BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

NEW DELHI

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TITLE	Sag Compensating Springs			DATE	19.02.15	19.02.15	19.02.15
				GROUP	TBEM		
				W.O. No	83012		

CUSTOMER	**MADHYA PRADESH POWER TRANSMISSION LTD.**
PROJECT	**Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turnkey basis (Lot no. 1) Balaghat, Badnawar, Bhopal, Chhegaon and Nagda**

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SECTION – 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENT AND QUANTITIES

1. SCOPE:-

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of Sag Compensating Springs.

This section covers the scope and quantities of Sag Compensating Springs. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification. For environmental conditions, refer Section-3 carefully.

The specification comprise of following sections:

Section-1: Scope, specific technical requirements & Bill of Quantities.
Section-2: Equipment specifications
Section-3: General technical requirements for all equipments under the project.
Section-4: Guaranteed Technical Particulars

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

The equipment is required for the following projects:

Name of the Customer : Madhya Pradesh Power Transmission Company Ltd.

Name of the Project : Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turnkey basis (Lot no.- 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda

The term 'Owner' appearing in this specification shall refer to MPPTCL, the term 'Purchaser/Employer' shall refer to BHEL and the term 'Contractor' shall refer to the successful Bidder.

2. SPECIFIC TECHNICAL REQUIREMENTS:-

As per Section-2.

3. BILL OF QUANTITIES:-

Sl.	Description	Unit	Balaghat (Kirnapur)	Badnawar	Bhopal	Chhegaon	Nagda
1.	Sag Compensating Springs	Nos.	54	90	36	18	0

NOTE:-

1) **The quantities indicated above are subject to change by ±20%.**
2) **Sag compensating spring shall be suitable for string insulator hardware. Drawing of the string insulator hardware shall be provided at contract stage.**

4. TYPE TESTING:-

The offered equipments should be fully type tested as per the relevant standards. In case the equipment of the type and design offered, has already been type tested, Bidder shall invariably furnish type test reports from the reputed and approved national/international laboratory/Government approved test houses to prove that specifications of equipments offered conform to the relevant standard.
Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered equipments could be verified. While submitting bids the model and type etc., shall be clearly indicated.

Type test reports furnished with the offer should not pertain to the period earlier than five years from the **date of opening of Bid which is 20.11.13.**

In case the type tests were carried out earlier than five years, the manufacturer will have to conduct these tests, without any commercial & delivery implication to BHEL, before commencement of supply. In both the above cases type test certificate must be submitted with the bid. The Bidders have to submit one complete set of Type Test reports for the offered equipments.
All the tests as per relevant IS/IEC shall be carried out.

5. INSPECTION & TESTING:-

Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, as per the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

Prior to dispatch, the routine & acceptance tests shall be carried out on equipment in accordance with the applicable IEC /IS and the material shall be offered for final inspection to BHEL and MPPTCL in accordance with agreed quality plan with 3 weeks advance information.

6. QUALITY PLAN:-

The contractor shall carry out contract works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / MPPTCL approval within 1 week of P.O. placement.

SECTION – II
TECHNICAL SPECIFICATION FOR SAG COMPENSATING SPRINGS

1.0 SCOPE -

This scope of this specification covers design, manufacturing supply of Sag Compensating Springs for EHV substations as per Section-I. The bidder mentioned in the Section of Technical specification means “Original Equipment Manufacturer (OEM)”. The purchaser means the “BHEL”.

In case bidder is not OEM, sole responsibility of offering equipment / material of manufacturer as per this specification requirement shall rest on the bidder.

1.1 STANDARDS -

Applicable standards for offered equipment / material shall be as per Section-3.

1.2 CLIMATIC CONDITIONS –

Applicable climatic conditions shall be as per Section-3.

1.3 SYSTEM PARTICULARS -

Applicable system particulars shall be as per Section-3.

2. DESCRIPTION AND STANDARD TECHNICAL PARTICULARS OF SAG COMPENSATING SPRINGS.

2.1 The Sag Compensating Springs are used to compensate the differential sag of quadruple “MOOSE” main string and twin moose ACSR of transfer bus bars due to temperature variations over a range from 0^0 C to 80^0 C so that it is within the contact zone of 300 mm of pantograph isolators used. The main frame of the spring shall be designed for heavy-duty operation for which it is intended. The main frame assembly comprises of end plates, guide rod, bolts, nuts, eyes or clevises for anchoring and sheet metal housing.

2.2 The spring shall be helical and made of high quality spring steel rods formed by centre-less grinding. The spring shall be pre-compressed, so that under all conditions the spring will work under compression. The ends of the spring shall be flat, closed and rounded.

2.3 The spring steel shall have low average stresses to ensure long and maintenance free life.

2.4 The tension rods and guide rod shall be made of stainless steel. There shall be three numbers guide rods arranged in triangular configuration, so that stresses developed due to the load coming on the spring is equally distributed on all the bolts. These rods are provided to ensure that the springs remain “Buckle Proof” in all the combination to ensure that no bolt loosens or gives way under working conditions.

2.5. The springs shall be manufactured by hot coiling method and “Shot peened “ to induce compressive stresses in the spring to over come fatigue. It shall be

guaranteed that under complete compression of the spring the permissible stress will not be exceeded.

2.6. The springs shall be based in an approved manner to relieve hydrogen embrittlement.

2.7. The springs being intended for outdoor use shall be coated with chlorinated rubberized paint over a lead oxide base.

2.8. The coiling shall normally be right wound and the total number of coils shall be determined by the design considerations to give the specified performance.

2.9. Since the spring is intended for outdoor use, it shall be ensured that the spring is not affected by weathering conditions changing with time. It shall have an over all outer sheet metal enclosure, the thickness of sheet being at least 3mm. The enclosure shall be electro-galvanized and be provided with drain holes to drain the rainwater that may collect.

2.10. Adequately designed eyes/hooks as required shall be provided on both sides and on the end plates of the spring so that the spring can be attached to the insulator assembly easily at the time of anchoring the spring.

2.11. The Sag Compensating Springs shall be provided with a copper strip of sufficient length designed for specified short circuit current in parallel with the entire spring assembly to avoid the fault current flowing through the spring and thus damaging it subsequently.

2.12. The EHV System is subjected to heavy short circuits and under the influence of the increasing short circuit forces, the springs will get compressed till they are boxed. Any further increase in the force will only stress the anchoring hooks and plates and guide rods. These shall therefore have sufficient strength to sustain the maximum dynamic force. The spring shall be designed a factor of safety of 2.5 tension loadings. There should be one set or two springs per phase attached at any one side of the span.

2.13 Each Compensating Springs shall be tested individually and bidder shall submit the test reports.

2.14. Tenderer shall furnish basic calculations to establish the suitability of the spring constant in Kg/Cm (f-Kg/Cm) in keeping the sag within the maximum and minimum limits as indicated in the Technical Parameters.

2.15 The Bidder shall submit following information/ drawing for Sag Compensating Spring with their Bid:-

(i) Fully Dimensional Drawing giving as assembly and detailed Bill of Material and Weight.

(ii) Technical details with descriptive literature / catalog and photographs of offered item.

(iii) The material used for various parts shall be clearly specified in the drawing.

(iv) Total assembled weight.

(v) Any other Technical Parameters.

3.0 TECHNICAL PARAMETERS OF SAG COMPENSATING SPRINGS ON THE BASIS OF WHICH TENDERER HAS TO BE SUBMIT THE OFFER

a. CONDUCTOR DETAILS

1.	Conductor	:	ACSR
2.	Stranding	:	54/7/3.53 mm
3.	Code name	:	MOOSE
4.	Span between the bay	:	54 Meters.
5.	No. of sub-conductor/phase	:	4
6.	Weight per meter	:	2.004 Kg.
7.	Area of cross section	:	5.97 cm^2
8.	Co-efficient of linear expansion	:	19.35 X 10^o
9.	Modules of elasticity	:	0.686 x 10^b Kg/ cm^2
10.	Basic tension per sub conductor (i) at temperature 0 ^{o} C (ii) at wind pressure of 45 Kg/ m^2 acting on full projected area.	:	1000 Kg.
11.	Spring required	:	On one end of conductor.
12.	No. of springs/phase	:	Two (1 Set)
13.	Max/Min static tension per spring for a spring Constant of 60 Kg/Cm.	:	2000/1460 Kg.

b. PERFORMANCE REQUIREMENT

1.	Maximum permissible sag.	:	1700 mm
2.	Maximum permissible differential sag to be Limited by spring.	:	300 mm
3.	Temp. at site in shade and temp. at site in sun	:	50^0 C & 65^0 C
4.	Short circuit current & short circuit duration	:	40 KA per phase, 1 Sec.
5.	Maximum dynamic force for which accessory is to be designed.	:	7500 Kg.
6.	Temp. Variation Min /Max.	:	0^0 C / 80^0 C

4.0 MARKING:

Each Sag Compensating Springs shall be marked with the trade mark of the manufacturer and year of manufacturing. Marks shall be forged or stamped with a steel die. The mark shall be distinct, durable and conspicuous.

5.0 PACKING AND FORWARDING:

(i) The Sag Compensating Springs shall be packed in suitable sized strong and weather resistant wooden cases/crates. The packing shall be of sufficient strength to withstand rough handling during

transit, storage and subsequent handling in the field.

(ii) All packing cases shall be marked legibly and correctly so as to ensure their safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty or illegible markings. Each wooden case / crate shall have all the markings stenciled on it in indelible ink.

(iii) The list showing quantity of components, product drawing and assembly / maintenance instructions for the users should be sent with each consignment.

6.0 INSPECTION :

(i) Purchaser and its representatives shall at all times be entitled to have access to the works and to all places of manufacturing where Sag Compensating Springs are manufactured and the Bidder shall afford all facilities to them for unrestricted inspection of the works, inspection of raw material, inspection of manufacturing process of Sag Compensating Springs and for conducting necessary tests as detailed in the Bidding document.

(ii) The successful Bidder may keep the Purchaser informed in advance of the time of starting and progress of manufacture of Sag Compensating Springs in its various stages so that arrangements could be made for stage inspection.

(iii) No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested or inspection waiver is granted.

(iv) The acceptance of any quantity of Sag Compensating Springs shall in no way relieve the Bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection, if such materials are later found to be defective.

(v) Immediately after finalization of the programme of acceptance/ routine testing, the successful Bidder shall give advance intimation in writing intimating the date and the place at which the materials shall be ready for inspection and testing. All acceptance tests shall be carried out in presence of Purchaser's representative. They will also provide such assistance as may be required for or as may be reasonably demanded by Purchaser's representative to carry out such tests efficiently. The material shall not be dispatched unless the same is inspected and approved or the waiver of inspection is granted.

(vi) When the specified tests are conducted successfully in presence of Purchaser's representative, the successful Bidder shall submit the test certificate in duplicate duly witnessed by representative to Purchaser's for approval. The material shall not be dispatched until these certificates are approved.

(vii) Successful Bidder's request for pre-despatch inspection waiver should invariably accompany with the test certificate in duplicate as per the relevant IS and guaranteed technical particulars of the order, for Purchaser's approval.

7.0 QUALITY ASSURANCE PLAN:

7.1 The Bidder must establish that they are following a proper quality assurance programme for manufacture of Materials. The Bidder shall invariably furnish following information alongwith his Bid;

i. Statement giving list of important raw materials, names of vendors for the raw material, list of standards according to which the raw material is purchased and copies of test certificates thereof.

ii. Information and copies of test certificates as in (i) above in respect of bought out items.

iii. List of manufacturing facilities available.

iv. Levels of automation achieved and list of areas where manual processing exists.

v. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

vi. List of testing equipment available with the Bidder for final testing of material specified and test plant limitation, if any, vis-à-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

7.2 The successful Bidder shall within 30 days of placement of order, submit following information to the Purchaser:

i. List of raw material as well as bought out accessories and the names of sub-suppliers selected from the lists furnished along with Bid.

ii. Type test certificates of the raw material and bought out accessories.

iii. Quality Assurance Plan (QAP) with hold-up points for purchaser's inspection. The quality assurance plans and hold-up points shall be discussed between the Purchaser and supplier before the QAP is finalized.

7.3 The successful Bidder shall submit the routine test certificates of bought out items and raw material at the time of routine testing.

8.0 STAGE INSPECTION:

Successful Bidder shall strictly adhere to the approved detailed manufacturing and quality assurance Programme. The MPPTCL have right to depute its officer during the manufacture of the Sag Compensating Springs at various stages of Manufacturing for Stage Inspection.

Intimation for stage inspections as above for various lots shall be given by you one week in advance to organize deputation of inspecting officer. During stage inspections, the inspecting officer shall verify the sources of raw material, its

quality etc. During this stage, following documents shall be verified by our inspector as a proof towards use of raw material for manufacture of Sag Compensating Springs ordered by us.

i Invoice of the supplier
ii Factory test certificate
iii Packing list
iv Bill of lading, if applicable
v Bill of entry certificate by customs, if applicable

The Purchaser also reserves the right to carry out stage inspections at other stages also, for which advance intimation shall be given and all necessary cooperation shall be rendered by the manufacturer. Only after approval of the purchaser, the supplier shall proceed ahead for manufacturing of the Sag Compensating Springs. During stage inspection, adherence to the approved Quality Assurance Plan will also be checked. In case the inspecting officer does not visit the works for stage inspection, the supplier may proceed ahead as per their standard manufacturing process.

A complete record of stage inspection shall be kept by you and this record shall be made available for inspection by the representative of the MPPTCL.

SECTION-3

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.
The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other respective sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer/ Purchaser/ Owner	Madhya Pradesh power Transmission company Ltd.				
b)	Project Title	Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turn key basis (Lot no. 1) – Balaghat , Badnawar, Bhopal, Chhegaon and Nagda substation				
c)	Location	Balaghat	Badnawar	Bhopal	Chhegaon	Nagada
		Balaghat is Located in district of Balaghat of Madhya Pradesh. Distance between Jabalpur to Balaghat is 232 km by Road and 130 km by Rails.	Badnawar is Located in district of Dhar of Madhya Pradesh. Distance between Badnawar to Ujain is 70 km by Road .	Bhopal site is located 20 kM away from Bhopal city.	Chhegaon is located in Khandwa district of Madhya Pradesh . Distance between Chhegaon to Khandwa is 15 km by Road.	Nagda is located in Ujjain district of Madhya Pradesh. The road distance between Nagda to Ujjain is 47 km
d)	Transport Facilities	Road/Rail				
e)	Postal Address	To follow				

SITE CONDITIONS		
a)	Maximum ambient air temperature	50°C
b)	Minimum ambient air temperature	1°C
c)	Average daily ambient temperature	35°C
d)	Maximum Relative humidity	95 %(sometimes approach saturation)
e)	Pollution Severity	Heavily Polluted
f)	Seismic level (horizontal acceleration)	0.3g
g)	Wind zone as per IS 802 (PART 1) - 1995velocity	4
h)	maximum wind pressure	150kg/sq.mts
i)	Average annual rainfall	1250 mm
j)	Maximum altitude above mean see level	1000m
k)	Isolceraunic level	90 days per year
l)	Climate	Moderately hot & humid tropical climate , conductive ti rust & fungus growth

AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V 50 Hz, 3-phase 4 wire, solidly earthed
1 phase A.C power supply	240V ,50 Hz, 1-phase , 2 wire
D.C. power supply	**220V , 2-wire ungrounded**, for all equipments and panels except PLCC of 400kV /220kV /132kV /33kV substation
D.C. power supply	48V , 2 wire system positively earthed for PLCC

The above supply voltage may vary as below and all devices shall be suitable for continuous operation over entire range of voltage**.**

i.	AC supply	Voltage + 10 % to -25% , frequency ± 4%
ii.	DC supply	Voltage + 10 % to -20%

SYSTEM PARAMETERS

Description parameters	**400kV System**	**220kV System**	**132kV System**	**33kV System**
System operating voltage	400 kV	220kV	132kV	33kV
Maximum operating voltage(rms)	420 kV	220kV	145kV	36 kV
Rated frequency	50Hz			
Full wave impulse withstand voltage (1.2/50 micro second)	1425kVP	1050kVP	650kVP	250kVP/ 170kVP
One minute Power frequency dry/wet withstand voltage (rms)	630kV/ 520kV	460kV	275kV	95kV/70kV
Switching Impulse withstand voltage (250/2500 micro sec.) dry and wet	1050kVP	-	-	-
Corona extinction voltage	320kV	156kV	105kV	-
Maximum radio interference voltage for frequency between 0.5MHz and 2 MHz at 320kV rms phase for 400kV system , 156kVrms for 220kV system & 92 kV rms for 132kV system	1000 Micro volt	1000 Micro volt	500 Micro volt	-
Rated short time current	40 kA for three seconds/one second as applicable			25 kA for three seconds/2 6.2kA for two second
Creepage distance @25mm/kV	10500mm	6125mm	3625mm	900mm
System Earthing	Effectively Earthed			

3.2 GENERAL TECHNICAL REQUIREMENT

3.2.1 TYPE TESTS

All equipment/systems to be supplied shall conform to type tests as per relevant standards and proven type. The Bidder / Contractor shall furnish the reports of all the type tests carried out in within last **five years from the date of bid opening (i.e. 20.11.13)** as listed in relevant clauses in respective electrical specification and relevant standards for all components / equipment / systems. These reports should be for the tests conducted on identical/similar components/equipment/systems to those offered/proposed to be supplied under this contract.

Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type

test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off.

In case Contractor is not able to submit report of type test(s) conducted in last five years, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer/Purchaser, and reports shall be submitted for approval. No charges shall be paid under this contract. All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

3.2.2 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

3.3 MATERIAL/WORKMANSHIP

3.3.1 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modem practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to

previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.
The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.
All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

3.3.2 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

3.4 COLOUR SCHEME AND CODES FOR PIPE SERVICE/PANELS

The contractor shall propose a color scheme for those equipment/Items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include:

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

Painting process shall be of powder coating type.All surface shall be cleaned , phosphated and given two coats of rust –resistant primer followed by two coats of finish paints . The interior of all panels cabinets and enclosures shall be finished with gloss white enamel. Two final powder coats of synthetic enamel paint of light grey

shade(697 of IS-5) shall be given to exterior surface of all the panels. Sufficient quantities of touch paint shall be furnished for application at site. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

3.5 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.6 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

3.7 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be throughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for paintaing shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitabley wrapped or other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per shade no. 697 of IS:5.

3.8 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support

channels, structures, shall be hot dip galvanised conforming to latest version of IS:2629 & or 4759 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvasized. Minimum weight of zinc coating shall be **610 gm/sq.m** and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

3.9 PACKING

The following details are to be clearly indicated in the material forwarding documents:

a) Name and address of the consignee.
b) Purchase order number.
c) Name of supplier/s.
d) Description of equipment / material.
e) Net weight.
f) Gross weight.

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost.The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc.

Mandatory spares shall be packed in separate packing with clear identification.

3.10 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser’s information only. Any

demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.11 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc to be installed shall be provided with degree of protection as detailed here under:

a) Installed out door: IP-55

b) Installed indoor in air conditioned area: IP-31

c) Installed in covered area IP:52

d) Installed indoor-in non air-conditioned area where possibilities of entry of water is limited:IP-41

e) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.12 RATING PLATES, NAME PLATES AND LABELS

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may required by the Purchaser. The rating plate of each equipment shall be according to IEC requirements.

All such nameplate instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternately two separate plates one with Hindi and other with English inscriptions may be provided. All measurements shall be in M.K.S units.

3.13 EARTHING

Circuit breakers, LA, Isolator, CVT , CT , BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels, Relay panel, outdoor

marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.14 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be **1100 V grade box** –clamp type and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be **non-disconnecting stud type equivalent to Elmex type CATM4**, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits :	Minimum of 2 nos. of 2.5 sq.mm, copper flexible.
All CT circuits :	Minimum of 4 nos. of 2.5 sq.mm, copper flexible..

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. **At**

least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publictions, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

3.15 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of **CRCA** sheet steel of minimum 2.5 mm thickness. The thickness of door s/covers shall not be less than 2.5 mm. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled **Neoprene gaskets**. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/box

shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required

3.16 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heater shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heater to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centered in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of a resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and air. Alternatively, they shall consist of resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze the surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

3.17 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.

3.18 DOCUMENTATION

3.18.1 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless any thing is waived.

All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.18.2 DRAWINGS

All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearances and spaces required for installation and interconnection between various portions of equipments and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, name of consultant ,the unit designation, contract no. , and the name of the Project .If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer if so required.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.18.3 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalised at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	Approval/comments/by employer on Initial submission	Within 2 weeks of receipt
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer enclosed sheet for details of Title block.

3.18.4 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

1) Drawings

2) Guaranteed Technical Particulars

3) Type Test Reports

4) Manufacturing Quality Plan

3.18.5 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1.	Drawings and Data Sheets	1	6	21	7 nos of all drawings/documents
2.	Drawings “As Built “	-	-	21	
3.	Type Test Reports	1	6	21	
4.	Erection Manuals	-	6	21	
5.	Operation and Maintenance Manuals	-	6	21	
6.	Manufacturing Quality Plan	1	6	21	
7.	Field Quality Plan	1	6	21	
8.	Inspection Test Reports	-	-	21	

Soft copies of drawings at contract stage shall also be submitted in **PDF format**.

Drawings will also be submitted in mini cartridges in AUTOCAD Release -14 package or any other CAD package along with conversion files for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

SECTION - 4

GUARANTEED TECHNICAL PARTICULARS FOR SAG COMPENSATNG SPRINGS

Sl. No.	Parameters	
1.	Max/Min static tension per spring for a spring Constant of 60 Kg/Cm	
2.	Maximum permissible sag.	
3.	Maximum permissible differential sag to be limited by spring.	
4.	Temp. at site in shade and temp. at site in sun	
5.	Short circuit current & short circuit duration	
6.	Maximum dynamic force for which accessory is to be designed	
7.	Temp. Variation Min /Max.	

SECTION – 5

Check List

Put a tick mark (√) in 'YES/NO' Column if the specified requirement is met, or put a (X) mark, if the specified requirement is not met and give comments in the "Remarks" column.

TECHNICAL REQUIREMENTS

Sl. No.	Parameters	Sag Compensating Spring	Yes/No	Remarks
1.	Max/Min static tension per spring for a spring Constant of 60 Kg/Cm	2000/1460 Kg.		
2.	Maximum permissible sag.	1700 mm		
3.	Maximum permissible differential sag to be limited by spring.	300 mm		
4.	Temp. at site in shade and temp. at site in sun	50^0 C & 65^0 C		
5.	Short circuit current & short circuit duration	40KA per phase, 1 Sec.		
6.	Maximum dynamic force for which accessory is to be designed	7500 Kg.		
7.	Temp. Variation Min /Max.	0^0 C / 80^0 C		

2. TYPE TESTS

Whether Type test reports of the tests conducted (not more than 5 years earlier) on similar material submitted with offer. **YES/NO**

Whether Type test reports are as per relevant IEC and technical specification attached here **YES/NO**

If type test report submitted, indicate report number and date.

If the valid type tests reports are not available with the bidder, then the type test, as per relevant IEC and technical specification shall be conducted by the bidder without any cost and delivery implication to BHEL. **YES/NO**

ANNEXURE - A
SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list below all technical deviation clause wise w.r.t. tender specifications:

S.No.	Page No.	Clause No.	Deviation	Reason / Justification

Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date: Tenderer's Stamp & Signature