



TITLE:  
**SPECIFICATION FOR 132  
KV & 220 KV EMERGENCY  
RESTORATION TOWERS.**

Doc. No.	KP1/3CB/TSP/03/014
Issue No.	1
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**Note:** the **Guaranteed Technical Particulars** shall be filled and signed by the *Manufacturer for all clauses* and submitted together with catalogues, brochures, drawings, technical data and test reports for tender evaluation



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**0.1 Circulation List**

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Procurement Manager
3	Stores & Stock Control Manager
4	Transmission Manager
5	Deputy Manager, Technical Audit

**0.2 Amendment Record**

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

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**FOREWORD**

This specification has been prepared by the Research and Development Department in collaboration with Transmission Department both of The Kenya Power and Lighting Company Limited (Kenya Power) and it lays down requirements for Emergency Restoration Towers. It is intended for use by Kenya Power in the procurement of Emergency Restoration Towers.

It shall be the responsibility of the manufacturer to ensure adequacy of the design and good engineering practice in the manufacture of the Emergency Restoration Towers for Kenya Power. The manufacturer shall submit information which confirms satisfactory service experience with products which fall within the scope of this specification.

**1. SCOPE**

This specification is for Emergency Restoration System Towers (**ERS Towers**).

**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. **Equivalent** or superior standards shall also be considered.

- IEEE 1070: Design and Testing of Transmission Modular Restoration Structure Components.
- BS 3288: Insulator and Conductor Fittings for Overhead Power Lines
- BS 4579: Performance of Mechanical and Compression Joints in Electric Cable Wire and Connectors.
- ISO 1459: Metallic coatings - Protection against corrosion by hot dip galvanizing - Guiding principles
- BS EN ISO 1461 Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods.
- ANSI C29.12, 13, 17&18 Allowed strength ratings for insulators.
- ASCE 10 -97 Design of Latticed Steel Transmission Structures.
- ASCE Manual 72 Guidelines for Design of Monopole Bases.
- ASCE Manual 74 Guidelines for Electrical Transmission Line Structural Loading.
- ASCE Manual 91 Design of Guyed Electrical Transmission Structures.

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**3. TERMS AND DEFINITIONS**

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

**4. REQUIREMENTS**

**4.1 SERVICE CONDITIONS**

The Emergency Restoration Towers shall be suitable for continuous operation outdoors in tropical areas at altitudes of up to 2200m above sea level, humidity of up to 90%, 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. The ERS Towers shall also be designed to withstand wind speeds of up to 40m/sec.

**4.2 DESIGN CONSTRUCTION AND WORKMANSHIP.**

**4.2.1 Design Criteria for ERS Towers:**

The towers shall be designed to withstand the conditions stated in Table 4.2.1 below:

*Table 4.2.1- Design Criteria for ERS Towers*

	Description	Units	132kV	220kV
1.	Minimum Insulator Length	mm	1300	2600
2.	Minimum Creepage distance	mm	4100	6800
3.	Smallest/ Biggest Conductor Name		ACSR Wolf/ ACSR Goat	ACSR Bears/ ACSR Canary
4.	Conductor Diameters Range	mm	16.75 - 25.97	23.45 - 29.51
5.	Conductor unit weight Range	Kg/Km	506 - 1493	1215 - 1724
6.	Conductor Ultimate tensile strength	kN	73 - 138.8	117.9 - 144.7
7.	No. of conductors per phase		1	1
8.	Earth wire Type		7/8 ACS Steel	7/8 ACS Steel
9.	Earth wire diameter	mm	10	10
10.	Earth wire unit weight	Kg/Km	400	400
11.	Earth wire ultimate tenson	kN	72.3	72.3
12.	Phase-to-phase clearance	m	3.5	5.5
13.	Minimum Cable to ground clearance at mid span	m	7.5	8.0
14.	Minimum Cable height at the tower	m	18.0	20.0
15.	Conductor Sag tenson at EDT		20%	20%

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	Description	Units	132kV	220kV
16.	Wind Velocity	m/sec	40	40
17.	Ruling Span	m	300	330
18.	Line angle for suspension towers		0-2°	0-2°
19.	Line angle for anchor towers		10-90°	10-90°
20.	Min/ Max Ambient Temperature	°C	-1 / 40	-1 / 40

### 20.2.1 Strength Factors

The minimum strength factors presented in the table below should be used for each tower component in order to ensure a safe configuration design.

Table 4.2.2- Allowed Percentages of Strength Ratings/Strength Factors

Elements	% of Ultimate Capacity	Reference Standard
Steel guy cables Guy strain insulators Anchors	65% 65% 50%	ASCE 10-97 ASCE Manual 72 ASCE Manual 91
Hardware (turnbuckle, shackle, etc.) Plates and metal rods (aluminum or steel)	60% 60%	ASCE 10-97 ASCE Manual 74 ASCE Manual 91
Suspension/ strain insulators Line post insulators – compression – tension	50% of SML 50% of Euler 50% of STL	NESC 2007, ANSI c29.12-1997, ANSI c29.17-2002, ANSI c29.18-2003,
Suspension clamps for cables Strain clamps for cables	60% 60%	ASCE 10-97 ASCE Manual 74 ASCE Manual 91
Plates and simple structural elements Modules and complex tower components	60% 50%	ASCE 10-97 ASCE manual 74

### 20.2.2 Modular Structures

20.2.2.1 The ERS structure shall be made of aluminum alloy and be of modular construction allowing easy adoption to various line designs / configurations. All structural shapes and plates used in fabrication of all sections, foundations, guy

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plates and boxes should be of 6061-T6 and 6061-T651 aluminum alloy, or equivalent standards.

All components **must be fully interchangeable** regardless whether they are used in suspension, angle or dead end conditions. To ensure uniform compatibility of the ERS supplied under the contract, all components of modular restoration structures shall be geometrically identical / mutually compatible.

- 20.2.2.2 The mast sections shall be lightweight, made of high strength aluminum alloy. The shape, size, dimensions and weight of individual components shall be such that manual handling of the components is possible. The structure column section shall not be more than 3 meters in length. Also, the weight of each section of ERS tower shall not exceed 150kg.
- 20.2.2.3 The structure should include an integrated rail system, which allows the required sliding gin pole and the safety devices to slide from the bottom to the top of the tower without any interruption or disassembly.
- 20.2.2.4 The structure modules should have attachment points at a maximum of each 0.5m on the tower in order to install guys, insulators or any other accessories.

**20.2.3** The foundation plate shall be designed to rest on the ground surface with anchors or metal stakes to avoid sliding. It shall be made of light weight; high strength material. The base area of the foundation plate shall be designed to work safely on regular earth bearing capacity soils (200kpa or more).

**20.2.4** The articulated base shall be of such design that it can be fixed on the foundation plate. It shall allow assembly of structures over itself. It shall allow leaning and rotation in all directions. It shall minimize column eccentricity and eliminate torsion loading on structures due to its rotational capability. It shall be made of lightweight, high strength material.

**20.2.5 Ground Anchoring Assembly-**

Depending on the prevailing soil conditions, different anchoring arrangements shall be required. The suitable anchoring assembly for following type of soils shall be supplied:

- a. For soft soils.
- b. For soft rock soils.
- c. For hard rock soils.
- d. For poor soils.

**20.2.6** The design and construction of all the ERS tower components must ensure safe, easy and quick manual assembly and erection.

**20.2.7 Insulators:**

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The ERS shall be equipped with all necessary insulators, fittings and other accessories necessary for attaching the conductor sizes listed in Table 4.2.1 above.

Every insulator body shall have a durable and legible trade mark and year of manufacture as well as the rated combined mechanical strength in kilo Newton.

The insulators shall be of the modular design so as to be able to use for all required voltages using the same size insulator in series.

**20.2.8 Modification:**

Design modification should be tested in accordance with the specification as set forth in the Clause for testing in the standards IEEE1070 – 2006 or equivalent. Any design modification should not inhibit the basic interchangeability and integrity of the equipment.

All design modification should meet or exceed the technical and fabrication requirements set forth in IEEE 1070 – 2006. Complete test data and test certifications should be permanently documented and made available to the users of the components.

**20.2.9 Requirements for processing of materials**

The following should be taken into consideration during the manufacturing processes of the ERS towers

*Table 4.2.10- Requirements for Materials Processing*

Process	Standards	Additional requirements
General	IEEE 1070 – 2006 standards or equivalent	All work should be performed using the best modern practices of the industry. All applicable standards should be stated. Materials should be new and free of defects or irregularities. All components of the same design and designations should be identical; like components should be interchangeable. All corners should be rounded and sharp edges should be broken.
Fabrication		Fabrication should not begin until the purchaser has approved drawings. Best modern practice to be used in manufacture and fabrication of types of materials.

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Process	Standards	Additional requirements
Bending		All bending should maintain sufficient thickness of material in order to provide full strength without impairing the material.
Cutting		Cutting of plates and structural shapes should be guided by electrical or mechanical means to assure a neat accurate cut. Cuts should be clean and free from sharp edges.
Welding	IEEE 1070 – 2006 standards or equivalent	Any welding, if necessary, should be in accordance with <i>Aluminum Structural Welding Code</i> All welds should be completely seal. There should be no voids or seams between joining surfaces into which fluids may enter. The Ultimate Strength Bending of the welds should be equivalent or greater than those defined in IEEE 1070 – 2006 standards.
Drilling and Milling		All load bearing holes should be drilled, and all slots should be milled in all material thickness. Punching of holes or slots is <b>not allowed</b> .

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**4.3 PARTICULAR REQUIREMENTS (Guaranteed Technical Particulars)**

	Description	Minimum Requirements	Bidder's Offer
1	TOWER SECTION	Model/Type Reference Number	
		Features (performance requirements) <ul style="list-style-type: none"> <li>▪ Column sections should be of one common length, and should all be interchangeable.</li> <li>▪ Column section length of not more than 3m;</li> <li>▪ Should be able to withstand compression forces of at least 290kN as outlined in the test procedures of IEEE 1070-2006</li> <li>▪ Should be able to withstand bending forces of at least 11.34kN as outlined in the test procedures of IEEE 1070-2006</li> <li>▪ Should be able to withstand torsion forces of at least 8kN as outlined in the test procedures of IEEE 1070-2006</li> <li>▪ Dimension design and tolerance; as per recommended in IEEE 1070 – 2006 or equivalent.</li> </ul>	
		List all the Test Certificate and Test Reports submitted.	
2	FOUNDATION BASE	Model/Type Reference Number	
		Features (performance requirements) <ul style="list-style-type: none"> <li>▪ Should be of light weight and volume for ease of handling. The plate should be less than 252Kg.</li> <li>▪ Handholds (lifting rings) provided should be at least 6" wide to facilitate a comfortable grip.</li> <li>▪ The design and tolerance considerations should conform to those defined in IEEE 1070 – 2006 standards or equivalent.</li> </ul>	
		List all the Test Certificate and Test Reports submitted.	
3	GUY PLATES	Model/Type Reference Number	
		Features (performance requirements) <ul style="list-style-type: none"> <li>▪ Plates should be of uniform sizes and interchangeable at all positions.</li> </ul>	

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	Description	Minimum Requirements	Bidder's Offer
		<ul style="list-style-type: none"> <li>▪ The assembly bolts should be long enough to connect two column end plates and three guy plates.</li> <li>▪ The holes in the guy plates should be able to accommodate spread or straight guys.</li> <li>▪ The plates shall be able to withstand traction test of at least 260kN, as outlined in the test procedures of IEEE 1070-2006</li> <li>▪ The design considerations should conform to those defined in IEEE 1070 – 2006 standards or equivalent.</li> </ul>	
		List all the Test Certificate and Test Reports submitted.	
4	BOLTS NUTS AND WASHERS	Model/Type Reference Number Features (performance requirements) <ul style="list-style-type: none"> <li>▪ All bolts should be made from AISI C1040 steel, or equivalent.</li> <li>▪ Bolts and Nuts should be hot-dip galvanized in accordance with BS EN ISO 1461.</li> <li>▪ Ultimate Strength Bending testing should be as per those defined in IEEE 1070 – 2006 standards or equivalent.</li> <li>▪ Ultimate strength to be pull tested and withstand/exceed 107kN as defined in IEEE 1070 – 2006 standards</li> </ul>	
		List all the Test Certificate and Test Reports submitted.	
5	Statement of compliance to specification and/or deviations if any		

.....  
**Manufacturer's Name, Signature, Stamp and Date**

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**5. TESTS AND INSPECTION**

5.1 The emergency restoration towers, accessories and fittings shall be tested in accordance with the relevant requirements of IEEE, 1070 - 2006 and this specification. It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified.

5.2 Copies of previous Test Certificates and Test Reports (**for all applicable type tests**) certified by the relevant International or National Testing/ Standards Authority of the country of manufacture or ISO/IEC 17025 accredited testing laboratory shall be submitted with the tender (including certificate of accreditation for laboratory) for the purpose of technical evaluation, all in English Language.

Copies of Test Reports to be submitted for tender evaluation shall include the results of the appropriate type tests emergency restoration towers, accessories and fittings identical in all essential details with those to be supplied. The Test Reports shall include Structural strength Type Tests, Mechanical Type Tests and applicable Electrical Type Tests.

5.3 Routine and sample test reports for the emergency restoration towers, accessories and fittings to be supplied shall be submitted to Kenya Power for approval before shipment/delivery of the goods. The test reports shall include Verification of Dimensions, Mechanical Type Tests and Electrical Type Tests.

Kenya Power shall nominate two engineers to witness acceptance tests at the factory.

5.4 On receipt of the emergency restoration towers, accessories and fittings, Kenya Power will inspect them for acceptance at stores and may perform or have tests performed in order to verify compliance with this specification.

The supplier shall replace without charge to Kenya Power, any emergency restoration towers, accessories and fittings which upon examination, test or use fail to meet any or all of the requirements in this specification.

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**6. MARKING, LABELLING AND PACKING**

- 6.1 Instructions for installation and details on applicable tools shall be included in each package, all in English Language. The packaging shall protect accessories and fittings against damage.
- 6.2 Every column section, foundation plates and anchoring assembly should be marked with the manufacturer's name, part number, tower type, serial number and date of manufacture. Guy plates should be marked with part numbers. In addition, each column section should be marked with the applied proof test load. These markings should be permanently embossed on a nameplate in a protected location.

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