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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-1A TO PY55223 STANDARD SPECIFICATION FOR LT SWITCHBOARDS PROJECT 40MW CDQ WASTE HEAT RECOVERY CO-GENERATION POWER PLANT CUSTOMER M/S TATA STEEL LIMITED, JAMSHEDPUR CONSULTANT TATA CONSULTING ENGINEERS, KOLKATA			
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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.		operational and maintenance functions. Design shall include all reasonable precautions and provisions for the safety of operating and maintenance personnel. 3.3.5 All inscriptions on panels/devices shall be made on 2 mm thick laminated aluminium plate. 4.0 CONSTRUCTION 4.1 The Switchboards shall conform to IS:8623 for factory built assemblies, IS:60947 for general requirement of switchgear and IS:5578 and IS:11353 for marking and arrangement of busbars and internal wiring etc. 4.2 Totally enclosed, self-supporting, floor mounted, dust and vermin-proof cubicle type construction with multi-tier fully compartmental arrangement. Draw out modules shall have self-aligning multi-finger silver plated contacts for power termination. 4.3 All panels shall be of uniform height placed side by side and single/double front arrangement (as per SLDs) having front access for operation as well as cabling and rear access for maintenance of risers. 4.4 All switchboards shall be designed for front and rear access unless otherwise agreed with the Purchaser. 4.5 The cubicle shall be made-up of bolted steel members with front, back and side panels of heavy gauge pressed CRCA sheet steel with 2 mm thickness for all members except the doors of the modules, the rear covers, the covers of cable chambers and busbar chambers as well as non-load bearing partition walls which may be of 1.6 mm with adequate stiffeners to prevent buckling. 4.6 The individual module shall have rolled edges with neoprene rubber gaskets to form a dust proof structure. The doors shall have concealed hinges and shall be interlocked with the main MCCB operating handle so that it cannot be opened when the MCCB is 'ON'. A feature for defeating the interlock shall also be provided for maintenance purpose. The transporting sections of the switchboards shall be provided with necessary gasket to avoid any gap on complete assembly at site. 4.7 The moving portion of the switchgear shall have locking arrangement in all the three positions, namely, SERVICE / TEST / ISOLATED. Arrangement for covering the power and control contacts with a shutter shall be provided when the moving carriage is withdrawn from the switchgear. 4.8 The MCC/DB modules shall be arranged in vertical sections with barriers between each module. The bus chamber as well as the breaker cubicles shall have inter panel fire barrier. A liberally sized vertical cable alley shall be provided to accommodate all cables. 4.9 All switches, indicating lamps, protective relays and indicating instruments shall be flush mounted on the respective module compartments and other auxiliary devices of the switchgear may be mounted inside the module. 4.10 The panels shall be rigid, vibration proof and free from bends and twists. Panel door and side doors shall have lock. 4.11 Cubicle layout/device arrangement shall be as given below: 4.11.1 Modular construction with each cubicle having segregated motor circuit compartments arranged in tier formation with each compartment housing one motor control circuit with lockable hinged door and neoprene gasket all around. 4.11.2 Common horizontal busbar chamber at the top as well as vertical risers at the back for 3-phase busbars (TP bus system). 4.11.3 Cable compartment at side/back with cable entry arrangement from top or bottom as required. Cable termination chamber shall have ample space for easy termination of aluminium conductor cables. 4.11.4 Busbar compartments with front bolted cover plates and cable compartments with swing doors and locking arrangement.		
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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.		4.11.5 Sheet steel barriers shall be provided between individual compartments and cable alley. This barrier shall be provided with opening for power and control connections and it shall be possible to safely carryout maintenance work on cable connections to any one circuit in the cable alley with the busbars and the adjacent circuits live. Isolating metal barriers shall be provided between various sections to give complete compartmentalization. 4.11.6 Rear cover shall be easily removable type construction for single front panels. 4.12 Limiting dimensions/clearances shall be as given below: 4.12.1 Minimum 250 mm height enclosure on the top part of the cubicle for housing the busbars. 4.12.2 Cubicle base channel shall be of atleast 50mm x 25mm size fabricated out of 3mm thick hot rolled steel sheet painted black. 4.12.3 Components with operating handle, and those requiring adjustments such as overload relays, etc. shall be mounted between 300 to 1900 mm from bottom. 4.13 All live busbars, contacts and cable terminations (including cable connection to ACB outgoing links) shall have suitable protective covers to prevent accidental contact. 4.14 All busbars shall be sleeved to full voltage and identified with colored tapes for phase/neutral identification. 4.15 Heat shrinkable sleeve/tape (for joints) shall be used for main busbars. 4.16 Door interlock with MCCB (or switch where provided) so that the compartment door can be opened only when the power device is in off state. Defeat interlock facility shall be provided. 4.17 All circuit breakers, Isolators, MCCBs are to be provided with padlocking arrangement. 4.18 Continuous Electrolytic Al [E-91 grade] as per IS 3082 earth bus bar of size 50 x 10mm at the bottom for the whole switchboard line up with studs at two ends for earth connection. 4.19 Suitable removable type eyebolts shall be provided for the lifting of the panel/shipping section. These bolts, when removed shall not leave any opening in the panels. 4.20 All identical equipment and corresponding parts shall be fully interchangeable. 4.21 The accessibility to busbars, cable terminations and all other components and devices shall be simple and easy. 4.22 The panels shall be extendible at both ends for the additions of vertical sections either by a breaker panel or a non-breaker panel. 5.0 BUSBAR 5.1 The busbars shall be of high conductivity electrolytic Aluminium, liberally sized for continuous as well as short circuit current ratings and shall conform to relevant standards. The continuous current rating of the busbars shall be the same as that of the incoming feeder rating and shall carry this continuous current without exceeding the temperature of 85°C considering an ambient of 50°C. 5.2 All switchboards shall have continuous three-phase and neutral air-insulated busbars extending full length of the switchboard and run horizontally in separate busbar compartment. Vertical busbars shall be used for connection to individual sections of the panels, fully shrouded with removable partitions. 5.3 The main busbars shall have continuous current rating as required but in no case less than the current rating of incomer. The rating of the neutral busbar shall be same as that of phase busbars for single phase switchboards. 5.4 The current carrying capacity of the vertical busbars shall not be less than the current rating of the main busbars in case of incoming feeders and current rating of the breakers in case of outgoing feeders. The busbar rating shall not be decided on the basis of CT ratios.		
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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.		5.5 The busbars shall be of aluminium alloy conforming to IS: 5082. 5.6 The busbars shall be provided with heat shrinkable insulated sleeves of 1100 V grade and shall be taped for colour coding at interval and at joints. 5.7 The busbars shall be properly supported through insulators to withstand, without damage, effects of available short-circuit current. 5.8 Busbar support shall be arc resistant, non-hygroscopic, insulating, self-extinguishing, fire retardant material located at uniform intervals providing adequate support for the busbars and droppers. 5.9 Busbar support should be capable of withstanding the effects of available short-circuit current without any damage. 5.10 Arrangement and marking of the busbar and main connections shall be as per IS: 5578 and IS: 11353. The main busbars shall run throughout the length of the MCC. Similarly vertical droppers shall extend for the full height of the panel. 5.11 Clearances in air of live parts shall be atleast 25.4 mm for phase-to-phase and 19.4mm for phase-to-earth. However clearances between terminals at components shall be as per applicable individual standards for components. 5.12 Precautions for connection of busbars shall be taken against bimetallic action, local heating and corrosion. 5.13 The busbars shall be arranged in such a way that they can be extended at the free ends without difficulty. 5.14 Removable type shrouds shall be provided for busbar joints and fish plate joint. 5.15 Auxiliary supply busbars shall run horizontally in a separate enclosure within the power busbar compartment with necessary tee-off connectors for distributing auxiliary supply to each vertical panel. Rubber grommets shall be used for all wire entries to make the entries dust and vermin-proof. 5.16 The busbars shall be colour marked as follows: <i>Phase (R) - Red</i> <i>Phase (Y) - Yellow</i> <i>Phase (B) - Blue</i> <i>Earth (E) – Green</i> R, Y and B are the three-phase of AC circuit with anti-clockwise vector rotation. 6.0 CONTROL SUPPLY AND CONTROL BUSBAR 6.1 The control voltage adopted shall be as specified in item 3.2.1 above. 6.2 The AC control circuit power shall be fed from two full capacity control transformers having manual selection for the working control transformer. 6.3 Each control transformer circuit shall be housed in separate compartment of the MCC. The control transformers shall be dry type with class F insulation with class B temperature rise. The transformer shall be complete with MCCB/MCBs. 6.4 The control transformers shall be provided with +2½ per cent and +5 per cent tapings on the primary side. 6.5 The control supply to each motor shall be fed over individual MCB located in the respective module.		
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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.		7.0 EARTHING 7.1 An earth busbar in form of Continuous Electrolytic Al [E-91 grade] as per IS 3082 of size 50 x 10mm shall be provided in the bottom part of each cubicle and shall run for the entire length of the switchboard. 7.2 The switchboard shall have two separate earthing terminal studs for earthing as per Indian Electricity Rules. 7.3 All doors (Including doors of vacant compartment) and movable parts shall be connected to the earth bus with flexible copper connections. 7.4 All non-current carrying metallic parts of the mounted equipment shall be earthed. Minimum 4 nos, 10 mm diameter bolts with nuts shall be provided on the earth bus for termination of fourth core of cable per vertical panel. 8.0 INTERNAL WIRING 8.1 The internal power wiring of the modules shall be with 1.1 kV heavy duty single core stranded copper conductor PVC cable or copper busbars with adequate spacing. 8.2 The control wiring shall be done with 1100V grade, PVC insulated, stranded copper conductors of minimum 2.5 mm² size for CT circuits and 1.5 mm² for other circuits. 8.3 The control wiring shall be laid in flame retardant low smoke type PVC ducts with snap-on covers neatly bunched and cleated with no joints or tappings between two terminations. 8.4 Not more than two connections shall be made at any one terminal. The wiring shall be so arranged and supported as to prevent any strain on the terminations. 8.5 Shorting links/suitable-shortening arrangement for shorting CT secondary shall be provided. 8.6 For control devices mounted on the door/swiveling instrument plate, flexible cables of proper length shall be provided to prevent breaking of wires. 8.7 All the wiring shall be accessible from the front. 8.8 Identification tubular type ferrules shall be provided at the device ends as well as at the terminals. Marking of the auxiliary control wiring shall be as per IS: 5578 and IS: 11353. 8.9 Inter panels wiring within each shipping section shall be switchboard vendor's responsibility. For wiring between shipping sections, vendor shall provide terminal blocks on adjoining shipping sections and supply suitable jumpering wires. Interpanel wiring shall be taken thorough PVC sleeves or rubber grommets. 8.10 Adequate space shall be provided inside feeder compartments for easy maintenance. 9.0 TERMINATION 9.1 Ample space for connection of cables shall be provided such that cable cores are not in contact with any metal part of the switchgear. All internal power connections shall be of copper. 9.2 Power and control terminals shall be stud type, complete with crimping type connectors. Screw type terminals with screws directly impinging on conductors are not acceptable. Terminals for CTs shall be disconnecting type. 9.3 All external cable connections shall be brought in through cable compartment with power and control circuits physically segregated. 9.4 The termination arrangement of multiple cables shall permit connection and disconnection of each individual cable without disturbing the other cables. 9.5 Power and control wiring shall be identified with separate colours.		
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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.		9.6 Liberal space shall be provided for cabling and to accommodate any conventional type of cable glands for PVC insulated and PVC sheathed armored/ unarmored aluminium conductor cable. 9.7 All terminations shall be suitable for accepting cable sockets for aluminium conductor cables. 9.8 All spare contacts of relays and switches shall be wired up to the terminal board. 9.9 For control cables, minimum 10% spare terminals shall be provided on the terminal blocks of each feeder. 9.10 The cable termination compartment shall be provided with suitable removable gland plates at the bottom with holes drilled for cable entry as per cable requirements. 9.11 For single core cables, Aluminium gland plates shall be supplied. 9.12 Cable compartment shall have provision to accommodate cable glands on detachable gland plate, arrangement for clamping cables inside compartment on perforated sheet steel sections. 9.13 For termination of cables crimping type lugs of proper size shall be provided. All lugs shall be insulated/ sleeved. 9.14 Cable glands suitable for PVC insulated, PVC sheathed armored/ unarmored cables shall be provided. The cable compartment shall have bolted type cover plates with gaskets. It shall have provision for clamping of cables inside compartment on perforated sheet steel sections. 9.15 Cable compartments shall be provided with bolted doors. 9.16 The lowermost terminal block shall have minimum clearance of 200 mm from the bottom plate. The minimum clearance between adjacent rows of terminal blocks shall be minimum 100 mm. 10.0 NAME PLATES 10.1 A nameplate with the switchgear tag no. shall be fixed at the top of the central panel. 10.2 A separate nameplate giving feeder details shall be fixed for each compartment also. 10.3 Nameplate shall be provided for each equipment /component and for each feeder mounted over each panel. 10.4 Special warning labels shall also be provided wherever necessary inside or outside the switchboard. 10.5 Engraved nameplates shall preferably be of 3 ply (Black-White-Black) lamicoide sheets of anodized aluminium. Back engraved Perspex sheet shall also be acceptable. Name plates shall be fastened by screws and not adhesives. Anodized aluminium legend plates shall be provided for all push-buttons, control switches pilot lamps etc. with standard marking. 11.0 CONTROL DEVICES 11.1 Air Circuit Breaker (ACB) 11.1.1 Design 11.1.1.1 ACB shall be air-break, metal clad, drawout type, 3-pole type. 11.1.1.2 Circuit breakers shall be provided with motor operated spring charged stored energy closing mechanism. Manual spring charging and closing mechanism shall also be provided. One open/ close operation of the circuit breaker shall be possible after failure of power supply to the motor. Shunt trip coil shall also be provided. The breaker shall not close unless the spring is fully charged. 11.1.1.3 Rated breaking duty: O-0.3s-CO-3s-CO 11.1.1.4 The breaker shall have the following positions with positive indication for each of them:		
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			11.4.6 Each push button shall be provided with minimum 2 NO & 2 NC contact.		
			11.5 Control Switch		
			11.5.1 The control and selector switches shall be rotary, back connected type having a cam operated contact mechanism.		
			11.5.2 It shall have suitable position indicators to show that the switch is in the selected position.		
			11.5.3 Position maintained or spring return arrangement shall be provided as required.		
			11.5.4 The contact design shall be such as to provide enhanced contact reliability required in circuits with electronic interfaces involving low voltage and small value currents.		
			11.5.5 Master switches, wherever provided, shall be cam-operated with a number of switching elements in modular construction.		
			11.5.6 The master switches shall be in the form of rotary control switch with pistol grip or twist type operating handles.		
			11.5.7 Lever control switch, where adopted, shall have necessary gearing with movement in one plane. Joystick type control switches shall have movement in two perpendicular planes.		
11.5.8 Potentiometer switches shall be provided with lever or joystick controls.					
11.6 Indicating Lamps					
11.6.1 All indicating lamps shall be of 22.4-mm diameter.					
11.6.2 Indicating lamps shall be provided with coloured lenses. Red lens shall be for 'Start' or 'ON' application, green for 'Stop' or 'OFF' application, Amber for 'Fault' indication and Clear for indication of general nature. Other colours may be adopted depending on the particular application.					
11.6.3 Low wattage, LED cluster type indicating lamps shall be provided with the lamp assembly complete with holder and suitably coloured lens and a nameplate showing its function.					
11.7 Limit Switches					
11.7.1 The limit switches shall have high mechanical endurance exceeding Class 10 and suitable for heavy-duty operation. Contacts shall be adequately rated to handle inductive currents in the circuits and shall be of design suitable for electronic interfaces as mentioned above.					
11.7.2 The limit switches shall be provided with actuators in the form of plungers, roller tappets, push-rollers, roller levers, as required. These actuators shall be operated by means of actuating bars, cams, stops etc.					
11.7.3 For repetitive cyclic operation as well as sequence control, programming and positioning application adjustable type rotary cam limit switches shall be adopted having enclosure similar to that specified above. The cam switch shall be complete with the associated gearbox to suit specific application.					
11.8 Resistors					
11.8.1 The resistors provided for motor starting and control shall be suitably rated for the starting conditions.					
11.8.2 The number of resistance steps shall be decided by the Bidder depending on application. The resistor elements shall be made of unbreakable, corrosion proof, joint less stainless steel grids or					

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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.		Ferro-chrome aluminium alloy. The grids shall be in punched form and suitable for use in tropical climate. 11.9 Overload relay 11.9.1 The overload reset push-buttons, where applicable shall be accessible only after opening the cubicle door if not otherwise specified. 11.9.2 For motor feeders type II co-ordination shall be provided for MCCB unit, contactor and overload relay. 11.9.3 Thermal over load relays shall be three element, ambient temperature compensated, time lagged and bimetal type. Each overload relay shall be provided with a built-in single phasing preventer. The relays shall be manually reset type with one changeover contact. Resetting of the relays shall be possible with the compartment door closed, with the resetting knob at the front. 11.10 Instrument transformer 11.10.1 The current and voltage transformers shall be cast resin insulated type, with primary and secondary terminals marked indelibly. 11.10.2 Facility shall be provided for short circuiting and grounding each CT secondary. The neutral side of the CT shall normally be earthed through a link. 11.10.3 The CTs shall be capable of withstanding the peak momentary short circuit and the symmetrical short circuit current. 11.10.4 Proper CT shall be considered for operation of EOCR and the composite motor protection relay for higher rated motors. 11.10.5 Saturable type heavy-duty current transformer shall be provided in case of high inertia loads. 11.10.6 In case, in-built CTs are provided along with communicable microprocessor based release, CTs as required considering four pole (3-phase & 1-N) breaker shall be provided to take care earth-fault protection also. 11.10.7 The CTs shall have insulation level and thermal and dynamic ratings corresponding to that of the circuit-breaker with which it is associated. 11.10.8 For PCC, bus voltage transformer shall be provided housed in a separate compartment. Secondary of voltage transformer shall be rated for 110 V AC. 11.11 Meters 11.11.1 All instruments and relays shall be of robust design, vibration-proof, housed in dust-proof casing and suitable for flush/semi-flush mounting on vertical panels. 11.11.2 They shall be mounted in the front of the panel at a suitable height to facilitate easy access and visibility. 11.11.3 The instruments shall be of parallax-free design and shall have glare-free front glass covers. Marking of the scale of all instruments shall be such that it is suitable for direct reading. 11.11.4 Suitable zero adjustment facility shall be provided with each indicating instrument and it shall be suitable for operation from the front of the instrument casing. 11.11.5 All indicating instrument shall be magnetically screened. The meters shall be capable of carrying the CT secondary current under fault condition for the specified period without any damage. 11.11.6 The ammeters in the motor feeders shall be CT operated having a spread out scale in the working range and compressed scale beyond the working range to read the starting current of 6-14 times the rated current of the circuit. A red mark at the rated current shall also be provided in the scale. 11.11.7 Test terminal block shall be provided with MFM.		
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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.		11.11.8 Digital meters and MFM shall be provided with communication port for hook up with DCS. 11.12 Switch Fuse Unit 11.12.1 The switches shall be TP/TPN heavy duty, air break mechanism operated by a suitable external handle with position indicator. 11.12.2 The live terminals shall be shrouded to avoid accidental contact. Combined fuse-switch of double-break type may be offered wherever practicable. Switches for motor circuits shall be of AC 23 category and of other circuits shall be of AC 22 category. 11.12.3 The fuses shall be of HRC link type with a breaking capacity of 80 kA. The motor fuse rating and characteristics shall be suitably chosen so that they do not operate during the starting period of the motor. 12.0 Other features to be provided in Switch boards 12.1 Each Switchboard shall be provided with a voltmeter, protective HRC fuses and a 3-position selector switch to indicate the three-phase voltages on the incoming line side (unless separate metering is shown in SLD or specified elsewhere in the Specification). 12.2 The motor control circuit shall be provided with test facilities so that it is possible to test the control circuit with the main circuit disconnected. 12.3 For switchboards necessary interlocking between power circuit and control circuit shall be provided so that control circuit cannot be energized, when the main MCCB/isolator is in off position. However, this interlocking shall be defeated in test position. Auxiliary contact of the main isolator shall be used in the control circuit. Use of micro-switch is not permitted. 12.4 Spare contacts of all relays/power contactors shall be wired up to the terminal block. 12.5 The switchboard panels shall be provided with space heaters to prevent moisture condensation. The space heater shall be located in the bottom part of each panel and shall be supplied from 240 V AC auxiliary bus for space heater. The space heater shall be provided with a thermostat having adjustable setting and double pole miniature circuit breaker. 12.6 Illumination lamps with door limit switch shall be provided in each breaker panel and cable alley of each panel in case of non ACB modules. 12.7 Industrial type 16 A socket along with plug shall be provided in each shipping section of the MCC. 12.8 Space heater bus shall be provided in the switchboard for feeding power to space heater, Illumination lamp and sockets. Space heater bus shall be fed from incoming line of the switchboard before the incomer (unless otherwise specified in SLD). 12.9 Only one make of devices shall be used for all MCCs such as MCCBs, MPCBs, isolators, contactors, protective relays, auxiliary relays, actuating devices etc. as far as possible. Type-2 co-ordination shall be ensured while selecting the power circuit devices supported by necessary test certificate as per IS: 60947. 12.10 Required auxiliary relays/contactors/timers shall be provided for interlocking and multiplying contacts. Electrically set/reset relay shall be used for multiplying breaker auxiliary contacts wherever contacts are used for interlocking purposes. 13.0 PAINTING 13.1 As per Annexure-14. 14.0 TESTS 14.1 All tests shall be conducted as per relevant IS/IEC/IEEE standards and shall be performed in the presence of Owner/Owner's representative, if so desired by the Owner/Owner's representative. All		
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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.		equipments shall be type tested as per the relevant standards. If relevant type test reports are not available the same shall be conducted without any cost implications. 14.2 All components, devices and wiring shall be checked for correct operation before dispatch. 14.3 All switchgear offered shall be arc resistant design and the switchgear shall be tested for internal arc as per IEC. Internal Arc testing procedure and certificate shall be furnished. LT switchgears shall be fully type tested. 14.4 Type test certificates shall be submitted to the Purchaser for all equipment as stipulated in the relevant standards.		
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