

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D20	
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan ELECTRICAL EQUIPMENT INSTALLATION	SHEET 1 of 3	
1.0 <u>GUIDELINES FOR INSTALLATION OF ELECTRICAL EQUIPMENT</u> 1.1. All electrical equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, squat and properly aligned and oriented. Tolerances shall be as established in the Manufacturer's drawings. 1.2. Transformers Care shall be taken during handling of insulating oil to prevent ingress of moisture or foreign matter. In the testing, circulating, filtering or otherwise handling of oil, rubber hoses shall not be used. Circulation and filtering of oil, heating of oil by regulated short circuit current during drying runs and sampling and testing of oil shall be in accordance with the Manufacturer's instructions and specified Code of Practice. 1.3. Switchgear, Control/Relay Panels 1.3.1. Switchgears and control relay panels/desks shall be installed in accordance with specified code of practice and the Manufacturer's instructions. 1.3.2. In joining shipping sections of the switchgear/panels/control centres together, adjacent housing or panel sections provided shall be bolted together after alignment has been completed. 1.4. Motors The installation, commissioning of the motors shall be as per the applicable code of practice and the Manufacturer's instructions. 1.5. Battery and chargers Each cell of the battery bank shall be inspected for breakage and condition of cover seals as soon as received at site. Each cell shall be filled with electrolyte in accordance with the Manufacturers instructions. Battery shall be set up on racks as soon as possible after receipt, utilising lifting devices supplied by the MANUFACTURER. The cells shall not be lifted by the terminals. 1.6. Switchyard 1.6.1. Switchyard equipment installation shall be carried out as required in the approved drawing/plan and elevation drawings of switchyard showing bus bar configurations, sizes, tensions, insulator details etc. 1.6.2. The above shall include installation of complete set of bus bars and all bays, conductors, complete with tension/suspension insulator strings, bus post insulators, equipment connections, bus bar connections to equipment, lightning shield wires including downcomers where they shall be connected to the test links. Tube type conductor lengths shall be joined by welding procedure. <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="padding: 2px 10px;">ISSUE R1</td></tr></table>			ISSUE R1
ISSUE R1			

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D20
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan ELECTRICAL EQUIPMENT INSTALLATION	SHEET 2 of 3

1.6.3. Installation work of breakers shall also include compressed plants with all accessories whenever applicable and necessary adjustments/alignments for proper operation of circuit breakers and their operating mechanisms. All insulators and bushings shall be protected against damage during installation.

1.6.4. RCC Trenches shall be provided in each bay for cabling to different equipment. Trench layout shall be such that no equipment is more than 5 Meter away from the trench.

1.6.5. Cabling between trench to equipment shall be done using conduits.

1.6.6. Conduits shall be sized so that only 40 % is occupied by the cables.

1.6.7. Rails shall be provided for moving the transformers from its installed location to the unloading bay and the nearest road for uploading. Mooring rings shall be provided along the run of the rails at regular intervals to facilitate pulling the transformer.

2.0 TESTING AND COMMISSIONING

2.1 All checks and tests as per the Manufacturer's drawings/manuals, relevant code of installation and commissioning check lists for various electrical equipment e.g. Transformers, breakers, isolators, CTs, PTs, motors, switchgear, relays, meters etc. shall be carried out.

2.2 The CONTRACTOR shall perform operating tests on all switchgear and panels to verify operation of switchgear/panels and correctness of the interconnections between various items of the equipment. This shall be done by applying normal AC or DC voltage to the circuits and operating the equipment for functional checking of all control circuits, e.g., closing, tripping, control interlock, supervision and alarm circuits. All connections in the switchgear shall be tested from point to point for possible grounds or short circuit.

2.3 Insulation resistance tests shall be carried out by following rating meggers :

(a)	Control circuits upto 220V	:	by 500 V megger
(b)	Power circuits, bus bars, connections upto 11kV	:	1000V megger
(c)	Power circuits, bus bars, connections above 11 kV	:	by 5000 V motor operated megger

3.0 In order to avoid hazards to personnel moving around the equipment such as switchgear etc. which is kept charged after installation before commissioning,

ISSUE
R1

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D20
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan ELECTRICAL EQUIPMENT INSTALLATION	SHEET 3 of 3
such equipment shall be suitably cordoned off to prevent anyone accidentally going near it. 4.0 The CONTRACTOR shall possess or obtain valid working licence from the concerned State Electricity Authority/Inspectorate for carrying out the electrical installation work in the region before commencing the work.		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D23
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan WIRING TERMINATIONS AND ACCESSORIES	SHEET 1 OF 9

1.0 **SCOPE**

- 1.1. This specification covers the requirements of Wiring, Terminations and Accessories.
- 1.2. Unless repugnant from the context the words "Cabinets", "Panel", "Desk", "Cubicle", "Board", "Module" or similar expressions connoting the same meaning whether used singly or severally shall cover all items included in this specification.

2.0 **CODES AND STANDARDS**

- 2.1. The design, manufacture and performance of equipment shall conform to latest applicable standards as on date of submission of the bid and shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in this specification shall be construed to relieve the BIDDER of this responsibility.
- 2.2. Unless otherwise specified, the Equipment shall conform to the latest applicable Indian and International standards.

3.0 **CONVENTIONAL SYSTEM** (Comprising Cables with Non-Plugin Type Terminations).

3.1.	<u>Panel Internal Wiring</u> (Includes all Wiring between panel mounted equipments and from equipment to the terminal blocks)	600 Volts grade, wires standard copper conductor concentric gray, insulated with PVC, shielding shall be provided where necessary.
3.2.	<u>Interpanel Wiring</u> (Wiring between panels)	(a) Where panels are mounted adjacent to one another those shall be done inside the panels with wires as per clause 3.1
3.3.		(b) When panels are located apart these shall be with conventional cables. 600V grade, insulated with XLPE/PVC, steel tape armoured, flame retardant neoprene overall jacketed. Cables should meet vertical

ISSUE
R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED			VOLUME IV SECTION: D23					
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan			SHEET 2 OF 9					
WIRING TERMINATIONS AND ACCESSORIES									
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(a) Connection between field mounted devices to distribution frames Same as 3.2 (b) above except in case of low level signals those shall be with twisted and screened. Low level signal includes all current /voltage signals working at voltage less than 110 V DC or AC.									
(b) Connection between distribution frame to terminal cabinets (buffer panels) pairs with individual core shielding and an additional overall shielding.									
(c) Connection between terminal cabinets and the control panels Pre-fabricated plug-in type cables as per clause 5.0.									
3.4. Panel Wiring 3.4.1. All internal wiring should be completed at factory so that the panel is ready for external connection. 3.4.2. Temporary wiring for testing should be removed before shipment. 3.4.3. Interpanel wiring of adjacent panels shall be completed for shipping section and neat arrangement shall be provided for interconnection between shipping section. 3.4.4. Wiring shall be continuous and no splicing or joints is permissible.									
				<table border="1"> <tr> <td>ISSUE R1</td> </tr> </table>	ISSUE R1				
ISSUE R1									



SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D23
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan WIRING TERMINATIONS AND ACCESSORIES	SHEET 3 OF 9
3.4.5. Panel wiring shall be securely supported, neatly arranged and easily accessible. Wiring gutters, troughs channel with covers, shall be used for this purpose. 3.4.6. Extra flexible wires (with 19 strands) shall be used where flexible cables are laid across hinges to devices mounted on doors. Size of wires for CT connections - not less than 2.5 mm² Size of wires for VT connections - not less than 1.5 mm² Other circuits - not less than 1.5 mm² Power circuits - As required by the connected load but minimum size shall be 4 sq mm. 3.4.7. Wiring termination shall be made with solderless crimping type tinned copper lugs. Insulation sleeves shall be provided over lugs for all terminations. 3.4.8. Core identification with plastic ferrules marked with wire numbers shall be provided at both ends. 3.4.9. Trip circuit wires shall be distinguished by an additional red coloured ferrules. 3.4.10. Generally only one wire shall terminate on a terminal except in case of jumering where in maximum of two wires is permitted. 3.4.11. Wiring circuits for power supply to transducers amplifiers shall have adequate short circuit protection by fuses. 3.4.12. If accidental short circuits of certain wires are likely to result in mal-operation, such wires shall not be terminated on adjacent terminal blocks for example trip circuits of circuits breakers. 3.4.13. Trouble contact in alarm circuits shall have two wires for duplication of connection. 3.4.14. Numbering system to be adopted for the ferrules shall be subject to purchaser's approval. Ferrules and numbers shall be such size and quality so that they are clearly visible and should not fade over the life of the panel. 3.4.15. All wiring shall be neatly dressed and secured so that they do not obstruct access to any part or the details written on the components. 3.5. <u>Terminal Blocks</u> 3.5.1. Terminal blocks shall be 600V grade, 10 amp one piece moulded complete with barriers stud type terminals, washers, nuts, lock nuts, identification strip and hanged terminal cover.		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D23
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan WIRING TERMINATIONS AND ACCESSORIES	SHEET 4 OF 9

3.5.2. Terminal blocks for CTs & VT leads shall have test links and isolating facility, CT leads shall also have short circuit and earthing facility.

3.5.3. 10% of spare terminals, uniformly disturbed on all terminal block group shall be provided.

3.5.4. All spare contacts of terminals of mounted equipment and devices shall be wired to terminal block for future use.

3.5.5. For duplex panels, provision shall be made for control cables entries in both front and rear sections. Wiring gutters shall be provided for interconnections between front and rear sections.

3.5.6. Unless otherwise specified, terminal blocks shall be suitable for connecting minimum 2 nos. 2.5 mm² conductors.

3.5.7. The following clearances shall be provided.

(a) From cable gland plate to } Minimum 250 mm
Bottom most terminal.

(b) Between two rows of } Minimum 250 mm
terminal blocks

3.5.8. All necessary cable terminating accessories such as, gland plates, packing glands, copper lugs etc. shall be provided by BIDDER for termination of his external cables to the panels.

3.5.9. As far as possible terminals for connection to the same external cable core shall be located adjacent to each other and arrangement shall be such as not more than one core terminates on a terminal block.

3.5.10. Transparent covers of good quality and strength shall be provided for all TBs.

3.5.11. Terminal block used for wiring of circuits at voltage more than or equal to 110 V AC/DC shall be physically segregated from the rest of the TBs.

4.0 Intra panel (in panel internal) Wiring
Inter-connection between modules located on the same panel shall be made with wires having plug in type connector. The wires shall be same as in clause 3.1.

ISSUE
R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D23
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan WIRING TERMINATIONS AND ACCESSORIES	SHEET 5 OF 9

4.1. Inter Panel Wiring (i.e. between panel) Connection
Interconnection between panels described in clause 5.0 shall be made with cables prefabricated plug-in type multiple pin connectors. Cables shall be plugged in directly to the respective modules without intervening terminal blocks. Cables shall be as per clause 3.2.

5.0. **PREFABRICATED CABLES & CONNECTION PLUGS**

5.1. They shall have following features.

5.1.1. 10% of spare core with a minimum of 5 spares. The spare cores shall not be connected to end connectors.

5.1.2. These cables shall be flexible and have as small a diameter as possible for easy handling.

5.1.3. Connecting plugs shall be adequate to accommodate the overall diameter of the cables.

5.1.4. Multiple wire connectors shall be of one type to minimise variety of spare pin.

5.1.5. Each connection of pin to plug socket shall be by at least two parallel paths such as bifurcated connectors. The contact surfaces shall be plated with noble metal alloy. Cable connection to the pack of each plug in pin shall be soldered or made by means of equipped lugs. Cables shall be firmly secured to the plug by clamping over the outer sheath. Accidental removal of connectors shall be prevented by means of a mechanical clip or locking device.

5.1.6. All terminations shall be made with the tools recommended by its manufacturer of the pin, lug or plug. A sample of finished connection to be submitted to purchase for his prior approval.

5.1.7. The cables shall be sized adequately for the applications and the following general stipulations shall apply

a) Carry 100 A current for 3 seconds

b) Withstand 10,000 A and 20,000A for 0.025 second for AC & DC contacts respectively.

5.1.8. The cables shall be suitable for indoor/outdoor, above/below ground applications in cable carrier system such as racks, pipes trenches and luxury.

5.1.9. The bid shall give complete details of the proposed cable and termination arrangement indicating special requirements if any for each control system/panels.

ISSUE
R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D23
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan WIRING TERMINATIONS AND ACCESSORIES	SHEET 6 OF 9
5.1.10. Connectors shall be properly polarised and shall have electrical characteristics equal to or better than associated cables. 5.1.11. Electrical clearances and creepage distances on connectors shall be at least same as on terminal blocks or similar conventionally mixed circuits. 5.1.12. All connectors shall be furnished with cable restraints which securely grip the cable jacket and prevent motion between the end of the cable joshier and connector pin. 5.1.13. BIDDER shall furnish detailed cable schedule and interconnections for all prefabricated cables in his scope of supply. 6.0 <u>TERMINAL CABINETS - WIRING AND EARTHING ARRANGEMENTS</u> 6.1. As the terminal cabinets will be used for terminating conventional cables from field instruments/distribution frame as well as prefabricated cables for connection to panels in the control room, it shall consist of both the conventional type of terminal blocks as well as those required to terminate prefabricated plug-in type connectors. 6.2. Telephone type terminals blocks may be provided for pre-fabricated cables. The tags or pins shall be arranged with due consideration given to cable access. Soldered terminations or any other type such as "maxitermipoint" or equivalent systems of terminations are acceptable. The test points (for testing current loops shall be terminated by soldered terminations. 6.3. Tags or pins shall be of corrosion resistant material. 6.4. The insulation between adjacent terminals or between any terminal & the framework shall withstand a test voltage of 2 KV for one minute. 6.5. Moulding materials shall be self-extinguishing or resistant to flame propagation, substantially non-hygroscopic and shall not carbonise when testing for tracking. The mouldings shall be dimensionally stable, heat resistant and have a high impact strength. Mouldings shall also be mechanically robust. 6.6. Each branch of a current loop shall have provision for being shorted out in order to isolate the branch without disturbing the rest of the loop. This shorting shall be done by means of a plug, a jumper wire with plugs, or another device, e.g. diode, subject to PURCHASER'S approval. The short circuit facility shall be incorporated in the terminals. 6.7. External cables shall be sorted to minimise the length of jumper wires. This shall not apply to cores within one cable, as these cores shall be connected to consecutive terminals. 6.8. The terminal block wiring shall be done in such a way that the jumper connections and external cable connections are made on different sides of the terminal block. The sides on which jumper connections and external cable connections are made shall be consistent and unambiguous throughout.		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D23
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan WIRING TERMINATIONS AND ACCESSORIES	SHEET 7 OF 9

6.9. Where applicable, marshalling and core connection shall be done according to a colour code or number code, whereby the same colours or numbers are connected to terminals in the same row/column of a terminal block in a sequential manner.

6.10. The wiring layout shall be such that the field wiring is separated from jumper wiring.

7.0 EARTHING

7.1. Two separate earth systems are required for the terminal cabinet, these being for the framework and for cable screens respectively.

7.2. Insulation between the two earths, after completion of the installation of the marshalling rack and prior to connection of the two earths to the station earth shall withstand a test resistance of not less than one (1) meg-ohm at 500 volts).

7.3. All metal parts other than those forming part of an electrical circuit shall be connected to a copper earth bar run along the inside bottom of the terminal cabinet. The minimum section of the earth bar shall be (25mm x 3mm). A 15mm diameter hole is to be provided at each end of the bar. Connection of the earth bar to the station earth shall be carried out by the Bidder.

7.4. A central earthing point for all screens shall be provided within the terminal cabinet by the BIDDER. Connection between the screen terminals and this earthing point shall be made by means of jumper wires. Connection of this earthing point to the station earth shall be carried out by the Bidder.

7.5. Every terminal and test plug shall be uniquely identified within the terminal cabinet by means of a terminal number. Appropriate labels shall be used to permit quick and unambiguous identification of each terminal and test plug.

7.6. All labels shall have white lettering on a black or dark blue background and shall not discolour or distort in service.

8.0 GENERAL REQUIREMENTS

Following general arrangements shall apply to wiring as well as panel layouts. These are applicable for both the environmental and special system covered above.

8.1. Auxiliary busbars for AC and DC supplies, VT circuits, annunciator circuit buses and other common services shall be provided near the top of the panels, running throughout the entire length of panels. These buses shall have a nominal cross section equivalent to a copper diameter of 6 mm and shall be suitably insulated all along their run. Insulated clamps shall be provided for tap connections. DC buses shall be divided into two sections to permit two independent supply points.

ISSUE
R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D23									
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan WIRING TERMINATIONS AND ACCESSORIES	SHEET 8 OF 9									
8.2. The unused instrument space on the front or rear of the panels shall be kept clear of wiring, to facilitate addition of divides without rewiring associated portion of the panels. 8.3. Longitudinal troughs extending throughout the full length of the panels shall be provided for inter-panel wiring. Interconnections to adjacent panels shall be brought out to a separate set of terminal blocks located near the slots or holes meant for taking the interconnecting wires. Arrangements shall permit easy interconnections to adjacent panels at Site and wires for this purpose shall be provided by the BIDDER and shall be looped and bunched properly inside the panels. 8.4. The BIDDER shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment. Such internal wiring shall conform to the control wiring diagrams (to be supplied later) for terminal to terminal connections physically as well as electrically for convenience in trouble shooting. 8.5. All external cables and their cores shall present a neat appearance and shall be suitably braced, placed in troughing, clipped or laced to prevent effects of vibration. Jumper wires shall be held in troughing, marshalling stirrups or channels to present neat appearance, and to enable modifications to be easily performed on the jumper wires. They shall not be tied, clamped or bound in any way. 8.6. All electrical panels/boards/terminal cabinets supplied under this specification shall be fitted with cable boxes and cable glands complete with all necessary accessories. All boxes shall be of adequate proportions and designed in such a manner that they can be opened for inspection without disturbing the gland plate or incoming cable. 9.0 The BIDDER shall indicate in the following in Data Sheet the specification and performance characteristics of cables included in his scope of supply. The BIDDER shall also recommend the selection and application criteria as indicated in clause 6.1 of this Section for the following categories of interconnecting cables emanating from equipment in his scope of supply. For this, he may either furnish the information in Data Sheet or attach additional sheets to elaborate on the data called for. <table border="1"> <thead> <tr> <th><u>Cables emanating from</u></th> <th><u>Purpose</u></th> <th><u>Category</u></th> </tr> </thead> <tbody> <tr> <td>i) Power supply distribution/ sub-distribution panels</td> <td>For power supply to various panels</td> <td>A</td> </tr> <tr> <td>ii) Field mounted transmitters</td> <td>Controllers, recorders,</td> <td>B</td> </tr> </tbody> </table>			<u>Cables emanating from</u>	<u>Purpose</u>	<u>Category</u>	i) Power supply distribution/ sub-distribution panels	For power supply to various panels	A	ii) Field mounted transmitters	Controllers, recorders,	B
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		ISSUE R1									

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED		VOLUME IV SECTION: D23
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan WIRING TERMINATIONS AND ACCESSORIES		SHEET 9 OF 9
(Analog signal 4-20mA DC) indicators, DAS, etc.			
iii)	Thermocouple (Analog mV signal)	Cold junction compensating box (where provided)	C (Special compensating cable)
iv)	Cold junction compensating box (Analog mV signal)	Indicators, recorders, controllers, signal conditioning, etc.	D
v)	RTD	Indicators, recorders & DAS	E
vi)	Oxygen analyser probe	Oxygen analyser transmitter	F
vii)	Oxygen analyser transmitter (Analog signal 4-20mA DC)	Recorders and DAS	G
viii)	Flow switches, pressure switches, level switches, temperature switches, etc. (Binary signals)	Alarm and interlock	H
			ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D 29-1
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan COMMISSIONING CHECK LIST CONTROL PANELS	SHEET 1 OF 1

1	PRE-COMMISSIONING CHECKS	
	Check the following :	
	a.	Nameplate details of all associated equipment, according to specification.
	b.	Physical damages on Panels and their proper rectification, as required.
	c.	Tightness of all bolts, clamps and connecting terminals, locking of all bolts.
	d.	Cleanliness.
	e.	Earthing of the Panel.
2.	COMMISSIONING CHECKS	
	a.	Switch developments should be checked.
	b.	Each wire shall be traced by continuity tests and it should be ensured that the wiring is as per relevant drawings. All interconnections between panels and equipment shall be similarly checked.
	c.	All the wiring to be meggered with respect to earth.
	d.	Checks on relays, as per document.
	e.	Checks on meters, as per document.
	f.	Settings of relays, other alarms, tripping devices and interlocks as per scheme and calculation.
	g.	Functional checking of all control circuits (e.g. closing, tripping, control, interlock, supervision, and alarm circuits including proper functions of the component equipment) to be done.

**ISSUE
R1**

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D29-4
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan COMMISSIONING CHECK LIST LT CABLES	SHEET 1 OF 1

A PRELIMINARY CHECKS

1. Check that parameters are as per specification.
2. Check for physical damage
3. Ensure that gland plates of single core power cables are of non-magnetic material
4. Bimetallic lugs are used when connections are made between different materials (e.g. Copper & Aluminum)

B COMMISSIONING CHECK LIST

1. Meggar test between each case and armour 1 sheath
2. Continuity check
3. Check connections
4. Armour of single core cables should be earthed at one end only for multi core cables they are earthed at both ends

ISSUE
R2

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D29-5
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan COMMISSIONING CHECK LIST LT MOTORS	SHEET 1 OF 1

A

PRELIMINARY CHECKS

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box

B

COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Over load and short circuit relay tests and settings
4. Control and interlocks should be checked
5. Phase sequence and direction of rotation
6. Operation of timer in case of star delta starting
7. Measure starting current starting timer and no load current
8. On load operations starting and running currents

ISSUE R1

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D29-7
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan COMMISSIONING CHECK LIST METERS	SHEET 1 OF 1

1. Check nameplate details are according to specification.
2. Check for physical damages.
3. Check calibration by comparing it with a substandard meter (secondary injection).
4. Megger all insulated portions.
5. Check C.T. and V.T. connections with particular reference to their polarities for power type meters.
6. Make tabulation of calibration parameters and compare with test certificates.

ISSUE
R1

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION : D29-8
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan COMMISSIONING CHECK LIST RELAYS	SHEET 1 OF 4

1. Check name plate details according to specifications
2. Check for any physical damage
3. Check internal wiring
4.
 - a) Megger all terminals to body
 - b) Megger for IR between AC and DC terminals
5. Check type of protection
 - A) Generator protection
 - B) Motor protection
 - C) Line protection

A) **Generator Protection**

- a) Differential relays for generator, generator transformer and unit auxiliary transformer
- b) Stator earth fault
- c) Negative phase sequence
- d) Loss of excitation
- e) Reverse power
- f) Rotor E/F
- g) Under-frequency
- h) Over-voltage

Back-up protection

- i) Impedance or voltage restraint over-current
- j) Over fluming relays
- k) GT restricted E/F
- l) Unit auxiliary trapo. O/c

B. **Motor Protection**

- a) Thermal protection
- b) Stalling (Rotor) protection
- c) High set (cable protection)
- d) Unbalanced protection
- e) Prolonged start current
start time

ISSUE
R1

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION : D29-8
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan COMMISSIONING CHECK LIST RELAYS	SHEET 2 OF 4

f) Earth fault protection

C. **Line Protection**

a) Zone-1 Earth Fault

b) Zone-2 Earth Fault

c) Zone-3 Earth Fault

d) Zone-4 (reverse zone)

II a) Zone-1 Phase Fault

b) Zone-2 Phase Fault

c) Zone-3 Phase Fault

d) Zone-4 Phase Fault (reverse zone)

After zones are available can be set

III Zone-I Extension upto Zone-2

IV Switched on to a terminal fault (Numerical relay)

V Fault location by reactance relay (Numerical relay)

VI Back-up O/C (in case of distance scheme failure)

VII Local breaker backup protection

VIII High current set

6. Check operating characteristics by secondary injection

7. Check minimum pick-up drop out voltage of DC coils of auxiliary relays

8. Check operation of electrical / mechanical targets

9. Check relay settings

10. Check C.T. and V.T. connection with particular reference to their polarities for directional or distance type relays

11. Make-up tabulation of calibration parameters (such as current, voltage, time, etc.)

12. Brief Description of Check List

a) Generator Protection

1. Pickup current

2. If bias is there it should be checked

ISSUE
R1

SPEC.NO. TCE. 5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION : D29-8
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan COMMISSIONING CHECK LIST RELAYS	SHEET 3 OF 4
Voltage Operated Relay - Pick-up voltage - Self of starting resistance b) Stator Earth Fault - NGT operated a) Voltage inspection for all PIV9 - Current operated a) Sends urgent for all..... c) Negative phase sequence - By secondary injection alarm and Trp. Time characteristic to be checked - Relay trp. contacts to be checked after secondary injection d) Loss of Excitation - By impedance test kit circle and offset to be checked - PT, CT connections to be checked e) Reverse Power - By secondary current injection 2. Relay contacts to be checked f) Rotor E/F - Insulation resistance of Field winding to be checked with Relay setting - Lower the insulation value by resistors and pickup value to be checked g) Under Frequency With variable frequency for different setting to be checked. If the relay is having Stage-I & II, it should be tested for both stages h) Over-voltage Secondary injection of voltage for different relay setting to be done. Simulation of relay contact to be done for current operations i) Backup Impedance - By impedance test kit relay forward reach and Reverse reach shall be checked - Simulation of relay contacts to be checked j) Over-flung Relay		
		ISSUE R1

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By varying voltage or frequency the Relay shall be calibrated. Relay contacts shall be checked

k) GT restricted E/ F
Secondary current injection to be done for different plug setting

l) GT backup earth-fault
Secondary current injection to be done for different plug sections

m) Unit Auxiliary Transformer over current (O/C)
Secondary current injection to be done for different plug setting

MOTOR PROJECTION

1. As per manufacturer instruction the following checks shall be done:

a) Verify the thermal curve with respect to motor thermal time constant

b) Stalling protection : Current injection and operating time to be checked

c) High set : Terminal fault and cable fault high current to be injected according to relay setting to be checked

d) Unbalance Protection : Single phase injection according to relay setting to be injected and relay contacts to be checked

e) Prolonged start of time : According to relay setting current to be injected and operating time to be checked

LINE PROTECTION

While testing one function of protection other protection shall be set high or bypassed.

1. By Impedance test kit for various relay setting impedance to be checked. For different zones time of operation of relay to be checked

2. Zone-1 extension of relay shall be checked

3. Fault location shall be checked

4. Backup O/C : By current injection back up O/C can be calibrated

5. Local breaker backup protection : After the relay tripping command, if the current is injected, the relay will give LBB indication. This to be checked

6. High current set : High current injection to be injected and relay shall be calibrated.

ISSUE
R1

SPEC.NO. TCE. 5750A-H-500-01	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D29-9
PART-B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan COMMISSIONING CHECK LIST TRANSFORMERS-UPTO 5 MVA	SHEET 1 OF 2

A PRELIMINARY CHECKS

1. Compare name plate details with the specifications
2. Check for any physical damage, in particular the bushings. If damages are revealed, initiate corrective measures as required.
3. Check that the accessories are mounted as per drawings and are fitted firm and secure. Conservator/breather, oil and winding temperature indicators, radiators, lightning arrestors, discharge counters, pressure relief devices, equalizing pipes, buchholtz relays, oil level indicators and MOG, tap changer, drain valves, gaskets, bolts, CT's, etc.
4. Check tightness of bolts, clamps and connecting terminals
5. Check cleanliness of bushings
6. Check the oil level and leakage if any
7. Check whether breather line is free, silica gel is reactivated, and oil is available at the bottom of the breather
8. Check for clearances, at the bushing terminals particularly in case of bus ducts connected to transformer terminals
9. Check water tightness of terminal boxes and bus ducts ensure that spare cable entry holes are tightly closed
10. Check earthing of transformer tank and neutral point (earth resistance of the pit to be within specified limit) as per Indian Standards.
11. Ensure that all cooler and cooler header valves are open.
12. Release the air from bushings (very important) and buchholz relay
13. Check that the transformer is correctly installed with reference to its phasing. LV and HV bushing are properly installed and the phases are properly marked as per Indian Standards
14. Debris around transformer shall be cleared
15. Check whether HT & LT and control cabling are done properly as per drawing and are tight and properly supported/clamped.

B PRE-COMMISSIONING TESTS

1. Test the transformer for following:
 - (a) Voltage/turns ratio at all the taps

ISSUE
R1

SPEC.NO. TCE. 5750A-H-500-01	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D29-9
PART-B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan COMMISSIONING CHECK LIST TRANSFORMERS-UPTO 5 MVA	SHEET 2 OF 2
(b) Short circuit impedance at full winding (c) Magnetic balance at full winding (d) PI valve (Insulation resistance valve) 2. Vector group test 3. Phase sequence test 4. Test the transformer oil for dielectric strength, tan-delta, acidity, resistivity and dissolved gases 5. Line connection as per phasing diagram 6. Insulation resistance of control wiring 7. Buchholz relay operation (for alarm and trip) 8. OLTC control indicating and alarm circuits, if provided 9. Calibration of temperature indicators (oil and winding) 10. Operation test of all protective devices and interlocks 11. Calibration of meters and relays and setting of recommended value 12. Check the lightning arrestor installation; if applicable C <u>COMMISSIONING TESTS</u> 1. Charge the transformer from the normal direction of power flow 2. Keep the transformer on no-load for 24 hours and observe the noise, oil and winding temperature 3. If the transformer is found to be normal in (2) above, load the transformers gradually. Monitor the winding/oil temperature every hour 4. After 24 hours air releasing to be done.		
		ISSUE R1