

BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION BUSINESS ENGINEERING MANAGEMENT NEW DELHI								
DOCUMENT No.		TB-381-316-108		Rev	00	Prepared	Checked	Approved
CUSTOMER Doc. No.				NAME	DM/MS	DKM	RS	
TYPE OF DOC.		TECHNICAL SPECIFICATION		SIGN	<i>[Signature]</i>			
TITLE 132 KV XLPE POWER CABLE				DATE	<i>[Signature]</i> 18/11/2017			
				GROUP	TBEM			
				W.O. No				
CUSTOMER		NTPC LIMITED						
PROJECT		NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW)						
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Rev.	Date	Altered	Checked	Approved	REVISION DETAILS			
Distribution				CUSTOMER	TBMM	O/C		
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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 in the same format (Annexure-1)	
2.	Schedule of Technical Deviation format duly signed. (Section -6)	
3.	Supporting documents as asked in the Technical PQR. (Annexure-A1)	
4.	Checklist of Technical parameters as per Section-5 duly filled and signed.	

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

ANNEXURE- A1

TECHNICAL PRE QUALIFICATION REQUIREMENT (PQR)

Name of Project : - NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW)

Name of Item : - 132 kV Cables & Accessories

Date : - 24.01.17

PQR Sr. No	PQR Description	Supporting Document to be attached
01	The vendor should have designed, manufactured, supplied, erected/supervised erection and commissioned/supervised commissioning of at least 4.0 Km of 132 KV or higher grade XLPE insulated cables in one or more installations which should be in successful operation for at least two (2) years as on 12-01-2015.	1. UNPRICED PO/ WO COPIES 2. DISPATCH/ MATERIAL RECEIPT DETAILS 3. PERFORMANCE CERTIFICATE

SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

The scope covers the supply and services required for the comprehensive functional system covering 132kV XLPE Cables, cable sealing end, cable joints, accessories etc. for interconnecting switchyard and transformer yard (GT-1, 2 and 3).

This technical specification covers the complete requirements (Point to Point) of **turnkey execution** including supply & services of complete 132kV Cable system (HT & Earthing /Bonding Cables, Clamps, Cable Sealing, earthing, link boxes etc.) complete in all respect along with accessories.

Supply - Design, manufacturing, quality assurance, quality control, shop assembly, testing at works, packing and dispatch.

Services - Installation (including transporting, supervision of unloading, laying of cable at site in BHEL provided trench), clamping, commissioning, performance and acceptance testing.

This section covers the specific technical requirements.

In case of any discrepancies between the requirements mentioned under Section-1/Section-2 and those specified in the Section-3. The following shall be order of prevailing

- a. Statutory Regulations
- b. Section-1
- c. Section – 2 (NTPC Hydro Specification)
- d. International standards

The equipment is required for the following project.

Name of Customer : NTPC LIMITED.

Name of the project : NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT
(3X40MW)

Main Contractor : BHEL

Refer Section - 3 for Project Details and General Specifications.

2.0 Project Information

Rammam Stage-III Hydro Electric Project is a run of the river scheme across the Rammam river between the confluence of Lodhama Khola with Rammam to Rammam with river Rangit. The scheme involves construction of Barrage on river Rammam approximately 240 m D/s of Rammam stage-II Power House with 3.5 m finished diameter, 8.2 Km. long horse shoe shaped HRT, 2.7 M diameter, 1.53 Km long pressure shaft/ penstock, 740 m long tailrace channel and surface power house.

The installed capacity of the project is 120 MW (3x40 MW) would be provided by 3 Vertical Axis Pelton turbines driven generating units of 40 MW each. It is proposed to provide Inlet Valve of spherical type for each turbine, which would be accommodated in the powerhouse. The generation voltage of 11kV would be stepped up to 132kV through three single phase 17 MVA, 11/132/√3 kV ODWF type step up transformers located near upstream wall of the power house for each unit. The 11kV isolated phase bus ducts would connect the 11 kV generator terminals with 11kV bushings of step up transformers. The 132kV terminal of the transformers would be connected with 132kV

switchyard through 132kV XLPE Cables. Power from the project will be evacuated through three Nos. 132kV lines to be laid by WBSEB.

Climate Condition

The project lies between EL 910m to 375 m. The area has moderate climatic conditions with no snow fall in the project area. Rainfall in the Project area is from June to August and in December, January. The Power House service bay floor is located at EL 412 m & the centre line of turbine runner has been set at EL 400 m.

The climatic conditions are given below: -

- i) Maximum temperature in the project area: 30° C
- ii) Minimum temperature in the project area: 3° C
- iii) Maximum Relative humidity: <95 %
- iv) Minimum Relative humidity: >35 %
- v) Average annual rainfall: 2800 mm

Also refer Section-3.

132kV Cable is required for interconnection of Switchyard and Transformer yard:

Total no of 3-phase circuits = 3 (GT-1, GT-2 & GT-3)

Breakup as below:

Sl No	Circuit	End A	End B	No of circuits	LENGTH (APPROX IN MTR)
1.	GT-1, 2 & 3	Switchyard Outdoor CSE	Transformer yard, Outdoor CSE	3x3x350	3150
2.	Spare Runs	Switchyard	Transformer yard	2x350	700

2.1 General

It may be noted that:

• Schedule –

- Supplier will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning.
- Bidder to submit list of consumables with shelf life of less than two years. It shall be supplied before erection after clearance from BHEL.
- Calculation - Bidder will submit short circuit current calculation, continuous current rating calculation and sheath standing voltage calculation for justifying the size of the 132kV cable in line with proposed laying condition. Any other calculations which may be required during detailed engineering stage may also be submitted.
- Store will be provided by BHEL (**which is approx. 1.5km away from Switchyard**). Bidder to provide their requirement of space in open and closed store during tender stage. Supervision of loading, unloading & storage along with verification shall be in bidder's scope.

Office facilities & accommodation for supplier staff, Travel expenses for supplier staff, Transportation of all tools and equipment, Transportation of material tools and equipment between storage /warehouse and complete ETC shall be in supplier scope.

- Transportation of all tools, material and equipment between store/warehouse to site and complete erection is in scope. Bidder to arrange crane/ hydra for transportation, erection etc. Transportation of empty cable drums to store and storage in Store is also in bidder's scope.
- **Construction Supply** - The necessary power supply at site shall be provided by BHEL at one point only.
- **Terminal Connector** - Cable Sealing Ends are required at switchyard & Transformer yard end (Outdoor type). Terminal connector for connection between cable sealing end and overhead conductor for outdoor termination only shall be provided by BHEL (at switchyard end).
- **Installation –**
 - The cable will be laid in cable trenches. The cable trench and support structures/angles in the trenches will be supplied and fixed by BHEL as per detailed design and drawing provided by bidder. The typical sketch for reference shall also be given with bid based on which the design calculations will be done.
 - Provision of manpower in the grade of foreman and skilled technician, provision of laying supervisor, provision for laying tools and equipment, cable pulling, cut cable, place cable, supply of cable cleat, installation of cable cleat etc. to complete is deemed to be included in scope.
 - The necessary holes required for fixing clamp on the cable rack assembly shall be done by vendor.
 - **Termination:** Provision of Jointer and termination material, tools and Terminating Scaffolding, cranes for lifting for the joints and termination materials, assembly of joint and sealing ends will be in vendor's scope.
 - Any cable or accessories damage during laying will be repaired/replaced by bidder to the satisfaction of owner/BHEL.
 - Bidder to note that GT-1, GT-2 & GT-3 shall be commissioned separately. Cables for these bays shall be commissioned accordingly.
- **Site Test:** Provision of test engineer, supply of all test equipment (including DC test for outer sheath) and arrangement like cranes etc. AC voltage test of insulation with voltage of U_0 (complying with IEC 60840) etc. for completion of total site work. AC supply shall be arranged by BHEL/NTPC Hydro from nearby grid.
- Any other tools and tackles and accessories required to complete the cable laying, termination and ETC shall be included in the offer. Please note BHEL shall not provide any equipment, tool and tackles for installation or carrying out any test.

2.2 SPECIFIC TECHNICAL REQUIREMENTS

S.N.	Particulars	Value
	Cable construction	
1.	Type of Cables	Cross-linked polyethylene insulated
2.	No. of Cores	Single
3.	Conductor size	400 sq. mm
4.	Conductor material	Copper

S.N.	Particulars	Value
	Shape	Compacted Circular
	Conductor Screen	Extruded semi conducting compound
	Insulation Material	Extruded Cross Linked poly Ethylene (XLPE)
	Insulation Screen	Extruded semi conducting compound
	Bedding	Layer of swellable semi conducting tape(s) to form water barrier
	Metallic Sheath	Aluminium or lead with copper wires screen and copper binder tape as per requirement
	Outer Sheath	Flame retardant Polyethylene (PE) / FRLS PVC
	System Parameters	
5.	Normal system voltage	132 KV
6.	Maximum system voltage	145 KV
7.	Rated Short Circuit Withstand Current at a rated voltage for 1 second	Symmetrical short circuit 31.5kA r.m.s for 1 second
8.	System frequency	50hz
9.	Frequency variation	+3%, -5%
10.	Rated continuous Current	650 Amp.
11.	Overload capacity	Nil
12.	Maximum allowable temperature for cable and accessories. Operating Temperature of conductor: Maximum permissible temperature during normal operation under combined effect of ambient and maximum load Maximum permissible temperature during short circuit under combined effect of ambient and maximum load (with conductor temperature at inception of short circuit as 90 deg. C).	As per IEC 90 deg C 250 deg C
13.	Basic impulse insulation level (1.2/50 micro second wave)	650 kV (peak)
14.	Power frequency withstand voltage	As per relevant IEC
15.	Laying conditions	
(a)	Laid on cable racks in cable trench with suitable spacing between cables	2d mm centre to centre (typical) where "d" is overall diameter of finished cable
(b)	Earthing of screen - GT end - Switchyard end	Solidly earthed link box (CCPU) without SVL (sheath voltage limiter). Solidly earthed link box (CCPU) with SVL (sheath voltage limiter)
(c)	Ambient air temp.	40 deg. C
(d)	Type of atmosphere	Heavily polluted

2.3 QUANTITIES:

Technical Specification for 132 kV XLPE Power Cables & Accessories

Material and Services required for the execution of the job are listed in Annexure-I. All items listed in the BOQs shall be offered. Any item not appearing Annexure-I but required for completeness of the job is deemed to be included in the scope.

As per Annexure-I

Notes:

- 1) The un-price BOQ shall be strictly as per ANNEXURE-I.
- 2) **Cable Length** - The exact length shall also be decided by supplier after visiting site & making precise measurements at contract stage. Manufacturing lengths and drum length shall be determined as per the joint site survey with NTPC Hydro/BHEL.
 - a. The Payment of cables length (for supply) will be as per approved quantities after joint survey.
 - b. The Payment of cables length (for installation) will be as per actual measurement at site which shall also include cable sealing ends.
 - c. The exact length may vary by -20% to +20% at Contract Stage based on actual measurement at site and calculations submitted by the bidder. Individual quantity of other items may vary to any extent and may get deleted during contract/execution stage.
- 3) The cable cleats including hardware for fixing the cable on BHEL provided support structure shall be in supplier scope.
- 4) Earthing of HT cables shall be in supplier scope. Earth mat grid exists at both ends (switchyard and transformer yard) and will be interconnected. The accessories shall necessarily include the following but not limited to: Earthing cable, earth continuity cables, bonding cables etc. as per the requirements. Any special earthing required shall be supplied and installed by the bidder in the cable trench. The complete earthing BOQ items shall be clearly mentioned in the offer.
- 5) Earthing and Link Box: Design of support structure for link box, earthing cable, installation of link box, installation of earthing cable, connection of bonding cable, etc. to complete is deemed to be included in bidder's scope.
- 6) Earthing of 132kV cable rack with suitable size of flat shall be in BHEL scope.

OTHER SERVICES FOR CABLES:

The specification envisages turnkey execution of a COMPLETE, POINT TO POINT, 132 kV CABLE SYSTEM and the scope includes services (including laying, supervision, termination, clamping, testing and commissioning of the cable system) necessary to execute the job to satisfaction of NTPC Hydro and BHEL.

Any other item /service required for the execution for the complete job shall be included in the offer, whether specifically mentioned in the specification or not.

Bids in which only Supplies or only Installation Services are offered shall be rejected.

2.3.1 132KV CABLE DOCUMENT TO BE SUBMITTED:

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Documents list is as per **Annexure-II**.

2.4 Drg. Enclosed

S. N.	NTPC Hydro /BHEL Drg. No.	Drawing Title
1	5602-002-P-E-C-A-24	CROSS SECTION OF POWER HOUSE THROUGH WATER CONDUCTING SYSTEM
2	5602-003-P-E-E-A- 127	CABLE ROUTING FROM POWER HOUSE TO SWITCHYARD
3	SKETCH	CABLE TRENCH ALIGNMENT FROM POWER HOUSE TO SWITCH YARD
4	SKETCH	TYPICAL LAYING ARRANGEMENT OF 132KV XLPE POWER CABLE BETWEEN GT & 132KV SWYD.
5	SKETCH	TYPICAL SECTION AT SWITCHYARD END & GT YARD END.

2.5 Type Testing

The 132kV Cabling system (132 kV XLPE Cables, cable sealing end, cable joints etc., complete in all respect along with accessories) should have been type tested (as per relevant IEC 60840/61462 standard) from accredited laboratory (accredited base on relevant ISO / IEC / EN by the national accreditation body of the country where laboratory is located).. The cable jointing kit and cable sealing end shall be same as that used in type test.

The Type Tests on 132kV System (XLPE Cables, cable joints, cable sealing end etc.) shall meet the requirements as per page 13, 14 of clause-7.00.00 of Section-2 and Quality Assurance Plan.

All the equipment shall have valid type test certificates as per relevant standards. At contract stage, the reports for all type tests and additional type tests as per technical specification shall be submitted for NTPC approval.

All the equipment shall have valid type test certificates as per relevant standards. The test - reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening. In case the test reports are of the tests conducted earlier than 10 (ten) years prior to the date of bid opening, the bidder shall repeat these test(s) at no extra cost to BHEL/ NTPC Hydro and no delivery implication. Date of Bid opening is 12.01.15.

In the event of any discrepancy in the test reports i.e. any test report not acceptable to NTPC due to any design / manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification on any/all additional type tests not carried out, same shall be carried out without any additional cost and delivery implication to the BHEL/ NTPC Hydro.

After installation, the cables and accessories shall also be subjected to site tests as per clause no. 7.04.00 of Section-2 but not limited to this.

(A) Following type tests reports shall be submitted on cable system as per cl. no. 12 of IEC60840 (but not limited to this).

- i) Bending test
- ii) Tan δ measurement
- iii) Heating cycle voltage test
- iv) Partial discharge test
 - a) At ambient temperature

- iv) Partial discharge test
 - a) At ambient temperature
 - b) At high temperature
- v) Lightning impulse voltage test followed by a power frequency withstand voltage test
- vi) Test of outer protection
- vii) Examination of cable system with cable & accessories
- viii) The resistivity of the cable semi-conducting screen
- ix) Non electrical type test as per cl. no. 12.5 of IECC-60840

(B) Following type tests shall be carried out on cable accessories-
As per cl. no. 15 of IEC 60840

2.6 INSPECTION & TESTING

Prior to dispatch, the routine & acceptance tests shall be carried out on cables and accessories in accordance with the applicable IEC /IS and the material shall be offered for final inspection to BHEL and NTPC Hydro in accordance with approved quality assurance plan. Bidder shall submit detailed Quality Plan for BHEL / NTPC Hydro approval.

The contractor shall carry out the 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.

Inspection and Testing shall be as per Section-2 and Quality Assurance Plan of NTPC.

2.6.1 Acceptance Tests (Sample Tests) -

(A) Acceptance Tests (Sample Tests) on Cables (Cl. 10 of IEC 60840)

Following tests shall be carried out on minimum 10% of the drums subject to minimum one sample in each lot:

- i) Conductor Examination
- ii) Measurements of Electrical resistance of conductor and of metal screen
- iii) Measurement of thickness of insulation and oversheath
- iv) Measurement of thickness of metal sheath
- v) Measurements of diameters , if required
- vi) Hot set test for XLPE insulation
- vii) Measurement of capacitance
- viii) Lightning impulse voltage test
- ix) Water penetration test
- x) Test on components of cables with a longitudinal applied metal tape or foil, bonded to the oversheath

(B) Sample tests on accessories -As per cl. no. 11 of IEC 60840

2.6.2 ROUTINE TESTS

Following routine test shall be carried out as per Clause 9 of IEC 60840 on samples drawn from each drum and each accessory.

- a) Partial discharge test
- b) Voltage test
- c) Electrical test on oversheath of the cable

2.7 FIELD TESTS

All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by the Contractor, in presence of representative of the Employer as per clause no. 7.04.00 of Section-2, page 14 of 17.

Procedure to be adopted for conducting the operational, pre-commissioning, commissioning, performance and field acceptance test shall be submitted well in advance, at least six months before start of relevant testing, for approval by the employer.

2.8 QUALITY PLAN

The contractor shall carry out the 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.

Attached Quality Assurance Plan (QAP) for 132KV XLPE CABLES, of NTPC in Section-2 shall be followed.

2.9 QUALIFYING REQUIREMENT:

The vendor should have designed, manufactured, supplied, erected/supervised erection and commissioned/supervised commissioning of at least 4.0 Km of 132 KV or higher grade XLPE insulated cables in one or more installations which should be in successful operation for at least two (2) years as on 12-01-2015.

2.10 TITLE BLCOK

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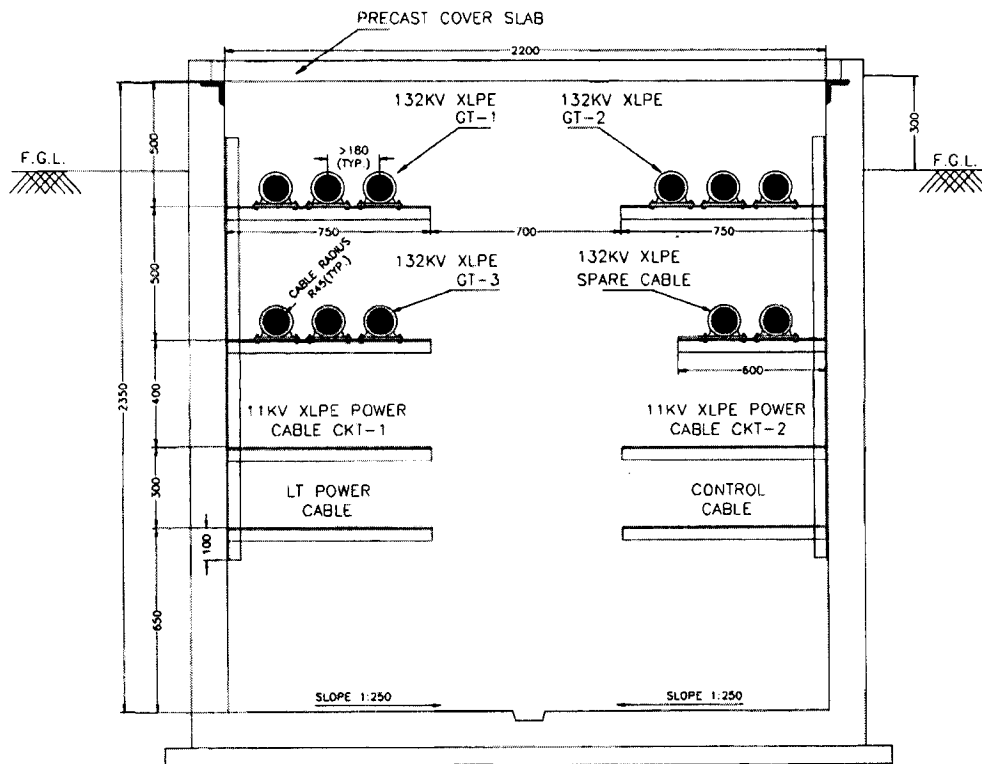
Bill of Quantity

Annexure-I

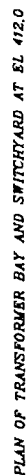
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Sl. No.	Description	Unit	Qty.
A	Main items		
1	Supply item - 132kV XLPE, Cu. conductor, 1CX400sqmm cable	Mtrs.	3850
2	Supply item - 132kV cable sealing end (outdoor type) suitable for terminating the cables in the Air insulated switchyard and GT yard including all accessories like necessary hardware, clamps for fixing the cable on structure etc. (excluding structure and terminal connector)	Nos.	22
3	Supply item -132kV Straight through joints for 132kV cable, if required. It shall be complete in all respects.	Nos.	2
4	Supply item - Single pole link box without SVL including all cable/cable accessories required for the connection	Set	10
5	Supply item - Single pole link box with SVL including all cable/cable accessories required for the connection	Set	10
6	Supply item - Sheath Voltage Limiter	Set	3
7	Supply item - Earthing materials for 132kV XLPE cables as per requirement, including earthing / bonding cable along with accessories etc. for complete system (1 Lot is complete package, Bidder to provide quantity/ price break-up of each item).	lot	1
8	Supply item - Non magnetic clamps for fixing 132kV cable in flat formation on cable racks (1 Lot is complete package, Bidder to provide quantity break-up).	lot	1
9	Supply item - Non magnetic, Single type cleats/ clamps for fixing 132kV cables to structure (1 Lot is complete package, Bidder to provide quantity break-up).	lot	1
10	Supply item - Consumables having limited shelf life required during erection, testing and commissioning. (1 lot is for complete package).	lot	1
B	Services		
11	Services - Erection, Testing & Commissioning of 132kV XLPE, Cu. conductor, 1CX400sqmm cable in flat formation by fixing clamps and/or single form on support structure using cleats/ clamps. It includes fixing of cables on support structures for cable sealing ends and fixing of clamps on cable rack assembly/ support structure by making holes etc, if required.	Mtrs.	3850
12	Services - Erection, Testing & Commissioning of 132kV cable sealing end (outdoor type) in switchyard and GT yard including all accessories like necessary hardware, clamps for fixing the cable on structure etc. It includes <u>fixing of clamps & connectors, if required.</u>	Nos.	18
13	Services - Erection, Testing & Commissioning of 132kV Straight through joints for 132kV cable, if required. It shall be complete in all respects.	Nos.	2
14	Services - Erection, Testing & Commissioning of of earthing system for 132kV XLPE cable including installation of 1-phase earthing link box with SVL (sheath voltage limiter) and earthing/ bonding cable alongwith cable accessories required.	Set	9
15	Services - Erection, Testing & Commissioning of of earthing system for 132kV XLPE cable including installation of 1-phase earthing link box without SVL (sheath voltage limiter) and earthing/ bonding cable alongwith cable accessories required.	Set	9
16	Services - Field testing & commissioning of 132kV XLPE Cables (1 Lot for 1 circuit).	Lot	3
17	Services - Field testing & commissioning of spare 132kV XLPE Cables (1 Lot for 2 runs).	Lot	1
18	Services - Site Survey for laying of 132kV XLPE cable at site.	Lot	1

DWG. NO DM/RAAMAM/01 REV.00



SKETCH:- TYPICAL LAYING ARRANGEMENT OF 132KV CABLE BETWEEN GT AND 132KV SWYD



1. ALL DIMENSIONS ARE IN MM.
2. DRAWING NOT TO BE SCALED. ONLY WRITTEN DIMENSIONS ARE TO BE REFERRED.
3. THIS DRG. SHALL BE REFERRED ONLY FOR LAYOUT OF CABLE ROUTING FROM POWER HOUSE TO SWITCHYARD.
4. THE CABLE TRENCH CROSSING THE NALA SHALL OF THE SAME CROSS SECTION AND TO BE RUN ADJACENT TO THE BRIDGE/CULVERT.
4. FOR CABLE TRENCH CROSS SECTION REFER POWER HOUSE CROSS SECTION DRG.

FOR TENDER PURPOSE ONLY

	PROJECT FILE#	KARNATAKA POWER CORPORATION LIMITED CONSULTANCY AND ENGINEERING SERVICES DIVISION	PROJECT NO. 100 DATE 10/01/84	PROJECT NO. 100 DATE 10/01/84	PROJECT NO. 100 DATE 10/01/84	PROJECT NO. 100 DATE 10/01/84	PROJECT NO. 100 DATE 10/01/84
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LEGEND:—

- | | | |
|---|---|---|
| CEMENT CONCRETE
BLOCK WALL | PLUM CONCRETE | CONCRETE |
|  |  |  |

NOTES:

- THIS DRAWING SHOWS THE CROSS SECTION OF POWER HOUR THROUGH WATTS CONDUCTOR SYSTEM.
- ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
- DRAWING SHALL NOT BE SCALED. ONLY WRITTEN DIMENSIONS SHALL BE FOLLOWED.
- FOR ROOF TRUSS, W TYPE TRUSS CAN BE ADOPTED OVER WHICH 75 MM THICK RCC SLAB CAN BE PROVIDED.

FOR TENDER PURPOSE ONLY

एनटीपीसी NTPC	एनटीपीसी लिमिटेड NTPC Limited
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(A wholly owned subsidiary of NTPC)

HYDROELECTRIC PROJECT
[20400000]

CROSS SECTION OF POWER HOUSE THROUGH
WATER CONDUCTOR SYSTEM

[illegible]

CROSS SECTION OF POWER HOUSE
THROUGH WATER CONDUCTOR SYSTEM

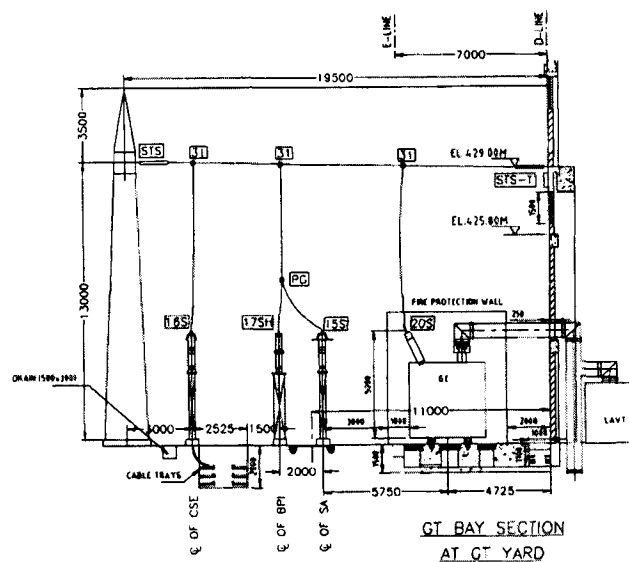
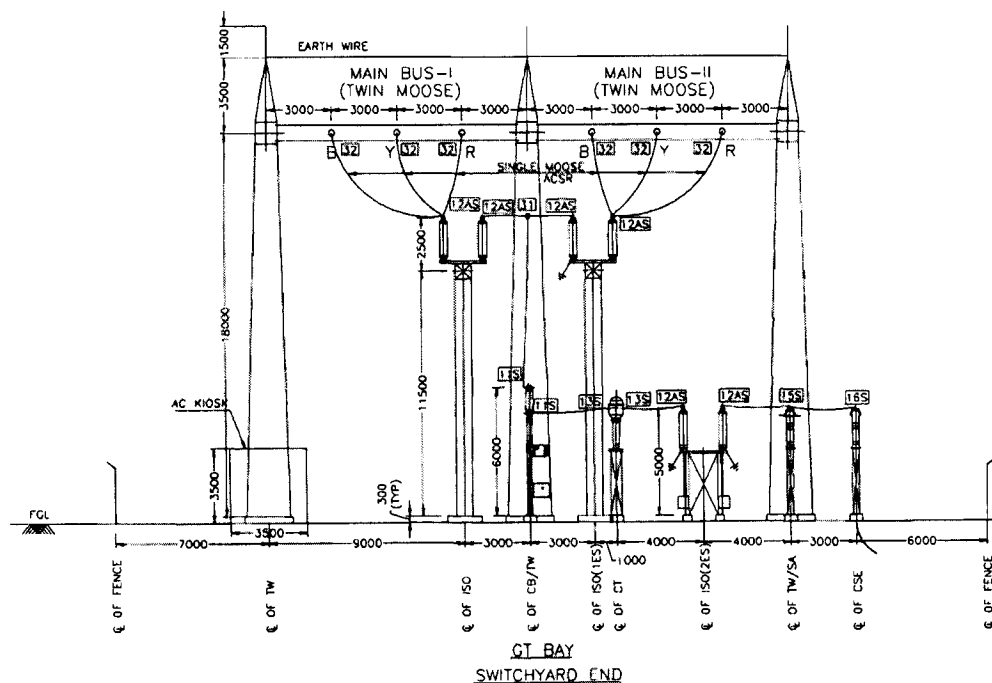


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POINT	NORTHING	EASTING
T1	24285.061	30492.201
T2	24241.546	30542.968
T3	24261.356	30559.927
T4	24261.506	30561.137
T5	24254.655	30569.923
T6	24248.434	30565.164
T7	24251.557	30620.204
T8	24240.948	30642.349
T9	24231.048	30654.349
T10	24217.828	30673.176
T11	24214.965	30675.416
T12	24213.766	30677.018

1. 5602-305R2-POC-C-111
2. 5602-305R2-POC-C-113
3. 5602-305R2-POC-C-201
4. 5602-305R2-POC-C-211
5. 5602-906-H115-PW-F-001
6. 5602-906-H115-PW-F-007
7. 5602-906-H115-PW-F-009
8. 5602-003-H230-PW-F-109

1. ALL DIMENSIONS ARE IN MILLIMETERS AND GRID AND STATIONING ARE IN METERS.
2. THIS SKETCH IS PREPARED ON THE BASIS OF REFERENCE DRAWINGS AS MENTIONED AND CONTOUR SURVEY PROVIDED BY SITE.
3. CABLE TRENCH ALIGNMENT SHOWN IS INDICATIVE & FOR PLANNING PURPOSE ONLY. THE SAME MAY BE MODIFIED FOR CONSTRUCTION PURPOSES.
4. CABLE TRENCH ALIGNMENT WITH POWER HOUSE COMPLEX SHALL BE FINALISED AS PER EACH REQUIREMENT CONSIDERING OTHER EQUIPMENTS/FACILITIES.



SUPPLIER'S LOGO		SUPPLIER'S NAME AND ADDRESS		FIELD QUALITY PLAN				PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:				NTPC Hydro	
ITEM :		SUB-SYSTEM:		QP NO.: REV. NO.: DATE: PAGE: OF		PROJECT		PACKAGE		CONTRACT NO.		MAIN-SUPPLIER	
SL NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK #	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	REMARKS				
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.			

MANUFACTURER/ SUB-SUPPLIER		SIGNATURE		DOC. NO.:		REV.	
MAIN-SUPPLIER		REVIEWED BY		APPROVED BY		APPROVAL SEAL	
LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS #: A - CRITICAL, B-MAJOR, C-MINOR; 'A' SHALL BE WITNESSED BY NTPC FQA, 'B' SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)		FOR NTPC USE					

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DRAWING SCHEDULE

Sl. No.	NTPC Drawing No	Drawing Title
1	5602-003-H211-PVE-B-030	OGA drawing of cable termination kits
2	5602-003-H211-PVE-B-043	General Cable Support drawing with Four horizontal supports including hardware & inserts etc for 132KV Cables
3	5602-003-H211-PVE-B-044	General Cable Support drawing with Two horizontal supports including hardware & inserts etc - 132KV Cables
4	5602-003-H211-PVE-B-045	132KV Cable Outdoor Termination Support Structure drawing at the Switchyard including hardware, inserts & foundation (For Reference)
5	5602-003-H211-PVE-B-046	132KV Cable Outdoor Termination Support Structure drawing at GT yard Termination including hardware, inserts & foundation (For Reference)
6	5602-003-H211-PVE-B-047	Special Cable support structures drawing 132KV Cables
7	5602-003-H211-PVE-F-051	Layout and cable installation drawing - 132KV Cables
8	5602-003-H211-PVE-G-072	Field Quality Plan- 132KV Cables
9	5602-003-H211-PVE-Q-068	Manufacturing Quality plan for 132KV Cables, Accessories & Support structures
10	5602-003-H211-PVE-U-052	Cable and Accessories load on civil work in GT yard, Cable Trench & Switchyard - 132KV Cables
11	5602-003-H211-PVE-U-053	Calculation of cable continuous rated current - 132KV Cables
12	5602-003-H211-PVE-U-054	Calculation of cable short circuit current - 132KV Cables
13	5602-003-H211-PVE-U-055	Cable loss calculation - 132KV Cables
14	5602-003-H211-PVE-U-056	Electrodynamic force calculation in short circuit - 132KV Cables
15	5602-003-H211-PVE-U-057	Cable Mechanical strength calculation -132KV Cables
16	5602-003-H211-PVE-U-058	Overvoltage calculation of cable sheath protection -132KV Cables
17	5602-003-H211-PVE-U-059	Calculation of pulling force and side pressure during cable laying and installation -132KV Cables
18	5602-003-H211-PVE-U-060	Structure Design calculations for Cable Supports (in GT yard, Cable trench & Switchyard)- 132KV Cables
19	5602-003-H211-PVE-U-061	Calculation of cable length -132KV Cables
20	5602-003-H211-PVE-U-074	Structure Design Calculation for Support for Switchyard & GT outdoor Cable Termination- 132KV Cables
21	5602-003-H211-PVE-W-069	Type Test Procedure for 132KV Cable & Accessories
22	5602-003-H211-PVE-W-070	Type Test Reports for 132KV Cables & Accessories
23	5602-003-H211-PVE-W-071	Type Test Reports for Bonding Cable for 132KV cables
24	5602-003-H211-PVE-W-073	Commissioning Test Procedure -132KV Cables
25	5602-003-H211-PVE-X-062	Cable drum handling and storage- 132KV Cables
26	5602-003-H211-PVE-X-063	Storage of Termination & other material -132KV Cables
27	5602-003-H211-PVE-X-064	Cable installation -132KV Cables
28	5602-003-H211-PVE-X-065	GT yard termination Assembly & Erection- 132KV Cables
29	5602-003-H211-PVE-X-066	Switchyard Outdoor termination Assembly & Erection- 132KV Cables
30	5602-003-H211-PVE-X-067	Operation and Maintenance Procedure- 132KV Cables
31	5602-003-H211-PVE-Y-033	Drawing and Technical Data Sheet for 132 KV Cable
32	5602-003-H211-PVE-Y-034	132 KV Cable sizing & Selection
33	5602-003-H211-PVE-Y-035	132KV Cable GT outdoor termination drawing & Technical Data Sheet
34	5602-003-H211-PVE-Y-036	132KV Cable Switchyard Outdoor Termination drawing & Technical Data Sheet
35	5602-003-H211-PVE-Y-037	Bonding cable drawing & Technical Data Sheet for 132KV Cable system
36	5602-003-H211-PVE-Y-038	Bonding cable sizing & selection

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37	5602-003-H211-PVE-Y-039	132KV Cable - Earthing Link Box drawing including Lightning arrester & Technical Data Sheet for both types (with & without SVL)	
38	5602-003-H211-PVE-Y-040	132KV Cable Fixing clamp drawing & Technical Data Sheet	
39	5602-003-H211-PVE-Y-041	132KV Cable Drums details	
40	5602-003-H211-PVE-Y-042	132KV Circuit earthing drawing	

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PROJECT: NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW)	
CUSTOMER: NTPC LIMITED	
Technical Specification of 132 kV Power Cable	TB-381-316-108
Section-2: Equipment specification	REV.00

SECTION 2

EQUIPMENT SPECIFICATION

- NTPC specification for 132KV CABLE – PART-B, SUB-SECTION – E16

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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)		एन सी पी सी NTPC नवीय hydro																																	
1.00.00	CODES AND STANDARDS																																			
1.01.00	The design, manufacture, testing and performance of the cables supplied under this specification shall comply with the latest edition of the following Standards, Rules and Acts. IEC Standards <table><tr><td>IEC 60840</td><td>Power cables with extruded insulation and their accessories for rated voltages above 30kv (Um=36kv) upto 150 kV (Um=170kv) Test methods and requirements</td></tr><tr><td>IEC 60060</td><td>H.V.Test Techniques</td></tr><tr><td>IEC 60885</td><td>Electrical test methods for Electric cables.</td></tr><tr><td>IEC 60228</td><td>Conductors of Insulated cables</td></tr><tr><td>IEC 60229</td><td>Tests on cable oversheath which have a special protective function and are applied by extrusion.</td></tr><tr><td>IEC 61462</td><td>Composite Insulators- Hollow insulators for use in outdoor and indoor electrical equipment - Definitions, test methods, acceptance criteria and design recommendations</td></tr><tr><td>IEC 60230</td><td>High Voltage Test Techniques</td></tr><tr><td></td><td>- Partial discharge measurements</td></tr><tr><td>IEC 60270</td><td>Impulse tests on cables and their accessories.</td></tr><tr><td>IEC 60287</td><td>Electric cables - Calculations of the current ratings</td></tr><tr><td>IEC 60540</td><td>Test methods for insulation and sheath of electric cables and cords (Elastomeric and thermoplastic compounds)</td></tr><tr><td>IEC 60183</td><td>Guide to the selection of high voltage cables</td></tr><tr><td>IEC 60811</td><td>Common test methods for insulating and sheathing</td></tr><tr><td>Part-1 to 4</td><td>materials of electric cables</td></tr><tr><td>IEC 60885 Part-3</td><td>Electrical test methods for electric cables</td></tr><tr><td></td><td>-Test methods for partial discharge measurements on lengths of extruded power cables.</td></tr></table>				IEC 60840	Power cables with extruded insulation and their accessories for rated voltages above 30kv (Um=36kv) upto 150 kV (Um=170kv) Test methods and requirements	IEC 60060	H.V.Test Techniques	IEC 60885	Electrical test methods for Electric cables.	IEC 60228	Conductors of Insulated cables	IEC 60229	Tests on cable oversheath which have a special protective function and are applied by extrusion.	IEC 61462	Composite Insulators- Hollow insulators for use in outdoor and indoor electrical equipment - Definitions, test methods, acceptance criteria and design recommendations	IEC 60230	High Voltage Test Techniques		- Partial discharge measurements	IEC 60270	Impulse tests on cables and their accessories.	IEC 60287	Electric cables - Calculations of the current ratings	IEC 60540	Test methods for insulation and sheath of electric cables and cords (Elastomeric and thermoplastic compounds)	IEC 60183	Guide to the selection of high voltage cables	IEC 60811	Common test methods for insulating and sheathing	Part-1 to 4	materials of electric cables	IEC 60885 Part-3	Electrical test methods for electric cables		-Test methods for partial discharge measurements on lengths of extruded power cables.
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RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E 16	PAGE 2 OF 17																																

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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)	
	IEC 60060 Part 1 High Voltage Test Techniques IEC 60187 General Definitions & Test Requirements IEC 60068 Seismic Test Methods For Equipments IEC 60137 Insulated Bushings for alternating Voltages for above 1000 volts IEC 60506 Switching Impulse test on EHV insulators IEC 60376 Specifications & acceptance of new SF6 Gas IEC 60332 Part 1 Test on electric cables under fire conditions IEC 60859 Cable connections for gas insulated metal enclosed switchgear ANSI/IEEE/IS Std Guide Electrical safety and Sub- station grounding: and Rules 2000 Indian Standards & Rules IS 5216 Guide for safety procedures and practice in electrical works. IS 7098 (Part-II) XLPE Cable for working voltage 66kV up to and including 220kV Indian Electricity Act 1910. IS 5831 Electric Power Connectors IS 2633 Methods for testing uniformity of coating in Zinc coated articles IS 1893 Criteria for earth quake resistant design of structures 1.02.00 132 KV cables accessories and support systems meeting any other international standard which ensures and equal or better quality than the standard mention above are also acceptable. The contractor proposing any other standards than the above referred standards must specifically indicate the standards to which the cable conforms. The deviations, if any, from the above codes & standards that affect performance and rating are required to be clearly indicated by the Contractor with the offer. The Contractor is required to furnish copies of the applicable standards in English language at the time of bidding. 1.03.00 The compliance of 132 KV cables & accessories manufactured with the provisions of these specifications shall not relieve the contractor of his responsibility of furnishing cables of proper design, electrically & mechanically suitably to meet the operating guarantees at the specified service conditions.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E 16 PAGE 3 OF 17

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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)	नदीपीसी NTPC नारदी hydro
2.00.00	GENERAL DESIGN ASPECTS	
2.01.00	MECHANICAL ASPECTS	
2.01.01	The 132 KV cables <u>for both the outgoing circuits</u> shall be installed in the same tunnel/ trench, which is naturally ventilated and no forced ventilation cooling is envisaged.	
2.01.02	Each 132 KV cable of single core 400 sq.mm size shall be supplied in single length. The exact length of each cable shall be finalized during detailed design stage. The cable joints shall not be permitted.	
2.01.03	Laying arrangement of 132 KV cables shall be such as to achieve optimum space saving, neat and logical arrangement when laid in horizontal snaking formation. The routine inspections and possible repairs for all elements shall be accessible without removing support structures.	
2.01.04	The 132 KV cables shall be securely supported for the entire length with suitable cable clamps and spacers to maintain continuous equal space between the cables laid in horizontal snaking formation.	
2.01.05	Cables shall be supported on suitable cable supporting arrangement of galvanized steel in such a way so as to avoid development of any type of stress in the cable. The laying of cables shall be in a horizontal snaking formation to absorb the thermal expansion and contraction of the cables. Necessary calculations in this regard shall be furnished during design stage.	
2.01.06	The ambient temperature at project site varies between sub zero to (+) 27°C. The relative humidity varies between 35% to about 70%. However, ambient temperature of (+) 40 °C along with the other climatic parameters as specified, shall be taken in to consideration while designing the cables and accessories.	
2.01.07	All the accessories shall be identical allowing for interchangeability.	
2.01.08	The cable system shall withstand the electro mechanical forces due to short circuit and earth fault currents including superimposed seismic forces.	
2.01.09	All accessories of power cables shall be capable of withstanding the specified seismic forces along with short circuit forces.	
2.02.00	ELECTRICAL ASPECTS	
2.02.01	The 132 KV cables and accessories shall be suitable for flow of power, under isolated operation with the system and connected to grid system and according to loading cycle of Rammam Stage III H.E. Power Project (3X40 MW).	
2.02.02	All lengths of 132 KV cables and accessories shall be capable of continuous operation at the maximum rated current without exceeding the maximum conductor temperature as specified in the Guaranteed and other Technical Particulars.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-B SUB-SECTION – E 16 PAGE 4 OF 17

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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)	नर्मदी नदी NTPC राजकोट Hydro
2.02.03	Thermal rating for all current carrying parts of the cable system shall be suitable for the normal rated current and for the rated symmetrical short circuit current of 40kA for duration of 1 second.	
2.02.04	The contours of energized metal parts of the 132 KV cable end terminations shall be such as to eliminate areas/points of high electrostatic flux concentrations. Surfaces shall be smooth with no projections or irregularities, which may cause visible corona.	
2.02.05	Metal clamps and spacers for the 132 KV cables and other metal parts shall be of non-magnetic material.	
3.00.00	132 KV CABLE	
3.01.00	General	
3.01.01	The cable shall confirm to IEC-60840. The cable shall consists of single core 400 sq. mm stranded copper compacted circular conductor, extruded semi conducting compound conductor screen, cross linked polyethylene (XLPE) dry cured insulation, extruded semi conducting compound insulation screen, bedding of swellable type water blocking semi conducting tape, copper wire screen with copper binder tape(as per requirement), semi conducting swellable tape, aluminium sheath and extruded flame retardant Polyethylene (PE)/ FRLS PVC outer-sheath with overall graphite coating.	
3.01.02	The conductor screen, insulation and semi-conducting insulation screen shall be extruded in one operation of triple extrusion process, so as to obtain continuously smooth interfaces. The conductor screen and insulation screen shall be of semi-conducting compound. The copper wire/tape screen together with aluminium sheath shall be capable of withstanding the short circuit current of 31.5 KA for one second. The Contractor shall furnish the supporting calculations for screen sizing.	
3.01.03	The cable shall be suitable for use in solidly earthed system at one point.	
3.01.04	The cable shall be suitable for installation in air in underground tunnels and/or built up concrete trenches with restricted air circulation. The cable shall withstand all mechanical and thermal stresses under steady state and transient operating conditions. There may be chances of water flooding in concrete trenches for which cables shall be suitable.	
3.01.05	Repair to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are also not acceptable.	
3.01.06	Cable ends shall be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture.	
3.01.07	Each cable length shall be provided with a pulling socket eye which shall be fitted to the pulling end. Pulling socket eye shall be able to take the pulling force.	
3.01.08	The Eccentricity of the core shall not exceed 10% and Ovality of the core shall not exceed 5%.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-B SUB-SECTION - E 16 PAGE 5 OF 17

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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)	नवीनी NTPC आरडी hydro
3.02.00 3.03.00 3.04.00 3.05.00 3.06.00 3.07.00	The Eccentricity shall be calculated as $(t_{max} - t_{min})/t_{max} \leq 0.10$ The Ovality shall be calculated as $(d_{max} - d_{min})/d_{max} \leq 0.05$ where t_{max}/t_{min} are the maximum/minimum thickness of insulation and d_{max}/d_{min} are the maximum/minimum diameter of the core. Conductor Conductor shall consist of plain annealed copper wires in accordance with IEC-60228 or equivalent and the shape shall be circular and very well compacted to facilitate a smooth interface between conductor screen(shield) and the insulation. The conductor shall have smooth surface with no intermediate joint. Conductor Screen Conductor screen shall consist of extruded semi-conducting compound applied over the conductor, which shall be firmly bonded to the inner surface of the insulation layer. The semi-conducting compound shall be free from any void and protrusion. Insulation Insulation shall be of extruded Cross Linked Polyethylene (XLPE). The insulation shall be free from any void and contaminant. The average thickness of insulation shall not be less than the nominal value guaranteed in the technical particulars. The minimum thickness of insulation at any point shall not be less than 90% of the nominal value guaranteed in technical particulars. Insulation Screen Insulation screen shall consist of extruded semi-conducting compound and shall firmly be bonded to the insulation. The semi-conducting compound shall be free from any void and protrusion. Bedding Bedding shall consist of layer(s) of swellable semi conducting tape(s) to be applied over the extruded semi-conducting insulation screen with suitable overlap. Semi-conducting swelling tape(s) shall also be provided over copper wire screen (if applicable). Metallic Sheath The metallic inner-sheath shall consist of aluminium . The calculations for sizing and short circuit withstand capability of the metallic sheath, along with copper wire screen & copper binder tape (if applicable) shall be submitted during detailed design stage. The average thickness of sheath shall not be less than the nominal value specified in guaranteed technical particulars.	
	RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI PART-B SUB-SECTION - E 16 PAGE 6 OF 17

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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)	
3.08.00	Outer Sheath Outer sheath shall consist of extruded black and flame retardant PE / FRLS PVC compound, in accordance with IEC-60840/60332 Part1. The average thickness shall not be less than the nominal value specified in the guaranteed technical particulars.	
3.09.00	Cable Identification/ Marking Atleast the following clear markings shall be provided over outer sheath of the cable at an interval of five metres throughout the length of the cable by embossing: i) Rated voltage ii) Conductor size iii) Type of insulation iv) Manufacturer's name v) Year of manufacture vi) Purchaser's name vii) Sequential marking of length of cable in metres by embossing/printing at every meter The embossing/printing shall be progressive, automatic, in line and marking shall be legible and indelible.	
4.00.00	CABLE DRUMS	
4.01.01	Cables shall be supplied in steel drums of heavy construction.	
4.01.02	The employer may insist on supply of drums with definite cable lengths (with ± 2 meter tolerance) with definite cable lengths to be decided during detailed Engineering. Drums with shorter lengths shall not be accepted. Contractor shall not be reimbursed for any excess lengths supplied. Cable joints shall not be permitted.	
5.00.00	CABLE ACCESSORIES	
5.01.00	CABLE TERMINATIONS / SEALING ENDS The sealing ends shall be located in the Generator Transformer yard & Switchyard to connect XLPE cables with for overhead transmission lines. The sealing ends shall be suitable for connection of 1 nos. 1C X 400 sq.mm XLPE cable per phase. Each termination/sealing end shall be complete with all fittings, supporting structures, earthing, accessories, consumables etc. as required during erection, testing and commissioning.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-B SUB-SECTION - E 16 PAGE 7 OF 17

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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)	
	The termination shall be oil filled / SF6 insulation type suitable for connection of 1 Nos. 1C X 400 sq.mm XLPE cable per phase for Switchyard end & Generator Transformer end and shall be made completely weatherproof through cable sealing ends. Accessories shall consist of stress relief system comprising of pre moulded material. The housing of each of the outdoor sealing end shall be composite type or porcelain type insulator to give high creepage distance. The minimum nominal specific creepage distance shall be 25mm/kV. Each outdoor type sealing end shall be supplied complete with mounting plate insulators to insulate the sealing end from supporting structure. Each sealing end shall be provided with two terminals, diagrammatically opposite each, suitable for bolting of the metallic sheath of cable. 5.02.00 Link Boxes 5.02.01 Link boxes shall be suitable for outdoor installation in heavily polluted atmosphere and shall be made completely weather proof. There shall be one link box for <u>each</u> phase. The cable screen/sheath connections shall be bolted type. The connecting bar and disconnecting link shall be of copper. The arrangement shall be installed in a water tight box of min. 2mm thick CRCA steel having degree of protection as IP 55. Disconnecting links shall be provided to sealing ends to facilitate periodic checking of the integrity of the outer sheath. 5.02.02 The outdoor terminal end shall have suitable type of disconnecting link box Cable Covering Protective Unit (CCPU) to disconnect the earthing circuit during testing with sheath voltage limiter. The GIS side indoor terminal end shall have disconnecting link box (CCPU) for direct earthing. 5.02.03 The disconnecting link box shall be mounted on the galvanized supporting steel structure and provide for each circuit individually. The protective device (sheath voltage limiter) shall be of non linear resistor type and shall be made of zinc oxide compound. 5.02.04 The switchable blade shall be made of copper. All pins and disconnections shall be weather proof. All link contacts shall be of copper. They shall be self-adjusting type. The contacts shall be designed so that the pressure may not change with the normal wear and tear during operation. 5.02.05 BONDING CABLE Bonding cable shall be used for earthing the metallic sheath of 132 KV cable and as earth continuity wire, equalizing earth level between disconnecting links. Construction and materials of bonding cable shall comply with relevant IEC or equivalent standards and the cross sectional area shall be minimum 300mm² copper so as to withstand the short circuit rating of the cable system. The cable shall be 1.1kV grade , single core, XLPE insulated and PVC outer sheathed.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E 16 PAGE 8 OF 17

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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)	नर्मदी पी पी NTPC रामम hydro
5.02.06	TERMINATION/SEALING END SUPPORTING STRUCTURE Supporting structure for outdoor/ indoor termination /sealing end shall consist of galvanized steel members. The supporting structures shall be uniform, clean, smooth and free from spangle as possible. All galvanizing shall comply with the requirements of the relevant IEC/IS or ASTM Standards.	
5.02.07	CABLE SUPPORTS AND ACCESSORIES	
5.02.07.01	Cable support system shall be pre-fabricated bolted type.	
5.02.07.02	Support system for cables shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall have provision for supporting cantilever arms & cables. The support system shall be of the type as described hereunder: a. Cable supporting steel work for cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc. b. The system shall be designed in such a way so that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares, fittings and accessories shall be prefabricated and factory galvanised. c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form the arrangements required to support the cables. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the structural steel or insert plates will be permitted. Any cutting or welding of the galvanised surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied d. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation. e. The typical arrangement of flexible support system is described briefly below: i) The main support channel and cantilever arms shall be fabricated out of rolled steel sheet conforming to IS. ii) The length of cantilever arms shall be decided based on minimum spacing between two cables as 2D with horizontal snaking arrangement, where D = overall diameter of cable. iii) Cantilever arms portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened. The exposed end portion of each cantilever shall have a rubber cap to avoid injury etc.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-B SUB-SECTION – E 16 PAGE 9 OF 17

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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)	एनटीपीसी NTPC रामम hydro																																				
5.02.07.03	The support system shall be designed by the Contractor to fully meet the requirements as specified. The cable support shall be designed and supplied complete in all respect with necessary embedment, hardware, cable earthing materials etc. The Contractor shall submit the detailed drawings of the system offered by him including length & supporting arrangement for each cantilever arm along with the load calculations during detailed engineering.																																					
5.02.08	132 KV CABLE CLAMPS Each cable shall be a clamped with single way aluminium clamps at each support. The material of the clamps shall be aluminum alloy in accordance with relevant IEC/IS or equivalent standards and the cable clamps shall be designed for the type, rating and diameter of cable to be clamped, as required. The cable clamp shall be bolted type into two halves and shall completely cover the cable similar to as shown in enclosed drawing as Annexure-I.																																					
5.03.00	All accessories shall be suitable for the technical parameters as specified and shall be suitably de-rated to the site conditions. TECHNICAL REQUIREMENTS The following criteria and ratings shall apply to the design and manufacture of 132 kV Cables and Accessories: <table border="0" data-bbox="448 1003 1374 1783"> <tr> <td>1</td><td>Type of Cables</td><td>Cross-linked polyethylene insulated</td></tr> <tr> <td>2</td><td>No. of Cores</td><td>Single.</td></tr> <tr> <td>3</td><td>Conductor size</td><td>400 sq. mm</td></tr> <tr> <td>4</td><td>Conductor material</td><td>Copper</td></tr> <tr> <td></td><td>Shape</td><td>Compacted Circular</td></tr> <tr> <td></td><td>Conductor Screen</td><td>Extruded semi conducting compound</td></tr> <tr> <td></td><td>Insulation Material</td><td>Extruded Cross Linked poly Ethylene (XLPE)</td></tr> <tr> <td></td><td>Insulation Screen</td><td>Extruded semi conducting compound</td></tr> <tr> <td></td><td>Bedding</td><td>Layer of swellable semi conducting tape(s) to form water barrier</td></tr> <tr> <td></td><td>Metallic Sheath</td><td>Aluminium ☐ with copper wires screen and copper binder tape as per requirement</td></tr> <tr> <td></td><td>Outer Sheath</td><td>Flame retardant Polyethylene (PE) / FRLS PVC</td></tr> <tr> <td>5</td><td>Normal system voltage</td><td>132 KV</td></tr> </table>		1	Type of Cables	Cross-linked polyethylene insulated	2	No. of Cores	Single.	3	Conductor size	400 sq. mm	4	Conductor material	Copper		Shape	Compacted Circular		Conductor Screen	Extruded semi conducting compound		Insulation Material	Extruded Cross Linked poly Ethylene (XLPE)		Insulation Screen	Extruded semi conducting compound		Bedding	Layer of swellable semi conducting tape(s) to form water barrier		Metallic Sheath	Aluminium ☐ with copper wires screen and copper binder tape as per requirement		Outer Sheath	Flame retardant Polyethylene (PE) / FRLS PVC	5	Normal system voltage	132 KV
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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)		एन टी पी सी NTPC National Thermal Power Corporation Hydro
	6	Maximum system voltage	145 KV
	7	Rated Short Circuit Withstand Current at a rated voltage for 1 second	Symmetrical short circuit 31.5kA r.m.s for 1 second
	8	System frequency	50hz
	9	Frequency variation	+3% -5%
	10	Rated continuous Current	650 Amp.
	11	Overload capacity	Nil
	12	Maximum allowable temperature for cable and accessories.	As per IEC
		Operating Temperature of conductor:	
		Maximum permissible temperature during normal operation under combined effect of ambient and maximum load	90 deg C
		Maximum permissible temperature during short circuit under combined effect of ambient and maximum load (with conductor temperature at inception of short circuit as 90 deg. C).	250 deg C
	13	Basic impulse insulation level (1.2/50 micro second wave)	650 kV (peak)
	14	Power frequency withstand voltage	As per relevant IEC
	15	Laying conditions	
	(a)	Laid on cable racks in cable trench with suitable spacing between cables	2d mm centre to centre (typical) where "d" is overall diameter of finished cable
	(b)	Earthing of screen	
		- GT end	Solidly earthed link box (CCPU) without SVL (sheath voltage limiter).
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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)		एन टी सी NTPC रामम hydro
	- Switchyard end	Solidly earthed link box (CCPU) with SVL (sheath voltage limiter)	
	(c) Ambient air temp.	40 deg. C	
	(d) Type of atmosphere	Heavily polluted	
6.00.00	INSTALLATION WORK AT SITE		
6.01.00	Cable installation shall be carried out generally as per applicable standard/manufacturer's guidelines.		
6.02.00	Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall the drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For un-reeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out from over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture.		
6.03.00	While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangement. Pulling tension shall not exceed the values recommended by cable Manufacturer. Cable ends shall be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture. Selection of cable drums for each run shall be so planned so as to avoid straight through joints. Cable splices will not be allowed except where called for by the drawings or is unavoidable and permitted by the Project Manager. Care should be taken while laying the cables so as to avoid damage to cables.		
6.04.00	Bending radii for cables shall be as per manufacturer's recommendations. Manufacturer's instructions shall be strictly adhered to and necessary conducting medium for checking healthiness of outer sheath shall be applied.		
6.05.00	In each cable run, extra length shall be kept at suitable point to enable two straight joints to be made, should the cable develop fault at a later stage.		
6.06.00	Contractor shall ensure that the drawings, instructions and recommendations are correctly followed to avoid damage to the equipment.		
6.07.00	Contractor shall carry out the bonding of screen at the both ends of terminal using the insulated conductor of required size with earth mat. ✓		
6.08.00	The Contractor shall ensure that the cables and accessories supplied by him are installed in a neat workman-like manner such that it is levelled, properly aligned and well oriented. The tolerance shall be as established in the Contractor's drawing and/or as stipulated by the Employer.		
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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)	
6.09.00	The cable termination work shall be carried out by an experienced cable jointer who shall have adequate experience in jointing and termination of 132kV or higher grade XLPE cables. The successful Contractor shall submit, sufficiently in advance, the bio-data of the cable jointer giving the details of his qualification and experience for employer's approval.	
6.10.00	In order to identify the phases and circuits the identification tags shall be provided at each end of the cable as well as at an interval of 100m in the cable length for each phase and circuit.	
7.00.00	TESTS:	
7.01.00	TESTS FOR 132KV CABLES:	
7.01.01	The bidder shall clearly specify compliance to conducting all tests at works and at site and shall make necessary arrangement for testing equipment, as required, for works & site testing.	
7.01.02	Type Tests: - All type tests, routine tests and Acceptance tests on 132kV cables shall be carried out as per IEC 60840. - Three (3) samples of one meter each shall be cut from the 132kV cable and individual weights of Copper Aluminium XLPE and PE materials shall be used for Price Adjustment formula as per Appendix-II to Contract Agreement (Section-VII) and clause no. 11 of GCC (Section-IV).	
7.01.03	Routine tests and Acceptance tests shall be conducted on cables as per IEC 60840, Technical specifications and other relevant standards.	
7.02.00	TESTS FOR 132KV CABLE ACCESSORIES:	
7.02.01	All type Test for 132 KV cables accessories shall be in accordance with IEC 60840/ IEC 61462 as applicable.	
7.02.02	The Contractor shall clearly specify compliance to all tests at works and at site and shall make necessary arrangement of testing equipment requirement for works & site testing.	
7.02.03	Routine tests and Acceptance tests on the accessories shall be in accordance with standard IEC 60840/ IEC 61462 as applicable.	
7.03.00	TYPE TESTS FOR CABLE SUPPORT SYSTEM: The type test for cable support system shall be as follows: - Load test - Vertical support, channel nut slip characteristics - Weld integrity test	
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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)	एनटीपीसी NTPC राष्ट्रीय hydro
7.04.00	The detailed arrangement for test setup, method core testing and allowable deflection /values shall be finalized during detailed engineering as per NTPC requirements. SITE TESTS: Following site tests shall be carried out by the Contractor and all the equipment required for the site tests shall be arranged by the Contractor. a) HV test as per clause 15.2 IEC 60840. b) After completion of installation non metallic outer sheath shall be tested in accordance with clause- 5 IEC 60229. c) The insulation resistance of the cable shall be checked before & after the HV test on cable. d) The core resistance shall be measured and the value corrected in accordance with clause 5 of IEC 60228.	
8.00.00	PACKING & SHIPMENT	
8.01.00	Immediately after the completion of tests at works both ends of the cables shall be sealed with suitable end caps to prevent the ingress of moisture, dirt and insects. Each length of cable shall be supplied on a seaworthy robust steel drum.	
8.02.00	Drums or part of drums made from ferrous metals shall be treated with suitable rust preventive finish of coating to avoid rusting, during transit or storage.	
8.03.00	Indoor and outdoor cable accessories, cable support systems and other associated items shall be packed in robust wooden or suitable cases. Hydrophobic materials shall be dully protected from sea water or rain during transportation and storage.	
8.04.00	The bonding cable shall be supplied on wooden /steel drum.	
8.05.00	Shipping dimensions of cable drums shall be as large as practicable but within transport limitations specified.	
8.06.00	The construction of cable drums shall be suitable for convenient handling of drums during loading/ unloading, in transit and storage & laying at site. The cable drums shall be suitable for wheel mounting.	
8.07.00	The supplier shall indicate the methods of storage of cable drums and accessories at site during detailed design stage.	
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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)																नवीनी NTPC Hydro	
	132KV CABLES																	
	Attributes / Characteristics Item Components Sub System Assembly		Make, Type, Rating, TC	Dimension/surface finish	Mechanical Properties	Chemical Composition/Purity	Electrical Properties	Triple Extrusion & Curing / Hot Set Test	Eccentricity / ovality	Void & Contamination Test	Metallic (Cu) Screening	Moisture Barrier	Extrusion	Overlapping / Binding	Spark test on outer Sheath	Thermal stability of Sheath	Constructional feature as per NTPC SPEC.	Routine and acceptance test as per relevant standard and NTPC specification
	Copper (IEC 60228)	Y	Y	Y	Y	Y												
	Semiconducting compound	Y		Y		Y												
	PVC Compound (IEC 60840)	Y		Y		Y												
	Swelling Tape(Water blocking tape)	Y	Y	Y														
	Copper tape/Foil/Wire	Y	Y	Y		Y												
	XLPE Compound (IEC60840)	Y		Y		Y												
	Lead Alloy/ AL	Y		Y	Y													
	Laminated/ Binder Tape	Y	Y	Y														
	Steel drum		Y															
	Triple extrusion & Curing of Cores		Y	Y		Y	Y	Y	Y									
	Semiconducting swellable tape over insulation screening	Y	Y	Y		Y					Y		Y					
	Copper wire screening/copper tape		Y								Y							
	Lead sheathing											Y	Y					
	Laminated/ Binder Tape		Y											Y				
	Inner Sheathing		Y										Y			Y		
	Outer Sheathing (Graphite Coated PVC)		Y										Y		Y	Y		
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CLAUSE NO.	132KV CABLES AND ACCESSORIES (E16)															एनटीपीसी NTPC रामम hydro		
	Power Cable Final inspection (IEC – 60840)		Y	Y		Y	Y		Y	Y			Y	Y	Y	Y	Y	Y
Notes: 1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents. 2. Make of all major Bought Out Items will be subject to NTPC approval.																		
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SECTION- 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

In following clauses contractors stands for supplier/ vendor/ bidder and employer stands for purchaser/ NTPC/ BHEL.

3.1 PROJECT DETAILS

	Particular	Details
a)	Customer	NTPC HYDRO LIMITED.
b)	Engineer/Consultant/ Inspector	NTPC HYDRO LIMITED.
c)	Project Title	NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW): 132kV Switchyard
d)	Project Location	The project can be accessed from Siliguri via Ghoom in Darjeling district of West Bengal or from Jorhang in Sikkim by road. Bagdogra is nearest airport. New Jalpaiguri is the nearest broad gauge railway station. The proposed project site is connected by all-weather metalled road from Siliguri.
e)	Latitude & Longitude	North: 27°6'00", 27°9'00" and East: 88°8'00", 88°14'00"
f)	Nearest Railway Station	New Jalpaiguri
g)	Distance of project location from the Railway station	75kms (approx.)
h)	Nearest Major Town	Siliguri
i)	Distance of the town from the project site	140km.
j)	Nearest commercial airport	Bagdogra
k)	Distance of airport from the project site	-
<u>SITE CONDITIONS</u> (for design purposes)		
a)	Design ambient temperature	40°C
b)	Maximum Relative humidity	Max. <95% & ^Min. >35%
c)	Height above mean sea level	Less than 910meter

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d)	Pollution Severity	Class-III, Heavy (25mm/kV)
e)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3) 1987
f)	Basic Wind speed "Vb" at ten meters above the mean ground level.	47 m/ sec
g)	Category of terrain	Cat -2
h)	Risk Coefficient "K1"	1.07

3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	132 kV
1	Highest system voltage	145 kVrms
2	Lightning Impulse voltage	
	Phase to earth and between phases	650kVp
	Across isolating distance	750kVp
3	Switching impulse voltage	--
4	Power frequency withstand for 1 min (rms)	
	Phase to earth and between phases	275 kV(rms)
	Across isolating distance	315 kV(rms)
5	Max. fault level (1 sec.)	31.5kA
6	Minimum creep age distance	3625mm
7	Radio Interference Voltage at level 92kV	Not more than 1000μV

3.1.2 AUXILIARY POWER:

Sl.No.	Nominal Connection Voltage	Variations in Voltage	Frequency	Phase	Neutral
1	415V	±10%	50±5%	3Phase , 4 Wire	Solidly Earthed
2	240V	±10%	50±5%	1 phase	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Fault level of 415V system shall not be less than 20kA.

3.1.3 CLEARANCES:

Sl.No.	Nominal Voltage	Phase to Phase (mm)	Phase to Earth (mm)	Section Clearance (mm)	Ground Clearance (mm)
1	132kV	1300	1300	4000	5000

3.1.4 The various minimum heights of the switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	2nd Level	3rd Level
132kV	5000mm	11500mm	14000mm/18000mm

The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or support insulators to the bottom of the equipment structure, where it rests on the foundation pad shall be 2250mm.

3.2 INSTRUCTION TO BIDDERS:

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification.

It is recognized that the bidders may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals

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offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures, makes shall be as defined in Section-Lighting System.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

3.3 CODES AND STANDARDS

The supplier is required to follow local statutory regulations stipulated in the latest amended Electricity Supply Act 1948 and Indian Electricity Rules 1956, and other local rules and regulations.

The equipment to be furnished under this specification shall conform to latest issue with all amendments of standards and/ or codes specified under respective section heads. The standards mentioned in the specification are not mutually exclusive or complete in them, but intended to complement each other. The supplier shall also note that list of standards presented in this specification is not complete. Whenever necessary the list standards shall be considered in conjunction with specific IS/IEC. When the specified requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards which ensure equivalent or better performance that specified in the standards referred under section shall also be acceptable.

In case governing standards for the equivalent for the equipment is different from IS/ IEC, the salient points of difference shall be clearly brought out in additional information schedule along with English language version of standard of relevant extract of the same. The equipment conforming to standards other than IS/ IEC shall be subject to Purchaser's approval.

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The full names of the codes and standards mentioned in abbreviations under various equipment heads are as follows:

BS	British Standards
IEC/ CISPR	International Electro-technical Commission
IS	Bureau of Indian Standards
ISO	International Organization for Standards
NEMA	National Electric Manufacturers Association

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain; restrike etc. under such over voltage conditions. All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factor like wind load, temperature variation, ice & snow, (not applicable for this project) short circuit etc for the equipment.

The equipment shall also comply with the following:

- All equipment shall be suitable for hot line washing.
- To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
- Piping, if any, between equipment control cabinet or operating mechanism to marshalling box of the equipment shall bear proper identification to facilitate the connection at site.
- All equipment shall be supplied with necessary inter-pole cabling, and its cost shall be included in the cost of equipment.

3.5 ENGINEERING DATA

3.5.1 Drawings

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

Each drawing submitted by the Contractor shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

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

The review of these data by the purchaser will cover only general conformance of the data to the specification and documents, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect substation layout.. This review by the purchaser may not indicate a thorough review of the dimensions, quantities and details

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of the equipment, material, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the purchaser shall not be considered by the contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

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

All engineering data submitted by the contractor after final process including review and approval by the purchaser shall form part of the contract document and the entire work performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the purchaser in writing.

3.5.2 Approval Procedure

The following procedure for submission and review/approval of the drawings, data, reports, information, etc. shall be followed by Contractor:

- a. All data/information furnished by Vendor in the form of drawings, documents, Catalogues or in any other form for NTPC's information/interface and/or review and approval are referred by the general term "drawings".
- b. The 'Master drawings list' shall be submitted for review and approval of Employer before award of contract. The Contractor shall have to prepare and submit any other drawings and reference documents in addition to the drawings contained in the list, if so required during engineering stage as felt necessary by the Employer. Number of copies of the list for the distribution shall be as mutually agreed between Contractor and Employer.
- c. All drawings (including those of sub vendors') shall bear at the right hand bottom corner the 'title block' with all relevant information duly filled in. The Contractor shall give this format to his sub vendor along with his purchase order for sub vendor's compliance. The size of title block basic format and its contents shall not be changed. All drawings shall be in English language. All dimensions shall be in metric units.
- d. Contractor shall submit all the drawings in five (5) copies for review of Employer. Employer shall forward their comments within four (4) weeks of receipt of drawings.
- e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

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- f. Contractor shall resubmit the drawings approved under Category II and III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.)
- g. In case Contractor does not agree with any specific comment, he shall furnish the explanation for the same to Employer consideration. In all such cases Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.
- h. It is the responsibility of the Contractor to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.
- i. Contractor shall not make any changes in the portion of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawings identifying the changes (along with reasons for changes) for Employer's review and approval.
- j. Approval of drawings will not in any way relieve the Contractor of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.
- k. The drawing approval progress report shall be submitted in at least three (3) copies within one (1) week from the last date of the every month.

3.5.3 Erection Drawings.

- a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/equipment with identification number, match marks, bill of materials, assembly procedures etc.
- b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

3.5.4 Instruction Manual

- a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipment for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least thirty (30) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipment, the transportation, storage, installation, testing, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. These instruction manuals shall be submitted in five (5) copies for approval.
- b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall be corporate and the updated final instruction manuals shall be submitted.

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- c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.
- d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets, drawings and list of parts with procedures for ordering spares. Maintenance instructions shall include charts showing lubrication, checking, and testing and replacement procedure to be carried out daily, weekly, and monthly and at longer intervals to ensure trouble free operation. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or breakdown. A collection of the manufacturer's standard leaflets will not be accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

3.5.5 Final Submission of drawings and documents:

The Contractor shall furnish the following after approval of all drawings /documents and test reports:

- a. List of drawings bearing the Employer's and Contractor's drawing number.
- b. Ten (10) bound sets along with 4 CD-ROMs of all drawing.
- c. All documents/designs in five (5) copies as noted above.
- d. Contractor shall also furnish nine (9) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Contractor shall also furnish four (4) sets of film reproducible or CD-ROMs of all as-built drawings as decided by the Employer.
- e. The Contractor shall also furnish eleven (11) copies of instruction manuals (after approval) for all the equipment.

3.5.6 TEST REPORTS

Five (5) copies of all test reports shall be supplied for approval before shipment of Equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval seven bound copies of all type and routine test reports shall be submitted to Employer.

3.6 MATERIAL /WORKMANSHIP

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such

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approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

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

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

The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

3.7 LIMIT OF CONTRACT

All the equipment, materials and services furnished by the manufacturer shall be complete in every respect with all mountings, fitting, fixtures and standard accessories normally provided with such equipment, and needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in technical specification and unless included in the list of exclusions. The manufacturer shall supply at no extra cost to Employer any additional material/service not covered specifically but which are found to be required for fulfillment of the scope of work under specification.

3.8 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

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

SPACE HEATERS

The heaters shall be suitable for continuous operation at 230 V as supply voltage. On –off switch and fuse shall be provided.

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

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a

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value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistance varnish shall be applied on 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 interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

Ventilation opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

Degree of Protection

The enclosure of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

- a. Installed out door: IP- 55
- b. Installed indoor in air conditioned area: IP-31
- c. Installed in covered area: IP-52
- d. Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-41.
- e. For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS: 13947 (Part -I) / IEC-947 (Part-I) / IS 12063/IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

3.9 RATING PLATES, NAME PLATES AND LABELS

- 3.9.1 The equipment nameplate should preferably be of stainless steel. In case of aluminium, it should be at least 2mm thick.. The inscription on the nameplate shall be engraved and no punching shall be accepted except for equipment serial number and year of manufacture. These nameplates shall be black with white engraved lettering.
- 3.9.2 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.
- 3.9.3 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.
- 3.9.4 Name plates of cubicles and panels may be made of non-rusting metal or 3 ply lamicaid.
- 3.9.5 Each switch shall a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.

3.10 GALVANISING :

- 3.10.1 The galvanised surface shall consist of a continuous film adhering to the steel. The finished surface shall be clean and smooth, and shall be free from defects like dissolved patches, base, spot, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits,

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blistered surfaces, flaking or peeling off, etc. The presence of any of these defects shall render the material liable to rejection.

3.10.2 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, smooth continuous and free from acid spots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at Contractor's cost. The amount of zinc deposit shall be not less than 610 gms. per sq.m. of surface area and in addition, the thickness of zinc at any spot shall not be less than 85 microns and foundation bolts shall have heavier zinc coating at least 800 gram/m².

3.10.3 . The Employer reserves the right to measure the thickness of zinc deposit by Elko meter or any other instrument acceptable to Employer and reject any component which shows thickness of zinc at any location less than 85 microns. The testing on the galvanised materials shall be carried out as per IS:2633.

3.10.4 The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area. The threads having extra deposit of zinc shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have minimum deposits of zinc on them as specified.

3.11 PAINTING

The sheet steel to be painted shall be pre-treated in tanks in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint on panels shall be applied. Electrostatic painting shall also be acceptable. Finishing paint on outside of the panels shall be as required otherwise by the Employer. The inside of the panels shall be glossy white. Each coat of finishing shall be properly stoved. The paint thickness shall not be less than 50 microns. Finished parts shall be coated by peelable compound by spraying method to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

3.12 QUALITY ASSURANCE PROGRAMME

3.12.1 The Contractor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his subcontractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS- 14001.

A quality assurance programme of the contractor shall generally cover the following:

- i. His organisation structure for the management and implementation of the proposed quality assurance programme
- ii. Quality System Manual
- iii. Design Control System
- iv. Documentation Data Control System
- v. Qualification data for Bidder's key Personnel.

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- vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- vii. System for shop manufacturing and site erection controls including process, fabrication and assembly.
- viii. Control of non-conforming items and system for corrective actions and resolution of deviations.
- ix. Inspection and test procedure both for manufacture and field activities.
- x. Control of calibration and testing of measuring testing equipments.
- xi. System for Quality Audits.
- xii. System for identification and appraisal of inspection status.
- xiii. System for authorising release of manufactured product to the Employer.
- xiv. System for handling storage and delivery.
- xv. System for maintenance of records, and
- xvi. Furnishing quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

3.12.2 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 3.12.2.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.
- 3.12.2.2 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.
- 3.12.2.3 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control Organisation, during various stages of site activities starting from receipt of materials/equipment at site.
- 3.12.2.4 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.

These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification, approved quality plans and

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applicable standards must be documented and referred to Employer along with technical justification for approval and dis-positioning.

- 3.12.2.5 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of MDCC.
- 3.12.2.6 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- 3.12.2.7 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.

All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
- 3.12.2.8 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
- 3.12.2.9 Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.
- 3.12.2.10 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with.
- 3.12.2.11 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 3.12.2.12 No welding shall be carried out on cast iron components for repair.
- 3.12.2.13 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 3.12.2.14 All non-destructive examination shall be performed in accordance with written procedures as per International Standards; The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.
- 3.12.2.15 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's

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quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.

Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders/contracts for such bought out items/components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor.

- 3.12.2.16 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub vendor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- 3.12.2.17 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
- 3.12.2.18 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
- 3.12.2.19 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
- 3.12.2.20 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
- 3.12.2.21 **Burn in and Elevated Temperature Test Requirement for Electronics solid State Equipment**
 - a) All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from manufacturing works, as per the following cycle.
 - b) Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg. C. The equipment shall be interconnected with devices which will cause it to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C.

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c) **Burn in Test Cycle**

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

In case the Contractor/ sub-contractor is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Contractor/ sub- contractor along with the statistical figures to validate the alternate procedure to be forwarded.

The Contractor/Sub-contractor shall carry out routine test on 100% item at contractor/sub-contractor's works. The quantum of check/test for routine & acceptance test by employer shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

3.12.3 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (☐) mark within three weeks after despatch of the equipment.

3.12.3.1 Typical contents of Quality Assurance Document are as below:-

- i) Quality Plan,
- ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
- iii) Factory test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- iv) Type test report (wherever applicable).
- v) Non-destructive examination results /reports including radiography interpretation reports.
Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- vi) Heat Treatment Certificate/Record (Time- temperature Chart)
- vii) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure)Verification sketches, if used and methods used to verify that the inspection and testing points in the Quality Plan were performed satisfactorily
- viii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
- ix) Certificate of Conformance (COC) whoever applicable.
- x) MDCC

3.12.3.2 Similarly, the contractor shall be required to submit two hard copies and two sets on CD ROM of Quality Assurance Documents (in line with above) pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

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- 3.12.3.3 Due to the large variety of equipment items, it is always possible to adapt the content of the quality document to better match the particularities of any equipment. This shall be done in agreement with the Supplier and the Inspector.

The Quality Document file shall be progressively completed by the Supplier's sub- supplier to allow regular reviews by all parties during the manufacturing.

Each quality document shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

- 3.12.3.4 Before shipping any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

- i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory. The Inspector shall stamp the quality document (or applicable section) for release.
- ii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing finalizing the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
- iii) If a decision is made to ship equipment, whereas all outstanding actions cannot be readily cleared for the release of the quality document by the time as per contract documents (or finalization of the applicable section of the quality document within one month as per corresponding shipment date).The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status (signed by the Supplier Representative) to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed.

The final quality document will be compiled and issued at the final assembly place of equipment before shipment.

3.12.3.5 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer not later than 1 month after the delivery date for the corresponding equipment. One set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 1 month after the date of the last delivery similarly as stated above.

3.13 TYPE TESTING , INSPECTION, TESTING & INSPECTION CERTIFICATE

- 3.13.1 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

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- 3.13.2 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
- 3.13.3 The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
- 3.13.4 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- 3.13.5 When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 3.13.6 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.
- 3.13.7 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
- 3.13.8 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 3.03.00, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
- 3.13.9 All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipments in the presence of Project Manager / Inspector.

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3.14 PACKAGING & PROTECTION

3.14.1 Packing, Marking and shipping

The packing and shipping shall be carried out in accordance with the standard practice of Contractor and with the following additional requirements:

- a) The equipment shall be prepared in such a manner as to protect the equipment from damage or deterioration during shipping or storage. The shipments can be exposed to heavy rains, hot sun, high humidity and sudden extreme changes of temperature. The equipment shall be packed and shipped so as to protect it from all such conditions and any other abnormal conditions, generally expected during shipping & storage.
- b) The metallic containers, if any, shall be considered as the property of the Contractor and he will be allowed to remove them from site once the contents are unpacked, inspected, documented and placed in temporary storage or in final position.
- c) The equipment shall be shipped in such a manner as to facilitate unloading, handling and storage en-route and at the site. The Contractor shall provide lifting lugs and special lifting devices for proper handling and erection.
- d) The Contractor shall be liable for any damage or loss resulting due to careless, improper, poor or insufficient packing and handling.
- e) Spare parts and spare equipment shall be packed separately in containers adequate for long term storage, plainly marked "Spare Parts Only". They shall be crated individually or in kits to be used in one single renewal or overhaul operation. Other spare part kits shall not be disturbed when using one set or kit.
- f) The Contractor shall at all times protect and preserve from damage, loss, corrosion and all other forms of damage, all parts of the works.

3.14.2 Transportation

- a) The Contractor shall make a careful examination of access rail/roadways to the site in order to confirm the practical maximum transport weight and dimensions as well as a careful examination of the ports of disembarkation particularly with respect to the capacity of the cranes installed and access roads.
- b) All instruments and computer/microprocessor based equipment imported into India from overseas for the purpose of this contract shall be air freighted to the nearest possible point and further by rail/road taking due precautions as per manufacturer's recommendations. Employer shall have the right to decide the items that should be air freighted and Employer's decision shall be binding on Contractor.

3.14.3 Insurance

- a) The Contractor shall insure all shipments and works at his own expense for not less than the full replacement cost plus any additional cost for accelerated manufacturing of the replacement parts.
- b) Loss or the damage to equipment during shipping or transportation to the site(s) or otherwise shall not constitute grounds for claims for extension in time or for extra

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3.14.4 Storage of Equipment

- a) The Contractor shall provide and construct adequate storage sheds for proper storage of equipment. Sensitive equipment shall be stored indoors. All equipment during storage shall be protected against damage due to act of nature or accidents. The storage instructions of the equipment manufacturers shall be strictly adhered to.
- b) The necessary transport packing shall be removed as soon as possible after receipt of equipment at the work site(s).

3.15 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

- 3.15.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of aluminium.. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.
- 3.15.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.
- 3.15.3 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.
- 3.15.4 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.
- 3.15.5 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.
- 3.15.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.
- 3.15.7 Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last at least till erection time.

3.16 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT.

- 3.16.1 All types of control cabinets, junction boxes, marshalling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:439 as applicable.
- 3.16.2 They shall be of painted sheet steel or aluminium. The thickness of sheet steel shall be 2mm cold rolled or 2.5mm hot rolled. The thickness of aluminium shall be 3mm and shall provide rigidity. Top of the boxes shall be sloped towards rear of the box. The paint shall be of grey RAL 9002 on the outside and glossy white inside. However, the junction and switch boxes shall be of hot dip galvanised sheet steel of 1.6mm thickness.
- 3.16.3 The cabinets/boxes/kiosks/panels shall be free standing or wall mounting or pedestal mounting type. They shall have hinged doors with padlocking arrangement. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets.
- 3.16.4 The degree of protection of all the outdoor boxes shall not be less than IP 55 as per IS 2147.

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- 3.16.5 The cable entry shall be from bottom, for which removable gasketed cable gland plates shall be provided.
- 3.16.6 Suitable 240V, single phase, 50Hz ac heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10deg. above the ambient.
- 3.16.7 The size of enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/kiosk/panel shall be provided with a 15A, 240V ac, 2 pole, 3 pin industrial grade receptacle with switch. For incoming supply, MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be of rotary switch type.
- 3.16.8 Each cabinet/box/kiosk/panel shall be provided with two earthing pads to receive 75mmx12mm GS flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire. The cabinets/boxes/kiosks/panels shall also be provided with danger plate, and internal wiring diagram pasted on inside of the door. The front label shall be on a 3mm thick plastic plate with white letters engraved on black background

3.17 TERMINAL BLOCKS

- 3.17.1 They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4.
- 3.17.2 The terminal blocks shall be of 1100 V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.
- 3.17.3 They shall be of moulded, non-inflammable thermosetting plastic. The material shall not deteriorate with varied conditions of temperature and humidity. The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating plastic material. Insulating barriers shall be provided between the terminal blocks so that the barriers do not hinder the wiring operation without removing the barriers.
- 3.17.4 The terminals shall be provided with marking tags for wiring identification.
- 3.17.5 Unless otherwise required (expected current rating) or specified, terminal blocks shall be suitable for connecting the following conductors on each side: All CT & VT circuits - Min. four 2.5 sq.mm. Copper flexible conductor AC & DC power supply -Two 16 sq.mm. Aluminium conductor circuits other control circuits - Min. two 2.5 sq.mm. copper flexible conductor

The terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall also be provided with short circuiting and earthing facilities.

3.18 Wiring

- 3.18.1 All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows:
- a) All circuits except CT circuits 2.5 sq.mm
 - b) CT circuits 4 sq. mm (minimum number of strands shall be 3 per conductor).
- 3.18.2 All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.
- 3.18.3 Wire terminations shall be made with solder-less crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring

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diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires shall not fall off when the wires and shall not fall off when the wire is disconnected from terminal blocks.

- 3.18.4 All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrules purposes.
- 3.18.5 All terminals including spare terminals of auxiliary equipment shall be wired up to terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be wired out. Inter-pole cabling for all equipment's shall be carried out by the Contractor.

3.19 CABLE GLANDS AND LUGS

- 3.19.1 Cable glands shall be Double compression type, tinned/Nicked plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and off tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.
- 3.19.2 The cable glands shall be tested as per BS: 6121. The cable glands shall also be duly tested for dust proof and weather proof termination.
- 3.19.3 Cables lugs shall be tinned copper solder less crimping type conforming to IS: 8309 and 8394 suitable for aluminium or copper conductor (as applicable). The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

3.20 CONDUITS, PIPES AND ACCESSORIES

- 3.20.1 The Contractor shall supply and install all rigid conduits, mild steel pipes, flexible conduits, Hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.
- 3.20.2 Rigid conduits shall be flow-coat metal conduits of Nagarjuna Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/ pipes shall be of a reputed make.
- 3.20.3 Flexible conduits shall be heat-resistant lead coated steel, water-leak, fire and rust proof, and be of PLICA make or equivalent.

3.21 MOTOR CONTROL CENTRE

- 3.21.1 The 415 Volt motor control centres (if provided separately) shall conform to the requirements for boxes/cabinets/kiosks. They shall be fixed type, shall be fully sectionalised and shall be equipped with load break switches. Motor feeders shall be provided with isolating switch fuse unit and Contractor with thermal overload relay and single phase protection. The motor Contractor shall have one normally open auxiliary contact for alarm purposes. The motor control circuit shall be independent from all other control circuits.
- 3.21.2 Isolating Switches
The incoming power supply isolating switch operation handle shall be interlocked with the control cabinet door as to prevent opening of door when main switch is closed. Device for by passing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.

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3.21.3 Fuses

All fuses shall be of the HRC cartridge type, conforming to IS: 2208 and suitable to mount on plugin type of fuse bases. Fuses shall be provided with visible operation indicators to show that they have operated. All accessible live connections shall be adequately shrouded, and it shall be possible to change fuses with the circuit alive, without danger of contact with live conductor. Insulated fuse pulling handle shall be supplied with each control cabinet.

3.22 MOTORS

3.22.1 Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall conform to type tests and shall be subjected to routine tests as per applicable standards.

3.22.2 Enclosures

- a) For motors to be installed outdoor, the motor enclosure shall have degree of protection IP: 55. For motors to be installed indoor, i.e. inside a box, the motor enclosure shall be dust proof equivalent to IP: 44.
- b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- c) Motors shall have drain plugs so located that they will drain water resulting condensation or other causes from all pockets in the motor casing.
- d) Motors weighing more than 25 kg shall be provided with eyebolts, lugs or other means or facility for lifting.

3.22.3 Operational Features :

- a) Continuous motor ratings (name plate rating) shall be at least suitable for the driven equipment at design duty operating point of driven equipment that will arise in service.
- b) Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously in the given system.

3.22.4 Starting Requirements

- a) All induction motors shall be suitable for full voltage direct on-line starting. These shall be capable of starting and accelerating to the rated speed along with the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops.
- b) Motors shall be capable of withstanding the electro-dynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The locked rotor current shall not exceed six(6) times the rated full load current for all motors subject to tolerance given in IS:325.
- d) Motors when started with driven equipment imposing full starting torque and supply voltage conditions specified shall be capable of withstanding at least two successive starts from cold condition at room temperature and one start from hot

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condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.

- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by a least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Contractor shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speeds lower than 20% and open for speeds above 20% of the rated. The speed switch shall be capable of withstanding 120% of the rated speed in either directions of rotation.

3.22.5 The maximum permissible temperature rise over the ambient temperature shall be within the limits specified in IS: 325 (for 3 phase induction motors) after adjustment due to increased ambient temperature specified.

3.22.6 The double amplitude of motor vibration shall be within the limits specified in IS: 729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

3.22.7 All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes.

3.23 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

- a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.
- b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
- c) Heat run test on contacts
- d) IR/HV test, etc.

3.24 LAMPS AND SOCKETS

3.24.1 Lamps:
All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

3.24.2 Sockets
All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

3.24.3 Hand Lamp:

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

3.25 Switches and Fuses:

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch-fuse units.

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Selection of the main and sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS 9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal Protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

All control switches shall be of rotary type. Toggle/piano switches shall not be accepted.

3.26 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

3.26.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5284. The support insulators shall be manufactured and tested as per IS: 2544 / IEC 168/IEC 273. The insulators shall also conform to IEC 815 as applicable.

Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

3.26.2 Porcelain used shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Hollow porcelain should be in one integral piece in green & fired stage.

3.26.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burns and other similar defects.

3.26.4 When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or when operating at normal rated voltage.

3.26.5 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.

3.26.6 Contractor shall make available data on all the essential features of design including the method of assembly of shells and metal parts, number of shells per insulator, the manner in which mechanical stresses are transmitted through shells to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

3.26.7 Post type insulators shall consist of a porcelain part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.

3.26.8 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

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- 3.26.9 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued; porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.
- 3.26.10 Bushings, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/ sample test in accordance with relevant standards.
- 3.26.11 Insulator shall also meet requirement of IEC - 815 as applicable, having alternate long & short sheds.

3.27 TYPE, ROUTINE & ACCEPTANCE TESTS:

All equipment to be supplied shall be of type tested design. During contract stage, bidder shall submit for Owner's approval the reports of all the type tests listed in specification/ IS/ IEC and carried out within last ten years from the date 12.01.2015. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the tests should have been either conducted at an independent laboratory or should have been witnessed by a client.

However if contractor is not able to submit report of the type tests conducted within ten years from the date 12.01.2015 or in the case of type test reports are not found to be meeting the specification requirements, the bidder shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design change". Minor changes if any shall be highlighted on the endorsement sheet.

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SECTION - IV

GUARANTEED TECHNICAL PARTICULARS FOR 132 KV POWER CABLE

- NTPC datasheet for 132 kV Power Cable (11 pages)

CLAUSE NO.	132 KV CABLES & ACCESSORIES (E16)			एनटीपीसी NTPC रामम hydro
	Bidder's Name			
	<u>TECHNICAL PARTICULARS</u>			
	Technical Information and data to be submitted with proposal.			
I)	Testing and Calculations:			
A.	Pre-Qualification Test			
	1. Manufacture meeting the requirement of IEC: 62067 with respect to Pre-Qualification test	Yes/No		
	2. Certificates and detailed Pre-Qualification Test Reports enclosed alongwith the Bid.			
B.	Complete Technical Literature supported by catalogues giving constructional feature, cross section drawings, type of material, installation practices with respect to 132 KV cables and Accessories and any other relevant general information enclosed alongwith the bid.			
C.	Metallic screen and sheath sizing calculations meet the short circuit requirements enclosed alongwith the bid.			
II)	TECHNICAL PARTICULARS:			
Sl. No.	Particulars	Unit	Details / Values	
A.	132 KV Cables			
1.	Manufacturer's name & Country of origin			
2.	Standards according to which cable is manufactured and tested			
3.	Type			
4.	No. of phases per circuit			
5.	No. of cables per phase			
6.	No. of cores per cable			
7.	Rated Voltage	KV		
8.	Highest system voltage	KV		
9.	Rated continuous current	A		
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL DATA SHEETS		PART-G SECTION - VI
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CLAUSE NO.	132 KV CABLES & ACCESSORIES (E16)	
	Bidder's Name 10. Rated short-time current withstand capacity for 1 second a) For conductor KA b) For metallic sheath KA 11. Electrical stresses (AC Voltage) Short circuit forces a) On conductor i) Average KV/mm ii) maximum KV/mm b) On conductor screen semi-conductor layer i) Average KV/mm ii) Maximum KV/mm c) On insulation screen semi-conductor layer i) Average KV/mm ii) Maximum KV/mm d) Insulation i) Average KV/mm ii) Maximum KV/mm 12. Rated frequency Hz 13. Insulation level a) Power Frequency withstand voltage KV b) 1.2/50 micro-second lightning impulse withstand voltage KV (peak) c) 250/2500 micro-second switching impulse withstand voltage KV (peak)	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO : CS-5602-003-9	TECHNICAL DATA SHEETS	PART-G SECTION - VI PAGE 2 OF 11

CLAUSE NO.	132 KV CABLES & ACCESSORIES (E16)	एन टी सी NTPC हाइड्रो hydro
14. a) b) c) i) ii) 15. a) b) c) d) e) 16. 17. a) b) c) d)	Bidder's Name Temperature Max. temperature rise over ambient °C temperature of 40°C Maximum permissible conductor °C temperature during short circuit Heating time constant when cable is switched on From zero load (cold condition) to a load seconds of continuous current and corresponding conductor temperature From zero load (cold condition) to a Seconds load of maximum continuous current to attain 90°C temperature, keeping the load constant Guaranteed Power loss in conductor in W each cable length at rated voltage and current Guaranteed Dielectric power loss in W each cable length at rated voltage and current Guaranteed power loss in metallic W sheath in each cable length at rated voltage and current Guaranteed total power loss in each W cable length at rated voltage and current (a+b+c) Maximum permissible iron losses in kW supporting structures Maximum total power losses per meter W Conductor details Type Material and shape Cross-sectional area mm² No. of strands/Diameter of each strand No./mm	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL DATA SHEETS	PART-G SECTION - VI PAGE 3 OF 11

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CLAUSE NO.	132 KV CABLES & ACCESSORIES (E16)		ગાંધીધામ NTPC રામમ Hydro
		Bidder's Name	
e)	Weight of copper in cable	Kg/m	
f)	Current density in conductor	A/mm ²	
g)	Conductivity of conductor	Mho/m	
h)	Ultimate tensile strength of conductor	N/mm ²	
i)	Maximum short-circuit current rating & duration	KA/sec	
j)	Impedance of conductor per meter	Ω	
k)	Resistance per meter		
i)	DC at 20°C	Ω	
ii)	AC at 20°C	Ω	
18.	Conductor screening		
a)	Material		
b)	Thickness	mm	
c)	Electric stress level		
i)	Maximum	KV/mm	
ii)	Average	KV/mm	
d)	Maximum resistivity	Ω -m	
19.	Insulation details		
a)	Material		
b)	Thickness	mm	
c)	Relative permittivity		
d)	Dielectric loss angle (at rated voltages at 20°C & 90°C)		
e)	Insulation resistance constant	Ω -cm	
f)	Elongation	%	
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CLAUSE NO.	132 KV CABLES & ACCESSORIES (E16)			एनटीपीसी NTPC साइडो hydro
	Bidder's Name			
B.	132kV Cable Accessories			
1.	Outdoor termination			
a)	Name and country of manufacturer			
b)	Type			
c)	Insulating medium			
d)	Type of interface			
e)	Material and colour of the bushing			
f)	Bushing particulars			
i)	Make & country of manufacture			
ii)	Type			
iii)	Voltage class		KV	
iv)	Power frequency withstand voltage		KV	
v)	Lightning impulse withstand voltage		KV(peak)	
vi)	Switching impulse withstand voltage		KV(peak)	
vii)	Flash over values			
	-Dry		KV	
	-Wet		KV	
viii)	Puncture values		KV	
ix)	Creepage distance		mm	
x)	Compression strength		Kg/cm ²	
xi)	Cantilever strength		Kg-m	
xii)	Pressure differential withstand capacity of insulators			
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CLAUSE NO.	132 KV CABLES & ACCESSORIES (E16)		
	Bidder's Name		
xiii)	Minimum creepage distance of porcelain bushing	mm /KV	
g)	Is terminal type tested, if yes, to which standard?		
h)	Overall dimensions of termination	mm	
i)	Connecting clamps		
i)	Normal current rating	KA	
ii)	Short circuit current rating	KA	
iii)	Overall dimensions (LxBxH)	mm	
iv)	Permissible tension for outdoor termination	Kg/mm ²	
2.	Indoor Termination		
a)	Name and country of manufacture		
b)	Type		
c)	Insulation medium		
d)	Type of interface		
e)	Is terminal type tested, if yes, to which standard?		
f)	Overall dimensions (LxBxH)	mm	
g)	Overall weight	Kg	
h) i)	Normal current rating	A	
ii)	Short circuit current rating	KA	
i)	Max. permissible pressure of SF6 gas in indoor termination		
j)	Designed pressure of SF6 gas in indoor termination		
k)	Permissible tension for indoor termination	Kg/mm ²	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL DATA SHEETS	PART-G SECTION - VI PAGE 8 OF 11

CLAUSE NO.	132 KV CABLES & ACCESSORIES (E16)	एन टी सी NTPC हाइड्रो hydro
C. a)	Bidder's Name	
	Disconnecting Link (CCPU) i) Material and size ii) Continuous current rating A iii) Momentary current rating KA b) Earthing Devices i) Earthing conductor - Material & size - Continuous current rating A - Momentary current rating KA ii) CCPU Cable link Box - Material - Size & weight - Protection code iii) Technical particulars of Sheath Voltage Limiter (SVL) - Type - Rated voltage KV - Voltage limiting range - Fault current rating for 1 second KA - Lightning impulse voltage withstand capacity KV (peak) - Power frequency withstand voltage KV(rms) - Momentary current rating KA - Continuous current rating A	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL DATA SHEETS PART-G SECTION - VI PAGE 9 OF 11

CLAUSE NO.	132 KV CABLES & ACCESSORIES (E16)	
- D. a) b) c) d) e) F. i) ii) iii) iv) v) G. 1. a) b) c) 2. a) b) 3	Bidder's Name Residual voltage V Cable drums Flange diameter mm Drum diameter & width mm Drum weight Kg Drum material Spindle hole diameter mm Bonding Cable Material Size mm² Type of bonding Current carrying capacity A Voltage grade V Other Information Details of interface Max. force at interface - Tensile - Compressive Tolerance on positioning of flanges Earthing arrangement Minimum recommended clearance Between the cable mm Between the racks mm Details of cable end sealing, cable clamping arrangement etc.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO : CS-5602-003-9	TECHNICAL DATA SHEETS	PART-G SECTION - VI PAGE 10 OF 11

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CLAUSE NO.	132 KV CABLES & ACCESSORIES (E16)	एन टी सी NTPC राष्ट्रीय hydro
	Bidder's Name 4. Details of cable handling, laying and pulling device 5. Weight and dimensions of shipping packages a) Name and shipping weight of the Kg heaviest package of cable drums etc. b) Name and dimensions (LxBxH) of the m largest package c) Shipping weight of all special cable laying, handling devices, wrenches and tools etc. d) Shipping weight and dimensions of each XLPE cable end termination e) Maximum length of 132kV, single m phase, single core of 400mm² copper conductor XLPE insulated power cable which can be supplied in single length f) Standard length m 6. Cable loading i) Continuous over loading at one go ii) Total hours of emergency to which cable can be loaded during its life	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL DATA SHEETS	PART-G SECTION - VI PAGE 11 OF 11

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CUSTOMER: NTPC LIMITED	
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SECTION - 5 QUALITY PLAN

Supplier shall follow valid approved Quality Plan of NTPC/BHEL.

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PROJECT: NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW)

CUSTOMER: NTPC LIMITED

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SECTION – 6

CHECK LIST

1. TECHNICAL REQUIREMENTS FOR 132KV XLPE CABLES, CABLE SEALING END, ETC., COMPLETE IN ALL RESPECT ALONG WITH ACCESSORIES

Sl.	Particulars	Reply by bidder.	
1	TECHNICAL QUALIFYING REQUIREMENT		
1.1	The vendor should have designed, manufactured, supplied, erected/ supervised erection and commissioned/ supervised commissioning of at least 4.0 Km of 132 KV or higher grade XLPE insulated cables in one or more installations which should be in successful operation for at least two (2) years as on 12-01-2015.	Confirmed	Yes/No
1.2	The bid shall be submitted by the Manufacturer of the 132 kV Cable. The bidder's scope includes supply and services like installation, testing and commissioning. Bids submitted by agents will not be considered.	Confirmed	Yes/No
1.3	All the documents shall be submitted in English. Translated pages should be attested by the bidder.	Confirmed	Yes/No
2	Un-priced Offer –.		
2.1	Confirm that all items have been quoted. (If any item has not been quoted, the same shall be specifically brought out in Schedule of Technical Deviation)	Confirmed	Yes/No
2.2	The Specification envisages turnkey execution of a COMPLETE, POINT TO POINT, 132KV CABLE SYSTEM and the scope includes all materials and installation services (including laying, supervision, termination, clamping, testing and commissioning of the cable system, point to point) necessary to execute the job to satisfaction of NTPC and BHEL. This includes all accessories required to complete the job in all respect.	Confirmed	Yes/No
2.3	Any other item /service required for the execution for the complete job is deemed to be included in the offer, whether specifically mentioned in the specification or not. The Bill of quantities included in the offer shall clearly reflect such additional items along with their respective quantities and prices. List of items required for completeness (Attach list, if required)	Additional items required	Yes/No
2.4	Support structure and foundation for cable termination shall be provided by BHEL based on the input (configuration, loads etc) provided by bidder. The erection of structure shall be done by BHEL.	Noted	Yes/No
2.5	The cable trench and support structures/angles in the trenches will be provided by BHEL as per detailed design and drawing provided by bidder. The design of the cable support structures/angles in the cable trench will be given by bidder. The supply and erection of cable supports shall be in BHEL scope. Changes to be made during cable laying and during cable jointing shall be in bidder's scope. The drawings shall also be given with bid especially for tunnel.	Confirmed. Drgs of cable support given alongwith bid	Yes/No
2.6	Terminal connector for overhead connection with cable sealing end shall be provided by BHEL.	Confirmed	Yes/No

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Sl.	Particulars	Reply by bidder.	
2.7	Confirm that the consumables (list to be enclosed by bidder during contract stage) with shelf life of fewer than two years shall be supplied before erection after clearance from BHEL.	Confirmed	Yes/No
3	Cable Lengths		
3.1	Manufacturing lengths and drum length shall be determined as per the joint route survey with NTPC /BHEL.	Confirmed	Yes/No
3.2	The Payment of cables length (for supply) will be as per approved quantities after joint survey.	Confirmed	Yes/No
3.3	The Payment of cables length (for installation) will be as per actual measurement at site which shall include margin for cable sealing end and two joints in future.	Confirmed	Yes/No
4	Technical		
4.1	Altitude: The project lies between EL 910m to 375 m. The area has moderate climatic conditions with no snow fall in the project area. Rainfall in the Project area is from June to August and in December, January. The Power House service bay floor is located at EL 412 m & the centre line of turbine runner has been set at EL 400 m. <i>Bidder to inform what steps have been taken to ensure the same at bid stage.</i>	Writeup attached with bid.	Yes/No
4.2	Sub-zero temperature : The climatic conditions are given below: - i) Maximum temperature in the project area: 30° C ii) Minimum temperature in the project area: 3° C iii) Maximum Relative humidity: <95 % iv) Minimum Relative humidity: >35 % v) Average annual rainfall: 2800 mm <i>Bidder to inform what steps have been taken to ensure the same at bid stage.</i>	Writeup attached with bid.	Yes/No
4.3	Calculations		
4.3.1	Calculations – All calculations have been submitted along with configuration of cable laying in cable TRENCH arrangement	Enclosed with bid	Yes/No
4.3.2	Continuous current rating of cable with under voltage condition along with overload As per relevant IEC, thermal stresses in respect of short circuit current, external serving of cable, surrounding medium , etc., shall also be considered for current rating	Enclosed with bid	Yes/No
4.3.3	Bonding details and Sheath voltage calculations	Enclosed with bid	Yes/No
4.3.4	Calculation for sizing of metallic screen	Enclosed with bid	Yes/No
4.4	Technical Deviations		
4.4.1	Confirm that the Complete systems have been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. Deviations mentioned elsewhere in the bid will not be considered.	Confirmed	Yes/No
4.4.2	Technical Deviation sheet has been submitted.	Confirmed	Yes/No

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Sl.	Particulars	Reply by bidder.	
5	Barchart		
5.1	Bidder will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning.	Confirmed	Yes/No
6	Conditions		
6.1	The necessary power supply at site shall be provided by BHEL at one point only.	Noted	Yes/No
6.2	<u>Cable Laying:</u> Provision of manpower in the grade of foreman and skilled technician, provision of laying supervisor, provision for laying tools and equipment, cable pulling, cut cable, place cable, supply of cable cleat, installation of cable cleat , etc. to complete.	Confirmed	Yes/No
6.3	<u>Jointing and Termination:</u> Provision of Jointer and Jointing material, tools and Jointing and Terminating Scaffolding, cranes for lifting for the joints and sealing end materials, assemble of joint and sealing ends. Design of support structure for sealing end and joint, etc. to complete.	Confirmed	Yes/No
6.4	<u>Store</u> shall be provided by BHEL for cables and accessories. Confirm that the space required for the material being supplied, both indoor and outdoor has been indicated.	Details given with the bid.	Yes/No
6.5	Any tools and tackles and accessories required to complete the cable laying, termination and ETC shall be included in the offer. Please note BHEL shall not provide any equipment, tool and tackles for carrying out any test /or laying of cables.	Noted	Yes/No
6.6	Earthing of HT cables shall be in bidder scope. The items and accessories required for completeness of earthing at ends and joints but not limited to: Earthing cable, Bonding cable, Earth continuity cables, Link boxes etc as per the requirements. Earth mat grid is existing and interconnected at both end (generator transformer yard and 132kv switchyard). Any special earthing required for cable jointing area inside cable trench like electrodes and other associated earthing material shall be supplied and installed by the bidder in the cable trench. The complete earthing BOQ items and shall be clearly mentioned in the offer.	Details given with the bid.	Yes/No
6.7	Storage, warehouse for cables and accessories, consumable material and returnable equipment, tools and tackles, office facilities & accommodation for bidder's staff, Travel expenses for bidder's staff, Transportation of all tools and equipment, Transportation of material tools and equipment between storage and warehouse and complete erection.	Confirmed	Yes/No
6.8	The entire installation, supply and erection of cable sealing end is in bidder scope - BHEL will only provide constructed cable trench with installed cable support -Any accessories viz. support insulator between structure and cable sealing, clamps for fixing cable with structure, support insulator in cable trench, addition support at joints, etc. to	Confirmed	Yes/No

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Sl.	Particulars	Reply by bidder.	
	complete the entire job shall be supplied by bidder at no extra cost.		
6.9	Any damage in civil works during installation will be repaired by the bidder.	Confirmed	Yes/No
7	Site Test		
7.1	Provision of test engineer, supply of all test equipment and arrangement like cranes (for lifting of cable drums, test equipment etc), all Test Equipment (DC voltage test equipment etc) for completion of total site work shall be in bidder's scope.	Confirmed	Yes/No
7.2	All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by the Contractor, in presence of representative of the Employer as per section-1 & 2.	Confirmed	Yes/No
7.3	No separate site test will be conducted by BHEL/Customer	Confirmed	Yes/No
8	TYPE TESTS REQUIREMENTS		
8.1	The 132kV Cabling system (132 kV XLPE Cables, cable sealing end, etc., complete in all respect along with accessories) should have been type tested (as per relevant IEC / IEEE standard) as per clause no. 1.6 of Section-1. The cable jointing kit and cable sealing end shall be of same make and type as that used in type test.	Confirmed	Yes/No
8.2	PQ test report for 132 kV cable system (1CX 400 sq.mm cable along with accessories like cable end terminations and cable joints etc) has been submitted with offer. Differences, if any, in the items offered and those which have been PQ tested shall be clearly brought out along with explanation for suitability.	Confirmed and enclosed with bid	Yes/No
8.3	Type test report for 132 kV cable system (1CX 400 sq.mm cable along with accessories like cable end terminations and cable joints etc) shall be submitted with the bid. Differences, if any, in the items offered and those which have been Type tested shall be clearly brought out along with explanation for suitability. Type test reports will be vetted by BHEL/ NTPC at contract stage and if the same is not acceptable to BHEL/ NTPC, bidder has to repeat type tests without any cost and delivery extension.	Confirmed and enclosed with bid	Yes/No
8.4	The Type Tests on 132kV System (XLPE Cables, cable joints, cable sealing end etc.) shall meet the requirements as per <u>Section-2 and Quality Assurance Plan</u> .	Confirmed	Yes/No
8.5	The test - reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening. Date of Bid opening is 12-01-2015.	Confirmed	Yes/No
8.6	In case the test reports are not found technically valid during contract stage by BHEL/ NTPC or if the tests were conducted earlier than 10 (ten) years prior to the date of bid opening, the bidder shall repeat these test(s) <u>at no extra cost to the purchaser and no delivery implication</u> . Technical valid - Any error or (any/all additional type tests not carried out) or discrepancy in the test reports vis-à-vis offered equipment due	Confirmed	Yes/No

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Sl.	Particulars	Reply by bidder.	
	to any design / manufacturing changes (including substitution of components) or non-compliance with the requirement stipulated in the Technical Specification.		
8.7	The PQ and type tests conducted earlier should have either been conducted in an accredited laboratory (accredited base on applicable ISO / IEC Guide or EN by the national accreditation body of the country where laboratory is located). If the laboratory is not a national laboratory and member of STL, relevant papers of accreditation shall be submitted in English. If the laboratory is in-house, the tests should have been witnessed by an independent agency.	Confirmed	Yes/No
8.8	The type test report shall be complete including list the test objects, photographs, oscillographs, test arrangement, drawing of tested objects (cables, accessories, etc), test connections. The type test report shall be in English. If it is in any other language, it should include an English version (Translation shall be attested by the Bidder). The English version should be complete with measured values and conclusion.	Confirmed	Yes/No
9	INSPECTION & TESTING		
9.1	Inspection and Testing shall be as per Quality Assurance Plan of NTPC.	Confirmed	Yes/No

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ANNEXURE - A
SCHEDULE OF TECHNICAL DEVIATIONS

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

S.No.	Page No.	Clause No.	Deviation	Reason / Justification
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Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date:

Tenderer's Stamp & Signature