



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

DOCUMENT No.	TB 390 510 202	Rev 00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	MLK	VK	VK
TITLE 1.1 kV Aux Power & Control Cables		SIGN			
		DATE	27/09/17		
		GROUP	TBEM	W.O. No	27/9/17
CUSTOMER	NTPC-SAIL POWER COMPANY (P) LIMITED				
CONSULTANT	MECON LTD				
PROJECT	ROURKELA PP-II EXPANSION PROJECT (1X250MW)				

CONTENTS

Sec. No.	Description	No. of Sheets
1.	Scope, Specific Technical Requirement and Quantities	17
2.	Equipment Specification	05
3.	Project Details & General Technical Requirements	22
4.	Guaranteed Technical Particulars (To be furnished at Contract Stage)	04
5.	Checklist (To be furnished at Tender Stage)	05

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
Distribution			To Copies	TBTS	O/C	TBMM	TBQM	TBCM
				-	1	-	-	1

COPYRIGHT & CONFIDENTIAL
The information in this document is the property of BHARAT HEAVY ELECTRICALS LIMITED
This must not be used directly or indirectly in any way detrimental to the interest of the Company.

SECTION 1
SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This Specification covers the requirements of design, manufacture, testing at manufacturer's Works, packing, supply, delivery at site of 1.1 kV Aux Power & Control Cables as listed under this specification. This section covers the specific technical requirements of 1.1 kV Aux Power & Control Cables. This constitutes minimum technical parameters for the above item as specified by the customer (NSPCL). The offered equipment shall also comply with the General Specification for the project as detailed under section-3 of this specification.

In case of any conflict between the technical details mentioned in this section and the remaining sections of this document, then Section-1 shall prevail and is to be considered as binding requirement.

The specification comprise of following sections:

- Section-1: Scope, Specific Technical Requirements and Quantities.
- Section-2: Equipment Specification.
- Section-3: Project Details and General Technical Requirements.
- Section-4: Guaranteed Technical Particulars.
- Section-5: Checklist.

Note: The term 'Owner' appearing in this specification shall refer to NSPCL, the term 'Purchaser' shall refer to BHEL and the term 'Contractor' shall refer to the successful Bidder.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer: NTPC-SAIL POWER COMPANY (P) LIMITED
Name of of the project: ROURKELA PP-II EXPANSION PROJECT (1X250MW)

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

- 1.2.1** As per Annexure-1A (NSPCL specification, 14 pages)
- 1.2.2** (a) Strip armouring method (a) mentioned in Table 5, Page-6 of IS: 1554 (Part 1) - 1988 shall not be accepted for any of the cables.
(b) Strip armouring method (a) mentioned in Table 6, Page-6 of IS: 7098 (Part 1) - 1988 shall not be accepted for any of the cables.

1.3 QUANTITIES

Sl. No.	Type of Control Cables	Quantity (Km)
1.1	2C x 2.5 sq.mm PVC/Copper, Armoured Control cable	1.6
1.2	3C x 2.5 sq mm PVC/Copper, Armoured Control cable	2.2
1.3	5C x 2.5 sq mm PVC/Copper, Armoured Control cable	3
1.4	10C x 2.5sqmm PVC/Copper, Armoured Control cable	12
1.5	14C x 2.5 sq mm PVC/Copper, Armoured Control cable	5
1.6	19C x 2.5 sq mm PVC/Copper, Armoured Control cable	11
	Type of Aux Power Cables	
2.1	2C x 16 sq.mm PVC/Aluminium, Armoured Aux. Power cable	3
2.2	4C x 6 sq mm PVC/Aluminium, Armoured Aux. Power cable	0.6
2.3	3.5C x 70 sq mm PVC/Aluminium, Armoured Aux. Power cable	1
2.4	3.5C x 185 sq mm XLPE/Aluminium, Armoured Aux. Power cable	0.6
2.5	4C x 16 sq mm PVC/Aluminium, Armoured Aux. Power cable	2.2
2.6	4C x 50 sq mm PVC/Aluminium, Armoured Aux. Power cable	1.3
2.7	1C x 95 sq mm PVC/Aluminium, Armoured Aux. Power cable	0.5

Note:-

The cable type, size and length requirement shall be as per tables below. *However, the length of each cable type procured may be subject to a change of +/- 30% before placement of order. Quantity variation on the total ordered quantity shall be +/- 20% during contract execution stage.*

The standard drum length for control cables shall not be less than 1000 metres & for power cables it shall not be less than 500m. Cut lengths for cable marked as (*) above shall be informed during detailed engineering stage. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. *Some of the cable type might not be ordered at all at contract stage.*

The Employer shall have the option of rejecting cable drums with shorter lengths. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/- 2%.

Manufacturing clearance shall be divided into single / two Lots.

Second lot shall be cleared for manufacturing based on progress of engineering and site requirements.

1.4 TESTS

Tests shall be carried out as per clause no.5.00.00 & 5.01.00 of Annexure-1A. The prices for conducting all tests are deemed to be included in respective cable prices.

1.5 QUALITY PLAN

The manufacturer shall carry out contract works in accordance with sound quality management principles

which shall include items 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. Manufacturer shall submit detailed Quality Plan for BHEL / customer's approval.

6.0 PROVEN-MAKE CRITERIA FOR LT POWER AND CONTROL CABLES

6.1 Sub-Qualifying Requirements for LT Control Cables:

Bidder should have manufactured and supplied prior to the date of Techno-Commercial bid opening (02.04.2015).

- a. At least 300 km of PVC insulated, PVC sheathed stranded copper conductor of 1.1 kV grade cables in one single contract
- b. At least one (1) km of Flame retardant low smoke cables.

6.2 Sub-Qualifying Requirement for LT Power Cables

Bidder should have manufactured and supplied prior to the date of Techno-Commercial bid opening (02.04.2015).

- a. At least 100 Kms of aluminium conductor, XLPE insulated, PVC sheathed power cables of 1.1 kV or higher grade in one single contract.
- b. At least 100 km of aluminium conductor, PVC insulated, PVC sheathed power cables of 1.1 kV or higher grade in one single contract.
- c. At least one (1) km of flame retardant low smoke cables.
- d. 1.1 kV or higher grade power cable of minimum 630 sq.mm. Conductor size.

ANNEXURE - I A

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	---	---

CHAPTER 16.2

TECHNICAL SPECIFICATION FOR LT POWER CABLES

1.00.00 **CODES & STANDARDS**

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

2.00.00 TECHNICAL REQUIREMENTS

- 2.01.00** The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.
- 2.02.00** All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.
- 2.03.00** Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be stranded.
- 2.04.00** XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.
- 2.05.00** The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.
- 2.06.00** For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows :

Calculated nominal dia. of cable under armour	Size and Type of armour
Upto 13 mm	1.4mm dia GS wire
Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 & upto 55mm	1.4 mm thick GS formed wire /2.5mm dia GS wire
Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

- 2.06.01** The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm² per meter at 20 deg C. The sizes of aluminium armouring shall be same as indicated above for galvanized steel.

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

- 2.06.02 The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire.
- 2.07.00 Outer sheath shall be of PVC as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.
- (a.) Oxygen index of min. 29 (as per IS 10810 Part-58).
 - (b.) Acid gas emission of max. 20% (as per IEC-754-I).
 - (c.) Smoke density rating shall not be more than 60 % (as per ASTM D-2843).
- 2.08.00 Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:
- 1 core - Red, Black, Yellow or Blue
 - 2 core - Red & Black
 - 3 core - Red, Yellow & Blue
 - 4 core - Red, Yellow, Blue and Black
- 2.09.00 For reduced neutral conductors, the core shall be black.
- 2.10.00 In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.
- (a.) Cable size and voltage grade - To be embossed
 - (b.) Word 'FRLS' at every 5 metre - To be embossed
 - (c.) Sequential marking of length of the cable in metres at every one metre -To be embossed / printed
- The embossing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

- 2.11.00 All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.
- 2.12.00 Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum, over the declared value in the technical data sheets.
- 2.13.00 In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
- 2.14.00 Cable selection & sizing
- 2.14.01 Cables shall be sized based on the following considerations:
- Rated current of the equipment
 - The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage
 - Short circuit withstand capability
- This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.
- 2.14.02 Derating Factors
- Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:
- Variation in ambient temperature for cables laid in air
 - Grouping of cables
 - Variation in ground temperature and soil resistivity for buried cables.
- 2.14.03 Cable lengths shall be considered in such a way that straight through cable joints are avoided.
- 2.14.04 Cables shall be armoured type if laid in switchyard area, CHP area or directly buried.
- 2.14.05 All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and preferable sizes are 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm.

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

3.00.00 CONSTRUCTIONAL FEATURES

3.01.00 1.1 KV Grade Power Cables

- (a) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/ unarmoured, PVC outsheathed conforming to IS:7098. (Part-I).
- (b) 1.1KV grade PVC power cables shall have aluminium conductor(compact type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured/ unarmoured, PVC outer-sheathed conforming to IS:1554 (Part-I).
- (c) 1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968.

4.00.00 CABLE DRUMS

- (a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.
- (b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.
- (c.) The standard drum length for power cables shall not be less than 1000 metres; however for cable sizes of 1C X 630mm², 3C X 150mm² and 3C X 240mm² (sizes if applicable) standard drum length shall be 750 meters. The length per drum shall be subjected to a maximum tolerance of +/- 5%

Rourkela Power Project (PP – III : 1 x 250 MW) EPC Package	Technical Specification Section – VI, Vol – II-E Bid Doc. No. : CC&M-C-347-211	Chapter – 16.2 LT Power Cable	Page 5 of 7
--	--	----------------------------------	-------------

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

of the standard drum length. The Owner shall have the option of rejecting cable drums with shorter lengths.

5.00.00 TESTS

- 1.0 All equipments to be supplied shall be of type tested design. During detailed engineering, the bidder shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
- 2.0 However if the bidder is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) 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.
- 3.0 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.
- 4.0 The type test reports once approved for any projects shall be treated as reference

For subsequent projects of NSPCL, 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.

5.01.00 Type Tests

- 5.01.01 The reports for the following type tests shall be submitted for one size each of LT XLPE and LT PVC Power cables. Size shall be decided by the owner during detailed engineering:

S.No.	Type test	Remarks
	For Conductor	
1.	Resistance test	
2.	Tensile test	For circular non-compacted

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

		conductors only
3.	Wrapping test	For circular non-compacted only
	For Armour Wires/ Formed Wires	
4.	Measurement of Dimensions	
5.	Tensile Test	
6.	Elongation test	
7.	Torsion test	For round wires only
8.	Wrapping test	For aluminium wires / formed wires only.
9.	Resistance test	
10(a)	Mass of zinc coating test	For GS Formed wires/wires only
10(b)	Uniformity of zinc coating	For GS Formed wires /wires only
11.	Adhesion test	For GS Formed wires/wires only
	For PVC/XLPE insulation & PVC Sheath	
12.	Test for thickness	
13.	Tensile strength & elongation tests before ageing and after ageing	
14.	Ageing in air oven	
15.	Loss of mass test	For PVC insulation and sheath only
16.	Hot deformation test	For PVC insulation and sheath only
17.	Heat shock test	For PVC insulation and sheath only
18.	Shrinkage test	
19.	Thermal stability test	For PVC insulation and sheath only
20.	Hot set test	For XLPE insulation only
21.	Water absorption test	For XLPE insulation only
22.	Oxygen index test	For outer sheath only
23.	Smoke density test	For outer sheath only
24.	Acid gas generation test	For outer sheath only
	For completed cables	
25.	Insulation resistance test (Volume resistivity method)	
26.	High voltage test	
27.	Flammability test as per IEC-332 Part-3 (Category-B)	
Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of LT power cables enclosed.		

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

CHAPTER 16.3

TECHNICAL SPECIFICATION FOR LT CONTROL CABLES

1.00.00 CODES & STANDARDS

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D –2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

2.00.00 TECHNICAL REQUIREMENTS

- 2.01.00** The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.
- 2.02.00** All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

under steady state and transient operating conditions as specified elsewhere in this specification.

- 2.03.00 Conductor of control cables shall be made of stranded, plain annealed copper.
- 2.04.00 PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.
- 2.05.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.
- 2.06.00 For multicore armoured cables, the armouring shall be of galvanised steel as follows:

Calculated nominal dia of cable under armour	Size and Type of armour
Upto 13 mm	1.4mm dia GS wire
Above 13 upto 25 mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 upto 55mm	1.4 mm thick GS formed wire/2.5mm dia GS wire
Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.

- 2.07.00 Outer sheath shall be of PVC as per IS: 5831 and grey in colour. In addition to meeting all the requirements of Indian Standards referred to, outer sheath of all the cables shall have the following FRLS properties.
- (a.) Oxygen index of min. 29. (As per IS 10810 Part-58)
- (b.) Acid gas emission of max. 20% (As per IEC-754-I)

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

- (c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM D-2843.

2.08.00 Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.

1 core - Red, Black, Yellow or Blue

2 core - Red & Black

3 core - Red, Yellow & Blue

4 core - Red, Yellow, Blue and Black

5 core - Red, Yellow, Blue, Black and Grey

2.09.00 For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu- Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.

2.10.00 In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath:

(a.) Cable size and voltage grade - To be embossed

(b.) Word 'FRLS' at every 5 metre - To be embossed

(c.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed.

The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

- 2.11.00 All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.
- 2.12.00 Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum over the declared value in the technical data sheets.
- 2.13.00 In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
- 2.14.00 Cable selection & sizing
- Control cables shall be sized based on the following considerations:
- (a) The minimum conductor cross-section shall be 1.5 sq.mm.
- (b) The minimum number of spare cores in control cables shall be as follows:
- | No. of cores in cable | Min. No. of spare cores |
|-----------------------|-------------------------|
| 2C, 3C | NIL |
| 5C | 1 |
| 7C-12C | 2 |
| 14C & above | 3 |
- 2.14.01 Cable lengths shall be considered in such a way that straight through cable joints are avoided.
- 2.14.02 Cables shall be armoured type if laid in switchyard area, CHP area or directly buried.
- 3.00.00 **CONSTRUCTIONAL FEATURES**
- 3.01.00 1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).
- 3.02.00 1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outersheathed with heat resistant,

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968. Minimum conductor size shall be 2.5 sqmm.

4.00.00 CABLE DRUMS

- (a.) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.
- (b.) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.
- (c.) The standard drum length for control cables shall not be less than 1000 metres. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Owner shall have the option of rejecting cable drums with shorter lengths.

5.00.00 TESTS

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

However if the bidder is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) 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.

Rourkela Power Project (PP – III : 1 x 250 MW) EPC Package	Technical Specification Section – VI, Vol – II-E Bid Doc. No. : CC&M-C-347-211	Chapter – 16.3 LT Control Cables	Page 5 of 7
--	--	-------------------------------------	-------------

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

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 NSPCL, 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.

5.01.00 TYPE TESTS

5.01.01 The reports for the following type tests shall be submitted for one size of control cables. Size shall be decided by the owner during detailed engineering

S. No.	Type Test	Remarks
	For Conductor	
1.	Resistance test	
	For Armour Wires / Formed Wires (If applicable)	
2.	Measurement of Dimensions	
3.	Tensile Test	
4.	Elongation test	
5.	Torsion test	For round wire only
6.	Wrapping test	For aluminium wires / formed wires only.
7.	Resistance test	
8(a).	Mass of zinc Coating test	For GS wires/formed wires only
8(b).	Uniformity of zinc coating	For GS wires/formed wires only
9.	Adhesion test	For GS wires/formed wires only
	For PVC insulation & PVC Sheath	
10.	Test for thickness	
11.	Tensile strength and elongation test before ageing and after ageing	
12.	Ageing in air oven	
13.	Loss of mass test	For PVC insulation and sheath only
14.	Hot deformation test	For PVC insulation and sheath only
15.	Heat shock test	For PVC insulation and sheath only

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	--	---

16.	Shrinkage test	
17.	Thermal stability test	For PVC insulation and sheath only
18.	Oxygen index test	For outer sheath only
19.	Smoke density test	For outer sheath only
20.	Acid gas generation test	For outer sheath only
	For completed cables	
21.	Insulation resistance test (Volume resistivity method)	
22.	High voltage test	
23.	Flammability test as per IEC-332 Part-3 (Category-B)	

5.02.00 Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Control Cables enclosed.

SECTION-2

2.0 SCOPE

This technical specification covers the requirement of design, manufacture, testing, packing and dispatch of 1.1 kV grade Auxiliary power and control cables (FRLS type). No deviation from the requirements specified in various clauses of this specification shall be allowed.

2.1 APPLICABLE STANDARDS

The auxiliary power and control cables shall conform to following latest Indian and International standards and their amendments.

IS 1554 (Part I)	PVC insulated (heavy duty) electric cables - For working voltage up to and including 1100V
IS 7098 (Part I)	XLPE insulated PVC sheathed cables - For working voltage up to and including 1100V
IS 5831	PVC insulation and sheath of electric cables.
IS 8130	Conductors for insulated electric cables and flexible cords.
IS 3975	Low Carbon Galvanized Steel Wires, Formed Wires and Tapes for Armouring of Cables - Specification
IS 10810	Method of tests for cables.
IEEE-383	Standard for type test of class IE electric cables, field splices, and connections for nuclear power generating stations.
ASTM-D2843	Standard test method for density of smoke from burning or decomposition of plastics.
ASTM-D2863	Standard test method for measuring minimum oxygen concentration to support candle - like combustion of plastics (oxygen index).
IEC: 60754 (Part-1 & 2)	Test on gases evolved during combustion of electric cables -
IEC: 60332 (Part I to 3)	Tests on electric and optical fibre cables under fire conditions
IS 3961 (Part II)	Recommended current rating for cables - PVC insulated and PVC sheathed heavy-duty cables.
IS 10418	Drums for electric cables.
SS 4241475	Swedish chimney test

2.2 CONSTRUCTIONAL FEATURES

Technical Specification: 1.1 kV Aux Power & Control Cables

- i) Cables shall be suitable for laying in racks, ducts, trenches, conduits and underground-buried installation with uncontrolled back fill and chances of flooding by water. They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.
- ii) The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects.
- iii) A distinct extruded inner sheath shall be provided in all armoured cable. The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, softer than insulation & suitable for the operating temperature of the cable & compatible with the insulating material. The outer sheath shall be suitable for the operating temp. of the cable. For single core cable, inner sheath may not be provided.
- iv) Progressive sequential marking of the length of cable in meters at every one-meter shall be provided on the outer sheath of all cables.
- v) All power & control cables shall have an extruded outer sheath of PVC having following flame retardant & low smoke evolution properties.
Oxygen index - Minimum 29 (to ASTM D 2863).
Acid gas emission - Maximum 20% by weight (to IEC 754 – I).
Smoke density rating – Maximum 60% (to ASTM D 2843).
- vi) All cables shall be suitable for high ambient high humid tropical Indian climatic conditions.
- vii) The normal current rating of all PVC insulated cables shall be as per IS 3961.
- viii) All cables shall conform to type test and shall be subjected to routine and acceptance tests listed in the specification.
- ix) Allowable tolerance on the overall diameter of the cables shall be $\pm 2\text{mm}$.
- x) The minimum bending radius for the cables shall be equal to $12 \times D$, where D is the overall diameter of the cable for multicore cables and $15 \times D$ for single core cable.
- xi) Suitable chemicals shall be added to the outer sheath of all cables to protect from rodent, vermin and termite attack.
- xii) Repaired cables shall not be acceptable.
- xiii) Cores shall be identified as per IS 1554 (Part-I)/ IS 7098 Part-I for the cables upto five (5) cores and for cables with more than five (5) cores the identification of cores shall be done by printing legible Hindu Arabic numerals on all cores as per Clause 10.3 of IS 1554 (Part-1).
- xiv) Manufacturer's name, type of cable, number of cores, year of manufacture and sequential marking of length in metres at every one metre shall be permanently marked on the outer sheath throughout the entire length of cable.

2.3 CURRENT RATING FOR CONTROL and AUX. POWER CABLES

- 2.3.1 Normal current rating shall not be less than that covered by IS 3961. Vendor shall submit data in respect of all cables in the prescribed format.

Technical Specification: 1.1 kV Aux Power & Control Cables

2.3.2 PVC insulated cables shall be suitable for continuous conductor temperature of 70 °C and short circuit withstand temperature of 160 °C. Tables giving de-rating factors for various conditions of cable installation including the following, for all types of cables shall be furnished -

- Variation in ambient air temperature.
- Variation in ground temperature.
- Depth of laying.
- Cables laid in the ground
- Cables laid in trench
- Cables laid in ducts
- Soil resistivity.
- Grouping of cables.

Overall derating factor for cable shall be 0.8 or less.

2.3.3 The value of short circuit withstand current ratings of all cables shall be indicated for a short circuit for 1 second duration and should also specify the maximum temperature during short circuit.

2.3.4 The following factors shall also be accounted for, while specifying the maximum short circuit withstand of the cables.

2.3.4.1 Deformation of the insulation, due to thermo-mechanical forces produced by the short circuit conditions, can reduce the effective thickness of insulation.

2.3.4.2 Conductor and core screens can be adversely affected with loss of screening effect. Likewise the thermal properties of the outer sheath material can be the limitation.

2.3.4.3 It is essential that the accessories, which are used in the cable system with mechanical and/or soldered connections, are suitable for the temperature adopted for the cables.

2.3.5 Formula for calculating short circuit current for different duration or curve showing short time current v/s time for different sizes of cables shall be furnished by vendor.

2.4 CABLE DRUMS

2.4.1 Cables shall be supplied in non-returnable wooden cable drum or steel drum of heavy construction. It shall be made of good quality wood, pressure impregnated against fungal and insect attack. Wood preservative shall be applied to the entire drum. The ends of the each length of cable shall be sealed before dispatch.

2.4.2 All Control and Power Cables shall be supplied in drum length of 1000 m, unless otherwise specified. For power cable with conductor cross sectional area 300sqmm and above may be supplied in 500m drums. Each drum shall contain one continuous length of cable. Owner shall have the option of rejecting cable drums with shorter lengths. The cable length per drum is allowed a tolerance of $\pm 5\%$. The tolerance allowed on total quantity of each size is $\pm 2\%$. Where the ordered quantity is not multiple of 1000/500 m and the incremental quantity is very small, the same may be included in one of the drums. Otherwise, an additional length for the incremental quantity will be supplied.

Technical Specification: 1.1 kV Aux Power & Control Cables

- 2.4.3 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.
- 2.4.4 A clear space of at least 40mm shall be left between the cables and the logging.
- 2.4.5 Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of the cable, net and gross weight stenciled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wordings shall be marked on one end of the reel indicating the direction in which it should be rolled.
- 2.4.6 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

2.5 TESTS

All types and sizes of cables shall be subjected to following routine and acceptance tests and type tests.

2.5.1 Type and Acceptance test

The following test shall be performed on one length from each manufacturing series of same type and size of cable, covering at least 10% of all cable drums / test reports shall be submitted as per Section-5. The type and acceptance tests shall be witnessed by purchaser / purchaser's representatives.

- a) Annealing test (for Copper conductor), Tensile & Wrapping Tests (for Aluminium for conductor) as per IS 8130.
- b) Conductor resistance test as per IS 8130.
- c) Test for armouring wires/ formed wire (% Elongation, Tensile, Torsion/ winding, Resistance, Wt of Zinc coating, Dimension and uniformity of coating) as per IS 1554 (Part-I), IS 7098 (Part-I), IS 3975.
- d) Check for dimensions of insulation, sheath and conductor as per IS 1554 (Part-I), IS 7098 (Part-I).
- e) Physical tests for insulation and sheath as per IS 1554 (Part-I), IS 7098 (Part-I), IS 5831 as applicable.
- f) Insulation resistance test as per IS 1554 (Part-I), IS 7098 (Part-I), IS 5831 as applicable.
- g) High voltage test at room temperature as per IS 1554 (Part I), IS 7098 (Part-I) as applicable.
- h) High voltage test (water immersion test) as per clause 16.3 of IS 1554 (Part I).
- i) Flammability test as per clause 2.5 IEEE-383 / IEC 60332 part 3.
- j) Smoke density rating test as per ASTM-D2843.
- k) Oxygen index and Temperature index test as per ASTM-D2863.
- l) Acid gas generation test as per IEC: 60754
- m) Flammability test as per IS 1554 Part-I/ IS 7098 Part-1.
- n) Swedish chimney test F3 category as per SS 4241475

~~— Following special type tests shall be performed on one sample from each lot of the offered cables:~~

- ~~a) Hydraulic Stability Test~~
- ~~b) Ultraviolet Test as per DIN 53387~~

2.5.2 Routine tests

The following routine tests shall be conducted on full length of the cable. These shall be witnessed by purchaser / purchaser's representatives.

- a) High voltage test as per clause 16.2 of IS 1554 (Part I).
- b) Conductor resistance test as per clause 6.3 of IS 8130.

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.

3.1 PROJECT DETAILS

Name of the Project: 220kV GIS - ROURKELA POWER
PROJECT (PP – III: 1X250 MW)

Name of the Customer: NTPC SAIL POWER COMPANY (P) LIMITED

Location & Land Availability:

The proposed unit of 1x250 MW will be installed on the western side of existing 2x60 MW units within the boundary of Rourkela Steel Plant in Sundergarh district of Orissa.

Approximately 80 acres of land is available for construction main plant and accessories. For ash dyke about 70 acres of land is available at a distance of approx 6 KM from plant towards southwest. Presently most of land is filled with blast furnace slag. The main power house building of proposed unit of 1x250 MW will be located on western side of existing 2x60 MW switchyard. The indicative latitude & longitude of the proposed site is as follows:

☐	Latitude	:	22°13'19"	N
☐	Longitude	:	84°53'51"	E

Availability of Infrastructure Facilities Road

The site is connected by road of NH-23 through a link road from a road junction at Panposh located approx. 10 KM from proposed site.

Railway siding

The nearest railway station Rourkela is situated about one km from the proposed plant site. A new railway siding will be developed for receiving coal from the source.

Airport/Air strip

The nearest airport is at Ranchi which is about 170 KM by rail and 225 KM by road from the proposed site.

Seaport

The nearest seaport is at Paradip (Orissa) which is around 400 Kms from the proposed site.

3.1.1 SITE CONDITIONS

1.	Average elevation above mean sea level	194m
2.	Barometric pressure	983 mb
3.	Ambient temperature	
	a. Absolute maximum	48 °C
	b. Absolute minimum	6 °C
4.	Relative humidity (Maximum)	65 %
5.	Annual Average Rainfall	2656.6 mm
6.	Heaviest in 24 Hrs.	257.8 mm
7.	Seismic Zone	Zone-II (As per latest Revision of IS 1893 /2002) Part-I
8.	Pollution Level	Very Heavily Polluted

3.1.2 SYSTEM PARAMETERS

3.1.2.1	Continuous current carrying capacity (rms) at 50° C ambient temperature.	2500A (min)
3.1.2.2	Short time current carrying Capacity	40kA for 3 sec (220 kV)
3.1.2.3	Maximum temperature rise over ambient of 50° C	28 ° C
3.1.2.4	Voltage	220/245kV (Nom/Max)
3.1.2.5	Frequency	50Hz
3.1.2.6	System neutral earthing	Effectively earthed

PROJECT: NSPCL-Rourkela PP-II Expansion (1x250 MW)
CUSTOMER: NTPC SAIL POWER COMPANY (P) LIMITED (NSPCL)

Technical Specification of GIS

Section-3: Project Details and General Specification

3.1.2.7	Insulation Level	
3.1.2.8	One minute Dry Power frequency Withstand Voltage (kV rms)	460
3.1.2.9	One minute Wet power frequency Withstand Voltage	460
3.1.2.10	Impulse withstand (kV)	1050
3.1.2.11	Creepage distance	31 (mm/kV)

3.1.3 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	6600 V, 3ph, 3W, 50 Hz non-effectively earthed, Fault level 40 KA symm.	Transformers(6.6KV/415V)
L.T. Supply	415V, 3 phase , 4W, 50 Hz, effectively earthed, Fault level 50 KA symm	Motors and loads up to 160 KW for CHP and 200KW for remaining areas and lighting transformers (1:1)
	240V, 1ph, 2W, 50 Hz, effectively earthed	Motors up to 200W, Lighting, space heaters, A.C. control & protective devices.
	240V AC,1 ph,50 Hz. UPS system	DCS/PLC, control & instrumentation
	110V,1ph, 50 Hz	Control, protection & metering
	24V AC	Maintenance Lighting
D.C. Supply	220V, 2W, unearthed, Fault level 25 KA*	D.C. alarm, control & protective devices, DC motors, Emergency lighting.
	24V DC	Control & Instrumentation

RANGE OF VARIATION

A.C. Supply

Voltage: $\pm 10\%$ Frequency: $\pm 5\%$ Combined Volt: 10%+ frequency (absolute sum)

During starting of largest motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment, while running, shall successfully ride over such period without affecting system performance.

D.C. Supply Voltage:
198 to 240 Volt

System Earthing

220KV, 33KV & 415V systems are effectively earthed. High resistance type non-effective earthing shall be used for 6.6 kV systems to limit earth fault current. Resistors shall be connected to the Star point of the concerned transformers.

Fault Levels

1	220 KV System	40KA for 3 secs.
2	6.6 KV System	40KA for 3 secs.
3	415 V system	50KA for 1 secs.
4	220V DC	20KA for 1 secs.

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

Voltage	Equipment /1st Level
220kV	6000mm

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 2550mm.

3.2 SPECIAL INSTRUCTIONS TO BIDDERS

General

The Bidder shall base the equipment design on the information given in this specification. The equipment shall be complete in all respects. Any item which is not specifically mentioned herein but found essential for safe and efficient operation and maintenance and satisfactory performance of the system shall be deemed to have been included in the scope of the Bidder. It shall be presumed that the Bidder has studied the site, all the drawings, tender documents and is fully aware of the scope of work involved and the site conditions prevailing.

The Bidder shall include one set of new and unused Tools & Tackles as specified in relevant sections of the specification.

The Bidder shall include in his scope, the requirement of chemicals, resins, lubricants, lube oils, and all other consumables required for testing, commissioning upto the completion of trial operation of unit.

A stainless steel name plate with letters engraved in English language shall be provided for the equipment. The name plate shall indicate make, identification, number, capacity, rating and weight of the equipment. The name plate shall be fitted at a prominent place on the body of each equipment with the help of S.S. screws.

All the instruments shall be calibrated only in metric units. English shall be the language of all communications.

Any additional work / equipment and materials which may not have been specially mentioned in this specification but are required to make the equipment complete in every respect in accordance with technical specification and are necessary for safe & efficient operation & maintenance and guaranteed performance of the equipment shall be deemed to have been included under the scope of this specification and shall be provided by the bidder within the quoted price.

The Bidder shall furnish all the drawings, documents, load data and other information / data like fault diagnosis, operation, maintenance, erection manuals etc, general details and layout drawings, design calculations and equipment specification of equipment, together with “as built drawings” for the equipment.

3.3 Codes and Standards

- a. All equipment, systems and works covered under this specification shall comply, in all respect, with requirements of applicable latest statutes and that of latest editions of codes and standards. Latest regulations and safety & environmental requirements as applicable in India / state of installation shall also be complied with.
- b. All codes and standards mentioned shall mean as relevant and applicable to a particular equipment / system.
- c. All other codes/standards not covered in Section 1 / Section 2 but required for the plant and system offered shall also be referred / followed by the Bidder. The Bidder, along with the bid, shall submit a comprehensive list of codes and standards to be followed for various equipment / system.

PROJECT: NSPCL-Rourkela PP-II Expansion (1x250 MW)
CUSTOMER: NTPC SAIL POWER COMPANY (P) LIMITED (NSPCL)

Technical Specification of GIS

Section-3: Project Details and General Specification

- d. In all cases where IBR does not govern, German, American, British, ISO or other international standards established to be equivalent or superior to the codes specified are also acceptable. In the event of any conflict between the requirements of equivalent codes and standards and the requirements of Indian standards / regulations, the latter will govern unless specified otherwise in the specifications.
- e. The Bidder shall be responsible to be in possession of all the specified Codes / Standards and ensure reference to the same before submitting the offer/ bid.
- f. Mandatory codes / local regulations to be followed for safety, design, fabrication and operation of the switchyard shall be, followed:
- g. If the equipment supplied does not conform to the codes and standards mentioned in this specification, but is manufactured to the Bidder's own standard, developed as a result of his experience, is also acceptable provided the same is found to be superior to the above mentioned codes and standards. The Bidder shall identify such equipment and shall also present sufficient data to the Owner / Consultant to support his design and to establish the superiority. The design may be accepted by Owner/ his Consultants only if the Purchase / his consultant is satisfied that sufficient experience exists with the design proposed.
- h. Design not meeting the stipulations of the codes and standards will not be acceptable.
- i. Apart from various codes and standards mentioned in Section 1/2, the Manufacturer shall comply with other requirements of codes and standards mentioned in this Specification for detailed design, manufacture, testing, erection, construction etc.

Control System	IEEE – 122 , 1992
Metering / Dosing pumps	API 675 – 1987 (Positive displacement pumps – controlled volume) API 676 – 1987 (Positive displacement pumps – Rotary).
Centrifugal pumps	API 610 – 1990, ASME PTC 8.2 – 1965
Gear Box	API 613 – 1993 & AGMA 420 & 421
Coupling	API 671 – 1993
Structural	IS 1893 – 1991, IS 875-1992 & IS 800 – 1991
Pressure Vessel	ASME Sec. VIII, Div. 1 – 1995
Piping	ANSI B 31.1-1995 / 31.3 – 1993, IBR
Valve	API
Instrument	ISA, API
Electrical	As per specification attached & relevant
	IS/IEC
Tanks	API 650- 1993
Electrodes	AWS, IS
Painting	IS Standards

Performances Tests	
Overload test of crane and hoists	IS 3177

3.4 Deviations and Assumptions

Bidders requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. In the event of conflict between the Technical Specifications and the condition of contract, the requirements as indicated in the technical specification shall govern, unless confirmed otherwise by the Owner in writing before the award of contract, based on written request from the bidder for such a clarification.

In the event of conflict between requirements of any two clauses of the specification documents, the more stringent requirements shall apply, unless otherwise confirmed by the Owner in writing before the award of this contract, based on a written request from the Bidder for such clarification.

The Bidders are advised that while making their Bid Proposals and quoting prices, all terms and conditions of bidding documents may appropriately be taken into consideration. Bidders are required to furnish a certificate indicating their full compliance to the terms and conditions of the bidding documents.

3.5 Limit of Contract

Equipment furnished shall be complete in all 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 respective specifications, unless included in the list of exclusions. All similar standard components/ parts of similar standard equipment provided shall be interchangeable with one another.

During execution of the contract, successful Bidder (Bidder) shall furnish the engineering data / drawings / calculations, etc. in accordance with the schedule of information agreed between Owner and the Bidder. Review of these data by the Owner's Engineer / Consultant will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under specifications, external connections and of the dimensions which might affect plant layout.

This review by the Owner's Engineer / Consultant may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicative of the accuracy of the information submitted. This review and/ or approval by the Engineer shall not be construed by the Bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements specified under these specifications and documents.

3.6 Latent Defects

Notwithstanding the issue of the Take Over Certificate, the Contractor shall be responsible for making good with all possible speed any Latent Defect in any Works /equipment of the plant which appears at any time before the expiry of defect liability period. And shall remedy such defect at its own cost and expense. The latent defect liability period shall be a minimum of 5 years from the end of defect liability period. The defects to which this applies are defects in design, materials or workmanship or defects arising from any act or omission of the Contractor done or omitted prior to Take-over of the portion of the Plant affected by the defects or during the Warranty Period which a reasonable examination at the end of the Warranty Period would not have disclosed.

3.7 Completion Schedule

The Bidder shall submit Time Bar chart indicating completion date of major activities such as submission of design data / calculations and drawings for approval, manufacturing of components / units, supply, inspection etc. without which the Tender shall not be considered. Time Bar Chart furnished shall afterwards form part of the contract and cannot be altered arbitrarily except Force Majeure conditions as may be agreed with the Owner.

3.8 Drawings & Documents for Owner's use and Archives

The Bidder shall submit all final drawings, documents, manuals for Owner's use and for reference / record required during course of operation and maintenance of the plant. Numbers of copies and their form (hard copy, electronic form, reproducible) to be submitted and the details of the documents, drawings, manual etc. to be furnished by the Bidder are described elsewhere in the specification.

Drawings, documents, calculation, data & Information to be submitted by the Bidder along with the offer:

Technical Data to be submitted with the Tender

- 1) List of performance tests proposed by the Bidder to demonstrate the guaranteed parameters for generator and other electrical equipment.
- 2) Specific energy consumption.
- 3) Type test certificates for major categories of equipment, issued by independent testing authority.
- 4) Guaranteed Technical Parameters.
- 5) Technical catalogues.
- 6) Manufacturing Quality Plan

3.9 DRAWINGS & DOCUMENTS TO BE SUBMITTED BY THE SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT

One set of soft copies of all the approved drawings, documents including as built drawings shall be furnished by the Bidder to the Owner / Consultant in compact discs.

White prints or other non-reproducible drawings can be mailed folded. Blue prints shall generally not be used.

All drawings, prepared by the Bidder shall be as per IS: 696. Supplier's standard drawings are exempted from the above size limitation, unless his "standard" includes drawings of very large size or length. There shall be sufficient reference notes on the drawings to permit identification of all the drawings which are required for a proper understanding.

Bills of material and drawings shall be cross-referenced for easy identification.

All drawings shall be dimensioned in the metric system. Where drawings are usually made in the British (or other) system, they shall also have metric system dimensions in parentheses or below dimension line. Titles and written notations shall be in English. If the original is in another language it shall carry English translation. The translations will appear immediately on the drawings. Attached lists of translated words shall not be accepted.

PROJECT: NSPCL-Rourkela PP-II Expansion (1x250 MW)
CUSTOMER: NTPC SAIL POWER COMPANY (P) LIMITED (NSPCL)

Technical Specification of GIS

Section-3: Project Details and General Specification

Drawings and bills of material shall be identified by a numbering system to be mutually agreed later on. Any additional identification numbers or symbols that the Bidder selects to use for his own purposes are permissible so long as Owner's number is the prime means of identification.

The scale of the drawing shall be shown clearly in the title block of the drawing. Wherever possible, scales of drawings shall be:-

1 : 1	1 : 2.5	1 : 5	1 : 10	1 : 20	1 : 25
1 : 50	1 : 100	1 : 200	1 : 300	1 : 500	
1 : 1000	1 : 2000	1 : 5000			

All reproducible must be made from original drawings.

All revised drawing shall clearly indicate the number, date and subject to each revision. All the revisions carried out in the drawings shall be clearly identified and marked.

Drawing list shall be kept up-to-date, incorporating all new additions, cancellations and changes, and will be reissued periodically with Progress Report.

General arrangement drawings shall be submitted for approval to the Owner/ Consultant prior to the commencement of detail engineering by the Bidder. These drawings shall show to scale all major equipment including electrical equipment and building outlines and overall dimensions as well as tie-in dimensions and clearances shall be clearly indicated. Approved arrangement drawings shall be used as basis for design and preparation of detail drawing to be prepared by the Bidder. The Bidder shall furnish all the necessary drawings, data etc., of the plant/equipment with appropriate "Status" stamp in adequate no. of copies as indicated below:

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	6	6	-
2	Drawings "As Built "	-	-	6	-
3	Type Test Reports	1	6	6	02
4	Erection Manuals	-	6	6	-
5	Operation and Maintenance Manuals	-	6	6	-
6	Manufacturing Quality Plan	1	6	6	-
7	Field Quality Plan	1	6	6	-
8	Inspection Test Reports	-	-	6	-

All instruction manuals / O&M Manual/"as built drawing" : 6 copies each

Operation & Maintenance Manuals

Instruction manuals, presenting the basic categories of information for the operating and/or maintenance personnel, as detailed herein below shall be furnished by Bidder.

The instruction manuals shall present the following basic categories of information in particular complete and comprehensive manner and prepared for the use by operating and/or maintenance personnel.

- i. Instructions for initial commissioning, short duration and long duration shut down.
- ii. Instruction for operation, routine inspection and maintenance including preventive maintenance.
- iii. Recommendation for inspection points, method of inspection and period of inspection.
- iv. Information on detection, cause and rectification of troubles and faults.
- v. Instructions on normal repairs and overhaul.
- vi. Complete parts list with proper and complete identification (Tag nos./Serial nos. as shown in the respective approved drawings) and ordering information for all replaceable parts. The identification details of equivalent and alternative makes for these spare parts which are not manufacturer's own product shall also be listed.
- vii. List of all special tools and tackle & spares and instructions for use of such tools and tackle & spares.
- viii. One complete set of as built drawings of the entire systems.
- ix. The information shall be organized in a logical and orderly sequence. A general description of equipment including significant technical characteristics shall be included to familiarize operating and maintenance personnel with the equipment. Such description and technical characteristics shall not differ from the approved data.
- x. Necessary drawings, curves and other illustrations shall be included or copies of appropriate approved drawings shall be bound in the manuals. Tests, adjustment and calibration information, as appropriate, shall be included. Safety and other warning notices and installation, maintenance and operating cautions shall be emphasized.
- xi. Write-up, figures, part list etc., shall be clearly legible. The manuals shall be prepared on good quality paper securely bound in durable folders.
- xii. The instruction manuals shall be subject to Consultant's approval in the same fashion as that for drawings.
- xiii. Instruction manual shall give step by step procedure for Erection, testing and commissioning
- xiv. Operation, Maintenance and Repair Instruction manual shall also contain:
- xv. List of spare parts with ordering specifications and manufacturer's catalogues
- xvi. List of consumables, lubricants, chemicals with specifications, brand names and annual consumption figures.
- xvii. Drawings relevant for erection, operation, maintenance and repair of the equipment.
- xviii. Procedure for ordering spares.
- xix. Maintenance Manual shall also include:
- xx. Diagnostic trouble shooting / fault location charts
- xxi. Tests for checking of proper functioning.

Drawings / documents for approval

List of drawings with schedule of submission five (05) days from the date of placement of order.

Quality Control & Quality Assurance plan.

G.A. and Cross Sectional drawings of all equipment indicating weights, material of construction, bill of material, dimension, specification etc.

Final design calculations and assumptions.

Actual performance data and characteristic curves based on the testing at site.

Technical Specification of GIS

Section-3: Project Details and General Specification

Technical specification of all equipment, motors, for all system and all other accessories.
Final list of drawings.
As built drawings.

Technical document for Reference / Information

Civil foundation drawings with static & dynamic load data of all equipment indicating cable trench, pipe trench, conduits, inserts, cable entries to motor, field devices etc.

Technical literature and catalogue of bought out items.

Drive list to be furnished within fifteen (15) days from the date of placement of order.

List of special tools & tackles to be supplied

Test certificates.

Part number and description of all spare parts.

Reproducible of all final drawings.

Total list of all equipment with dispatch schedule.

All other relevant drawings / documents / certificates not specifically mentioned above but deemed essential for successful functioning of the equipment.

Methodology of drawing Approval

Bidder shall submit all drawings / documents / data sheets / calculations etc. which require approval clearly indicating the category (Approval / Information) to BHEL in hard copies/ soft copies in adequate number. BHEL shall compile the observation/ comments along with MECON/NSPCL's comments and shall send stamped copies of the drawing / document to Bidder for further action at their end.

Bidder shall send the Approved working drawings to BHEL for their record, reference and use.

Electrical wiring diagram for all interlock in lubrication system etc., including wiring inside local panel.

Foundation drawing with loading data.

Miscellaneous

- i. General arrangement and cross sectional drawings of all major components with bill of material.
- ii. Foundation drawings, load data & design calculation for all equipment.
- iii. Erection drawings for all equipment and structures showing complete erection details.
- iv. Engineering and design calculations of installations and units.
- v. QAPs
- vi. Detailed procedures of shop testing of all the items applicable shall be submitted to the Owner/ Consultant for approval before conducting tests.

PROJECT: NSPCL-Rourkela PP-II Expansion (1x250 MW)
CUSTOMER: NTPC SAIL POWER COMPANY (P) LIMITED (NSPCL)

Technical Specification of GIS

Section-3: Project Details and General Specification

- vii. Following shop test certificates/test curves/data, shall be furnished.
- Materials and components test certificates.
 - Performance test results and characteristic curves of all fans, pumps, and electric drive motors etc.
 - Non-destructive test results as applicable.
 - Reports and test certificates of shop tests.
 - Type test & routine test certificates.
- viii. Detailed quality assurance program along with quality plan shall be submitted.

Following data shall be furnished:-

- a. Technical data of all the plant, equipment, drive motors, instruments, panels, etc. shall be furnished.
- b. Following lists/tables / write ups shall be furnished, complete with tag nos. and brief specification. Proper numbering system as approved by Consultant/Owner shall be adopted.
- i. Instrument schedule (with service, range, make of instrument).
 - ii. Flow element schedule.
 - iii. Valve schedule.
 - iv. Pipe schedule.
 - v. Cable schedule (Power & Control).
 - vi. Schedule of actuators (electric/pneumatic)

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

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

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

3.10 Workmanship and Quality Control

All moving parts of equipment, which can conceivably cause injury to the operator and otherwise authorized personnel within the vicinity of working area shall be suitably guarded and warning displays shall be put at prominent places.

The Bidder shall clearly indicate and identify the plans and procedures, which shall be followed in the design, manufacture and installation of plant and equipment to control and assure to the Owner of the desired quality.

3.11 Provision for exposure to hot and humid climate

a. ENCLOSURE

Enclosure protection class shall be as detailed in the respective chapters.

Equipment enclosure, intended for outdoor service, shall be of weather-proof construction, generally conforming to degree of protection IP-55.

For equipment located in hazardous areas like lub oil handling, hydrogen handling areas, FOPH etc. increased safety type enclosure, such as flame/explosion proof type, shall be provided. Such enclosures shall be certified by recognized authority as suitable for use in that particular environment.

b. TROPICAL PROTECTION

All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

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

d. 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.

e. 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.

3.12 NAME PLATE

Nameplate of approved design shall be furnished on each panel and for each instrument or device mounted on panel.

The material for nameplate shall be 3 mm thick lamicoid or approved equal, with white letters on black background.

3.13 GALVANISING

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

ii. 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. The Employer reserves the right to measure the thickness of zinc deposit by Elkometer 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.

iii. 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.

3.14 Surface Preparation and Painting

The surface of plant & equipment shall be suitably cleaned and coated with anti-rust primer to protect against corrosion and damage during transit and transportation to the site.

Painting shall be done as per details indicated in the relevant Sections of this specification.

Unless explicitly stated in relevant chapters of the specification, the painting of all electrical equipment shall be as follows:

Epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 50 microns shall be acceptable for finish coat. Paint shade shall be as per technical specification.

All sheet steel work shall be pretreated, 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. After passivation, Electrostatic Powder Coating shall be used. Powder should meet requirements of IS 13871 (Powder costing specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the Owner. The paint thickness shall not be less than 50 microns. Finished parts shall be suitably packed and wrapped with protective covering to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

3.15 QUALITY ASSURANCE

- i. The Contractor shall follow his standard procedures for quality assurance and control. A copy of the said standard procedures shall be submitted to the Owner / Purchaser for his reference. However, Owner / Purchaser reserves the right to review the same and give his observations, if any, for compliance.
- ii. The procedures shall be in such a form as to clearly delineate the manufacturing sequence, inspection points, tests and test procedures, acceptable ranges / values, reference drawings etc.
- iii. The Owner / Purchaser shall inform the Contractor as to which of the inspection points and tests shall be witnessed. As a minimum, inspection and testing of the finished equipment shall be made prior to shipment, unless specifically waived by the Owner / Purchaser. The contractor shall give at least fifteen (15) days advance notice regarding readiness of the equipment.
- iv. Manufacturing and quality control procedures shall be available for audit to the Owner / Purchaser and/or its representative at the place of manufacture.
- v. The Owner / Purchaser reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.
- vi. The Owner / Purchaser may inspect the Contractor's facilities prior to award of contract.
- vii. The Owner / Purchaser may witness any or all of the tests stipulated in the relevant standards and this specification.
- viii. The Owner / Purchaser may conduct surveillance of the Contractor's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.

QUALITY ASSURANCE REQUIREMENTS

3.15.1.1 QUALITY ASSURANCE PROGRAMME

- a. To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorized representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following:
- b. His organization structure for the management and implementation of the proposed quality assurance programme.
- c. Documentation control system.

Technical Specification of GIS

Section-3: Project Details and General Specification

- d. Qualification data for Bidder's key personnel.
- e. 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.
- f. System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- g. Control of non-conforming items and system for corrective actions.
- h. Inspection and test procedure both for manufacture and all site related works.
- i. Control of calibration and testing of measuring and testing equipments.
- j. System for quality audit.
- k. System for indication and appraisal of inspection status.
- l. System for authorizing release of manufactured product to the Owner.
- m. System for handling storage and delivery.
- n. System for maintenance of records.
- o. Furnishing of 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 as per format enclosed at Annexure-I to this section.

3.15.1.2 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- i) 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 Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Authorized representative for approval. Schedule of finalization of such quality plans will be finalized before award.
- ii) 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 Quality Control organization, 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.
- iii) 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 organization, during various stages of site activities from receipt of materials/equipment at site.
- iv) 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 Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorized representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorized representative and beyond which the work will not proceed without consent of Owner/Authorized representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorized representative for approval and dispositioning.

- v) No material shall be dispatched from the manufacturer's works before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/Authorized representative, and duly authorized for dispatch issuance of Material Dispatch Clearance Certificate (MDCC).
- vi) Materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report as per Owner's approved QAP. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.
- vii) Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.
- viii) 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 Owner.
- ix) All brazers, welders etc. employed on any part of the contract at Contractor's/Sub-Contractor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorized representative.
- x) For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.
- xi) All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non-destructive examination). Results of NDT shall be properly recorded and submitted for approval.
- xii) All the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Contractor and finalized with the Owner shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalized and approved by the Owner/Authorized representative and form part of the Purchase Order between the Contractor and the Vendor.
- xiii) All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalized with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed. Owner 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 Owner carry out such audit and surveillance. Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject an equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.

- xiv) Quality requirements for main equipment shall equally apply for spares and replacement items.
- xv) Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.
- xvi) For quality assurance of all civil works refer to the specifications for civil works.

3.15.1.3 QUALITY ASSURANCE DOCUMENTS

- i) The Contractor shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after dispatch of the equipment:
- ii) Material mill test reports on components as specified by the specification.
- iii) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- iv) Non-destructive examination results /reports including radiography interpretation reports.
- v) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- vi) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- vii) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- viii) Stress relief time temperature charts.
- ix) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :
- x) When some important repair work is involved to make the job acceptable.
- xi) The repair work remains part of the accepted product quality.
- xii) Letter of conformity certifying that the requirement is in compliance with finalized specification requirements.

3.16 Inspection and Testing

The plant and equipment shall be subjected to inspection and witnessing of shop tests by the Owner / Consultant or the agency mutually agreed between Owner and the Bidder / Supplier. The supplier shall inform the Owner/ his Consultants at least fifteen days in advance of the date when the plant and equipment shall be made available for inspection and testing. The Owner and / or his Consultant shall be given full access to the tests and testing premises and can inspect the factories and offices of the supplier or sub-vendor, if so required. After inspection and testing, all certificates /documents as required by the Owner / Consultant shall be submitted for approval to the Owner before clearance for dispatch of equipment can be given.

For plant and equipment for which tests at works may not have been witnessed by Owner / Consultant, the tests and quality certificates duly signed by appropriate authority acceptable to Owner / Consultant shall be submitted to the Owner / Consultant for approval within 6 weeks in advance of the dispatch.

Inspection by the Owner or his representative shall not relieve the Bidder of his liability for rectifying any defects which may subsequently appear or be detected during or after erection and during guarantee test. After rectification, the testing of equipment shall be repeated to the satisfaction of the Owner / Consultant.

Drawings / Data to be submitted with the Tender

In order to enable the Owner / Consultant to properly evaluate the tenders, the drawings / documents / technical particulars.

3.17 Packing, Dispatch, Handling & Transportation

All equipment, shall be suitably packed for protection against mechanical damages and climatic conditions during transit and storage. Packing and weather proofing shall be subject to approval of the Owner / his Consultant. This approval shall be general and may not be required every time for an article to be dispatched. However, the Owner reserves the right to examine the packing for any particular consignment at supplier's/ manufacturer's works before dispatch.

The supplier shall be entirely responsible for the insurance, shipment, handling and transportation.

The equipment shall not be dispatched by the Bidder from the place of manufacture to the site until the dispatch instructions are issued by the Owner.

3.18 ELECTRICAL SWITCH BOARDS

General

Switchboards shall be dead-front, free-standing, vertical, cubicle/panel type, completely wired, having access doors with concealed hinges and locking type latches.

Panels shall be fabricated from minimum 2 mm. thick CRCA (cold rolled continuously annealed) sheet steel, free from any surface imperfections and suitably reinforced to provide a sturdy and rigid assembly. Gland plate thickness shall be min 3.0 mm of non-magnetic material.

Panels shall be adequately sized for installation of field cables and access for maintenance. The working zone shall be limited between 450 mm and 1800 mm from floor level.

Each panel shall be provided with internal illumination lamp operated by door switch, space heater with switch fuse unit, and plug socket with switch for hand lamp.

Removable eye bolt/lifting lugs shall be furnished on all panels.

Module selection chart is included in this specification for guidance purpose. Bidder to note that this is only for guidance of the bidder. Actual size, rating etc. shall be as per detailed engineering by the bidder.

3.18.1 Equipment Mounting

All instruments, switches etc. mounted on the front face of the panels shall be of flush type.

All equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of service to others.

All equipment inside the panel shall be so located that their terminals and adjustments are readily accessible for inspection and maintenance. Adequate ventilation shall be provided in enclosed panel.

Each of the LV switchboards shall be designed for 1.1 times the required rating as a spare capacity. Further all LV Switchboard shall be provided with 20 % spare modules of each rating and type of module.

3.18.2 Panel Wiring

All panels shall be fully wired at the factory to ensure proper functioning of all control, protection and interlock schemes. All wiring for external connections shall be brought to terminal blocks and numbered.

All auxiliary wiring shall be carried out with 650V grade, single core stranded copper conductor, color coded, PVC insulated wires. Conductor size shall be 1.5 mm² (min.) for control circuit wiring and 2.5 mm² (min) for CT, PT and space heater circuits.

Solderless compression/clamp type connection shall be used for wire terminals. Wiring shall be continuous between terminals without splicing. Each wire shall be identified at both ends with permanent markers having wire numbers as per approved wiring drawings.

3.18.3 Terminal block

Terminal blocks shall be 650V grade, 10Amps rated, made up of unbreakable polyamide 6.6 grade. The terminals shall be either screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design.

Terminal blocks for CT and VT secondary leads shall be of stud type, made up of unbreakable polyamide 6.6 grade. They shall be provided with links to facilitate testing, isolation star / delta formation and earthing. Terminal blocks for CT secondary shall have the short circuiting facility. The terminals for remote ammeter connection etc. shall also be disconnecting type only. All metal parts shall be of nonferrous material. Screws shall be captive.

All panel wiring for external connections shall terminate on separate terminal blocks which shall be suitable for connecting two (2) stranded copper conductors of 2.5 sq. mm on each side, or alternatively, the terminal blocks shall have the possibility of double shorting space to facilitate looping.

Not more than two wires shall be connected to one terminal. Spare terminal equal in number to 20% of active terminals shall be furnished.

Terminal housing Material should be a) Fire resistant/retardant, b) Of high aging stability and c) Unbreakable.

Cable terminals Material should a) be of copper alloy b) Be able to rigidly hold the cable with adequate pressure, c) have low contact resistance and d) have sufficient contact surface.

3.18.4 Grounding

A copper ground bus, sized to carry maximum short circuit current, shall run along the entire length of panel structure and shall have terminal connector at each end for connection to station ground grid (50 X 6 mm G.I. flat).

Tests

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.

Special Cables

Special cables for specific purpose, as required, shall be supplied and installed by the Bidder.

3.18.5 CONDUITS

Conduits shall be of heavy gauge rigid steel, hot-dip galvanized, cut square reamed, threaded and screwed tight at all joints.

Conduit entrances to pull boxes and switches shall have double lock nuts & insulating bushings. No running thread shall be used.

Flexible metallic conduit shall be used for connection to equipment, which are subject to vibration, and also for connection to level/limit/pressure switches.

3.19 Performance Guarantee and Penalties

All the plant and equipment supplied shall be guaranteed for quality workmanship and compliance with the specified requirements for integrated performance to deliver rated outputs. Non-compliance and non-performance shall be subjected to correction.

3.20 TYPE, ROUTINE & ACCEPTANCE TESTS:

All equipments 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 this specification and carried out within last ten years from the date **02/04/2015**. These reports should be for the test 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 **02/04/2015** 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.

PROJECT: NSPCL-Rourkela PP-II Expansion (1x250 MW)
CUSTOMER: NTPC SAIL POWER COMPANY (P) LIMITED (NSPCL)

Technical Specification of GIS

Section-3: Project Details and General Specification

3.21 Title Block :

		NTPC – SAIL POWER COMPANY (P) LIMITED			
Project		ROURKELA PP-II EXPANSION PROJECT (1X250 MW)			
		Consultant (मैकॉन लिमिटेड) MECON LIMITED			
BHARAT HEAVY ELECTRICALS LTD  TRANSMISSION BUSINESS GROUP		DRN			
		DESN			
		CHD			
		APPD			
DEPT : TBG	SCALE NTS		DRAWING NUMBER		
TITLE :					Pg.No 1/--

-----XXXX-----

SECTION - IV (GTP)

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III: 1X250 MW)	
	TECHNICAL SPECIFICATION FOR EPC PACKAGE	

8.1.2	Type / Material		
8.2	Degree of protection Indoor/Outdoor		
8.3	Junction Box		
8.3.1	Make		
8.3.2	Type / Material		
8.4	Terminal Block		
8.4.1	Make		
8.4.2	Type		
8.4.3	Voltage Grade		
8.5	Push Button		
8.5.1	Make		
8.5.2	Type		
8.5.3	Voltage Grade		
8.6	Indicating lamps		
8.6.1	Make		
8.6.2	Type		
8.6.3	Voltage Grade		
8.7	Meters		
8.7.1	Make		
8.7.2	Type		
8.7.3	Voltage Grade		
8.8	Selector Switch		
8.8.1	Make		
8.8.2	Type		
8.8.3	Voltage Grade		
XV	CABLES		
1.1	Make		
1.2	Type		
1.3	Specifications and Standards		
1.4	Design ambient temperature	°C	
1.5	System Particulars		
2	CABLES(Fill separate columns for the following particulars for each type and size of cables)		
2.1	Name of the Manufacturer		
2.2	Cable size		
2.3	No. of cores		
2.4	Whether cable will carry ISI mark	Yes /No	
2.5	Voltage grade		
2.6	Suitable for earthed/unearthed system		
2.7	Permissible voltage and frequency variation for satisfactory operation		
2.8	Conductor		

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III: 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	---	---

2.8.1	Material		
2.8.2	Applicable standard		
2.8.3	Grade		
2.8.4	Size		
2.8.5	No.& dia.of wire in each conductor No./mm		
2.9	Shielding on conductor		
2.9.1	Material		
2.9.2	Type		
2.9.3	Thickness		
2.10	Insulation		
2.10.1	Material		
2.10.2	Type/Applicable standard		
2.10.3	Thickness		
2.11	Inner sheath		
2.11.1	Material		
2.11.2	Type/applicable std.		
2.11.3	Thickness	mm	
2.11.4	Whether triple extrusion technique for HT adopted?	Yes /No	
2.12	Maximum acid-gas generation by weight (%) of outer sheath to IEC 754-1.		
2.13	Approx. weight of finished cable	(kg/km)	
2.14	Overall diameter of cable (D)	mm	
2.15	Inner sheath		
2.15.1	Material, confirming standard / type		
2.15.2	Extruded	Yes /No	
2.15.3	Whether inner sheath will be of FRLS material and meet special Tests as per specification for FRLS cables	Yes /No	
2.16	Filler Material details		
2.16.1	Armouring		
2.16.	Material		

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III: 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	---	---

2			
2.16.3	Type of armouring		
2.16.4	Whether galvanised	Yes /No	
2.16.5	Outer sheath		
2.16.5.1	Material confirming standard/ type		
2.16.5.2	Extruded		
2.16.6	Whether outer sheath will be of FRLS material and will meet the special tests as per specification	Yes /No	
2.17	Short circuit withstand capacity		
2.17.1	Short circuit current	kA	
2.17.2	Duration of short circuit	Sec	
2.18	Allowable/attainable maximum conductor temperature when carrying continuously currents		
2.19	Allowable/attainable maximum conductor temperature at the termination of short circuit current		
2.20	Conductor resistance		
2.20.1	a) Thickness of insulation		
	b) Thickness of sheath		
	i. inner		
	ii. outer		
2.20.2	Insulation resistance		
2.20.3	Tensile strength of conductor		
2.20.4	a) Tensile strength at break of		
	i. Insulation		
	ii. Inner sheath		
	iii. Outer sheath		
	b) Elongation at break of		
	i) Insulation		
	ii) Inner sheath		
	iii) Outer sheath		

	NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III: 1X250 MW) TECHNICAL SPECIFICATION FOR EPC PACKAGE	
---	---	---

2.20.5	Oxygen index value		
2.20.6	Smoke density		
2.20.7	Acid gas generation		
2.20.8	Flame propagation as tested by flammability test.		
2.21	Factory tests (Enumerate in detail for each type of cable)		
2.21.1	Type tests		
2.21.2	Acceptance tests		
2.21.3	Routine tests		
2.21.4	Special tests to prove FRLS/FS properties		
2.22	Is the offered cable guaranteed to safely withstand continuous conductor temperature of 90 °C for XLPE,FS/ 85 °C for HRPVC	Yes /No	
XVI NEUTRAL GROUNDING TRANSFORMER			
1	General		
1.1	Quantity		
1.2	Manufacturer		
1.3	Applicable standards		
1.4	Type		
1.5	Duty cycle		
1.6	Generator Neutral Earthing		
1.7	Degree of protections NGT/NGR		
1.8	Cooling		
1.9	Resistor		
1.10	Resistor material & connection		
1.11	Duty cycle		
1.12	Maximum allowable Temperature rise °C over ambient (50 Deg. C)		
XVII NEUTRAL GROUNDING RESISTOR			
A	General		
1	Make		
1.0	Type		
1.1	Service		
1.2	Reference Standard		
1.3	Rating		

SECTION-5

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

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

BHEL ENQUIRY. NO:

BIDDER OFFER REFERENCE:

A)

(1)	(2)	(3)	(4)	(5)
S.No.	Parameters	Data	Yes / No	Remarks in case reply in Col (4) is <i>NO</i>
1.0	Applicable Standard	Latest IS -1554, 5831, 8130, 7098, 3975, 613, ASTM-D2843, ASTM-D2863, IEC60754, IEC60332, IS3961, IS 10418, SS4241475, NEMA WC-70, IEEE-383; For screened cables, standards mentioned in Annexure-1B, Section-1.		
2.0	Type	FRLS		
3.0	Construction feature for PVC Control and Aux Power cable			
3.1a	Material of Conductor for Control cables	Plain Annealed, High Conductivity, Stranded, untinned Copper, Grade EC		
3.1b	Material of Conductor for Screened Cable	High Conductivity, Annealed bare copper, Electrolytic grade, Strands: 7x0.3mm (nom)		
3.2	Material of Conductor for Power cables	Stranded Aluminium, Grade H2 /H4		
3.3	Conductor Insulation for Control and Power cables	As per Annexure-1A, Section-1		
3.4a	Conductor insulation for <i>Screened Control Cable</i>	PVC Type Y13 (Insulation Thickness suitable for 1.1kV Voltage class as per relevant standards)		
(1)	(2)	(3)	(4)	(5)
S.No.	Parameters	Data	Yes / No	Remarks in

				case reply in Col (4) is <i>NO</i>
3.4b	Shielding for <i>Screened Control Cable</i>	Al- Mylar Tape a) Individual Pair Shielding: 28 Micron Thickness (Min.) b) Overall cable assembly Shielding : 55micron Thickness (min)		
3.4c	Drain Wire for <i>Screened Control Cable</i>	For individual & Overall Shield: 7 Strand, 20 AWG (0.51sq.mm) annealed Tin coated copper		
3.5	Inner sheath	Extruded PVC, Type ST-1		
3.6a	Armouring for Control Cables	Galvanised Steel Round wire /formed wire for multicore cables		
3.6b	Armouring for Screened Control Cable	Galvanised Steel Round wire		
3.7	Armouring for Aux Power Cables	Aluminium round wire for Single core And Galvanised Steel round wire/formed wire for Multi- core cables		
3.8a	Outer sheath for Control and Power cables	PVC extruded, FRLS, Type ST-1		
3.8b	Outer sheath for <i>Screened Control Cable</i>	PVC extruded, FRLS, Compound YM1		
4.0	Construction feature for XLPE Aux Power cable			
4.1	Material of Conductor for Power cables	Stranded Aluminium, Grade H2 /H4		
4.2	Conductor Insulation	XLPE		
4.3	Inner sheath	Extruded PVC, Type-ST2		
(1)	(2)	(3)	(4)	(5)
S.No.	Parameters	Data	Yes / No	Remarks in case reply in Col (4) is <i>NO</i>
4.4	Armouring for Aux	Aluminium round wire for		

	Power Cables	Single core And Galvanised Steel round wire/formed wire for Multi- core cables		
4.5	Outer sheath	PVC extruded, FRLS, Type ST-2		
5.0	FRLS properties of Outer sheath			
5.1	Minimum Oxygen index	29		
5.2	Minimum Temperature index	250°C		
5.3	Acid gas emission	Max 20% by weight		
5.4	Smoke density rating	Max 60%		
6.0	Tolerance on overall diameter	± 2mm		
7.0	Chemicals added to outer sheath to protect from rodent, vermin and termite attack	Yes		
8.0	Drum lengths shall be 1000m for cables with conductor cross section area less than 300 sq mm	Yes		
9.0	Tolerance on total quantity	± 2%		
10.0	Minimum bending radius for multicore cables	12 x D		
(1)	(2)	(3)	(4)	(5)
S.No.	Parameters	Data	Yes / No	Remarks in case reply in Col (4) is NO
11.0	Core Identification	By colour coding as per IS 1554 (Part-I)/ IS 7098 Part-I for the cables upto five (5) cores; and for the cables with		

		more than five (5) cores, by printing legible Hindu Arabic numerals on all cores as per Clause 10.3 of IS 1554 (Part-1).		
12.0	The fillers and inner sheaths shall be of non-hygroscopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable	Yes		

B) TYPE TESTS

Tests shall be carried out as per clause no.5.00.00 & 5.01.00 of Annexure-1A. **(YES)**

C)

(1)	(2)	(3)
S.No.	Description	Confirmation of Supplier
1.	Bidder to confirm that at all drawings / data sheets/QP/ valid type tests reports/ all relevant information shall be submitted to BHEL for organising approval of ultimate customer.	

Date:

Signature of the authorized representative of Bidder

Company Seal