भारत हैवी ईलैक्ट्रिकल्स लिमिटेड

BHARAT HEAVY ELECTRICALS LIMITED

पारेषण व्यापार अभियांत्रिकी प्रबंधन

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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TITLE/ शीर्षक				नाम / NAME	**TDT**	**TDT**	**VK**
HVAC POWER DISTRIBUTION BOARD (SWITCHYARD AREA)				दिनांक/ DATE	**29-06-22**	**29-06-22**	**29-06-22**
				समूह/GROUP	**TBEM**	W.O. No	**83001**

ग्राहक/ CUSTOMER	**UP RAJYA VIDYUT UTPADAN NIGAM LTD. (UPRVUNL)**
परामर्शदाता/ CONSULTANT	**DEVELOPMENT CONSULTANTS PVT. LTD. (DCPL)**
REVIEW CONSULTANT	**NATIONAL THERMAL POWER CORPORATION LTD (NTPC LTD.)**
परियोजना/ PROJECT	**1 X 660 MW PANKI TPS – 400 KV SWITCHYARD**

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ENCLOSURES

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b. ANNEXURES TO SECTION -5

Annexure-A – Tender drawings (1 Nos.)

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS

Distribution	To	TBEM	TBMM	TBQM	Vendor
	Copies	1	1	1	4

SECTION-1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE:

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch, supervision of testing and commissioning of metal enclosed, indoor floor mounted, compartmentalized HVAC Power Distribution Board as listed in clause **1.2** below.

This section covers the scope and quantities of HVAC Power Distribution Board. The specific technical Requirements for the above item as specified by the customer are given in Section-2. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

In case of any discrepancies between the requirements mentioned under Section-1/Section-2 and those specified in the Section-3, the specifications given under Section-1/Section-2 shall prevail and shall be treated as binding requirements.

The term "Owner/Customer/Employer" appearing in this specification shall refer to ultimate customer, the term "Purchaser/Contractor" shall refer to BHEL and the term "Sub-contractor/Bidder/Manufacturer" shall refer to the successful Bidder.

The equipment is required for the following project:

Name of Customer: UPRVUNL
Name of the Project: 400kV Switchyard for Panki Thermal Power Station (1x660MW)
Name of Consultants: NTPC (Review Consultant)
DCPL, Kolkata

Refer Section - 3 for Project Details and General Specifications.

1.1 SPECIFIC TECHNICAL REQUIREMENTS:

Please refer Annexure-A drawing for drawing of HVAC Power Distribution Board.

9962-001-TB-572-PVE-P-220-01	Schematic GA & SLD for HVAC Power Distribution Board

For further Technical Requirements, refer Section-2

1.2 BILL OF QUANTITY:

HVAC power distribution board and a small distribution board shall be supplied as one set as per drg. details mentioned in Cl. No. 1.1 above and as per table below. No. of feeders will not change during detailed engineering stage, however there may/ may not be change in schematic & wiring diagram of the panel. The same will be decided during detailed engineering with end client.

Sl. No.	Items	Unit	Qty.
1.	HVAC Power Distribution board	Set	1
1.1	Wall Mounted Distribution board		

Two nos. incomers of adequate capacity shall be provided from the ACDB and the same will be terminated in air conditioning PDB with a changeover switch.

This Panel shall feed power to Package AC units -3 nos., heater, humidifier, Cassette AC units, supply & exhaust air fans, fire dampers.

Refer chapter 15A – 415 Switchgears of UPRVUNL-DCPL specification provided as Annexure to Sec- 2 of this specification for details regarding PDB panel to be provided.

Interlocking of PDB or MCC panel shall be done with Fire alarm panel to trip HVAC system in case of fire. Also PDB/ MCC panel shall have provisions for interface of ACVS with DDCMIS system.

1.3 MANDATORY SPARES

Following spares shall be in supply scope of the contractor:

S. N.	Item	Qty
A.	**Electrical items – PDB panel**	
1.	Aux. contact set	4 Nos.
2.	Current transformer (metering)	1 No.
3.	Current transformer (Protection)	1 No.
4.	CT for Bimetal O/L relays	1 no. of each type & rating
5.	Relays	1 no. of each type & rating
6.	Control fuses & neutral links (if applicable)	30 % 0f population for fuses, 10 % of population for link
7.	Indicating lamps	20 % of installed quantity.
8.	Bus bar support insulators(each type)	5 % of installed quantity.
9.	Bus duct flexible connectors	1 no. of each type
10.	MCCB	1 no. of each type
11.	Power fuses (if applicable)	10% of each type
12.	Thermal bimetal relays	6 nos. of each rating and size.
13.	Terminal blocks	10 % of installed quantity
14.	Busbar aluminium flat pieces	12 meters of each size.

1.4 TYPE TESTING, ERECTION, TESTING & COMMISSIONING

a. Type tests shall be in line with Clause 6.27.02 of Chapter-15A of Annexure to Section 2.

b. The type test reports submitted shall be of tests conducted after **02.11.2010.** The bidder should have conducted type test on identical or similar equipment/ components to those offered. In case type test reports are found to be technically unacceptable to

BHEL/UPRVUNL/CONSULTANT, the type test shall be conducted without cost and delivery implication to BHEL/UPRVUNL.

1.5 DEVIATIONS

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained later.

1.6 PACKING

1.6.1 All equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and outdoor storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.

1.6.2 The Bidder shall include and provide for security, protection and packing the equipment to avoid loss or damage during transport by any mode.

1.6.3 All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the purchaser.

1.6.4 The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.

1.6.5 Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.

1.6.6 Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.

1.6.7 All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.

1.6.8 Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.

1.6.9 Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for

any loss, damage or depreciation to the stores.

1.7 QUALITY PLAN:

Bidder shall follow UPRUVNL approved Quality Plan at contract stage. Any Comments during detailed engineering from BHEL/UPRUVNL to be incorporated without any cost and delivery implications to BHEL/UPRUVNL.

1.8 SUPERVISION OF INSTALLATION & COMMISSIONING

Manufacturer of LT Switchboard shall supervise the installation and commissioning and perform commissioning tests as recommended in O&M manual / or relevant standards. All necessary instruments, material, tools and tackles required for installation, testing at site and commissioning are to be arranged by the manufacturer.

1.9 DRAWINGS / DOCUMENTS

Bidder shall submit all necessary drawings and documents for approval.
However, Following drawing/documents are required for manufacturing clearance:

- GA
- Schematic Drawings
- Type Test Reports (TTR)
- Manufacturing Quality Plan (MQP)

Date of Submission of first lot of drawing will be counted only from the date of submission of reasonably correct drawings.

SECTION-2

Equipment specification of HVAC Power distribution board shall be as per relevant applicable clauses of Annexure to this section - UPRUVNL – Tech. spec. for 415V SWITCHGEARS, NON-SEGREGATED PHASE BUSDUCT AND DC BOARDS

CHAPTER 15A : 415V SWITCHGEARS, NON SEGREGATED PHASE BUSDUCT AND DC BOARDS

1.01.00 SCOPE

1.01.01 This specification is intended to cover design, engineering, manufacture, assembly, shop testing, inspection, packing, delivery to site, erection, testing and commissioning of following with all fittings and accessories for efficient & trouble free operation

1. 415 V Power control Centre (PCC)
2. 415 V Motor Control Centers (MCC)
3. 415 V Motor cum Power control centre (PMCC)
4. 415 V Distribution Boards (DB) and Fuse boards
5. DC starters
6. Solenoid valve boards
7. LPBS
8. 415 V Non segregated phase bus ducts

1.01.02 Base channel frame of all boards and fuse boards along with necessary mounting hardware.

1. Set of accessories as listed below:
2. Breaker lifting & handling trolley
3. Racking in/out handle for breakers
4. Racking in/out handle for drawout MCC modules

1.01.03 20% spare outgoing feeders with atleast one of each type and rating shall be provided in each switchgear.

1.01.03 Mandatory Spares

1.01.04 All provisions and accessories shall be furnished for termination and connection of cables, including removable gland plates cable supports, crimp type tinned copper/aluminium lugs, double compression type brass glands with tapered washer (power cables only) and terminal blocks. Cable Schedules for all Power cables and control cables shall be submitted after final dispatch of the switchboards.

1.01.05 Foundation bolts for all the floor mounted equipment, and fixing bolts and accessories for wall mounted equipment.

1.01.06 All interconnecting wiring between various panels/compartments of a switchgear or MCC shall be carried out internally by the Contractor at his works/site.

1.01.07 Certain switchgears with very long lengths shall be sectionalized and physically separated for ease of operation and maintenance. Interconnection of such sections by bus trunking shall be in Bidder's scope.

1.01.08 Bidder shall supply dummy panels, if required for floor beam crossing without any price implication.

1.01.09 415V Switchgears shall have Air Break Spring Charged D.C. Motor operated stored energy type Circuit Breakers with integral manual spring charging

handle for Incoming and Tie feeders. These Breakers shall be electrically operated type, and shall be provided with electrical and mechanical interlocks to prevent paralleling of two different sources of supply.

1.01.10 All MCCs/Switchgears shall be of single/double front construction. All Switchgears/MCCs shall be sectionalized, and Breakers shall be provided for Incoming and Bus Section feeders as specified. These shall be electrically interlocked (if Incomers are through breakers) and castel-key interlocked (if Incomers are through load break Switch/fuse-switch unit). But provision shall be made to defeat interlock to enable parallel operation in case of emergency.

1.01.11 All Switchgears shall be easily extendable on either side. The Bidder shall supply Switchgear in various shipping sections consisting of Incomer, Ties and Motor modules. Bidder may be required to change module types, sizes and the components in respect of certain feeders even during erection, testing and commissioning.

1.01.12 The Bidder shall furnish calculations and/or type-test certificates prove adequacy of the busbar sizes offered, for specified current and short time current ratings. Bus bars in particular and droppers (HBB/VBB) shall be supported on SMC/DMC/FRP supports and covered with heat-shrunk PVC sleeves which shall be shrunk fit and not capable of being removed without destruction. While continuous current ratings of the droppers in each Switchgear Cubicle shall be at least equal to the corresponding Breaker rating, short time current rating shall be same as that for Horizontal Main Bus bars. Only those dropper ratings will be allowed as have passed a type test.

1.01.13 All fuses, switches, fuse switch combinations, contactors and overload relays shall conform to Type-II class of Co-ordination as per IS-13947. Bidder shall furnish Type-II Co-ordination, p & q type test report as per IS: 13947 for all modules along with Bid. Moreover rating of switch shall be at least same or more than that of associated fuse in all cases. The bidder shall have to carryout the 'p', 'q' test as per IS: 13947 before the supply of equipment at Central Power Research Institute.

1.01.14 The Contractor shall furnish relay application checks/ calculations to check adequacy of the CTs/VTs as well as suitability of relay settings/setting ranges proposed by the Bidder. These checks/ calculations shall be furnished during detailed engineering stage for each and every feeder.

1.01.15 LT Switchgear for stacker reclaimer shall be fixed type and no spare shall be provided.

2.00.00 Auto Changeover

2.01.00 Auto-changeover facility will be provided in PCC and MCCs as required during detailed Engineering. These Switchgears/MCC will normally operate with Buscoupler open. If sustained under voltage is detected on any one of the bus section, the respective Incoming Breaker shall trip and bus - coupler shall close if voltage is available on the other bus section. Auto changeover shall be blocked if the Incoming Breaker has tripped due to bus fault. Manual change over from one source of supply to the other or vice versa shall be possible by momentary paralleling of the two supplies after checking synchronism with the help of a synchro check relay. On closing the Incoming breaker, the running Breaker should trip within a preset time. An annunciation shall be provided if the two bus sections remains paralleled for more than a preset time. If the

running breaker fails to trip within the preset time the incoming breaker shall trip. All necessary voltage/isolating transformer; synchrocheck relay etc. shall be supplied for this.

2.02.00 Emergency switchgear will normally have the four incomers one from Unit PMCC, which is normally closed and second from Misc. PMCC, third from DG Set-1 and fourth from standby DG without any bus coupler. In case of sustained under voltage on already closed first incomer, the same will trip and the second incomer will close automatically after a preset time delay. In case the second incomer also trips due to sustained under voltage; automatic starting signal will be given to DIESEL GENERATOR. After DG has run upto rated speed and voltage is built up, the DG breaker shall be automatically closed. In case the main DG fails to start than command shall be given to the standby DG Set. After the standby DG has run upto rated speed and voltage is built up the standby DG breaker shall be automatically closed. Auto changeover on Emergency PCC shall be blocked if lockout trip relay of any incomer is energized due to fault. Changeover from one source to the other will be manually accomplished by first tripping the running source and then closing the breaker of incoming source. Only reputed make auxiliary relays are to be used for status changeover of contacts used in control circuit, auxiliary contactors are not acceptable.

3.00.00 GENERAL

3.01.00 POWER CONTROL CENTER (PCC)

3.01.01 POWER CONTROL CENTER hereinafter referred to as PCC, shall mean a continuous line-up of breaker panels, used to feed Motor Control Centres. All PCCs shall have duplicate incomers and a bus-section. Incomers, bus- section, and all outgoing feeder of a PCC shall be breaker controlled & SFU. Distribution of outgoing feeders shall be such as to ensure uniform loading on each section of the PCC.

3.01.02 MOTOR CONTROL CENTER, hereinafter referred to as MCC, shall mean a continuous line-up of vertical sections housing breaker panels, switch fuse, contactor operated modules. All incomers and Bus-sections shall be breaker controlled except few, which are castle key inter-locked. Whenever bus-sections are provided, all outgoing feeders shall be breaker/switch fuse controlled, or contactor operated depending upon the rating and application. Distribution of outgoing feeders shall be such as to ensure uniform loading on each section of the MCC.

3.01.03 POWER-CUM-MOTOR CONTROL CENTER, hereinafter referred to as PMCC, shall mean a continuous line-up of vertical sections housing breaker panels, switch fuse, and contactor-operated modules. All PMCCs shall have duplicate incomers and a bus-section. Incomers and bus-sections shall be breaker controlled. Depending upon the rating and application, outgoing feeders may be breaker controlled, switch fuse controlled, or contactor operated. Distribution of outgoing feeders shall be such as to ensure uniform loading on each section of the PMCC.

3.01.04 DISTRIBUTION BOARD, hereinafter referred to as DB, shall mean a continuous line-up of vertical sections housing switch fuse modules only. ACDBs shall have duplicate incomers and a bus-section. Powerhouse main DCDBs shall have two incomers from its associated battery charger with bus sectionaliser. Wherever bus-sections are provided, distribution of outgoing feeders shall be

such as to ensure uniform loading on each section of DB. Two(2) nos Floor wise DC sub DB shall be provided having single Incomer from Each Bus section of main DCDB to cater supply for HT/LT switchgear and Transformer auxiliary supply as source 1 & source 2. Valve DBs shall be provided on floor wise/area wise of boiler and turbine side to cater valve load and will be wall mounted fed from respective boiler/turbine MCC. Valve DBs shall have single incomer only.

3.01.05 SOLENOID VALVE BOARD, hereinafter referred to as SVB, shall mean a continuous line-up of vertical sections housing switch-fuse modules and contactor -operated modules. SVBs may have one incomer, which shall be switch fuse controlled. All outgoing feeders shall be contactor operated. FUSE BOARD, hereinafter referred to as FB, shall mean a continuous line-up of vertical sections housing switch fuse only. FBs Boards may be fed from DBs and may have one incomer.

3.01.06 AC fuse boards shall consist of:

- 1 no. 63A TPN SFU as incomer with lamps and meters.
- 9 nos. 16A SPN SFU & 3 nos 16A TPN SFU as outgoing.

3.01.07 DC fuse boards shall consist of:

- 1 no. 63A switch as incomer with meters, lamps and auxiliary contactors.
- 8 nos outgoing feeders with 16A HRC fuses.

3.01.08 The 110 V supply for HT panel & Motors Space Heater, wherever required shall be derived through 415V/110V isolation transformer.

4.00.00 CODES AND STANDARDS

4.00.01 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standard (IS) except where modified and / or supplemented by this specification. Indian Standards for the equipment covered under this specification are as follows:

IS:8623	:	Specification for factory built assemblies of switchgear & control gear for voltages upto and including 1000V AC/1200 V DC.
IS:4237	:	General requirements for switchgear and control gear for voltages not exceeding 1000V,
IS:2147	:	Degree of protection provided by enclosures for low voltage switchgear and control gear.
IS:3202	:	Code of practice for climate proofing of electrical equipment.
IS:3072	:	Code of practice for installation and maintenance of Switchgear.
IS:8544	:	A.C. Motor starters of voltage not exceeding 1000 V.
IS:2516	:	A.C. Circuit Breakers.

IS:4064	:	Air-breaker switches, air break disconnectors, air break disconnector and fuse combination units for voltage not exceeding 1000V AC or 1200V DC.
IS:2705	:	Current transformers
IS:3156	:	Voltage transformers
IS:3231	:	Electrical relays for power system protection.
IS:1248	:	Electrical Indicating instruments.
IS:722	:	AC Electricity Meters.
IS:375	:	Marking and arrangements of bus bars.
IS:2208 & IS:9224 (Part-II)}	:	HRC Cartridge Fuses.
IS:2959	:	Contactors
IS:6875	:	Switches and push buttons.
IS:6005	:	Code of practice of phosphating iron and steel.
IS:5082	:	Wrought Aluminium and aluminium alloys for electrical purposes.
IS:2629	:	Hot dip galvanising.
IS:13947	:	Low voltage switchgear and Control Gear.

4.00.02 Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such cases copies of the English version of the standard adopted shall be submitted alongwith the bid.

4.00.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS codes of practice. In addition, other rules or regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

5.00.00 DESIGN CRITERIA

5.01.00 The SWGR/PCC/MCC/BUSDUCT and DBs will be used to supply auxiliary power for normal and start-up operation, control and protection for 415/230V AC and 220V DC auxiliary services of generating units.

5.02.00 Duty involves direct-on-line starting of large induction motors upto 160 KW and also under certain emergency conditions automatic transfer of loads from one source of supply to other. Motor starting current varies from 6 to 8 times full load current with maximum of 3 starts per hour.

5.03.00 The equipment will be located in a clean but hot, humid and tropical atmosphere, highly polluted at places with coal dust and/ or fly ash.

5.04.00 Circuit breaker/ switchgear shall not produce any harmful over voltage during switching off induction motors/ supply. If required, surge protective devices shall be included in the scope of supply to limit over voltage.

5.05.00 For continuous operation at specified ratings, the temperature rise of the various equipment shall be limited to the site permissible values stipulated in this specification.

5.06.00 Incomers, buscouplers & outgoings rated below 630A are to be provided with Motorised MCCB. 630A and above shall be ACB controlled .

5.07.00 Loads of outgoing feeders wherever applicable shall also be considered while sizing the busbars, equipments and components. All equipment and components shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents listed in the annexure without any damage or deterioration of materials.

5.08.00 Busbars for PCC/PMCCs shall be sized to carry continuously the associated transformer secondary current plus a 20 % margin.

5.09.00 Busbars of MCCs/DBs/SVBs/FB shall be sized to carry continuously the running load connected to it with a 20% margin.

5.10.00 In cubicle ratings of incomer and bus section breakers/switches shall be identical to the associated busbar rating.

5.11.00 MCC shall have sufficient number of spare modules (at least 20% of various sizes used with a minimum of 1 no. for each rating). The rating of the incomer shall be selected considering the requirement of spares. The spare feeders shall be provided with all equipment and complete wiring similar to their respective active feeders.

5.12.00 The control circuitry of all modules in respective PCC/MCC shall be suitable for interfacing with plant DCS for remote monitoring switching and control.

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 Construction of SWGR/PCC/ MCC/ DBs

6.01.01 SWGR/PCC/MCC/DBs shall be indoor, air insulated, metal-clad, floor mounting type. All SWGRs/PCCs/MCCs shall be fully draw out type having self aligning type secondary plug in contracts. All DBs shall be fixed type. The design and construction shall be such as to allow extension at either end.

6.01.02 PCCs/DBs/SVBs shall be single front construction and PMCCs/MCCs shall be of double front construction. Breaker panels of PMCCs shall be of single front construction.

6.01.03 The enclosure of the equipment shall be dust and weather proof, conforming to a degree of protection IP-52 for ratings upto 1600A and IP-42 for ratings above 1600A. The switchboard frames shall be fabricated using suitable mild steel structural section or braced and shall be cold rolled sheet steel of thickness of not less than 2 mm. The frames shall be enclosed in cold rolled sheet steel of not less than 1.6 mm. The doors and covers shall also be of cold rolled steel of thickness not less than 1.6mm. Adequate stiffness shall be provided wherever necessary. Gland plates shall be 3.00mm. The design shall

be such that specified degree of protection shall be achieved even after a breaker control module has been taken out of the panel.

6.01.04 SWGR/PCC/MCC/ DB assembly shall comprise a continuous line up of dead front, free-standing vertical sections, housing the control modules in multitier formation. The installations of circuit breakers, however, shall be limited to the single tier formation.

6.01.05 The design shall be fully compartmentalized with metal/ insulating partitions between compartments. FBs shall be non compartmentalized. The working height shall be limited within 300mm to 1900 mm. However for MCC modules minimum height shall be limited to 400mm. Switch boards shall be mounted on base frame of 100 mm height from the finished floor.

6.01.06 Each breaker/ control module/ switch fuse unit shall be housed in a separate compartment, complete with an individual front access door having sufficient opening with concealed type hinges. Each vertical section of single front board shall have a removable back cover.

6.01.07 All doors and covers shall be provided with life long rubber and life long pasting neoprene gaskets. MCC module shall also be dust and vermin proof when the module is taken out from the chassis. Suitable arrangement to achieve this feature shall be provided.

6.01.08 All switches push buttons, lamps, indicating instruments shall be flush/ mounted on respective module compartment whereas relays and other auxiliary devices may be mounted on a separate cubicle. All meters indicating lamps and protective relays shall be visible on the door.

6.01.09 A full height vertical cable alley with cable supports shall be provided in each section to facilitate dressing of unit wiring. The chamber shall be liberally sized to accommodate all cables and shall have hinged doors opening on opposite sides with respect to the module doors and removable cover at back side for access. The width of the cable chamber when viewed from front of the switchboard shall not be less than 250 mm. Base frame of 100 x 50 x 6 mm is to be supplied separately.

6.01.10 Breaker cubicle shall be so sized as to permit easy closing of the front access door when the breaker is pulled out to 'ISOLATED' position. The breaker can be operated both in SERVICE and TEST position with the door closed.

6.01.11 A horizontal wire way, extending the entire length, shall be provided at the top of each SWGR/PCC/MCC/ DB for inter panel wiring. The chamber shall be liberally sized to accommodate all cables and shall have removable cover at the front for access.

6.01.12 In all the motor feeders dual output transducers shall be provided. Further all the incomers, Bus couplers and outgoing feeders shall also have dual output transducers

6.01.13 Local Push button stations shall be in sheet steel (2mm) or cast aluminium enclosure of weatherproof neoprene gasketted construction suitable for outdoor use without canopy conforming to IPW-55 or better. The push buttons of spring return type and stay put type shall be as per enclosed drawing. The push button shall be provide with separate terminal blocks.

6.01.14 Interposing relay (coupling relay) shall be provided for each feeder.

6.01.15 Incomers shall be provided at the ends of an assembly and bus section, wherever required, shall be provided at the middle of the assembly.

6.01.16 Four (4) nos. lifting lugs shall be provided for each section, two (2) nos. on either end of the section.

6.01.17 After isolation of the power and control circuit connections, it shall be possible to safely carry out maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.

6.01.18 The 250A & above feeders up to 630A shall have MCCB, MCCB shall be provided with microprocessor based inbuilt front adjustable releases (overload & short circuit) and shall have adjustable earth fault protection unit also. MCCB shall have current limiting feature. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door cannot be opened unless the MCCB is in OFF position. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlock.

6.02.00 BUS AND BUS TAPS FOR SWGR/PCC/MCC/DB

6.02.01 The main, tap off buses and connections shall be of high conductivity aluminium. The size for specified current ratings shall be such that maximum temp. rise at bus bar joints shall be limited to 85 Deg. C (i.e. 35 Deg., C rise over 50 Deg. C ambient).

6.02.02 Vertical bus bars shall be designed as per system requirement.

6.02.03 All bus connections shall be provided with anti-oxide grease. For all bus connections adequate contact pressure shall be ensured by means of two bolt connection with plain and spring washers and locknuts. The protruding bolts of different phases/ poles shall be staggered and shall not see each other directly. Bimetallic connectors shall be furnished for connections between dissimilar metals. Alternatively the joints surfaces shall be silver plated.

6.02.04 Bus bars and connections shall be fully insulated for working voltage with adequate phases/ ground clearance. Insulating sleeves for bus bars and shrouds for joints shall be provided. Shrouds for bus bar joints and tapping points shall be two part click-fit type epoxy resin cast/ fiber glass moulded.

6.02.05 Minimum clearance of 25mm is required between phases/ poles for entire run of horizontal and vertical busbars and 19 mm between phase and earth irrespective of sleeve/ shroud provided for bus bars.

6.02.06 For all other components, the clearance between two live parts, a live part and earthed part, and isolating distance shall be at least 10 mm throughout.

6.02.07 Wherever it is not possible to maintain the above mentioned clearances, insulation shall be provided by means of barriers. All connections from busbars upto the fuses shall be fully shrouded to minimize risk of phase to phase and phase to earth faults.

6.02.08 Insulating shrouds for busbar joints shall be moulded type. SWGR/PCC/MCC/ DB with higher clearances shall be preferred considering dust laden environmental condition in which SWGR/PMCC/ MCC/ DB has to operate. Bus supports shall be flame retardant, track resistant non-hygroscopic type epoxy/ SMC/ DMC with high creepage surface. Separate supports shall be provided for each phase and neutral busbar

6.02.09 Cross section of busbar shall be uniform throughout the length of assembly. All buses and connections shall be supported and braced to withstand, the stresses due to maximum short-circuit current and also to take care of any thermal expansion.

6.02.10 Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from the ground to SWGR/PCC/ MCC/ DB assembly.

6.02.11 The horizontal busbar chamber shall be separate and totally enclosed. Control/ space heater buses shall be of copper and shall be extended throughout the length of the switchboard. These buses shall be supported by non-hygroscopic material and segregated from main busbar. Busbar chamber provided for control and auxiliary buses shall be segregated from main busbar chamber.

6.02.12 Busbar chamber provided for vertical busbar shall be segregated from cable alley chamber and outgoing terminals.

6.02.13 Bolted disconnect links shall be provided for DBS for all incoming and outgoing feeders for isolation of neutral, if necessary.

6.02.14 One metal sheet shall be provided between two adjacent vertical sections running to the full height of switchgear except for horizontal bus bar chamber. However, each shipping section shall have metal sheets at both ends.

DBs shall be fixed type construction.

6.02.15 415V Non-segregated phase busduct :

a) The entire bus duct shall be designed for dust, vermin and weather proofconstruction. A suitable aluminium sheet flange-protection hood shall beprovided to cover all outdoor bus duct enclosure joints to facilitate additional protection against rain water ingress. All horizontal runs of bus duct shall have a suitable sloped enclosure top to prevent retention of water for both indoor and out door portion of bus ducts. Bus duct enclosure shall have a degree of protection of IP-55.

b) The material of the conductor shall be aluminium. The bus bars shall be rated in accordance with the service conditions and the rated continuous and short time current ratings.

c) All steel structures required for bus duct support shall be hot dip galvanised.

d) The temperature rise of the bus bars and joints when carrying ninety percent (90%) of the rated current along the full run shall not exceed 40°C over an ambient of 50°C. The maximum temperature rise during short circuit conditions shall not exceed 200°C.

6.03.00 MCC/SVB/DB MODULES

6.03.01 Draw out type control module shall have self- aligning, plug in power / control disconnects. All disconnects shall be silver-plated to ensure good contacts.

6.03.02 The design shall be such as to permit easy withdrawal / reinsertion of the unit guide rails to ensure correct alignment & all the power contacts meet accurately every time the module is inserted.

6.03.03 Various module sizes should be multiples of one basic unit to facilitate modifications at site. Suitable provision for this purpose should also be incorporated in the vertical busbars.

6.03.04 Control module shall house the control components for a circuit such as switch, fuse, contractors, relays, push buttons, lamps etc. as per requirement only the push button actuators, lens of indicating lamps, and transparent windows for meters shall be mounted on module door such that when the module is withdrawn the cubicle door shall be provided the specified degree of protection when the module door is closed. These modules shall be designed to withstand internal arc faults i.e. in the event of fault occurring in one module the arc should not spread to neighboring module and should not affect their functioning.

6.03.05 The equipment layout shall provide sufficient working space in between the components and subject to Owner's approval.

6.03.06 It shall be possible to carry out routine, maintenance checks or small changes in a module without physically taking the module away from switchboard.

6.03.07 Automatic safety shutters shall be provided to fully cover the female primary disconnects when the module is withdrawn. Under any circumstances it shall not be possible to access the vertical dropper accidentally and also suitable means shall be provided to avoid any phase short circuit in vertical droppers.

6.03.08 The module shall be dust & vermin proof even when module is completely withdrawn. Suitable means shall be provided to achieve this feature.

6.03.09 Draw out type control modules of same size and type shall be electrically and physically interchangeable.

6.03.10 Draw out control modules of PCC/MCC shall have the SERVICE, TEST & ISOLATED positions with positive indications and interlocking for each position. The doors of individual modules and the cable alley should open in opposite directions to facilitate clear view of the module when the operator is working on the cable terminals.

6.03.11 In service position, both power and control circuits shall be engaged. It shall not be possible to open the module door when the module is in service position.

6.03.12 In TEST position, the power circuits shall be disengaged but the control circuits shall be engaged. It shall be possible to close the module door when the module is in TEST position. Keeping the front access door of module in closed condition, the breker can be placed in ISOLATED, TEST or SERVICE position from outside.

6.03.13 In ISOLATED position, both power and control circuits shall be disengaged.

6.03.14 Motor feeders of 30KW and above shall be provided with Ammeters & 75 KW and above shall be provided with Ammeter with selector switch.

6.03.15 For entire plant except CHP, motors rated 90kW and above till 200kW shall be ACB controlled. In CHP motors rated 90kW and above till 160 kW shall be ACB controlled.For motors 90 KW and above numerical protection relays are envisaged.. All motor feeder modules shall also be provided with local/field/Remote selector switches on the module itself.

6.03.16 For selection of modules please refer Cl. 6.04.00 below.

6.04.00 Circuit Breakers

6.04.01 Breakers shall have anti-pumping feature.

6.04.02 Circuit breakers shall have minimum interrupting capacity equal to the listed fault level.

6.04.03 Circuit breaker shall be three poles for motors and four poles for incomer, bus coupler and outgoing feeder single throw, air break type with stored energy, trip free mechanism and shunt trip.

6.04.04 The circuit breaker shall have short circuit and overload microprocessor based relay. The relay shall have facility of wide range current settings. The over current relay shall have family of IDMT characteristics curves to arrive at full discrimination with down stream over current relays / fuses MCCBs etc. The short circuit protection shall have adjustable time delay settings. If discrimination is not achieved with the relay, suitable external relays shall be provided for over current & short circuit protection.

6.04.05 One potential free contact for remote annunciation for each over current short circuit and under voltage, circuit breaker tripping.

6.04.06 Circuit breakers shall be draw out type, having SERVICE, TEST & ISOLATED positions with positive indication for each position.

6.04.07 Circuit breakers of identical rating shall be physically and electrically interchangeable.

6.04.08 All circuit breakers shall be of motor wound spring charged mechanism and also shall have hand operated spring charged mechanism facility.

6.04.09 For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close/ open operation of the circuit breaker shall be possible after failure of power supply to the motor.

6.04.10 Mechanical safety interlock shall be provided to prevent the circuit breaker from being racked in or out of the service position when the breaker is closed.

6.04.11 Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.

6.04.12 Each breaker shall be provided with an closing and emergency manual trip, mechanical ON-OFF indicator, an operation counter and mechanism charge/ discharge indicator.

6.04.13 In addition to the auxiliary contacts required for normal breaker operation and indication, each breaker shall be provided with following for interlocking purpose:-

- Position/ cell switch with 4 NO + 4 NC contacts.
- Auxiliary switch, with 6 NO + 6 NC contacts, mounted on the stationary portion of the switchgear/ PMCC/ MCC and operated mechanically by a sliding lever from the breaker in SERVICE position.
- Alternatively. Electrically reset latching relay may be used for the purpose. The exact requirement of contacts of position/cells switch, limit switch, auxiliary switch and latching relay shall be decided by the contractor taking into account the scheme requirement spares.
- Spring charge limit switch shall be provided for breakers with motor wound sring charging mechanism. These limit switches for motor duty shall be provided with minimum 2 NO + 2 NC aux. contacts.
- Limit / auxiliary switches shall be convertible type that is suitable for changing N.O contact to N.C. and vice-versa.

6.04.14 Provision of mechanical closing of breaker only in 'Test' and 'Widrawn' position shall be made. Alternatively, mechanical closing facility should be normally inaccessible, accessibility rendered only after deliberate removal of shrouds. It shall be possible to close the door with breaker in test position.

6.04.15 Mechanical tripping shall be through red 'Trip' push button outside the panels for breakers, and through control switches for other circuits.

6.05.00 Switches

6.05.01 Switches shall be double/ tripple pole, air break, AC23 motor duty for motor feeders and AC22 heavy duty for other feeders. Motors duty switches shall be capable of safety making and breaking the locked rotor current of the associated motor circuit. Rotary switches shall be provided with dummy packet between the phases to ensure higher creepage distance.

6.05.02 The switch shall have quick-make, quick break mechanism operated by a suitable external handle, complete with position indicator. This handle shall have provision for padlocking in ON and OFF position.

6.05.03 The compartment door shall be interlocked mechanically with the switch such that the door cannot be opened unless the switch is in OFF position. Means shall be provided for releasing this interlock at any time.

6.05.04 Switches shall be capable of withstanding the let-through fault current of back-up fuses or circuit breakers.

6.05.05 If two switches are specified for any MCC/ DB incomer, these switches shall be mechanically/ key interlocked so as to ensure that only one switch can be closed at a time. If bus coupler switch is provided these shall be

mechanically/ key interlocked so as to ensure that only two switch can be closed at a time.

6.05.06 Incomers for MCCs and DBs rated below 250A shall be load break isolator.

6.06.00 Fuses

Fuses shall be HRC type with operation indicator, preferably link type, with a minimum interrupting capacity equal to the listed short circuit current.

Fuses shall be furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.

Motor fuse characteristics and ratings shall be chosen to ride over starting period without blowing. The fuse on incoming feeder, if specified, shall be chosen to provide discrimination with motor/ feeder fuses.

Isolating switches shall be of AC23A catergory when used in motor circuit, and AC 22A category for other applications. Fuse switch combination shall be provided wherever possible.

6.07.00 A.C. Starter

6.07.01 Contactors

a) Motor starter contactors shall be of air break, electromagnetic type suitable for DOL starting of motor, and shall be utilization category AC-3 for ordinary and AC-4 for reversing starters. For conveyor motors, minimum rating of power contactors shall be 200% of the full load current of the motors. For other motors minimum rating of power contactors shall be 160% of full load current of motor. DC contactor shall be DC-3 utiliztion category.

b) Each contactor shall be provided with two (2) normally open and two (2) normally closed auxiliary contacts rated 10 A at 240V AC or 2A at 220V DC. The exact requirement of contacts shall be decided by the contractor taking into account the scheme requirements and spares.

c) Reversing contacts shall be electrically and mechanically interlocked.

d) Contactors associated with timer to achieve delayed dropout feature shall be provided for some essential auxiliaries. The timer used for this purpose shall be electronic type only.

e) Reacceleration system to be adopted for Boiler MCC, turbine MCC and Emergency MCC contactor operated motor feeder.

f) All the contactor, starters shall comply with the requirement of type-2 co-ordination as specified by IEC 60947-4-1.

6.07.02 Thermal overload

a) Thermal overload relays shall be three element, positive acting, ambient temperature compensated with adjustable settings. Single

Phasing Preventor shall be provided as an inbuilt feature of the thermal overload relay.

b) Relays shall be manual reset type with one changeover contact. Resetting of relays shall be possible with compartment door closed, with direct operated reset knob. Colour of resetting button shall be BLACK.

c) Relays may be direct acting or C.T. operated, depending on current rating, C.T.s shall be included in the scope of supply.

d) For all motors having long starting time, the relays shall be provided with saturable current transformer to avoid spurious tripping during starting of the motor. The current transformer will have linear characteristic upto approx. twice the setting current.

6.08.00 DC STARTER

a) DC starters shall be complete with switch fuse units, contactors, resistors, relays,meters, push buttons, lamps, etc.

b) Starters hsall be furnished in totally enclosed floor mounting, sheet steel cubicles complete with a hinged front access door. Minimum thickness of sheet steel shall be 2 mm.

c) The cubicle enclosure shall provide dust and humidity protection, the degree of protection being not less than IP 54.

d) The resistor enclosure shall be provided with ventilating louvers and wire mesh guard and shall have a degree of protection IP 23.

e) Cubicle space heater shall be provided to maintain internal temperature above dew point. Heater shall be furnished with SFU and thermostat control.

6.09.00 Control & Indication

6.09.01 The circuit breaker shall be wired up for local and remote operation. Each breaker cubicle shall be equipped with following:-

a. One (1) "STEST-LOCAL-REMOTE" selector switch stay put type with black pistol grip handle and key interlock for motor feeder breaker and one (1) "LOCAL REMOTE" selector switch stayput type with black pistol gird handle and key interlock for incoming and outgoing tie feeders.

b. Two (2) heavy duty, oil tight, push buttons for TRIP & CLOSE.

c. One (1) heavy duty, oil-tight, CLOSE-NEUTRAL-TRIP Switch

d. Indicating light on front of compartment:

GREEN	-	Breaker open
RED	-	Breaker closed
AMBER	-	Trip/Trip circuit trouble
BLUE	-	Breaker Spring charged
AMBER	-	Breaker, Auto trip

WHITE	-	Trip coil healthy
WHITE	-	Breaker in test position
YELLOW	-	Breaker in service position

e. Lamps shall be LED type with coloured dome. Lamps and lens shall be replaceable from the front. LED lamp shall be made in accordance with InP technology (Aluminuim Indium Gallium Phosphide technology). The body shall be made of poly carbonate unbreakable lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd. All push button lamp shall be as per LED indicating lamp.

f. One voltage operated earth fault relay (64) shall be provided across the neutral grounding resistor through voltage transformer for each PCC/MCC incomer fed from transformer directly. Relay shall have at least 2 nos. contacts; one shall be connected to shown earth fault lamp indication (window) on incomer panel and other for indication on operating console.

g. Two(2) incomers and bus coupler shall be so interlocked that no two incomers shall operate in parallel.

6.09.02 The control module shall be connected for local remote operation. Each control module shall be equipped with the following:

6.09.03 Required nos. of push buttons as per scheme drawing.

6.09.04 Each push button shall have two (2) normally open and two (2) normally closed contact rated 10A at 240V.

6.09.05 Push button shall be heavy duty, oil tight, push to actuate type with integral escutcheon plate marked with its function.

6.09.06 One (1) MCC-REMOTE-LOCAL selector switch having make before break feature shall be provided for unidirectional motor feeders.

6.09.07 Lamps shall be LED type with coloured lens. Lens and lamps shall be replaceable from the front.

6.09.08 For control supply, the contractor shall provide 415/240 on load control transformers with 100% standby arrangement.

6.09.09 DCDBs shall be provided with indication to monitor healthiness of the incoming DC supplies.

6.10.00 Current Transformer

6.10.01 Current Transformers shall be epoxy cast-resin type rated 10 VA. All secondary connections shall be brought out to terminal blocks where wye or delta connection will be made.

6.10.02 Motor feeders rated 30 kW to below 75 kW, shall be provided with CTs for metering. Motor feeders rated 75 kW and above, separate CTs shall be provided for metering and protections. SFU rated 100 A and above for outgoing feeder shall be provided with CT and ammeter.

6.10.03 Accuracy class of the current transformers shall be:-

a. Class PS for differential
b. Class 5P20 for other relaying
c. Class 1.0, ISF < 5 for metering other than MEAA
d. CTs for MEAA metering shall be as per Chapter-1

6.10.04 Separate wire shall be used for metering and protection as far as possible. Secondary wire terminals shall be made available accordingly.

6.10.05 Terminals with CT secondary shorting links for metering leads and TEST terminals block for C.T. secondary relay and KWH leads shall be provided.

6.10.06 VA Burden of CT's shall be adequate (15 VA minimum) for connection to remote metering system. Also additional terminal blocks etc. as may be required shall be provided in panels.

6.10.07 Feeder requiring remote metering and/or current monitoring shall be provided with current transducers with calibration for full scale reading. The output shall be 4-20 mA DC which shall correspond to the normal range.

6.10.08 CT secondary shall be rated 1 A for metering and protection.

6.11.00 Voltage Transformer

6.11.01 Three nos. single phase voltage transformer shall be provided in each incoming power supply circuit with voltmeter and selector switch. Additional three nos. voltage transformers shall be provided for each bus section voltmeter and its selector switch.

6.11.02 Voltage transformers shall be epoxy cast resin and shall have an accuracy class of 1.0. Voltage Transformers mounted on breaker carriage is not acceptable. Voltage rating for the Transformer shall be 1.2 continuous and 1.5 for 30 second.

6.11.03 Voltage transformer shall capable to withstand 200% of rated voltage continuously without change in its characteristics.

6.11.04 High voltage windings of voltage transformer shall be protected by current limiting fuses.

6.11.05 Low voltage fuses, sized to prevent overload shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the MCC is energised.

6.11.06 VTs for MEAA metering shall be as per Chapter-1

6.12.00 Control Transformers

6.12.01 For control supply control transformers of adequate rating (min. 5 KVA rating) with 100% standby shall be provided.

6.12.02 For motor space heating supply, the transformers of adequate rating (min. 2 KVA rating) with 100% standby shall be provided.

6.12.03 All the control transformers shall be placed in spacious compartments to have proper air circulation and keep lower temperature of transformer and its module.

6.12.04 All the control transformers shall be provided with selector switch, fuses, indicating lamps. Each control transformer shall feed to its control buses of respective bus section during normal operation. In case of failure of one of the control transformer, provision shall be made to tap the control supplies from other bus section control transformer by auto changeover using aux. relays contacts/switch. Bidder has to develop scheme accordingly. This logic shall be made applicable for space heating and winding heating control transformer also.

6.12.04 All control transformer shall conform to IS: 12021.

6.12.05 For unit Emergency Switchgear 2 Nos of control transformer shall be provided with auto change over scheme.

6.12.06 Control transformer shall have + 2.5% to + 5% tappings in steps of 2.5

6.13.00 RELAYS

a) The protective relays shall be static or numerical type. However, numerical type shall be preferred. All relays, auxiliary relays and devices shall be of reputed make and types proven for the application and shall be subject to purchaser approval. The relays and timers shall have appropriate setting ranges, accuracy, resetting ratio, transient over-reach and other characteristics to provide required sensitivity to the satisfaction of the owner.

b) Relays shall be suitable for efficient and reliable operation of the protection scheme. Necessary auxiliary relays, timers, trip relays, etc. required for complete scheme, interlocking, alarm, logging, etc. shall be provided. Control relay shall not trip the circuit breaker when relay is de-energized.

c) Relays shall be flush mounted on the front with connections at the rear shall be draw-out or plug-in type/ modular case with proper testing facilities. Provision shall be made for easy isolation of trip circuits for testing and maintenance.

d) Auxiliary relays shall be provided in the trip circuits of protections located outside the board, such as buchholz relay, temperature indicators, fire protection, etc.

e) Control circuits shall operate at suitable voltage of 110V AC or 220V DC. Necessary control supply transformers having primary and secondary fuses shall be provided for each MCC, 2x100% per section. However the breakers shall operate on 220V DC. The auxiliary bus bars for control supply shall be segregated from main bus bars. The control supplies shall be monitored.

f) Contractor shall fully co-ordinate overload and short circuit tripping of breaker with upstream and down stream breakers/ fuses/ MCCBs motor starters. Various equipments shall meet requirement of Type-II class of coordination as per IEC.

g) In case of remote controlled breaker panels, following shall be provided.

Each feeder shall have local/ remote selector switch. Closing from local shall be possible only in test position whereas closing from remote shall be possible in either service or test position. Tripping from local shall be possible only when local/ remote selector switch is in local position. Tripping from remote shall be possible when breaker is in service position or selector switch is in remote position.

h) Suitable self powered transducers as per IS : 12784 Part - I (if required) for feeding signals to panel mounted electrical meters (ammeters, voltmeters, VAR meters and watt meters etc.) and DCCMIS shall be provided. Alternatively, analog signals from numerical relays shall be directly used.

i) The motor feeders for essential auxiliaries shall have contactors with delayed drop-out feature adjustable up to three seconds.

6.13.01 General-B

(a) All protective relays shall be of numerical microprocessor based multifunctional type having communication facility for connection to DCS through PC via PLC console.
(b) All relays shall conform to the requirements of IS 3231 / IEC: 60255 standards.
(c) Vendor shall ensure availability of spare parts and maintenance support for the equipment for at least 15 years from the date of supply.
(d) Any foreign relay manufacturer through his Indian partner or subsidiary company in India shall provide application, testing, commissioning and other necessary support for minimum 15 years. They shall also maintain adequate inventory of each type of relay or spares to meet the requirement arising during project execution and plant operation

6.13.02 Technical Requirement

(a) Auxiliary Power Supply

Unless otherwise specified, relay shall be suitable to accept both AC / DC supplies with range 110V to 240 V with tolerance of $\pm$20%. The auxiliary power supply shall preferably be site selectable requiring no additional hardware.

(b) Basic Requirement and Constructional Requirement

(i) Relays shall be suitable for flush mounting on the front with connections from the rear. The enclosure shall be dust tight having degree of protection minimum as IP:5X.
(ii) Relay shall have draw out feature with plug in type PCB for easy replacement. In case of fixed type relay, the terminals shall be easily accessible for testing and commissioning.
(iii) Relay shall have self-diagnostic feature with indication of relay failure on rely front. However, while diagnostic circuit runs, it must not interfere in the main protective relay circuit and allow working of main protective circuit continuously. Relay faults (self-diagnostic) shall be communicated and annunciated to HMI.
(iv) Design of the relay shall be such that it must operate selectively and with proper discrimination. It must be immune to any kind of electromagnetic interference. Vendor to submit all related type test reports for the offered model along with the offer.

(c) Display & Indication

(i) All numerical relays shall have keypad / keys to allow relay settings from relay front. In addition, relay shall have front port for downloading / uploading of relay settings from the PC / Laptop. All hand-reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable.
(ii) All relays shall have LED / LCD display for settings, status, faults and events. LCD display shall be backlit and temperature compensated up to 65^0C for contrast and legibility.
(iii) As a minimum, the relay shall have LED indicating lamps for fault trip, relay healthy / unhealthy and control supply on.
(iv) The relay shall have at least 6 programmable LEDs on relay front.

(d) Software Security
Relay shall be provided with password protection against unauthorized write access. However, viewing of metering data, setting and status and event data as read only parameters should be without password protection.

(e) Disturbance, Event Recording & data Storage
Status, disturbance data and events shall be stored in non-volatile memory or memory backed up by battery. It should be possible to store minimum 50 events with date and time stamp, last 5 fault records and last disturbance record. When auxiliary power fails, it should be possible to see the latest state of display when power is restored. Also, in case of power supply failure lock out status of the relay should be stored and kept in memory to allow the working of interlock logic properly on restoration of the supply.

(f) Trip Circuit Supervision & Lock out function

(i) Relay shall have built in lockout function. Lock out feature shall be self reset or hand reset and shall be software selectable.
(ii) For trip circuit supervision separate relay shall be provided.

(g) Input / Output Interface, Filters an galvanic Isolation.

(h) Relay shall have at least 4 No contacts each shall separately be programmable for either hand reset or self-reset. The contact rating shall be minimum 5A at 250V AC / DC.

(i) Relay shall be made immune to capacitance effect due to long length cables.
(ii) All IOs shall have galvanic isolation. Analog inputs shall be protected against switching surges,, harmonics etc.

(i) Serial Communication

(i) Relay shall have RS 485 or FO (Fiber Optic) port for serial c communication.
(ii) All relays should be able to communicate with DCS system. Data shall be available at the DCS on request.
(iii) Protocol adapted for communication to DCS should facilitate easy interface with world wide used open protocol like Modbus or IEC 13 protocols.

(iv) It shall be also possible for Relay Parameterization as well Downloading of Disturbance Records form PC provided in Unit & Engineering Workstations located in Switchgear Room of each unit i.e. Unit & Engineering workstations shall be provided each in four (4) Switchgear Rooms. Necessary software to be provided for this purpose. Communication protocol shall be selected from relay to PC to provide all information.

6.14.00 Protection

i) 415V AC and 220V DC Incomers

a) Time graded short circuit protection on incoming supply feeder circuit breakers to main switchgears (PCCs and MCCs)

b) Instantaneous over-current protection on all outgoing feeders

c) Under- voltage protection for 415V bus

d) Sensitive earth fault detectors shall be provided in DC system to annunciate earth faults

ii) 415 Volts motor feeders

1) Contactor controlled motor feeders (Motors below 90 kW)

i) Instantaneous short circuit protection on all phases through HRC cartridge type fuses rated for 80 kA rms (prospective breaking capacity at 415V).
ii) Thermal overload protection
iii) Single phasing protection for motors protected by fuses

2) Breaker controlled motors feeders (motors rated above 200 kW)
i) Instantaneous short circuit protection on all phases
ii) Overload protection on two phases
iii) Over load alarm on third phase
iv) Earth fault protection
v) Under voltage protection
vi) Unbalance (negative sequence)
vii) Hand reset lockout relay with a blue lamp for monitoring

6.15.00 Secondary wiring

6.15.01 The MCC/DB shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and interlocking schemes.

6.15.02 Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired upto terminal blocks.

6.15.03 Wiring shall be done with flexible, 650V grade, PVC insulated switchboard wires with stranded copper conductors of 2.5 sq.mm for current circuits and 1.5 sq.mm for voltage circuits and control circuits. Colour code shall be maintained por voltage and current circuits.

6.15.04 Each wire shall be identified, at both ends with permanent tubular type printed markers bearing wire numbers as per Contractor's wiring diagrams. Each wire shall be ferruled by plastic tube with indelible ink print at both ends having terminal block no., terminal nos., destination no, as per approved drawing.

6.15.05 Wire terminations shall be made with crimping type connectors with insulating sleeves. Wire shall not be spliced between terminals. Fork type lugs shall be provided for all control terminals. The lugs shall be suitable for 2.5 sq.mm stranded copper conductor. However, C.T. wiring shall be done by using circular type lugs.

6.15.06 For power wiring inside module copper cables are to be used.

6.15.07 Terminal blocks with loose wires shall be provided in each shipping section for inter panel wiring.

6.15.08 All control terminals shall be of 10 sq.mm size and shall be sliding type for draw out module and clip on type for fixed type module.

6.16.00 Terminal Blocks

6.16.01 Terminal blocks shall be 660V grade box-clamp type with marking strips, similar to ELMEX 10 sq.mm or equal. Terminals for C.T.secondary leads shall have provision for shorting or any other equivalent new technology terminal blocks after approval of owner.

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

6.16.03 Terminal block shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

6.16.04 Coloured terminal blocks for connection of power cables (R,Y,B phases) shall be provided.

6.16.05 Twisted pair 0.5sq.mm copper cable will be used for DCS/BMS/ATRS surface

6.17.00 Cable Termination

6.17.01 SWGR/PCC/MCC/DB shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection.

6.17.02 All provisions and accessories shall be furnished for termination and connection of cables, including removable gland plates cable supports, crimp type tinned copper/aluminium lugs, double compression type brass glands with tapered washer (power cables only) and terminal blocks. Terminating of power cables shall be shrouded to avoid accidental touch. Suitable supporting clamps shall be provided for cables to eliminate stresses on terminals.

6.17.03 Twisted pair 0.5 sq mm copper cable shall be used for DCS/BMS/ATRS interface.

6.17.04 Gland plates shall be minimum 4 mm thick for single core cable and 3mm for muti core cable. The gland plate and supporting arrangement for I/C Power cables shall be such as to prevent flow of eddy current.

6.17.05 Gland plates shall be easily removable type. The gland plate shall be mounted at 40/50 mm above the bottom of base frame of switch board.

6.17.06 Cabling area above gland plate shall be free of any earth bus, neutral bus etc. so that the total gland plate area is usable for cabling and also do not obstruct removal of gland plate.

6.18.00 Busduct Connection

Busduct connections, wherever provided, shall be furnished alongwith transition panel if required. Busduct connections shall be generally from top.

All connecting bus work shall have the same continuous rating as associated SWGR/PCC/MCC bus and shall be fully braced for the specified short circuit current.

All provisions such as matching flange and other accessories shall be furnished for connection to busduct.

All the incomers from transformer shall be connected by Bus duct.

6.19.00 Ground Bus

i. A ground bus made of copper/GI rated to maximum fault current shall be extended to full length of the MCC/DB.
ii. The ground bus shall be provided with two-bolt drilling with G.S. bolts and nuts at each end to receive 50x6 mm G.S.flat.
iii. Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and V.T. unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.
iv. The frames of all other drawout modules shall be grounded through heavy multiple contacts at all times except when the power disconnects are separated by a safe distance.
v. Wherever the schematic diagrams indicate a definite ground at the SWGR/PCC/ MCC a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto.
vi. C.T. and V.T. secondary neutral shall be earthed through removable links so that earth of one circuit maybe removed without disturbing others.
vii. Door earthing shall be done by using 2.5 sq.mm stranded flexible copper conductor PVC insulated (Green colour).

6.20.00 Name Plates

Name Plates of approved design shall be furnished at each cubicle/control compartment, at the top of each MCC/DB and at each instrument and device mounted on or inside the cubicle.

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

The name plate shall be held by self-tapping screws. Name plate size shall be minimum 40 X 150 mm of 0.5mm thick for instrument/devices & 75 x 450 mm of 1mm thick for panels. The size of lettering shall be minimum 5 mm for

module/feeder designation; however, component designation letter size shall be 6 mm.

Caution notice on suitable metal plate shall be affixed at the back of each vertical panel for single front construction.

Board labels and panel Nos. shall be provided both on front and rear at two locations each if board is more than 10 meters in length.

6.21.00 Space Heaters and Plug Sockets

Each vertical section shall be provided with thermostat controlled space heater and 5A, 3 pin plug socket.

In addition, motor feeders 30 KW and above shall be wired up for feeding the motor space heater through suitably rated starter auxiliary NC contact.

Cubicle heater, Motor heater, plug socket circuit shall have individual switch fuse units.

For valve / actuator provision of space heater supply shall be provided.

6.22.00 A.C./D.C. Power Supply

The following power supplies shall be arranged to each SWGR/PCC/ MCC:

a) For each SWGR/PCC/MCC 220V DC Double feeder power supply shall be arranged by contractor for breaker control.

b) For control module in SWGR/PCC/MCC, 240V power supply shall be arranged by the contractor.

c) 240V power supply for motor space heating/hand lamps shall be arranged by the contractor in MCC.

d) Each SWGR/PCC/MCC shall be provided with group control transformer with 100% standby and on load changeover facility.

Isolating switch fuse units / MCBs shall be provided at each SWGR/PCC/MCC/DB for the AC/DC supplies.

Bus wires of adequate capacity shall be provided to distribute the AC/DC supplies to different cubicles. Isolating switch fuse units / MCBs shall be provided at each cubicle for AC/DC supplies.

AC load shall be so distributed as to present a balanced loading on three phase supply system.

6.23.00 Control

It shall be possible to control the starter/ breaker from local, near the motor or switchgear and remote - from Central Control Room(CCR) through potential free contacts from DCS or Trip-N-Close control switches from remote electrical control panel. it should be possible to inhibit starting of a motor from any position by a lockable stop push button located near the motor. all motor starters shall enable direct on line(DOL) starting of motors.

Every circuit breaker controlled module will have one close auxiliary relay (car) and one open auxiliary relay(oar) to operate in conjunction with open/close commands from dcs or sms.

Facilities shall be provided to connect field permissive contacts for interlocking. Necessary time delays associated with the schemes should be incorporated. At least twenty (20) percent spare terminals shall be provided for external interlocking.

6.24.00 Tropical Protection

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

Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

6.25.00 Painting for SWGR/PCC/MCC/DB

All surfaces shall be subject to tank pretreatment process to produce a smooth, clean surface free of scale, grease and rust.

The SWGR/PCC/ MCC/DB and all other components shall be powdered coated RAL 7032(Siemens grey).

Sufficient quantity of touch-up paint shall be furnished for application at site.

6.26.00 Accessories

The following accessories shall be furnished alongwith the SWGR/PCC/ MCC.

a. Breaker lifting and handling truck.
b. Device for slow opening and closing of breaker – one per breaker.
c. Breaker racking in /out handle – one per breaker.

6.27.00 Tests

All the equipment shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

6.27.01 Routine Tests

A) The tests for SWGR/PCC/MCC/DB shall include but not necessarily limited to the following:

a. Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme and proper functioning of the equipment.

b. All wiring and current carrying part shall be given appropriate high voltage test.

c. Primary current and voltage shall be applied to all instrument transformers.

d. Routine test shall be carried out on all equipment such as circuit breakers, contactors, switch fuse, instrument transformers, relays, meters etc.

6.27.02 **Type Tests:**

1. General:

a) All equipments to be supplied shall be of type tested design. The Contractor shall submit for owner's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the tests 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.

b) In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost either at third party lab or in presence of client/owner's representative and submit the reports for approval.

c) 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.

2. **LT Switchgear**

The following type test certificates on each type & rating of LT switchgear and MCC panel shall be submitted.

a) Short time withstand test.

b) Temperature rise test.

c) Class II- Protection co-ordination test for any three ratings of MCC module as selected by employer.

d) Test sequence -1 & combined test sequence on each rating of circuit breaker mounted inside the panel.

e) Degree of protection tests.

f) Type test certificates for Numerical relays.

6.28.00 TEST WITNESS

Test shall be performed in presence of Owner's/ representative if so desired by the owner. The contractor shall give at least thirty(30) days advance notice of the date when tests are to be carried out.

DATASHEET FOR 415V PCC/PMCC/MCC/DBs

Sr. No.	Item	Units	

1.0	**GENERAL**			
(a)	Type		Metal-clad, drawout (PCC/PMCC/MCC) Metal-clad, fixed (DB)	
(b)	Service		Indoor	
(c)	Enclosure		For ampere rating upto 1600 A- degree of protection of PCC/PMCC/MCC shall be IP-52 and above 1600 A the degree of protection will be IP-42.	
1.1	SYSTEM		AC	DC
(a)	Voltage	V	415V ±10%	220V ±10%
(b)	Phase		3-phase and neutral	-
(c)	Combined voltage and frequency variation		±10% (absolute sum)	-
(d)	System grounding		Solidly grounded	ungrounded
1.2	RATED CURRENT AT 50 degC AMBIENT			
(a)	Busbar		*By Bidder	
(b)	Circuit breaker		*By Bidder	
(c)	Switches		16A to 400 A	
1.3	SHORT CIRCUIT RATING		AC	DC
(a)	Interrupting	kA	50 kA	25* kA
(b)	Short Time for 1 second	kA	50 kA	25* kA
1.4	HV FOR 1 MINUTE (MIN.)	kV	2.5 kV	1.5* kV
(a)	Indicative only; the actual value will be decided by the Bidder, after substantiating the same by calculation.			
1.5	A.C./D.C POWER SUPPLY			
(a)	Control Voltage for Circuit breaker	V	220V DC±10%	
(b)	Control voltage for MCC modules	V	110V AC ±10% , 1 Ph, 50 Hz ±5%	
(c)	Service voltage	V	110V AC ±10% , 1 Ph, 50 Hz ±5%	
2.0	**CIRCUIT BREAKER**			
2.1	DUTY CYCLE		0-3'-CO-3'-CO	
2.2	BREAKING CURRENT			
(a)	A.C. symmetrical	kA	50kA	
2.3	MAKING CURRENT	kA	105kA Peak	
2.4	AUXILIARY VOLTAGE			
(a)	Closing	V	220V D.C. (85-110%)	
(b)	Tripping	V	220V D.C. (70-110%)	
(c)	Spring Charging	V	220V D.C. (85-110%)	
3.0	**CONTACTOR DUTY**		AC	DC
			Class 3- Category AC-3 for unidirectional/inching duty drives	Class 1- Category DC-2
4.0	**BUSBAR INSULATOR**		Epoxy/Eparchy	

MODULE SELECTION

I) OUTGOING FEEDER FOR A.C.

TYPE	FUSE RATING	MODULE SIZES
AF	32	200MM
BF	63A	200 MM
CF	100 A	300 MM
DF	200 A	400 MM
EF	400A	600 MM

II) **MOTOR FEEDER**

TYPE	**MOTOR RATING**	**MCCBRATING**	**CONTACTOR RATING**	**MODULE SIZE**
AU / AR	0-5.5 KW	32 A	16 A	400 MM
BU /BR	5.6-11 MW	32 A	32 A	400 MM
CU	11.1-29.9KW	63 A	63 A	600 MM
DU	30 -46 KW 37 – 45 kW	100 A 125 A	100 A 100 A	900 MM
EU	50 - 75 KW	200 A	160 A	900 MM
FU	75.1 -89.9 KW	200 A	185 A	900 MM

NOTE:

1. Fuse and thermal overload relay are to be co-ordinated with motor rating by the contractor

2. Module sizes are based on the minimum module width of 400 mm. Cable alley of 250 mm and panel depth 450 mm (single front)

3. For auxiliary building and for street lighting, bidder to provide necessary feeders in the MCC for MLDBs.

4. All rating shown are indicative only. Exact requirement will be decided by successful bidder based on proven design. Type II coordination shall be achieved during finalization of component rating.

CHAPTER 15B : 415V SWITCHGEARS, NON SEGREGATED PHASE BUSDUCT AND DC BOARDS

1.01.00 SCOPE

1.01.01 Each set of 415V non-segregated phase bus duct will originate from 415V Switchgear Incomer panel terminals and will terminate at transformer terminals. The bus duct run shall be complete with all bends, flexible, bellows and terminal adaptor boxes, interconnection hardware etc. as required.

1.01.02 All supporting steel structures, fasteners and necessary hardware for complete bus-duct installation.

1.01.03 One set of special tools and tackles.

1.01.04 Mandatory Spare parts.

1.01.05 Recommended spare parts for three (3) years operation

1.01.06 All relevant drawings, data and instruction manuals.

2.00.00 DESIGN CRITERIA

2.01.00 The 415V non-segregated phase bus duct will serve as interconnection between the 415V Indoor Switchgear and outdoor/Indoor transformer terminals. It is also used for trunking connection between two separate switchgear panels, wherever applicable.

2.02.00 The 415V non-segregated phase bus duct shall be installed indoor / outdoor in a hot, humid and tropical atmosphere.

2.03.00 The portion of bus duct at the transformer end will be subjected to vibration normally prevalent for this type of installation in a power generating station/industrial plants. Suitable means shall be provided to isolate the transformer vibration from rest of the bus structure/ bus duct.

2.04.00 The current carrying capacity of the bus duct shall take into account the service conditions, including skin effect, ambient temperature, bus insulation and exposure to sunlight.

2.05.00 For continuous operation at specified ratings, temperature rise of the bus duct and auxiliary equipment shall be limited to the permissible values indicated in the annexure of this specification.

2.06.00 Bus duct shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents listed in the annexure without any damage or deterioration of material.

2.07.00 Bus duct and supporting structures shall be designed & constructed so as to withstand without damage the horizontal/ vertical ground accelerations due to earthquake.

2.08.00 The bus ducts shall be self cooled and shall not be equipped with blower or any other type of forced ventilation.

3.00.00 SPECIFIC REQUIREMENTS

3.01.00 General

3.01.01 The 415V bus duct shall be non-segregated phase enclosure, natural air cooled type.

3.01.02 All parts and accessories shall have appropriate match mark and part numbers for easy identification and installation at site.

3.02.00 Enclosures

Phases shall be enclosed in a weather-proof, dust-tight enclosure without any barrier between phases. It shall preferably be rectangular in shape adequately rigid with stiffeners as required. Enclosure for indoor run shall be IP52 protected. Outdoor enclosure shall have IP 55 degree of protection.

The enclosure shall be made of sheet steel for rated continuous current up to and including 2000A at site condition. Above 2000A bus duct enclosure shall be made of Aluminum alloy. The thickness of enclosure material shall not be less than 3mm.

3.02.02 Circumferential neoprene rubber gaskets (joint less type) shall be provided for dust tight joints with adjacent enclosure section.

3.02.03 The bus enclosure shall have extended bellows or equivalent means to allow for temperature changes and vibrations. Flexible joints shall be provided in enclosures at all points where the bus duct terminates at equipment to withstand vibration, expansion/contraction and at suitable intervals in any straight run of the bus duct where expansion and contraction would otherwise result in stresses in the supporting structures.

3.02.04 Horizontal runs of bus duct shall have suitably sloped enclosure top to prevent retention of water for both indoor and outdoor portions of the bus duct.. For outdoor runs, the shipping sections shall be provided with flange protection hood to facilitate additional protection against rain water ingress through joints.

3.02.05 Suitable inspection openings shall be provided for access to support insulators, bus joints, transformer terminals, switch gear terminals etc. All inspection openings shall have reliable sealing arrangement with neoprene gaskets.

3.02.06 Filtered drains for drainage of condensate shall be provided at the lowest points and at such locations where accumulation of condensate can be expected.

3.02.07 Shipping length of the bus duct shall be not more than three (3) meters in length.

3.03.00 Bus Conductor

3.03.01 The bus conductor shall be of high conductivity electrolytic grade copper or aluminum alloy as indicated in the annexure, supported on fine glazed porcelain / cast resin / FRP insulators fixed to enclosure.

3.03.02 The bus conductor shall be designed for bolted connections throughout the run.

3.03.03 Flexible connections shall be provided between bus sections to allow for expansion and contraction of the conductor. Flexible connection shall also be provided at all equipment terminations.

3.03.04 All contact surfaces shall be silver plated to ensure an efficient and trouble-free connection. All connection hardware shall be non- magnetic and shall have high corrosion resistance.

3.03.05 Bus bars shall be color coded at regular intervals for easy identification. Markings on the bar shall be Red for R-phase, Yellow for Y-phase and Blue for B-phase.

3.03.06 All bolted joints shall be provided with high grade stainless steel nuts bolts, plain and belle-ville washers.

3.04.00 Insulators

3.04.01 Bus support insulators shall be bus post type, interchangeable, high creep, high strength, flame retardant, non hygroscopic, wet processed, fine glazed porcelain. Alternatively good quality cast resin / FRP insulators may be offered.

3.04.02 Insulator shall be mounted in such a way so as to permit easy removal or replacement without disassembly of the bus. The insulator mounting plate shall be designed for cantilever loading to withstand the short circuit. Support span shall be taken into consideration.

3.04.03 The conductor shall be fastened on the insulator through fixed and slip joints so as to allow conductor expansion or contraction without straining the insulator.

3.05.00 Connections & Terminations

3.05.01 All matching flanges, gaskets, fittings, hardware and supports required for termination of the bus duct at the switchgears, transformers and other equipment shall be furnished.

3.05.02 In this connection the contractor is required to co-ordinate through the Engineer with the suppliers of the 415V Switchgears, transformers with regard to connection details, mechanical and thermal stresses.

3.05.03 Flexible connections both for conductor and enclosure shall be furnished :

a. At all equipment termination to provide for misalignment upto 25 mm. (1") in all directions.

b. Between bus duct supported from building steel to prevent transmission of vibration.

3.05.04 The equipment terminal connections shall be readily accessible and shall provide sufficient air gap for safe isolation of equipment during testing.

3.05.05 If the material of bus conductor and that of the equipment terminal connectors are different then suitable bi-metallic connectors shall be furnished.

3.06.00 Grounding

3.06.01 A separately run Galvanized steel flat suitably clamped along the enclosure shall be used as the ground bus. All parts of the bus enclosure, supporting structures and equipment frames shall be bonded to above ground bus.

3.06.02 Ground pad shall be bolted type to accommodate 75x10 mm. Galvanized steel flats at two points at each end of termination, complete with suitable tapped holes, bolts and washers.

3.07.00 Supporting Structures

3.07.01 All supporting structures required for hanging and/or supporting the complete bus duct shall be furnished. These include all members, indoor/outdoor posts, bolts, shims, base plates, beams, hangers, brackets, bracings and hardware.

3.07.02 All buses shall be adequately supported and braced to successfully withstand normal operation, vibration, thermal expansion, short circuit forces and all specified design loads.

3.07.03 Support shall be designed to provide tolerance of ±12 mm. (1/2") in the horizontal and vertical directions.

3.07.04 All steel members shall be hot-dip galvanized after fabrication. All hardware shall be of high strength steel with weather resistant finish.

3.07.05 Concrete foundation, building steel, concrete, inserts/plates will be provided by Owner/Purchaser. The Contractor shall co-ordinate with the Owner/Purchaser for this purpose giving well in advance the details of his requirements so as to enable the Owner/Purchaser to arrange for the same in time.

3.08.00 Name Plate

3.08.01 Suitable name plate shall be furnished with each piece of equipment.

3.08.02 Materials for name plate shall be anodized aluminium, 3 mm thick, using white letters on black background.

3.09.00 Finish

3.09.01 Except for supporting steel structurals and hardwire which shall be galvanized, all equipment shall be finished with a undercoat of high quality primer followed by two coats of synthetic enamel paints unless otherwise stated.

3.09.02 The interior surface of the bus duct enclosure shall be treated with matt black paint to enable efficient heat dissipation. The shade of exterior surface finish for indoor and outdoor portion shall be as indicated in the Annexure.

3.09.03 Pretreatment consisting of de greasing, de rusting etc. shall be done on all fabricated parts before painting or galvanizing.

3.09.04 Paints shall be carefully selected to withstand heat and weather conditions. The paint shall not scale-off or crinkle or get removed by abrasion due to normal handling.

3.09.05 Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished.

4.00.00 TESTS

4.01.00 Routine Test

Bus Duct shall be subjected to the following minimum tests :

a. Visual inspection and verification of dimensions.
b. Dry power frequency voltage withstand for 1-minute.

4.02.00 Type Test

Certified copies of type test certificates (not less than five years old) for similar equipment supplied by the bidder shall be submitted otherwise type test shall be carried out by the bidder within the contracted price and delivery schedule. Type test certificate for the following test shall be furnished:

a. Impulse voltage withstand on a typical section of bus duct including one bend.

b. Heat run test on representative sections of 3 phase bus duct, including one bend and flexible joints.

c. Short circuit test on representative sections of 3 phase bus duct, including one bend. The sections having longest span between support insulators shall be chosen.

d. Degree of protection test (air and water) on a representative section of bus duct

4.03.00 All cubicles shall be completely wired up at the factory and subject to wiring check and power frequency withstand tests on control/secondary wiring.

4.04.00 Test Witness

Tests shall be performed in presence of Owner/Purchaser's representative if so desired. The Contractor shall give at least seven (7) days' advance notice of the date when the tests are to be carried out.

4.05.00 Test Certificates

4.05.01 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner/Purchaser.

4.05.02 The equipment shall be dispatched from works only after receipt of Owner/Purchaser's written approval of the test reports.

4.05.03 Type test certificate on any equipment, if so desired by the Owner/Purchaser, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

5.00.00 SPECIAL TOOLS & TACKLES

5.01.00 A set of special tools & tackles which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

5.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

6.00.00 SPARES

6.01.00 The Bidder shall submit a list of recommended spare parts for three (3) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during placement of order.

6.02.00 The Bidder shall quote and supply mandatory spare parts as per the list. The final quantity shall be decided during placement of order.

6.03.00 Each list shall be complete with specification, make, identification number, unit rate, quantity etc.

7.00.00 DRAWINGS, DATA & MANUALS

7.01.00 Drawings, Data and Manuals shall be submitted with the bid and in quantities and procedures as specified in General Condition of Contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.

7.02.00 To be Submitted with the Bid

7.02.01 General Arrangement Drawing - Plan and Sections.

7.02.02 Typical details of bus insulator assembly, conductor/enclosure connections rigid & flexible, etc.

7.02.03 Bill of Materials.

7.02.04 Technical leaflets/Write-ups on various pieces of equipment offered.

7.02.05 Type test reports on similar equipment. The type test certificates shall not be more than 5 years old.

7.03.00 To be Submitted for Approval and Distribution
(A) : 'Approval' Category
(R) : 'Reference' Category

7.03.01 Sizing of the busbars and calculation for temperature rise for bus conductor and enclosure (A).

7.03.02 Calculation for short circuit forces justifying the proposed arrangement (A).

7.03.03 Dimensional general arrangement drawings with cross-sections of Busduct layout

7.03.04 Detailed material list with parts number. (R)

7.03.05 Details of bus insulator assembly, rigid and flexible connections of both bus conductor and enclosure, grounding provision, equipment termination arrangement etc. (A)

7.03.06 Foundation Plan and loading.(A)

7.03.07 Supporting steel structure and calculations. (A)

7.03.08 Set up layout of the busduct for carrying out type test (A)

7.03.09 Instruction manual for Busduct.(R)

The manual shall clearly indicate method of installation, check ups and tests to be carried out before commissioning of the equipment. The manual shall also indicate detail procedure of field welding of conductor and enclosure

7.03.10 Any other relevant drawing or data necessary for satisfactory installation, operation and maintenance.

7.04.00 The drawings and document marked with (A) above are of 'Approval' category and are subject to review by Owner/Purchaser. Those marked (R) are for 'reference' category.

The Owner/Purchaser may also review the documents marked (R) if found necessary. The contractor shall note that the approval of drawings & documents by the Owner/Purchaser does not relieve him of his contractual obligation.

7.05.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, curves, etc require to fully describe the equipment are to be submitted with the bid.

7.06.00 All drawings shall be prepared by using Auto CAD approved version and all documents shall be generated using MS Office. The paper copy of the drawings & document shall be submitted for approval & reference. All final drawings and documents shall be submitted in CD in Auto CAD (approved version) and MS office format as applicable for Owner/Purchaser's future reference.

DATASHEET FOR NON-SEGREGATED PHASE BUSDUCT

SR. NO.	**ITEM**	**UNITS**	
1.0	**GENERAL**		
1.1	Type		Non- segregated
1.2	Service		Indoor/Outdoor
1.3	Material enclosure		Sheet steel/Aluminium
1.4	Conductor		Aluminium/Aluminium alloy/copper
1.5	Thickness of enclosure	mm	2 mm for sheet steel 3 mm for aluminium (min)
2.0	**SYSTEM**		
2.1	Voltage	V	415V AC $\pm$ 10%
2.2	Phase		3 phase and neutral
2.3	Frequency	Hz	50 Hz $\pm$5%
2.4	Combined voltage and frequency variation		$\pm$ 10% (absolute sum)
3.0	Service voltage (for space heater)		240 V AC $\pm$10%, 1-phase

4.0	Rated current at 50 degC ambient	V	To be decided by the Tenderers
5.0	Short time current rating		50
6.0	For one (1) second	kA	2.5 kV (rms)
7.0	One (1) minute power frequency withstand voltage (minimum) (over 50 degC ambient)	kV	
7.1	Bus conductor		
(a)	With silver Plated bolted joints	degC	55 degC
(b)	With Plain or Tin joints	degC	40 degC
7.2	Bus enclosure and structure	degC	30 degC
8.0	Busbar insulator		Epoxy/Eparchy
9.0	1 min. power freq. withstand voltage		2.5 kV
10.0	Max. short circuit withstand current		50kA for 1 second
11.0	Momentary dynamic current withstand		105kA (Peak)
12.0	Phase to Phase clearance	mm	25
13.0	Phase to Earth clearance	mm	20

CHAPTER 16 : LOCAL CONTROL BOARDS / PANELS, LOCAL, ISOLATING SWITCH UNIT AND LOCAL PUSH BUTTON STATIONS

1.00.00 SCOPE OF SUPPLY

1.01.00 The following equipment shall be furnished with all accessories:
(a) Complete set of Local control panels: as required.
(b) Local push button stations: as required.
(c) Local isolating switch fuse unit : As required.

1.02.00 Furnishing, mounting, and wiring of all equipments, devices and accessories.

1.03.00 Floor channel sill, vibration damping pad, and kick plates for all floor- mounted control boards/panels, complete with holding down bolts and nuts.

1.04.00 Mounting hardware for all control panels and local push button stations.

2.00.00 CODES AND STANDARDS

2.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian standards (IS) and IEC except where modified and/or supplemented by this specification.

2.02.00 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian electricity rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

3.01.00 Local push button stations (LPBS) will be used for controlling drives from local as required.

3.02.00 Local Isolating Switch (L.I.S) Units will be used for local isolation of power supply to various machines in the Workshop Building.

3.03.00 All equipment except L.I.S and LPB stations, will be located in a clean but hot, humid and tropical atmosphere. LPBS will be generally installed in a hot, humid, and tropical atmosphere, heavily polluted at places with fly ash and/or coal dust, and shall be suitable for outdoor service with degree of protection specified elsewhere in this specification.

3.04.00 All control panels and LPBS shall be liberally sized so as to provide spacious layout of equipment and devices with sufficient working space in between.

3.05.00 Adequate space/ terminals shall be kept in the boards/panels for installing additional equipment in future.

3.06.00 For continuous operation at specified ratings, temperature rise of the various components/equipment shall be limited to the permissible values stipulated in the relevant standards and/or this specification.

3.07.00 All equipment/components there of shall be capable of withstanding the mechanical forces and thermal stresses of the system short circuit current without any damage or deterioration of material.

3.08.00 Design, material selection, and workmanship shall be such as to present a neat appearance outside and inside with no welds, rivets, screws, or bolt heads apparent from the exterior surface of the boards/panels. All instrument cut-outs, mounting studs, and support brackets shall be accurately located.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 CONSTRUCTION

4.01.01 Local control panel

(a) Local Control Boards may consist of a number of vertical panels mounted side_by_side, in which case, they shall be bolted together to form a compact unit. Where two panels meet, the joints shall be smooth, close_fitting, and unobtrusive.

(b) The control panels shall be totally enclosed type, conforming to degree of protection IP-54 or better.

(c) Generally, the local control panels shall be free-standing, floor-mounted, dead-front assemblies.

(d) Floor- mounted control panels shall be assembled on channel/angle base plates with anti-vibration mountings and stainless steel kick plates.

(e) Control panels shall be of folded sheet steel construction, minimum 2 mm thick, and free from all surface defects.

The panels shall have sufficient structural reinforcement to ensure a plane surface, to limit vibration, and to provide rigidity during shipment and installation.

(f) All floor mounted panels shall have rear door.

(g) Doors shall have concealed type hinges and padlocking arrangement. Doors shall be grounded by flexible copper braid.

(h) All doors and removable covers shall be provided with neoprene rubber gaskets all round and latches sufficiently strong to hold them in alignment when closed.

(i) Working height of the panels shall be limited between 750 mm and 1800 mm above floor level.

(j) Local control panel shall be provided with two (2) nos. control transformer for control supply (1*100% standby)

4.02.00 Local Push Button Stations

(a) LPBS shall be furnished in sheet steel enclosure of dust and vermin proof, weatherproof, gasketted construction, suitable for outdoor use without canopy, and conforming to degree of protection. IP-55 or better.

(b) LPBS shall be suitable for column/structure/wall mounting and shall be complete with push-buttons, terminal blocks, anodized aluminium inscription plate, two(2) nos, earthing terminals, removable gland plate along with crimp type tinned copper lugs and compression type glands for cable/conduit entry from top and bottom. The earthing terminals shall be suitable for connection to one (1) No. 8 SWG G.I. wire.

(c) LPBS shall have one (1) stop lockable type push buttons.

(d) All push buttons shall have a minimum of two(2) Normally open and two normally closed electrically separate contacts, rated minimum 10A at operating voltage.

(e) Wiring shall be done by 1.5 sq mm. 1100V grade, PVC/XLPE insulated, stranded copper conductor, cable. Each wire shall be identified at both ends by ferrules with wire designation.

(f) Terminals shall have provision for connecting at least two(2) nos 2.5 sq. mm copper cable and shall be rated for carrying continuously minimum 10A at 240V A.C. and 2A at 220V DC.

4.03.00 Local Isolating Switch Units

a) L.I.S. Units shall be furnished in sheet steel enclosure of dust and vermin_proof, weather_proof, gasketted construction, suitable for outdoor use without canopy, and conforming to degree of protection IP_55 or better.

b) L.I.S. Units shall be suitable for column/structure/wall mounting and shall be complete with load_break switch, terminal blocks, anodized aluminum inscription plate, two (2) nos. earthing pads, removable gland plate along with crimp type tinned copper lugs and compression type glands for cable/conduit entry from top and bottom. The earthing pads shall be suitable for connection to 25 x 3 mm G.S. flat

c) Load_break switches shall be four_pole, air break, heavy-duty type. Duty class of load_break switches shall be AC_23 for motor feeders. Motor feeder switches shall be capable of safely breaking the locked rotor current of the associated motor circuit.

d) Terminals shall be clip_on type, 10 sq.mm. minimum.

4.04.00 EQUIPMENT MOUNTING

a) All equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of services to others. No equipment shall be mounted on panel door.

b) All equipment mounted inside the panels shall be so located that their terminals and adjustments are readily accessible for inspection or maintenance.

c) For Local Control Boards/Panels control components such as push buttons, indicating lamps, selector switches, indicating meters etc. shall be flush mounted on the front face of the board/panel while switch fuses, supervision relays (AC/DC) etc. shall be mounted inside.

4.05.00 MIMIC DIAGRAM

a) Mimic diagram of electrical connections shall be furnished on the front face of all electrical control panels.

b) Mimic buses shall be at least 3mm thick and 10 mm in width, made of suitably treated metal strips or approved equivalent and colour coded to denote different voltages.

c) The mimic representation, colour and size of diagram are subject to the approval of the purchaser.

4.06.00 LIGHTING, SPACE HEATING AND RECEPTACLES

a) Each panel shall be provided with interior fluorescent tube with door switch, space heater with thermostat and 5A, 3-pin receptacle with plug. Third pin of the socket shall be effectively grounded through the metallic structure.

b) Tube, heater and receptacle circuits shall be suitable for available A.C. supply and furnished with individual ON-OFF switch.

c) The lamp shall be located at the ceiling and guarded with protective cage. Space heater shall be located near the floor so as not to pose any hazard to service personnel.

4.07.00 DC POWER SUPPLY

a) Necessary D.C. supplies as required for control and service shall be arranged by the contractor. Duplicate feeders shall be arranged for D.C. supply.

b) Fuse and link shall be provided for individual circuits for protection and also for isolation from bus wire without disturbing other circuits.

c) The fuse requirements in each panel shall be grouped in easily accessible fuse blocks or distribution panel. The grouping shall be done in a neat and orderly fashion.

d) Alarm relays with reverse flag shall be provided to annunciate failure of main incoming A.C. and D.C. power supplies and annunciation D.C. supply in each panel. Lamp indications shall be provided individually for main D.C. supply-1 fail, main D.C. supply-2 fail, and panel annunciation D.C. supply fail. A common A.C. electric bell shall be provided to give an audible alarm in case of failure of D.C. supply-1/D.C. supply-

2/annunciation D.C. supply in any panel. A common push-button shall also be provided for cancellation of lamp indications and audible alarm.

e) Separate circuits shall be provided for:
- Indication and alarm
- Tripping, and
- Control

f) For lighting, auxiliary supply and space heating A.C. supply shall be used. D.C supply shall be used for providing control supply to annunciator.

g) Bus wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles of a VDB. Isolating switch fuse units shall be provided at each cubicle for A.C/D.C supplies.

4.08.00 WIRING

a) All wire termination shall be made with insulated sleeve solderless crimping type tinned copper lugs. Wires shall not be tapped or spliced between terminals.

b) The panels shall be fully wired up at the factory to ensure proper functioning of control, protection and metering schemes.

c) All spare contacts of relays and switches shall be wired up to terminal blocks.

d) Wiring shall be done with flexible, heat resistant, 1100V grade, PVC insulated, switchboard wires with stranded copper conductor, 2.5 sq.mm for current, 1.5 sq mm for control circuits and voltage circuits.

e) Each wire shall be ferruled by plastic tube with indelliable ink print at both end having terminal block no. terminal numbers, destination number as per approved wiring drawing.

f) Colour codes shall be used for wiring as per latest revision of IS: 375.

4.09.00 TERMINAL BLOCK

a) Multiway terminal blocks complete with necessary binding screws and washers for wire connections and marking strip for circuit identification shall be furnished for terminating the panel wiring and outgoing cables.

b) Terminals shall be box-clamp type, 10 sq mm minimum. Terminals for C.T. secondary leads shall have provision of shorting and grounding.

c) Not more than two wires shall be connected to one terminal. If necessary, a number of terminals shall be jumpered together to provide wiring points.

d) Each terminal shall be identified with designation as per approved schematic. At least 20% of the total number of active terminals shall be furnished as spare in each panel.

e) The wiring and terminals shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

f) The terminal blocks shall be located to allow easy access and also to suit floor opening for cable entry.

g) The terminal blocks within the panels shall be mounted on vertical support brackets. The support brackets shall be tack welded to the interior sheet steel mounting plates of the cabinet. Support brackets shall not be welded directly to the walls of the enclosure. The terminal blocks shall be attached to the support brackets with round head machine screws.

h) Terminal blocks shall generally be mounted vertically with adequate spacing (not less than 100 mm) between adjacent rows.

i) The bottom of the terminal block shall be at least 200 mm above the incoming cable gland plate.

4.10.00 CABLE ENTRY

The control panels shall have provisions of cable entry from the bottom. Bottom plate shall be provided to make entry dust-tight.

4.11.00 GROUNDING

a) 50 x 6 mm G.S. ground bus shall be provided in each control panel extending along the entire length of the assembly.

b) The ground bus shall have two-bolt drilling with G.S. bolts and nuts at each end and shall be suitable for connection to 50 x 6 mm G.S. flat.

c) The ground bus shall be bolted to the panel structures and shall effectively ground the entire assembly. The cases of meters, relays and switching devices shall be grounded through the steel structure.

d) Whenever a circuit is grounded, a single wire from the circuit shall be run independently to the ground bus and connected to it.

4.12.00 PAINTING

Panels and Push-button stations shall be finished with two coats of Siemens RAL 7032. Panels and push-button stations shall be stoved after each spraying of finish paint. Painting process shall be of power coating.

Caution Notice plate shall be affixed at the back of each panel.

4.13.00 FUSES

Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the system short circuit current.

Fuses shall be furnished complete with fuse boxes and fittings of such design as to permit easy and safe replacement of fuse element. Visible indication shall be on blowing of the fuse.

4.14.00 CONTACTORS

a) Contactors shall be three pole, air break type, with non-bouncing silver/silver alloy contacts. Contactor duty shall be class 3 – category AC3 for unidirectional drives and AC4 for bi-directional and inching drives/class 1- category DC2.

b) Each contactor shall be provided with minimum two (2) NO and two (2) NC auxiliary contacts rated 10A at operating voltage. The exact requirement of contacts shall be decided by the Tenderers taking into account the scheme requirements and spares.

c) Contactor starters shall comply with the requirements of IS-8544 (Part 1) in respect of co-ordination of the characteristics of contactor, overload relay, and fuse. The type of co-ordination shall be Type-C as per IS-8544.

4.15.00 PUSH BUTTON

a) All push buttons shall be oil tight, heavy duty, push to actuate type, with coloured button and inscription plate marked with its function. The colour of "ON" and "OFF" push buttons shall be RED and GREEN respectively. RESET push buttons shall be coloured black.

b) Each push button shall have minimum 2 NO + 2NC contacts, rated 10A at 240V AC and 2A at 220V DC.

c) Push buttons shall be shrouded type except for emergency trip button, which shall be mushroom type for easy identification.

4.16.00 LAMPS

a) Lamps shall be LED type.

b) LED lamp shall be made in accordance with INP Technology (Aluminium Indium Gallium Phosphide Technology). The body shall be made of Poly Carbonate Unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd. All push button lamp shall be as per LED indicating lamp.

4.17.00 METERS

a) All indicating instruments shall be switchboard type, back connected, suitable for flush mounting, 96*96 mm with 240 deg scale, antiglare glass and accuracy class of $\pm$ 2% of the full scale. The dials shall be made of such material as to ensure freedom from warping, fading and discolouring during the lifetime of the instruments.

b) All indicating instruments shall be enclosed in dust-tight cases suitable for tropical use.

c) Meters shall have provision for zero- adjustment from front of the panel.

d) Meters shall be compensated for temperature errors and factory calibrated to read the primary quantities directly without using a multiplying factor.

e) D.C. ammeters, wherever required, shall be provided with external shunt if the current exceeds 5A. The rated voltage drop for the shunts shall be 75mV.

4.18.00 ANNUNCIATOR SYSTEM

a) Each control panel shall be provided with an annunciator window board. The annunciator boards shall be back connected and suitable for semi-flush mounting.

b) The annunciator system shall be solid-state type with optical isolation for input signals. The functional requirements shall be as per Annexure-C.

c) Each annunciator group shall be independent, complete with its own power supply, acknowledge-reset-test buttons and other necessary accessories.

d) Hooter for audible alarm shall be common for each control panel assembly.

e) Each annunciator group shall be provided with a common alarm relay for group alarm annunciation in remote control room. The common alarm relay will operate on actuation of any alarm point of the group.

f) The annunciator shall be non-integral type with hardware box mounted separately for easy access and maintenance.

g) Audible alarms with different tones shall be used for trip, non-trip and ring back functions.

h) The window size shall be such as to accommodate minimum three (3) lines of twelve(12) characters each. Each character shall be minimum 4.75 mm high.

i) The annunciator system shall be suitable for suitable for operation from both NO and NC type initiating contacts.

j) At least 10% spare channels and window facia shall be provided in each annunciator group.

4.19.00 FUNCTIONAL REQUIREMENTS OF ANNUNCIATOR

Type

The annunciation system shall be manually reset type with ring back facility, suitable for operation from 220V DC ungrounded supply.

Function

The sequence of operation shall be similar to ISA-2A with fast/slow blinking as detailed below:

(a)	Field	Visual	Audible	Ringback
(b)	Condition	Display	Alarm	Alarm

(c)	Normal	Off	Silent	Silent
(d)	Abnormal	Fast blinking	On	Silent
(e)	Acknowledge	Steady on	Silent	Silent
(f)	Return to normal	Slow blinking	Silent	On
(g)	Reset	Off	Silent	Silent
(h)	Normal before acknowledge	Slow blinking	On	On
(i)	Acknowledge	Steady on	Silent	On
(j)	Reset	Off	silent	Silent
(k)	test	Fast blinking	on	On

4.20.00 RELAYS

Auxiliary shall be furnished in fixed, dust-tight, casings and mounted inside the panel.

The relays shall have adequate numbers of contacts to suit scheme requirements. Besides, each relay shall have spares contacts for future use. Contacts shall be silver surfaced, bounce-free, and capable of repeated operation without deterioration.

4.21.00 AUXILIARY DEVICES

The contractor shall furnish, install, and wire-up all auxiliary devices such as timing/switching/lockout/auxiliary relays/auxiliary contactors, etc as required for the proper functioning of the approved schemes.

The contractor shall number the various types of relays and contactors as per the numbers appearing in the approved schematic/Wiring appearing in the approved Schematic/Wiring diagrams.

4.22.00 TESTS

All control boards/panels, L.I.S. Units and LPBS shall be completely assembled, wired, adjusted and tested at the factory prior to shipment to ensure accuracy of wiring, correctness of control scheme and proper functioning of all components.

4.22.01 ROUTINE TESTS

The tests shall include wiring continuity tests, high voltage tests, insulation measurement test both before and after high voltage test, and functional tests to ensure accuracy of wiring operation of the control/ protection/metering schemes and individual equipment. Detailed test report including procedure and drawing shall be furnished.

All switches, meters, relays and other devices shall be tested and calibrated in accordance with relevant IS standards.

Type test certificate on any equipment, if so desired by the Purchaser shall be furnished. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design.

4.23.00 TEST WITNESS

Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried

CHAPTER 17 : AC & DC MOTORS

1.00 MOTORS

1.1 SCOPE

This specification is intended to cover design, manufacture, assembly and testing of AC Squirrel Cage Induction Motors for use in Thermal Power Plants and is supplement to the driven equipment specifications under which these motors are being procured for the project.

SITE CONDITIONS

Site conditions are covered in 'Project Data', contained in specification of the driven equipment.

1.2 Gases, Fumes & Dust Particles

1.2.01 General - Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical, conducive to fungus growth.

1.2.02 **Dust Particles**

1 Outdoor locations - Heavily dusty with abrasive dust and coal particles of size five (5) to hundred (100) microns present in atmosphere in large quantity.

2 Indoor Locations.

2.1 Coal conveyors - As for outdoor as per clause 1.02.02.1 above.

2.2 Other locations - Lightly dusty with abrasive dust and coal particles of size five (5) to twenty (20) microns present in atmosphere.

1.2.03 **Special Fumes**

1 Water treatment plant and acid cleaning room - Acid and alkali fuses present.

2 Fuel oil pumping areas & Hydrogen generation plant - Explosive fuses (flameproof motors required).

1.2.04 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.3 **LOCATION OF MOTOR** - As required

1.4 **SPECIFICATIONS & STANDARDS**.....Motors shall comply with the latest revisions of all relevant standards of BIS (IS-325, IS-900, IS-996, IS-1231, IS-1885, IS-2148, IS-2223, IS-2253, IS-2254, IS-2848, IS-3202, IS-4029, IS-4691, IS-4722, IS-4728, IS-4889, IS-6362, IS-7816, IS-8223, IS-8789 , IS: 12615, IS:3177 and IEC : 60034 3Φ Induction motor) except as modified herein or in driven equipment specification.

Motors conforming to BS or IEC Publications, which ensure equivalent quality shall also be acceptable.In case of any difference between IS Specification/International Standards (IEC; NEMA etc.), this motor specification prevails.

1.5 TYPE

1.5.1 AC Motors:

a) Squirrel cage induction motor suitable for direct-on-line starting.

b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg. C ambient temperature), shall be **Efficiency class-IE2**, conforming to IS 12615, or IEC:60034-30.

c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

1.5.2 DC Motors Shunt wound.

1.6 **VOLTAGE (NOMINAL)**

1.6.1 **LV Motors**

For motors upto and including 200 KW - Four hundred fifteen (415) V.

1.6.2 **MV MOTORS**

For motors above 200kW upto and including 1500kW, Three point three (3.3) kV.

For CHP conveyors motor above 160 kW, 3.3 kV, AC supply is to be used. However all the motors on stacker reclaimer shall be on 415 V AC only.

1.6.3 **HV Motors**

For motors above 1500kW - eleven(11) KV

1.6.4 All motors are to be designed for system grounding described in "System Particulars" under site information of the Driven Equipment Specification.

1.7 **FREQUENCY (NOMINAL)** - fifty (50) Hertz

1.8 NUMBER OF PHASES - Three (3)

1.9 SPEED - As required by the driven equipment

1.10 TYPE OF STARTING :

Direct on-line (VFD/Soft-starter/star/delta starting in special cases)

1.11 DUTY

1.11.1 Continuous motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment,

whichever is higher, considering highest system frequency and voltage variation. Crane motors shall be rated for S4 duty, 40% cyclic duration factor. If however, a higher margin is stipulated in the accompanying driven equipment specification, the higher stipulated margin shall prevail.

1.11.2 All HT motors shall have vibration pads for mounting vibration detectors.

1.11.3 All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes.

1.11.4 Motors shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment atleast twenty five (25) percent above or below, preferably above the motor operating speed (to avoid resonance in vibration over the operating speed) range.

1.11.5 All LV motors rated 0.37kW and higher with S1 duty shall be compulsorily be of energy efficiency level IE 2 as per IS 12615:2011.

Motors rated above 37kW shall have efficiency higher than 0.92 and high power factor of atleast 0.88.

1.12 SUPPLY VARIATIONS

Motors shall be capable of running continuously at full load under following variations in power supply:

1.12.1 All equipments shall be suitable for rated frequency of 50 Hz with a variation of (+) 3% and (-)5%, voltage variation of ($\pm$) 6% for 11 kV & 3.3 kV and ($\pm$)10% for 415V and 10% (absolute sum) combined variation of voltage and frequency unless specifically brought out in the specification.

1.13 ABNORMAL CONDITIONS CAPABILITY

Motor shall have following capabilities as specified design ambient temperature:

1.13.1 The motors shall also be capable of running up again after voltage collapse to about 40% for approximate duration of 0.5 sec. Subsequent rise in voltage to 70% and further to 80% and 100%, the total duration not exceeding 20 sec.

1.13.2 Low Voltage Running :

Motor shall be capable of running satisfactorily at seventy five (75) percent nominal voltage for five (5) minutes.

1.13.3 Momentary Low Voltage Withstanding :

Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.

1.14 STARTING CAPABILITY

1.14.1 Low Voltage Starting :

Motor shall be capable of starting and accelerating to full speed at full load (including loaded equipment e.g. mills and conveyors etc) at eighty (80)

percent nominal voltage at motor terminals. Mill motors may be permitted to start with terminal voltage not below 90%.

1.14.2 Cold Motor Starting ..... Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment eg mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.

1.14.3 Hot Motor Starting ..... Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment e.g. mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.

1.14.4 Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.

1.14.5 Break-away Starting Current .....Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below:

1.14.5.1 Motors above 1500 KW upto 4000kW ..... 600% without any positive tolerance except for ID Fan Motor.

1.14.5.2 Motors above 4000 KW ..... 450%. Not subject to any positive tolerance.

1.14.5.3 For D.C. Motors the starting current shall be limited to 2 times full load current.

1.14.5.3 **Starting voltage requirement**

a) All Motors (except Mill Motors)

- 80% of rated voltage for Motors upto 4000 kW
- 75% of rated voltage for Motors above 4000 kW

b) For Mill Motors:

- 85% of rated voltage for Motors above 1000 kW
- 90% of rated voltage for Motors below 1000 kW

Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.

1.14.5.4 **Starting Time**

1.14.5.4.1 For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.

1.14.5.4.2 For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.

1.14.5.4.3 For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.

1.14.5.5 **Torque Requirements:-**

1.14.5.5.1 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10%. Motor full load torque.

1.14.5.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty Motors.

1.15 **SAFE STALL TIME**

1.15.1 To avoid problem in selecting standard protective relays without using speed switches, safe stall time under hot conditions (corresponding to 110% nominal voltage at motor terminals) shall be more than the accelerating time (corresponding to 80% nominal voltage at motor terminals) by the following minimum values :

1.15.1.01 Two (2) seconds, where accelerating time (at 80% nominal voltage) does not exceed 20 seconds.

1.15.1.02 Three (3) seconds, where accelerating time (at 80% nominal voltage) exceeds 20 seconds.

1.15.1.03 At no stage, speed switch shall be provided to achieve the above requirements mentioned under Clause No. 1.14.5.4

1.16 **CLASS OF INSULATION**

1.16.1 LV Motors ..... Class F.

1.16.2 MV & HV Motors ..... Class F

1.16.03 However temperature rise shall be restricted to limits corresponding to Class 'B' insulation for both HT & LT motors. The temperature under abnormal running conditions shall be limited to 5°C above class 'B' limits.

1.16.04 The value of the polarization index for motors above 200kW should not be less than 2 when determined according to IS: 7816.

1.17 **TEMPERATURE RISE UNDER NORMAL CONDITIONS**..... Temperature rise over specified design ambient temperature when motor is running with full load at nominal supply voltage & frequency shall not exceed the values given below:

S.No.	Specified Design Ambient Temperature	Thermometer Method	Resistance Method
1.17.01	50°C	60°C	70°C
1.17.02	45°C	65°C	75°C
1.17.03	40°C	70°C	80°C

1.18 **BUS TRANSFER WITHSTAND CAPABILITY**

Motors will be connected to an automatic bus transfer system and hence may be subjected to one hundred and fifty (150) percent of the nominal voltage during changeover of buses due to the vector difference between the residual voltage and incoming supply voltage and the duration of this condition may be one second. Motors shall be capable of withstanding the voltage and torque stresses developed under such conditions without damage. The manufacturer/ vendor shall indicate the special precautions taken to meet the above requirements and confirm.

1.18.01 That about 5000 bus transfers, in lifetime of motor, shall not puncture its insulation.

1.18.02 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.

1.18.03 That the motor windings shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.

1.18.04 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

1.19 **TYPE OF ENCLOSURE**

1.19.01 Outdoor Motors ..... IP 55 (Additional canopy to be provided by EPC contractor.

1.19.02 Indoor Motors ..... IP 55

1.19.03 IP-55 degree of protection shall be achieved without application of any compound, putty etc.

1.19.04 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv. as detailed below:

a) Fuel Oil area : Group IIB
b) Hydrogen generation plant area : Group IIC (or Group-I, Div-II as per NEC or Class-1, Gr-B, Div-II as per NEMA/IEC60034).

1.20 **METHOD OF COOLING**

1.20.1 Method of cooling shall be IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA). However, motors rated 3000kW or above can be closed air circuit water cooled (CACW).

1.20.2 Large capacity motors not available with above types of cooling may be accepted with IC 81 W for IC 91 W (CACW) cooling subject to the approval of the Owner.

1.21 **TYPE OF MOUNTING** ..... As required for the driven equipment.

1.21 **MAXIMUM MECHANICAL VIBRATIONS**

1.21.01 Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits

prescribed in IS: 12075 / IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.

1.21.02 Noise level

The noise level of motors shall not exceed 85 db (A) at 1m from operating motor measured in accordance with IS: 10265.

1.21.03 Motor body shall have two earthing points on opposite sides.

1.21.04 11 KV motors shall be offered with Separate Insulated Connector (Elastimould or Equivalent make) as per IEEE 386. The offered Elastimould terminations shall be provided with protective cover and trifurcating sleeves. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.

1.21.05 3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

1.21.06 The spacing between gland plate & centre of terminal stud shall be as per Table-I.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	**Minimum distance between centre of stud and gland plate in mm**
UP to 3 KW	**As per manufacturer's practice.**
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331

Above 125 KW-upto 200 KW 203

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

1.21.07 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

1.21.08 For motors rated 1500 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

1.21.09 The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.

(a)	Below 110KW	:	10.0
(b)	From 110 KW & upto 200 KW	:	9.0
(c)	Above 200 KW & upto 1000KW	:	10.0
(d)	From 1001KW & upto 4000KW	:	9.0
(e)	Above 4000KW	:	6 to 6.5

1.22 WINDING & INSULATION

(a)	Type	:	Non-hygroscopic, oil resistant, flame resistant
(b)	Starting duty	:	Two hot starts in succession, with motor initially at normal running temperature.
(c)	11kV & 3.3 kV AC motors	:	Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Presure Impregnated i.e resin poor method. Thelightning Impulse& interturn insulation surge withstand level shall be as per IEC-60034 part-15
(d)	240VAC, 415V AC & 220V DC motors	:	Thermal Class(B) or better

1.23 DIRECTION OF ROTATION

1.23.1 As needed by driven equipment.

1.23.2 The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

1.23.3 If, in the case of HT motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.

1.24 BEARINGS

1.24.1 General ..... Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 20,000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.

Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.

If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.

Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.

For MV & HV motors, the bearings shall be insulated wherever necessary to prevent damage to motor bearings from shaft current.

When pressure oiling is required for horizontal motors, bearings shall be sleeve type arranged for pressure oiling supplied from lubrication system of driven machine, with ring oiling for starting and emergency duty. Ring oiling system shall be adequate for starting and continuous operation of motor for at least half an hour, without pressure oiling system in operation. Oil sight flow gauges shall be provided to indicate oil flow through each bearing.

Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.

Sleeve bearings for use with motors having flexible coupling with limited end play, shall have adequate axial end play to prevent transmission of thrust from driven equipment to motor bearings.

Bearings shall be of reputed make subject to the approval of the Owner/Consulting Engineer.

1.24.2 Large motors ..... Large motors shall preferably have spherically seated babitted, ring forced, feed lubricated, water-cooled bearings. If anti-friction bearings are provided, these shall be roller bearings rated for a minimum standard life of 30000 hours taking all bearing and driven equipment loads into account.

1.25 **SHAFT EXTENSION** ..... Key slotted bare shaft extension of required length with key on driving end.

1.26 **DRAIN HOLES** ..... Two (2) drain holes with plugs, one (1) on either end of motor at the bottom most point.

1.27 **LIFTING DEVICES** ..... Motors shall be provided with eyebolts, lugs or other means to facilitate safe lifting.

1.28 **DOWEL PINS**..... It shall be possible to drill holes vertically inclined through motor feet or mounting flange for installing dowel pins after assembling motor and driven equipment, before despatch (for completed driving + driven

equipment assembly) or at site after erection (for separate supplies of above equipment).

1.29 **CENTERING SPIGOT**..... Flange mounted motor shall have centering spigot to match driven equipment socket.

1.30 **EASE OF MAINTENANCE**..... Motor shall be so constructed that it can be de-assembled and reassembled with ease.

1.31 **NAMEPLATES**..... Motor shall have nameplate(s) showing diagram of connections, all particulars as per IS: 325 and following additional information:

In addition, an arrow block shall be screwed on to the body of motor on the non-driving end to indicate direction of rotation of motor.

1.31.1 Temperature rise under normal/abnormal conditions.

1.31.2 Type of bearing and recommended lubricants.

1.32 **FINISH**..... Motor shall have glossy, light grey finish No. 631 as per IS: 5 for withstanding site conditions as per Clause 1.00 above.

All sharp edges and scales shall be removed from the surface, which shall then be thoroughly degreased, de-rusted and given two (2) coats of primer and two (2) coats of finish paint. It is preferred that a phosphate coat is given to motor prior to application of primer coat. Motors for water treatment plant shall have Zinc Chromate base with acid resistant Epilex 4 paint.

1.33 **TERMINAL BOXES**

1.33.1 General .....Motors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight confirming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Owner /Consulting Engineer. All terminal boxes shall be suitable for proper termination of the type and tentative size of cables specified in Clause 1.34 below, however, exact size of cables shall be furnished by Owner during engineering stage.

The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core cables are to be terminated. All HT motors shall be provided with phase segregated terminal box.

Terminal bushings and clamps shall be non-absorbent, non- inflammable, insulated material for connecting with cable.

1.33.2 **Main Terminal Box**

1.33.2.1 LV Motors ..... Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.

1.33.2.2 MV & HV Motors ..... Motor shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. These should be interchangeable to facilitate cable routing.

Neutral terminal box for HT motors rated above 1500 KW shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These transformers shall be supplied and mounted in the motor terminal box. In addition to above, 3 Nos. of identical current transformers shall be supplied loose for mounting in the switchgear. Stator phase terminal box may either be phase segregated of standard terminal box suitable for both top and bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable or push on type terminating Kit. Terminal leading shall be stud type or leading wire type.

1.33.2.3 Cable End Boxes.....Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables of sizes as specified in Clause 1.34 below.

Cable box shall be suitable for glanding the cables; and shall have adequate space between cable glands terminating studs to allow suitable bends of cable inside the cable box for all 3 phases of relevant cable sizes specified.

1.33.2.4 The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.

Min. fault level for MV Motors - 40 KA

Min. fault level for LV & HV Motors - 50 KA

1.33.2.5 **PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:**

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	**Clearance**
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

1.33.2.6 Terminal Accessories.....Each terminal end shall be furnished with bimetallic washers, spring washers, nuts and crimp type aluminium (preferably tinned) lugs suitable for cables of sizes as specified in Clause 1.34 below.

1.34 **TYPE AND SIZE OF CABLES**

1.34.1 **Space Heaters**

1.34.1.1 For LV Motors: Two point five (2.5) mm^2, two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).

1.34.1.2 For MV & HV Motors: Six (6) mm^2 two core aluminium conductor PVC insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).

1.34.2 For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm^2 ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm^2, ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).

1.34.3 Bearing Temperature Indicators - For each indicator, 0.5 mm^2 six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.

1.34.4 For Moisture Detectors.....As for space heaters as per Clause 33.01.01 above.

1.34.5 **For Main Terminals**

LT Motors

1. Three (3) core cables ……Stranded aluminium conductor, XLPE insulated, colour coded, laid up, PVC sheathed, GI wire / strip armoured, FRLS PVC jacketed overall, 650 / 1100V grade, heavy-duty cables as per IS: 1554 (Part-I).

2. Single core cables ……Stranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC jacketed overall, 650 / 1100V grade, heavy duty cable as per IS: 1554 (Part-I).

HT Motors

1. Three (3) core cables …… stranded aluminium conductor, XLPE insulated, screened colour coded, laid up, PVC sheathed, GI wire/strip armoured FRLS PVC jacketed overall, 6.6 KV / 11 KV grade, heavy duty cables as per requirement for unearthed system as per IS: 7098 (Part-II).

The size and no. of cable to be intimated to the successful bidder during detailed engineering and the contrcator shall provide terminal box, cable gland and lugs suitable for the same.

Cable size may be increased in some cases because of large number of cables in under-ground ducts or because of vaoltage drop consideration. The supplier shall supply with terminal box and cable accessories suitable for higher size of cable at no extra cost.

1.35 **EARTHING**

1.35.01 General..... Two (2) grounding terminals one (1) on either side at the bottom suitable for connecting mild steel/GI flat/GI wire grounding conductor, size of grounding conductor shall be decided during detailed engineering.

1.35.02 LV Motors.....At each earthing point, two (2) drilled and tapped holes with hexagonal head bolts, plain washers, spring washers and tinned lugs (for motors upto 5.5 KW) for size of conductor specified shall be provided.

1.35.03 MV & HV Motors.....Non-corrodible metallic grounding pad shall be welded or brazed at each earthing point. The size of grounding pad shall be 75x65x25 mm. Grounding pad shall have 40 mm apart two (2) drilled and tapped holes with hexagonal head bolts, plain washers and spring washers for size of conductor specified. In addition, one suitable earthing terminal shall be provided inside the stator phase terminal box for earthing metallic shield of XLPE cables.

1.36 **EMBEDDED TEMPERATURE DETECTORS**.....HT motor shall be provided with six (6) Nos. duplex resistance temperature detectors (RTDs) embedded in stator winding at locations where high temperatures are expected. In addition one (1) duplex type RTD shall be provided in each bearing. The RTDs shall be 3 wire duplex platinum resistance type having a value of 100 ohms at 0 Deg.C

1.37 **BEARINGS TEMPERATURE INDICATORS**..... HT motors shall be provided with dial type two (2) bearing temperature indicators and will have two (2) sets of contacts, each set having 2 NO + 2 NC contacts rated for 5A at 240V AC and 0.5A at 220V DC. One set will be set to operate at lower value to give alarm and other set at a higher value to trip the motor.

1.38 **SPACE HEATERS**.....Valve / Damper actuator motors; and Motors above 30 KW shall be provided with one (1) or two (2) space heaters suitable for 240V, 50 Hertz single phase AC supply and of adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation or deterioration of insulation during shut down. Heaters shall be mounted inside the motor in accessible locations so that their removal and replacement is simple. Motors upto 30 kW shall have stator windings suitable for connections to 24V, 50 Hz AC supply for space heating.

Motors upto 30 kW shall have stator windings suitable for connection to 24V, 50 Hz ac supply for space heating

The terminals of space heaters shall be brought out to a separate totally enclosed dust proof and weatherproof terminal box.

1.39 **HOT AIR TEMPERATURE DETECTOR**

If the motor is of CACA or CACW enclosure, a thermometer with alarm contracts in hot air circuit shall be provided.

1.40 **WATER FLOW INDICATOR**

If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits.

1.41 **MOISTURE DETECTORS**.....Motors with type of cooling 1C 81W or 1C 91 W shall be provided with moisture detectors for raising alarm in the event of water tube failure.

1.42 **BED PLATE**.....Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.

1.43 **OTHER ACCESSORIES**..... Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.

1.44 **TYPE TEST**

1.44.01 **HT MOTORS**

a) The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract.

b) The type tests shall be carried out in presence of the Purchaser's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Purchaser's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

c) In case the contractor has conducted such specified type test(s) within last five years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Purchaser's for waival of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Purchaser's reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.

d) Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last five 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 contractor is not able to submit report of the type test(s) conducted within last five 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 contractor shall conduct all such tests under this contract at no additional cost to the Purchaser's either at third party lab or in presence of client representative and submit the reports for approval.

e) **LIST OF TYPE TESTS TO BE CONDUCTED**

The following type tests shall be conducted on each type and rating of HT motor

i) No load saturation and loss curves upto approximately 115% of rated voltage

ii) Measurement of noise at no load.

iii) Momentary excess torque test (subject to test bed constraint).

iv) Full load test(subject to test bed constraint)

v) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

f) **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of HT motor

i) Degree of protection test for the enclosure followed by IR, HV and no load run test.

ii) Terminal box-fault level withstand test for each type of terminal box of HT motors only.

iii) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15

iv) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

1.44.02 **LT Motors**

a) LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Purchaser's approval the reports of all the type tests as listed in this specification and carried out within last five 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.

b) However if the contractor is not able to submit report of the type test(s) conducted within last five 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 Purchaser's shall conduct all such tests under this contract at no additional cost to the Purchaser either at third party lab or in presence of client representative and submit the reports for approval.

1.44.03 **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only

i) Measurement of resistance of windings of stator and wound rotor.
ii) No load test at rated voltage to determine input current power and speed.
iii) Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
iv) Full load test to determine efficiency power factor and slip .
v) Temperature rise test.
vi) Momentary excess torque test.
vii) High voltage test.
viii) Test for vibration severity of motor.
ix) Test for noise levels of motor(Shall be limited as per clause no 1.21.01 of this section)
x) Test for degree of protection and
xi) Over speed test.
xii) Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

1.44.04 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.

1.45 **INFORMATION WITH PROPOSAL**

1.45.1 AC Motor Data Sheet.

1.45.2 Dimension Drawing/Foundation load details of motor and driven equipment.
1.45.03 Manufacturer's catalogue showing constructional details.

1.46.00 **INFORMATION ON AWARD OF CONTRACT**.....Within six (6) weeks from the date of award of the Contract, following shall be furnished:

1.46.01 Motor Data Sheet.

1.46.02 Certified binding dimension drawing of motor complete with all accessories and fittings specifically showing terminal boxes, terminal spacing and sizes, earthing connections and sizes thereof, mounting details, lifting lugs, final foundation loads and dimensions with tolerances of centering spigot (where needed), shaft extension and key.

1.46.03 Following characteristics curves:

1.46.03.01 Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment.

1.46.03.02 Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage

1.46.03.03 Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.

1.46.03.04 Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.

1.46.03.05 Efficiency, power factor, current and speed versus power output curves.

1.46.03.06 Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage.

1.46.03.07 Negative phase sequence current withstand characteristics.

1.47 COMMISIONING CHECK LIST (HT MOTORS)

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

6. Checking stator (motor air gap) Check – Grease lubrication (for ball or roller bearing) is adequate if the motor was in storage for very long period replace the grease, by fresh grease after flushing the bearing clean. Excess grease in the bearing (housing … is overheat of bearings) Check 0 the free rotation of the rotor in decoupled condition. Check the air gap between stator and rotor at four positions 90o apart at driving and non-driving end. Compare the recorded values with factory results. For slip ring motors : with starting resistances.

   a) Check the variation of resistance
   b) Check brush lifting and slip ring short.

B COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Measure resistance of motor winding (in case of large motors)
4. Control and interlocks should be checked
5. Motor protection relay to be calibrated
6. Phase sequence and direction of rotation
7. Other than DOL scheme to be checked example trafo starts
9. Measure starting current starting timer and no load current
10. On load operations starting and running currents (observed vibrations, temperatures of bearings and body)
11. On load operation, starting and running currents (observed vibrations, temperatures of bearings and body)
12. In case of forced water cooling of start or check winding temperatures as ready by built in RTDs.
13. Water level (start up cooling) low to be checked for limit switch operation.

1.48 COMMISIONING CHECK LIST (LT MOTORS)

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

1.49 DC MOTOR SPECIFICATION

DC Motor will be of continuous duty type totally enclosed fan cooled (TEFC) having IP-54 degree of protection suitable for 220 V DC supply. DC motor will be shunt wound type having high torque characteristic suitable for Bi-directional rotation at rated speed and output. The general constructional features and details of DC motor will be in line with details/ particulars stipulated in the specification for AC squirrel cage induction motors.

Contractor will furnish the data in respect of DC motors.

SECTION - 3

PROJECT DETAILS GENERAL TECHNICAL REQUIREMENTS

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

	Particular	**Details**
a)	Customer	Uttar Pradesh Rajya Vidyut Utpadan Nigam Ltd.
b)	Engineer Consultant	DCPL
c)	Engineer Review Consultant/ Inspector	NTPC Ltd.
d)	Project Title	Panki Thermal Power Project (3x660 MW): 400kV Switchyard
e)	Project Location	Place: Panki District: Kanpur State: Uttar Pradesh
f)	Latitude & Longitude	North N26028'20" East E 80014'32"
g)	Nearest Railway Station	Panki
h)	Distance of project location from the Railway station	5 Km
i)	Nearest Major Town	Kanpur
j)	Distance of the town from the project site	16 Km.
k)	Nearest Highway from the project site	National Highway - 25
l)	Nearest airport	Kanpur – 25 Km Lucknow – 80 Km
m)	Nearest commercial airport	440 Km
n)		
	SITE CONDITIONS (for design purposes)	
a)	Design ambient temperature	50°C
b)	Maximum Relative humidity	85 %
c)	Height above mean sea level	Less than 1000 meters
d)	Pollution Severity	Heavily polluted (With Coal dust & Fly ash) and Highly Corrosive environment.

e)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3) 1987
f)	Basic Wind speed "Vb" at ten meters above the mean ground level.	47 m/ sec
g)	Siesmic data	Zone-III as per IS: 1893

3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	400 kV
1	Highest system voltage	420 kV rms
2	Lightning Impulse voltage	±1425kVp
3	Switching impulse voltage	±1050kVp
4	Power frequency withstand for 1 min (rms)	630 kV(rms)
5	Max. fault level (1 sec.)	50 kA
6	Minimum creepage distance	13020 mm

3.1.2 AUXILIARY POWER:

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

Combined variation of voltage and frequency shall be + 10%. Design fault level of 415V system shall be restricted to 50kA rms for 1 second & for 25kA for 1 sec. for 220V DC system.

The operational limits for variation of DC voltage are (+) 10% to (-) 15%.

3.4 ENGINEERING DATA

3.4.1 Drawings

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

Each drawing submitted by the Contractor (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All

the dimensions should be in metric units.

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

The review of these data by the purchaser will cover only general conformance of the data to the specification and documents, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect plan layout. This review by the purchaser may not indicate a thorough review of the dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the purchaser shall not be considered by the contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

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

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

3.5.2 Approval Procedure

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

a. All data/information furnished by Vendor in the form of drawings, documents, Catalogues or in any other form for NTPC’s information/interface and/or review and approval are referred by the general term “drawings”.
b. The ‘Master drawings list’ indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.
c. All drawings (including those of subvendor’s) shall bear at the right hand bottom corner the ‘title plate’ with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor’s compliance.
d. Contractor shall submit all the drawings in five (5) copies for review of Employer.Employer shall forward their comments within four (4) weeks of receipt of drawings.
e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved

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

f. Contractor shall resubmit the drawings approved under Category II, III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.).

g. In case Contractor does not agree with any specific comment, he shall furnish the explanation for the same to Employer consideration. In all such cases Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

h. It is the responsibility of the Contractor to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

i. Contractor shall not make any changes in the portion of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawings identifying the changes (along with reasons for changes) for Employer's review and approval. Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.

j. Approval of drawings will not in any way relieve the Contractor of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

3.5.3 Erection Drawings.

a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/ equipment with identification number, match marks, bill of materials, assembly procedures etc.

b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

3.5.4 Instruction Manual

a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipments for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least sixty (60) days before the first shipment of the

equipment. The instruction manuals shall contain full details and drawings of all the equipments, the transportation, storage, installation, testing, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. These instruction manuals shall be submitted in five (5) copies for approval.

b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall being corporate and the updated final instruction manuals shall be submitted.

c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.

d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets.

e. The manuals shall include the following

a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.

b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.

f. A collection of the manufacturer's standard leaflets will not accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

3.5.5 Operation & Maintenance Manuals

The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

3.5.6 As Built Drawings

After final acceptance of individual equipment/system by the Owner, the Bidder will update all original drawings and documents for the equipment/ system to "as built" conditions in requisite number.

Drawings must be checked by the Bidder in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Owner. In case

drawings are found to be submitted without proper endorsement for checking by the Bidder, the same shall not be reviewed and returned to the Bidder for re-submission. The Bidder shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/drawings at site which are needed as an input to the engineering. The Bidder shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Owner's scope and submit all necessary drawings/ documents for the same.

3.5.7 MATERIAL /WORKMANSHIP

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

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

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

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

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

3.5 DEGREE OF PROTECTION

Degree of protection for various enclosures as per IS: 13947 shall be as follows:

1. **LT Switchgear/MCC/DBs/Fuse Boards**

i. Compartments and busbar chambers upto 1600A	:	IP52
ii. Compartments and busbar chambers above 1600A	:	IP42
iii. Switchgear located outdoor	:	IP55
2. Motors		
i. Indoor motors	:	IP55
ii. Outdoor motors	:	IP55 with canopy
3. Transformers		
i. Indoor Transformer	:	IP22
ii. Cable box-indoor area	:	IP52
iii. Cable box-outdoor area	:	IP54
iv. Indoor kiosks and marshalling boxes	:	IP54
v. Outdoor kiosks and marshalling boxes	:	IP55
4. Push Button Stations and any other kiosk/box/panel/ enclosure		
i. Indoor	:	IP54
ii. Outdoor	:	IP55
iii. In dusty areas, e.g. conveyor galleries, transfer points, crusher house, bunker floor etc.	:	IP65
5. Junction boxes for cables/wires	:	IP55
6. Outdoor lighting fixtures	:	IP55

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

3.6 PRESERVATIVE SHOP COATING

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.

Transformers and other electrical equipment if included shall be shop finished with one or more coats of primer and two coats of high grade epoxy. The finished colours shall be as per manufacturer's standards, to be selected and specified by the Owner at a later date.

Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Owner.

3.7 RATING PLATES, NAME PLATES AND LABELS

1. Each equipment shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.
2. Such nameplates or labels shall be of white non hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.
3. The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.
4. Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.
5. Each switch shall a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.
6. All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.
7. All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

3.8 PAINTING

3.15.1 All surfaces to be painted including interior and exteriors of enclosures and other metal parts shall be shot or sand blasted or chemically treated to remove all rust, scale, grease and other adhering foreign matters. If not specified or approved otherwise later, colour of finishing paint shall be RAL 7032 with glossy finish except for panels which shall have matt finish. The paints used shall be epoxy-based or of suitable type to withstand the salty atmosphere prevalent in the coastal areas.

3.15.2 All metal parts not accessible for painting shall be made of corrosion resistant materials. All machine finished or bright surfaces shall be coated with a suitable rust preventive compound and wrapped or otherwise protected.

3.15.3 Paints shall be carefully selected to withstand tropical heat and extremes of weather specified herein. It shall not scale-off or crinkle or be removed by abrasion due to normal handling.

3.15.4 Should finished paint chip-off or crinkle during transit or installation, the Contractor shall arrange for re-painting the equipment at site at his own cost.

3.9 QUALITY ASSURANCE

The Contractor shall follow his standard procedures for quality assurance and control. This shall be in standard format indicating test witness and customer hold point shall be submitted for approval by the successful bidder. 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.

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.

Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

Manufacturing and quality control procedures shall be available for audit to the Owner/Purchaser and/or its representative at the place of manufacture.
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.

The Owner/Purchaser may inspect the Contractor's facilities prior to award of contract.

The Owner/Purchaser may witness any or all of the tests stipulated in the relevant standards and this specification.

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.

3.10 QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points, as necessary. Such programs shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA program shall be generally in line with ISO-9001/IS-14001. A quality assurance program of the contractor shall generally cover the following:

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

vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

vii. System for shop manufacturing and site erection controls including process, fabrication and assembly.

viii. Control of non-conforming items and system for corrective actions and resolution of deviations.

ix. Inspection and test procedure both for manufacture and field activities.

x. Control of calibration and testing of measuring testing equipments.

xi. System for Quality Audits.

xii. System for identification and appraisal of inspection status.

xiii. System for authorising release of manufactured product to the Employer.

xiv. System for handling storage and delivery.

xv. System for maintenance of records, and

xvi. Furnishing quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed as Annexure-I.

3.11 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 Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.

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/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.

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 Organisation, during various stages of site activities starting 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 Employer's approval without which manufacturer shall not proceed.

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

vi. No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of MDCC.

vii. All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

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 Employer.

ix. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.

x. All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.

xi. Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.

xii. For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.

xiii. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

xiv. No welding shall be carried out on cast iron components for repair.

xv. Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

xvi. All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

xvii. In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 50mm shall be ultrasonically tested.

xviii. The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the subcontractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified subcontractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

xix. For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.

xx. Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub vendor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.

xxi. The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractors and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

xxii. Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply

with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

xxiii. For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

xxiv. Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

3.12 QUALITY ASSURANCE DOCUMENTS

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

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

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.
The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.

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

i) Quality Plan,

ii) Material mill test reports on components as specified by the specification and approved Quality Plans.

iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

iv) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

v) Heat Treatment Certificate/Record (Time- temperature Chart)

vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).

vii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.

viii) Certificate of Conformance (COC) whoever applicable.

ix) MDCC

x) Similarly, the contractor shall be required to submit two hard copies and two sets on CD ROM of Quality Assurance Documents (in line with above) pertaining to field activities as

per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

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

xii) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory. The Inspector shall stamp the quality document (or applicable section) for release.

xiii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing finalizing the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

xiv) If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

3.13 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer after the delivery date for the corresponding equipment. One set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.

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

3.14 INSPECTION, TESTING & INSPECTION CERTIFICATE

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

ii. The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the

Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

iii. The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

iv. The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

v. When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

vi. In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

vii. The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.

viii. To facilitate advance planning of inspection in addition to giving inspection notice, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer

Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

ix. All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by cutomer/consultant. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

3.15 PACKAGING & TRANSPORTATION

3.24.1 Packing, Marking and shipping

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

a) The equipment shall be prepared in such a manner as to protect the equipment from damage or deterioration during shipping or storage. The shipments can be exposed to heavy rains, hot sun, high humidity and sudden extreme changes of temperature. The equipment shall be packed and shipped so as to protect it from all such conditions and any other abnormal conditions, generally expected during shipping & storage. **Packing shall be done by high quality material suitable for at least 1 year storage at site.**

b) The metallic containers, if any, shall be considered as the property of the Contractor and he will be allowed to remove them from site once the contents are unpacked, inspected, documented and placed in temporary storage or in final position.

c) The equipment shall be shipped in such a manner as to facilitate unloading, handling and storage enroute and at the site. The Contractor shall provide lifting lugs and special lifting devices for proper handling and erection.

d) The Contractor shall be liable for any damage or loss resulting due to careless, improper, poor or insufficient packing and handling.

e) Spare parts and spare equipment shall be packed separately in containers adequate for long term storage, plainly marked “Spare Parts Only”. They shall be crated individually or in kits to be used in one single renewal or overhaul operation. Other spare part kits shall not be disturbed when using one set or kit.

f) The Contractor shall at all times protect and preserve from damage, loss, corrosion and all other forms of damage, all parts of the works.

3.24.2 Insurance

a) The Contractor shall insure all shipments and works at his own expense for not less than the full replacement cost plus any additional cost for accelerated manufacturing of the replacement parts.

b) Loss or the damage to equipment during shipping or transportation to the site(s) or otherwise shall not constitute groups for claims for extension in time or for extra payment.

3.15.1 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

3.24.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS: 617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.

3.24.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.

3.24.3 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.

3.24.4 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.

3.24.5 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.

3.24.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.

3.24.7 Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last atleast till erection time.

3.15.1 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS, AND DISC INSULATORS

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

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

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

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

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

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

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

3.25.8 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued, porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.

3.25.9 Insulator shall also meet requirement of IEC - 815 as applicable, having alternate long & short sheds.

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

3.26.1 All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:439 as applicable.

3.26.2 Mechanism Box/ Control Cabinet/ Kiosks: A sheet steel (atleast 2.5 mm thick), dust and vermin proof M.Box/CCC/CMB shall be provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber.

3.26.3 Junction Boxes: The junction boxes shall be made of minimum 2 mm thick sheet steel. Gland plates shall be removable type and made of 3 mm thick sheet steel. The boxes shall be provided with detachable cover or hinged door with captive screws. Top of the box shall be arranged to slope towards the rear of the box. The box shall be hot dip galvanised and shall be provided with suitable neoprene gaskets to achieve requisite degree of protection. Adequate spacing shall be provided to terminate the external cables. The boxes shall be suitable for mounting on various types of steel structures. The terminal blocks provided shall be of 650 V grade, rated for 10 A for control cables. Suitable numbering for terminal blocks shall be done. In case of junction box for power cable, the box shall be rated for maximum current carrying capacity. Terminal blocks shall be of one piece, Klippon RSF-1 or ELMEX CSLT-1 type with insulating barriers.

3.26.4 The cabinets/boxes/kiosks/panels shall be free standing or wall mounting or pedestal mounting type. They shall have hinged doors with padlocking arrangement. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets.

3.26.5 The degree of protection of of all the outdoor boxes shall not be less than IP 55 as per IS 2147.

3.26.6 The cable entry shall be from bottom, for which removable gasketed cable gland plates shall be provided.

3.26.7 Suitable 240V, single phase, 50Hz ac heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10deg. above the ambient.

3.26.8 The size of enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/kiosk/panel shall be provided with a 15A, 240V ac, 2 pole, 3 pin industrial grade receptacle with switch. For incoming supply, MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be of rotary switch type.

3.26.9 Each cabinet/box/kiosk/panel shall be provided with two earthing pads to receive 75mm x 12mm GS flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire. The cabinets/ boxes/ kiosks/ panels shall also be provided with danger plate, and internal wiring diagram pasted on inside of the door. The front label shall be on a 3mm thick plastic plate with white letters engraved on black background.

3.17 TERMINAL BLOCKS

3.27.1 They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4.

3.27.2 The terminal blocks shall be of 650 V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.

3.27.3 They shall be of moulded, non-inflammable thermosetting plastic. The material shall not deteriorate with varied conditions of temperature and humidity. The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating plastic material. Insulating barriers shall be provided between the terminal blocks so that the barriers do not hinder the wiring operation without removing the barriers.

3.27.4 The terminals shall be provided with marking tags for wiring identification.

3.27.5 Unless otherwise required (expected current rating) or specified, terminal blocks shall be suitable for connecting the following conductors on each side:

All CT & VT circuits - Min. four 2.5 sq.mm. copper flexible conductor

AC & DC power supply -Two 16 sq.mm. Aluminium conductor

Other control circuits - Min. two 2.5 sq.mm. copper flexible conductor.

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

3.18 Wiring

3.28.1 All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows:

a) All circuits except CT circuits 2.5 sq.mm

b) CT circuits 4 sq. mm (minimum number of strands shall be 3 per conductor).

3.28.2 All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.

3.28.3 Wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires shall not fall off when the wires and shall not fall off when the wire is disconnected from terminal blocks.

3.28.4 All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrules purposes.

3.28.5 All terminals including spare terminals of auxiliary equipment shall be wired upto terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be wired out. Interpole cabling for all equipment's shall be carried out by the Contractor.

3.19 CABLE GLANDS AND LUGS

3.29.1 Cable glands shall be Double compression type, tinned/Nicked plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and off tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.

3.29.2 The cable glands shall be tested as per BS: 6121. The cable glands shall also be duly tested for dust proof and weather proof termination.

3.29.3 Cables lugs for power cables shall be tinned copper solder less crimping type conforming to IS:8309 and 8394 suitable for aluminum or copper conductor (as applicable). Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipment. The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

3.20 CONDUITS, PIPES AND ACCESSORIES

3.30.1 The bidder shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.

3.30.2 Rigid conduits shall be flow-coat metal conduits of Nagarjuna Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/ pipes shall be of a reputed make.

3.30.3 Flexible conduits shall be heat-resistant lead coated steel, water-leak, fire and rust proof, and be of PLICA make or equivalent.

3.21 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

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

3.22 LAMPS AND SOCKETS

3.32.1 Lamps:

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

3.32.2 Sockets

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

3.32.3 Hand Lamp:

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

3.23 SWITCHES & FUSES:

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch-fuse units. Selection of the main and sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS 9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal Protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.
All control switches shall be of rotary type. Toggle/piano switches shall not be accepted.

TESTS

3.24 General

During manufacture, the Owner/Purchaser's representative(s) shall have the right to expedite and/or inspect design, materials, workmanship and progress of manufacture of the Contractor's and their Sub-Contractor's equipment and may reject defective materials considered unsuitable for the intended purpose or which do not comply with the intent of the tender specification. The Contractor, upon any such rejection by the Purchaser or his representative(s), shall replace the defective or unsuitable materials. The Contractor shall provide every reasonable inspection facility to the Purchaser's Inspector(s) or representative(s) at his own and his Sub-Contractor's works.

The Contractor shall give thirty (30) day notice of readiness for inspection of component parts and/or before final assembly and test, so that the Purchaser's representative(s) may inspect the materials and witness such tests before shipment. The Purchaser's representative(s) may, at any time, inspect and request copies of any or all test data of raw materials and finished components which shall be immediately furnished.

Material being furnished against this order shall only be shipped when factory inspection, satisfactory to the Purchaser and/or their representative(s) has been conducted. Such inspection and acceptance for shipment shall not, however, relieve the Contractor from his entire responsibility for furnishing equipment conforming to the requirement of the tender specification nor shall prejudice any claim, right or privilege which the Purchaser may have because of the use or supply of defective or unsatisfactory materials or equipment. Should the inspection be waived by the purchaser, such waival shall not also relieve the Contractor, in any way, from his entire obligations under the
Contract.

The equipment shall, at the factory or after installation, be demonstrated capable of performing satisfactorily upto the Contractor's guaranteed performance. All tests required by the tender specification including retests and inspection that may be necessary owing the failure to meet any tests specified, shall be made at the Contractor's expenses. Additional tests, as necessary, shall be made to locate such failure(s) and after determining the causes of failure(s) and rectifying it, specified tests shall be repeated to establish that the rebuilt equipment meets the tender specification requirements in every respect.

Should the equipment ultimately fail to pass the specified tests, the Purchaser will have the option to reject the unit.

Tests during Manufacture

During the manufacture of equipment, tests specified in Standard Specification(s) shall be performed on each unit in addition to any of manufacturer's standard tests and requisite number of copies of tests certificates as per Distribution Schedule shall be furnished.

Routine Tests

After completion of manufacture routine tests as specified in relevant Standards and in Standard Specification(s) shall be performed on equipment and requisite number of copies of test certificates as per Distribution Schedule shall be furnished.

All tests shall be conducted in accordance with Indian Standards in effect at the time of testing and in presence of representative(s) of the Purchaser/ Consulting Engineer.

Tests on Associated Components

Cast epoxy resin insulators, surge absorbers, current transformers, voltage transformers, control devices and other associated components as applicable, shall be tested in accordance with the relevant Indian standards and/or Manufacturer's Standards.

Type Tests

Contractor will have to submit Type test reports for all equipment for review. The test reports shall be of same or higher rating. In case the test reports are **older than 5 years from the date of techno commercial bid opening i.e. 02.11.15** or related to equipment of lower rating then fresh type tests have to be conducted without any implication.

Site Tests

The Bidder shall indicate tests recommended to be carried out at site during installation and commissioning to ensure satisfactory performance of all the equipment supplied.

Testing Facility

The Bidder shall state in the Proposal the testing facilities available at his works. Should full capacity testing equipment be not available, the Bidder shall state the method proposed to be adopted with detailed computations and justification for adopting such a method to reliably ascertain the equipment characteristics corresponding to full capacity testing.

SECTION 4
LIST OF DOCUMENTS

1.0 LIST OF TECHNICAL DATASHEETS

In this section panel drawings that are required for works at site are listed.

The list furnished here is tentative and additional documents may be required during detailed engineering.

Sl. No.	Item Description	NTPC Doc. No.
01.	Schematic GA & SLD for HVAC Power Distribution Board along with Electrical Load List	9962-001-TB-572-PVE-P-220-01

SCHEDULES AND ENCLOSURES

SECTION- 5

ENCLOSURES TO SPECIFICATION

SCHEDULES TO BE FILLED UP BY THE BIDDER

Schedule 2 **Schedules of Deviations**

Schedule 3 **Schedule of past experience and qualifying requirements**

Schedule 4 **Schedule of performance certificates**

Schedule 5 **Schedule of type test and special tests**

Schedule 6 **Details of contact persons (technical & commercial)**

Schedule 7 **Enclosures to Specification**

ANNEXURE-A Drawings

SCHEDULE - 1

MAKES OF IMPORTANT ITEMS / COMPONENTS OF EQUIPMENTS AND THEIR DETAILS

ITEM NAME	NAME OF MANUFACTURER	PLACE OF MANUFACTURE OF ITEM	PLACE OF TESTING AND INSPECTION	COMPLIANCE WITH ISO 9001 (YES/NO)

Place

Date

Bidder

Signature of the authorized representative of

Name ----------

Designation----------

Company seal----------

SCHEDULE - 2

SCHEDULE OF TECHNICAL DEVIATION

The following are the deviations / variations / exceptions from the specification:

Section	Clause No. / Page No.	Statement of deviation/ Variations/Exceptions

1) In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract are deemed to be in compliance with the specification.

2) If there is NIL deviation, even then the format to be filled as **NIL DEVIATION**

3) Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

Place — Signature of the authorized representative of Bidder

Name ----------

Date — Designation----------

Company seal----------

SCHEDULE – 3

SCHEDULE OF PAST EXPERIENCE AND QUALIFYING REQUIREMENT

Following is the list of earlier orders executed by us for supply of equipment / material of similar nature over the last past five years:

S.No.	Item	Brief rating	Qty	customer	Date Of order	Date of supply	Order value

Place

Date

Signature of the authorized representative of Bidder

Name----------

Designation----------

Company seal ----------

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

SCHEDULE – 4

SCHEDULE OF PERFORMANCE CERTIFICATE

Bidder shall furnish the performance certificate of the similar equipment having The following details:

S.No.	Item	Brief rating	Qty	Customer	Date Of supply

Place

Date

Signature of the authorized representative of Bidder

Name----------

Designation----------

Company seal ----------

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

SCHEDULE - 5

SCHEDULE OF TYPE TESTS AND SPECIAL TESTS

The following type tests and special tests as called for in the Specification shall be conducted (all type tests / special tests as mentioned in the relevant clauses of the Specification shall be listed here):

Sl no.	Clause no/ page no of Specification	Details of test	Lab in which to be conducted	Whether test to be conducted free or on chargeable basis. Mention 'FREE' or 'CHARGEABLE'	If charges per test have been quoted for in the price bid. YES / NO
		A. Type Tests			
		1.			
		2.			
		B. Routine Tests			**DO NOT**
		1.			**MENTION**
		2.			**ANY PRICE**
		C. Site Tests			**IN THIS**
		1.			**COLUMN**
		2.			
		D. Special Tests (specified)			
		1.			
		2.			
		E. Other tests at works / site recommended by the Bidder			
		1.			
		2.			

NOTE:

1) Details have to be furnished on cables as well as accessories, each separately.

2) NO PRICE SHALL BE FURNISHED IN THIS FORMAT.

Place

Signature of the authorized representative of Bidder

Name----------

Date

Designation----------

Company seal----------

SCHEDULE - 6

DETAILS OF CONTACT PERSON BOTH TECHNICAL AND COMMERCIAL

Name

Address for correspondence

Phone No.

Fax No.

Email

Place

Date

Signature of the authorized representative of Bidder

Name----------

Designation----------

Company seal ----------

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

SCHEDULE –7

ENCLOSURES TO SPECIFICATION

- **Annexure-A- DRAWING**

Drg. No.	Drg. Title
9962-001-TB-572-PVE-P-220-01	Schematic GA & SLD for HVAC Power Distribution Board along with Electrical Load List

PROJECT	PANKI
END USER	NTPC
EPC	BHEL TBG
HVAC SUPPLIER	
DOCUMENT TITLE	FEEDER LIST
DATE	

Location	AHU ROOM		HVAC PANEL (SINGLE FRONT FLOOR MOUNTED FIXED PANEL 50KA)										
SR. NO.	DESCRIPTION	TAG NOS.	LOCATION	RATING (KW)	VOLTAGE RATING	WORKING QTY.	STANDBY QTY.	SPARE QTY.	TOTAL FEEDER	FEEDER TYPE	WORKING LOAD (KW)	SCHEME TYPE	CABLE SIZE
1	INCOMER	--	PACKAGE AC ROOM	70.57	415VAC , 3P+N	1	1	-	2	MCCB TPN		501	
2	PACKAGE AC 16.5TR		PACKAGE AC ROOM	19	415VAC , 3P+N	2	1	1	4	MCCB TPN POWER FEEDER	38	502	3.5CX25 SQMM AL
3	DB		PACKAGE AC ROOM	14.07	415VAC , 3P+N	1	0	0	1	MCCB TPN POWER FEEDER	14.07	502	3.5CX25 SQMM AL
4	DUCT Heater		PACKAGE AC ROOM	14	415VAC , 3P+N	1	0	1	2	MCCB+CONTACTOR	14	503	3.5CX25 SQMM AL
5	Humidifier Heater		PACKAGE AC ROOM	4.5	415VAC , 3P+N	1	0	0	1	MCCB+CONTACTOR	4.5	503	4CX4 SQMM COPPER
									10				

DB details (WALL FITTED)

LOAD DESCRIPTION **	QUANTITY	SWITCHGEAR TYPE	CABLE SIZE	REMARKS
CASSETE AC 3TR	4	MCB 4P	4CX2.5SQMM CU	
CASSETE AC 2TR	7	MCB 2P	2CX2.5SQMM CU	
SUPPLY AIR FAN (10000)CMH 0.75kw	4	MPCB	3CX2.5SQMM CU	LOCAL DOL STARTER IN FIELD (NEARBY FAN)
EXHAUST AIR FAN (11500)CMH 0.75kw	2	MPCB	3CX2.5SQMM CU	LOCAL DOL STARTER IN FIELD (NEARBY FAN)
EXHAUST FAN (4000)CMH 0.55kw	1	MPCB	3CX2.5SQMM CU	LOCAL DOL STARTER IN FIELD (NEARBY FAN)
Motorised Fire Damper	7	MCB DP	2CX1.5SQMM CU	

FIRST ANGLE PROJECTION ▲ ALL DIMENSIONS ARE IN MM

OWNER:	ADVANCE VENTILATION PVT LTD
PROJECT:	PANKI THERMAL POWER STATION (1X660MW)
C&S electric	C&S ELECTRIC LTD. C-59 NOIDA PHASE-II, NOIDA-201305 DIST. GAUTAM BUDH NAGAR (U.P)
TITLE	GENERAL NOTES FOR HVAC PANEL & DB

REV.					
	III -		IV -	DRG. NO.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022		II -	DRG. NO.	---

	Date	Name
Drawn	23.03.22	NITESH
Checked	24.03.22	GAURAV
Approved	24.03.22	GAURAV

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

CONSULTANT:-
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

Client	ADVANCE VENTILATION PVT LTD
Work	HVAC PANEL
Details	GENERAL NOTES
Order No.	22A-2051

DRG. NO.	REV.
AVPL/J3729/001	R1

SCALE: NTS	SHEET NO.	01
	NO. OF SHEET	03

GENERAL NOTES

A) SYSTEM:-

(a)	VOLTAGE (AC)	: 415V±10%, AC 3PH, 4W, 50Hz., SOLIDLY EARTHED.
(b)	FREQUENCY	: 50HZ. ±5%
(c)	FAULT LEVEL	: 50kA FOR 1 SEC. & 105kA PEAK.
(d)	AMBIENT TEMP.	: 50°C
(e)	MAX. TEMP. RISE OVER AND ABOVE AMBIENT	: 35°C

B) CONTROL VOLTAGE:-

(a)	AC CONTROL SUPPLY	: 110V AC,±10% 50HZ,±5%
(c)	SPACE HEATER	: 240V AC,±10% 50HZ,±5%

C) PANEL CONSTRUCTION:- : 3b, Type-2

1)	SHEET THICKNESS:	: IN mm. UNLESS SPECIFIED.
a)	LOAD BEARING MEMBERS	: 2.0mm. CRCA
b)	DOORS & COVERS	: 1.6mm. CRCA
c)	GLAND PLATE (FOR SINGLE CORE CABLE)	: 4mm. AL. (NON-MAGNETIC)
d)	GLAND PLATES (FOR MULTI CORE CABLE)	: 3mm. HRSS/CRCA.
e)	BASE FRAME	: 3mm. CRCA
f)	GASKET TYPE	: NEOPRENE
g)	CABLE ALLEY (WIDTH)	: 300mm.
h)	DEGREE OF PROTECTION	
	I) UPTO 1600A	: IP-52
	II) ABOVE 1600A	: IP-42
i)	PANEL TYPE (MCC)	: SINGLE FRONT DRAWOUT TYPE
j)	PANEL TYPE (DB)	: WALL MOUNTED NON-COMPERTMENTLIZED
k)	CABLE ENTRY	: BOTTOM
m)	PAINT SHADE:	
	I) COMPLETE PANEL(EXTERIOR & INTERIOR)	: RAL-7032
	II) MOUNTING PLATE & TROLLEYS	: RAL-9002
	I) PAINT THICKNESS/PROCESS	: MINIMUM 50 MICRONS (POWDER COATING)
	IV) PANEL SPACE HEATER	: IN EACH CABLE ALLEY

D) BUSBAR:-

a)	BUSBAR MATERIAL & GRADE TYPE	: HIGH CONDUCTIVITY ALUMINIUM ALLOY.
b)	EARTH BUSBAR MATERIAL TYPE	: 50X10mm2 G.I.THROUGHOUT LENGTH OF PANEL THE HORIZONTAL EARTH BUS SHALL PROJECT OUT OF THE PANEL AND SHALL HAVE AT LEAST TWO HOLES FOR EARTH CONNECTIONS.
c)	LIVE CONNECTION FROM BUSBAR TO SWITCHES	: SHALL BE SHROUDED
d)	BUSBAR, INSULATING SLEEVE	: HEAT SHRINKABLE PVC INSULATED-(UL224)
e)	COLOUR OF INSULATING SLEEVE	: BLACK
f)	PHASE IDENTIFICATION CODING	: COLOURED PVC TAPE AT SUITABLE INTERVALS
g)	ACCESSIBLE BUSBAR JOINTS	: REMOVABLE SHROUDS
h)	MINIMUM CLEARANCE BETWEEN VERTICAL/ HORIZONTAL/MAIN BUSBARS & ACB BUS LINKS	: PHASE TO PHASE - 25.0mm. : PHASE TO EARTH - 19.0mm.
i)	WHEREVER THE CLEARENCE/GAP BETWEEN THE TWO LIVE PARTS IS NOT POSSIBLE SUITABLE INSULATING SLEEVE TO BE PROVIDED TO MAINTAIN THE GAP OF MINIMUM 10mm.	
j)	SAFETY SHUTTER	: YES FOR MODULE TROLLEY

E) WIRING:- (STANDARD COPPER CONDUCTOR 1100V, GRADE)

CT CIRCUIT	: 2.5 mm2 (R,Y,B, BLACK)
SPACE HEATER CIRCUIT	: 2.5 mm2 (BLACK)
PT CIRCUIT	: 2.5 mm2 (R,Y,B)
AC CONTROL CIRCUIT	: 1.5 mm2 (BLACK)
DC CONTROL CIRCUIT	: 1.5 mm2 (GREY)
DOOR EARTHING	: 2.5 mm2 (GREEN)

REV.						
	III -		IV -		DRG. NO.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022		II -		DRG. NO.	---

	Date	Name	PROJECT:-				
Drawn	23.03.22	NITESH	PANKI THERMAL POWER STATION (1X660MW)	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04	Client	ADVANCE VENTILATION PVT LTD	DRG. NO. AVPL/J3729/001 / REV. R1
Checked	24.03.22	GAURAV	CONSULTANT:-		Work	HVAC PANEL	
Approved	24.03.22	GAURAV	ADVANCE VENTILATION PVT LTD , SONEPAT		Details	GENERAL NOTES	SCALE: NTS / SHEET NO. 02 / NO. OF SHEET 03
					Order No.	22A-2051	

GENERAL NOTES

F) OTHER NOTES:-

(a). NAME PLATE : ANODISED ALUMINIUM PLATE WITH BLACK BACKGROUND

(b). LETTER SIZE (FOR FEEDERS) : 5mm. SIZE WHITE LETTERS ENGRAVED

(b1).LETTER SIZE (FOR COMPONENT): 6mm. SIZE WHITE LETTERS PRINTED STICKER

(c). GLAND PLATE : UNDRILLED TYPE

(d). CONTROL TERMINALS : CAGE CLAMP / FIXED TYPE FOR FIXED MODULE
: PLUG IN TYPE FOR DRAWOUT MODULE

(e). WORKING HEIGHT OF POWER SWITCH, MINIMUM : 300MM (FROM FINISH FLOOR LEVEL)

(f). WORKING HEIGHT OF POWER SWITCH, MAXIMUM : 1900MM (FROM FINISH FLOOR LEVEL)

(g). RED FERRULE 'T' SHALL BE USED FOR TRIP CKT. WIRING OF BREAKER CUBICLES. AS SHOWN IN DRGS.

(h). PRINTED SINGLE TUBE FERRULE MARKED TO CORRESPONDENT WITH WIRING DIAGRAM SHALL BE PROVIDED.

(i). ALL CT TERMINALS SHALL BE DISCONNECTING TYPE WITH CT SHORTING FACILITY AND SUITABLE FOR RING TYPE LUGS. POWER TERMINAL SHALL BE SUITABLE FOR RING TYPE LUGS.

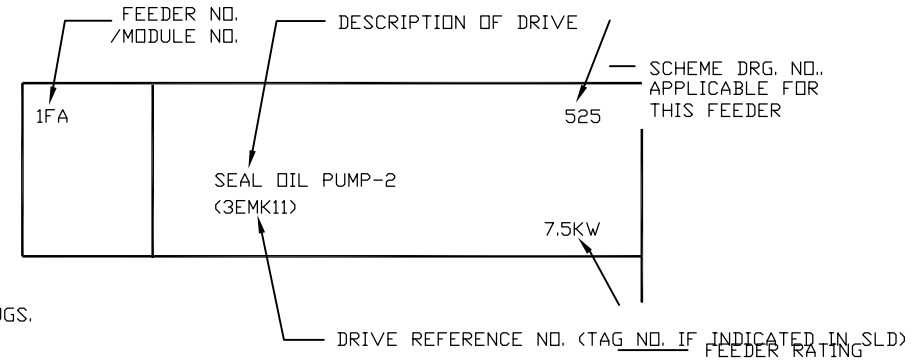
(j). PANELS SHALL HAVE PROVISION FOR EXTENSION AT BOTH ENDS.

(k). CAUTION NAME PLATE FOR CAUTION LIVE TERMINALS SHALL BE PROVIDED AT ALL POINTS WHERE THE TERMINALS ARE LIKELY TO REMAIN LIVE & ISOLATION IS POSSIBLE ONLY AT REMOTE END.

(l). DANGER NOTICE BOARD SHALL BE PROVIDED ON BOTH SIDES OF THE MCC.

(m). MCC's PROVIDED WITH MOTORIZED MCCB AS TWO INCOMERS SHALL BE PROVIDED WITH ELECTRICAL INTERLOCK TO PREVENT PARALLELING OF INCOMERS. (WHEREVER REQUIRED)

(r). FEEDER DESCRIPTION PLATES AS PER FOLLOWING SAMPLE SHALL BE PROVIDED EMPTY COMPARTMENT LABELS SHALL BE WITH COMPARTMENT NUMBERS ONLY. DIMENSIONS FOR NAME PLATE SHALL BE AS PER MANUFACTURER'S STANDARD.



TYPICAL EXAMPLE FOR FEEDER DESCRIPTION PLATE

(s). MODULE OF SAME SIZE & TYPE SHALL BE PHYSICALLY & ELECTRICALLY INTERCHANGEABLE.

I) SIZE OF INTER MODULE POWER WIRING SHALL BE AS FOLLOWS :-

b) POWER WIRING FOR SWITCH FUSE/MCCB FEEDERS

RATING	WIRE/SOLID LINK SIZE	COLOUR OF WIRE
25A	4mm2 FLEX. CU.	BLACK WITH COLOUR CODING
32A	6mm2 FLEX. CU.	"
63A	16mm2 FLEX. CU.	"
100A	35mm2 FLEX. CU.	"
125A	50mm2 FLEX. CU.	"
250A	25X8mm2 TINNED CU. / 25X10mm2 AL./Eq.	-
400A	30X10mm2 TINNED CU. / 40X10mm2 AL./Eq.	-
630A	40X10mm2 TINNED CU. / 50X12mm2 AL./Eq.	-

REV.						
	III -		IV -		DRG. NO.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022		II -		DRG. NO.	---

	Date	Name
Drawn	23.03.22	NITESH
Checked	24.03.22	GAURAV
Approved	24.03.22	GAURAV

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

CONSULTANT:-
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

Client	ADVANCE VENTILATION PVT LTD
Work	HVAC PANEL
Details	GENERAL NOTES
Order No.	22A-2051

DRG. NO.	REV.
AVPL/J3729/001	R1
SCALE: NTS	SHEET NO. 03
	NO. OF SHEET 03

GENERAL ARRANGEMENT DRAWING OF HVAC PANEL

REV.		
	III -	IV -
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022	II -

	Date	Name
Drawn	23.03.22	NITESH
Checked	24.03.22	GAURAV
Approved	24.03.22	GAURAV

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER:-
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S electric

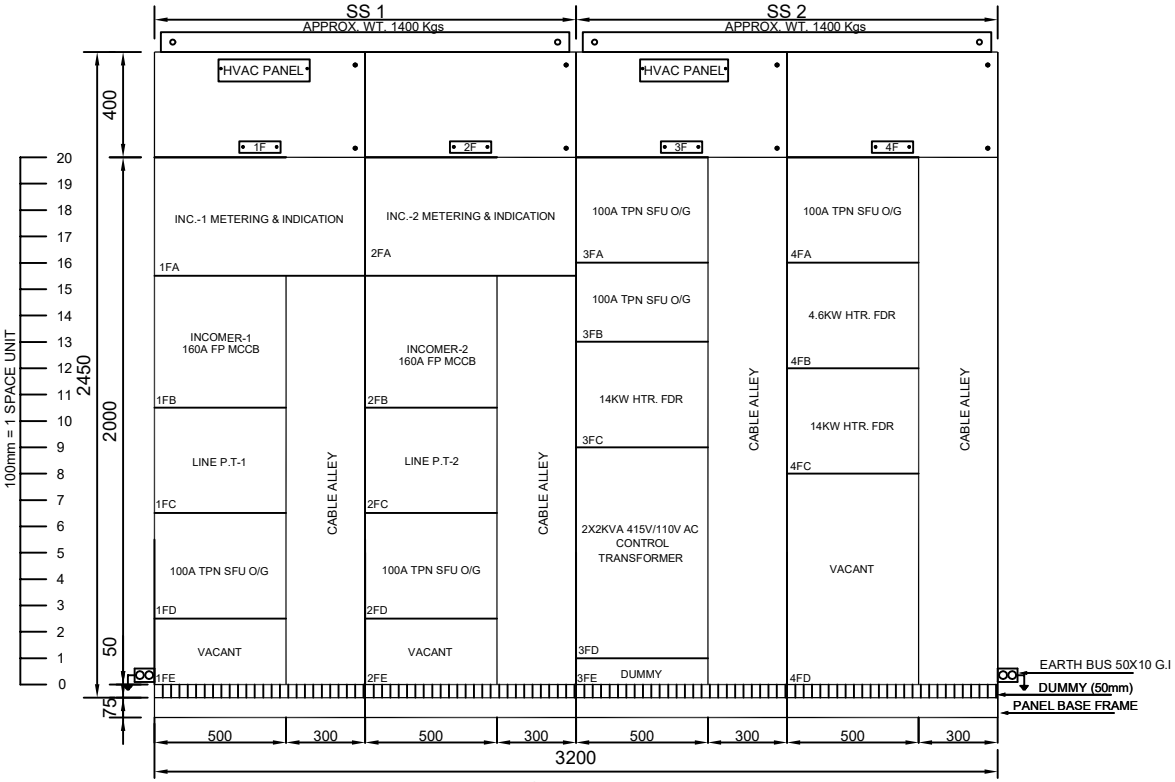
C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)

FORMAT No. : QAF-04/04

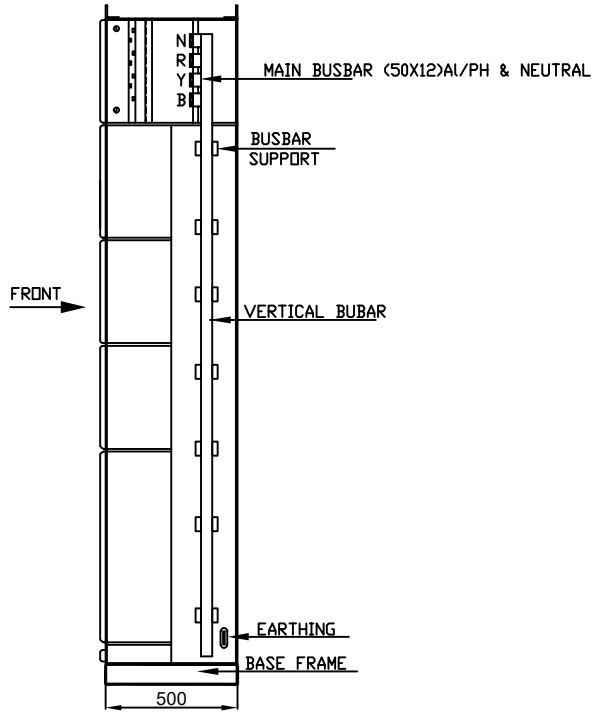
PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
DRG. NO.	---
Client	ADVANCE VENTILATION PVT LTD
Work	HVAC PANEL
Details	GENERAL ARRANGEMENT DRAWING
P.O NO-	22A-2051

DRG. NO.	REV.
AVPL/J3729/201	R1

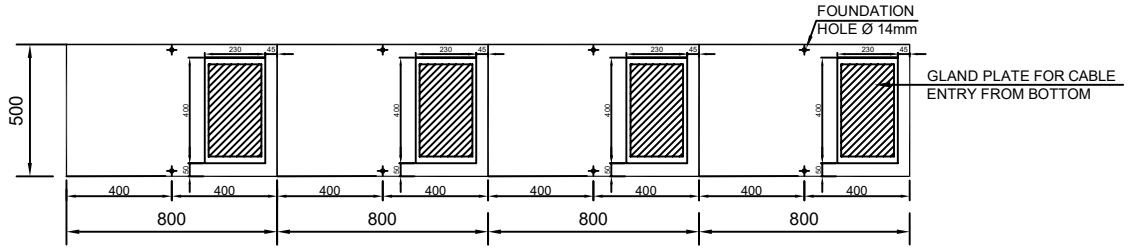
SCALE: NTS	SHEET NO.	01
	NO. OF SHEET	02



FRONT VIEW



SECTIONAL SIDE VIEW
SINGLE FRONT MCC (TYPICAL)

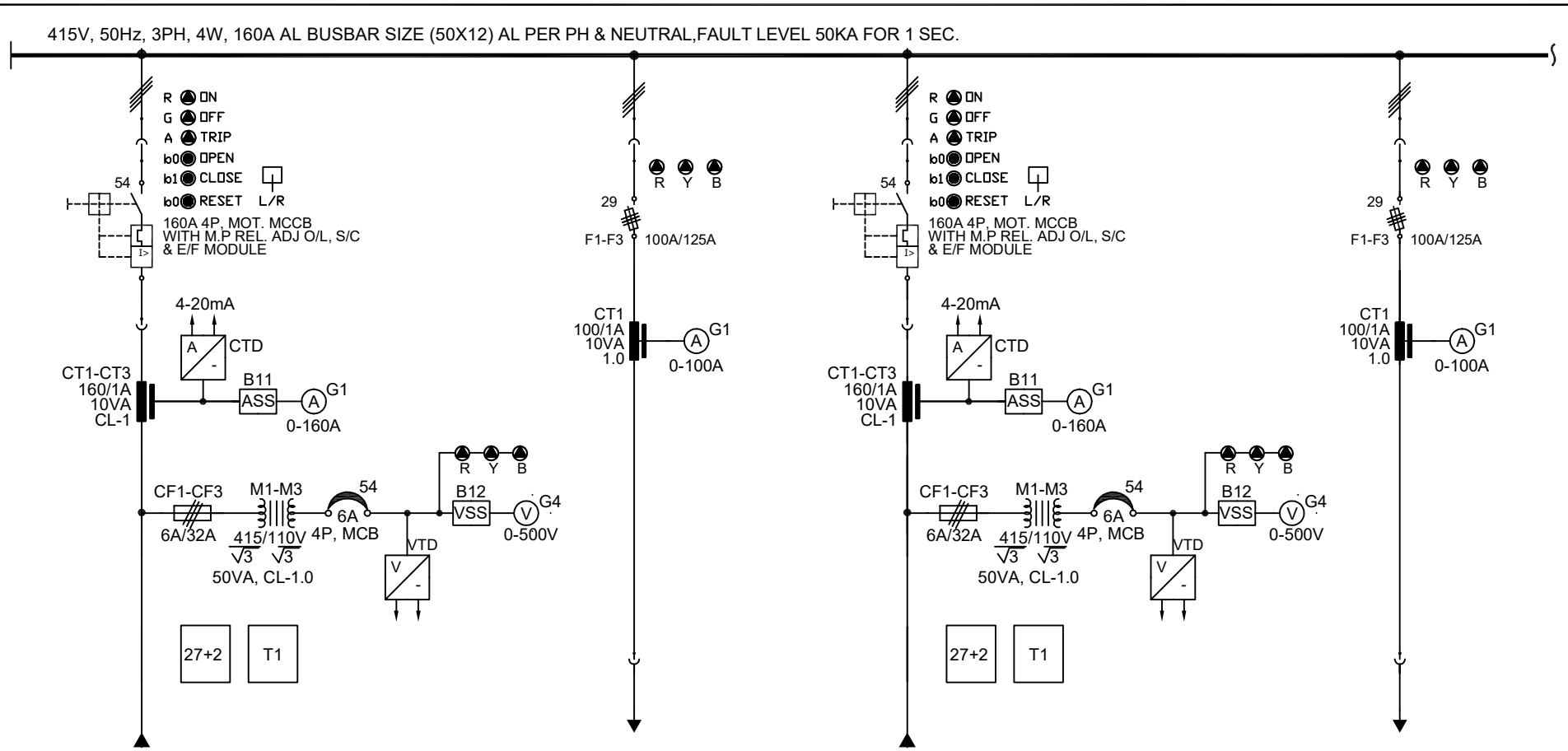


FOUNDATION VIEW

REV.	III -			IV -		PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI		
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022			II -		DRG. NO.	---		
	Date	Name	PROJECT:- PANKI THERMAL POWER STATION (1X660MW)	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04		Client ADVANCE VENTILATION PVT LTD	DRG. NO. AVPL/J3729/201	REV. R1	
Drawn	23.03.22	NITESH				Work HVAC PANEL			
Checked	24.03.22	GAURAV	OWNER:- ADVANCE VENTILATION PVT LTD , SONEPAT			Details GENERAL ARRANGEMENT DRAWING			
Approved	24.03.22	GAURAV				P.O NO- 22A-2051	SCALE: NTS	SHEET NO. 02	NO. OF SHEET 02

SINGLE LINE DIAGRAM OF HVAC PANEL

REV.							
	III -			IV -		PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022			II -		DRG. NO.	---
	Date	Name	PROJECT:- PANKI THERMAL POWER STATION (1X660MW)	C&S electric	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04	Client ADVANCE VENTILATION PVT LTD	DRG. NO. AVPL/J3729/101 / REV. R1
Drawn	23.03.22	NITESH				Work HVAC PANEL	
Checked	24.03.22	GAURAV	OWNER:- ADVANCE VENTILATION PVT LTD , SONEPAT			Details SINGLE LINE DIAGRAM	
Approved	24.03.22	GAURAV				P.O NO- 22A-2051	SCALE: NTS / SHEET NO. 01 / NO. OF SHEET 04



FEEDER / COMPT. NO.	1FA, 1FB & 1FC	1FD	2FA, 2FB & 2FC	2FD
FEEDER RATING	160A	100A(19KW)	160A	100A(19KW)
FEEDER DESCRIPTION	INCOMER-1 FROM ACDB	PACKAGE AC 16.5TR-1	INCOMER-2 FROM ACDB	PACKAGE AC 16.5TR-3
POWER CABLE (mm^2)	----	3.5CX25 SQMM AL.	----	3.5CX25 SQMM AL.
CONTROL CABLE (mm^2)				
FEEDER TYPE	MCCB I/C	SFU O/G (TP+N)	MCCB I/C	SFU O/G (TP+N)
SCHEME DWG. NO.	AVPL/J3729/501	AVPL/J3729/502	AVPL/J3729/501	AVPL/J3729/502

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	III -		IV -		
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022		II -	DRG. NO.	---

	Date	Name
Drawn	23.03.22	NITESH
Checked	24.03.22	GAURAV
Approved	24.03.22	GAURAV

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER:-
ADVANCE VENTILATION PVT LTD , SONEPAT

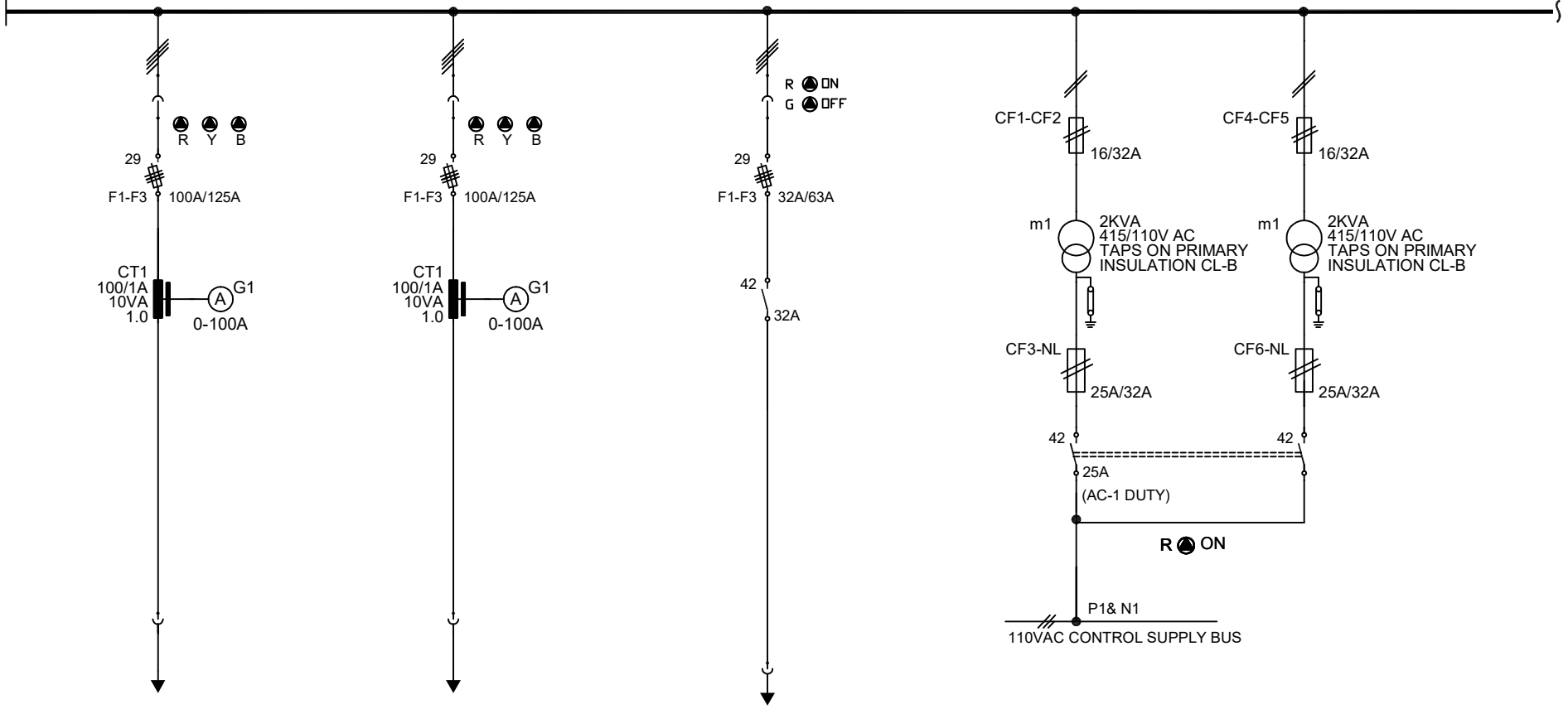
C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)

FORMAT No. : QAF-04/04

Client	ADVANCE VENTILATION PVT LTD
Work	HVAC PANEL
Details	SINGLE LINE DIAGRAM
P.O NO-	22A-2051

DRG. NO.	REV.
AVPL/J3729/101	R1
SCALE: NTS	SHEET NO. 02
	NO. OF SHEET 04



FEEDER / COMPT. NO.	3FA	3FB	3FC	3FD
FEEDER RATING	100A(19KW)	100A(19KW)	14KW	2X2KVA
FEEDER DESCRIPTION	SPARE	TO DB	SPARE	CONTROL TRANSFORMER
				110V, AC CONTROL SUPPLY
POWER CABLE (mm^2)	----	3.5CX25 SQMM AL.	----	----
CONTROL CABLE (mm^2)				
FEEDER TYPE	SFU O/G (TP+N)	SFU O/G (TP+N)	HTR. FDR.	CST
SCHEME DWG. NO.	AVPL/J3729/502	AVPL/J3729/502	AVPL/J3729/503	AVPL/J3729/504

REV.			
	III -	IV -	PROJECT DOC. REF. M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022	II -	DRG. NO. ---

	Date	Name
Drawn	23.03.22	NITESH
Checked	24.03.22	GAURAV
Approved	24.03.22	GAURAV

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER:-
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

Client ADVANCE VENTILATION PVT LTD
Work HVAC PANEL
Details SINGLE LINE DIAGRAM
P.O NO- 22A-2051

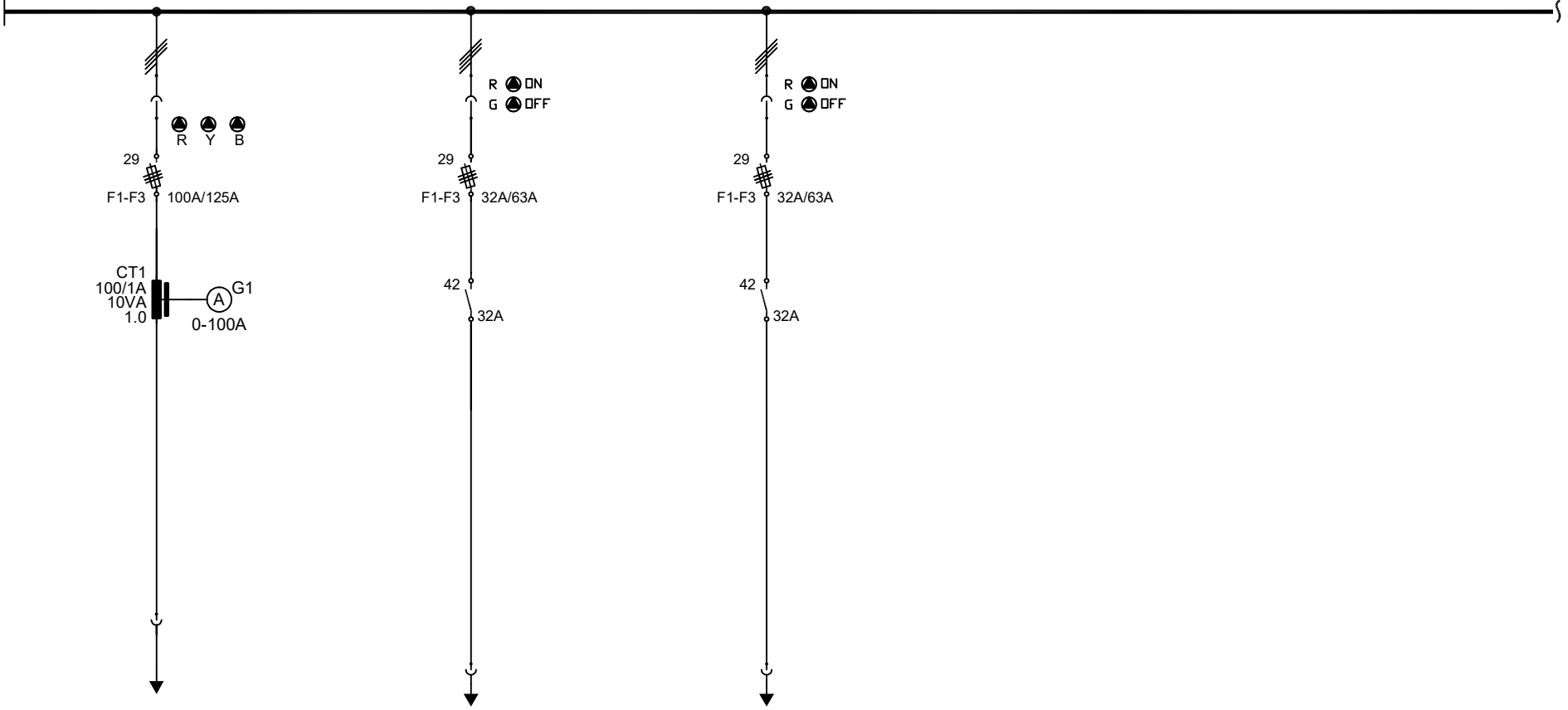
DRG. NO. AVPL/J3729/101

REV. R1

SCALE: NTS

SHEET NO. 03
NO. OF SHEET 04

415V, 50Hz, 3PH, 4W, 160A AL BUSBAR SIZE (50X12) AL PER PH & NEUTRAL,FAULT LEVEL 50KA FOR 1 SEC.



FEEDER / COMPT. NO.	4FA	4FB	4FC
FEEDER RATING	100A(19KW)	4.6KW	14KW
FEEDER DESCRIPTION	PACKAGE AC 16.5TR-2	HUMIDIFIER HEATER	DUCT HEATER
POWER CABLE (mm^2)	3.5CX25 SQMM AL.	4CX4 SQMM CU.	3.5CX25 SQMM AL.
CONTROL CABLE (mm^2)			
FEEDER TYPE	SFU O/G (TP+N)	HTR. FDR.	HTR. FDR.
SCHEME DWG. NO.	AVPL/J3729/502	AVPL/J3729/503	AVPL/J3729/503

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	III -		IV -		
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022		II -	DRG. NO.	---

	Date	Name
Drawn	23.03.22	NITESH
Checked	24.03.22	GAURAV
Approved	24.03.22	GAURAV

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER:-
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)

FORMAT No. : QAF-04/04

Client ADVANCE VENTILATION PVT LTD
Work HVAC PANEL
Details SINGLE LINE DIAGRAM
P.O NO- 22A-2051

DRG. NO. AVPL/J3729/101

REV. R1

SCALE: NTS

SHEET NO.	04
NO. OF SHEET	04

GENERAL ARRANGEMENT DRAWING OF WALL MOUNTED DB

REV.		
	III -	IV -
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022

	Date	Name
Drawn	23.03.22	NITESH
Checked	24.03.22	GAURAV
Approved	24.03.22	GAURAV

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER:-
ADVANCE VENTILATION PVT LTD , SONEPAT

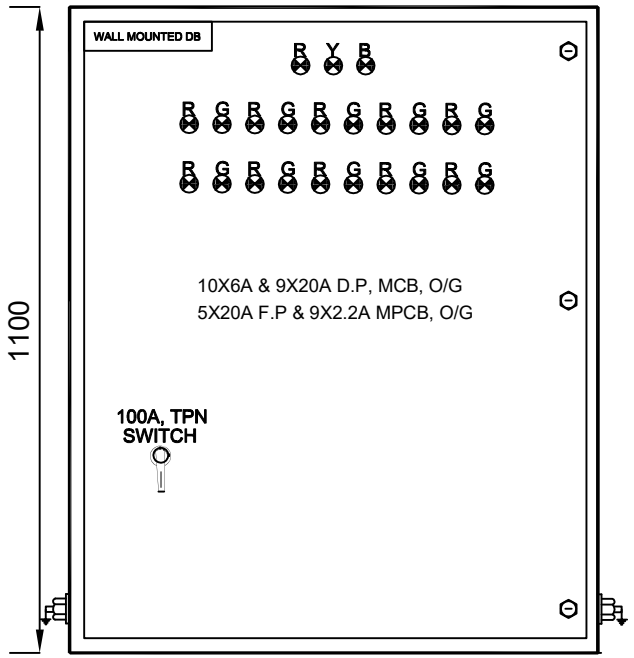
C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

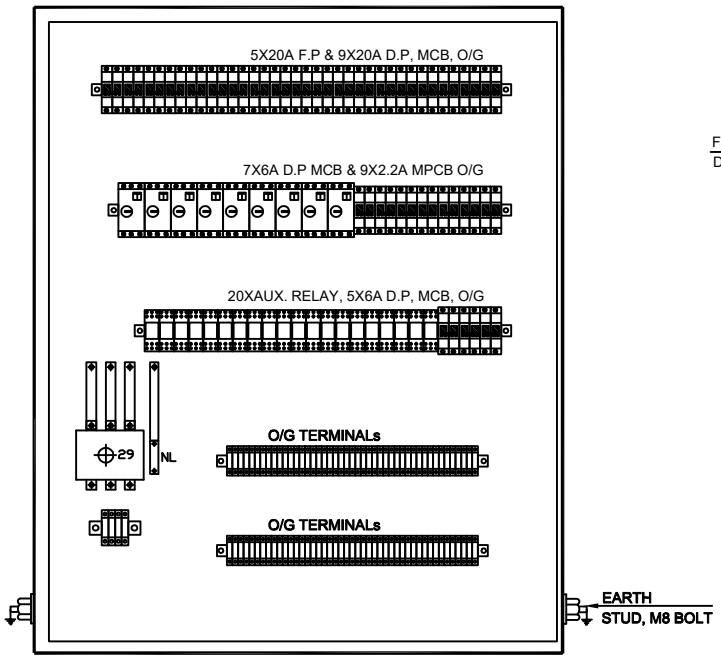
PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
DRG. NO.	---
Client	ADVANCE VENTILATION PVT LTD
Work	WALL MOUNTED DB
Details	GENERAL ARRANGEMENT DRAWING
P.O NO-	22A-2051

DRG. NO.	REV.
AVPL/J3729/202	R2

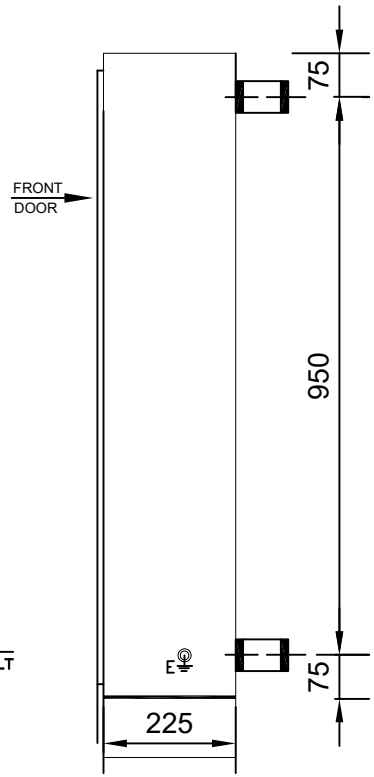
SCALE: NTS	SHEET NO.	01
	NO. OF SHEET	02



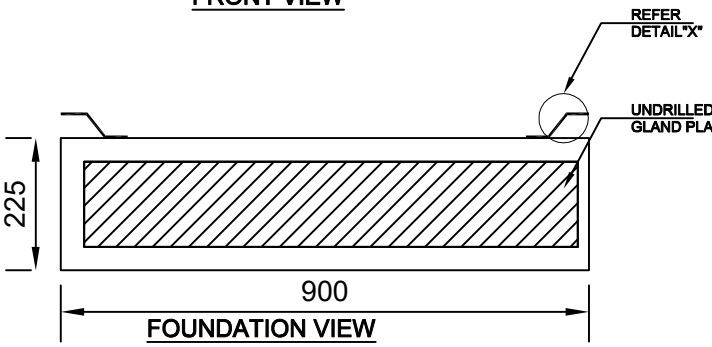
FRONT VIEW



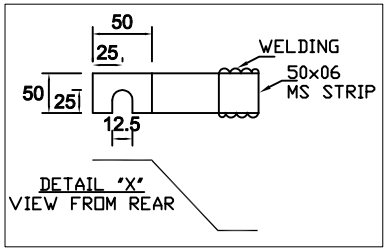
INTERNAL VIEW



SIDE VIEW



FOUNDATION VIEW



DB MOUNTING CLAMP DETAIL

REV.	III -			IV -			PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI		
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022			I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022			DRG. NO.	---		
	Date	Name	PROJECT:- PANKI THERMAL POWER STATION (1X660MW)	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04			Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	23.03.22	NITESH					Work	WALL MOUNTED DB	AVPL/J3729/202	R2
Checked	24.03.22	GAURAV	OWNER:- ADVANCE VENTILATION PVT LTD , SONEPAT				Details	GENERAL ARRANGEMENT DRAWING		
Approved	24.03.22	GAURAV					P.O NO- 22A-2051		SCALE: NTS SHEET NO. 02 / NO. OF SHEET 02	

SINGLE LINE DIAGRAM OF WALL MOUNTED DB

REV.						
	III -			IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022			I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	DRG. NO.	---

	Date	Name
Drawn	23.03.22	NITESH
Checked	24.03.22	GAURAV
Approved	24.03.22	GAURAV

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER:-
ADVANCE VENTILATION PVT LTD , SONEPAT

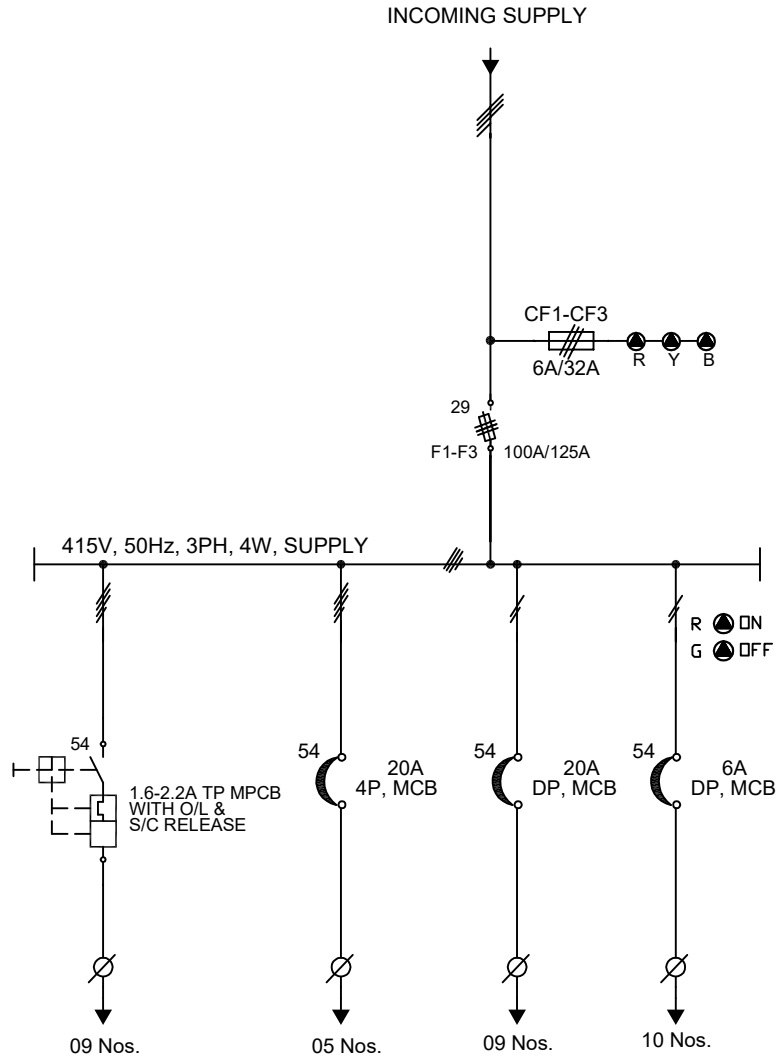
C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

Client	ADVANCE VENTILATION PVT LTD
Work	WALL MOUNTED DB
Details	SINGLE LINE DIAGRAM
P.O NO-	22A-2051

DRG. NO.	REV.
AVPL/J3729/102	R2

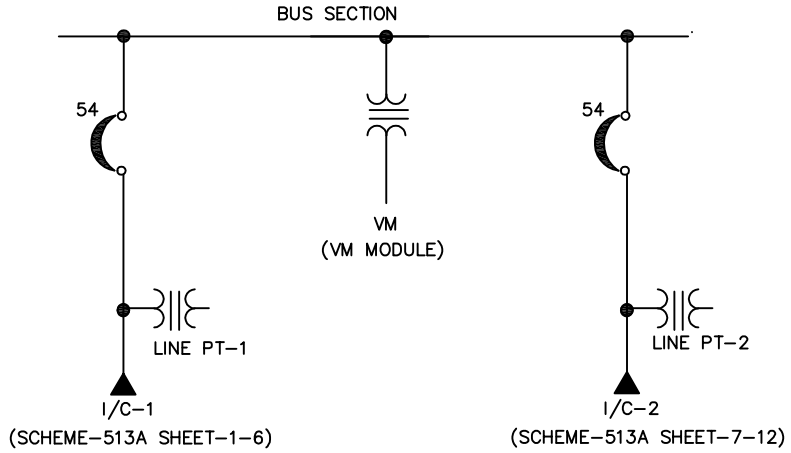
SCALE: NTS	SHEET NO.	01
	NO. OF SHEET	02



FEEDER DESCRIPTION LIST

DESCRIPTION	RATING	CABLE SIZE
CASSETE AC 3TR-1	20A FP	4CX2.5SQMM CU
CASSETE AC 3TR-2	20A FP	4CX2.5SQMM CU
CASSETE AC 3TR-3	20A FP	4CX2.5SQMM CU
CASSETE AC 3TR-4	20A FP	4CX2.5SQMM CU
SPARE	20A FP	--
CASSETE AC 2TR-1	20A DP	2CX2.5SQMM CU
CASSETE AC 2TR-2	20A DP	2CX2.5SQMM CU
CASSETE AC 2TR-3	20A DP	2CX2.5SQMM CU
CASSETE AC 2TR-4	20A DP	2CX2.5SQMM CU
CASSETE AC 2TR-5	20A DP	2CX2.5SQMM CU
CASSETE AC 2TR-6	20A DP	2CX2.5SQMM CU
CASSETE AC 2TR-7	20A DP	2CX2.5SQMM CU
SPARE	20A DP	--
SPARE	20A DP	--
MOTORISED FIRE DAMPER-1	6A DP	2CX1.5SQMM CU
MOTORISED FIRE DAMPER-2	6A DP	2CX1.5SQMM CU
MOTORISED FIRE DAMPER-3	6A DP	2CX1.5SQMM CU
MOTORISED FIRE DAMPER-4	6A DP	2CX1.5SQMM CU
MOTORISED FIRE DAMPER-5	6A DP	2CX1.5SQMM CU
MOTORISED FIRE DAMPER-6	6A DP	2CX1.5SQMM CU
MOTORISED FIRE DAMPER-7	6A DP	2CX1.5SQMM CU
SPARE	6A DP	--
SPARE	6A DP	--
SPARE	6A DP	--
SUPPLY AIR FAN (10000)CMH 0.75KW-1	1.6-2.2A TP MPCB	3CX2.5SQMM CU
SUPPLY AIR FAN (10000)CMH 0.75KW-2	1.6-2.2A TP MPCB	3CX2.5SQMM CU
SUPPLY AIR FAN (10000)CMH 0.75KW-3	1.6-2.2A TP MPCB	3CX2.5SQMM CU
SUPPLY AIR FAN (10000)CMH 0.75KW-4	1.6-2.2A TP MPCB	3CX2.5SQMM CU
EXHAUST AIR FAN (11500)CMH 0.75KW-1	1.6-2.2A TP MPCB	3CX2.5SQMM CU
EXHAUST AIR FAN (11500)CMH 0.75KW-2	1.6-2.2A TP MPCB	3CX2.5SQMM CU
EXHAUST FAN (4000)CMH 0.55KW	1.6-2.2A TP MPCB	3CX2.5SQMM CU
SPARE	1.6-2.2A TP MPCB	--
SPARE	1.6-2.2A TP MPCB	--

REV.	III -			IV -		PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI	
	I - REVISED AS PER CLIENT COMMENTS DATED 21.05.2022			I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		DRG. NO.	---	
	Date	Name	PROJECT:- PANKI THERMAL POWER STATION (1X660MW)	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04		Client ADVANCE VENTILATION PVT LTD	DRG. NO. AVPL/J3729/102	REV. R2
Drawn	23.03.22	NITESH				Work WALL MOUNTED DB		
Checked	24.03.22	GAURAV	OWNER:- ADVANCE VENTILATION PVT LTD , SONEPAT			Details SINGLE LINE DIAGRAM	SCALE: NTS	SHEET NO. 02
Approved	24.03.22	GAURAV				P.O NO- 22A-2051		NO. OF SHEET 02

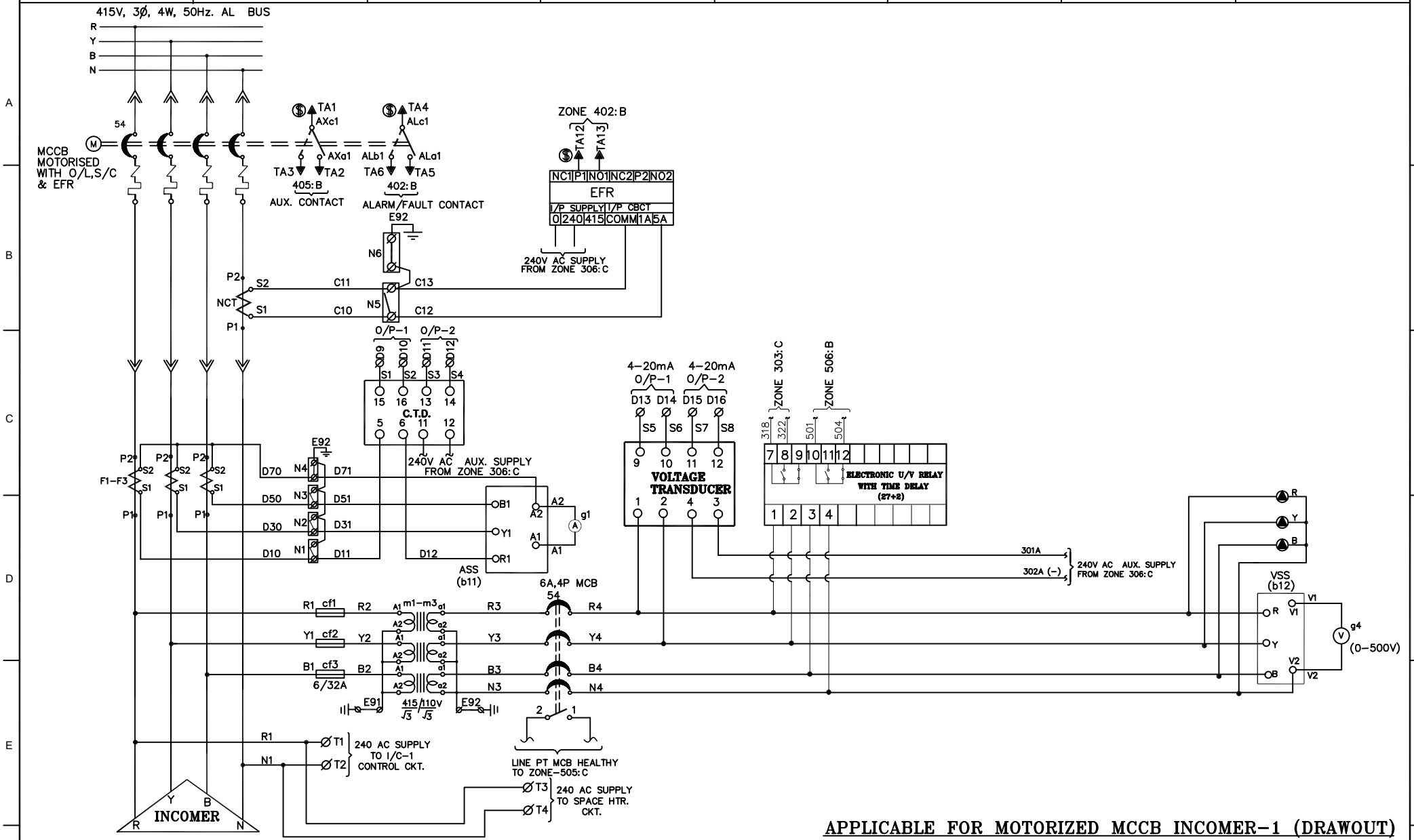


CONTROL SCHEME FOR CHANGEOVER BETWEEN TWO MCCB INCOMER, 3PHASE, 4WIRE MODULE TYPE MCCB I/C - AUX. SUPPLY-240V AC

OWNER:	ADVANCE VENTILATION PVT LTD
PROJECT:	PANKI THERMAL POWER STATION (1X660MW)
C&S electric	C&S ELECTRIC LTD. C–59 NOIDA PHASE–II, NOIDA–201305 DIST. GAUTAM BUDH NAGAR (U.P)
TITLE	SCHEMATIC DIAGRAM FOR MODULE TYPE–MCCB I/C

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI		
	III -		IV -				
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.			

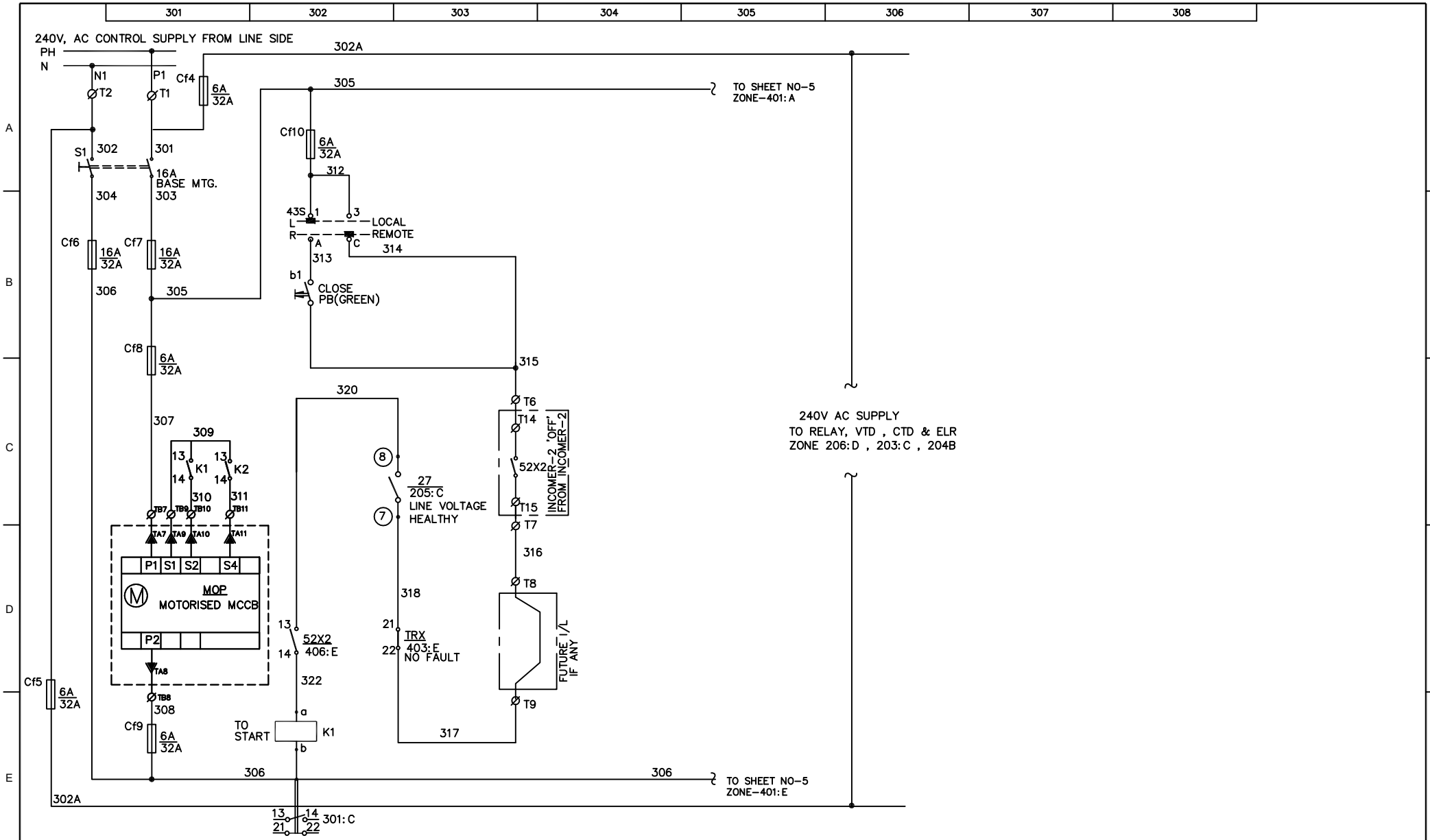
	Date	Name	PROJECT:-	C&S electric	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04	Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)			Work	INCOMER-1, MODULE TYPE-MCCB I/C	AVPL/J3729/501	R1
Checked	29.04.2022	D. GIRI	OWNER			Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT			Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 1 / NO.OF SHEET 12



APPLICABLE FOR MOTORIZED MCCB INCOMER-1 (DRAWOUT)

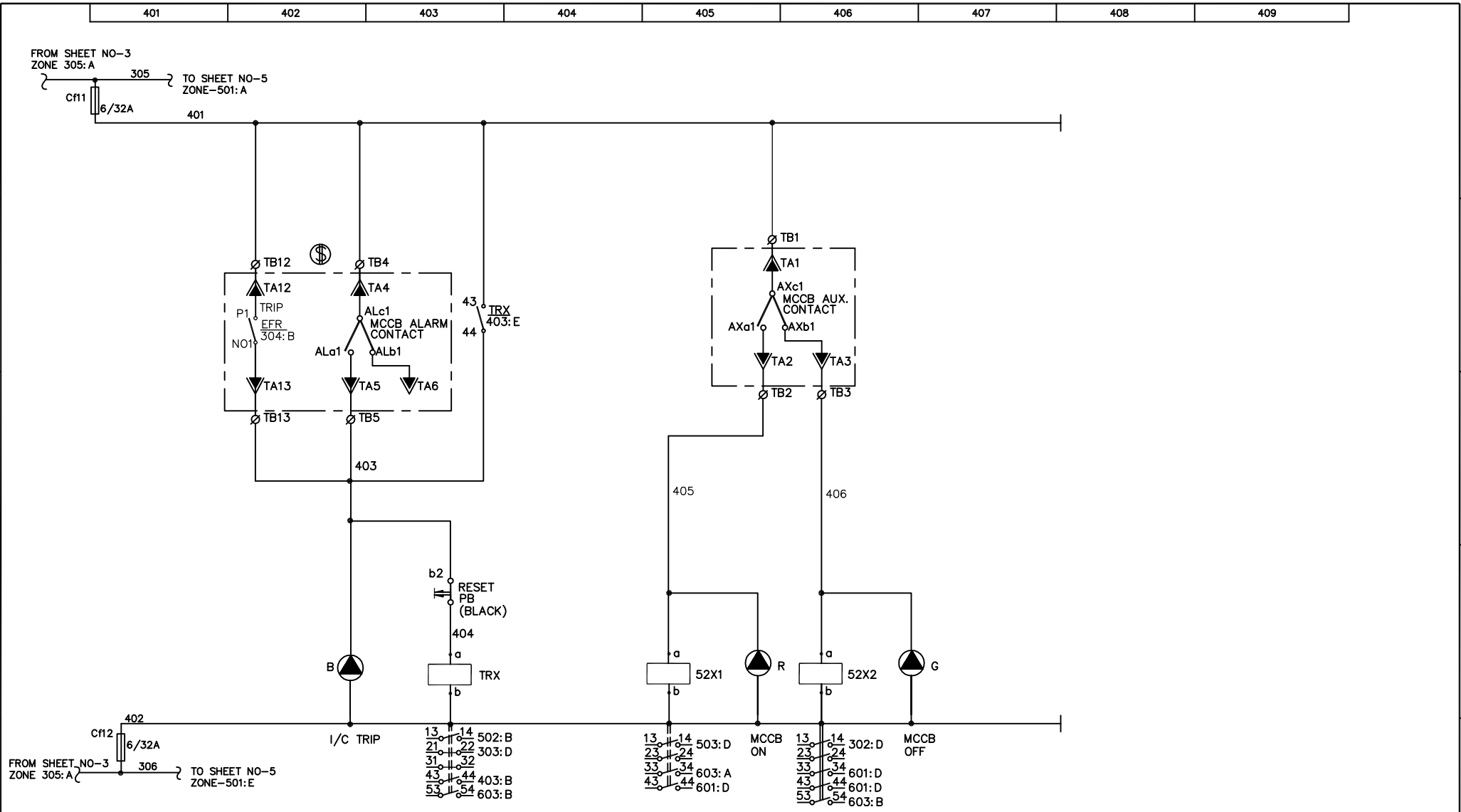
REV.	III -	IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI	
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.		

	Date	Name	PROJECT:-	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04	Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)		Work	INCOMER-1, MODULE TYPE-MCCB I/C	AVPL/J3729/501	R1
Checked	29.04.2022	D. GIRI	OWNER		Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT		Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 2 / NO.OF SHEET 12



INCOMER-1

REV.	III -		IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI		
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.			
	Date	Name	PROJECT:- PANKI THERMAL POWER STATION (1X660MW)	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04	Client	ADVANCE VENTILATION PVT LTD	DRG. NO. AVPL/J3729/501	REV. R1
Drawn	28.04.2022	NITESH			Work	INCOMER-1, MODULE TYPE-MCCB I/C		
Checked	29.04.2022	D. GIRI	OWNER ADVANCE VENTILATION PVT LTD , SONEPAT		Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI			Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 3 / NO.OF SHEET 12

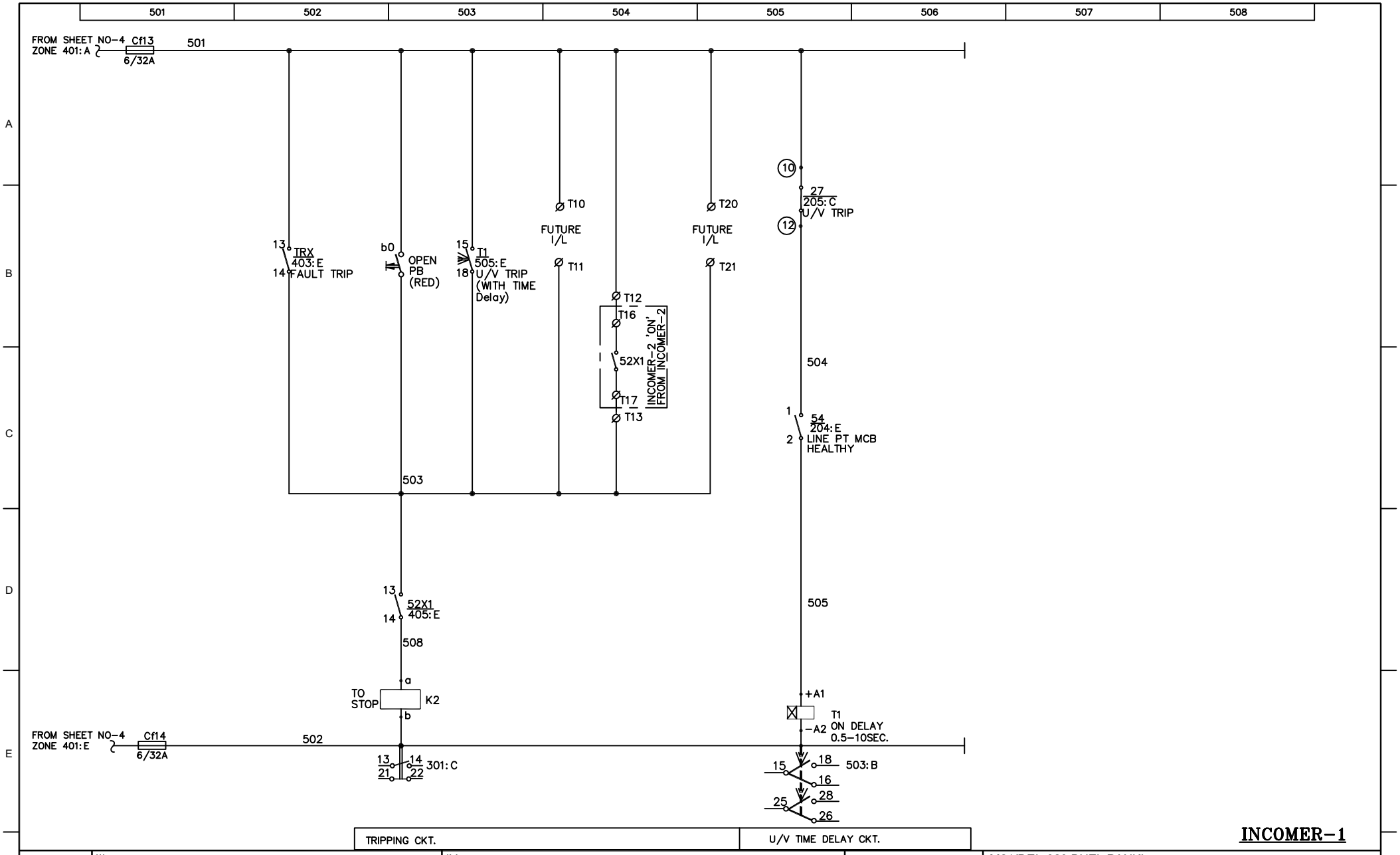


FAULT CKT.	MCCB ON CONTACT MULTIPLICATION	MCCB OFF CONTACT MULTIPLICATION

INCOMER-1

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI		
	III -		IV -				
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.			

	Date	Name	PROJECT:-		Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04	Work	INCOMER-1, MODULE TYPE-MCCB I/C	AVPL/J3729/501	R1
Checked	29.04.2022	D. GIRI	OWNER		Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT		Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 4 / NO.OF SHEET 12

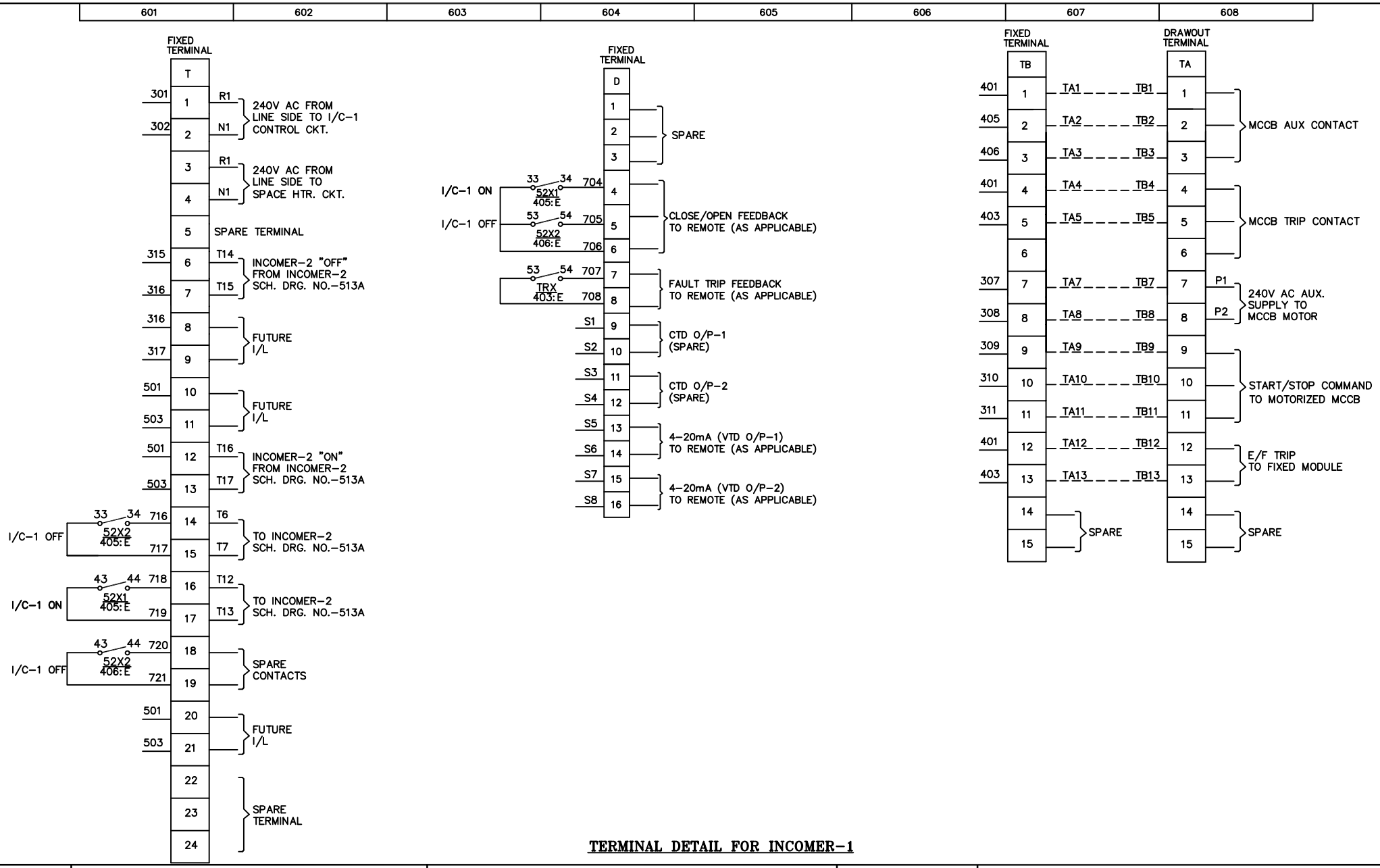


INCOMER-1

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI		
	III -		IV -				
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.			
	Date	Name	PROJECT:-	Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)	Work	INCOMER-1, MODULE TYPE-MCCB I/C	AVPL/J3729/501	R1
Checked	29.04.2022	D. GIRI	OWNER	Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT	Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 5 / NO.OF SHEET 12

C&S electric

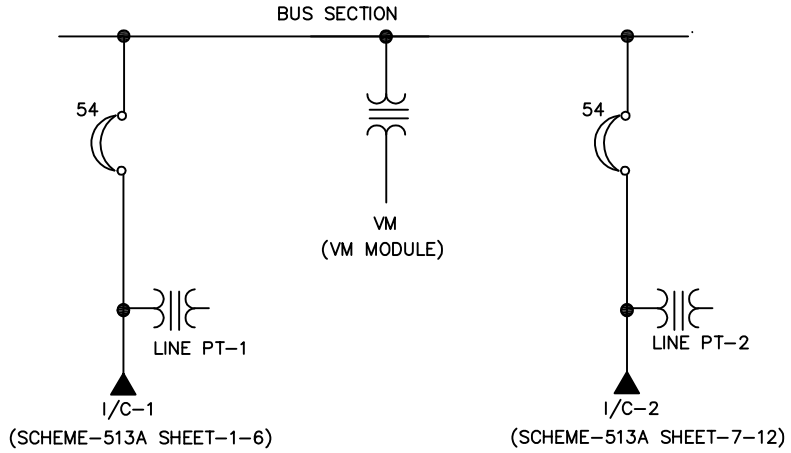
C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04



TERMINAL DETAIL FOR INCOMER-1

REV.	III -	IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.	

	Date	Name	PROJECT:-	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04	Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)		Work	INCOMER-1, MODULE TYPE-MCCB I/C	AVPL/J3729/501	R1
Checked	29.04.2022	D. GIRI	OWNER		Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT		Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 6 / NO.OF SHEET 12

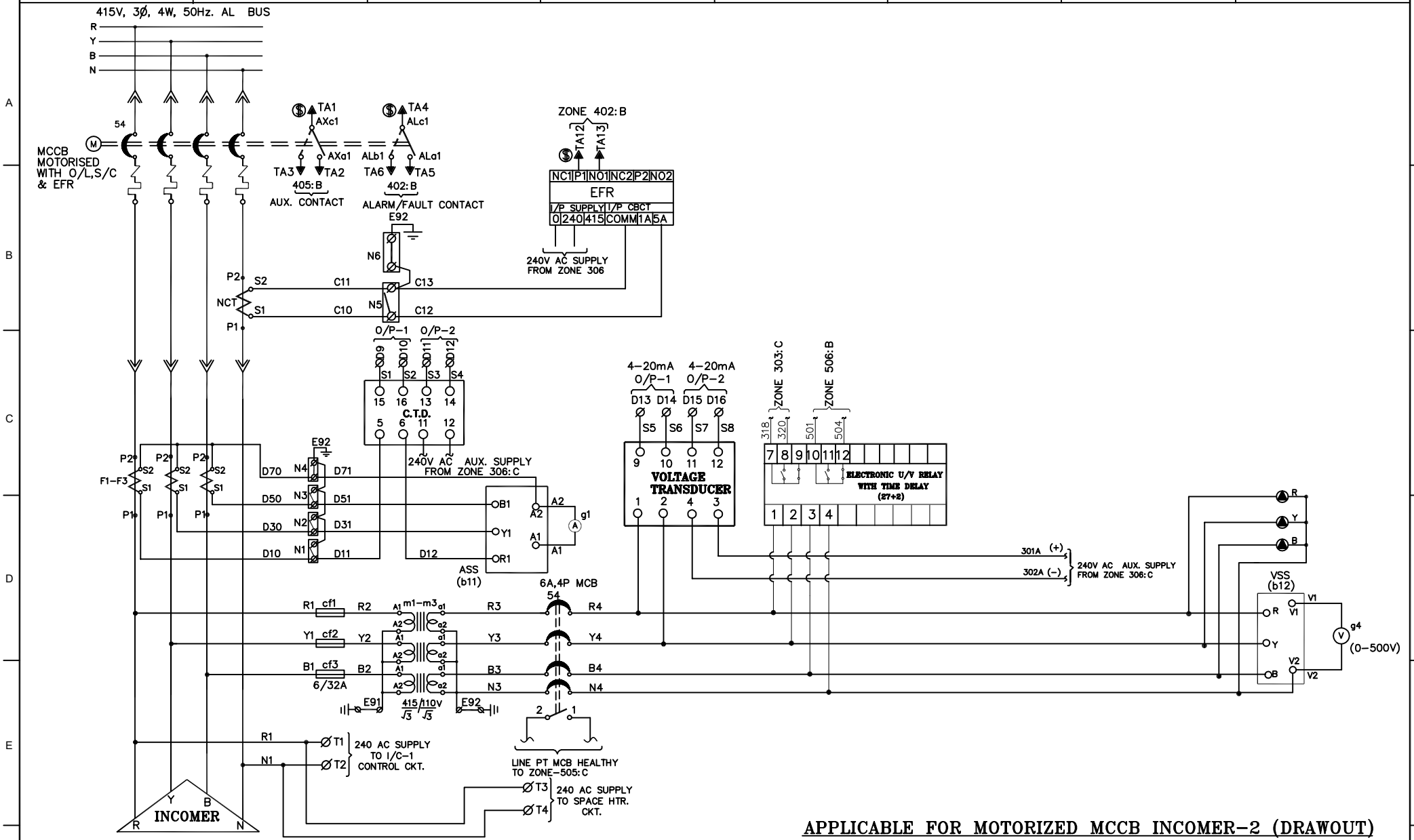


CONTROL SCHEME FOR CHANGEOVER BETWEEN TWO MCCB INCOMER, 3PHASE, 4WIRE MODULE TYPE MCCB I/C - AUX. SUPPLY-240V AC

OWNER:	ADVANCE VENTILATION PVT LTD
PROJECT:	PANKI THERMAL POWER STATION (1X660MW)
C&S electric	C&S ELECTRIC LTD. C–59 NOIDA PHASE–II, NOIDA–201305 DIST. GAUTAM BUDH NAGAR (U.P)
TITLE	SCHEMATIC DIAGRAM FOR MODULE TYPE–MCCB I/C

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI		
	III -		IV -				
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.			
	Date	Name	PROJECT:- PANKI THERMAL POWER STATION (1X660MW)	C&S electric	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04	Client	ADVANCE VENTILATION PVT LTD
Drawn	28.04.2022	NITESH				Work	INCOMER-2, MODULE TYPE-MCCB I/C
Checked	29.04.2022	D. GIRI	OWNER ADVANCE VENTILATION PVT LTD , SONEPAT			Details	SCHEMATIC / WIRING DIAGRAM
Approved	29.04.2022	D. GIRI				Order No.	22A-2051 DATED 02.02.2022

DRG. NO.	REV.
AVPL/J3729/501	R1
SCALE: NTS	SHEET NO. 7 / NO.OF SHEET 12



APPLICABLE FOR MOTORIZED MCCB INCOMER-2 (DRAWOUT)

REV.	III -	IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI	
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.		

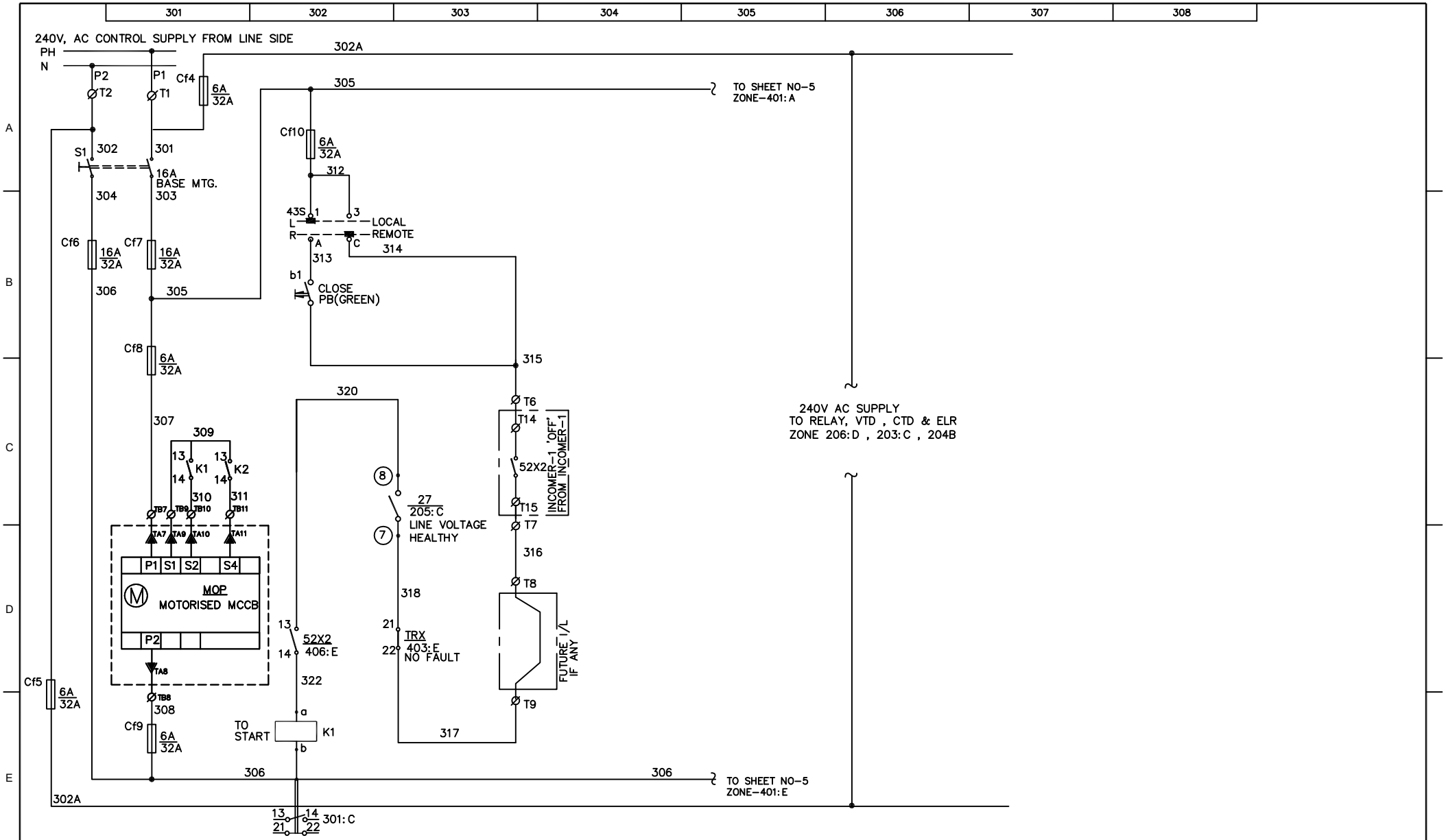
	Date	Name
Drawn	28.04.2022	NITESH
Checked	29.04.2022	D. GIRI
Approved	29.04.2022	D. GIRI

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)
OWNER
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

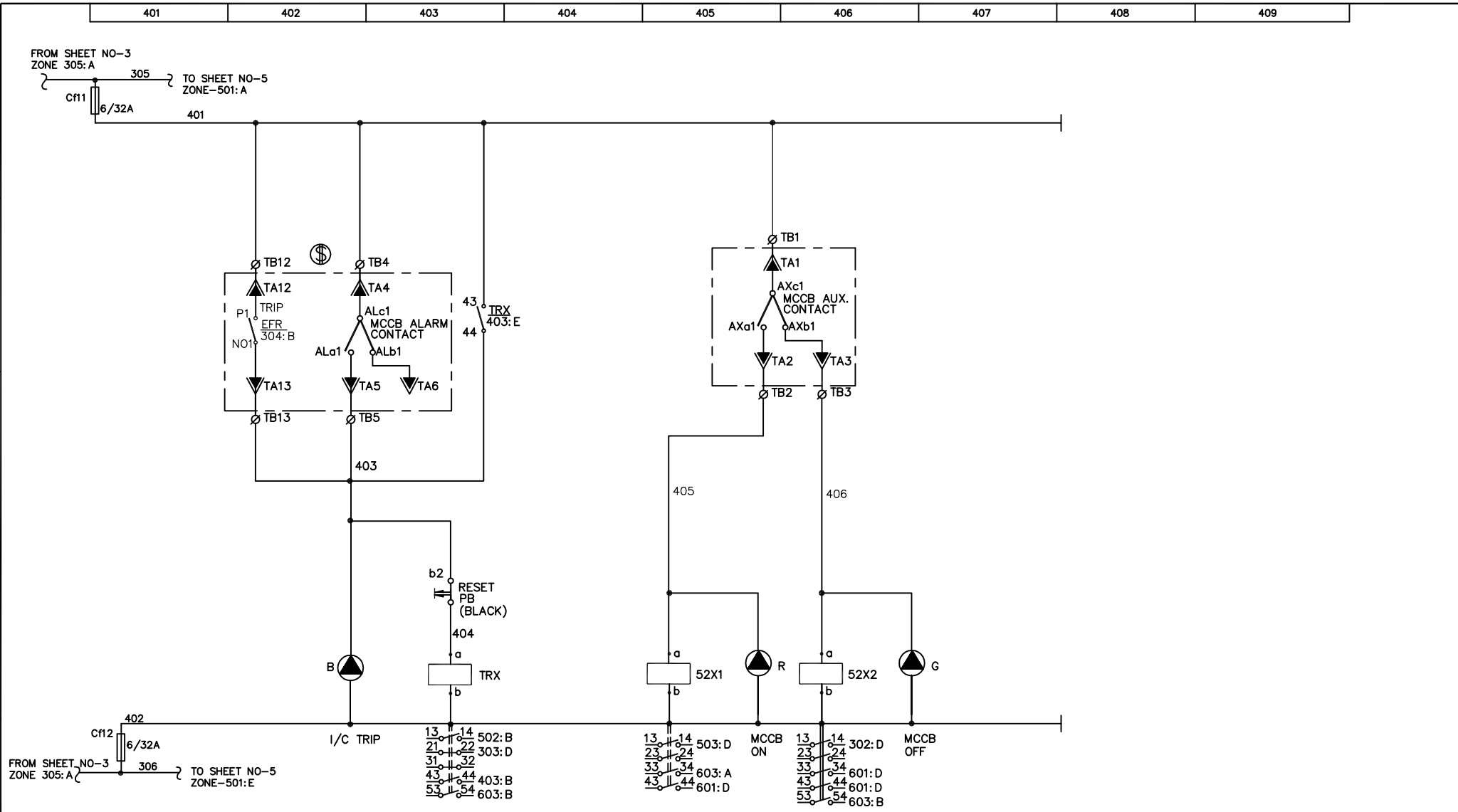
Client	ADVANCE VENTILATION PVT LTD	DRG. NO.		REV.
Work	INCOMER-2, MODULE TYPE-MCCB I/C	AVPL/J3729/501		R1
Details	SCHEMATIC / WIRING DIAGRAM			
Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO.	8
			NO.OF SHEET	12



INCOMER-2

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI		
	III -		IV -				
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.			

	Date	Name	PROJECT:-	C&S ELECTRIC LTD.	Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)	C-59, NOIDA PHASE II, NOIDA - 201305	Work	INCOMER-2, MODULE TYPE-MCCB I/C	AVPL/J3729/501	R1
Checked	29.04.2022	D. GIRI	OWNER	DIST. GAUTAM BUDH NAGAR (U.P)	Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT	FORMAT No. : QAF-04/04	Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 9 / NO.OF SHEET 12

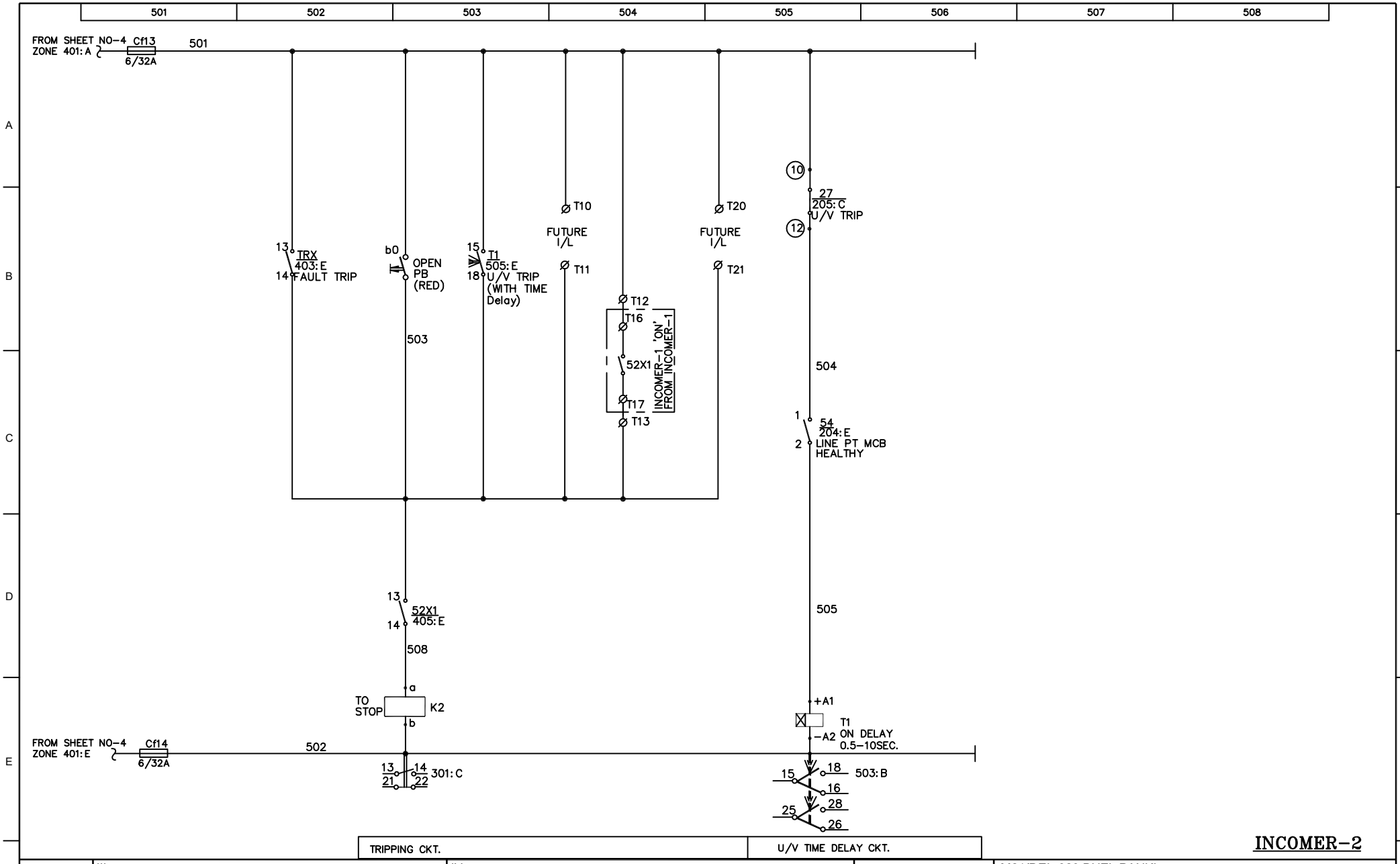


FAULT CKT.	MCCB ON CONTACT MULTIPLICATION	MCCB OFF CONTACT MULTIPLICATION

INCOMER-2

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI		
	III -		IV -				
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.			

	Date	Name	PROJECT:-	C&S ELECTRIC LTD. C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04	Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)		Work	INCOMER-2, MODULE TYPE-MCCB I/C	AVPL/J3729/501	R1
Checked	29.04.2022	D. GIRI	OWNER		Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT		Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 10 / NO.OF SHEET 12

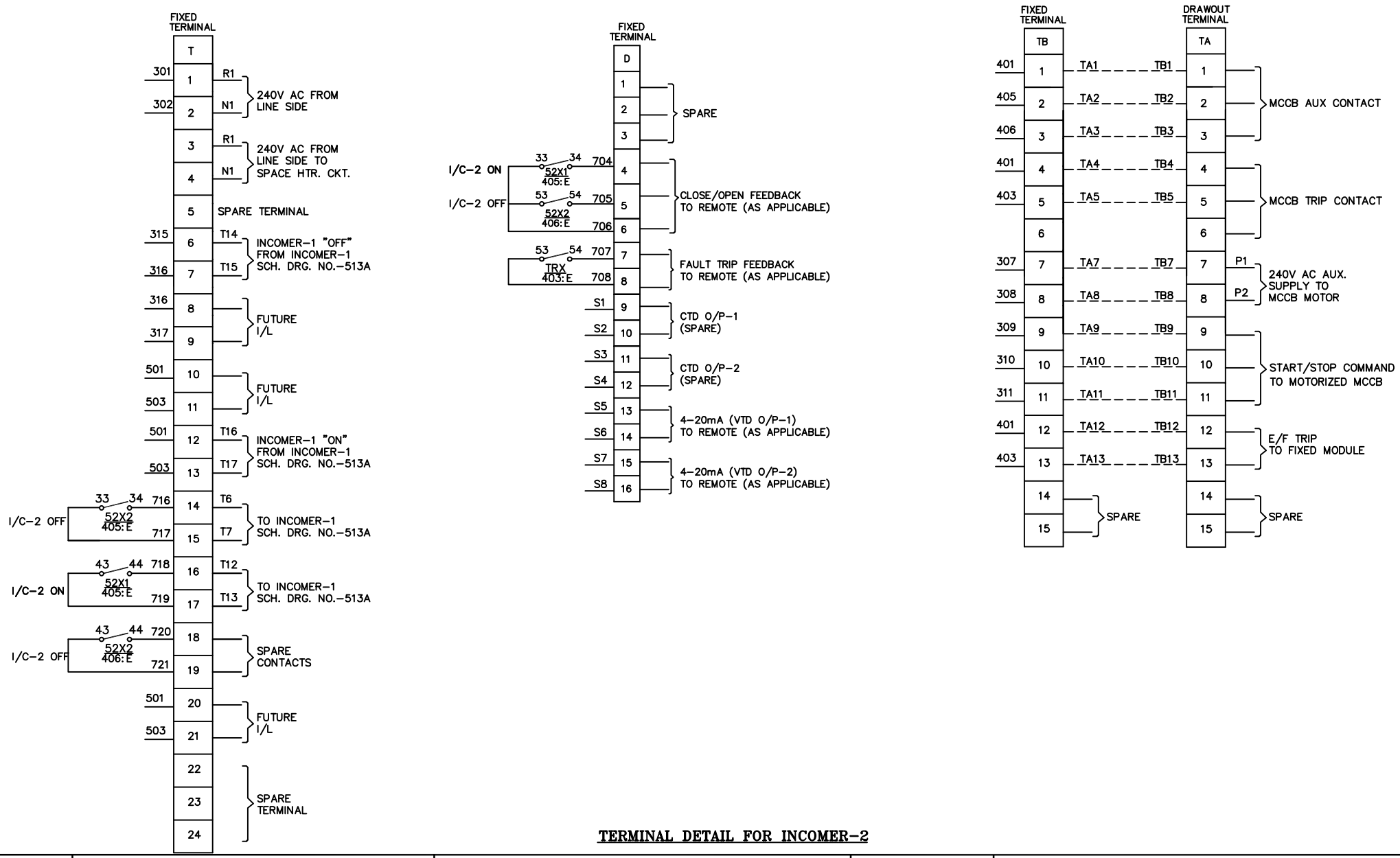


INCOMER-2

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI		
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.			
	Date	Name	PROJECT:-	Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)	Work	INCOMER-2, MODULE TYPE-MCCB I/C	AVPL/J3729/501	R1
Checked	29.04.2022	D. GIRI	OWNER	Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT	Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 11 / NO.OF SHEET 12

C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04



TERMINAL DETAIL FOR INCOMER-2

REV.	III -	IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.	

	Date	Name	PROJECT:-
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)
Checked	29.04.2022	D. GIRI	OWNER
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT

C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

		DRG. NO.	REV.
Client	ADVANCE VENTILATION PVT LTD	AVPL/J3729/501	R1
Work	INCOMER-2, MODULE TYPE-MCCB I/C		
Details	SCHEMATIC / WIRING DIAGRAM		
Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 12 / NO.OF SHEET 12

OWNER:	ADVANCE VENTILATION PVT LTD
PROJECT:	PANKI THERMAL POWER STATION (1X660MW)
	C&S ELECTRIC LTD. C-59 NOIDA PHASE-II, NOIDA-201305 DIST. GAUTAM BUDH NAGAR (U.P)
TITLE	SCHEMATIC DIAGRAM FOR MODULE TYPE-VM

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	III -		IV -		
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.	

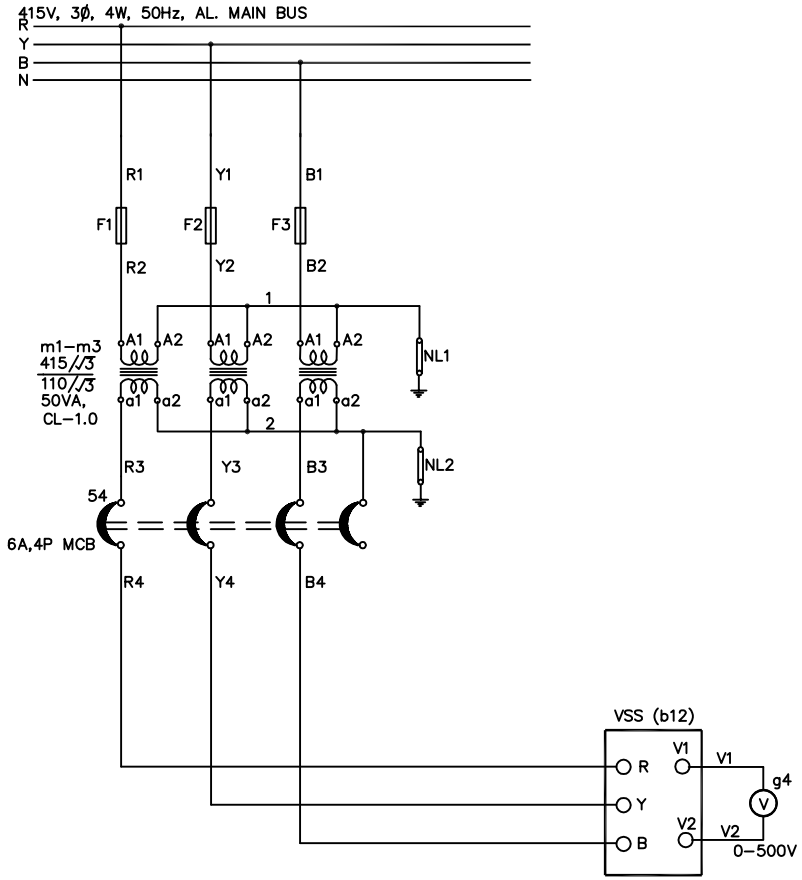
	Date	Name
Drawn	28.04.2022	NITESH
Checked	29.04.2022	D. GIRI
Approved	29.04.2022	D.GIRI

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

		DRG. NO.	REV.
Client	ADVANCE VENTILATION PVT LTD	AVPL/J3729/505	R1
Work	VM		
Details	SCHEMATIC / WIRING DIAGRAM		
Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 1 / NO.OF SHEET 2



REV.	III -	IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.	

	Date	Name	PROJECT:-	C&S ELECTRIC LTD.	Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)	C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04	Work	VM	AVPL/J3729/505	R1
Checked	29.04.2022	D. GIRI	OWNER		Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D.GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT		Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 2 / NO.OF SHEET 2

OWNER:	ADVANCE VENTILATION PVT LTD
PROJECT:	PANKI THERMAL POWER STATION (1X660MW)
	C&S ELECTRIC LTD. C-59 NOIDA PHASE-II, NOIDA-201305 DIST. GAUTAM BUDH NAGAR (U.P)
TITLE	SCHEMATIC DIAGRAM FOR MODULE TYPE-SFU O/G (TP+N)

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	III -		IV -		
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.	

	Date	Name
Drawn	28.04.2022	NITESH
Checked	29.04.2022	D. GIRI
Approved	29.04.2022	D. GIRI

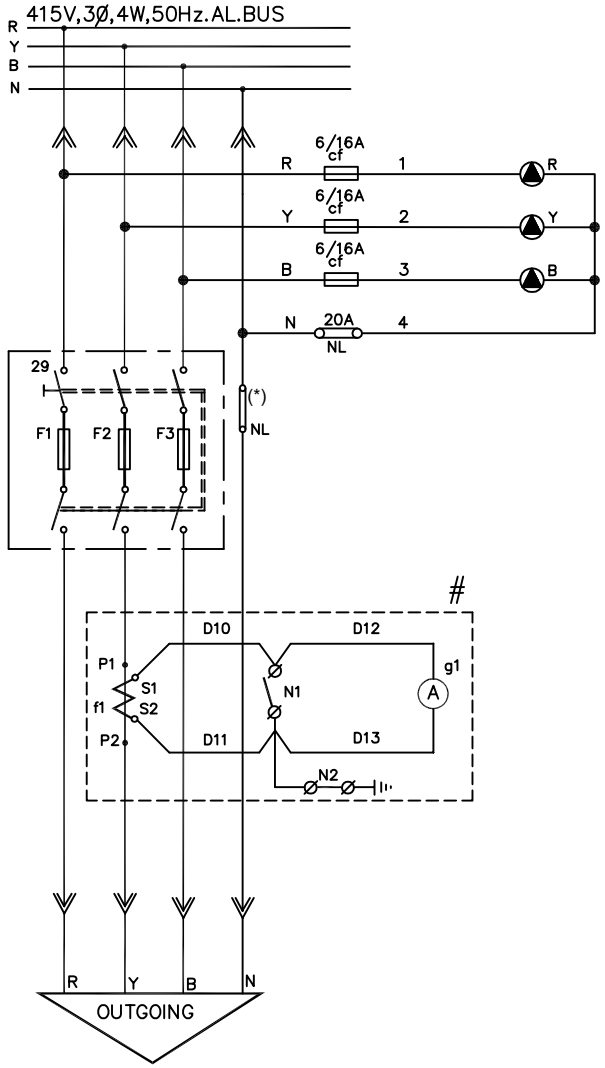
PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

Client	ADVANCE VENTILATION PVT LTD
Work	SFU O/G (TP+N)
Details	SCHEMATIC / WIRING DIAGRAM
Order No.	22A-2051 DATED 02.02.2022

DRG. NO.	REV.
AVPL/J3729/502	R1
SCALE: NTS	SHEET NO. 1
	NO.OF SHEET 2



SCHEME APPLICABLE FOR <250A 3PH WITH NEUTRAL LINK SFU OUTGOING FEEDER MODULE TYPE–E (DRAWOUT TYPE)

SFU RATED 100A AND ABOVE FOR OUTGOING FEEDER SHALL BE PROVIDED WITH CT AND AMMETER

REV.	III -	IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.	

	Date	Name
Drawn	28.04.2022	NITESH
Checked	29.04.2022	D. GIRI
Approved	29.04.2022	D. GIRI

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

Client	ADVANCE VENTILATION PVT LTD
Work	SFU O/G (TP+N)
Details	SCHEMATIC / WIRING DIAGRAM
Order No.	22A-2051 DATED 02.02.2022

DRG. NO.	REV.
AVPL/J3729/502	R1
SCALE: NTS	SHEET NO. 2
	NO.OF SHEET 2

OWNER:	ADVANCE VENTILATION PVT LTD
PROJECT:	PANKI THERMAL POWER STATION (1X660MW)
C&S electric	C&S ELECTRIC LTD. C-59 NOIDA PHASE-II, NOIDA-201305 DIST. GAUTAM BUDH NAGAR (U.P)
TITLE	SCHEMATIC DIAGRAM FOR MODULE TYPE-HTR. FDR.

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	III -		IV -		
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.	

	Date	Name
Drawn	28.04.2022	NITESH
Checked	29.04.2022	D. GIRI
Approved	29.04.2022	D. GIRI

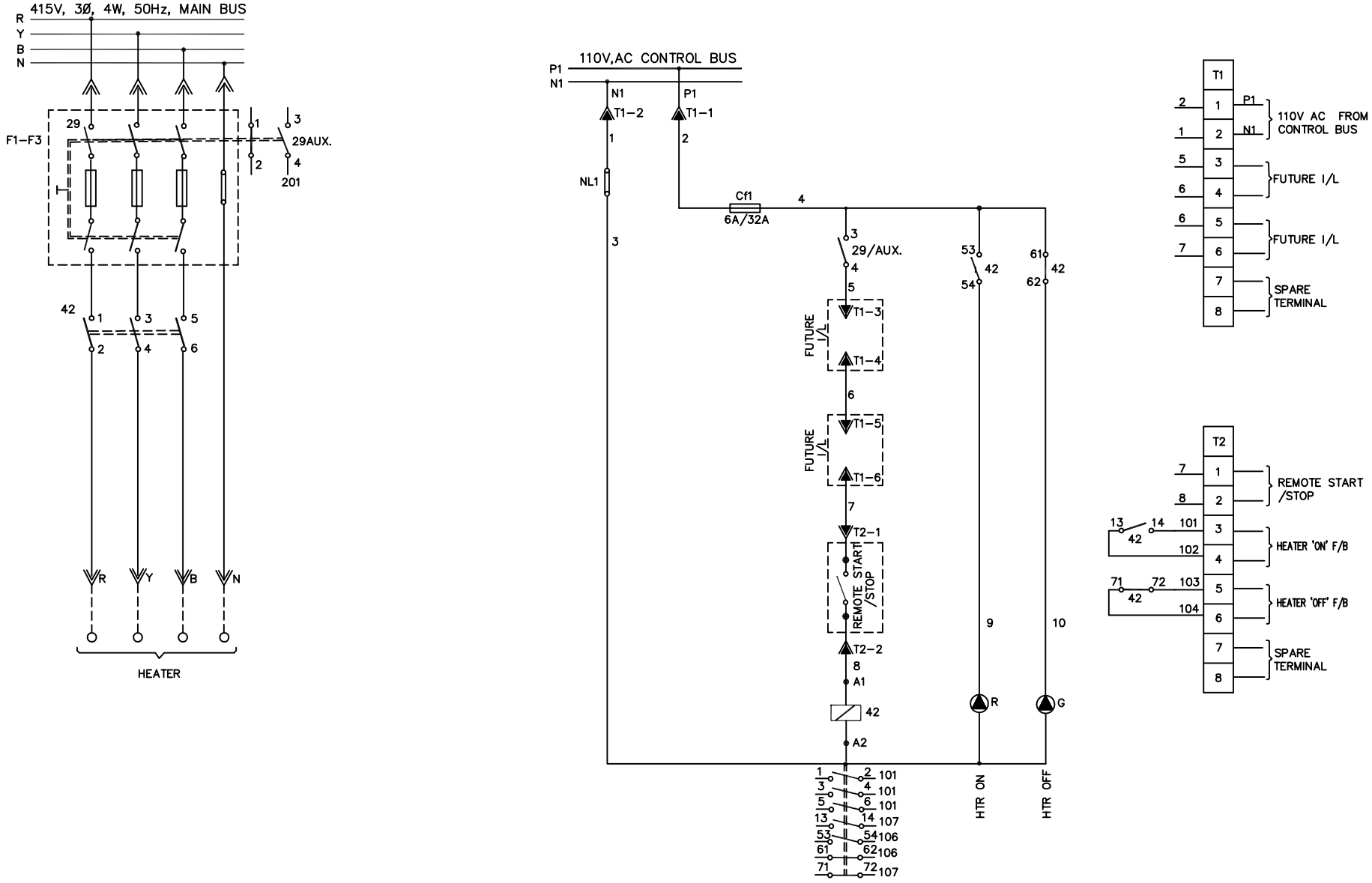
PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

		DRG. NO.	REV.
Client	ADVANCE VENTILATION PVT LTD	AVPL/J3729/503	R1
Work	HTR. FDR.		
Details	SCHEMATIC / WIRING DIAGRAM		
Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 1 / NO.OF SHEET 2



REV.	III -	IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.	

	Date	Name
Drawn	28.04.2022	NITESH
Checked	29.04.2022	D. GIRI
Approved	29.04.2022	D. GIRI

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Work	HTR. FDR.	AVPL/J3729/503	R1
Details	SCHEMATIC / WIRING DIAGRAM		
Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 2 / NO.OF SHEET 2

OWNER:	ADVANCE VENTILATION PVT LTD
PROJECT:	PANKI THERMAL POWER STATION (1X660MW)
	C&S ELECTRIC LTD. C-59 NOIDA PHASE-II, NOIDA-201305 DIST. GAUTAM BUDH NAGAR (U.P)
TITLE	SCHEMATIC DIAGRAM FOR MODULE TYPE-CST

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	III -		IV -		
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.	

	Date	Name
Drawn	28.04.2022	NITESH
Checked	29.04.2022	D. GIRI
Approved	29.04.2022	D. GIRI

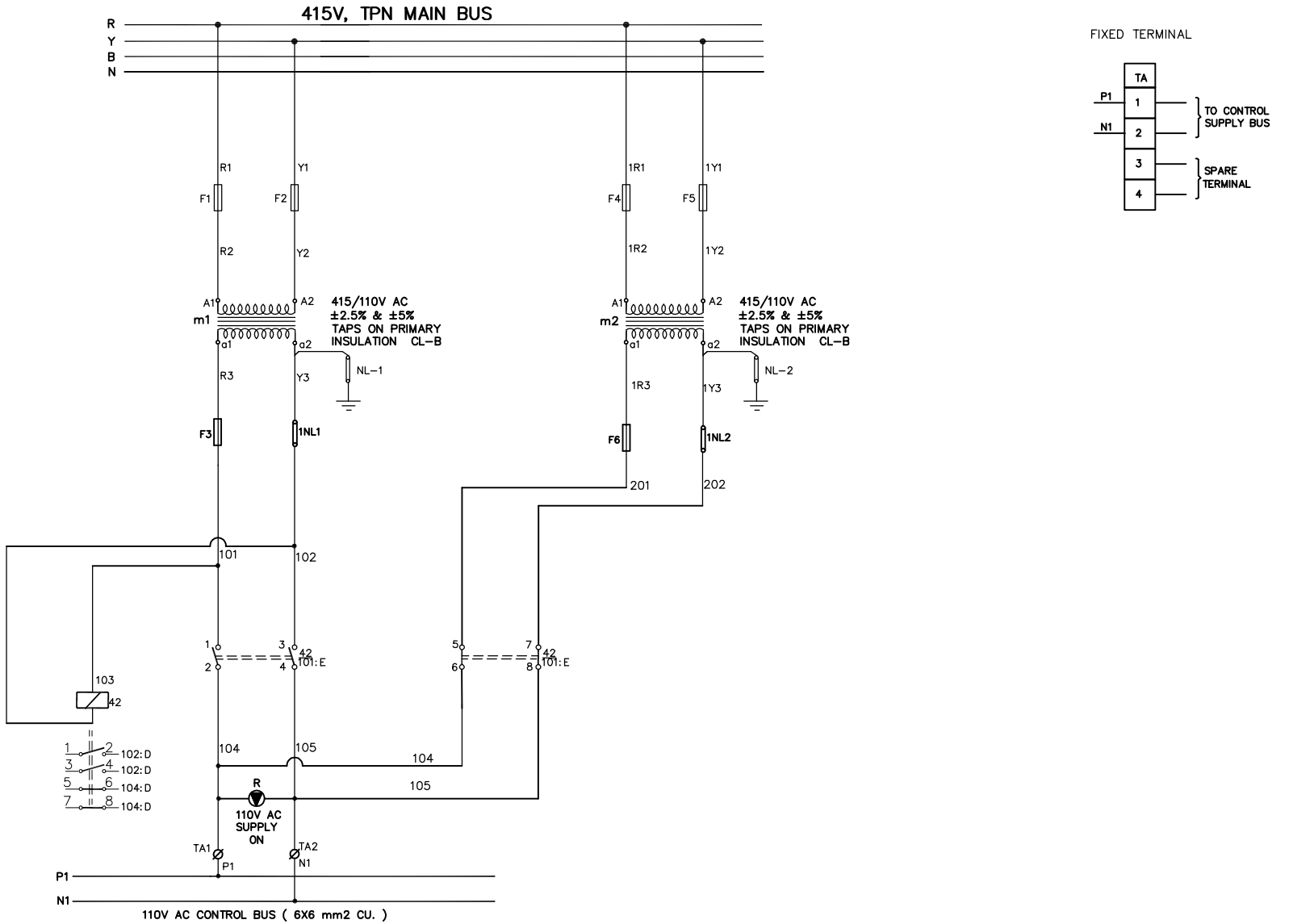
PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

Client	ADVANCE VENTILATION PVT LTD
Work	CST
Details	SCHEMATIC / WIRING DIAGRAM
Order No.	22A-2051 DATED 02.02.2022

DRG. NO.	REV.
AVPL/J3729/504	R1
SCALE: NTS	SHEET NO. 1
	NO.OF SHEET 2



REV.	III -	IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.	

	Date	Name
Drawn	28.04.2022	NITESH
Checked	29.04.2022	D. GIRI
Approved	29.04.2022	D. GIRI

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S electric

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

Client	ADVANCE VENTILATION PVT LTD
Work	CST
Details	SCHEMATIC / WIRING DIAGRAM
Order No.	22A-2051 DATED 02.02.2022

DRG. NO.	REV.
AVPL/J3729/504	R1
SCALE: NTS	SHEET NO. 2
	NO.OF SHEET 2

OWNER:	ADVANCE VENTILATION PVT LTD
PROJECT:	PANKI THERMAL POWER STATION (1X660MW)
	C&S ELECTRIC LTD. C-59 NOIDA PHASE-II, NOIDA-201305 DIST. GAUTAM BUDH NAGAR (U.P)
TITLE	SCHEMATIC DIAGRAM FOR MODULE TYPE-SPACE HTR.

REV.				PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	III -		IV -		
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022		II -	DRG. NO.	

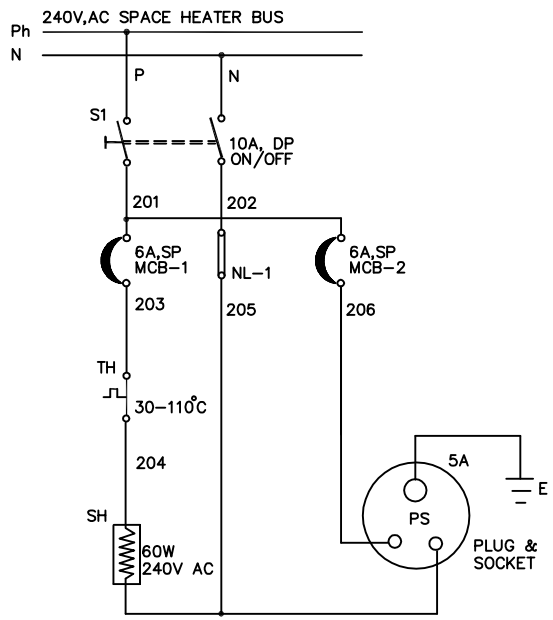
	Date	Name
Drawn	28.04.2022	NITESH
Checked	29.04.2022	D. GIRI
Approved	29.04.2022	D. GIRI

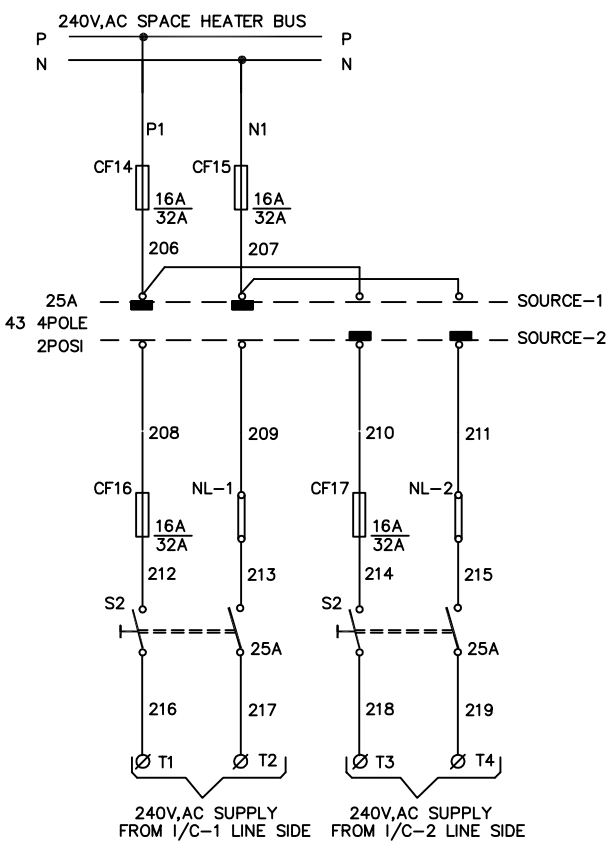
PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

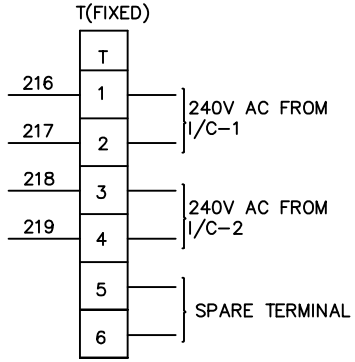
OWNER
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

		DRG. NO.	REV.
Client	ADVANCE VENTILATION PVT LTD	AVPL/J3729/506	R1
Work	SPACE HEATER CIRCUIT		
Details	SCHEMATIC / WIRING DIAGRAM		
Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 1 / NO.OF SHEET 2







PANEL SPACE HEATER CIRCUIT SHALL BE PROVIDED IN CABLE ALLEY OF EACH VERTICAL PANEL

NOTE:-

1. 240V, AC SUPPLY SOURCE FOR SPACE HEATER BUS TO BE PROVIDED IN INCOMER-1.

REV.	III -	IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.	

	Date	Name	PROJECT:-	C&S ELECTRIC LTD.	Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)	C-59, NOIDA PHASE II, NOIDA - 201305	Work	SPACE HEATER CIRCUIT	AVPL/J3729/506	R1
Checked	29.04.2022	D. GIRI	OWNER	DIST. GAUTAM BUDH NAGAR (U.P)	Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT	FORMAT No. : QAF-04/04	Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 2 / NO.OF SHEET 2

OWNER:	ADVANCE VENTILATION PVT LTD
PROJECT:	PANKI THERMAL POWER STATION (1X660MW)
	C&S ELECTRIC LTD. C-59 NOIDA PHASE-II, NOIDA-201305 DIST. GAUTAM BUDH NAGAR (U.P)
TITLE	SCHEMATIC DIAGRAM FOR WALL MOUNTED DB

REV.		PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	III -	IV -	
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.

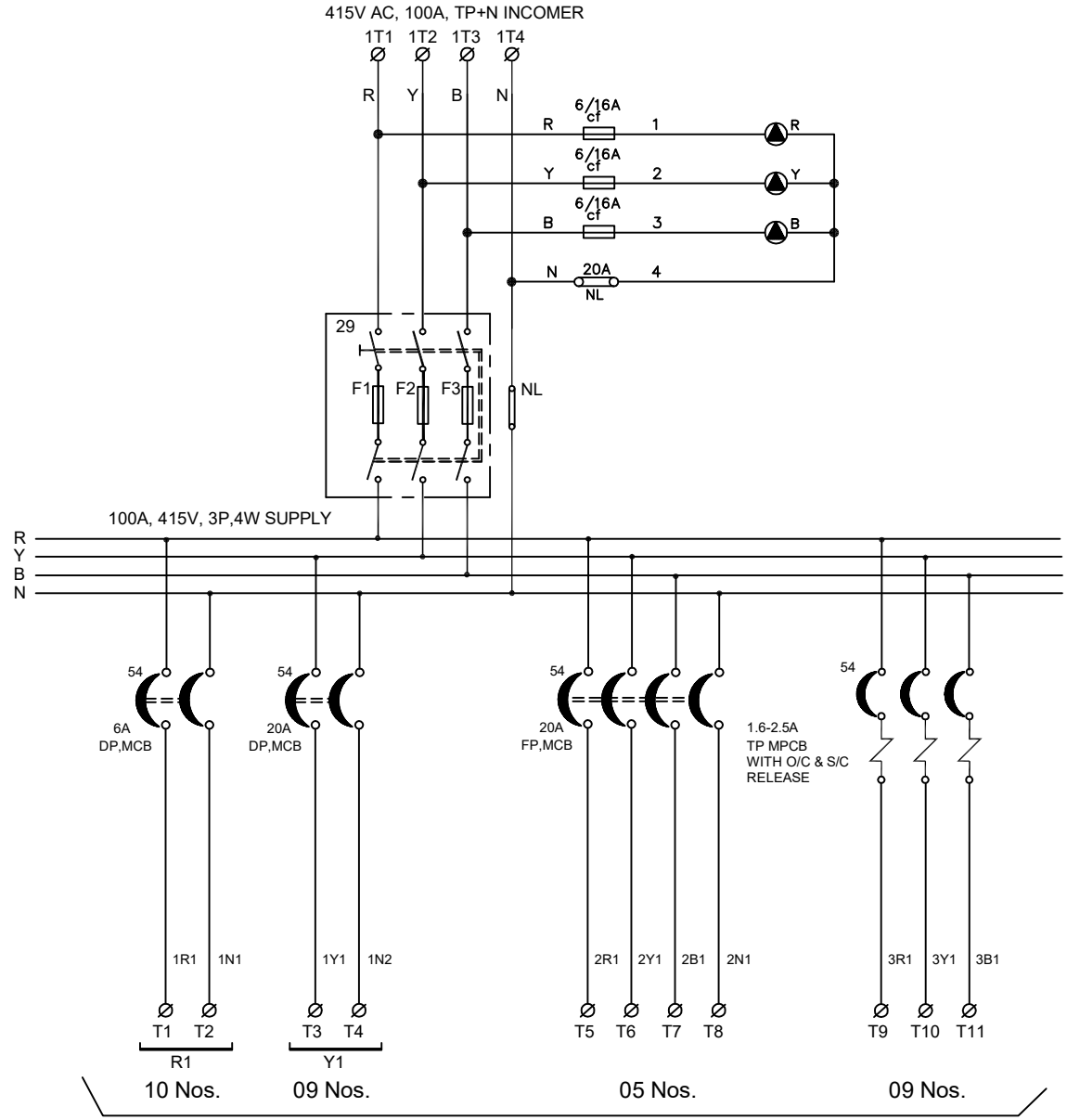
	Date	Name
Drawn	28.04.2022	NITESH
Checked	29.04.2022	D. GIRI
Approved	29.04.2022	D. GIRI

PROJECT:-
PANKI THERMAL POWER STATION (1X660MW)

OWNER
ADVANCE VENTILATION PVT LTD , SONEPAT

C&S ELECTRIC LTD.
C-59, NOIDA PHASE II, NOIDA - 201305
DIST. GAUTAM BUDH NAGAR (U.P)
FORMAT No. : QAF-04/04

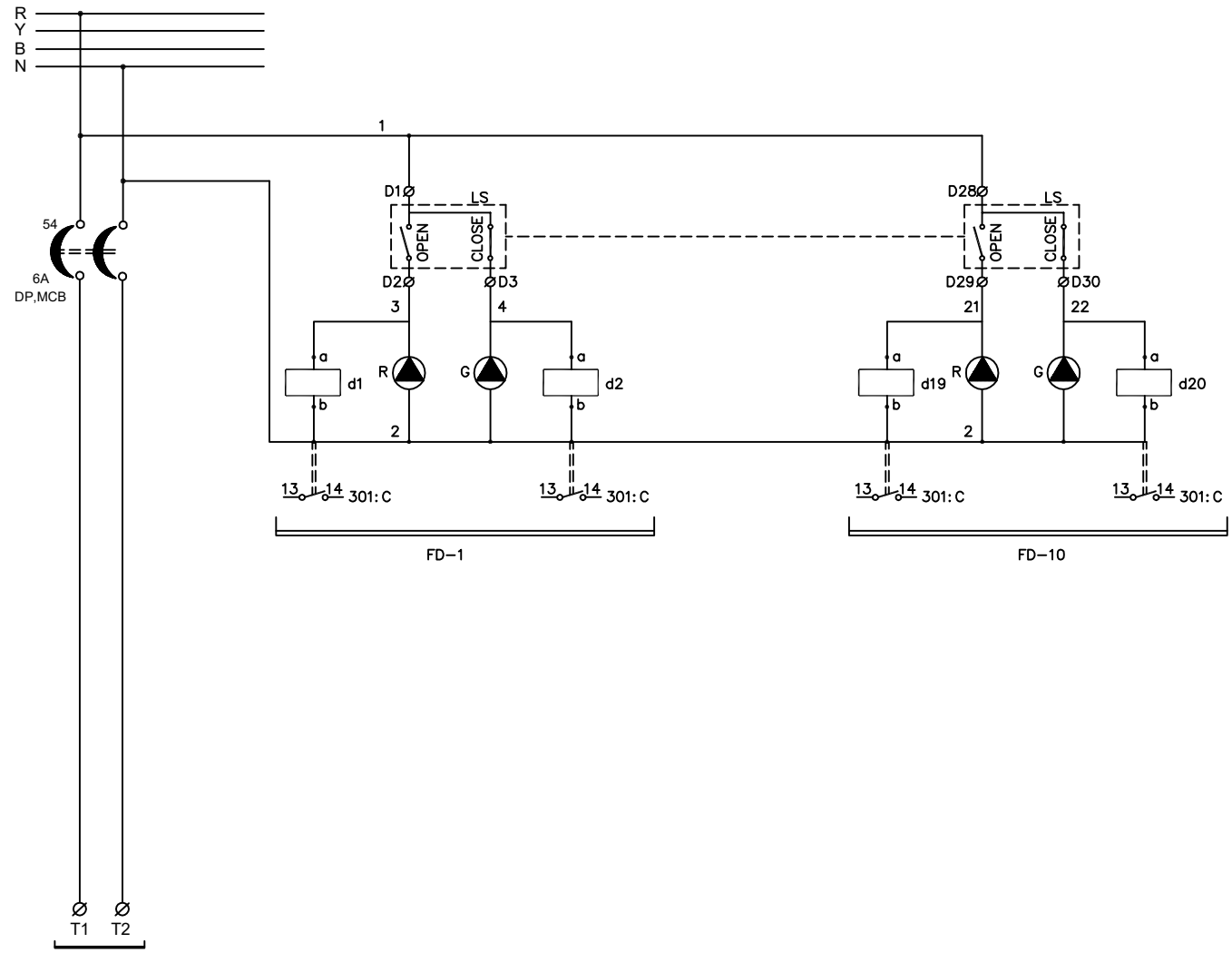
		DRG. NO.	REV.
Client	ADVANCE VENTILATION PVT LTD	AVPL/J3729507	R1
Work	WALL MOUNTED DB		
Details	SCHEMATIC / WIRING DIAGRAM		
Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 1 / NO.OF SHEET 3

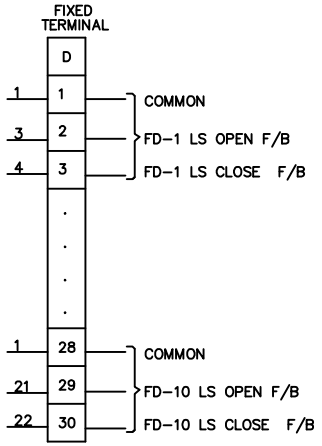


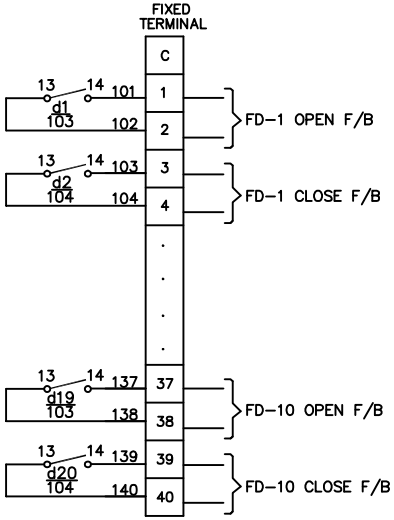
TYP. OUTGOINGS

REV.	III -	IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.	

	Date	Name	PROJECT:-	C&S ELECTRIC LTD.	Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)	C-59, NOIDA PHASE II, NOIDA - 201305 DIST. GAUTAM BUDH NAGAR (U.P) FORMAT No. : QAF-04/04	Work	WALL MOUNTED DB	AVPL/J3729507	R1
Checked	29.04.2022	D. GIRI	OWNER		Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT		Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 2 / NO.OF SHEET 3







SCHEME APPLICABLE FOR 6A DP MCB ONLY.

REV.	III -	IV -	PROJECT DOC. REF.	M21/DEL-029.BHEL,PANKI
	I - REVISED AS PER CLIENT COMMENTS DATED 03.06.2022	II -	DRG. NO.	

	Date	Name	PROJECT:-	C&S ELECTRIC LTD.	Client	ADVANCE VENTILATION PVT LTD	DRG. NO.	REV.
Drawn	28.04.2022	NITESH	PANKI THERMAL POWER STATION (1X660MW)	C-59, NOIDA PHASE II, NOIDA - 201305	Work	WALL MOUNTED DB	AVPL/J3729507	R1
Checked	29.04.2022	D. GIRI	OWNER	DIST. GAUTAM BUDH NAGAR (U.P)	Details	SCHEMATIC / WIRING DIAGRAM		
Approved	29.04.2022	D. GIRI	ADVANCE VENTILATION PVT LTD , SONEPAT	FORMAT No. : QAF-04/04	Order No.	22A-2051 DATED 02.02.2022	SCALE: NTS	SHEET NO. 3 / NO.OF SHEET 3