



GUJARAT ENERGY TRANSMISSION CORPORATION LTD.

SARDAR PATEL VIDYUT BHAVAN,
RACE COURSE, BARODA – 390 007.

TECHNICAL SPECIFICATIONS **FOR**

Dry Type Air Core Reactor

GETCO/E/TS – AIRREACTOR/R2 Feb - 23

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SECTION – I
Dry type Air Core Series Reactor
GENERAL TECHNICAL REQUIREMENTS

1.1 SCOPE:

The scope covers design, manufacture, testing at the manufacturer's works, supply and delivery of Dry Type Air Core Series reactor alongwith Porcelain bus post Insulator, Terminal connector & structure. The scope includes basic requirements of Series Reactor, as indicated in Schedule – A of respective tender, with suitable mounting arrangement structure, suitable terminal connectors, Bus post insulators etc, as specified herein.

Equipments offered shall be complete with all parts/material/accessories necessary for their successful and trouble free operations such parts will be deemed to be within the scope of supply, irrespective of whether they are specifically indicated here in or not.

1.2 STANDARDS:

1.2.1. *The Dry Type Air Core Reactor shall conform to the following standards.*

Sr. no.	Item	Conforming to National/International Standard
	<i>Dry Type Air Core Series</i>	<i>IS:5553(Part 3):1990,</i>
<i>1</i>	<i>Reactor</i>	<i>IEC 60076-6</i>
<i>2.</i>	<i>Bus Post insulator</i>	<i>IS:2544</i>
<i>3.</i>	<i>Terminal Connector</i>	<i>IS: 5561</i>
<i>4.</i>	<i>Structural steel</i>	<i>IS:2062</i>
<i>5.</i>	<i>Hot Dip Galvanizing</i>	<i>IS:2629, IS:6745</i>

All IS/IEC shall be read with latest amendments in vogue on the date of technical bid opening.

Equipment meeting the requirements of any other authoritative standards which ensure equal or better quality than the standards mentioned above shall also be acceptable. However, in the event of the equipment offered conforming to any other standards, salient points of the standard adopted shall be indicated in the technical bid itself. However, acceptance of any equipment conforming to any other authoritative standard will be purely at the discretion of the GETCO.

It is not the intent to specify herein complete details of design and construction. The equipment offer shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respect and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements.

1.2.2 General Arrangement of Dry Type Air Core Reactor:

- a) The Reactor shall be of outdoor type, suitable for operation in the climatic conditions as given in this specification and suitable to mount on insulated on structure.

1.3 DRAWINGS:

The General Arrangement drawings of Reactor, Solid Core BPI & structure illustrating the technical details of this Dry Type Air Core Reactor shall be submitted at the time of tender.

- 1.3.1
- 1.3.2 Drawings, diagrams, instructions and reports shall be identified by descriptive titles indicating their applications to the equipment offered. All dimensions shall be in metric system.
- 1.3.3 All the drawings of individual equipment shall be marked with all Technical details, Guaranteed Technical Particulars, details of manufacturer etc.
- 1.3.4 On approval of all drawings one set of drawings shall be sent to each consignee & one set each to the concerned Division & Circle office. All Approved drawings in AutoCAD format shall be submitted to Corporate Office.

1.4 GENERAL DESIGN of Dry Type Air Core Series Reactor:

1.4.1 SERIES REACTORS:

The series reactor is required to limit the inrush current during switching operation & suppress the harmonic currents. The series reactor shall be Aluminium wound, outdoor type, 50Hz, air cored, non-magnetically shielded, air cooled type and suitable for operation in climatic conditions specified herein, conforming to IS: 5553 (as amended up to date). The reactor shall be Single Phase natural air cooled, coreless type, with one terminal pad each on incoming and outgoing side suitable for terminal connector as given in Schedule-A of respective tender.

The voltage rating of the series reactor's base insulator shall be nominal system voltage.

Series reactors shall be capable of withstanding the specified short circuit currents.

It shall be provided with BPI support Insulators with BIL rating same as that of reactor.

1.4.2 TERMINAL CONNECTORS

The various outdoor equipments shall be supplied with compression type universal terminal connectors having STC rating of 25 kA for 3 sec for voltages upto 33 kV & 40kA for 3 sec for voltages upto 400 kV. Thickness of any current carrying part of Terminal connector shall not be less than 12mm. The terminal connector shall be suitable to the conductor as given in Schedule-A of the Tender.

1.4.2 PORCELAIN SOLID CORE BUS POST INSULATOR

Each Reactor shall be provided with one Bus Post Insulator of same Voltage class as that of Reactor. Insulators shall be of "Post Type" and the metal fitting cemented by insulator manufacturers. The Insulator shall be of GETCO approved make. All malleable iron steel work, steel bolts and nuts and flanges shall be hot dip galvanized in accordance with IS: 2629/1966 with the latest amendment thereof.

1.4.3 STRUCTURE

The support structure for all type of Reactors are in scope of bidder if specified in schedule – A of respective tender. The support structure specifications are attached separately. The structure for Dry Type Air Core Reactor shall be lattice type. Design calculations along with bill of Material for structure shall be submitted by the successful bidder.

1.5 TESTS:

The Dry Type Air Core Reactor offered shall be fully tested for following tests from NABL accredited laboratory shall be carried out in accordance with latest / amended / up to date IS/IEC. The bidder has to submit the all type test reports as stated hereunder for the offered item along with the technical bid. The type test reports from NABL approved laboratory shall not be older than TEN years. Type Test shall be valid as on the last date of submission of bid.

IMPORTANT NOTE: In case of non-submission/partial submission or type test reports of which validity is over, bidder shall submit pending type test report/s from NABL accredited laboratory, in the event of an order, before commencement of supply without affecting delivery schedule, free of cost to GETCO. Confirmation for above shall be invariably submitted along with technical bid.

1. Series Reactor:

- a) Temperature rise test at rated continuous current
- b) Lightning impulse test for current-limiting reactors
- c) Short-circuit test for current-limiting reactors

2a. Bus post Insulator (132 & 66 kV)

- a) Visual Examination,
- b) Verification of dimensions,
- c) Visible discharge (Corona extinction) test,
- d) Lightning Impulse Voltage withstand test,
- e) Lightning Impulse 50% flashover Voltage test,
- f) Dry Power frequency voltage withstand test,
- g) Wet Power frequency voltage withstand test,
- h) Dry Power frequency flashover voltage test,
- i) Wet Power frequency flashover voltage test,
- j) Temperature Cycle test,
- k) RIV test,
- l) Corona inception & extinction,
- m) Switching Impulse voltage test
- n) Mechanical Strength test
 - a. Compression Test,
 - b. Tensile Test,
 - c. Torsion Test,
 - d. Cantilever Strength test and,
 - e. Bending test
- o) Porosity Test
- p) Galvanizing test

2b. Bus Post insulator (11kV & 22 KV)

- a) Visual examination
- b) Verification of dimensions
- c) Visible discharge test
- d) Impulse voltage withstand test
- e) Dry power-frequency voltage withstand test
- f) Wet power-frequency voltage withstand test
- g) Temperature cycle test
- h) Test for mechanical strength
- i) Porosity test
- j) Galvanizing test

3. Terminal connector

- a) STC test on terminal connector.

If bidder has submitted all valid type / special / additional test reports as per requirement of technical specifications, then the same are not required to be repeated. However, those tests which are covered under acceptance/ additional/ routine tests will be required to be carried out during the inspection, which is not a repetition.

b) Routine & Acceptance Tests:

The equipment shall comply with all routine and acceptance tests. Routine and acceptance tests as per relevant IS shall be carried out on each equipment in presence of GETCO representative, at manufacturer's works only. All test reports should be submitted before dispatch of the equipment. Selection of samples for acceptance Test shall be 10% of the offered lot. The Inspection of Bus Post Insulator shall be offered at OEM works. The sample size for offered lot for Bus Post Insulator shall be as per IS 2544.

1. Series Reactor:

- a) *Measurement of winding resistance*
- b) *Measurement of Impedance*
- c) *Measurement of Load losses*
- d) *Measurement of separate source withstand*
- e) *Winding over voltage test.*
- f) *Measurement of IR value*

2. Bus Post insulator

- a) *Verification of dimensions*
- b) *Temperature cycle test*
- c) *Mechanical strength test*
- d) *Porosity test*
- e) *Galvanizing test*

3. Terminal connector

- a) *Verification of dimensions*

1.6 GUARANTEED TECHNICAL PARTICULARS:

The bidders shall furnish along with the bid complete guaranteed technical particulars as called for in Section-I & Schedule-A of this Specification. Particulars which are subject to guarantee shall be clearly marked. Bids lacking information in this respect shall not be considered.

1.7 INSTRUCTION MANUALS:

Operation and Maintenance manuals for Dry Type Air Core Reactor shall be submitted with technical bid and in the event of an order for approval with drawings. Also, copies shall be submitted along with dispatch to each consignee.

A printed booklet giving the safe working instructions and safety measures along with maintenance schedule and procedure to be followed shall be supplied.

The manuals shall be spiral bound and shall contain all the printed drawings, requisite information for erection, operation and maintenance of the equipment. The manuals shall include all the required details/drawings, along with the following particulars:

- a) Marked erection prints identifying the component parts of the equipment as dispatched with assembly drawings.

1.8 GUARANTEE :

The bidder shall guarantee the Dry type Air Core Reactor, Bus Post Insulator & Terminal connector for 36 months from date of commissioning and 42 months from the dated of supply, whichever is Earlier

1.9 INSPECTION OF THE EQUIPMENTS:

- 1.9.1 The successful bidder shall offer inspection of the Dry type Air Core Reactor unit complete in all respects.
- 1.9.2 During inspection, certificates of bought out items, which are used in manufacturing of Dry type Air Core Reactor should be furnished.
- 1.9.3 Factory inspection, if required, will be done by the GETCO before placement of order. The bidder shall give full co-operation to GETCO's officers for factory inspection.

1.10 DEVIATION FROM SPECIFICATION:

No deviation to this specification is accepted and if any deviation is found in the offer, it may result into rejection of the offer. Deviation mentioned at place other than Annex-12 of tender shall not be considered.

1.11 QUALITY ASSURANCE PLAN:

The Bidder shall invariably furnish following information along with his offer. Information shall be separately given for individual type of equipment offered.

- i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material in presence of Bidder's representative, copies of test certificates.
- ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- iii) List of manufacturing facilities available.
- iv) Level 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) Special features provided in the equipment to make it maintenance free.

List of testing equipment available with the Bidder for final testing of equipment 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.

SECTION – II

Dry type Air Core Reactor

SPECIFIC TECHNICAL REQUIREMENTS**2.1 SCOPE:**

2.1.1 This section covers the specific technical particulars, climatic and Isoceraunic conditions and system particulars suiting with the Dry Type Air Core Reactor supported by BPI & mounted on structure which shall be offered as per the "General Technical Requirements" given in Clause 2.3

2.2 CLIMATIC & ISOCERAUNIC CONDITIONS :

2.2.1 The climatic conditions at site under which the equipment shall operate satisfactorily are as follows :-

a)	Maximum ambient temperature of the air in Shade (°C)	50
b)	Minimum ambient temperature of the air in Shade (°C)	04
c)	Maximum daily average ambient temperature (°C)	40
d)	Maximum yearly average ambient temperature (°C)	35
e)	Maximum relative humidity (%)	95
f)	Average number of thunder-storm days per annum	15
g)	Average annual rainfall (Cm)	115
h)	Maximum wind pressure (kg/m ²)	150
i)	Earthquake acceleration (g)	0.08 X 2
j)	Height above mean sea level (m)	Not exceeding 1000

2.2.2 The equipment offered shall be suitable for continuous operation at the full rated capacity under the above conditions. Since the sub-stations are likely to be near the Sea shore or in an industrial area, the equipment offered shall be suitable for heavily polluted atmosphere.

2.3 TYPE AND RATING :

2.3.1 Air Core Series Reactor (Single Phase):

Sr No.	Particular	11 kV			22 kV	132 kV	
1	Rated (KVAR)	72.11	60	36	96	4	8
2	HSV (kV)	12	12	12	24	145	145
3	Type	Air Cored, AN Cooled (Aluminum Wound)					
4	Rated Continuous Current (Amps)	164.34	138	94.5	109.56	23.9	47.8
5	Frequency	50 Hz					
6	Short circuit level	16 times of 130% rated continuous current bank for 2 Sec.					
7	Thermal Class of Insulation	Class-F					
8	BIL	12kV/28kVrms/75kVp			24kV/55kVrms/125kVp	145kV/275kVrms/650kVp	
9	Reactance per phase (Ω/ph)	2.66	3.2	4.031	7.99	6.99	3.49
10	Inductance(mH)	8.47	10.19	12.83	25.44	22.28	11.14

2.3.2 Porcelain Bus Post Insulator

Sr. No.	Description	Unit	Solid core post insulator			
			11 kV	22 kV	66 kV	132 kV
01	02	03	04	05	06	07
01	Highest system voltage	KV	12	24	72.5	145
02	Height of unit	mm	215 ± 1	305±1	770 ± 1	1500±2.5
03	Bending strength (approximate failing load): a) Upright	Kgf	407	407	400	600
04	Tensile strength (Approximate)	Kgf	1427	2039	3500	7000
05	Compression strength (Approximate)	Kgf	2855	4078	7000	14000
06	Torsion strength (Approximate)	KgfM.	61.18	81.58	200	300

07	a)	Power frequency flashover voltage (dry)	KV	--	--	180	275
	b)	-do- (wet)	KV	--	--	155	275
08	a)	Impulse flashover voltage (Positive)	KV	--	--	355	650
	b)	-do- (Negative)	KV	--	--	405	650
09	a)	One-minute power frequency withstands voltage (dry)	KV	35	55	165	275
	b)	-do- (wet)	KV	35	55	140	275
10		Impulse positive/negative withstand voltage	KV	75	125	350	650
11		Power frequency puncture voltage	KV	Puncture proof	Puncture proof	Puncture proof	Puncture proof
12		Visible Discharge	KV	105	53	18	9
13		Creepage distance (Approximate)	mm	300	600	1815	3625
14		Top metal fitting PCD	mm	76	76	127 ± 0.2	4 holes of M16 PCD = 127
16		Bottom metal fitting PCD	mm	76	76	127 ± 0.2	4 holes of M18 and PCD = 225
17		All ferrous part should be hot dip galvanized to IS:2629/1966		Yes	Yes	Yes	Yes
18		Suitable for Hot line washing		Yes	Yes	Yes	Yes
19		Nuts & bolts Size		M12	M12	M16	M16

2.3.3 EARTHQUAKE & WIND DESIGN LOADS:

Each equipment including its structures shall be designed to withstand repeated earthquake acceleration of 0.8 x 2 g and wind loads of 100 Kg/m² on the projected area (non-simultaneous) without damage to component parts and without impairment of operation.

BIDDER SCHEDULES
SCHEDULE A
GUARANTEED TECHNICAL PARTICULARS FOR SERIES REACTORS
(To be filled in, signed and guaranteed by the Bidders)

Sr No.	GTP Points	11 kV	22 kV	66 kV	132 kV
1	Manufacturer's name.				
2	Manufacturer's type, designation.				
3	Reference Standard.				
4	Rated line voltage (KV)				
5	No. of phases.				
6	Rated frequency.				
7	Reactance/Phase (Ohms)				
8	Choke Voltage/Phase (Volts)				
9	Rated continuous current.				
10	Rated KVAR				
11	Losses at Rated continuous current and at 75°C (KW)				
12	Maximum permissible continuous current.				
13	Temperature rises over ambient specified.				
14	Basic Insulation Levels :				
	a) Impulse withstand voltage. (1.2/50 Micro Second Wave)				
	b) 1-Minute Power frequency withstand voltage dry & wet.				
15	Rated Short time current.(2 seconds KA (rms)				
16	Bushings: Type, make & Test Voltages.				
17	Terminal arrangement.				
18	Overall Dimension (Ht X Dia)				
19	Total weight				
20	Primary Winding Material				
21	Cross section area of Primary Winding(mm ²)				
22	Insulation Class				

SCHEDULE - A
SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS
FOR 145/72.5/24/12 kV POST INSULATORS
(To be filled in and signed by the Tenderer)

Sr. No.	Description	Unit	Guaranteed. Value
1	Highest system voltage	kV	
2	Height of unit	mm	
3	Bending strength (approx. failing load): i) Upright	kN	
4	Tensile strength (Approx.)	kN	
5	Compression strength (Approx.)	kN	
6	Torsional strength (Approx.)	kN	
7	a) Power frequency flashover voltage (Dry) b) Power frequency flashover voltage (Wet)	kV	
8	a) Impulse flashover voltage (Positive) b) Impulse flashover voltage (Negative)	kVp kVp	
9	a) 1 min. power frequency withstand voltage (Dry) b) 1 min. power frequency withstand voltage (Wet)	kV (rms)	
10	Lightning Impulse positive / negative withstand voltage.	kVp	
11	Power frequency puncture voltage.	kV	
12	Visible discharge voltage	kV	
13	Radio Interference Voltage	Micro Volts	
14	Creepage distance (Minimum) : a) Total b) Protected	mm mm	
15	Dry Arcing distance (Minimum)	mm	
16	Top metal fitting PCD	mm	
17	Bottom metal fitting PCD	mm	
18	All ferrous parts should be hot dip galvanized to IS:No.2629/1966.	--	YES / NO

Date: