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PART-C

TECHNICAL SPECIFICATION

SECTION-II

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TECHNICAL SPECIFICATIONS

SECTION-II

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TECHNICAL SPECIFICATION

SECTION -II

1.0 Technical Description

- 1.1 The Emergency Restoration System (ERS) shall generally conform to IEEE-1070. However, other ERS supplying equipments, materials, workmanship and other requirements such as design, geometry, fabrication and testing that provide performance in accordance with the functional specifications of the bidding documents will also be accepted.

1.2 Modular Restoration Structures

- 1.2.1 The ERS structure shall be of modular construction allowing easy adoption to various line designs/ configuration. To ensure uniform compatibility of the ERS supplied under the contract all components of modular restoration structures shall be geometrically identical/ mutually compatible.

- 1.2.2 The structure components shall be of light weight, made of high strength Aluminum Alloy or Hot Dip Galvanized Structural Steel or a combination of high strength Aluminum Alloy and Hot Dip Galvanized Structural Steel. The ERS with structures made of all these materials shall be considered equivalent. The shape, size, dimensions and weight of individual components shall be such that manual handling of the components is possible. The ERS structure shall facilitate tower climbing. The structure column section shall not be more than 4.2m (14 feet) in length. Also, weight of the structure column section shall not exceed 200 kgs. The weight of any other individual component of ERS shall not exceed 260 kgs.

- 1.2.3 ERS towers shall be of following configuration types:-

- (i) Suspension ERS towers with horizontal V insulator assembly (to be suitable for upto 10 deg line deviation). These towers can also be used as running angle towers at reduced span using suspension insulator string of insulator assembly.
- (ii) Tension/Dead end towers (to be suitable for upto 60 deg line deviation) with tension insulator assembly and horizontal V insulator assembly for jumper. These towers can also be used as suspension/running angle towers with provision of horizontal insulator assy./suspension insulator string.

Each ERS suspension tower shall accommodate three phases of one circuit for circuit-wise restoration of D/C lines. Typical sketches of suspension & tension ERS towers envisaged to be used for restoration are enclosed in the Bidding Documents.

- 1.2.4 The tower structures, composite insulators and hardware components shall be designed for circuit-wise restoration of 400 kV Double Circuit Transmission Lines with Quad/ Twin conductor per phase
- 1.2.5 The structures shall be designed to withstand the loads that results from the load cases specified at Clause 1.10.3 of this Section of Technical Specification.

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- 1.2.6 Locating pins and alignment holes may be provided in each structure to simplify assembly and erection.

1.3 Foundation/ Base Plates

The foundation/ base plates shall be designed to rest on the ground surface with anchors or metal stakes to avoid sliding. They shall be made of light weight, high strength material. The foundation/ base plates shall be designed for loads on foundation/ base plates under specified loading conditions considered for design of ERS structures. The detailed designs shall be submitted by the Supplier during detailed engineering. The bearing capacity shall be considered as 27,350 kg/sqm for normal soil and 10,000 kg/sqm for low bearing capacity soil.

1.4 Gimbal Joints/Articulation

The Gimbal joint/Articulation shall be of such design that it can be fixed on the foundation plate and it shall allow assembly of structures over itself. It shall allow leaning and rotation in all directions. It shall minimise column eccentricity and eliminate torsional loading on structures due to its rotational capability. It shall be made of light weight, high strength material. To facilitate temporary fixing & alignment of gimbal/ articulation joint during erection of ERS structures, suitable arrangement with turn buckles or alternate means shall be provided.

1.5 Guy Plates/ Swivels, Box section/ Connecting Box & Provisions for Earthwire

The design of Guy plates shall be such that they shall allow attachment of insulators and guy wires to the structure. It shall be assembled between two column structures and have predetermined holes to allow attachment of insulators and guy wires. Depending upon the requirement, the angle of guy plates shall be 0/0, 0/45 or 45/45. It shall be made of light weight, high strength material, easy for handling manually.

Box section (if required) shall be of such design that it allows attachment/mounting of insulators and guy wires to the structure. It shall be assembled between column structures and shall have predetermined holes on sides to allow attachment of insulators and guy wires. It shall be made of light weight, high strength material.

Alternatively, swivels or other means of attachment of insulators and guy wires to the structure in various directions simultaneously shall also be acceptable.

Suitable provisions shall be provided on the ERS tower for installation of earthwire, as required.

- 1.5.1 Actual number of guy plates/ swivels for attachment of guys shall be finalised based on design analysis of ERS towers during detailed engineering.

1.6 Anchoring Assembly

Depending on the prevailing soil conditions, following different anchoring arrangement shall be supplied, the details of which are given in relevant schedule under Bid Proposal Sheets of Bidding Documents:

- (i) Cross plate assembly for normal soil
- (ii) Manta Ray or equivalent anchor assembly for normal soil

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- (iii) Triple Helix anchor assembly for loose/ marshy soil
- (iv) Large plate anchor assembly for loose/ marshy soil

Anchor assemblies shall be of minimum 150 kN UTS and shall include guy adaptor, extension rod & associated fittings as per specified requirements

- 1.6.1 The quantity for anchor assemblies in the Bill of Quantities has been kept corresponding to the estimated number of guys required. Actual number of anchors shall be finalised based on design analysis of ERS towers during detailed engineering.

1.7 Guy Wires and Guy Hardwares

- 1.7.1 Guy wires having minimum 150kN UTS (14.3mm dia) and made of high strength galvanised steel shall be supplied in standard lengths of 70m. Preformed guy grips and guy wire thimbles to be used alongwith the guy wires for attachment to the tower and anchoring assembly shall have minimum ultimate strength greater than that of guy wire.
- 1.7.2 Other Guy hardware comprising of turn buckle, anchor shackles, extension link/plates (as per requirements) as indicated in the relevant schedule under BPS of bidding documents shall also be supplied. The minimum UTS of guy hardware & components shall be 150 kN.
- 1.7.3 Actual number of guy wires & guy hardwares shall be finalised based on design analysis of ERS towers during detailed engineering.

1.8 Composite Insulator Strings, Hardware Fittings & Guy insulators

- 1.8.1 All necessary composite insulator assemblies and corresponding hardware required for proposed structures shall be supplied with each set of ERS. The hardware fittings shall include end attachment, yoke plate, suspension clamps, tension clamps, extension links, turn buckles, corona control rings, etc.
- 1.8.2 The insulator strings/assemblies shall be of following types:
- i. Horizontal V (single braced, double post) suspension insulator assembly alongwith hardware fittings comprising of:
 - a) Composite longrod suspension insulator (3.5 m length, 160 kN tensile strength)
 - b) Composite longrod post insulator (3.5 m length, minm 90mm core dia, 120 kN tensile strength, 90 kN compressive strength)
 - c) Hardware fittings including end attachment, yoke plates, suspension clamps, extension links, turnbuckles, corona/grading rings other fittings & components as per requirement
 - ii. Double tension insulator string assembly alongwith hardware fittings comprising of :
 - a) Composite longrod suspension insulator (3.5 m length, 160 kN tensile strength)
 - b) Hardware fittings including end attachment, yoke plates, tension clamps, extension links, turnbuckles, corona/grading rings other fittings & components as per requirement
 - iii. Horizontal V (single braced, single post) pilot suspension insulator assembly alongwith hardware fittings comprising of:

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- a) Composite longrod suspension insulator (3.5 m length, 160 kN tensile strength)
- b) Composite longrod post insulator (3.5 m length, minm 90mm core dia, 120 kN tensile strength, 90 kN compressive strength)
- c) Hardware fittings including end attachment, yoke plates, suspension clamps, extension links, turnbuckles, corona/grading rings other fittings & components as per requirement

The hardware fittings shall be suitable for Quad/ Twin ACSR Moose conductor.

- 1.8.3 Composite insulators (Suspension, post) with silicone weather sheds shall be supplied along with the associated corona control rings at each end. These insulators shall be supplied from manufacturers whose similar product is in satisfactory operation for 345/ 400 kV or above voltage application for a minimum period of two years as on date of bid opening.
- 1.8.4 The insulation characteristics shall comply for the system parameters given in Clause 7.1 of SECTION-1 of Technical Specification.
- 1.8.5 The composite insulators shall comply with the electrical and mechanical test requirements specified in IEC-1109.
- 1.8.6 These composite insulators shall be supplied in PVC tubing of proper size in order to protect these insulators. The PVC tube shall have the provision of closing and opening at one end.
- 1.8.7 Guy strain insulators shall be supplied for insulating portion of guy wires in proximity to live parts. Guy insulators shall be either composite longrod suspension insulators or insulating rods of minimum 160 kN ultimate tensile strength. These insulators shall be provided with suitable end fittings for attachment to guy wires & ERS structures.

1.9 Earthwire/ OPGW fittings

Earthwire/ OPGW fittings as per requirements indicated in the relevant schedule of the Bid Proposal sheets of the bidding documents shall also be supplied.

The suspension & tension/ dead end assemblies, fittings & components shall be suitable for 7/3.66 galvanised steel earthwire or equivalent OPGW having overall dia of max. 13.5 mm.

1.10 Detailed Design & Engineering

- 1.10.1 The Supplier shall be responsible for the design of ERS towers (based on the specified design parameters, loading criteria) and also analysis of their use under alternate tower configuration options specified in 1.2.3.
- 1.10.2 For various ERS components where type/rating/strength requirements are stipulated in item description of the Bill of Quantities indicated in the relevant schedule of BPS, the design analysis to determine suitability/extent of usage etc. shall also be carried out by the Supplier during detailed engineering stage.

1.10.3 Loading Criteria

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1.10.3.1 The design of ERS towers shall be carried out by the Supplier considering loads, loading conditions as per IS 802.

1.10.3.2 Following conductor bundle & earthwire parameters shall be considered for design of ERS towers

	Conductor	
a)	Name	ACSR 'MOOSE'
(b)	Strands and wire diameter of (i) Aluminium (ii) Steel	54/3.53mm 7/3.53mm
(c)	Conductor per phase	4 Nos./ 2 Nos.
(d)	Spacing between the conductors of same phase (sub conductor spacing)	457 mm (For Quad Bundle Conductor Wire) 450 mm (For Twin Bundle Conductor Wire)
(g)	Overall diameter	31.77mm
(h)	Weight	2004 Kg/Km
(i)	Minimum ultimate tensile Strength	161.2 KN

	Earthwire	
a)	Size (strands & wire diameter)	7/3.66 mm
b)	Overall diameter	10.98 mm
c)	Standard weight	583 kg/km
d)	Minimum ultimate tensile strength	68.4 KN

1.10.3.3 Following wind load parameters / wind loads shall be considered for design of ERS towers with reference to IS:802:-

S.No.	DESIGN PARAMETERS/ LOADS	ERS FOR 400 KV D/C QUAD/ TWIN LINE
1.	Wind Span (in metres)-S	400
2.	Basic Wind Load Parameters	
	Wind Zone (as per IS-875)	2
	Basic Wind Speed (m/sec)	39
	Reliability Level	1
	Risk Coeff.	1.0
	Terrain Roughness Coeff. (Terrain Category-1)	1.08
	Design Wind Pressure - N/sqm	563
3.	Wind Load on Conductor	
	Drag Coeff.	1.0
	Wind Pressure on Conductor – kg/sq. mt.	111.65

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	Gust Response Factor	2.12
	Wind Load on Conductor-bundle (kg) Where S – wind span (sum of half the span on either side of support, m) 400 m D – Dia of conductor (m) (31.77 mm) N- No. of sub-conductors (4 and 2)	$P_d \times C_{dc} \times L \times d \times G_c$
4.	Wind Load on Earthwire	
	Drag Coeff.	1.2
	Gust Response Factor	2.12
	Wind Load on Earthwire (kg) Where S – wind span in m (sum of half the span on either side of support) 400 m D – Dia of earthwire (m) (11.0 m)	$P_d \times C_{de} \times L \times d \times G_e$
5.	Wind Load on Towers	
	Gust Response Factor	2.13
	Wind Load on Tower (kg) Where Cdt – Drag Coeff. as per IS-802 depending upon solidarity ratio A – Net projected area of tower (sqm)	$483 \times C_{dt} \times A_e \times G_r$
6.	Wind Load on Insulators	
	Gust Response Factor	2.13
	Drag Coeff.	1.2
	Wind Load on Insulator (kg) Where A – Projected area of insulator (sqm)	$P_d \times C_{di} \times A_i \times G_i$

1.10.3.4 For calculation of vertical loads due to conductor weight span shall be considered as follows:

		Normal Condition (NC)	Broken Wire Condition (BWC)
Suspension Tower	Max.	600 m	360 m
	Min.	200 m	100 m
Tension Tower	Max.	600 m	360 m
	Min.	0	-300 m

1.10.3.5 Following criteria shall be considered for conductor & earth wire sag-tension calculations:-

- Conductor & earthwire tension at everyday temperature at no wind condition shall be considered as 22% & 20% of UTS respectively.
- Maximum sag shall be considered corresponding to 85 deg C conductor temperature & 53 deg C earth wire temperature.
- Maximum conductor/earthwire tension (for calculation of line deviation loads) shall be considered corresponding to 32 deg C & full wind pressure on conductor/earthwire on the entire wind span.

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- 1.10.3.6 The Supplier shall furnish the limit loads as well as ultimate strengths of all components (along with calculations) during engineering stage. The Ultimate strengths finalised during detailed engineering stage shall be applicable for testing purposes.

1.10.4 Electrical parameters

- 1.10.4.1 Electrical system parameters for design of ERS shall be same as those indicated for existing transmission lines under clause 6.1 of Section-I of Technical Specification.

- 1.10.4.2 Electrical clearances to be considered for ERS shall be as follows :-

S.No.	ELECTRICAL CLEARANCES	ERS FOR 400 KV D/C QUAD/ TWIN LINE
1.	Minimum Ground Clearance (m)	8.84
2.	Minimum Live-metal Clearance (m)	3.05
3.	Minimum Inter-phase/pole spacing (m)	8.0
4.	Minimum Mid-span clearance between conductor & earthwire (m)	9.0

- 1.10.4.3 Minimum total creepage distance (phase to ground) for insulators shall be 13020 mm

1.11 Erection & Stringing Equipments, Tools & Tackles

The Erection & Stringing Equipments, Tools & Tackles required for erection/assembly of structures as indicated in relevant schedule under Bid Proposal Sheets of the Bidding Documents shall be supplied with each set of ERS as per BOQ.

The bidders shall also indicate in their bid under additional information schedule or other relevant schedule, other recommended erection & stringing equipments, tools and tackles which in their opinion are required for use & deployment of ERS.

1.12 Containers for ERS

Required number of essential sized containers shall be supplied for storage of all ERS components/material (except structure/ mast sections) as well as for transportation of the same to restoration site. The containers shall have suitable stacking arrangement for storage & provision (sliding stacks or alternate arrangements) for easy access & removal of material from stacks. Estimated quantity of containers has been indicated in the relevant schedule of Bid Proposal Sheets. Actual quantity shall be finalised during detailed engineering.

The containers shall be such that these can be loaded on separate trucks or flat bed trailers for transportation.

The containers supplied shall be suitable for indoor storage & outdoor storage under service conditions mentioned at 7.1 of Section-1 of Technical Specification.

1.13 Computer Programs

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- 1.13.1 An extensive set of computer analysis programs/ PLSCADD program to assist in determining the capabilities of the structures shall be supplied with each set of ERS set. Two sets of such programs shall be supplied on CDs for compatible personnel computers using WINDOWS. The computer program(s) shall be suitable for copying & multiple use by at least 3 (three) users simultaneously & independently.
- 1.13.2 The programs shall be easy to use, i.e., user friendly and shall be accompanied by a thorough instruction manual.
- 1.13.3 The computer programme output data (for given load design scenario) shall include but not limited to guy wire tension, maximum span for a given conductor height, compressive loads for the foundation plate, right of way area requirement, total anchor load requirement ,graphic representations of the structures to be built.
- 1.13.4 The computer programme must have the capability to analyse all configuration of towers. Up-gradation of computer programme, if any, should be furnished free of cost for 5 years period.

1.14 List of Drawings and Documents

- 1.14.1 The Bidder, alongwith his Bid, shall furnish necessary description and illustration of the materials offered. Bidder shall also furnish a preliminary design of ERS structure considering design criteria stipulated in the specification.
- 1.14.2 The Bidder in his Bid shall furnish the drawings, calculations, test reports and literature pertaining to specified items which shall include but not be limited to the following information:
- a) Name and location of the factory or company manufacturing the ERS components, Composite insulators, hardwares and all other equipment offered.
 - b) Technical standard, manufacturing technology and quality assurance system for ERS components.
 - c) Description of the ERS structure, including broad dimensions of each part, unit weight.
 - d) Technical standards of all other main elements used in ERS and other equipment offered.
 - e) Test reports and certificates showing compliance with the tests as listed in Section-II of Technical Specification;
 - f) Description of Quality Control/Assurance Programme.
- 1.14.3 The Supplier shall also furnish 4 copies each of the following documents during detailed engineering in addition to drawings & documents specified in 1.14.2:
- a) Detailed design of the ERS structure & all components considering design criteria stipulated in the specification.
 - b) Detailed description of the ERS structure, including dimensions of each part, unit weight and cross-section drawings.
 - c) Erection drawings
 - d) Specific instructions for installation of ERS, maintenance and instruction manuals.

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- e) Drawings of each hardware item showing ultimate or breaking strength.
- f) Details of packing and
- g) Detailed drawings of jumper connections including electrical clearances

1.14.4 After Purchaser's approval and successful completion of all type tests, the Supplier shall within three weeks, submit 5 prints, one set of good quality reproducible, one set of colour drawings in AutoCAD stored in CDs & one set of micro films of the approved drawings for Purchaser's use.

1.14.5 Five (5) sets of nicely printed separate bound volumes of storage, maintenance, transportation & erection manuals in English for each equipment as well as stringing manuals shall be submitted by the Supplier for distribution, prior to the despatch of the equipment.

The manual shall contain in separate sections all the -drawings and information required for emergency restoration of the transmission lines. The manual shall also contain a set of all the approved drawings, type test reports/ performance test reports etc.

1.14.6 The Supplier shall also furnish five CDs demonstrating the procedure of installation/stringing of conductor and associated hardware and such other works and procedures (with slow motion sequences also) which would educate and guide the Purchaser's engineers in execution of work. The CDs shall be informative and self explanatory and in English language only.

1.15 Workmanship

All works shall be performed using the best modern practices of the industry. All material should be new and free of defects or irregularities. All components of the same design and designation should be identical and like components should be interchangeable. All corners should be rounded and sharp edges should be broken.

1.16 Galvanising

1.16.1 The structures and components of ERS made of steel shall be fully galvanised. Galvanising shall conform to IS: 2629 and IS:4759. Post treatment (chromating) recommended as per IS:2629 shall also be carried out after galvanising. All galvanised members shall withstand tests as per IS:2633. For fasteners, the galvanising shall conform to IS:1367 (Part-13). Spring washers shall be electrogalvanised as per Class-4 of IS:1573.

1.16.2 The steel strands of the guy wires shall be hot dip galvanised and shall have minimum zinc coating of 275 gms/sqmm after stranding. These shall withstand three & a half dips under the Standard Preece test.

1.16.3 Other ferrous components (of hardware fittings, etc.) shall be hot dip galvanised and shall have minimum average coating of zinc equivalent to 600 gms/sqmm. These shall withstand at least six dips of one minute duration under the Standard Preece test.

1.17 Quantities

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Bill of Quantities (BOQ) of various items of ERS are given in the relevant schedules under Bid Proposal Sheets of the bidding documents. The quantities of various items of ERS may vary based on final requirement to be determined after completion of detailed engineering. The final quantities shall be supplied by the Supplier at the same terms & conditions and unit rates shall remain the same for any variation in quantities of items of ERS. For overall quantity variation, provisions stipulated in relevant clauses under Conditions of Contract of the Bidding Documents shall be applicable.

2.0 Tests

2.1 General

The Bidder alongwith his bid shall furnish performance test certificates for the equipments/ material offered by him. If the Bidder is required to specially design the equipment to meet the Purchaser's Specification, then he should submit the performance test certificates for the equipments/material which are similar to those offered by him.

2.2 Production Tests and Performance Tests

All equipments covered under this Specification shall be subjected to Production and Performance tests during manufacturing, assembly and on completion. Cost of such tests shall be borne by the Supplier.

2.3 Production Tests

2.3.1 Production tests/Tests during Manufacture/ Routine tests of all major equipment/tools shall be conducted as per applicable standards/codes. In the absence of any Code/Standard, equipment shall be tested as per mutually agreed procedure between the Supplier and the Purchaser. These tests shall include all tests to be carried out at Supplier's works, works of his sub-vendor and at works where raw materials supplied for manufacture of equipments are fabricated.

2.3.2 The tests to be carried out shall include but not be limited to the tests described as follows:

(i) For Column Sections/Structures, Box Sections, Gimbals & Guy Plates

- a) Strength proof test
- b) Dimensional test
- c) Material analysis and testing

The test values for strength proof test shall be maximum of those specified in IEEE-1070 or 67 % of the ultimate strength values guaranteed by the Supplier and considered in the detailed design.

(ii) For Guy hardware, insulator string hardware & Anchor assembly hardware

- a) Dimensional test
- b) Material analysis and testing

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- c) Proof Load Test } As per Annexure-A

(iii) For Composite Insulators & Guy insulators

- a) Visual Examination } As per IEC:61109-2008
b) Mechanical routine test } As per IEC:61109-2008
c) Material analysis and testing of metal parts
d) Insulation resistance test for guy insulators (of insulating rods)

2.4 Performance Tests

2.4.1 Following Performance tests shall be carried out once at Supplier's works/ works of his sub-vendor before despatch of material which will be witnessed by purchaser's representative.

2.4.2 Tests for the IEEE standardised system shall be according to IEEE Standard 1070: 2006 "Guide for the Design and Testing of Transmission Modular Restoration Structure Components". For other types of structures tests shall be carried out according the objectives of IEEE Standard but test parameters shall be mutually discussed and agreed.

2.4.3 The acceptance values for the tests to be carried out as per IEEE 1070 shall be maximum of those stipulated either in IEEE 1070 or those guaranteed by the Supplier and considered in the detailed design.

2.4.3.1 For Column Sections/Structures

- i) Compression test } As per IEEE 1070
ii) Bending test } As per IEEE 1070
iii) Torsion strength test } As per IEEE 1070
iv) Combined bending and compression test } As per IEEE 1070
v) Ultimate strength bending test-Bolts } As per IEEE 1070
vi) Ultimate strength bending test-welds } As per IEEE 1070
vii) Column Buckling test } As per IEEE 1070

2.4.3.2 For Box Sections

- i) Box Section load test } As per IEEE 1070

2.4.3.3 For Guy Plates

- i) Guy Plate load test } As per IEEE 1070

2.4.3.4 For Gimbals

- i) Gimbal articulation test } As per IEEE 1070
ii) Gimbal compression test } As per IEEE 1070
iii) Gimbal transverse test } As per IEEE 1070

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2.4.3.5 For Bolts & Nut

- i) Ultimate strength test } As per IEEE 1070

2.4.3.6 Stainless steel washer / thaw test } As per IEEE 1070

2.4.3.7 For Composite Insulators & Composite Insulator strings

- (i) Design & Type Tests on composite insulators } As per IEC 1109

The above design & type tests on composite insulators shall not be required to be carried out if a valid test certificate is available for a similar design, i.e., tests conducted earlier should have been conducted in accredited laboratory (accredited based on ISO/IEC guide 25/17025 or EN 45001 by the National Accreditation body of the country where laboratory is located) or witnessed by the representative (s) of purchaser.

- (ii) Corona & RIV tests on composite insulator strings } As per Annexure-A

- (iii) Mechanical Strength Test on Composite insulators } As per Annexure-A

- (iv) Mechanical Strength Test on Hardware fittings } As per Annexure-A
of insulator strings

2.4.3.8 For guy wires, guy hardwares, guy insulators (of insulating rods) & anchoring assemblies

- (i) UTS/ Mechanical Strength Test } As per Annexure-A

2.4.4 The Purchaser's representative shall be given full access to all performance tests. The Supplier shall inform the Purchaser in accordance with clause no. 4.10.2 of Section-I of Technical Specification, so that, if the Purchaser so desires, his representative can witness the tests.

2.4.5 All test certificates and reports shall be submitted to the Purchaser for approval.

2.4.6 The entire cost of testing for the above production & performance tests shall be treated as included in the quoted Ex-works/ CIF price.

2.5 Additional Tests

2.5.1 The Purchaser reserves the right of having, at his own expense, any other test(s) of reasonable nature carried out at Supplier's premises, at site, or in any other place in addition to the aforesaid type tests, performance tests and tests during manufacture so as to satisfy himself that the material comply with the Specification.

2.5.2 The Purchaser also reserves the right to conduct all the tests mentioned in this Specification at his own expense on the samples selected from lots supplied to the Purchaser at Supplier's premises or at any other test centre. In case of evidence of non compliance, it shall be binding on the part of Supplier to prove the compliance of the items to the Technical Specification by repeat tests or corrections of deficiencies or replacement of defective items, all without any extra cost to the Purchaser.

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2.6 Test Reports

- 2.6.1 Copies of Performance test report shall be furnished in at least six copies. One copy shall be returned, duly certified by the Purchaser, only after which the materials will be despatched.
- 2.6.2 Record of Production test report/ Tests during Manufacture shall be maintained by the Supplier/Sub-Vendor at his works for periodic inspection by the Purchaser's representative.

2.7 Inspection

- 2.7.1 The Purchaser's representative shall at all times be entitled to have access to the works and all places of manufacture, where materials shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Supplier's, sub-vendor's works, raw materials, manufacturer's of all the materials and for conducting necessary tests as detailed herein.
- 2.7.2 The Supplier shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of materials in its various stages so that arrangements could be made for inspection.
- 2.7.3 Materials shall not be despatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the Purchaser in writing waives off the inspection. In the latter case also the materials shall be despatched only after all tests specified herein have been satisfactorily completed.
- 2.7.4 The acceptance of any quantity of materials shall in no way relieve the Supplier of his responsibility for meeting all the requirements of the Specification, and shall not prevent subsequent rejection, if such materials are later found to be defective.

3.0 Training & Demonstration

- 3.1 Upon receipt of the equipment at site, the Supplier is required to give field training & demonstrate installation of two typical types of suspension & one tension ERS structure using ERS structures & components supplied by the Supplier. All labour & other materials, equipments, tools & tackles required for field training & demonstration shall be provided by the Supplier with no extra cost.
- 3.2 In case of evidence of non compliance during demonstration, it shall be binding on the part of Supplier to prove the compliance of the items to the Technical Specification by replacement/modifications of relevant item(s)/components etc. or by providing additional item(s)/ components etc. and re-demonstrating compliance, all without any extra cost to the Purchaser.
- 3.3 The field training cum demonstration shall be carried out near to the designated destination store separately for each set of ERS supplied. The classroom training shall be provided by the Supplier to Purchaser's representatives anywhere in India for a period of 7 working days separately for each set of ERS supplied.
- 3.4 During field training, usage of each type of equipment, tools and tackles shall be clearly instructed and demonstrated to the Purchaser's representative. The training shall include the actual field training imparting first hand knowledge about the assembly of

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modular structures (all type of tower configurations), fixing of foundation plates, erecting of structures on the foundation, guying the tower with anchoring arrangement, etc.

- 3.5 The class room training shall include class room lectures, including training in computer analysis programme to assist the Purchaser's personnel in determining the capabilities of the structures, analysis of failure scenarios, selection of suitable scheme of deployment, etc. The class room training may also include explanation/demonstration of actual scenarios with scaled model. Special stress shall be given so as to ensure that the trained personnel acquire proficiency in restoring of failed structures so that they can take up this work independently. Training w.r.t storage & maintenance of ERS shall also be provided to Purchaser's Personnel.
- 3.6 Bidders are required to indicate training charges in the prescribed schedule of the bidding document. The training charges shall include the to and fro travel expenses, lodging and boarding charges, and any other miscellaneous charges.
- 3.7 The programme of training shall be mutually discussed and finalized by the Purchaser with the Supplier.

4.0 Standards

- 4.1 The material shall conform to the following Indian/International Standards, which shall mean latest revisions, amendments/changes adopted and published unless otherwise specified herein above. International and Internationally recognised standards to which these standards generally correspond are also listed below.
- 4.2 In the event of the supply of material conforming to any standard other than Standards listed below, the salient features of comparison shall be brought out and furnished alongwith the bid.

Sl. No.	Indian Standard	Title	International Standards
1.		IEEE Guide for the Design and Testing of Transmission Modular Restoration Structure components	IEEE 1070-2006
2.		Composite insulator units for overhead lines with a nominal voltage greater than 1000 V	IEC:61 466-1
3.		Composite insulators for A.C. overhead lines with a nominal voltage greater than 1000 V: Definitions, test methods and acceptance criteria	IEC:601109
4.		Loading test on overhead line towers	IEC:60852
5.		Loading and strength of overhead transmission lines	IEC:60826
6.		Specification for Alumunium alloy sheet and plate	ASTM B209

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7.	IS:802(Part-I)	Transmission Line towers: Materials, loads and permissible stresses	
8.	Central Board of Irrigation and Power Publication No. 268	Transmission Line Manual	
9.		IEEE Standard for Testing of Overhead Transmission and Distribution line Hardware	IEEE no.135.61-1997
10.	IS:1367	Technical Supply conditions for Threaded Steel Fasteners	
11.	IS:1573	Electro-plated coatings of Zinc or Iron & Steel	
12.	IS:2629	Recommended Practice for Hot Dip Galvanising of Iron & Steel	
13.	IS:2633	Method of Testing Uniformity of Coating of Zinc coated Articles	
14.	IS:4759	Specification of Hot Zinc Coatings on Structural Steel and other Allied Products	
15.	IS:4759	Loading test on overhead line structures	IEC:60652

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ANNEXURE-A

(i) Proof Load Test:

Each component shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength which shall be increased at a steady rate to 67% of the UTS specified. The load shall be held for one minute and then removed. After removal of the load the component shall not show any visual deformation.

(ii) Corona & RIV tests for composite insulator strings

a) Corona Extinction Voltage Test (Dry): The sample assembly when subjected to power frequency voltage shall have a corona extinction voltage of not less than 320 kV (rms) line to ground under dry condition for 400 kV line. There shall be no evidence of corona on any part of the sample. The atmospheric condition during testing shall be recorded and the test results shall be accordingly corrected with suitable correction factor as stipulated in IEC : 383.

b) RIV Test (Dry): Under the conditions as specified under (1.2) above, the insulator string along with complete hardware fittings shall have a radio interference voltage level below 1000 micro volts at one MHz when subjected to 50 Hz AC voltage of 305 kV line to ground under dry condition for 400 kV line. The test procedure shall be in accordance with IS:8263/IEC : 437.

Corona & RIV tests are to be conducted on one suspension & one tension string (horizontal V suspension & double tension insulator string) along with hardware fittings.

(iii) Mechanical Strength Test on Composite insulators:

One sample of each type of composite insulators shall be subjected to 67% of UTS (for both suspension and post insulator) & to 67% of Ultimate compression strength (for post insulator only). This load shall be held for 5 min. The insulator shall not show any visual deformation. Subsequently the load shall be further increased at a steady rate till the specified minimum UTS/ Ultimate compression strength and held for one minute. No fracture should occur during this period.

(iv) Mechanical Strength test on Hardware fitting components of insulator strings/ Mechanical strength test on guy hardwares, guy insulators (of insulating rods) & anchor assemblies:-

One sample of each component of the hardware fittings/ guy hardwares & anchor assemblies shall be subjected to 67% of UTS / Ultimate compression strength. This load shall be held for 5 min. The sample shall not show any visual deformation. Subsequently the load shall be further increased at a steady rate till the specified minimum UTS/ Ultimate compression strength and held for one minute. No fracture should occur during this period.

(v) Mechanical Strength test on Guy Wires

Circles perpendicular to the axis of the guy wire shall be marked at two places on a sample of guy wire of minimum 5 m length suitably compressed with standard clamps at either end. The load shall be increased at a steady rate up to 50% of UTS and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at steady rate to 100% of UTS and held for one minute. The guy wire sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

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