



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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TYPE OF DOC.	TECHNICAL SPECIFICATION			NAME	SK	SK	RS/DM
TITLE 765/400/132/66/54/52/33kV CLAMPS AND CONNECTORS				SIGN	<i>SK</i>	<i>SK</i>	<i>[Signature]</i>
				DATE	10.05.18	11/05/18	15/05/18
				GROUP	TBEM	W.O. No	86009
CUSTOMER	Tamilnadu Transmission Corporation Limited (TANTRANSCO)						
PROJECTS	765/400kV AIS S/S Ariyalur						

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	Attachment:	
	Check list for TE	01

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
				Distribution	TBMM	TBQM	TBCM	TBTS
				Copies	-	-	01	-

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CHECKLIST FOR TECHNICAL EVALUATION

Along with the Technical Bids of the offers, the Bidder should submit this checklist confirming the inclusion of the enclosures as listed below. (Shall tick as ✓)

Sr No	Documents to be enclosed	Bidder to check & confirm
1	Copy of Unpriced BOQ as enclosed in the Technical Specification to confirm that bidder has quoted as per BOQ OF SECTION-1	
2.	Schedule of Technical Deviation format duly signed.	
3.	Supporting documents as asked in the Technical requirements (if applicable as per tender requirements)	
4.	Checklist of Technical parameters as per Section-5 duly filled and signed.	
5.	Compliance to Technical Specification	

NOTE:- If the Bidder fails to submit any of the documents as asked in the above check list, their bid is likely to be rejected / not evaluated.

The above checklist is verified for:-

NIT Ref No. :

Name of Equipment :

Name of Project :

Name of Bidder :

Signed with Seal of Bidder.

Date

SECTION-1**SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & BILL OF QUANTITIES****1.1 SCOPE-**

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of Clamps & Connectors to site.

This section covers the scope, quantities, Specific Technical Requirements for Clamps & Connectors as specified by the customer (TANTRANSCO). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The equipment is required for the following project:

Name of the Customer : **Tamilnadu Transmission Corporation Limited (TANTRANSCO)**

Name of the Project : **765/400kV AIS S/S Ariyalur**

This specification comprises of following sections:

Section-1: Scope, specific technical requirements & Bill of Quantities.

Section-2: Equipment specifications

Section-3: General technical requirements for all equipment's under the project.

Section-4: Guaranteed Technical Particulars (to be filled at contract stage)

Section-5: Checklist (to be filled during tender stage.)

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

The scope of supplies shall be as per commercial terms and conditions enclosed separately with the enquiry.

1.2 SPECIFIC TECHNICAL REQUIREMENTS –

Specific technical requirements like rated voltage, rated current, conductor details, tube details and type of connectors etc. are given in enclosed Annexure-1A and Annexure-1B (Bill of Quantities for Equipment connectors). Other technical requirements for the connectors shall be as follows:

Sl. no.	Technical Particulars	765kV	400kV	132kV	33/52/54/66kV
1.	Fault current level for 1 second	50kA	63 kA	40 kA	25 kA
2.	Corona extinction voltage	508kV	320kV	105kV	-
3.	Max. radio interference voltage for frequency between 0.5 MHz and 2	2500 micro -volt at 508kV rms	1000 micro -volt at 266kV rms	500 micro -volt at 92kV rms	-

4.	Sub conductor spacing	450mm for Bull AAC and 457mm for Hexa Zebra	450mm for ACSR Bersimis	NA	250mm for ACSR Bersimis
5.	Continuous Current	As per BOQ Annexure-1A	As per BOQ Annexure-1B		
6.	Frequency	50Hz			
7.	Applicable IS	5561 with latest amendment			
8.	Minimum thickness of any part of clamps and connector	12mm			
9.	Minimum thickness of current carrying parts of clamps and connector	16mm			
10.	Material				
(a)	Terminal Connector	A6 Aluminum Alloy and by pressure / gravity die cast only. Sand casted terminal connectors are not acceptable			
(b)	For connecting equipment terminals made of copper or brass to ACSR Conductor	The bimetallic strips / sleeve shall be 2 mm thick.			
(c)	For connecting GI	Galvanised mild steel shield wire			
(d)	Bolts, nuts and plain washers	All nuts, bolts & washers shall be of Hot Dip Galvanised mild steel			
(e)	Spring washers for items 'a' to 'c'	Electro galvanised mild steel suitable for at least service conditions-3 as per IS:1573			

Note- 1- The equipment's connector suitable for Aluminium tube shall be such design that projected part of Aluminium tube should be fully covered to avoid entry of birds inside Aluminium tube.

Note-2 - The exact terminal detail of equipment's (terminal type, material, fixing details) will be furnished during detailed engineering. Tentative details of equipment's terminal type are mentioned in annexure-1A and Annexure-1B.

Note-3 – Procedure of Corona & RIV Test (if conducted) shall be as per enclosed Annexure-A.

Note -4- For 500MVA Auto transformer, 80MVAR Reactor, Current transformer, and Isolator = Clamps and connector shall be supplied in line with requirements of section -1 and Annexure-2.

Note -5- The design of corona end bell (BOQ SL. NO. 20, connected at the end of 4.5" tube) and straight connector (BOQ sl. No. 16, connected at the end of 4.5" tube) of Annexure-1A shall be such that both should not be foul each other.

Note -6- The design of corona end bell (BOQ SL. NO. 42, connected at the end of 4.0" tube) and straight connector (BOQ sl. No. 36, connected at the end of 4.0" tube) of Annexure-1B shall be such that both should not be foul each other.

1.3 BILL OF QUANTITIES-

The quantities shall be as per the enclosed Annexure 1A and 1B.

Annexure-1A for 765kV Clamps and connectors

Annexure-1B for 400/132/66/54/52/33kV Clamps and connectors

The scope of supply shall also include:

- i) All connector hardware along with bimetallic washers / strip/liners as required.
- ii) All hardware required for connecting to the respective equipment terminals.
- iii) Minimum 5 % extra hardware and bimetallic washers/strips/liners of each type.

Note - Total quantity may vary upto $\pm 30\%$.

1.4 TYPE TESTING -

Bidder shall submit valid type test reports (As per relevant IEC/IS standard) for the tests carried out not before **30.09.2011**. The reports should have been conducted on identical or similar equipment/components to those offered. In case type test reports are before **30.09.2011** or the reports of type tests are found to be technically unacceptable, the type test shall be conducted by the vendor without cost and delivery implication to BHEL. The type test if conducted shall be witnessed by BHEL/Customer.

1.5 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 / customer's approval within 1 week of P.O. placement.

Annexure -1A(BOQ of 765kV clamps and connectors for Ariyalur S/s.)

Sl. No.	Tentative Equipment Terminal details	Description of clamps and connector	Unit of Qty.	Total Qty.
A		765 kV EQUIPMENT CONNECTORS		
1	Palm/Al	765kV , 3150A , 50kA for 1 Second Circuit Breaker, Expansion type connector suitable for 4.5" IPS Aluminium tube with horizontal approach	Nos.	105
2	Stud/CU	765kV , 3150A, 50kA for 1 Second Isolator , Rigid type connector suitable for 4.5" IPS Aluminium tube with horizontal approach- Fixed contact side(i.e. stem terminal)	Nos.	89
3	Palm/Al	765kV , 3150A, 50kA for 1 Second Isolator , Rigid type connector suitable for 4.5" IPS Aluminium tube with horizontal approach- Moving contact side(i.e. pad terminal)	Nos.	129
4	Stud/CU	765kV , 3150A, 50kA for 1 Second Isolator , Expansion type connector suitable for 4.5" IPS Aluminium tube with horizontal approach- Fixed contact side(i.e. stem terminal)	Nos.	33
5	Stud/CU	765kV , 3150A, 50kA for 1 Second Isolator , Rigid type connector suitable for Quad AAC Bull conductor with horizontal approach- Fixed contact side(i.e. stem terminal)	Nos.	19
6	Palm/Al	765kV , 3150A, 50kA for 1 Second Isolator , Rigid type connector suitable for Quad AAC Bull conductor with horizontal approach- Moving contact side(i.e. pad terminal)	Nos.	9
7	Palm/CU	765kV , 3150A, 50kA for 1 Second Current Transformer , Rigid type connector suitable for 4.5" IPS Aluminium tube with horizontal approach	Nos.	81
8	Palm/CU	765kV , 3150A, 50kA for 1 Second Current Transformer , Expansion type connector suitable for 4.5" IPS Aluminium tube with horizontal approach	Nos.	57
9	Palm/Al	765kV , 50kA for 1 Second Capacitor Voltage Transformer , Rigid type connector suitable for Quad AAC Bull conductor with horizontal approach	Nos.	21
10	Palm/Maleable cast iron	765kV , 50kA for 1 Second bus post insulator , through sliding type connector suitable for 4.5" IPS Al tube with horizontal approach	Nos.	119
11	Palm/Maleable cast iron	765kV , 50kA for 1 Second bus post insulator , Rigid through type connector suitable for 4.5" IPS Al tube with horizontal approach	Nos.	15
12	Palm/Maleable cast iron	765kV , 3150A, 50kA for 1 Second , bus post insulator , Rigid /Expansion type connector suitable for 4.5" IPS Al tube with horizontal approach	Nos.	39
13	Palm/CU	765kV , 2000A, 50kA for 1 Second 500MVA Auto transformer HV bushing , Rigid type connector suitable for Quad AAC Bull conductor with horizontal approach	Nos.	9
14	Stud/CU	765kV , 2000A, 50kA for 1 Second 80MVAR Reactor HV bushing , Rigid type connector suitable for Quad AAC Bull conductor with horizontal approach	Nos.	21

Sam/llm

Annexure -1A(BOQ of 765kV clamps and connectors for Ariyalur S/s.)

Sl. No.	Tentative Equipment Terminal details	Description of clamps and connector	Unit of Qty.	Total Qty.
B		Two way PG Clamps /Tee/Welding sleeves and Spacers		
15		765kV, 3150A, Tee connector suitable for 4.5" tube run and Quad Bull AAC tap	Nos.	126
16		765kV , 3150A, straight connector suitable for 4.5" IPS Al tube and Quad Bull AAC Conductor in horizontal approach	Nos.	72
17		765kV,3150A, Tee connector suitable for Quad Bull AAC run and Quad Bull AAC tap	Nos.	51
18		765kV ,3150A, Tee connector suitable for Hexa Zebra run and Quad Bull AAC tap	Nos.	26
19		765kV,1000A, Two way PG clamp for single Bull AAC conductor	Nos.	51
20		765kV Corona end bell for 4.5" IPS Al. tube	Nos.	135
21		765kV flexible spacers suitable for Quad Bull AAC conductor	Nos.	807
22		765kV Rigid spacers suitable for Quad Bull AAC conductor	Nos.	536
23		765kV AL welding sleeve for 4.5 " Al tube	Nos.	168
24		765kV Corona end cap for 4.5" IPS Al. tube	Nos.	35
Conductor /Tube Size				
1		3.0" standard IPS Al Tube(Outer diameter =88.90mm, thickness 7.62mm), Tolerance in O.D. +2.2/ -0.0mm, Tolerance in thickness +2.2/ -0.0mm		
2		4" standard IPS Al Tube(Outer diameter =114.2mm, thickness 8.51mm), Tolerance in O.D. +2.2/ -0.0mm, Tolerance in thickness +2.2/ -0.0mm		
3		4.5" standard IPS Al Tube(Outer diameter =120mm, thickness 12.0mm), Tolerance in O.D. +1.5/ -0.0mm, Tolerance in thickness +1.0/ -0.0mm		
4		Bull AAC conductor (Overall diameter=38.25mm)		
5		ACSR Moose conductor (Overall diameter=31.77mm)		
6		ACSR Bersimis conductor (Overall diameter=35.05mm)		
7		ACSR Zebra conductor (Overall diameter=28.62mm)		
		Notes:		
1		The sub-conductor spacing for 765kV Bull AAC conductor is 450mm.		
2		The sub-conductor spacing for 765kV Hexa Zebra conductor is 457mm.		
3		The sub-conductor spacing for 400kV Bersimis ACSR conductor is 450mm.		
4		The sub-conductor spacing for 33kV / 66kV Bersimis conductor is 250mm.		
5		Bimetallic connectors shall be offered wherever dis-similar materials are coming into contact as detailed above.		
6		Rigid /Expansion =Expansion type on one side and Rigid type on other side (With Tube break, Continuity should be made by suitable arrangement and same shall be part of connector)		

Annexure -1B(BOQ of 400/132/66/54/52/33kV clamps and connectors for Ariyalur S/s.)

Sl. No.	Tentative Equipment Terminal details	Description of clamps and connector	Unit of Qty.	Total Qty.
A		400kV EQUIPMENT CONNECTORS		
1	Palm/Al	400kV , 3150A , 63kA for 1 Second Circuit Breaker, Expansion type connector suitable for 4" IPS Aluminium tube with horizontal approach	Nos.	81
2	Palm/Al	400kV , 3150A, 63kA for 1 Second Isolator , Rigid type connector suitable for 4" IPS Aluminium tube with horizontal approach	Nos.	131
3	Palm/Al	400kV , 3150A, 63kA for 1 Second Isolator , Expansion type connector suitable for 4" IPS Aluminium tube with horizontal approach	Nos.	39
4	Palm/Al	400kV , 3150A, 63kA for 1 Second Isolator , Rigid type connector suitable for Quad ACSR Bersimis conductotr with horizontal approach	Nos.	67
5	Palm/Al	400kV , 2000, 63kA for 1 Second Isolator , Rigid type connector suitable for twin ACSR Bersimis conductotr with horizontal approach	Nos.	15
6	Stud/CU	400kV , 3150A, 63kA for 1 Second Current Transformer, Rigid type connector suitable for 4" IPS Aluminium tube with horizontal approach	Nos.	57
7	Stud/CU	400kV , 3150A, 63kA for 1 Second Current Transformer, Expansion type connector suitable for 4" IPS Aluminium tube with horizontal approach	Nos.	57
8	Stud / M.S.E.T Rod	400kV ,63kA for 1 Second Capacitor Voltage Transformer , Rigid type connector suitable for twin ACSR Bersimis conductotr with horizontal approach	Nos.	27
9	Palm/Maleable cast iron	400kV , 63kA for 1 Second bus post insulator , through sliding type connector suitable for 4" IPS Al tube with horizontal approach	Nos.	23
10	Palm/Maleable cast iron	400kV , 63kA for 1 Second bus post insulator , Rigid through type connector suitable for twin ACSR Bersimis conductotr with horizontal approach	Nos.	21
11	Palm/Maleable cast iron	400kV ,3150A, 63kA for 1 Second bus post insulator ,Rigid/Expansion type connector suitable for 4" IPS Al tube with horizontal approach	Nos.	27
12	Stud/CU	400kV , 2500A, 63kA for 1 Second 500MVA Auto transformer IV bushing , Rigid type connector suitable for 4" IPS Aluminium tube with horizontal approach	Nos.	9
B		132/54/52/36/33kV EQUIPMENT CONNECTORS		
13	Stud/CU	132kV , 1250A, 40kA for 1 Second 80MVAR Reactor Neutral bushing , Rigid type connector suitable for single AAC Bull conductor with horizontal approach	Nos.	21
14	Palm/Al	132kV , 1250A, 40kA for 1 Second NGR Neutral bushing (towards LA side) , Rigid type connector suitable for single AAC Bull conductor with horizontal approach	Nos.	9

Annexure -1B(BOQ of 400/132/66/54/52/33kV clamps and connectors for Ariyalur S/s.)

Sl. No.	Tentative Equipment Terminal details	Description of clamps and connector	Unit of Qty.	Total Qty.
15	Palm/Al	132kV , 1250A, 40kA for 1 Second NGR Neutral bushing (towards CT side) , Rigid type connector suitable for single AAC Bull conductor with horizontal approach	Nos.	9
16	Stud/CU	33kV , 1250A, 25kA for 1 Second neutral current transformer of NGR , Rigid type connector suitable for single AAC Bull conductor with horizontal approach	Nos.	9
17	Stud/CU	33kV , 1250A, 25kA for 1 Second neutral current transformer of NGR , Rigid type connector suitable for single 75X12 mm MS flat with horizontal approach	Nos.	9
18	Stud/CU	33kV , 1250A, 25kA for 1 Second neutral current transformer of 500MVA Auto transformer , Rigid type connector suitable for twin ACSR Bersimis conductotr with horizontal approachh	Nos.	5
19	Stud/CU	33kV , 1250A, 25kA for 1 Second neutral current transformer of 500MVA Auto transformer , Rigid type connector suitable for single 75X12 mm MS flat with horizontal approach	Nos.	5
20	Palm/Al	132kV , 1250A, 31.5kA for 1 Second Circuit breaker , Expansion type connector suitable for 3" IPS Aluminium tube with horizontal approach	Nos.	15
21	Palm/Maleable cast iron	132kV , 40kA for 1 Second bus post insulator , through sliding type connector suitable for 3" IPS Al tube with horizontal approach	Nos.	9
22	Palm/Maleable cast iron	132kV , 40kA for 1 Second bus post insulator , Rigid through type connector suitable for 3" IPS Al tube with horizontal approach	Nos.	21
23	Palm/Maleable cast iron	132kV , 1250A, 40kA for 1 Second bus post insulator , Rigid /Expansion type connector suitable for 3" IPS Al tube with horizontal approach	Nos.	33
24	Stud/CU	52kV , 1250A, 25kA for 1 Second 500MVA Auto transformer LV bushing , Rigid type connector suitable for 3" IPS Aluminium tube with horizontal approach	Nos.	15
25	Palm/Brass	36kV , 1250A, 25kA for 1 Second 500MVA Auto transformer Neutral bushing , Rigid type connector suitable for 3" IPS Aluminium tube with horizontal approach	Nos.	9
26	Palm/MS	54kV , 25kA for 1 Second Surge Arrester , Rigid type connector suitable for single ACSR Bersimis conductotr with horizontal approachh	Nos.	15
27	Palm/Maleable cast iron	66kV , 25kA for 1 Second bus post insulator , through sliding type connector suitable for 3" IPS Al tube with horizontal approach	Nos.	21
28	Palm/Maleable cast iron	66kV , 25kA for 1 Second bus post insulator , Rigid through type connector suitable for 3" IPS Al tube with horizontal approach	Nos.	9
29	Palm/Maleable cast iron	66kV , 1250A, 25kA for 1 Second bus post insulator ,Rigid /Expansion type connector suitable for 3" IPS Al tube with horizontal approach	Nos.	45
30	Palm/Maleable cast iron	33kV , 25kA for 1 Second bus post insulator , through sliding type connector suitable for 3" IPS Al tube with horizontal approach	Nos.	11
31	Palm/Maleable cast iron	33kV , 25kA for 1 Second bus post insulator , Rigid through type connector suitable for 3" IPS Al tube with horizontal approach	Nos.	5

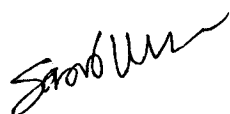
Annexure -1B(BOQ of 400/132/66/54/52/33kV clamps and connectors for Ariyalur S/s.)

Sl. No.	Tentative Equipment Terminal details	Description of clamps and connector	Unit of Qty.	Total Qty.
32	Palm/Maleable cast iron	33kV , 1250A, 25kA for 1 Second bus post insulator , Rigid /Expansion type connector suitable for 3" IPS Al tube with horizontal approach	Nos.	23
33	Palm/Maleable cast iron	33kV , 25kA for 1 Second Bus post insulator , Rigid through type connector suitable for single 75X12 mm MS flat with horizontal approach	Nos.	19
C		Two way PG Clamps /Tee/Welding sleeves and Spacers		
34		400kV, 3150A, Tee connector suitable for 4" tube run and Quad ACSR Bersimis tap	Nos.	26
35		400kV, 2000A, Tee connector suitable for 4" tube run and twin ACSR Bersimis tap	Nos.	7
36		400kV , 3150A, straight connector suitable for 4" IPS Al tube and Quad ACSR Bersimis Conductor in horizontal approach	Nos.	21
37		400kV, 3150A, Tee connector suitable for Quad ACSR Bersimis run and Quad ACSR Bersimis tap	Nos.	51
38		400kV, 3150A, Tee connector suitable for Quad ACSR moose run and Quad ACSR Bersimis tap	Nos.	19
39		400kV, 2000A, Tee connector suitable for Quad ACSR moose run and twin ACSR Bersimis tap	Nos.	19
40		400kV,1000A, Two way PG clamp for single ACSR Bersimis conductor	Nos.	38
41		400kV, 2000A, Tee connector suitable for Quad ACSR Bersimis run and twin ACSR Bersimis tap	Nos.	7
42		400kV Corona end bell for 4" IPS Al. tube	Nos.	21
43		400kV flexible spacers suitable for Quad ACSR Bersimis conductor	Nos.	649
44		400kV Rigid spacers suitable for Quad ACSR Bersimis conductor	Nos.	315
45		400kV Rigid spacers suitable for twin ACSR Bersimis conductor	Nos.	120
46		400kV AL welding sleeve for 4 " Al tube	Nos.	126
47		132kV, 1250A, Tee connector suitable for 3" tube run and single AAC Bull tap	Nos.	38
48		132kV, 1250A, Tee connector suitable for single AAC Bull run and single AAC Bull tap	Nos.	13
49		132kV Corona end bell for 3" IPS Al. tube	Nos.	26
50		132kV AL welding sleeve for 3 " Al tube	Nos.	32
51		66kV, 1250A, Tee connector suitable for 3" tube run and single ACSR Bersimis tap	Nos.	13
52		66kV, 1250A, Tee connector suitable for 3" tube run and twin ACSR Bersimis tap	Nos.	26
53		66kV Rigid spacers suitable for twin ACSR Bersimis conductor	Nos.	19
54		66kV Corona end bell for 3" IPS Al. tube	Nos.	26
55		66kV AL welding sleeve for 3 " Al tube	Nos.	51
56		33kV, 1250A, Tee connector suitable for 3" tube run and twin ACSR Bersimis tap	Nos.	15
57		33kV Corona end bell for 3" IPS Al. tube	Nos.	11
58		33kV AL welding sleeve for 3 " Al tube	Nos.	24

Signature

Annexure -1B(BOQ of 400/132/66/54/52/33kV clamps and connectors for Ariyalur S/s.)

Sl. No.	Tentative Equipment Terminal details	Description of clamps and connector	Unit of Qty.	Total Qty.
59		Tension clamps for 7/3.66mm(10.98mm dia) GI Wire	Nos.	178
60		Two way PG clamps for 7/3.66mm(10.98mm dia) GI Wire	Nos.	108
61		For connecting 7/3.66mm(10.98mm dia) GI Wire on one side and 75x12 mm MS flat on other side	Nos.	105
62		Structure clamps for 75X 12 mm MS flat on Lattice type structure	Nos.	8370
63		Structure clamps for 50x8 mm MS flat on Lattice type structure	Nos.	1270
64		400kV Corona end cap for 4" IPS Al. tube	Nos.	20
Conductor /Tube Size				
1		3.0" standard IPS Al Tube(Outer diameter =88.90mm, thickness 7.62mm), Tolerance in O.D. +2.2/ -0.0mm, Tolerance in thickness +2.2/ -0.0mm		
2		4" standard IPS Al Tube(Outer diameter =114.2mm, thickness 8.51mm), Tolerance in O.D. +2.2/ -0.0mm, Tolerance in thickness +2.2/ -0.0mm		
3		4.5" standard IPS Al Tube(Outer diameter =120mm, thickness 12.0mm), Tolerance in O.D. +1.5/ -0.0mm, Tolerance in thickness +1.0/ -0.0mm		
4		Bull AAC conductor (Overall diameter=38.25mm)		
5		ACSR Moose conductor (Overall diameter=31.77mm)		
6		ACSR Bersimis conductor (Overall diameter=35.05mm)		
7		ACSR Zebra conductor (Overall diameter=28.62mm)		
		Notes:		
1		The sub-conductor spacing for 765kV Bull AAC conductor is 450mm.		
2		The sub-conductor spacing for 765kV Hexa Zebra conductor is 457mm.		
3		The sub-conductor spacing for 400kV Bersimis ACSR conductor is 450mm.		
4		The sub-conductor spacing for 33kV / 66kV Bersimis conductor is 250mm.		
5		Bimetallic connectors shall be offered wherever dis-similar materials are coming into contact as detailed above.		
6		Rigid /Expansion =Expansion type on one side and Rigid type on other side (With Tube break, Continuity should be made by suitable arrangement and same shall be part of connector)		



- i) Bushing terminals on HV and IV sides, shall be out door type provided with * clamping arrangement and suitable bi-metallic sleeves to receive Quad AAC Bull with adequate spacing.
- ii) Bushing terminals on LV side shall be provided with clamping arrangement * and suitable bimetallic sleeves to receive Quad Besimis conductor with adequate spacing. The clamp shall be such that the conductor takes off from the bushings vertically.
- iii) The connectors shall be designed for minimum 120% of the maximum current carrying capacity of the conductor and the temperature rise under any condition shall not be more than 50% of that in the main conductor. ||
- iv) All the terminal connectors shall conform to IS:5561 of latest issue.
- v) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- vi) All ferrous parts shall be hot dip galvanised conforming to IS:2633. For bimetallic clamps copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminium body.
- vii) Size of the terminal/conductor for which the clamp/connector is suitable shall be embossed/punched on each clamp/connector.
- viii) Neutral bushing terminal shall be suitable to receive 3" Aluminium Bus with insulators up to ground level. Necessary outdoor type porcelain insulators, GI flats and bi-metallic sleeves shall also be supplied.

37.0 Oil Syringe

* FOR CONDUCTOR DETAILS
REFER BOR

The glass syringe and three way stop cock valve shall meet the following specification. The tentative dimensions are given below

Volume 50 ml } 1.5 %

Piston outside diameter 27.45 } 0.20 mm

Barrel Diameter (OD) 32.35 } 0.55 mm

Barrel Diameter (OD) 44.00 } 0.75 mm

Barrel Diameter (OD) 34.05 } 0.65 mm

Length (L) 178.00 mm } 0.50 mm

Dimensions

Increment 2.0 ml

The syringe shall be made from Heat resistant borosilicate Glass

The material and construction should be resistant to breakage from shock and sudden temperature changes.

Control Box : 220V DC

Fire extinguishing cubicle for lighting : 230 V AC

CONDITIONS FOR NIPPS GIVEN ANNEXURE-B

42.0 TERMINAL CONNECTORS

i) Bushing terminals on HV and IV sides, shall be out door type provided with clamping arrangement and suitable bi-metallic sleeves to receive Quad AAC Bull with adequate spacing.

ii) Bushing terminals on LV side shall be provided with clamping arrangement and suitable bimetallic sleeves to receive Quad Besimis conductor with adequate spacing. The clamp shall be such that the conductor takes off from the bushings vertically.

iii) The connectors shall be designed for minimum 120% of the maximum current carrying capacity of the conductor and the temperature rise under any condition shall not be more than 50% of that in the main conductor.

iv) All the terminal connectors shall conform to IS:5561 of latest issue.

v) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

vi) All ferrous parts shall be hot dip galvanised conforming to IS:2633. For bimetallic clamps copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminium body.

vii) Size of the terminal/conductor for which the clamp/connector is suitable shall be embossed/punched on each clamp/connector.

viii) Neutral bushing terminal shall be suitable to receive 3" Aluminium Bus with insulators up to ground level. Necessary outdoor type porcelain insulators, GI flats and bi-metallic sleeves shall also be supplied.

43.0 Technical Parameters

43.1 The parameters pertaining to the shunt reactor and neutral grounding

Reactor furnished under this specification are listed below:

43.2 Shunt Reactor 80 MVAR single phase at $765/\sqrt{3}$ kV

43.3 a) Rated Voltage (U_n) $765/\sqrt{3}$ kV

b) Maximum continuous operating voltage (U_m) $800/\sqrt{3}$ kV

43.4 Connection (3 phase) Star with neutral brought out

4.11. EARTHING:

Metal tank of Current Transformer shall be provided with 2 Nos. separate earthing terminals for bolted connection to 65 x 10 mm MS flat for connection to station earth-mat.

4.12. LIFTING ARRANGEMENTS:

Current Transformers shall be provided with suitable lifting arrangement to the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawing. Lifting arrangement (lifting eye) shall be positioned in such a way so as to avoid any damage to the porcelain housing or the tanks during lifting for installation/transport. Necessary string guides supplied shall be of removable type.

4.13. NAME PLATE:

The Current Transformer shall be provided with, legible name plate with the information specified in relevant standards, duly engraved/punched on it, including the capacitance and tan delta value.

4.14. TERMINAL CONNECTOR:

The Terminal Connectors (TC) required for connection of the Current Transformer is 4.5" Aluminium bus bar for 800KV CT and 4" Aluminium bus bar for 420 KV CT.

4.14.1 The Terminal Connectors shall meet the following requirements

- (i) Terminal connectors shall be manufactured and tested as per IS-5561.
- (ii) All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- (iii) No part of a clamp shall be less than 16mm thick
- (iv) All Ferrous parts shall be galvanized conforming to IS-2633
- (v) For bimetallic connectors, copper alloy liner of minimum thickness of 2mm shall be provided.
- (vi) Flexible connectors if used shall be made from tinned copper.
- (vii) All current carrying parts shall be designed and manufactured to have minimum contact resistance and the required current density.

(viii) Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS: 5561. The sharp edges shall be rounded off.

4.15. Enamel, if used for conductor insulation shall be either polyvinyl acetate type or amide type and shall meet the requirement of IS: 4800. polyester enamel shall not be used.

4.16. The temperature rise on any part of equipment shall not exceed the maximum temperature rise specified below under the conditions specified in test clauses. The permissible temperature rise indicated is for a maximum ambient temperature of 50°C.

Sl.No	Nature of the part or of the Liquid	Temperature	Maximum value of Temp. rise at a max. ambient air temp. not exceeding 50°C
01	Contacts in air, silver-faced copper, copper alloy or aluminium alloy (see Notes (i) & (ii))	105	55
	Bare copper or Tinned aluminium alloy	75	25
02.	Contacts in oil.		
	Silver -faced copper, copper alloy or aluminium alloy (see Note -ii)	90	40
	Bare copper or tinned aluminium alloy.	80	30
03.	Terminals to be connected to external conductors by screws or bolts silver-faced (see note-iii).	105	55
	Bare copper or Tinned aluminium alloy.	90	40
04.	Metal parts acting as springs	See note-iv	See note-iv
05.	Metal parts in contact with insulation of the following classes.		
	Class-Y : (For Non-impregnated materials)	90	40
	Class-A: (For materials immersed in oil or impregnated)	100	50
	Class-E: In Air	120	70
	In oil	100	50
		130	80

etc. for mounting the switch and for operation from ground shall be included. Rotating insulator base should be provided with tapered roller bearings of suitable capacity with suitable lubricating facility. The composite frame of the base shall be made of minimum size of 125 x 65 x 8 mm. Bottom PCD holes shall match

a) For 800 kV Insulator: (For Isolator)

Top PCD = 225 mm

No. of holes = 4 x 18mm dia.

Bottom PCD = 356 mm

No. of holes = 8 x 18mm dia.

b) For 420 kV Insulator: (For Isolator)

Top PCD = 127 mm

No. of holes = 4 x M16

Bottom PCD = 300 mm

No. of holes = 8 x 18 dia

5.2 INSULATORS: Insulator required for the switches is included in the scope of supply.

6.0 POWER TERMINAL CONNECTORS :

Clamp type terminal connectors shall be supplied and bolted to the terminals of the switches. They shall be hot tinned to prevent corrosion when connected to Aluminum bus. The clamps should be made entirely of non-ferrous parts non-magnetic steel. The terminal connectors to be supplied shall conform to IS 5561 of latest issue and suitable to receive Quad AAC Bull or / 4.5" Aluminium Bus Bar Rigid/ expansion type as per site requirements for 800 KV & for 420 KV terminal connectors suitable to receive 4" Aluminium busbar & Quad Bersimis conductor as per site condition. All power connectors should be corona free irrespective of voltage level.

7.0 TERMINAL PADS :

The terminal pads shall be hard drawn electrolytic copper flats. All electrical parts should be of adequate cross section to handle the designed rated current safely.

4.10 Clamps and connectors shall be designed to be corona controlled.

5.0 Tests

5.1 Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for approval ~~as per clause 9.2 above~~ except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable).

- i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)
- ii) Short time current test
- iii) Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)
- iv) Resistance test and tensile test

ANNEXURE-A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132kV above.

2. Test Levels: The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3. Test Methods for RIV:

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765kV, 400 kV, 220 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4. Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of

connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.

4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5. Test Records:

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.
- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

SECTION - 02

POWER / TERMINAL CONNECTORS

1.0. SCOPE :

The Power Connectors are for use in outdoor sub-stations in TAMILNADU.

2.0. CODES AND STANDARDS :

- 2.1. The power connectors should conform to IS 5561-1970 for the latest issue.
- 2.2. All materials used shall conform to the relevant Indian Standards.
- 2.3. The Aluminium alloys used in the manufacture of the connectors shall conform to designation A6 of IS 617-1975.
- 2.4. Conductor the bimetallic connector made from Aluminium Alloy Wherever for connecting equipment terminal made of copper or brass to ACSR casting shall be provided with bimetallic Strip.
- 2.5.1. All bolts and nuts shall have hexagonal heads.
- 2.5.2. All Bolts and Nuts shall be of stainless steel conforming to ISS 1570-304 quality.

2.5.3 The design of clamp shall be to our approval. The details of current take off as required by us shall be detailed out in drawing and shall be submitted along with the bid. In respect of the terminal connectors following should be ensured:-

- (a) The terminal connector should be made of A6 Aluminum Alloy and by pressure / gravity die cast only. Sand casted terminal connectors are not acceptable.
- (b) All castings shall be free from blow holes, surface blisters, cracks and Cavities. All sharp edges should be rounded off.
- (c) No part of clamp shall be less than 12 mm thick.
- (d) The bimetallic strips / sleeve shall be 2 mm thick.
- (e) All nuts, bolts & washers shall be of Hot Dip Galvanised mild steel.
- (f) The conductor should be tightened by six bolts. Conductor hold length must not be less than 100 mm.
- (g) The surface of clamps to be tightened by six bolts should be flat in shape so that it may be possible to open the nuts and bolts by normal flat spanners. Therefore, any type of groove in the clamp body for fixing of nuts should be avoided.
- (h) The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction, at both the sides, so that holding of clamp by throttling action of current may be avoided.
- (i) Space of at least 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.
- (j) All current carrying parts shall be designed and manufactured to have minimum contacts resistance.
- (k) The clamp for Twin Moose ACSR Conductor shall be in three pieces so that each conductor may be tightened separately.
- (l) Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamps except hardware

(m) All the power connectors should be corona free and type tested for RIV irrespective of voltage level.

3.0. RATING :

- 3.1. The rated current of Power Connectors shall be generally 3000 A and for switch end clamps 3000 A.
 - 3.2. The rated frequency of Power Connectors shall be 50 Hz.
 - 3.3. The rated short time current shall be 63 KA (rms)/ 1 sec for 400KV system and 50.0. KA (rms) for 1 Second for 765 KV system.
- The rated Peak short circuit current shall be 2.5 times that of rated S.T.C.

4.0. REQUIREMENTS :

- 4.1. The power connectors surface shall be smooth and free from cavities, blow holes and such other defects which would be likely to cause them to be unsatisfactory in service also capable of preventing the built up of non conducting oxide.
- 4.2. The power connectors shall be so designed and proportioned that they are capable for safety withstanding stresses to which they may be subjected during erection, normal service, under short circuit and climate conditions and that the effects of vibration both on the conductor and the connector itself are minimized. They shall be designed, manufactured, and finished so as to avoid sharp radius of curvature, ridges and excrescences which might lead to localized pressure on or damage to the conductor in service.
- 4.3. Sufficient contact pressure should be maintained at the joint by the provision of required number of bolts or other fixing arrangements. But the contact pressure should not be so great so as to cause relaxation of the joint by cold flow. The joint should be such that the pressure is maintained within this range under all conditions of service. To avoid excessive local pressure, the contact pressure should be evenly distributed by the use of pressure plates, washers or suitable saddles of adequate area and thickness.
- 4.4. The Power Connectors shall be so designed that the joints runs cooler than the associated Bus Bar.
- 4.5. The Power Connectors shall have short and as far as possible direct current paths.
- 4.6. The Power Connectors shall avoid crevices where moisture can accumulate or through which corrosive atmospheres can penetrate.
- 4.7. All the current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 4.8. The thickness of any current carrying parts shall not be less than 16 mm.
- 4.9. The clamps and fitting shall be so designed that the post Insulators shall not be subjected to any abnormal stresses due to thermal change in conductor.
- 4.10. All the clamps and fittings shall be as short as possible.
- 4.11. Wherever possible there shall be two halves and no U Bolts shall be used.

5.0. LIMITS OF TEMPERATURE RISE :

5.1. The limits of temperature rise specified are based on the following reference ambient temperatures :

- a) Maximum ambient air temperature : 45 Degree C
- b) Maximum daily average ambient temp. : 35 Degree C
- c) Maximum yearly ambient temperature : 30 Degree C

5.2 The temperature rise of Power Connectors above a reference ambient temperature 40 Degree C when carrying rated current shall not exceed 45 Degree C.

6.0. PROTECTION AGAINST CORROSION :

All parts of Power Connectors shall either be inherently resistant to atmospheric corrosion or be suitably protected against corrosion, both during storage and in service.

7.0. TESTS AND TEST CERTIFICATES :

TYPE TESTS :

- 7.1. Tenderers are requested to furnish copy of type test certificates for the material/equipment of their make in full shape as conforming to relevant IS/IEC Standards of latest issue obtained from a Government/ Government recognised Laboratory . The above type test certificates should accompany the drawings of the material/equipments, duly signed under seal by the Institution who have issued the type test certificate.
- 7.2. The above type test certificates shall be furnished and get them approved before offering of the inspection of first lot of materials/equipments at no extra cost to TANTRANSCO and no relaxation to TANTRANSCO's Delivery Clause will be given on this account.
- 7.3. The above type test should have been conducted not earlier than five years (5 years) as on the date of submission. Non submission of above type test certificates within the stipulated time will entail cancellation of Purchase Order without any further reference to the supplier.
- 7.4. The original type test certificates shall be furnished for verification on request Type Test conducted:
 - a) Tensile Test
 - b) Resistance Tests
 - c) Temperature Rise Test
 - d) Short Time Current Test
 - e) Dimensions Check
 - f) RIV Test & Corona Test for all power connectors in respective of voltage rating.

7.6 Acceptance Tests :

- a) Tensile Test
- b) Resistance Tests
- c) Dimensions check
- d) Galvanising Test wherever applicable

7.7 Routine Tests :

- a) Visual Inspection and
- b) Dimensional check.

8.0 INSPECTION :

The accredited representatives of the Purchaser shall have access to the contractor's works at any time during the working hours for the purpose of inspecting the manufacturing of materials and for testing and may select samples from the materials. The contractors shall provide facilities for the above.

SECTION – 3

GENERAL TECHNICAL REQUIREMENTS

3.0 FOREWORD

The provisions under this section are intended to supplement general requirements for the materials, equipment's and services covered under other sections.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

- a) Customer : M/s Tamil Nadu Transmission Corporation Limited
- b) Project Title : 765/400KV AIS SUB STATION AT ARIYALUR
- c) Transport facilities : Road/Rail

Physical and other parameters:

3.1.1 Location of the substation

- 3.1.2 Nearest Railway station : Tindivanam
Railway : Southern Railway

3.1.3 Meteorological data

- | | |
|---|----------------|
| (i) Atmosphere | : Polluted |
| (ii) Maximum ambient temperature | : 50°C |
| (iii) Minimum ambient temperature | : 20°C |
| (iv) Maximum daily average ambient air temperature | : 45° C |
| (v) Maximum yearly average ambient air temperature | : 32° C |
| (vi) Maximum Humidity (%) | : 100% |
| (vii) Average thunder storm days per annum | : 50 |
| (viii) Average rainy days per annum | : 65 |
| (ix) Average annual rainfall (mm) | : 750 mm |
| (x) No. of months during which tropical monsoon condition prevail | : 3 |
| (xi) Maximum wind pressure | : 150 Kgf/Sqmm |
| (xii) Altitude above MSL | : <1000M |

(xii) Basic Wind Speed

: 39 m/s (Zone -2)

However for design purpose, ambient temperature should be considered as 50° C and relative humidity as 100%.

3.1.4 System Parameter

SL No	Description of parameters	765kV System	400 kV System
1.	System operating Voltage	765kV	400kV
2.	Maximum operating voltage of the system(rms)	800kV	420kV
3.	Rated Frequency	50HZ	50H
4.	Number of Phases	3	3
5.	Rated Insulation Levels (i)Full wave impulse withstand voltage.(1.2 to 50 micro sec) (ii)Switching impulse withstand voltage(250/2500 micro sec) dry and wet. (iii) One minute power frequency dry withstand voltage (rms)frequency dry withstand voltage (rms)	2100kVp 1550kVp 830kV	1550kVp 1050kVp 630kV
6.	Corona extinction voltage	508kV	320kV
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV, and 266kV rms for 400kV system	2500 microvolts	1000 microvolts
8.	Minimum creepage distance (25mm/kV)	20000 mm	10500 mm
9.	Rated short circuit current for 1 sec. Duration	50kA	63kA
10.	System neutral earthing	Effectively earthed	Effectively earthed
11.	Seismic acceleration	0.3g horizontal	0.3g horizontal
12.	Plinth level of switchyard	300mm above FGL	300mm above FGL

3.2 GENERAL REQUIREMENT

3.2.0 ALL THE EQUIPMENTS / MATERIALS TO BE SUPPLIED SHOULD BE IN ACCORDANCE WITH RELEVANT LATEST / AMENDED IS/IEC, WHETHER IT HAS BEEN SPECIFICALLY MENTIONED IN THE SPECIFICATION OR NOT.

3.2.1 The bidder shall also furnish drawings for the following:

All EQUIPMENTS and type of clamps, fittings hardware's, insulators, bus bar . These designs / drawing shall be got approved by the purchaser before commencing the manufacture / construction / erection and are to be as per latest IS /IEC.

3.2.2 GENERAL:

The bidder shall be fully responsible for providing all equipment, materials system and services specified or otherwise which are required to complete the construction and successful commissioning of the substation in all respects.

Any other items not specifically mentioned in the specification but which are required for erection of materials/equipment under the scope of work, testing and commissioning are deemed to be included in the scope of the specification unless specifically excluded.

All items shall be supplied as per schedule and as specified in the relevant Indian standard of latest revision. The Technical specification of the main materials/equipment is furnished. The Technical specification contained herein for the materials are for the guidance of the tenderer.

The bidders are requested to procure the equipment's/materials/component only from reputed /qualified manufacturer as per Technical requirement stipulated in Section - I of Technical specifications. Approval of make of item shall be taken up by vendor from TANTRANSCO himself.

3.3 SPECIFIC REQUIREMENT

The bidder shall furnish make/manufacturer, catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification and get approval from competent authority before commencement of any work.

All steel materials, other than materials for earthing should be of galvanized if not specified.

3.4 STANDARD:

The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the date of bid opening) of standards specified in each section.

The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.

The Bidder shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.5 TYPE TEST:

The Type Test for all the equipments/materials used for this project should have been conducted in any approved Government/Govt. recognized laboratories conforming to latest IS/IEC. The above type test certificates should accompany the drawings of the materials equipments, duly signed under seal by the Institution, who have issued the type test certificate. The above type test should have been conducted not earlier than Ten years , subject to no change in design as on the originally scheduled date of technical bid opening i.e. **30.09.2016**

In case the type tests were conducted earlier than 10 (ten) years prior to the originally scheduled date of bid opening, the contractor shall repeat these test (s) at no extra cost to the purchaser.

However, in case of instrument transformers, the following type tests should have been conducted within 5 (five) years prior to the originally scheduled date of bid opening.

- i) Lightning Impulse Test
- ii) Switching Impulse Test
- iii) Multiple Chopped Impulse Test (For CT)
- iv) Chopped Impulse Test (For CVT)

In case the test reports are of these tests (for instrument transformers) as mentioned above are conducted earlier than 5 (five) years prior to the originally scheduled date of bid opening, the contractor shall repeat these test(s) at no extra cost to the BHEL. The original type test certificates shall be furnished for verification on request.

TANTRANSCO/BHEL reserves the right to demand repetition of some or all the type tests in the presence of purchaser's representative at no extra cost.

Non furnishing of type test certificates by the tenderers, will be liable for rejection.

3.6 MATERIALS AND WORKMANSHIP:

All the materials shall be of the best class and capable of satisfactory operation in the tropics with humid atmosphere conditions. Unless otherwise specified, they shall conform to the requirements of the appropriate IS/IEC. The workmanship shall be of the best grade and the entire construction in accordance with the best modern practice.

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The equipment shall be designed to facilitate inspection and repairs and to ensure satisfactory operation under atmosphere condition prevailing at site and under such sudden variation of load and voltage as may be met with under working conditions in the system including those due to faulty synchronizing and short circuit within the rating of the apparatus.

The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment.

All the equipment's should operate without undue vibration and with the least practicable amount of noise.

3.7 INSPECTION :

The inspection may be carried out by the TANTRANSCO/BHEL at any stage of manufacture. The supplier shall grant free access to TANTRANSCO's/BHEL representative at a reasonable time when the work is in progress. The TANTRANSCO/BHEL shall have access at all times to the works and all other places of manufacture/fabrication, where the equipments are being manufactured/fabricated and the bidder shall provide TANTRANSCO's/BHEL representative all facilities for unrestricted inspection of the works, raw materials, manufacture of all the accessories and for conducting necessary tests.

Inspection and acceptance of any equipment under this specification by the TANTRANSCO/BHEL shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective. The supplier shall keep the TANTRANSCO/BHEL informed in advance, about the manufacturing programme so that arrangement can be made for inspection.

The TANTRANSCO/BHEL , reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

The correct grade and quality of steel shall be used by the supplier. To ascertain quality of steel, the TANTRANSCO/BHEL may at his discretion get the material tested at an approved laboratory.

The bidder shall take an account the fabrication wastage while quoting the rates. The Employer will not accept any liability in connection with the wastage of steel during fabrication or otherwise. Steel shall be procured exclusively from the main producers. However, sections not rolled by main produces can be procured from reroller , provided rerolling of structural steel section is done from billets/ingots of tested quality. Rerolled sections are duly tested as per relevant standards. Supplier should obtain approval of list of primary producers of Steel and Zinc before Proto assembly .

The BHEL/TANTRANSCO or his representative shall have the right to inspect and/or test the goods /works to confirm their conformity to the supplier. BHEL/TANTRANSCO shall notify the supplier in writing of the identity of any representatives authorized for these purposes.

The inspections and tests may be conducted on the premises of the supplier or his Sub vendor at the

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point of delivery and /or at the goods' final destination. Where tests are conducted in the premises of Supplier, all reasonable facility and assistance including access to drawings and production data shall be furnished at no charge to the BHEL.

Should any inspected or tested goods fail to conform to specifications, the BHEL/TANTRANSCO may reject them and the supplier shall either replace the rejected goods or make all alterations necessary to meet specification requirements free of cost to the BHEL/TANTRANSCO within one week of intimation.

The BHEL/TANTRANSCO's right to inspect, test and where necessary reject the goods after the goods; arrival at the site, shall in no way be limited or waived by reason of the goods having been previously inspected. Tested and passed by the BHEL/TANTRANSCO or his representative prior to the goods dispatch.

Not less than 15 (Fifteen) days advance intimation shall be given about the quantity of materials that will be ready for inspection by the officers of TANTRANSCO/ BHEL/Third agency authorized by the Corporation. The materials should not be dispatched without instruction from the Corporation.

3.8 GUARANTEE:

The supplier shall guarantee that the goods under the Contract are new, unused of the most recent or current models and incorporated all recent improvements in design and materials unless provided otherwise in the Contract. The supplier shall further guarantee that the goods supplied under this Contract shall have no defects arising from design, materials or workmanship, installation and erection, if that may develop under normal use of the supplied goods. The supplier shall also guarantee the performance of the works executed by him including the performance of all the materials/goods supplied by him.

BHEL shall promptly notify supplier in writing of any claims arising under guarantee in respect of goods. Upon receipt of such notice, the supplier shall, with all reasonable speed, repair or replace the defective works or parts thereof, free of cost at site. All the expenses towards transportation of defective parts to supplier's works and of repaired/replaced parts to site shall be borne by the Supplier.

If the Supplier, having been notified, fails to remedy the defects within 14 days, the BHEL will proceed to take such remedial action as may be necessary, at the supplier's risk and expenses. All expenses in this regard will be recovered from Supplier.

3.9 PRE COMMISSIONING TESTING (if applicable) :-

On completion of erection of equipment's and before charging each item of equipment's shall be thoroughly cleaned and inspected jointly by the TANTRANSCO and the BHEL for correctness and completeness of installation and acceptability for charging leading to initial pre commissioning test. The pre commissioning testing to be carried all equipment's in the

presence of BHEL/ TANTRANSCO. Necessary tools, testing kits to be arranged by the Supplier.

3.10 DOCUMENTATION : All drawings shall conform to relevant international standards Organization (ISO) specification. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. units.

3.11 PAINING, GALVANISING:

All interiors and exteriors of all metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter and the surfaces treated by phosphating (e.g. seven tank phosphating sequences).

All metal surfaces exposed to atmosphere shall be given, in addition to the treatment, two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified.

The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external paintings shall be as per shade **No.697/631 of IS-5.**

Paint inside the metallic housing shall be of anti condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

All components shall be given adequate treatment of climate proofing as per **IS: 3202** so as to withstand corrosive and several service conditions.

All ferrous parts including all sizes of nuts, bolts, support channel structures, etc. as also the mechanism housing shall be hot dip galvanized conforming to latest version of IS : 2629 or epoxy painted. Spring washers shall be electro-galvanised.

All members of the structure members shall be hot dipped galvanised with a zinc coating of **610 gms. per square metre** . Galvanising shall be done after a work is completed, except that the nuts may be tapped or rerun after galvanization. The zinc coating shall be smooth, clean, of uniform thickness and free from defects. The preparation for galvanising itself shall not adversely affect the mechanical properties of the coated materials. The employer shall be at liberty to have the samples of zinc used, test checked in any laboratory at his own cost and reject the particular supply if it is below standard.

All galvanised material shall withstand test as per IS 2633-1972 or any other equivalent standard. The zinc used for galvanising fabricated material shall be of high grade Electrolytic zinc of 99.99% purity.

All nuts and pins shall be adequately locked. Nuts, bolts and pins used inside the transformer and tap-changer compartment where gaskets are not used shall be provided with spring washers or locknuts. Where galvanizing is specified, it shall be applied by the hot dipped process or by electro-galvanizing process and for all parts, other than steel wires, shall consist of a thickness of zinc coating equivalent to not less than 610gm of zinc per square meter of surface. The zinc coating shall be smooth, of uniform thickness and free from defects.

3.12 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly 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 painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise 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.

3.13 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.

3.14 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.

3.15 DELIVERY OF GOODS AND DOCUMENTS RELATED THERETO:

Delivery of goods shall be made by the supplier in accordance with the terms specified by the BHEL in its schedule of requirements.

3.16 INCIDENTAL SERVICES:

The Supplier is required to provide any or all the services broadly outlined in the Technical specification. Any other minor incidental service related to the scope of work like providing

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necessary assistance whether specifically mentioned or not must be carried out by the Supplier at his own cost. All tools, Tackles Plant etc., required for completion of above works shall be brought by the Supplier.

3.17 DISCREPANCIES BETWEEN DRAWING AND SPECIFICATION:

Should there be any discrepancy between the specifications and/or schedule of prices and/or drawings or any inconsistency, error or omission in either of them, reference must be made to the BHEL/TANTRANSCO for an explanation and the Supplier will be held responsible for any errors that may occur in the work through neglect of this precaution. The explanation of the BHEL/TANTRANSCO shall be final and binding on the Supplier.

3.18 LIST OF DRAWINGS AND DOCUMENTS :

The drawings for the equipments provided by the TANTRANSCO shall be followed strictly by the bidder while designing. For the rest of the equipments, the design is in the scope of the bidder and the same got approved by the TANTRANSCO.

The bidder shall furnish One sets of relevant descriptive and illustrative published literature pamphlets and the following drawings/documents for preliminary study along with the offer.

- (i) General outline drawings showing dimensions and shipping weights, quantity of insulating media , etc.
- (ii) Sectional views showing the general constructional features of the circuit breaker including operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance.
- (iii) Schematic diagrams of breaker offered for control supervision and re- closing.
- (iv) Structural drawing, design calculations and loading data for support structures.
- (v) Foundation drilling plan and loading data for foundation design.
- (vi) The Type Test Reports
- (vii) Bill of materials shall be furnished along with drawings.

The supplier shall, within 1 weeks of placement of order submit Six sets of final version of all the above drawings for BHEL/TANTRANSCO's approval. The TANTRANSCO shall communicate its comments/approval on the drawings to the supplier within reasonable period. The Supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for TANTRANSCO's approval within two weeks from the date of comments.. However the drawing approval does not absolve the supplier from complying with the terms of the specification.

The following should be supplied to each consignee circle along with the initial supply of equipment's ordered.

- 1) Five copies of printed and bound volumes of operation, maintenance and erection manual in English along with the copies of approved drawings and type test reports etc.
- 2) Three sets of manuals detailed in item (1) shall be supplied to the TANTRANSCO/BHEL within one week from the date of approval of drawings.
- 3) The spares for the Equipment's ordered under the scope of the Contract should also be supplied to the consignee circle along with initial supply of the

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breakers.

4) It should be noted that if the above conditions are not fulfilled the initial payment will not be released.

3.19 QUALITY ASSURANCE PLAN :

The bidder shall invariably furnish following information along with his offer. (i) Statement giving list of important raw materials including but not limited to:

- (a) Contact material
- (b) Insulation
- (c) Porcelain
- (d) Sealing material
- (e) Contactor, limit switches, etc. in control cabinet.

Name of sub-supplier for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials 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 accessories.

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

(iv) Special features provided in the equipment to make it maintenance free.

(v) List of testing equipment available with the Bidder for final testing of breakers vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in the relevant schedule i.e. schedule of deviations from specified test requirements.

The supplier shall submit following information to the TANTRANSCO.

1) List of raw materials as well bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

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

3) Quality assurance plan (QAP) withhold points for TANTRANSCO inspection. The quality assurance plan and hold point shall be discussed between the employer and supplier before the QAP is finalized.

The supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled breaker.

3.20 TEMPERATURE RISE :

The maximum temperature attained by any part of the equipment when in service at site under continuous full load conditions and exposed to the direct rays of the sun shall not exceed 30 deg. Cover an ambient of 50 deg. C limits specified in relevant IEC. When the standard specify the limit of temperature rise these shall be exceeded when corrected for the difference between ambient

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temperature at site and that specified in the approved specifications. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

3.21 PACKING AND FORWARDING:

The equipment shall be packed in crates suitable for vertical/horizontal Transport, as the case may be and suitable to withstand handling transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit due to improper and inadequate packing and handling. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc., shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

The supplier shall provide such packing of the goods as is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit to their final destination as indicated in the Contract and exposure to extreme temperatures, salt and precipitation etc., during transport and open storage. Packing case size and weights shall be taken into consideration wherever appropriate, the remoteness of the 'goods' final destination and absence of heavy mechanized handling facilities, at all points in transit.

The packing, marking and documentation within and outside the package shall comply strictly with such special requirements as shall be expressly provided for in the Contract or in any subsequent instructions issued by BHEL.

3.22 APPROVAL PROCEDURE

The scheduled dates for the submission of drawings as well as for, any data/information to be furnished by the Employer would be as per the following schedule. 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 BHEL/TANTRANSCO. The following schedule shall be followed generally for approval.

i.	First Submission	7 days after LOI/PO
ii.	Approval/comments/by employer on Initial submission	Reasonable time
iii.	Resubmission	Within 7 days (whenever from date of comments required) Including both ways postal time.
iv.	Approval or comments	Within 2 weeks of receipt of resubmission.
v.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The supplier may please note that all resubmissions must incorporate, all comments given in the submission by the BHEL/TANTRANSCO 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.

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The title block of drawings shall contain the following information incorporated in all contract drawings.
 Please refer below mention Title block for Submission of Documents.

Title Block

Customer	M/s Tamil Nadu Transmission Corporation Limited
Project:	765/400KV Air Insulated substation Ariyalur
Contractor	BHEL

3.23 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

Drawings, GTP ,Type Test Reports and List of Past Supplies. Drawings & Documents

submitted at the time of offer shall be subject to review at contract stage.

3.24 DOCUMENTATION SCHEDULE

Following Documentation schedule to be followed per project.

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
				Prints	CDs
1	Drawings and Data Sheets	1	7	10	5
2	Drawings "As Built "	-	-	10	
3	Type Test Reports	1	7	10	
4	Erection Manuals	-	7	10	
5	Operation and Maintenance Manuals	-	7	10	
6	Manufacturing Quality Plan	-	7	10	
7	Field Quality Plan	-	7	10	
8	Inspection Test Reports	-	7	10	

Note: Drawings will also be submitted in CD/DVD in Latest AUTOCAD-2004 or Later version or any other CAD package along with conversion files for all major items. Final Documentation shall be submitted in bound volumes with details of Customer & Project etc. written on top.

SECTION -4

(To be submitted by the supplier at the contract execution stage)

**GUARANTEED AND TECHNICAL PARTICULARS FOR CLAMPS AND CONNECTORS
Shall be submitted for all applicable class**

- | | |
|---|----------|
| 1) Manufacture's name and address | 1)..... |
| 2) Applicable standards | 2)..... |
| 3) Application | 3)..... |
| 4) Type | 4)..... |
| 5) For connection to | 5)..... |
| a) Conductor size and arrangement | (a)..... |
| b) Equipment terminal and arrangement | (b)..... |
| 6) Material (state percentage - composition of constituents and impurities present) | 6) |
| a) Clamp body | (a)..... |
| b) Bolts and nuts | (b)..... |
| c) Spring washers | (c)..... |
| d) Liners, if any | (d)..... |
| 7) Rated current (A) | 7)..... |
| 8) Maximum temperature rise over reference ambient temperature when carrying rated current (°C) | 8)..... |
| 9) Rated terminal load and factor of safety Kg) | 9)..... |
| 10) Minimum thickness of any part (mm) | 10)..... |
| 11) Weight of clamp complete with hardware (Kg) | 11)..... |
| 12) Machine accuracy for matching surface | 12)..... |
| 13) Service (Indoor/Outdoor) | 13)..... |

SECTION – 5

Check List

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:

BIDDER OFFER REFERENCE:

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.

1 TECHNICAL REQUIREMENTS (FOR CLAMPS & CONNECTORS)

(1) S.No.	(2)/(3) Parameter/ Requirement	(4) Yes / No	(5) Remarks in case reply in Col (4) is NO
1.	Material of Clamps/Fittings		
a)	The Terminal Connector is made of A6 Aluminum Alloy and by pressure / gravity die cast only and not by Sand casting.	YES/NO	
b)	The bimetallic strips / sleeve shall be 2 mm thick.	YES/NO	
c)	All nuts, bolts & washers shall be of Hot Dip Galvanised mild steel	YES/NO	
d)	Spring washers are of Electro galvanised mild steel suitable for atleast service conditions-3 as per IS:1573	YES/NO	
2.	Continuous current rating of the clamps/fittings (Is it compatible with the conductor rating/ equipment rating as per BOQ)	YES/NO	
3.	Maximum temperature rise (45°C) of the clamps/fittings over ambient temperature (40°C) when carrying rated current	YES/NO	
4.	Minimum thickness of any part of clamps and connector is 12mm	YES/NO	
5.	Minimum thickness of current carrying parts of clamps and connector is 16mm	YES/NO	
6.	Fault current level for 1 second		
a)	For 765kV = 50kA	YES/NO	
b)	For 400kV = 63kA	YES/NO	
c)	For 132kV = 40A	YES/NO	
d)	For 33/52/54/66kV = 25kA	YES/NO	
7.	Min Corona extinction voltage (kV)		
a)	For 765kV = 508kV	YES/NO	
b)	For 400kV = 320kV	YES/NO	
c)	For 132kV = 105kV	YES/NO	

8.	Max. radio interference voltage for frequency between 0.5 MHz and 2		
a)	For 765kV = 2500 micro -volt at 508kV rms	YES/NO	
b)	For 400kV = 1000 micro -volt at 266kV rms	YES/NO	
c)	For 132kV = 500 micro -volt at 92kV rms	YES/NO	
9.	Sub conductor spacing		
a)	For 765kV = 450mm for Bull AAC and 457mm for Hexa Zebra	YES/NO	
b)	For 400kV = 450mm for ACSR Bersimis	YES/NO	
c)	For 33/52/54/66kV = 250mm for ACSR Bersimis	YES/NO	
10.	All hardware required for connecting to the respective equipment terminals included in supplier scope	YES/NO	
11.	Please confirm that there are no deviations from the technical specifications.	YES/NO	
12.	Procedure of Corona & RIV Test (if conducted) shall be as per enclosed Annexure-A.	YES/NO	
13.	Whether similar items offered have been supplied?	YES/NO	

2. TYPE TESTS

Whether Type test reports of the tests carried out not before **30.09.2011** on similar material submitted.

YES/NO

If type test report submitted, indicate report number.

If the valid type test reports are not available with the bidder then type test shall be conducted by the bidder free of cost

YES/NO