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Kenya Power

VENTED NICKEL-CADMIUM BATTERIES, CHARGERS AND ACCESSORIES - SPECIFICATION

A Document of the Kenya Power & Lighting Co. Ltd

May 2021

0.1 Circulation List

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

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

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Issued by: Head of Section, Standards Development	Authorized by: Ag. Manager, Standards
Signed:	Signed:
Date: 2021-05-25	Date : 2021-05-25

0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
1	2021/05/25	1.Revise Title from sealed to Vented batteries 2.Include KPL series	Eng. S.K Nguli	Dr. Eng. Peter Kimemia

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FOREWORD

This Specification has been prepared by the Standards Department of the Kenya Power and Lighting Company Limited (abbreviated as KPLC) and it lays down the requirements for Vented Nickel Cadmium DC Battery Units and DC Chargers and their accessories.

This specification is intended for use by KPLC in purchasing of the batteries, chargers and their accessories and does not include the provisions of the contract.

It is based on IEC 60623 and IEC 62259 and the latest revisions of the standards.

It shall be the responsibility of the users of the specification for its correct application and to be knowledgeable of these standards.

1. SCOPE

1.1. This Specification covers newly manufactured vented nickel cadmium battery units, DC battery Chargers and accessories to be used in primary substation for DC supplies.

1.2. This specification is for a complete battery system consisting of the following items:

a) Vented Nickel cadmium battery units,
b) Battery racks.
c) Inter cell connectors,
d) DC battery chargers

1.3. This specification is for the following Nickel cadmium DC cells

Cell Type	Description of Cell(Ahr)
A	20
B	50
C	110
D	165
E	265
F	315
G	750
H	1200
J	1600

1.4. This specification is for the following DC battery chargers

Charger Type	Description of charger
A	30V for 20Ahr batteries
B	30V for 50 Ahr batteries
C	48V for 100 Ahr batteries
D	110V for 165 Ahr batteries
E	110V for 265 Ahr batteries
F	110V for 315Ahr batteries
G	110V for 750Ahr batteries
H	110V for 1200 Ahr batteries
J	220V for 1600 Ahr batteries

Note: ***The size of battery and battery charger required shall be specified in the tender.***

1.5. The specification also covers characteristics, dimensions, inspection, performance and parameters for test of the battery unit and its accessories as well as schedule of Guaranteed Technical Particulars to be fully filled with offered values and descriptions, signed by the manufacturer and submitted for tender evaluation.

1.6. The specification stipulates the minimum requirements for the batteries 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 batteries for The Kenya Power & Lighting Company.

1.7. The cadmium Nickel battery unit shall be supplied complete with batteries, charger battery rack and all necessary accessories

1.8. 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 edition of the referenced documents (including any amendments) applies.

IEC 60623: 2017 Secondary Cells and Batteries Containing Alkaline or other Non-Acid Electrolytes -Vented Nickel-Cadmium Prismatic Rechargeable Single Cells.

IEC 62259: Secondary cells and batteries containing alkaline or other non-acid electrolyte – Nickel-cadmium prismatic secondary cells with partial gas recombination

IEC 60993: Electrolyte for vented nickel-cadmium cells.

IEC 60622: Secondary cells and batteries containing alkaline or other non –acid electrolytes sealed nickel-cadmium prismatic rechargeable single cells

IEC 60903: Live working –Gloves of insulating materials

IEEE 1106: IEEE recommended practice for maintenance, testing, and replacement of vented nickel-cadmium batteries for stationary applications.

IEEE 1115: Recommended practice for sizing of Ni-Cd batteries for stationary applications

BS 381C: Specification for colors for Identification, coding and special purpose.

BS 718: Specifications for density hydrometers

BS 1704: Specifications for solid-stem general purpose thermometers.

ISO/IEC 17025: General Requirements for the Competence of Calibration and Testing Laboratories

ISO 9001:2015: Quality Management Systems- Requirements.

3. TERMS AND DEFINITIONS

For the purpose of this specification, the definitions given in the reference standards shall apply in addition to the ones given below:

a) Battery unit: A number of cells assembled in a rack.
b) Battery: Two or more battery units connected in series
c) Nominal voltage: The nominal voltage for a single rechargeable Ni-Cd cell, 1.2V.

d) Rated capacity: The capacity in ampere hours at the 5 hours (C_5) discharge rate to an end voltage of 1.0V, at 20±5^{0}C.

e) Mean terminal voltage: Mean terminal voltage per cell at various stages of a discharge cycle; calculated by dividing the terminal voltage of the series of cells by the number of cells.

f) **KPL Series:** Vented nickel prismatic rechargeable cells (K), pocket plate type (P), with Low rate of discharge (L) and specified rated capacity as per IEC 60623.

4. REQUIREMENTS

4.1. Service Conditions

The batteries and chargers covered in this specification shall be suitable for application under the following environmental conditions, since they shall be used in substations all over Kenya.

Table 1: Service Conditions

S. No.	Description	Condition
1	Max. temperature (Atmospheric)	(i) 40^{0}C (under sun) (ii) 30^{0}C (in shade) (Temperatures inside generator room may reach up to 60^{0}C)
2	Min. Temperature (Atmospheric)	-1^{0}C
3	Humidity	95% (Up to 100% during rainy season as per IEC 60721-3-5)
4	Altitude	Max. 2200m above sea level
5	Reference site condition	(i) Ambient temperature :25^{0}C (ii) Temperature inside engine compartment :60^{0}C
6	Dust	The dust content in air may reach as high a value as 1.6 mg/m^3
7	Atmospheric conditions in coastal areas in humidity salt laden and corrosive atmosphere	All the equipment shall be designed to work in coastal areas in humid, salt laden and corrosive atmosphere: (i) Maximum pH value: 8.5 (ii) Sulphate: 7 mg/litre (iii) Max. concentration of chlorine: 6 mg/litre (iv) Max. conductivity: 130 μ Siemens/CM (v) Humidity of 95%

4.2. Nickel Cadmium Battery Unit

4.2.1. **General requirements.**

4.2.1.1. The cell shall be rechargeable storage secondary cells of nickel -cadmium, alkaline electrolyte system cells, and tropical type consisting of cells of 1.2 nominal volts.

4.2.1.2. The cells shall be of prismatic type construction with dimensions complying with IEC 60622.

4.2.1.3. The cell designation covered shall have a nominal voltage per cell of 1.2V; at ampere hour capacity at the 5h (C_5) discharge; to an end voltage of 1.0V at 20±5^{0}C as per IEC 60623 and IEC 62259 requirements.

4.2.1.4. Vented nickel-cadmium prismatic secondary single cells shall be of low rate discharge(L) up to .5 *I*t A; or multiples of *I*t A, where *I*t A = *C*5 Ah/1 h with designation of KPL series according to IEC 60623

4.2.1.5. The battery shall be designed for float/standby service without excessive maintenance such as electrolyte replacement, while being capable of 1500 or fuller discharges with less than 10% loss of capacity.

4.2.1.6. It shall have negligible internal resistance, welded construction, and be at least 80% efficient on recharge.

4.2.1.7. The cells shall be individual, translucent containers to facilitate simple observation of the electrolyte level and serviceability, with the electrolyte level minimum clearly marked.

4.2.1.8. The design and construction of the cells shall also be suitable to withstand the harsh service conditions more so, dust and be able to withstand vibrations and shocks in service.

4.2.2. **Material and Construction.**

4.2.2.1. The cells shall be composed of positive plates (+), negative plates (-) (clearly and permanently marked), separators, cell containers, special events and electrolyte.

4.2.2.2. The cell shall be of robust explosion proof construction, having nonflammable housing and mechanical shock resistant lid/cover assembly

4.2.2.3. The battery unit sizing calculations to IEEE-1115 shall be submitted for evaluation. The cells shall utilize pocket plate construction technology.

4.2.2.4. The cells shall be assembled in a battery rack inter-connected by inter-cell connectors. All materials used shall be of best quality, free from flaws and defects and shall conform to the relevant standards applicable.

4.2.2.5. The workmanship shall conform to the highest standards accepted in practice. There shall be no impurities, which are harmful to the performance or life of a cell.

4.2.2.6. The manufacturer shall provide temperature-sensing facilities to at least 10% of the cells being procured. The temperature sensors shall be used to cut off charging of the battery from the charger once the predetermined limits are reached.

4.2.2.7. The design characteristics shall be as per Table 2.

Table 2: Design Tests Requirements as per IEC 60623

	Performance Characteristics	**Ratings**
1	Battery float voltage – 1.40 to 1.42V/cell	1.4V
2	Maximum voltage - 1.53V/cell	1.53V
3	Minimum voltage – 1.20V/cell	1.2V
4	Design Life	15years
5	Rated Capacity (5 hour rate)	specify
6	Nominal capacity normal charging current – max. $0.2C_5$ A	specify
7	Recommended charging voltage	1.455±0.005V/cell
8	State of charge coefficient	1.008
9	Internal Resistance	To be specified
10	Ageing coefficient	0.9
11	Charge efficiency, min	80%
12	Operating Temperature Range:	
	Discharge	-20 ~60^{0}C
	Charge	-10 ~60^{0}C
	Storage	-30 ~75^{0}C

4.2.3. **Overall dimension and Weight**

4.2.3.1. The battery cell shall be of prismatic (rectangular shape) and shall permit accommodation of all the battery units in the battery rack.

4.2.3.2. The tolerances on dimensions shall be +0/-4mm only applicable to the width.

4.2.3.3. The battery cell design, shape and dimensions shall be as shown in Fig. 1as per IEC 60623

Fig. 1: Prismatic cell with two terminals and four lug (IEC 60623)

4.2.3.4. The cell container shall be of high strength, alkali resistant and having insulating capacity to avoid shorting or leakage of current between plates of opposite polarity.

4.2.3.5. It shall be made of non-porous, non-hygroscopic, industrial grade expanded high impact polypropylene co-polymer or methacrylate butadiene styrene (MBS) material as per IEC 60623

4.2.3.6. The following table contains the technical specifications for the various types of cells as per IEC 60623

Table 3: Technical specifications for the various types of cells

Cell Type		A	B	C	D	E	F	G	H	I
Rated Capacity C_5(Ahr)		20	50	100	165	265	315	750	1200	1600
Rated end point voltage at discharge (20°C)		4	10	20	33	53	63	150	240	320
	Nominal	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2

Voltage(v/Cell), Volts	Floating	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
	Boost	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Charging Current(A)	Maintenance	0.16	0.4	0.8	1.3	2.2	2.5	6.0	9.6	12.8
	Boost	4	10	20	33	53	63	150	240	320
Max. Temp (°C)	>40	>40	>40	>40	>40	>40	>40	>40	>40	>40
No. of cells required per battery bank	30V 20Ahr	25								
	30V 50Ahr		25							
	48V 100Ahr			40						
	48V 265Ahr					40				
	110V 165Ahr				92					
	110V 315Ahr						92			
	110V 750Ahr							92		
	110V 1200Ahr								92	
	110V 1600Ahr									92
	220V 1200Ahr								184	
	220V 1600Ahr									184

4.2.4. **Positive and negative electrode plates**

4.2.4.1. The nickel-cadmium cell shall be composed of the positive plates containing nickel hydroxide and the negative plates containing cadmium hydroxide.

4.2.4.2. Individual pockets shall be formed from a nickel plated and perforated steel tape (pocket tape) and house strips of the active material.

4.2.4.3. The electrode strips shall be linked together mechanically to form the electrode plate and consecutively be cut to the appropriate width based on the cell type and range. The plates shall then be welded or mechanically linked to the plate frame to form the electrodes, then assembled to the plate block.

4.2.4.4. The electrodes shall be free from gradual deterioration by corrosion as the alkaline electrolyte does not react with steel, the substructure of the battery shall therefore remain intact for the total lifetime of the battery.

4.2.4.5. The integrity of the substructure shall be maintained by surrounding the electrochemical active mass in perforated nickel-steel pockets, reducing the risk of shedding or penetration of material as well as the risk of structural damage. This design shall also allow for the control of soft short circuits.

4.2.5. **Separator**

4.2.5.1. For the pocket plate design, the separator shall consist of layers of polypropylene fibrous membrane acting as separating grid in between two layers of plate group bars acting as current collectors.

4.2.5.2. The separator shall eliminate the possibility of short circuits due to trapped active material between the plates. They shall provide an optimum balance between performance, reliability and long life.

4.2.5.3. The separators shall also be dimensionally stable and shall not deform or deteriorate at the temperature of use.

4.2.5.4. Each cell shall be provided with a suitable guard, adequately secured to prevent damage to separators while inserting thermometers or service apparatus in a cell.

4.2.6. **Venting Device**

4.2.6.1. Each cell shall be equipped with a flame arrestor vent, fitted with plugs and a clip cover. This vent shall allow the escape of hydrogen gas produced in the cell hence helps prevent penetration of flames.

4.2.6.2. The venting device shall be of anti-splash type and shall allow gases to escape freely but shall effectively prevent the escape of electrolyte particles or spray.

4.2.6.3. Provision shall be made for drawing electrolyte samples, and for checking and servicing of the electrolyte.

4.2.7. **Terminal post**

4.2.7.1. All terminals shall be of nickel-plated steel and rated to cell capacity. Nickel-plated copper lugs shall be provided by the supplier for use of the purchaser for connecting up the load wiring.

4.2.7.2. The sizing of the terminals shall be as per clause 4.2.2.3.

4.2.8. **Electrolyte**

4.2.8.1. The electrolyte shall be prepared from battery grade potassium hydroxide (KOH) conforming to IEC 60993. The cells shall contain sufficient reserve electrolyte for efficient heat dissipation and to reduce water topping up interval. Reserve electrolyte shall not be less than 06 ml/Ah.

4.2.8.2. It shall be an aqueous solution of potassium hydroxide in distilled water made up to the specific gravity as specified by the manufacturer at 20±50C.

4.2.8.3. It shall be clear and colorless and free of noxious materials. The possible additives of the electrolyte shall be defined by the manufacturers.

4.3. Battery Charger

4.3.1. **Construction**

4.3.1.1. The battery charging equipment shall be contained in a well-ventilated vermin proof cubicle, fabricated from steel sheets.

4.3.1.2. The battery charger shall be supplied completely wired and fully assembled with all interconnections cable sockets, earth bar and earth terminal.

4.3.1.3. The wiring shall be complete to the terminal board requiring external connections. A cable gland plate shall be provided.

4.3.1.4. The cubicle for chargers above 30Volts shall be for floor mounting and supplied with holding down bolts. The chargers for 30Volts shall be for wall mounting with supplied brackets and bolts.

4.3.1.5. The cubicles shall be painted to give a dark admiralty gray color, shade no. 632 of BS 381C. The coating thickness shall not be less than 80μm .

4.3.1.6. The charging equipment shall operate from an AC mains supply of 230V with voltage variations of ±10% and frequency variations of ±10%

4.3.1.7. The DC output voltage regulation under extreme conditions of AC input and between 0 to 100% of battery loading shall be within ±1% at float voltage.

4.3.1.8. The charger shall be capable of automatically trickle charging the battery and loads and boost charge the battery.

4.3.1.9. The charging, either trickle (maintenance) or boost shall employ the constant current charging method.

4.3.1.10. In case of automatic boost charging, the charger shall have a temperature cut off input from batteries that shall stop the boost charging in case the temperature exceeds the cells maximum rating.

4.3.1.11. The charger shall employ temperature cut off, settable timer and drop of voltage (-δV) as means of detecting fully charged batteries and hence reducing the charging current.

4.3.1.12. The charger shall be protected against reverse polarity and overloads by appropriate means

4.3.1.13. The power transformer shall be of double wound, air cooled type with primary and secondary winds and an earth shield between the windings

4.3.1.14. The charger shall have alarm repeat relay with at least two contacts, one for local communication and the other for SCADA.

4.3.1.15. The charger shall have a local alarm annunciator that shall have an LED or LCD display of alarms. The alarms shall be reset manually.

4.3.1.16. The following alarms shall be provided

(a)Charger failure
(b)Positive and negative earth fault alarm (applicable for 48V)
(c) Battery low voltage
(d)Battery high voltage
(d)Mains failure
(e) Boost charge failure
(f)Battery temperature cut off alarm

4.3.1.17. The following indicating instruments shall be provided

(a) Ammeter to indicate the net charge output
(b)Voltmeter to indicate battery voltage
(c) Center zero ammeter connected on the positive lead to indicate the rate of charge or discharge
(d)Voltmeter to indicate the mains voltage
(e)Ammeter to indicate mains current

4.3.1.18. The following isolation switches and MCBs shall be provided

(a)A switch to disconnect charger from the A.C supply
(b)A switch to disconnect charger from battery
(c) A switch to disconnect battery from outgoing loads
(d)MCBs to protect battery from short circuit
(e) DC MCBs to protect the battery from a fault on the charger and outgoing loads
(f) MCBs to protect charger from short circuit

4.3.1.19. The table 4 contains the technical specifications for the battery chargers

Table 4: Technical specifications for the battery chargers

Charger Type		A	B	C	D	E	F	G	H	J
Charger for batteries (A hr)		20	50	100	165	165	315	750	1200	1600
DC output voltage(V)	Nominal	30	30	48	48	110	110	110	110	220
	Float range	34-36	34-36	52-56	52-56	120-129	120-129	120-129	120-129	240-258
	Boost range	≤40	≤40	≤64	≤64	≤147	≤147	≤147	≤147	≤294
Rated DC output current(A)		5	15	25	50	70	80	200	400	300
Trickle current range(A)		0.04-0.16	0.1-0.4	0.2-0.8	0.5-2.0	0.3-1.3	0.6-2.5	1.5-6.0	3.2-13	2.4-10
Boost Current range(A)		≤5	≤15	≤25	≤50	≤70	≤80	≤200	≤400	≤300
Mains type (no of Phases)		1	1	1	3	3	3	3	3	3
Mains A.C voltage(V)		240	240	240	415	415	415	415	415	415
Frequency(Hz)		50	50	50	50	50	50	50	50	50

4.3.1.20. All necessary tools and accessories required for safe and efficient operation and maintenance of the batteries and chargers under normal conditions shall be supplied as specified in clause 4.4.4

4.3.1.21. Full technical particulars and catalogues on the batteries and battery chargers shall be submitted.

4.4. Battery Rack and Accessories

4.4.1. For safe and reliable operation, the cells shall be mounted on suitable battery racks. The racks shall be designed, constructed and certified to the seismic design category D, with Occupancy Category IV, having a short-period response acceleration given by $0.50g \leq S_{DS}$ and a Component Importance Factor, Ip of 1.5 as per IBC2006, appropriate for use in generator stations.

4.4.2. The rack shall be constructed of phosphatized steel with coat of powder epoxy acid-resistant end frames and beams with powder coated polyethylene. It shall be supplied in knocked down arrangement to be assembled at site.

4.4.3. The rack assembly shall be single tier, two-step.

4.4.4. The rack shall be complete with the following accessories and their prices shall be included in the tender for evaluation:

(a) Digital voltmeter.
(b) Cell lifter, for cells over 30kg.
(c) Portable hydrometer to BS 718.
(d) Vent-hole thermometer to BS 1704 designation D.
(e) Set of cell numbers.
(f) Anticorrosion compound for battery connections.
(g) Non-ventilated safety goggles.
(h) Safety apron.
(i) Safety gloves of approved brand manufactured to IEC 60903.

4.5. Inter cell connectors

4.5.1. Nickel plated copper inter cell connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be nickel-plated steel/stainless steel. All terminals and cell inter-connectors shall be fully insulated or have insulation shrouds.

4.5.2. The connector covers shall be made of hard PVC plastic, insulating the positive and negative terminals against the short circuit from any metallic object falling on the battery.

4.5.3. All inter cell connectors and inter-row connector lead cables shall be sized for the maximum current draw of the charger,

4.5.4. All connectors and leads shall be suitable for carrying 30-minute discharge current continuously and rated for short circuit duty of 4kA for 1 second.

4.6. Sampling Scheme and Criteria for Acceptance

4.6.1. All cells of the same type, design and rating, manufactured by the same factory during the same period using the process and materials offered for inspection at a time shall constitute a lot.

4.6.2. The number of cells to be selected at random from the lot shall be in accordance with column 1 and 2 of Table 3.

Table 5: Sampling and acceptance criteria

Lot Size	First Stage	Second Stage	2n	C1	C2	C3
N	n	n				
Up to 50	2	2	4	0	1	1
51-300	3	3	6	0	1	1
301-500	5	5	10	0	2	2
501-1,000	8	8	16	0	2	2
> 1,001	13	13	26	0	3	4

Each cell selected in the first stage in accordance with column 2 shall be tested for acceptance.

a) A cell shall be declared defective if it fails in one or more of the acceptance tests.
b) If the number of defects is less than or equal to C1, the lot shall be considered as conforming but if the number of defective is equal to or less than C2 and greater than C1, a further sample of same size as taken in the first stage shall be taken and tested.
c) If the number of defectives cell in the two samples combined is less than C3, the lot shall be considered conforming otherwise the lot shall be considered as not conforming to the requirements of this specification.

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ANNEXES

A: Quality Management Systems

A.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 battery units and chargers complete with accessories will fulfill the requirements stated in the contract documents, standards, specifications and regulations.

A.2: The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2015.

A.3: The Manufacturer's Declaration of Conformity to applicable standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2015 certificate shall be submitted with the tender for evaluation.

A.4: The bidder shall indicate the delivery time of the battery unit, manufacturer's monthly & annual production capacity and experience in the production of the type and size of the batteries being offered.

B: TESTS AND INSPECTION

B.1: The battery units, chargers and their accessories shall be inspected and tested in accordance with the requirements of IEC 60623, IEC 62259, IEC 60993, IEEE 1106, IEEE 1115 and IBC2006 standards. 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.

B.2: Copies of previous Type Tests Reports issued by a third party testing laboratory that are 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)

B.3: Copies of type test reports to be submitted with the tender (by bidder) for evaluation shall be as stated below:

a) Discharge performance tests
   (i)Discharge performance at 20 °C
   (ii)Discharge performance at +5 °C

(iii)Discharge performance at –18 °C

b) High rate current test
c) Charge retention test
d) Endurance test
   (i)Endurance in cycles
   (ii)Permanent charge endurance
e) Charge acceptance at constant voltage test
f) Overcharge test
g) Vent plug operation test
h) Electrolyte retention test

B.4: Routine and sample test reports for the battery unit and accessories to be supplied shall be submitted by the supplier to KPLC for approval before shipment/delivery. KPLC Engineers will witness tests at the factory before shipment/delivery.

B.5: The acceptance test certificates shall be submitted for approval, before dispatch of the battery unit and accessories in bound volume. Also one set shall be submitted and sent with battery set.

B.6: Tests to be carried out at Manufacturer's works shall include:

a) Verification of constructional requirements.
b) Verification of marking and packaging.
c) Verifications of dimensions.
d) Charge retention test
e) Charge acceptance at constant voltage at high temperature test
f) Storage test
g) Test for voltage during discharge
h) Battery impedance measurement test.

B.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 battery unit and accessories, which upon examination test or use; fail to meet any of the requirements in the specification.

C: MARKING AND PACKAGING

C.1: MARKING

The following information shall be legibly and indelibly marked on each cell by molding screen printing and engraving process:

a) Serial Number of battery. Battery type;
b) Month and year of manufacture.
c) Manufacturer's name;
d) Country of Manufacture;
e) Nomenclature, Rated Voltage & Rated Ampere Hour Capacity;
f) Words "**PROPERTY OF KPLC**".

C.2: PACKAGING

C.2.1: Packing shall be suitable for handling during transit by rail/road and secured to avoid any loss or damage during transit.

C.2.2: The cases shall be furnished with an illustrated operating and maintenance instructions for the items.

C.2.3: The charger shall be supplied complete and fully assembled for operation

C.2.3: Each battery cell shall be supplied completely assembled and filled with electrolyte fully charged to at least 100% capacity and ready for service whereas the battery rack shall be shipped in knocked down units.

C.2.4: Instructions for safe handling of the batteries, chargers and accessories shall be provided together with necessary safety precautions to be taken in the management of the unit

D: DOCUMENTATION

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

a) Guaranteed Technical Particulars signed and stamped by the manufacturer;
b) Copies of the Manufacturer's catalogues, brochures, and technical data sheets for battery, associated rack system, and battery layout drawings.
c) Product Data: Electrical characteristics of selected battery.
d) Sales records for the last five years and at least four customer reference letters;
e) Details of manufacturing capacity and the manufacturer's experience;
f) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025;
g) Copy of accreditation certificate to ISO/IEC 17025 for the third party testing laboratory;
h) Manufacturers letter of authorization, ISO 9001:2015 certificate and other technical documents required in the tender.

D.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) 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.
c) Detailed test program to be used during factory testing;
d) Packaging details (including packaging materials).

D.3 The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during delivery of the batteries to KPLC stores.

E. 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		**KPLC requirements**	**Bidder's offer** (indicate full details)
Manufacturer's Name and address		Specify	
Country of Manufacture		Specify	
Bidder's Name and address		Specify	
1. Scope			
1.1-1.5		Specify	
2. Applicable Standards		Specify	
3. Terms & Definitions		Specify	
4. Requirements			
4.1 Service Conditions			
	Max. temperature (Atmospheric)	(i) 40^0C (under sun) (ii) 30^0C (in shade) (Temperatures inside generator room may reach up to 60^0C)	
	Min. Temperature (Atm.)	-1^0C	
	Humidity	90% (Up to 100% during rainy season as per IEC 60721-3-5)	
	Altitude	Max. 2200m above sea level	
	Reference site condition	Ambient temperature :25^0C Temperature inside engine compartment :60^0C	
	Atmospheric conditions in coastal areas in humidity salt laden and corrosive atmosphere	All the equipment shall be designed to work in coastal areas in humid, salt laden and corrosive atmosphere:	

Clause number			KPLC requirements	Bidder's offer (indicate full details)
			(i)Maximum pH value: 8.5 (ii)Sulphate: 7 mg/litre (iii)Max. concentration of chlorine: 6 mg/litre (iv)Maximum conductivity:130µ Siemens/CM	
4.2 Nickel Cadmium Battery Unit				
4.2.1 General requirements				
	1	Battery float voltage – 1.40 to 1.42V/cell	1.4V	
	2	Maximum voltage - 1.53V/cell	1.53V	
	3	Minimum voltage – 1.20V/cell	1.2V	
	4	Number of cells per battery unit	10	
	5	Design Life	15years	
	6	Rated Capacity (5 hour rate)	specify	
	7	Nominal capacity normal charging current – max. $0.2C_5$ A	specify	
	8	Recommended charging voltage	1.455±0.005V/cell	
	11	Power requirements for control	45A	
	12	State of charge coefficient	1.008	
	13	Internal Resistance	specify	
	14	Ageing coefficient	0.9	
	15	Charge efficiency, min	80%	
	16	Operating Temperature Range:		
		Discharge	-20 ~`60^{0}C	
		Charge	-10 ~`60^{0}C	
		Storage/float	-30 ~`75^{0}C	
4.2.1.1 Battery type			Pocket plate, nickel cadmium, alkaline electrolyte system	
4.2.1.4 Cell designation			KPL Series as per IEC 60623	Specify

Clause number	KPLC requirements	Bidder's offer (indicate full details)
4.2.1.5 Battery float/standby service	Less maintenance, capable of 1500 or more full charges with less than 10% loss of capacity	
4.2.1.6 Battery internal resistance	Neglegable,80% recharge efficiency	
4.2.1.7-4.2.1.8	Cell type and marking observability of electrolyte level .Ability to withstand harsh environments	
4.2.2 Material and construction		
4.2.2.1 Cell composition	Plates(+/-) separations vents, electrolyte, containers	
4.2.2.2 Cell housing and shock resistance	Non Flammable mechanical shock resistant	
4.2.2.3 Design of battery size	As per IEEE-115	
4.2.2.4 Battery rack	Detail the connection	
4.2.2.5 Workmanship	Too comply with the highest standard of manufacturing practice	
4.2.2.6 Temperature sensing units	10% of order quantity	
4.2.2.7 Design requirements	List and specify as per table 2 and IEC 60623	
4..2.3 Overall dimension		
Height, h (mm), max	state	
Width, d (mm)	state	
Length, b (mm), max	state	
Cell connection bolt size	2xM10	
Volume of electrolyte, cc	specify	
Approximate cell weight (Kg)	specify	
4.2.3.1 – 4.2.3.2	State construction type and dimension tolerances	
4.2.3.3 – 4.2.3.6	List materials of cell nature and standard of manufacture	

Clause number	KPLC requirements	Bidder's offer (indicate full details)
4.2.4 Cell container		
4.2.4.1-4.2.4.3	Specify	
4.2.5 Positive and negative electrode plate		
4.2.5.1-4.2.5.5	Specify	
4.2.6 Separator		
4.2.6.1 – 4.2.6.4	Specify	
4.2.7 Venting Device		
4.2.7.1 – 4.2.7.3	Specify	
4.2.8 Terminal post		
4.2.8.1 – 4.2.8.3	Specify	
4.2.9 Electrolyte		
4.2.9.1- 4.2.9.3	Specify	
4.3 Battery Charger		
4.3.1.1 material of cubicle construction	Specify gauge	
4.3.1.2-4.3.1.4: Accessories	list	
4.3.1.5 Final color of cubicle	Admiralty gray , shade 632 as per BS 381C,80µm,	
4.3.1.6:charging mode and accuracy	specify	
4.3.1.7: DC output regulation	state	
4.3.1.8- 4.3.1.10: Types of charging modes and regulation	specify	
4.3.1.11-4.3.1.13: protection against reverse polarity	specify	
4.3.1.14-4.3.1.15: Provisions for SCADA and display	specify	
4.3.1.16: Alarms provided	List	
4.3.1.17: Measuring instruments provided	List	
4.3.1.18: Isolation switches provided	List	
4.3.2: Type of charger to be supplied	state	

Clause number	KPLC requirements	Bidder's offer (indicate full details)
4.4 Battery Rack and Accessories		
4.4.1 Battery rack design, construction and certification.	Seismic design category D, Occupancy Category IV, with $0.50g \leq S_{DS}$, Ip = 1.5 as per IBC2006	
4.4.2 Rack material	Phosphatized steel with coat of powder epoxy alkaline-resistant end frames and beams with powder coated polyethylene.	
4.4.3 Rack dimensions		
Length ,L in mm, max	state	
Width, W in mm, max	state	
Height, H in mm, max	state	
4.4.4 Rack accessories		
Digital voltmeter,	Provide	
Cell lifter, for cells over 30kg.	Provide	
Portable hydrometer to BS 718.	Provide	
Vent-hole thermometer to BS 1704 designation D.	Provide	
Set of cell numbers.	Provide	
Anticorrosion compound for battery connections.	Provide	
Non-ventilated safety goggles.	Provide	
Safety apron.	Provide	
Safety gloves of approved brand manufactured to IEC 60903.	Provide	
4.5 Inter Cell Connectors		
4.5.1-4.5.4	Specify	
4.6 Sampling Criteria		
4.6.1-4.6.2	Specify	
4.7 Quality Management Systems		
4.7.1- 4.7.4	Specify	

Clause number		KPLC requirements	Bidder's offer (indicate full details)
5.0 Tests and Inspection			
5.1 – 5.7		Specify	
6.0 Marking and Packaging			
6.1. Marking		Specify	
6.2 . Packing			
6.2.1 – 6.2.3		Specify	
7. Documentation			
7.1 – 7.3		Specify	
8	Manufacturer's Guarantee and Warranty		Specify
9	List catalogues, brochures, technical data and drawings submitted to support the offer.		Specify
10	List customer sales records submitted to support the offer.		Specify
11	List Test Certificates submitted with tender		Specify
12	List test & calibration reports to be submitted to KPLC for approval before shipment		Specify
13	Statement of compliance to specification (indicate deviations if any & supporting documents)		Specify

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Manufacturer's Name, Signature, Stamp and Date