

TD-201 Rev No. 00	Form No.	 	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION, HYDERABAD	ANNEXURE-9 TO PY55223
				Rev No. 00
				Page 1 of 21
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company. ANNEXURE-9 TO PY55223 INSPECTION TEST REQUIREMENT PROJECT 40MW CDQ WASTE HEAT RECOVERY CO-GENERATION POWER PLANT CUSTOMER M/S TATA STEEL LIMITED, JAMSHEDPUR CONSULTANT TATA CONSULTING ENGINEERS, KOLKATA				

TD-201 Rev No. 00	Form No.	 	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION, HYDERABAD	ANNEXURE-9 TO PY55223 Rev No. 00 Page 2 of 21
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company.		1.0 INSTRUMENTS 1.1 In addition to the normal testing equipment such as multimeters, clamp on ammeter etc., the following instruments are required for the tests hereinafter specified. (a) Meggars - 500V, 2500V or 5000V (b) Earth resistance tester (low resistance meggar) (c) Mercury thermometer or thermal sensitive resistor circuit (d) High voltage tester 50kV AC/DC (e) Insulation oil testing unit (f) Portable relay testing unit 1.2 Prior to using testing and instrument devices, personnel shall be completely familiar with applicable manufacturer specifications. 2.0 RELAYS & PROTECTIVE DEVICES 2.1 For testing and setting relays, the following instructions shall apply: (a) All relays will be set in accordance with the relay setting schedule. (b) Relay with time characteristic shall be tested at 2 points on the time coordination curve to verify conformance with the manufacturer's data. (c) Protective relay settings and adjustment shall be made in accordance with manufacturer's applicable instruction booklets. (d) Circuit protective devices that have adjustable settings, such as moulded case circuit breakers, shall be set in accordance with the system coordination requirements. (e) Thermal overload relays used for motor protection shall be set for the motor nameplate full load current. (f) Other devices having variable timing characteristics, such as time delay relays used in the automatic restart of motor drivers, shall be set and tested in accordance with the intended control function. 3.0 FACTORY ACCEPTANCE TEST (FAT) 3.1 The attached document PEEC-04527 shall be referred for FAT procedure manual.		

TD-201 Rev No. 00	Form No.		PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	ANNEXURE-9 TO PY55223
				Rev. No. 00
				Page 3 of 21
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company. <u>QUALITY ASSURANCE REQUIREMENTS</u> The vendor shall prepare & submit Quality Assurance Plan (QAP) for respective package /equipment in customer QAP format. A customer standard QAP/typical QAP in customer format /BHEL format attached for respective equipment /package is a reference document for the vendor for future use by vendor for preparation and submission of QAP in customer format. Hence, no deviation to such document is acceptable. Any, additional type or special tests or routine tests or acceptance test if found necessary to establish the intended quality after detailed engineering then the same shall have to be incorporated in the QAP without any commercial implication. Customer QAP format is enclosed along with this document. Note: Vendor shall submit QAP within 07 days from PO receipt date.				

QUALITY PLAN		MAIN VENDOR			MAIN ITEM			QP.NO.					
		SUB-VENDOR			SUB-ITEM			QP. DATE					
CLIENT		PROJECT			PO.NO & DT.			TCE REF.					
SR.NO	COMPONENT/	CHARACTERISTICS CHECKED	TYPE/METHOD OF CHECK	EXTENT	REF.DOCUMENT /ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY				REMARKS/ HOLD POINTS (H)		
							S	M	T	C			
1	2	3	4	5	6	7	8				H	9	
NOTE	A.STATUTORY REQUIREMENTS SHALL BE COMPLIED WITH BY THE VENDOR. B.MATERIAL TESTS OF SAMPLES DRAWN BY TCESHALL BE WITNESSED BY TCE. C.FOR STAGES WITHNESSED/DOCUMENTS REVIEWED BY TCE, COPIES OF RELEVANT DOCUMENTS SHALL BE FURNISHED TO TCE. D.TCE'S IDENTIFICATION STAMP ON MATERIALS SHALL BE PRESERVED/GOT TRANSFERRED BY TCE AT APPROPRIATE STAGES. E.THE EXTENTINDICATED IN COLUMN 5 IS IN VENDOR'S SCOPE TCE/CLIENTMAY INSPECT AS PER THIS COLUMN OR RANDOM SAMPLES. F.COLUMN 6 SHALL BE AS PER TCE/CLIENT APPROVED DRAWINGS/DATASHEETS /SPECIFICATIONS WHEREVER APPLICABLE. G.INSTRUMENTS FOR LEAKTESTS & PERFORMANCE TESTS SHALL HAVE VALID CALIBRATION CERT. WITH TRACEABILITY TONATIONAL LEVEL. H.LEGENDS:S-SUB-VENDOR, M-MAIN VENDOR, T-TCE, C- TCE'S CLIENT, I-WITNESS, 2-DOCUMENTS REVIEW, H- HOLD POINT.										S	SIGN.	
											M	NAME	
												SIGN.	
											T	NAME	
												SIGN.	
											C	NAME	
SIGN.													

VENDOR'S NAME & ADDRESS:		TYPICAL MANUFACTURING QUALITY PLAN							QP. NO.:				
		CUSTOMER: BHEL, HYDERABAD – 32.				BHEL P.O.NO.:			REV NO: 00		DATE:		
		PROJECT: PRODUCT: LT SWITCHGEAR				P.O.DATE: BHEL SPEC:			REV:			PAGE 1 OF 6	
SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P W V			REMARKS
1.0	RAW MATERIALS & BOUGHT OUT ITEMS												
1.1	Steel for fabrication	Mechanical & chemical properties	Major	Chemical & Mechanical.	Sample	IS-513 & 1079	IS-513 & 1079	Log book/test certificate	√	2		1	
		Dimensions	Major	Measurement	Sample	Approved drawing	Approved drawing	-do-		2		1	
		Surface quality	Major	Visual	Random	Material spec.	Material spec.	-do-		2		1	Shall be free from rust, pitting, dents etc.
1.2	Air circuit breaker	Routine tests	Major	Electrical	100%	IS-13947, Part -2	IS-13947, Part -2	-do-	√	2		1	
		Type test	-do-	Electrical	Sample	-do-	-do-	-do-	√	2		1	
1.3	Air break Switches	Routine tests	Major	Electrical	100%	IS-13947, Part -3	IS-13947, Part -3	-do-	√	2		1	
		Type test	-do-	Electrical	Sample	-do-	-do-	-do-	√	2		1	
1.4	HRC fuses / MCCB / MCB	Routine tests	Major	Electrical	100%	IS-13703	IS-13703	-do-	√	2		1	
		Type test	-do-	Electrical	Sample	-do-	-do-	-do-	√	2		1	
1.5	Relays	Routine tests	Major	Electrical	100%	IS-3231/ Approved drgs/ Bhel tech spec	IS-3231/ Approved drgs/ Bhel tech spec	-do-	√	2		1	
		Type test	-do-	Electrical	Sample	-do-	-do-	-do-	√	2		1	

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 3. End client (if applicable) AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

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		BHEL SPEC:				REV:							
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										P	W	V	
1.6	Instrument transformers (CTs/PTs)	Routine tests	Major	Electric al	100%	IS-2026	IS-2026	-do-	√	2		1	
		Type test	-do-	Electric al	Sample	-do-	-do-	-do-	√	2		1	
1.7	Air break contactors	Routine tests	Major	Electric al	100%	IS-2959	IS-2959	-do-	√	2		1	
		Type test	-do-	Electric al	Sample	-do-	-do-	-do-	√	2		1	
1.8	Indicating instruments	Routine tests	Major	Electric al	100%	IS-1248	IS-1248	-do-	√	2		1	
		Type test	-do-	Electric al	Sample	-do-	-do-	-do-	√	2		1	
1.9	Bus Bars	Chemical composition	Major	chemica l	Sample	IS-5082 for Al IS-1897 for Cu	As per Spec.	-do-	√	2		1	
		Tensile strength	-do-	Mechan ical	-do-	IS-5082 for Al IS-1897 for Cu	As per Spec.	-do-		2		1	
		Conductivity	-do-	Electric al	-do-	IS-5082 for Al IS-1897 for Cu	As per Spec.	-do-		2		1	
1.10	Gaskets	Dimensions	-do-	Measur ement.	-do-	IS-3400	IS-3400	-do-		2		1	
		Routine tests	-do-	Mechan ical.	-do-	IS-3400	IS-3400	-do-	√	2		1	
		Type tests	-do-	Electric al	Sample	Bhel spec	Bhel spec	TC from independent agency	√	2		1	
2.0	INPROCESS INSPECTION												

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		PROJECT: PRODUCT: LT SWITCHGEAR				P.O.DATE:			PAGE 3 OF 6				
		BHEL SPEC:				REV:							
SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY			REMARKS
										P	W	V	
2.1	Panel fabrication	Visual check for pitting, rusting of plates	Major	Visual	100%	Visual	Visual	Log Book / QC REPORT		2		1	
		Pretreatment of sheet steel	Major	Process	100%	Spec	Spec	Log Book / QC REPORT		2		1	
		Dimensions after cubicle fabrication	Major	Measrt.	100%	Approved drawing	Approved drawing	-do-	√	2		1	
		Gasket between doors & Equipment	Major	visual	100%	Approved drawing	Approved drawing	-do-		2		1	
2.2	Wiring checks	Wire size	Major	visual	Sample	Wiring diagram	Wiring diagram	-do-		2		1	
		Proper wire clamping	Major	visual	-do-	Approved drawing	Approved drawing	-do-		2		1	
		Continuity check	Major	Electric al	100%	Schematic drawing	Schematic drawing	-do-		2		1	
		Tightness of termination	Major	visual	Random	As per shop practice	As per shop practice	-do-	√	2		1	
		Ferruling	Major	Visual	Radom	As per shop practice	As per shop practice	-do-		2		1	
3.0	FINAL INSPECTION & TESTING												
3.1	Switchgear Assembly	Visual check including layout, Tag plates, Bus marking and sleeving, Joint shrouding, Identification and location & mounting of components, Wiring arrangement & ferruling etc..	Major	Visual	100%	GA drawing	GA drawing	Log Book / QC REPORT	√	2	1, 3		

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PAGE 4 OF 6													
SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY			REMARKS
										P	W	V	
		Dimensional Check including operational height, Bus size, clearances, creepage distances, gland size etc..	-do-	Measur ement	100%	GA drawing	GA drawing	Log book /QC report	√	2	1, 3		
		Paint shade, DFT & Adhesion test	-do-	Visual & Measur ement.	Random	BHEL spec/ approved drg	BHEL spec/ approved drg	Inspection report	√	2	1, 3		
		Circuitry checks: Continuity, connections etc for power & control circuits.	Major	Electric al	100%	Wiring diagram	Wiring diagram	Inspection report	√	2	1, 3		
		Verification of Bus bar support arrangement with respect to the type tested panel drgs, provision for external cable termination and bus duct flange dimensions (if applicable)	Major	Visual & Measur ement	100%	Approved drgs /schematics & BHEL spec	Approved drgs /schematics & BHEL spec	Inspection report	√	2	1, 3		
		Bill of Material / Make of components checks	Major	Visual	100%	Approved data sheets /drgs & BHEL spec	Approved data sheets /drgs & BHEL spec	Inspection report	√	2	1, 3		

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		PROJECT: PRODUCT: LT SWITCHGEAR				P.O.DATE:			PAGE 5 OF 6				
		BHEL SPEC:				REV:							
SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY			REMARKS
										P	W	V	
		Manual and electrical operation check of Breakers, Relays etc.. & Operation check for all control functions and interlocks as per schematic drgs in test and service position including mechanical interlock as applicable	Major	Visual & Electric al	100%	Approved drgs /schematics & BHEL spec	Approved drgs /schematics & BHEL spec	Inspection report	√	2	1, 3		
		Relay operation check through primary /secondary injection	Major	Electric al	100%	Approved drgs /schematics & BHEL spec	Approved drgs /schematics & BHEL spec	Inspection report	√	2	1, 3		
		HV test on power & control circuits	Major	Electric al	100%	IS-8623	IS-8623	Inspection report	√	2	1, 3		
		IR test	Major	Electric al	100%	IS/BHEL spec	IS/BHEL spec	Inspection report	√	2	1, 3		
		Measurement of tightness of bus bar joints by torque wrench	Major	check	Random	As per manufacturer' s std	As per manufacturer's std	Inspection report	√	2	1, 3		
		Inter chageability of identical modules /feeders (if applicable)	Major	Visual	Random	As per manufacturer' s std	As per manufacturer's std	Inspection report	√	2	1, 3		
3.2	TYPE TEST	Short circuit making and breaking test	CRITICAL	Electric al	Sample	IS-13947 Part 1, clause 8.1.2 / BHEL spec	IS-13947 Part 1, clause 8.1.2 / BHEL spec	TEST CERTIFICAT E	√	2		1, 3	

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TD-201 Rev No. 00 Form No.	 HYDERABAD	DESIGN PROCEDURE PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD			PEEC-04527 REV 00 Page 1 of 11
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company.		FAT PROCEDURE MANUAL FOR LT SWITCHGEAR PACKAGE.			
Ref. Doc	Revision :00 Refer Record of Revisions	Prepared : <i>K. Rangamani</i> KRM	Checked:  BCM	Approved :  JKP	Date : 28.03.14

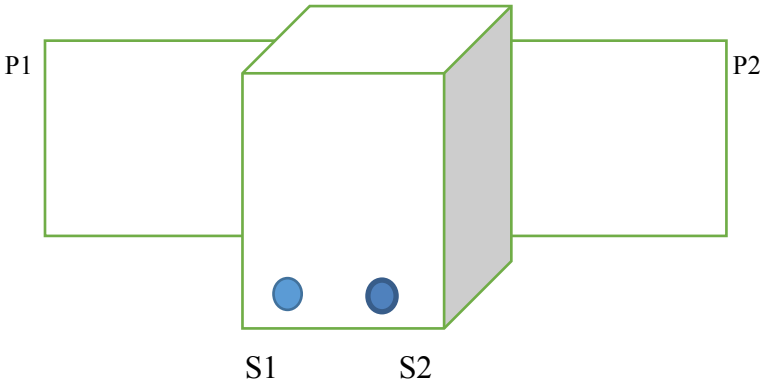
TD-201 Rev No. 00	Form No.		DESIGN PROCEDURE PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	PEEC-04527 REV. 00 Page 2 of 11
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		1. PURPOSE The purpose of this document is to create a standard procedure for factory acceptance testing of LT Switchboards. 2. SCOPE The scope of this document provides detail FAT procedure for Inspection of LT switchgear at Manufacturing works. This document will result in overcoming / minimizing the issues related to operation of feeders with logics and BOQ. 3. RESPONSIBILITY & AUTHORITY Package Engineers are responsible for implementation of this procedure in their respective projects. Head of Section (HOS) is responsible for overall implementation of this procedure in the department. 4. REFERENCE (a) Departmental Procedure (Ref. Doc.: PE&SDE/PDM R00). (b) IEC 60439-1/IS 8623 5. DEFINITIONS HOS - Head of Section 6. APPLICABLE DOCUMENTS • Approved General Arrangement Drawing (GA) • Approved Bill of Materials (BOM) • Approved Scheme Drawing • Approved QAP 7. PROCEDURE 7.1 All the components/products used in assembly of switchboards undergo testing, prior to assembly, as per relevant specifications / drawings. 7.2 Following Routine tests are to be carried out on Switchboards: • Visual Inspection for General Arrangement, Special features (as per drawings) and other Standard features indicated in Inspection checklist (Annexure-I)		
	Ref. Doc			

TD-201 Rev No. 00	Form No.		DESIGN PROCEDURE PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	PEEC-04527 REV. 00 Page 3 of 11
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	Ref. Doc			

TD-201 Rev No. 00	Form No.		DESIGN PROCEDURE PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	PEEC-04527 REV. 00 Page 4 of 11																																						
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		Annexure:I Board: <table border="0"> <thead> <tr> <th align="left">Sr.no</th> <th align="left">Check point</th> </tr> </thead> <tbody> <tr><td>1.</td><td>Overall Appearance & surface finish</td></tr> <tr><td>2.</td><td>Verticality of Panels</td></tr> <tr><td>3.</td><td>Waviness of doors etc.</td></tr> <tr><td>4.</td><td>Verification of BOM as per GA drawing</td></tr> <tr><td>5.</td><td>Overall Dimensions as per GA drawing</td></tr> <tr><td>6.</td><td>Interchangeability of similar modules (For draw out Modules)</td></tr> <tr><td>7.</td><td>Tightness of busbar joints (on random basis)</td></tr> <tr><td>8.</td><td>Provision for partitions and shrouds & effectiveness of safety shutters</td></tr> <tr><td>9.</td><td>Electrical Clearances & creepage distance</td></tr> <tr><td>10.</td><td>Earthing system throughout the board</td></tr> <tr><td>11.</td><td>Operational test as per scheme drawings</td></tr> <tr><td>12.</td><td>Wiring check as per scheme drawings</td></tr> <tr><td>13.</td><td>Phase sequence/Polarity check</td></tr> <tr><td>14.</td><td>Neatness of wiring</td></tr> <tr><td>15.</td><td>Accessibility & adequacy of space for external wiring termination</td></tr> <tr><td>16.</td><td>Insulation Resistance</td></tr> <tr><td>17.</td><td>High Voltage(Power Circuit)</td></tr> <tr><td>18.</td><td>High Voltage (Control Circuit)</td></tr> </tbody> </table> Insulation Resistance Test as per IEC 60439-1/IS 8623(Part 1) Megger No: Power Circuit with 500V DC Megger Control circuit with 500V DC Megger High Voltage Test as per IEC 60439-1/ IS 8623(Part 1),Clause 8.2.2 HV Trolley No: Power Circuit 2.5Kv for 1 sec. Control circuit 2.0kV for 1 sec.			Sr.no	Check point	1.	Overall Appearance & surface finish	2.	Verticality of Panels	3.	Waviness of doors etc.	4.	Verification of BOM as per GA drawing	5.	Overall Dimensions as per GA drawing	6.	Interchangeability of similar modules (For draw out Modules)	7.	Tightness of busbar joints (on random basis)	8.	Provision for partitions and shrouds & effectiveness of safety shutters	9.	Electrical Clearances & creepage distance	10.	Earthing system throughout the board	11.	Operational test as per scheme drawings	12.	Wiring check as per scheme drawings	13.	Phase sequence/Polarity check	14.	Neatness of wiring	15.	Accessibility & adequacy of space for external wiring termination	16.	Insulation Resistance	17.	High Voltage(Power Circuit)	18.	High Voltage (Control Circuit)
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TD-201 Rev No. 00	Form No.	 HYDERABAD	DESIGN PROCEDURE PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	PEEC-04527 REV. 00 Page 5 of 11
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		Annexure:II OPERATIONAL TESTS These tests are done in order to verify the functioning of various equipment as per the relevant approved scheme drawings. Before proceeding with the tests arrangement for non-available equipments and remote control equipments should be ensured , (ie. shorting of wires – instead of NC contact of relays which are not available , shorting of control terminals-instead of remote start push button etc). Connect the control supply as specified in the scheme diagram and check for the following: • Closing/ opening of contactors as per scheme. • Availability of power supply at the correct O/G terminals . This should be checked using test lamp/ multimeter. • Operations of auxiliary equipment like Indicating lamps , System selector switch, hooters, bells , etc . • Proper alignment of the push button and trip push button for overload relay. Trip the relay manually, close the door and check for alignment by resetting the relay. In case of schemes realized in numerical relay , Block logic diagram should be used to check the operation of ACB and other equipment.		
Ref. Doc				

TD-201 Rev No. 00	Form No.		DESIGN PROCEDURE PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	PEEC-04527 REV. 00 Page 6 of 11
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		Annexure:III CONTINUITY TESTING Continuity test is done to ensure the correct point to point connections of the circuit and also ensures wiring and fuses are healthy When used correctly a continuity test is simplest trouble shooting technique. This test is recommended where the operational test at rated voltage/current cannot be carried out. Continuity Tester: The tester generally operates as 12V. Indication of continuity will generally be visual. Procedure: When checking the continuity of a particular section in a circuit it must be taken care that all the parallel paths should be disconnected. This includes paths through equipment coils, indicating lamps, etc. If this is not ensured, results will be wrong or ambiguous. When checking a particular section in a scheme it is advisable to keep one probe of the continuity tester at the fixed location and use the other probe to check the continuity of the other points starting with the nearest and progressively moving outwards.		
Ref. Doc				

TD-201 Rev No. 00	Form No.		DESIGN PROCEDURE PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	PEEC-04527 REV. 00 Page 7 of 11
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Ref. Doc				

TD-201 Rev No. 00	Form No.		DESIGN PROCEDURE PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	PEEC-04527 REV. 00 Page 8 of 11
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		Annexure:V INSULATION RESISTANCE TEST a)IR test shall be carried out on Power circuit and control circuit separately before & after the dielectric test. b)Disconnect all the items in the circuit, which are connected directly across the phases & neutral. (e.g. voltmeters, indicating lamps etc.) c)500V DC megger shall be used for measuring IR values. d)IR values of following combinations shall be measured . Power circuit • Between Phases &Earth • Between Phases • Between Phases & Neutral • Between Neutral & Earth Control circuit • Between each control voltage bus & Earth Acceptance criteria: ✓ Ensure minimum value of 0.5 M ohm (for switchboard of 10 panels). ✓ In case of lower IR value, following shall be the acceptance criteria: Switchboard shall pass in Dielectric strength test as per IEC 60439-1 / IS 8623 IR values obtained after the Dielectric test shall not deviate from the IR values obtained before Dielectric test by more than 15%.		
Ref. Doc				

TD-201 Rev No. 00	Form No.	 HYDERABAD	DESIGN PROCEDURE PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	PEEC-04527 REV. 00 Page 9 of 11
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Ref. Doc				

TD-201 Rev No. 00	Form No.	 HYDERABAD	DESIGN PROCEDURE PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	PEEC-04527
				REV. 00
				Page 10 of 11
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	FINAL CHECK LIST Verification of the following: • Instruments used for above tests are with valid calibration. • Type test certificate. • Test certificate for individual component. • Painting procedure. • Material verification as per approved BOM. • Quantity of lugs and glands as per approved BOM. • Catalogues for individual component.			
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DESIGN GUIDELINES
PROJECT ENGINEERING & SYSTEMS DIVISION
HYDERABAD

PEEC-04525

Rev No. 00

Page 11 of 11

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