawing
6.2	Packed to minimize damage and moisture ingress	State
6.3	Meters' serial numbers, barcode information and batch numbers indicated	State
6.4	Weight per group/batch shall not exceed 15kgs	State
A	**Tests and Inspection**	
A.1	Responsibility of carrying out tests	State
A.2	Copies of Type Test Reports submitted with tender	State
A.3	Acceptance tests to be witnessed by KPLC at factory before shipment	State
A.4.1	Contact information of the testing facility	
A.4.2	Testing tools list and calibration certificates. List of tests the manufacturer can carry out.	State
A.5	Test reports to be submitted by supplier to KPLC for approval before shipment	State
A.5	Inspection at the stores and replacement of rejected meters	State compliance
B	**Quality Management System**	
B.1	Quality Assurance Plan	Provide

Clause number	KPLC requirement	Bidder's offer
B.2	Copy of ISO 9001:2008 Certificate or KEBS Diamond mark of quality	Provide
B.3	Manufacturer's experience	Provide
	Manufacturing Capacity (units per month)	Provide
	List of previous customers	Provide
	Customer reference letters	Provide
C	**Documentation and demonstration**	
C.1	Documents submitted with tender	Provide
C.2	Documents to be submitted by supplier to KPLC for approval before manufacture	Provide
C.3	Sample meter, software, manuals and optical interface submitted with tender	Provide
C.4	Meter with basic and extended data	Provide
C.5	Demonstration to KPLC staff at supplier's cost	State compliance
D	Schedule of technical data	State compliance
E	List of registers to be displayed & sequence of display	Provide list
G	Laptop computer specifications	Provide
H	Hand held Unit	Provide
	Statement of compliance to specification	Provide

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Manufacturer's Name, Signature, Stamp and Date

G. LAPTOP COMPUTER SPECIFICATIONS

Laptop Computer make/ Model	
Microprocessor	Intel® Core i7 2.4 GHz
Memory	8 GB (1600 MHz DDR3 SDRAM)
Cache	6 MB L3 Cache
Hard Drive:	500 GB SATA II
Multimedia Drive	DVD+/-RW Super Multi DL
Video Graphics	AMD Radeon™ HD 7650 , 2GB Dedicated
Display	15.6-inch Full HD anti-glare LED (1920 x 800 resolution)
Network Card	Integrated 10/100/1000 Ethernet LAN
Wireless Connectivity	Intel 802.11b/g/n WLAN
Sound	Altec Lansing speakers with Dolby Advanced Audio
Keyboard	Full-Size Keyboard with wireless mouse
Pointing Device	Touch Pad with Multi-Gesture Support and On/Off Button
External Ports	Digital Media Card Reader for Secure Digital and Multimedia cards
	1 Universal Serial Bus (USB) 2.0 2 Universal Serial Bus (USB) .3.0
	1 VGA (15-pin)
	1 RJ -45 (LAN)
	1 Headphone-out
	1 Microphone-in
Webcam	HD Webcam with integrated digital microphone
Security	Kensington MicroSaver lock slot
	Power-on password
	Accepts 3rd party security lock devices
Operating system	Windows 7 and above
Warranty	Minimum 1 Year warranty
Power	6-cell lithium ion Battery; External AC adapter
Power Supply	240V AC, 50Hz, British plugs
Carrying Case	Leather case