



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

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1. INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFERS

1. Two signed and stamped copies of the following shall be furnished by all bidders as technical offer:
 - a) Un-priced copy of Annexure-A duly stamped and signed by the bidder.
 - b) Complete dimension of all the boards including no. of panels, dimensions of each type of panels, module size of each type of feeders and minimum clearances required on all sides for each type of panels.
 - c) No. of Vertical consider by vendor for each boards are to be compulsory given along with offer.
 - d) A copy of the sheet "Instructions to Bidders for Preparing Technical Offer" duly stamped and signed by the bidder.
 - e) A copy of sheet "List of Contents" duly stamped and signed by the bidder.
 - f) Technical deviation/ clarification in BHEL Format, if any.
 - g) No. Of Breaker panels, No. of MCC panels, Weight & Dimensions of all boards.
2. Confirmations/ comments (if any) regarding delivery schedules shall be furnished as part of the commercial offer. Any reference elsewhere/ covering letter of technical offer shall not be considered by BHEL.
3. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
4. Any changes made by the bidder in the price schedule with respect to the Item description/ quantities, notes etc. from those given in various annexures of specification shall not be considered (i.e., technical description, quantities, notes etc. as per specification shall prevail).
5. Bidders to quote for all items/sub items even if those are not in their manufacturing range.
6. No raw material/Component/Sub Assembly/Assembly/Equipment shall be sourced from China directly or indirectly for manufacture or supply.
7. In case of any ambiguity in specification between various sections and end customer specification vendor should clearly brought out in technical deviations failing in which BHEL will have choice to prefer which ever it suits at later stage for which vendor should accept.
8. Vendor should bring out technical deviation clearly in deviation sheet if any.

BIDDER'S STAMP & SIGNATURE



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2. SCOPE OF ENQUIRY

1. This specification covers the design, manufacture, relay parameterization and site support, supply of networking hardware, site modification(if any), inspection and testing at manufacturer's works, proper packing and delivery to site of electrical control panel as mentioned in different sections of this specification for RAMMAM HEP (3X40MW) Project .
2. It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation up to vendor's guarantee.
3. The general terms and conditions, instruction to tenderer and other attachment referred to elsewhere are hereby made part of the tender specification.
4. The tendered shall be responsible for and governed by all requirements stipulated hereinafter.
5. Deviations, if any should be brought out very clearly on deviation sheet enclosed with specification only. Otherwise it will be presumed that the tenderer's offer is in line with what has been stated/ asked for in this specification.
6. The offer should be complete with technical data, catalogues, brochures and drawings as applicable.
7. Qualification data: In order to be able to propose to the client the proven-ness of the equipments/ item offered, the bidder is required to elaborate details of experience, capabilities, reference list etc. in the offer.
8. The documents shall be in English language and MKS system of units.



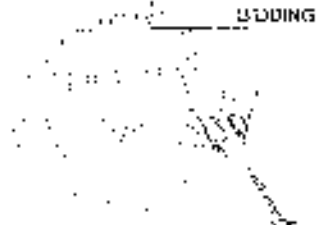
**RAMMAM HEP (3X40MW)
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3. PROJECT INFORMATION

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	CONTENT	
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KANAKAM STAGE-II HYDRO-ELECTRIC PROJECT (3 x 40 MW) ELECTRIC MECHANICAL WORKS LPC CONTRACT PACKAGE BIDDING DOC. NO. CS-6602-0039		TECHNICAL SPECIFICATION SECTION 'M' PART-A SUB-SECTION -1 PAGE 1 OF 8



CLAUSE NO.

PROJECT INFORMATION



1.00.00

BACKGROUND

3 Nos. of vertical shaft, generating units each of 40 MW coupled to 4-pole Vertical axis Pelton Turbines, are required to be installed in the Ramnam Stage - III Hydro Electric Project located in Darjeeling Dist. of West Bengal state. The project site can be accessed from Siliguri via Ghoom in Darjeeling District of West Bengal.

2.00.00

GENERAL FEATURES OF THE PROJECT

2.01.00

General

Ramnam Stage-III Hydro Electric Project is a run of the river scheme across the Ramnam river between the confluence of Lodhama Khola with Ramnam to Ramnam with river Rangit. The scheme involves construction of Barrage on river Ramnam approximately 240 m D/s of Ramnam stage - II Power House with 3.5 m finished diameter, 8.2 Km. long horse shoe shaped HRT, 2.7 M diameter, 1.53 Km long pressure shaft/penstock, 740 m long tailrace channel and surface power house. The installed capacity of the project is 120 MW (3x40 MW). Source of the water supply is Ramnam river which is an important tributary of the river Rangit. The Ramnam river originates in glacial area to the extreme west near the West Bengal and Nepal border, flows in a easterly direction for a considerable distance and joins the Rangit river near Naya Bazar. River Rangit in turn is a major tributary of the Teesta River. The Ramnam river originates from Mane Bhanjan - Tongbu - Phalut ridge of the lower Himalayas which are continuation of Kanchan Jungba mountain ranges, at an elevation of about EL 3631 M and drains a catchment of about 247 KM² up to the Barrage site. There is considerable snow fed region in the catchment area of Ramnam River in its upper reaches. A significant portion of the catchment area is covered with dense forest.

2.02.00

Hydraulic and Civil features

The Ramnam Stage-III Hydro Electric project is located on Ramnam River. It is developed as a run of river scheme by constructing a Barrage with 8.2 km long head race tunnel of horse shoe type having a diameter of 3.5 m to carry design discharge of 26 m³/s, one number restricted orifice type surge tank with 14.5 m diameter and 52.5 m height. One no. of 2.7 M diameter pressure shaft is considered to feed each unit turbine of 40 MW capacity that operate under a design head of 173 m.

The general layout of the scheme is indicated in the enclosed drawings: Drg.No. 5602-002 P-E-C-A-01-Geographical Location of the Project, Drg.No.5602-002-P-E-C-A-09 -General Project Layout and 5602-002-P-E-C-A-24 -Cross section of Power House through Water Conductor System.

3.00.00

SYSTEM DETAILS

3.01.00

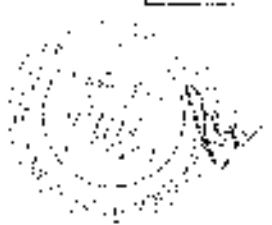
The installed capacity of 120 MW would be provided by 3 Vertical Axis Pelton turbines driven generating units of 40 MW each. It is proposed to provide Inlet Valve of spherical type for each turbine, which would be accommodated in the powerhouse. The generation voltage of 11 kV would be stepped up to 132 kV through three single phase 11/ 139/ $\sqrt{3}$ kV OLWT type step up transformers located near upstream wall of the power house for each unit. The 11

RAMNAM STAGE-III HYDRO ELECTRIC PROJECT
(3 x 40 MW)
LLC (RO MECHANICAL WORKS
EPC CONTRACT PACKAGE
BIDDING DOC. NO.: CS-5602-003-0

TECHNICAL SPECIFICATION
SECTION - VI

PART-A
SUB-SECTION - 1

PAGE
2 OF 6



4/5/20

CLAUSe NO.	PROJECT INFORMATION																							
3.02.00	kV isolated phase bus ducts would connect the 11 kV generator terminals with 11 kV bushings of step up transformers. The 132 kV terminal of the transformers would be connected with 132 kV switchyard through 132 kV XLPE Cables. Power from the project will be evacuated through three Nos. 132 kV lines to be laid by WDSLD. The power supply for unit auxiliaries is proposed to be obtained from three dry type 500KVA, 3 Phase, 11/0.433KV Unit Auxiliary Transformers. Auxiliary power for station services would be supplied from 11 kV and would be step down through 2 Nos. of 1600 KVA, 11/0.433 kV step down dry type Station Service Transformers. For emergency supply, 2 Nos. of 750 KVA, 11 KV DG sets would also be installed which would be connected to Station Auxiliary Board. The Overall Electrical Single Line Diagram is shown in the enclosed drawing. Drg.No. 5502-003-P E-L A-101 "SLD for Overall Electrical System".																							
3.03.00	E.O.T Crane One no. E.O.T. Crane of 125/25/5 T capacity with main and auxiliary hooks are proposed to be installed in the power house for handling assembly and erection of generating units & associated equipment. The clearances, limits for hook approach and other dimensions of the crane shall be suitable for the proposed layout of the power station. One no EOT crane of 50/10/5T will be provided in the Valve House building for erection and handling of Butterfly valve.																							
4.00.00	CLIMATIC CONDITIONS The project lies between El 910m to 375 m. The area has moderate climatic conditions with no snow fall in the project area. Rainfall in the Project area is from June to August and in December, January. The Power House service bay floor is located at LL 412 m & the centre line of turbine runner has been set at El 400 m. The climatic conditions are given below:- <table><tr><td>i)</td><td>Maximum temperature in the project area</td><td>:</td><td>36 °C</td></tr><tr><td>ii)</td><td>Minimum temperature in the project area</td><td>:</td><td>3 °C</td></tr><tr><td>iii)</td><td>Maximum Relative humidity</td><td>:</td><td><95 %</td></tr><tr><td>iv)</td><td>Minimum Relative humidity</td><td>:</td><td>>35 %</td></tr><tr><td>v)</td><td>Average annual rainfall</td><td>:</td><td>2800 mm</td></tr></table>				i)	Maximum temperature in the project area	:	36 °C	ii)	Minimum temperature in the project area	:	3 °C	iii)	Maximum Relative humidity	:	<95 %	iv)	Minimum Relative humidity	:	>35 %	v)	Average annual rainfall	:	2800 mm
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iv)	Minimum Relative humidity	:	>35 %																					
v)	Average annual rainfall	:	2800 mm																					
5.00.00	SEISMIC FORCES The Ramnam stage-II hydroelectric project is located at the margin of Zone-IV and Zone-V of the seismic zoning map of India. The equipment shall be designed to withstand seismic forces																							
RAMNAM STAGE-II HYDRO-ELECTRIC PROJECT (3 x 40 MW) ELECTRO-MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC. NO.:GS-6602-003-3		TECHNICAL SPECIFICATION SECTION -VI	PART-A SUB-SECTION -I	PAGE 3 OF 6																				

PROJECT INFORMATION



6.00.05

PETROGRAPHIC REPORT OF RIVER SEDIMENT

6.01.03

Grain size analysis of soil sample for Ramman Stage III project is given below:

Grain Size Analysis in Wt %

Clay %	Silt %	V.F. Sand %	F. Sand %	M. Sand %	Coarse Sand %	Total
(-)1.95 micron	(-)65.61 micron	(-)0.125 mm	(-)0.25 mm	(-)0.5 mm	(+)5mm	
0.20	6.0	60.34	25.23	4.98	1.25	100

6.02.00

Petrographic Report on the Sediments

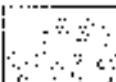
a) Megascopic Observation

The samples are loose sediments and are brownish grey in colour. The samples range in size from coarse sand to very fine sand. The sand fraction is composed dominantly of mica flakes, quartz, feldspar and organic matter including wooden fragments.

b) Microscopic Examination

The mineral assemblages and organic matter with their relative volume percentages (as per visual estimate) of different size of sand fractions are furnished below.

Size fraction	Mineral Assemblages (with relative abundance based on visual estimate)
+ 500µm (Coarse Sand)	Quartz 40%, Biotite 30%, Muscovite 10%, Feldspar 10%, Lithic fragment (quartzite) 10%, Organic matter (with cellulose structure, low) and clay concretion (few)
+ 250µm (Medium Sand)	Biotite 40%, Quartz 20%, Feldspar 20%, Muscovite 10%, Garnet (5%) and Chlorite-Sillimanite – Lithic fragment (Granite, Quartz-Chlorite Schist) – Clay concretions Amorphous carbonate-iron concretions (5%) Organic matter (with cellulose structure, low)
+ 125µm (Fine Sand)	Biotite 70%, Muscovite 20% and Quartz- Feldspar-Garnet (10%)
+ 0.063mm (Very Fine Sand)	Quartz 60%, Biotite 20%, Feldspar 10%, Muscovite 5% and Amphibole-Chlorite (<5%)
Roundness	Both quartz and feldspar grains are generally sub rounded. But in coarse sand (+500 µm) the feldspar grains are subangular.

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	The Lithic fragments are well rounded.		
	Sphericity	Quartz grain show moderate to high sphericity but feldspar grains are of moderate sphericity only. The Lithic fragments show high sphericity.	
7.00.00	TRANSPORTATION		
7.01.00	Location and Access		
	The proposed Raimnam Stage-III is located on the Raimnam River in the state of West Bengal. The Raimnam River forms the boundary with West Bengal and Sikkim. The diversion structure is just downstream at the confluence of Raimnam with Lodhama Khola and the power house is near Baraotia village on right bank of the Raimnam River. The project lies between Latitude 27°-6'-00"N to 27°-9'-00"N and Longitude 85°-5'-00"E to 85°-14'-00"E. The project can be accessed from Siliguri via Ghoom in Darjeeling District of West Bengal or from Jorhang in Sikkim by road. Bagdogra is the nearest airport and New Jalpaiguri is the nearest broad gauge railway station. The proposed project site is connected by all weather metalled road from Siliguri, the main city near by and connected to all parts of the country. The proposed project site can be accessed through the following approach roads from Siliguri: a) Approach roads to Barrage site; i) Via Siliguri – Manobhanjan – Lodhama (about 140 Km) ii) Via Siliguri – Kurseong – Bjanban – Lodhama (about 130 Km). b) Approach road to Power House site: i) Via Siliguri – Melli – Jorhang (Naya bazaar) (about 120 km) To have accessibility to various components of the project within the project area, a road network has been proposed with a single lane width as per BRO specifications.		
7.02.00	Transport Limitations		
	The weights and dimension of the packages for transportation to site shall be limited to the following:- a) Max. Weight of the package not to exceed 50 t. F. b) Max. Size of the package not to exceed L = 8500 mm, W= 3000 mm, and H = 8000 mm. The above information is tentative and it is the contractor's responsibility to verify the actual transport limitation.		
RAIMNAM STAGE-III HYDRO ELECTRIC PROJECT (3 x 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC. NO. CS-5502-003-6		TECHNICAL SPECIFICATION SECTION - VI	PART-A SUB-SECTION - I PAGE 5 OF 6

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8.00-00	BIDDER TO INFORM HIMSELF The Bidder shall make independent/their own investigations about the conditions and circumstances affecting his tender estimates and about the possibility of executing the works as described. During the evaluation of tenders, it shall be presumed that the Bidder have inspected and examined the site and its surroundings and to have satisfied themselves about the form and nature of the site, the quantities and materials necessary for the completion of the work and the means of transport and access to site, the requirements of accommodation, general labor position at the site and have quoted their prices after taking into account, the risks, contingencies and other circumstances which may influence or affect the execution of the Contract. Access to the site shall be allowed, to the prospective bidder(s) by prior appointment with the Employer.	
RANILAM STAGE III HYDRO ELECTRIC PROJECT (3 x 40 MW) FITTED MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC. NO. 05-5602-003-0		TECHNICAL SPECIFICATION SECTION - VI PART-A SUB SECTION - I PAGE 6 OF 6



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TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

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4. MIV ECP TECHNICAL SPECIFICATION

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PROJECT – RAMMAM HEP (3 x 40 MW – V.PELTON)

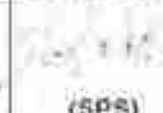
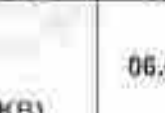
1. SCOPE:

This specification covers manufacturing, shop testing, supply, packing and delivery of MIV ELECTRICAL CONTROL PANEL as per schematic drawing for MIV Electrical Control Panel (Drg. No. 32130519801). The supplier shall ensure completeness of panels and shall also include any other devices, which are required for proper functioning of the schemes enclosed. The rating of equipments, wherever not specified shall be selected by the supplier. The successful bidder to prepare and submit outline general arrangement drawing including component layout for approval before start of manufacturing. Some of item described in this specification may not be relevant for this electrical control panel and may, please be ignored.

2. STANDARDS:

All equipment covered under this specification shall be of reputed make having proven quality and shall comply fully unless otherwise specified with the relevant latest issue of Indian Standard Specifications. Where the standards adopted are other than the standards mentioned below, full details of the same including deviation from the relevant India Standards shall be given in the offer.

IS – 8623	Factory built assemblies of low voltage switchgear and control gear.
IS – 2208	HRC Cartridge fuse – links up to 650V.
IS – 6875	Control switches for voltages up to and including
IEC – 337	1000V A. C.
IS – 2959	Contactors for voltages not exceeding 1000V A. C.
IS – 2147	Degree of protection for enclosures.
IS – 4064	Switches & switch – fuse units
IS – 1248	Meters and instruments
IS – 3231	Relays
IEC – 73	Colour of indicating lamps & push buttons
IS – 9224	Low voltage fuses
IS – 694	Small wiring cables
IS – 1941	Indicating lamps

REV.NO.				APPROVED:			
PREPARED		DISTRIBUTION.	QTY.	 (DH)			
CHECKED		HPE	01	PREPARED	CHECKED	ISSUED	DATE
APPROVED							
DATE		MM(H)	04	 (SPS)	 (AP)	 (PKB)	06.09.18

	HYDRO PROJECTS ENGINEERING DIVISION	SPECIFICATION NO.	REV 00
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3. PANELS:

3.1 GENERAL:

The panels shall be of prefabricated & bolted construction and free standing type with overall dimension not to be less than of 1700mm (H) X 1000mm (W) X 600mm (D) (Dimension without foundation frame). The panel shall be mounted on foundation frame of 300 mm (H) X 1000 mm (W) X 600 mm (D). The foundation frame is to be supplied along with panel. Total height of the panel including foundation frame should not be more than 2000mm. Sheet material of the panel shall be of cold rolled sheet steel with minimum thickness for load bearing members as 2.5 mm and for non-load bearing as 2 mm. Front hinged door shall be made of quality steel and treated for corrosion resistance under tropical weather conditions. The panels should be complete with anchors and fasteners for foundation and transport. The cubicles shall be provided with hinged doors fitted with neoprene gaskets, locks and handles. The cubicle should be designed to give the required degree of protection **IP52** or higher (dust, moisture and vermin proofing) as per IS: 13947 by use of proper gaskets. Suitable stiffener to be provided wherever required for panel to be sturdy. The panel / cubicle shall have 20% free space for mounting future devices. The DC power supply variation 220 V +15%/-15% and AC power supply 240 V $\pm 5\%$ frequency variation and $\pm 10\%$ voltage variation.

The door shall be provided with louvers for ventilation and they are complete with rubber sealing strips. Lifting lugs shall be provided.

The panel shall be fitted with anti – condensation heater (Strip type) to prevent moisture condensation on wiring and fluorescent lamp for lighting. Terminal blocks for external connection shall be accessible from door. Provision for cable entry from the Top and Bottom with removable gland plates shall be provided.

3.2 SAFETY EARTHING:

All metal casings of current carrying components shall be connected to an earthing strip (25 X 6 mm) made of copper (tin plated) with the help of a continuous soft drain bars or green colored insulated tinned copper conductor. Suitable clamps type terminations (2 nos.) for connecting earth strip to station earth shall be provided and these shall be made of brass.

3.3 WIRING:

Panel wiring shall be carried out with colour coded PVC wire of 650V grade conforming to latest issue of IS: 694. The wiring shall be done with PVC insulated stranded conductor tinned annealed copper wire of size 1.5 sq. mm and wiring subject to swing shall be done with flexible cables.

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The wiring shall be with identification ferrules (sleeved type) having black letters on white back ground at both ends as per IS: 375 (1963) and schematic diagrams. No portion of the wiring shall touch the metal portion and should be supported in such a way with sturdy clips and saddles so that the wires can be traced physically and easily when required.

The wires shall be connected to the control apparatus by means of copper tin plated lugs and shall be terminated on terminals mounted at convenient height for easy access. The size of control terminals shall be suitable for 4.0 mm sq cable terminations.

Colour

Black
Gray
Green/Yellow
Red
Black

Circuit function

Neutral
Single phase/ AC Control Supply
Earth
+Ve DC Control supply
-Ve DC Control supply

3.4 MULTIPLYING CONTACTORS:

The contactors shall have sufficient no (s) of aux contacts as per schematic diagram and suitable for control DC supply. If sufficient no of contacts are not available additional contacts shall be used.

3.5 CONTROL AND SELECTOR SWITCHES (SS1):

The control and selector switches shall be of multi – stage, rotary type, rated for 660 Volt AC and DC and having current rating of 5 amps. The switches shall be switch-board type.

A square or rectangular escutcheon plate for front of mounting shall be provided with main circuit label and position labels.

The mechanism housing shall be mounted in fire resistant material. The selector switches should be of stay put switches with spade type handle.

3.6 ILLUMINATED PUSH BUTTON (PL):

The illuminated push buttons shall have adequate current carrying capacity and shall have 1NO+1NC contact. It should have LED type of illumination lamp suitable for control supply voltage. It should have integral escutcheon plates engraved with its function.

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3.7 EMERGNECY PUSH BUTTON (PB-7E):

The emergency push button shall have adequate current carrying capacity with 1NO+1NC contact. It should be of Red in colour and with protective transparent cover.

3.8 INDICATION LAMPS (SL):

The indicating lamp shall have LED type illumination. These shall have LED and proper colour lenses as per schemes. It should have integral escutcheon plates engraved with its function.

3.9 TIMER (T):

The timers are used to provide pulse command to solenoids of MIV and bypass. It should be suitable for rated control voltage and with 2NO+2NC auxiliary contact.

3.10 TERMINAL BLOCKS:

Terminal blocks (**Device Ref.: TBP**) for power supply connection should be of Stud type and suitable for 6 sq mm CAT M4 of Elmex / CSTS B4 of connect well or its equivalent of make as per components and device list.

Terminal blocks (**Device ref.: TB1CT, TB1FB, TB1RT & TB1SP**) are control terminal blocks should be of screw type terminals and suitable for 4.0 sq mm CST 2.5 of Elmex or its equivalent of make as per components and device list.

3.11 NAME PLATES:

The name plates of **anodized aluminum** on front door and inside mounted item shall be provided on bottom of each device. Panel main label shall be provided on top of each panel. The label / name plates for device mounted on the front door of the panel shall be fixed by screws. The label / name plates for the device mounted inside the panel shall be fixed with adhesives.

3.12 PAINTING:

All sheet steel parts shall be acid cleaned, rust free, degreased before applying the powder coat of **RAL6019**.

- All sheet work shall be phosphated in accordance with IS: 60005 "Code of practice for phosphating Iron and steel".
- Oil, grease dirt and swarf shall be thoroughly removed by emulsion cleaning.

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- (c) Rust and scale shall be removed by pickling with dilute acid followed by washing and running water rinsing with slightly alkaline hot water and drying.
- (d) After phosphating, through rinsing shall be carried out with clean water followed by final rinsing with dilute dichromatic solution and oven drying.
- (e) Panel shall be powder coated with thickness of the coating of thickness > 95 mm. External colour of the panel shall be Semi Glossy Pastel Green **RAL 6019 grade** and internal colour of the panel shall be glossy white of shade **RAL 9003 grade**.

4.0 TEST AND INSPECTION :

All necessary Test / Test certificates shall be carried out / submitted to prove that the equipment supplied meets the requirement of this specification and relevant IS.

Assembled panels shall be subjected to following routine tests at supplier's work in presence of the BHEL representative and our customer.

- Visual inspection.
- Dimension check
- Megger testing with 1000 V megger before and after HV test.
- HV test 2 KV, 50 Hz. rms voltage applied for 1 minute between all terminal connected together and all metal parts intended to be earthed during service.
- Earth Continuity test.
- Functional test as per schematic diagram

3 copies of final test certificates shall be submitted for our reference and record.

5.0 DRAWING, DATA AND PARTICULARS: (TO BE SUBMITTED BY TENDERER / SUPPLIER)

The supplier shall submit the documents / drawings (1 set) at the time of offer which shall include the following:

- i) Details of all equipments including their type make specifications with catalogue and guaranteed technical particular.

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The supplier shall submit within four weeks from the date of award of contract, Drawings (two prints each) which shall include but not limited to the following, for customer (NHPC) APPROVAL

- Outline general arrangement including component layout arrangement drawing.
- Mounting and foundation details.
- Internal panels wiring diagram showing termination of external cables with proper terminal markings.
- Bill of material with exact make of equipment
- Quality Assurance plan.

Vendor should start manufacturing of the panel only after approval of GA drawing from BHEL / customer. The supplier shall provide 3 copies of all drawing certified for construction.

8 copies of Erection, operation and maintenance manual and drawing shall be supplied as per distribution schedule to be intimated two months prior to the dispatch of equipment. The manual shall also contain the catalogue of contractors, timer control switches, meters, indicating lamps and push button.

2 copies of packing list showing details of items packed in each box dispatched. The packing list has to be sent early to Indenter for approval prior to dispatch of panels.

Purchaser reserves the right for altering / modifying the control scheme even if the panels are under manufacture. The supplier shall have to make the corresponding changes in the panel as required.

6.0 COMPLETENESS OF EQUIPMENT:

All fittings and accessories which are necessary for the competence of the equipments shall be deemed to be included in the specification and shall be supplied by the supplier.

7.0 DRAWINGS AND DATA ENCLOSED WITH SPECIFICATION :

Schedule of equipment for MIVECP is attached as per drawing No. 32130519801.

	HYDRO PROJECTS ENGINEERING DIVISION	SPECIFICATION NO.	REV 00
	TITLE : SPECIFICATION OF ELECTRICAL CONTROL & INDICATION PANEL FOR MIV	241585457-A	Page 7 of 11

8.0 IDENTIFICATION:

The panel shall be identified with the following information.

1. MIV ELECTRICAL CONTROL PANEL
2. UNIT NO.: 01, 02 & 03
3. PROJECT: RAMMAM HEP
4. BHEL LOGO.

The above information shall be in a permanent form as a metal name plate or by engraving.

9.0 PACKING INSTRUCTIONS:

Packing box must be reusable type. Before putting panel in to wooden box, panel shall be entirely covered with polyethylene sheet of least 100-micron thickness after placing adequate quantity of silica gel packed in a cotton bag. Front side of panel shall be properly covered by polyethylene air bubble film to avoid damages of indicating meters and flush panel mountings.

The base of the wooden case shall be of wooden bottom and planks giving necessary reinforcement such that the bottom of the equipment is at a height of 200 mm minimum from ground level. Polyethylene coated bitumen hessian kraft paper shall be fixed in position above the wooden planks over which panel is to rest.

Polyethylene sheet of at least 100-micron thickness shall be laid over the base of polyethylene coated bitumen hessian kraft paper.

Four sides shall be lined from inside by polyethylene coated bitumen hessian kraft paper. It is preferable to have a single piece of above kraft paper fixed on the four sides. In case jointing is unavoidable, than it should be done by overlapping of approx. 200mm.

Empty space in the box shall be filled with adequate cushioning material wherever necessary i.e. thermocol pieces, wood wool etc to avoid moments and shocks.

The inner side of the top cover shall be lined with a polyethylene coated bitumen hessian kraft paper. A polyethylene sheet of at least 100 micron thick, which shall project approximately 150 mm on all side of the top covert shall be provided below the top cover, shall be folded cover. This projection, after nailing the top cover, on the side of the wooden box & tacked, to prevent ingress of water from the top.

The following details are to be marked on the packing box.



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ELECTRICAL CONTROL &
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- i) Address of Consignee.
- ii) P.O. No.
- iii) Description of item.
- iv) Case No.
- v) Net weight.
- vi) Gross weight.
- vii) Dimension of box.
- viii) Mark showing upright position.
- ix) Mark showing sling position wherever necessary.
- x) Mark showing umbrella (i.e. for item to be stored under covered storage)

10. GUARANTEE:

The equipment supplied shall be guaranteed for a period of 18 months from the date of supply of item. During the guarantee period the supplier shall remain liable for repair / replacement for any that may fail due to manufacturing / material defects by attending the same to **Baira Siul Power Station**.

Acceptance or waive of inspection does not absolve the supplier of his responsibility to rectify the equipment in case it does not perform satisfactorily at site where in it is actually used.

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SCHEDULE - "A"
GUARANTEED TECHNICAL PARTICULARS
**(TO BE FURNISHED FOR RELAYS, TIMERS, COMPARATOR MODULES, INDICATING
LAMPS, PUSH-BUTTONS)**

S.NO.	Description
1.0	<u>PANEL:</u>
1.1	Make
1.2	Overall dimension
1.3	Total weight
1.4	Degree of protection
1.5	Sheet steel thickness (mm)
1.6	Earthing arrangement
2.0	<u>PANEL LIGHTING:</u>
2.1	Make
2.2	Type
3.0	<u>SPACE HEATERS:</u>
3.1	Make
3.2	Type
3.3	Applicable standard
3.4	Rated voltage
3.5	Heater output
3.6	Thermostat setting
4.0	<u>INDICATING LAMPS:</u>
4.1	Name of manufacturer
4.2	Type of design
4.3	Rated voltage
4.4	Rated power consumption (watts)
4.5	Permissible voltage variation
5.0	<u>WIRING:</u>
5.1	Voltage grade
5.2	Insulation
5.3	Conductor material
	(a) Power wiring
	(b) Control wiring
5.4	Type of conductor, whether stranded or solid for control wiring.

	HYDRO PROJECTS ENGINEERING DIVISION	SPECIFICATION NO.	REV 00
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6.0	<u>TERMINAL:</u>
6.1	Type of terminal
6.2	Make
6.3	Rating
7.0	<u>LABELS:</u>
7.1	Material
7.2	Type of fixing
8.	<u>RELAYS / CONTACTORS</u>
8.1	Type
8.2	Make
8.3	Coil rating
8.4	VA burden
8.5	Power Consumption
8.6	Pick up to drop out ratio
8.7	Operating voltage range
9.0	<u>TIMER:</u>
9.1	Type
9.2	Make
9.3	Coil rating
9.4	VA burden
9.5	Power Consumption
9.6	Pick up to drop out ratio
9.7	Operating voltage range



**HYDRO PROJECTS ENGINEERING
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SPECIFICATION NO.

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ANNEXURE – A

LIST OF SPARES for MIV Electrical Control & Indication Panel:

Sl. No.	Item description	Quantity
1.	Timer (Device No. T1)	2 Nos.
2.	Auxiliary Relays / contactors (4 NO + 4 NC)	4 Nos.
3.	Indicating Lamp- Red (SL06)	6 Nos.
4.	Indicating Lamp –Green (SL05)	6 Nos.
5.	Indicating Lamp –Amber (SL01)	6 Nos.
6.	Illuminated Push button – Green {LED type, 1 NO contact} (PL02)	6 Nos.
7.	Illuminated Push button-Red {LED type, 1 NO contact} (PL01)	6 Nos.
8.	Push button Red (PB-7E)	1 No.
9.	MCB- 220 VDC (Q1)	2 Nos.
10.	MCB-240 VAC (Q51)	2 Nos.
11.	Selector switch (SS1)	2 Nos.
12.	Supply monitoring relay	2 Nos.
13.	DC-DC Converter (FPS)	2 Nos.



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

5. PV(BFV) ECP TECHNICAL SPECIFICATION

	HYDRO PROJECTS ENGINEERING DIVISION	SPECIFICATION NO.	REV 00
	TITLE : SPECIFICATION OF ELECTRICAL CONTROL & INDICATION PANEL FOR PENSTOCK BFV	241585457-B	Page 1 of 11

PROJECT – BAIRA SIUL HEP (3 x 60 MW – V. FRANCIS)

1. SCOPE:

This specification covers manufacturing, shop testing, supply, packing and delivery of PV (BFV) ELECTRICAL CONTROL PANEL as per schematic drawing for PV Electrical control panel (Org. No. 32170219801). The supplier shall ensure completeness of panels and shall also include any other devices, which are required for proper functioning of the schemes enclosed. The rating of equipments, wherever not specified shall be selected by the supplier. The successful bidder to prepare and submit outline general arrangement drawing including component layout for approval before start of manufacturing. Some of item described in this specification may not be relevant for this electrical control panel and may, please be ignored.

2. STANDARDS:

All equipment covered under this specification shall be of reputed make having proven quality and shall comply fully unless otherwise specified with the relevant latest issue of Indian Standard Specifications. Where the standards adopted are other than the standards mentioned below, full details of the same including deviation from the relevant India Standards shall be given in the offer.

IS – 8623	Factory built assemblies of low voltage switchgear and control gear.
IS – 2208	HRC Cartridge fuse – links up to 650V.
IS – 6875	Control switches for voltages up to and including
IEC – 337	1000V A. C.
IS – 2959	Contactors for voltages not exceeding 1000V A. C.
IS – 2147	Degree of protection for enclosures.
IS – 4064	Switches & switch – fuse units
IS – 1248	Meters and instruments
IS – 3231	Relays
IEC – 73	Colour of indicating lamps & push buttons
IS – 9224	Low voltage fuses
IS – 694	Small wiring cables
IS – 1941	Indicating lamps

REV.NO.		DISTRIBUTION.	QTY.	APPROVED:			
PREPARED				 (DH)			
CHECKED		HPE	01	PREPARED	CHECKED	ISSUED	DATE
APPROVED							
DATE		MM(H)	04	 (SPS)	 (AP)	 (PKB)	05.09.18

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3. PANELS:

3.1 GENERAL:

The panels shall be of prefabricated & bolted construction and free standing type with overall dimension not to be less than of 1700mm (H) X 1000mm (W) X 600mm (D) (Dimension without foundation frame). The panel shall be mounted on foundation frame of 300 mm (H) X 1000 mm (W) X 600 mm (D). The foundation frame is to be supplied along with panel. Total height of the panel including foundation frame should not be more than 2000mm. Sheet material of the panel shall be of cold rolled sheet steel with minimum thickness for load bearing members as 2.5 mm and for non-load bearing as 2 mm. Front hinged door shall be made of quality steel and treated for corrosion resistance under tropical weather conditions. The panels should be complete with anchors and fasteners for foundation and transport. The cubicles shall be provided with hinged doors fitted with neoprene gaskets, locks and handles. The cubicle should be designed to give the required degree of protection IP52 or higher (dust, moisture and vermin proofing) as per IS: 13947 by use of proper gaskets. Suitable stiffener to be provided wherever required for panel to be sturdy. The panel / cubicle shall have 20% free space for mounting future devices. The DC power supply variation 220 V +15%/-15% and AC power supply 240 V $\pm 5\%$ frequency variation and $\pm 10\%$ voltage variation.

The door shall be provided with louvers for ventilation and they are complete with rubber sealing strips. Lifting lugs shall be provided.

The panel shall be fitted with anti – condensation heater (Strip type) to prevent moisture condensation on wiring and fluorescent lamp for lighting. Terminal blocks for external connection shall be accessible from door. Provision for cable entry from the Top and Bottom with removable gland plates shall be provided.

3.2 SAFETY EARTHING:

All metal casings of current carrying components shall be connected to an earthing strip (25 X 6 mm) made of copper (tin plated) with the help of a continuous soft drain bars or green colored insulated tinned copper conductor. Suitable clamps type terminations (2 nos.) for connecting earth strip to station earth shall be provided and these shall be made of brass.

3.3 WIRING:

Panel wiring shall be carried out with colour coded PVC wire of 650V grade conforming to latest issue of IS: 694. The wiring shall be done with PVC insulated stranded conductor tinned annealed copper wire of size 1.5 sq. mm and wiring subject to swing shall be done with flexible cables.

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The wiring shall be with identification ferrules (sleeved type) having black letters on white back ground at both ends as per IS: 375 (1963) and schematic diagrams. No portion of the wiring shall touch the metal portion and should be supported in such a way with sturdy clips and saddles so that the wires can be traced physically and easily when required.

The wires shall be connected to the control apparatus by means of copper tin plated lugs and shall be terminated on terminals mounted at convenient height for easy access. The size of control terminals shall be suitable for 4.0 mm sq cable terminations.

Colour

Black
Gray
Green/Yellow
Red
Black

Circuit function

Neutral
Single phase/ AC Control Supply
Earth
+Ve DC Control supply
-Ve DC Control supply

3.4 MULTIPLYING CONTACTORS:

The contactors shall have sufficient no (s) of aux contacts as per schematic diagram and suitable for control DC supply. If sufficient no of contacts are not available additional contacts shall be used.

3.5 CONTROL AND SELECTOR SWITCHES (SS1):

The control and selector switches shall be of multi – stage, rotary type, rated for 660 volt AC and DC and having current rating of 5 amps. The switches shall be switch-board type.

A square or rectangular escutcheon plate for front of mounting shall be provided with main circuit label and position labels.

The mechanism housing shall be mounted in fire resistant material. The selector switches should be of stay put switches with spade type handle.

3.6 ILLUMINATED PUSH BUTTON (PL):

The illuminated push buttons shall have adequate current carrying capacity and shall have 1NO+1NC contact. It should have LED type of illumination lamp suitable for control supply voltage. It should have integral escutcheon plates engraved with its function.

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3.7 EMERGENCY PUSH BUTTON (PB-7E):

The emergency push button shall have adequate current carrying capacity with 1NO+1NC contact. It should be of Red in colour and with protective transparent cover.

3.8 INDICATION LAMPS (SL):

The Indicating lamp shall have LED type illumination. These shall have LED and proper colour lenses as per schemes. It should have integral escutcheon plates engraved with its function.

3.9 TIMER (T):

The timers are used to provide pulse command to solenoids of MIV and bypass. It should be suitable for rated control voltage and with 2NO+2NC auxiliary contact.

3.10 TERMINAL BLOCKS:

Terminal blocks (Device Ref.: TBP) for power supply connection should be of Stud type and suitable for 6 sq mm CAT M4 of Elmex / CSTS B4 of connectwell or its equivalent of make as per components and device list.

Terminal blocks (Device ref.: TB1CT, TB1FB, TB1RT & TB1SP) are control terminal blocks should be of screw type terminals and suitable for 4.0 sq mm CST 2.5 of Elmex or its equivalent of make as per components and device list.

3.11 NAME PLATES:

The name plates of **anodized aluminum** on front door and inside mounted item shall be provided on bottom of each device. Panel main label shall be provided on top of each panel. The label / name plates for device mounted on the front door of the panel shall be fixed by screws. The label / name plates for the device mounted inside the panel shall be fixed with adhesives.

3.12 PAINTING:

All sheet steel parts shall be acid cleaned, rust free, degreased before applying the powder coat of **RAL6019**.

- (a) All sheet work shall be phosphated in accordance with IS: 60005 "Code of practice for phosphating Iron and steel".

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- (b) Oil, grease dirt and swarf shall be thoroughly removed by emulsion cleaning.
- (c) Rust and scale shall be removed by pickling with dilute acid followed by washing and running water rinsing with slightly alkaline hot water and drying.
- (d) After phosphating, through rinsing shall be carried out with clean water followed by final rinsing with dilute dichromatic solution and oven drying.
- (e) Panel shall be powder coated with thickness of the coating of thickness > 95 mm. External colour of the panel shall be of Semi glossy Pastel Green of **RAL 6019 grade** and internal colour of the panel shall be glossy white of shade **RAL 9003 grade**.

4.0 TEST AND INSPECTION :

All necessary Test / Test certificates shall be carried out / submitted to prove that the equipment supplied meets the requirement of this specification and relevant IS.

Assembled panels shall be subjected to following routine tests at supplier's work in presence of the BHEL representative and our customer.

- Visual inspection.
- Dimension check
- Megger testing with 1000 V megger before and after HV test.
- HV test 2 KV, 50 Hz. rms voltage applied for 1 minute between all terminal connected together and all metal parts intended to be earthed during service.
- Earth Continuity test.
- Functional test as per schematic diagram

3 copies of final test certificates shall be submitted for our reference and record.

5.0 DRAWING, DATA AND PARTICULARS : (TO BE SUBMITTED BY TENDERER / SUPPLIER)

The supplier shall submit the documents / drawings (1 set) at the time of offer which shall include the following:

- i) Details of all equipments including their type make specifications with catalogue and guaranteed technical particular.

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The supplier shall submit within four weeks from the date of award of contract, Drawings (two prints each) which shall include but not limited to the following, for customer (NHPC) APPROVAL.

- Outline general arrangement including component layout arrangement drawing.
- Mounting and foundation details.
- Internal panels wiring diagram showing termination of external cables with proper terminal markings.
- Bill of material with exact make of equipment
- Quality Assurance plan.

Vendor should start manufacturing of the panel only after approval of GA drawing from BHEL / customer. The supplier shall provide 3 copies of all drawing certified for construction.

8 copies of Erection, operation and maintenance manual and drawing shall be supplied as per distribution schedule to be intimated two months prior to the dispatch of equipment. The manual shall also contain the catalogue of contractors, timer control switches, meters, indicating lamps and push button.

2 copies of packing list showing details of items packed in each box dispatched. The packing list has to be sent early to Indenter for approval prior to dispatch of panels.

Purchaser reserves the right for altering / modifying the control scheme even if the panels are under manufacture. The supplier shall have to make the corresponding changes in the panel as required.

6.0 COMPLETENESS OF EQUIPMENT:

All fittings and accessories which are necessary for the competence of the equipments shall be deemed to be included in the specification and shall be supplied by the supplier.

7.0 DRAWINGS AND DATA ENCLOSED WITH SPECIFICATION :

Schedule of equipment for PVECP is attached as per drawing No. 32170219801.

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8.0 IDENTIFICATION:

The panel shall be identified with the following information.

1. PV (BFV) ELECTRICAL CONTROL PANEL
2. UNIT NO.: 01
3. PROJECT: RAMMAM HEP
4. BHEL LOGO

The above information shall be in a permanent form as a metal name plate or by engraving.

9.0 PACKING INSTRUCTIONS:

Packing box must be reusable type. Before putting panel in to wooden box, panel shall be entirely covered with polyethylene sheet of least 100-micron thickness after placing adequate quantity of silica gel packed in a cotton bag. Front side of panel shall be properly covered by polyethylene air bubble film to avoid damages of indicating meters and flush panel mountings.

The base of the wooden case shall be of wooden bottom and planks giving necessary reinforcement such that the bottom of the equipment is at a height of 200 mm minimum from ground level. Polyethylene coated bitumen hessian kraft paper shall be fixed in position above the wooden planks over which panel is to rest.

Polyethylene sheet of at least 100-micron thickness shall be laid over the base of polyethylene coated bitumen hessian kraft paper.

Four sides shall be lined from inside by polyethylene coated bitumen hessian kraft paper. It is preferable to have a single piece of above kraft paper fixed on the four sides. In case jointing is unavoidable, than it should be done by overlapping of approx. 200mm.

Empty space in the box shall be filled with adequate cushioning material wherever necessary i.e. thermocol pieces, wood wool etc to avoid moments and shocks.

The inner side of the top cover shall be lined with a polyethylene coated bitumen hessian kraft paper. A polyethylene sheet of at least 100 micron thick, which shall project approximately 150 mm on all side of the top cover shall be provided below the top cover, shall be folded cover. This projection, after nailing the top cover, on the side of the wooden box & tacked, to prevent ingress of water from the top.

The following details are to be marked on the packing box.

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- i) Address of Consignee.
- ii) P.O. No.
- iii) Description of item.
- iv) Case No.
- v) Net weight.
- vi) Gross weight.
- vii) Dimension of box.
- viii) Mark showing upright position.
- ix) Mark showing sling position wherever necessary.
- x) Mark showing umbrella (i.e. for item to be stored under covered storage)

10. **GUARANTEE:**

The equipment supplied shall be guaranteed for a period of 18 months from the date of supply of item. During the guarantee period the supplier shall remain liable for repair / replacement for any that may fail due to manufacturing / material defects by attending the same to **Rammam Power Station**.

Acceptance or waive of inspection does not absolve the supplier of his responsibility to rectify the equipment in case it does not perform satisfactorily at site where in it is actually used.

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SCHEDULE - "A"
GUARANTEED TECHNICAL PARTICULARS
**(TO BE FURNISHED FOR RELAYS, TIMERS, COMPARATOR MODULES, INDICATING
LAMPS, PUSH-BUTTONS)**

S.NO.	Description
1.0	<u>PANEL:</u>
1.1	Make
1.2	Overall dimension
1.3	Total weight
1.4	Degree of protection
1.5	Sheet steel thickness (mm)
1.6	Earthing arrangement
2.0	<u>PANEL LIGHTING:</u>
2.1	Make
2.2	Type
3.0	<u>SPACE HEATERS:</u>
3.1	Make
3.2	Type
3.3	Applicable standard
3.4	Rated voltage
3.5	Heater output
3.6	Thermostat setting
4.0	<u>INDICATING LAMPS:</u>
4.1	Name of manufacturer
4.2	Type of design
4.3	Rated voltage
4.4	Rated power consumption (watts)
4.5	Permissible voltage variation
5.0	<u>WIRING:</u>
5.1	Voltage grade
5.2	Insulation
5.3	Conductor material
	(a) Power wiring
	(b) Control wiring
5.4	Type of conductor, whether stranded or solid for control wiring.

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6.0 TERMINAL:

- 6.1 Type of terminal
- 6.2 Make
- 6.3 Rating

7.0 LABELS:

- 7.1 Material
- 7.2 Type of fixing

8. RELAYS / CONTACTORS

- 8.1 Type
- 8.2 Make
- 8.3 Coil rating
- 8.4 VA burden
- 8.5 Power Consumption
- 8.6 Pick up to drop out ratio
- 8.7 Operating voltage range

9.0 TIMER:

- 9.1 Type
- 9.2 Make
- 9.3 Coil rating
- 9.4 VA burden
- 9.5 Power Consumption
- 9.6 Pick up to drop out ratio
- 9.7 Operating voltage range

	HYDRO PROJECTS ENGINEERING DIVISION	SPECIFICATION NO.	REV 00
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ANNEXURE – A

LIST OF SPARES for Penstock BFV Electrical Control & Indication Panel:

Sl. No.	Item description	Quantity
1.	Timer (Device No. T1)	2 Nos.
2.	Auxiliary Relays / contactors (4 NO + 4 NC)	2 Nos.
3.	Indicating lamp- Red (SL06)	2 Nos.
4.	Indicating lamp –Green (SL05)	2 Nos.
5.	Indicating lamp –Amber (SL01)	2 Nos.
6.	Illuminated Push button – Green {LED type, 1 NO contact} (PL02)	2 Nos.
7.	Illuminated Push button-Red {LED type, 1 NO contact} (PL01)	2 Nos.
8.	Push button Red (PB-7E)	1 No.
9.	MCB-240 VAC (Q51)	1 No.
10.	Selector switch (SS1)	1 No.
11.	AC-DC convertor along with Diode Oring module	1 Set



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

6. DRAWINGS/DOCUMENTS REQUIRED FROM VENDOR

SL.NO	DESCRIPTION	PRINTS	CD-ROM	MANUAL S
1	DRAWING /DOCUMENTS –FIRST SUBMISSION	3		
2	DRAWING /DOCUMENTS-SUBSEQUENT REVISED SUBMISSION	5		
3	DRAWING /DOCUMENTS-FINAL (AFTER CATEGORY –I APPROVAL)	5	5	
4	DRAWING AS BUILT	5	5	
5	O/M MANUAL-DRAFT			3
6	O/M MANUAL-FINAL		3	10
7	TYPE TEST CERTIFICATES	5		

ALL DRAWINGS SHALL BE SUBMITTED IN BOTH PDF AND AUTOCAD (.DWG 2004) FORMATS.



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

7. LIST OF CODES & STANDARDS

Notes:

- 1 Equipment, accessories, components, material and tests shall confirm, to the specifications of latest revision of applicable standards.
- 2 Equipment, accessories, components, material and tests shall confirm, in general, to the Specifications of

☒ S
☐ BS
☐ IEC

Unless marked otherwise in the list below. Applicable standards are to be ticked ☐

LV SWITCHGEAR

1	Switchgear General Requirements	☒ IS : 4237	☐ BS : 162	☐ IEC :
2	Factory built assemblies of LV Switchgear control gear	☒ IS : 8623	☐ BS:5486	☐ IEC : 439
3	Selection , installation and maintenance of switchgear and control gear	☒ IS : 10118	☐ :	☐ IEC :
4	Busbar main connections and accessories	☒ IS: 5578	☐ BS : 159	☐ IEC :
5	Rail mounting in switchgear and control gear installation	☒ IS :11039	☐ BS :	☐ IEC : 715
6	Marking and identification of conductor and apparatus terminal	☒ IS:11053	☐ BS :	☐ IEC :
7	Marking of insulated conductors	☒ IS: 5578	☐ BS :	☐ IEC : 391
8	Item designation	☒ IS :8270	☐ BS :	☐ IEC :
9	Climate proofing of electrical equipment	☒ IS: 3202	☐ BS : CP 1014	☐ IEC :
10	Degree of protection (enclosure)	☒ IS:13947	☐ BS :	☐ IEC : 144
11	Wrought aluminium & Al. alloys	☒ IS:5082	☐ BS: 2898	☐ IEC : 114
12	Copper of bus bars	☒ IS :	☐ BS :	☐ IEC : 28
13	LV circuit breakers	☒ IS :2516 Pt. I& II	☐ BS: 4752 ☐ BS:3871 SEC 1	☐ IEC : 157 -1
14	Starters	☒ IS : 8544	☐ BS: 4941	☐ IEC : 292-1
15	Identification of terminals of contractors and associated overload	☒ IS :10705	☐ BS:	☐ IEC : 158-1C
16	Air break switch	☒ IS :4064	☐ BS: 5419	☐ IEC : 408
17	Contactors	☒ IS:2959	☐ BS: 775	☐ IEC : 158-1
18	HRC cartridge fuses	☒ IS:13703	☐ BS: 88	☐ IEC : 269-1



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

19	Indicating instruments	☒ IS:1248	☐ BS: 89	☐ IEC : 51
20	Dimensions for panel mounted indicating instruments	☒ IS:2419	☐ BS:	☐ IEC :
21	AC electricity meters	☒ IS:722	☐ BS: 5685	☐ IEC : 521
22	Relays	☒ IS:3231	☐ BS:142	☐ IEC : 255
23	Static protective relays	☒ IS :8686	☐ BS:	☐ IEC :
24	Current transformers	☒ IS :2705	☐ BS: 3938	☐ IEC : 185
25	Voltage transformers	☒ IS: 3941	☐ BS: 3941	☐ IEC :
26	LV Control Transformers	☒ IS: 12021	☐ BS :	☐ IEC :
27	Miniature circuit breakers	☒ IS: 8828	☐ BS : 3871	☐ IEC :
28	Control switches & push button	☒ IS: 13947	☐ BS:	☐ IEC :
29	Thermostatic Bimetals	☒ IS: 8588	☐ BS:	☐ IEC :
30	Phosphating of iron & steel	☒ IS: 6005	☐ BS: 3189	☐ IEC :
31	"Colours for ready mixed paints and enamels"	☒ IS: 5	☐ BS:	☐ IEC :
32	Environmental tests	☒ IS: 2106	☐ BS:	☐ IEC :
33	Maintenance & field testing of relays	☒ IS:9124	☐ BS:	☐ IEC :
34	Specification for PVC insulated cables for working voltage upto & including 1100volts	☒ IS: 694	☐ BS:	☐ IEC :



RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

LPB & Local Starters:-

1	Factory built assemblies of LV Switchgear and control gear	☒ IS: 8623 PART -II	☐ BS :5486	☐ IEC : 439
2	Degree of protection	☒ IS: 13947	☐ BS :5420	☐ IEC : 144
3	Push button	☒ IS: 13947	☐ BS :	☐ IEC : 337
4	Climatic proofing of electrical equipment	☒ IS: 3202	☐ BS :CP1014	☐ IEC :
5	AC motors starters for voltage not exceeding 1000 V	☒ IS: 8544	☐ BS : 4941	☐ IEC : 292
6	Code of practice for phosphating iron & steel	☒ IS: 6005	☐ BS :3189	☐ IEC :
7	Colour for ready mixed paints & enamels	☒ IS: 5	☐ :	☐ IEC :



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

8. GENERAL PACKING SPECIFICATION



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

9. GENERAL PAINTING SPECIFICATION

GENERAL PAINTING SPECIFICATION
OF
LT SWITCHGEAR

Document No: EP- 4 - CP- SD - 001



BHARAT HEAVY ELECTRICALS LIMITED
CONTROL PANEL BUSINESS GROUP
ELECTROPORCELAINS DIVISION,
BENGALURU-560012

Date of issue: 13.04.2018



**GENERAL PAINTING SPECIFICATION
FOR
LOW VOLTAGE SWITCHGEAR**

SPECIFICATION NO. : EP-4-CP-SD-001

VOLUME -

SECTION -

REVISION
00

DATE: 13/04/2018

SHEET 1 OF 2

1. General Specification:

All 415V switchgears, MCC's, AC & DC distribution boards etc. shall be painted by powder coating process.

2. Pre-Treatment or Surface Preparation:

Minimum 7 tank process or better shall be used for pre-treatment or surface preparation of sheet steel used for enclosures. The sequence of pre-treatment process shall include but not be limited to the following steps:

TANK-1: DEGREASING

Sheet Metal Surface shall be cleaned of grease, oils, soils, lubricants, oxide films, Heat Treatment / welding Scales etc. by using ALKALINE DEGREASER at Room Temperature for a Duration of 30-40 Minutes

TANK-2: WATER RINSE-I

Sheet Metal Surface shall be rinsed with water

TANK-3: DERUSTING

Sheet Metal Surface shall be cleaned of Rust by using Mixed HYDROCHLORIC ACID at Room Temperature for a Duration of 20 Minutes.

TANK-4: WATER RINSE-II

Sheet Metal Surface shall be rinsed with water

TANK-5: SURFACE ACTIVATION

Sheet Metal Surface shall be activated for Zn & Mn phosphate Coating by using ACTIVATION CHEMICALS ACID at Room Temperature for a Duration of 20 Minutes.

TANK-6: PHOSPHATING

Sheet Metal Surface shall be smoothly & uniformly coated with Zn Phosphate by using ZINC PHOSPHATE SOLUTION at Room Temperature for a Duration of 5 - 20 Minutes

TANK-7: WATER RINSE-III

Sheet Metal Surface shall be rinsed with water

TANK-8: PASSIVATION

For Sealing Pores of Sheet Metal Surface for obtaining Maximum Corrosion Resistance over Phosphate Coating by DECXYLITE SOLUTION at Room Temperature for a Duration of 15 - 20 Minutes



**GENERAL PAINTING SPECIFICATION
FOR
LOW VOLTAGE SWITCHGEAR**

SPECIFICATION NO. : EP-4-CP-5D-001

VOLUME -

SECTION -

REVISION
00

DATE: 13/04/2018

SHEET 2 OF 2

3. Powder Coating:

The following steps shall be followed to complete the powder coating process -

• **OVEN DRYING**

Sheet Metal Parts shall be dried by HOT AIR at 150 Deg C Process, Duration-10-20 Minutes.

• **POWDER COATING**

Within 24 Hours of Oven Drying, Sheet Metal parts shall be coated with Powder of shade desired by client through Spraying in Spray Booths, and then Epoxy-Powder Coated/Sprayed Sheet Metal parts are BAKED in an electrically fired oven at 140-150 Deg C for 10-15 Minutes.

4. Paint Thickness:

To be followed as per Customer Specifications or Project-wise Technical Specification documents.

5. Paint Shade:

To be followed as per Customer Specifications or Project-wise Technical Specification documents.

6. Testing and Verification of Painting Process:

To be followed as per Customer Approved or Project-wise approved Quality Plan.

Routine tests:

- a. Test for Paint shade with reference to shade card
- b. Paint thickness measurement
- c. Adhesion test

Special Tests:

If any special tests are specified, the same shall be carried out as per approved Quality Plan



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

10. MANUFACTURING QUALITY PLAN FOR LV SWITCHGEAR



BHARAT HEAVY ELECTRICALS LIMITED
ELECTROPORCELAINS DIVISION, BANGALORE -560012
CONTROL PANEL BUSINESS GROUP



QUALITY ASSURANCE PLAN

Page 1 / 4

EQUIPMENT : LT SWITCHGEAR

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
							Perform	Witness	Verify	
1	Raw Material & Brought Out Items									
1.1	Steel Sheets									
a)	Dimension Size of Sheet, Uniformity of Thickness, Surface Finish.)	Measurement	As per sampling plan	Tech. Spec./ Appd.drg./ IS:513		TC	2/3	-	1	TC
b)	Hardness	Mechanical	-do-	-do-		TC	2/3	-		
c)	Bend Test	-do-	-do-	-do-		TC	2/3	-		
1.2	Aluminium/Copper/ Copper flats for Bus-bars & Links.									
a)	Dimension	Measurement	-do-	Tech. Spec./ Appd.drg./ IS:613		TC	2/3	-		
b)	Bend Test	Mechanical	-do-	Tech. Spec./ Appd.drg./ IS:191		TC	2/3	-		
c)	Hardness	-do-	-do-	-do-		TC	2/3	-	1	TC
d)	Tensile Strength	-do-	-do-	Tech. Spec./ Appd.drg./IS:1897		TC	2/3	-		
e)	Chemical Composition.	Chemical	-do-	Tech. Spec./ Appd.drg./IS:6160		TC	2/3	-		
f)	Conductivity	Electrical	-do-	Tech. Spec./ Appd.drg.		TC	2/3	-		
1.3	PVC/FRLS Wire									TC
a)	Dimension	Measurement	-do-	Tech. Spec./ Appd.drg./ IS:694		TC	2/3	-		
b)	Insulation Resistance	Electrical	-do-	-do-		TC	2/3	-		
c)	Conductor Resistance	Electrical	-do-	-do-		TC	2/3	-		
d)	Material Properties: (Annealing, TS, Thickness of Insulation & Sheath, etc.)	Mechanical	-do-	-do-		TC	2/3	-		

Note: a. In 'Inspection Agency' column figure 1,2,or 3 to be filled. 1- will indicate 'customer', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.

b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

Signature, Name & Seal
EPD Bangalore



BHARAT HEAVY ELECTRICALS LIMITED
ELECTROPORCELAINS DIVISION, BANGALORE -560012
CONTROL PANEL BUSINESS GROUP



QUALITY ASSURANCE PLAN

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EQUIPMENT : LT SWITCHGEAR

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
							Perform	Witness	Verify	
1.4	Electrical Meters (Ammeter, Voltmeter, Freq. meter etc.)									
a)	Physical condition	Visual	100%	Tech. Spec./ Appd.drg./IS:1248		TC	2/3	-		
b)	Verification of Scale & Range.	Electrical	-do-	-do-		TC	2/3	-		
c)	Insulation Resistance	-do-	-do-	-do-		TC	2/3	-	1	TC
d)	High Voltage Test	-do-	-do-	-do-		TC	2/3	-		
e)	Calibration Test	Verification	-do-	-do-		TC	2/3	-		
1.5	Current Transformer									
a)	Make, Type & Rating	Visual	100%	Tech.Spec./Appd.drg./IEC:44		TC	3-2	-	1	TC
b)	Routine Test	Test	100%	-do-		TC	3-2	-		
1.6	Voltage Transformer									
a)	Make, Type & Rating	Visual	100%	Tech. Spec./Appd.drg./IEC:186		TC	3-2	-	1	TC
b)	Routine Test	Test	100%	-do-		TC	3-2	-		
1.7	MCCB / MCB/MPCB									
a)	Make, Type & Rating	Visual	100%	Tech. Spec./Appd.drg./IS:8828		TC	3-2	-	1	
b)	Operational Test	Electrical	-do-	-do-		TC	3-2	-		
c)	High Voltage test	-do-	-do-	-do-		TC	3-2	-		
1.8	Overload Relay									
a)	Make, Type & Rating	Visual	100%	Tech. Spec./ Appd.drg./IS:8544		TC	2/3	-		
b)	Operational Test	Electrical	-do-	-do-		TC	2/3	-	1	
c)	High Voltage test	-do-	-do-	-do-		TC	2/3	-		

Note: a. In 'Inspection Agency' column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.

b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

Signature, Name & Seal
EPD Bangalore



BHARAT HEAVY ELECTRICALS LIMITED
ELECTROPORCELAINS DIVISION, BANGALORE -560012
CONTROL PANEL BUSINESS GROUP



QUALITY ASSURANCE PLAN

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EQUIPMENT : LT SWITCHGEAR

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1.9	Power & Auxiliary Contactor							1	TC
a)	Make, Type & Rating	Visual	100%	Tech. Spec./ Appd.drg./IS:2959	TC	2/3	-		
b)	Operational Test	Electrical	-do-	-do-	TC	2/3	-		
c)	High Voltage test	-do-	-do-	-do-	TC	2/3	-		
1.10	Bimetallic Overload Relays							1	TC
a)	Make, Type & Rating	Visual	100%	Tech. Spec./ Appd.drg./IS:8544	TC	2/3	-		
b)	Operational Test	Electrical	-do-	-do-	TC	2/3	-		
c)	High Voltage test	-do-	-do-	-do-	TC	2/3	-		
1.11	Timers (Electronics & Electro-pneumatic & Annunciators)							1	TC
a)	Time limits	Electrical	100%	Tech. Spec./ Appd.drg./ IS Code	TC	2/3	-		
b)	Operation	-do-	-do-	-do-	TC	2/3	-		
c)	High Voltage test	-do-	-do-	-do-	TC	2/3	-		
1.12	Switches & Control Switches								TC
a)	Breakage	Visual	100%	Tech. Spec./ Appd.drg./ IS:4064 & IS:6875	TC	2/3	-		
b)	Rating	Visual	-do-	-do-	TC	2/3	-		
c)	Operation	Electrical	-do-	-do-	TC	2/3	-		
d)	HV Test	-do-	-do-	-do-	TC	2/3	-		

Note: a. In 'Inspection Agency' column figure 1,2,or 3 to be filled. 1- will indicate 'customer', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.

b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

Signature, Name & Seal
EPD Bangalore



BHARAT HEAVY ELECTRICALS LIMITED
ELECTROPORCELAINS DIVISION, BANGALORE -560012
CONTROL PANEL BUSINESS GROUP



QUALITY ASSURANCE PLAN

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EQUIPMENT : LT SWITCHGEAR

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
2	Final Inspection								
2.1	Mechanical Checks						1		
a)	BOM verification	Visual	100%	Tech.Spec./Appd.drg./IEC:Code	JIR	2/3		-	} CHP
b)	Layout checking and Accessibility	Visual	-do	-do	JIR	2/3		-	
c)	Dimensional checks (Sheet thickness, Paint thickness, Paint shade & overall dimension)	Measurement	-do	-do	JIR	2/3		-	
d)	Name plate details	Visual	-do	-do	JIR	2/3		-	
e)	Mechanical operation of equipments.	Mechanical	-do	-do	JIR	2/3		-	
2.2	Electrical Checks						1		
a)	Electrical operation of equipments.	Electrical	-do	-do	JIR	2/3		-	
b)	Scheme checking	-do	-do	-do	JIR	2/3		-	
c)	IR Test before & after HV Test	-do	-do	-do	JIR	2/3		-	
d)	HV Test	-do	-do	-do	JIR	2/3		-	

Note: a. In 'Inspection Agency' column figure 1,2,or 3 to be filled. 1- will indicate 'customer',2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.

b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

Signature, Name & Seal
EPD Bangalore



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

11. MAKE OF COMPONENT



BHEL-EPD BANGALORE

LIST OF SUB-VENDORS

Sl. No.	Components List	Name of Sub-Vendor
1	Air Circuit Breaker (ACB)	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
2	Data Concentrator (DCS)	ABB
		Schneider
		SIEMENS
		SEL
		GE(ALSTOM)
3	Ethernet Switches	RUGGEDCOM
		GARRETTCOM
		NETGEAR
		HIRSCHMANN
		MOXA
		CISCO
4	a)Molded case circuit breakers (MCCB) , b) Motor Protection Circuit Breaker (MPCB),c)AC Power Contactor, d)Thermal Overload Relay (OLR)	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
5	SWITCH FUSE UNIT (SFU)	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
6	Miniature Circuit Breaker (MCB)	ABB
		Schneider
		L & T



BHEL-EPD BANGALORE

Sl. No.	Components List	Name of Sub-Vendor
		Siemens
		C & S Electric
		GE-POWER
		LEGRAND
		STANDARD
		HAVELLS
7	Electronic Motor Protection Relay (EMPR)	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
8	Current transformer / Voltage Transformers (VT/PT)	Automatic Electric
		Precise Electricals
		Kappa Electricals
		Pragati Electricals
		KALPA
		Indcoil
9	Control Transformers(CST)	Automatic Electric
		Precise Electricals
		Kappa Electricals
		Pragati Electricals
		KALPA
		Indcoil
10	Interposing Relays	Jyoti
		OEN
		PLA
		Schneider
		GUARDIAN
		OMRON
11	Numerical Protection Relay	ABB
		Siemens
		GE (ALSTOM)
		Schneider
		SEL
12	Electromechanical Protection Relay	ABB
		Siemens



BHEL-EPD BANGALORE

Sl. No.	Components List	Name of Sub-Vendor
		GE (ALSTOM)
		JVS
		L&T
13	Timer/ TIME DELAY RELAY	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
14	Multifunction Meter (MFM)	Conzerve(Schneider)
		L&T
		Rishabh
		Secure
		AE
		MECO
		ELMEASURE
15	Energy Meter(TVM)	Schneider
		Secure
		ABB
16	AC/DC Aux. Contactor	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
17	Auxiliary Relay	ABB
		GE(ALSTOM)
		L&T
		Siemens
		JVS
18	DC Power Contactor	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
		BCH electric ltd
19	Ammeter(Analog)	AE
		Rishabh



BHEL-EPD BANGALORE

Sl. No.	Components List	Name of Sub-Vendor
		IMP
		MECO
20	Voltmeter(Analog)	AE
		Rishabh
		IMP
		MECO
21	Ammeter(DIGITAL)	AE
		Rishabh
		L&T
		MECO
		Secure
		Schneider/conzerv
22	Voltmeter(DIGITAL)	AE
		Rishabh
		L&T
		MECO
		Secure
		Schneider/conzerv
23	FUSE Base with holder	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
24	FUSES (Power/Control)	GE-Power
		Siemens
		L & T
		C & S Electric
		Schneider
		COPPER BUSSMANN
		ABB
25	Control Switchs	Kaycee
		Salzer, L&T
		SWITRON
		RECOM
26	Indicating Lamp	Siemens
		RASS (C & S Electric)
		Vaishno
		L & T (ESBEE)



BHEL-EPD BANGALORE

Sl. No.	Components List	Name of Sub-Vendor
		Schneider
		ABB
		SECO
		TEKNIK
27	Push Button	Siemens
		RASS (C & S Electric)
		Vaishno
		L & T (ESBEE)
		TEKNIK
		Schneider
		ABB
28	Transducer	Southern Transducer
		AE
		Rishabh
		Secure
		MECO
29	Terminals Block	Phoenix
		Connect well
		Elemex
		Wago
30	Cable Glands	HEX
		Commet
		DOWELLS
		Jainson
		3D
		Sunil & Co.
31	Cable Lugs	HEX
		Commet
		DOWELLS
		Jainson
		3D
		Sunil & Co.
32	Local Motor Starter	L & T
		C & S Electric
		ABB
		BCH



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

12. GENERAL NOTES

SL.NO.	GENERAL NOTES:	
1	ITEM	ELECTRICAL CONTROL PANEL
2	TYPE OF PRODUCT	FLOOR MOUNTING
3	CABLE ENTRY	BOTTOM
4	DEGREE OF PROTECTION FOR ENCLOSURE	IP 52 or better
5	SHORT CKT LEVEL	20KA
6	SUPPLY VOLTAGE	
	POWER VOLTAGE	220VDC 2Ph 2WIRE / 240vac 2 ph 2 WIRE FOR CONTROL
		1 ph , 50 hz, 240 vac FOR ILLUMINATION CKT
7	FABRICATION (ENCLOSURE)	
7.01	LOAD BEARING MEMBER	2.5 mm THICK CRCA SHEET
7.02	NON LOAD BEARING	2.0 mm THICK CRCA SHEET
7.03	GLAND PLATE	3 mm THICK CRCA SHEET
7.04	TYPE OF GLAND PLATE	REMOVABLE UNDRILLED
7.05	BASE FRAME	ISMC100(BLACK)
8	EARTH BUS	25X6mm COPPER
9	PAINTING	POWDER COATING TYPE
9.01	POWDER TYPE	EPOXY BASED POWDER COATING
9.02	POWDER SHADE	
	END COVER	RAL 5012(WILL BE FINALISED DURING DETAILED ENGG.)
	COMPLETE PANEL(INTERIOR&EXTERIOR	RAL 9002
		PAINT SHADE THICKNESS: MIN 60 MICRON
11	SPARE TERMINALS	20% OF CONTROL TERMINALS 20% OF POWER TERMINAL
12	WIRING	

12.01	DC CONTROL	2.5 SQ MM MULTI STRANDED Cu FLEXIBLE WIRE BLUE AND WHITE COLOUR
12.02	EARTHING	2.5 SQ MM MULTI STRANDED Cu FLEXIBLE WIRE GREEN/YELLOW COLOUR OF 1100V GRADE
12.03	DC POWER	MULTI STRANDED Cu WIRE GREY COLOUR OF 1100V GRADE
13	GASKET	POLYURETHANE / NEOPRENE
14	FERRULES	PVC WHITE COLOUR WITH BLACK LETTERS NUMBER / CRISS-CROSS
15	NAME PLATE DETAILS	
	MATERIALS	ANODIZED ALUMINIUM
	COLOUR	WHITE LETTERS ON BLACK BACKGROUND



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

13. SCHEMATIC DIADRAGM MIV

PROJECT :- RAMMAM HEP (3X40 MW)
 RATING :- 3 X 40 MW (V. PELTON)
 DRG.NO. :- 3-21305-198-01

1. 02000019802 - DIAGRAM OF CONTROL GEAR FOR MIV

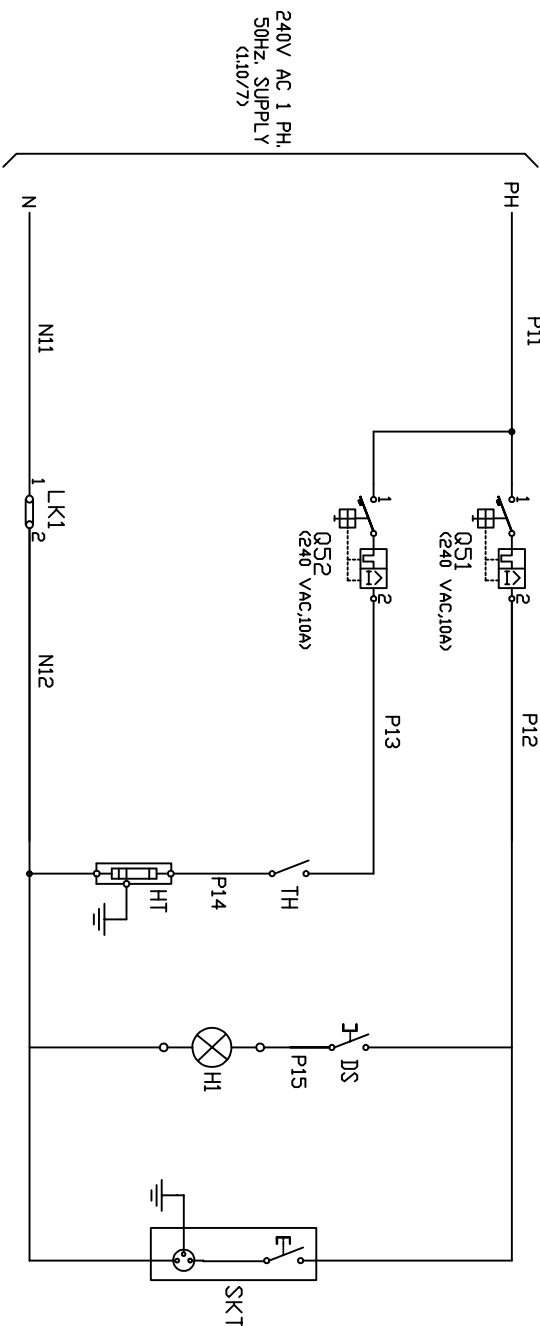
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<table><tr><th>SHT NO.</th><th>TITLE</th><th>CARD CODE</th></tr><tr><td>1</td><td>COVERING SHEET</td><td>0.00</td></tr><tr><td>2</td><td>INDEX SHEET</td><td>0.10</td></tr><tr><td>3</td><td>SYMBOL & LEGENDS</td><td>0.20</td></tr><tr><td>4</td><td>COMPONENTS & DEVICE LIST</td><td>0.30</td></tr><tr><td>5</td><td>SYSTEM (220 VDC), FIELD POWER (24 VDC), 240 VAC SUPPLY</td><td>1.10</td></tr><tr><td>6</td><td>CUBICLE HEATER & ILLUMINATION CIRCUIT</td><td>1.20</td></tr><tr><td>7</td><td>BYPASS VALVE OPEN</td><td>3.01</td></tr><tr><td>8</td><td>BYPASS VALVE CLOSE</td><td>3.02</td></tr><tr><td>9</td><td>SERVICE SEAL OPEN (DISENGAGE)</td><td>3.11</td></tr><tr><td>10</td><td>SERVICE SEAL CLOSE (ENGAGE)</td><td>3.12</td></tr><tr><td>11</td><td>MAIN INLET VALVE OPEN</td><td>3.21</td></tr><tr><td>12</td><td>MAIN INLET VALVE CLOSE</td><td>3.22</td></tr><tr><td>13</td><td>DECOMPRESSION VALVE & BRACK JET VALVE OPEN</td><td>3.41</td></tr><tr><td>14</td><td>DECOMPRESSION VALVE & BRACK JET VALVE CLOSE</td><td>3.42</td></tr><tr><td>15</td><td>EMERGENCY CLOSING</td><td>3.70</td></tr><tr><td>16</td><td>LOGIC CONTROL</td><td>3.71</td></tr><tr><td>17</td><td>MULTIPLIER RELAYS - 1</td><td>4.01</td></tr><tr><td>18</td><td>MULTIPLIER RELAYS - 2</td><td>4.02</td></tr><tr><td>19</td><td>MULTIPLIER RELAYS - 3</td><td>4.03</td></tr><tr><td>20</td><td>MULTIPLIER RELAYS - 4</td><td>4.04</td></tr><tr><td>21</td><td>STATUS INDICATION-1</td><td>5.01</td></tr><tr><td>22</td><td>STATUS INDICATION-2</td><td>5.02</td></tr><tr><td>23</td><td>STATUS INDICATION-3</td><td>5.03</td></tr><tr><td>24</td><td>STATUS INDICATION-4</td><td>5.04</td></tr><tr><td>25</td><td>STATUS INDICATION-5</td><td>5.05</td></tr></table>												SHT NO.	TITLE	CARD CODE	1	COVERING SHEET	0.00	2	INDEX SHEET	0.10	3	SYMBOL & LEGENDS	0.20	4	COMPONENTS & DEVICE LIST	0.30	5	SYSTEM (220 VDC), FIELD POWER (24 VDC), 240 VAC SUPPLY	1.10	6	CUBICLE HEATER & ILLUMINATION CIRCUIT	1.20	7	BYPASS VALVE OPEN	3.01	8	BYPASS VALVE CLOSE	3.02	9	SERVICE SEAL OPEN (DISENGAGE)	3.11	10	SERVICE SEAL CLOSE (ENGAGE)	3.12	11	MAIN INLET VALVE OPEN	3.21	12	MAIN INLET VALVE CLOSE	3.22	13	DECOMPRESSION VALVE & BRACK JET VALVE OPEN	3.41	14	DECOMPRESSION VALVE & BRACK JET VALVE CLOSE	3.42	15	EMERGENCY CLOSING	3.70	16	LOGIC CONTROL	3.71	17	MULTIPLIER RELAYS - 1	4.01	18	MULTIPLIER RELAYS - 2	4.02	19	MULTIPLIER RELAYS - 3	4.03	20	MULTIPLIER RELAYS - 4	4.04	21	STATUS INDICATION-1	5.01	22	STATUS INDICATION-2	5.02	23	STATUS INDICATION-3	5.03	24	STATUS INDICATION-4	5.04	25	STATUS INDICATION-5	5.05																							
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DRN		NAME	SIGN	DATE	NO. OF VNS			BHARAT HEAVY ELECTRICALS LTD.		CARD CODE																																																																																																						
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INVENTORY NO. SIGN.& DATE REF.DRG.NO.
N.A



DRN	NAME	SIGN	DATE	NO. OF VAR
SP			01.10.18	
CHKD	VKN		01.10.18	
APPRD	DH		01.10.18	

SUB-SUPPLIER/VENDOR		ISSUED BY		TITLE		CARD CODE	
		APPR. 418		CUBICLE HEATER & ILLUMINATION CIRCUIT		1.20	



BHARAT HEAVY ELECTRICALS LTD.
BHOPAL

PROJECT
RAMMAM STG-III HEP
(3x40MW)
SCHEMATIC DIAG. OF CONTROL & INDICATION PANEL FOR MIV

DRAWING NO.
3 21305 19801
REV.
00

01

1

2

3

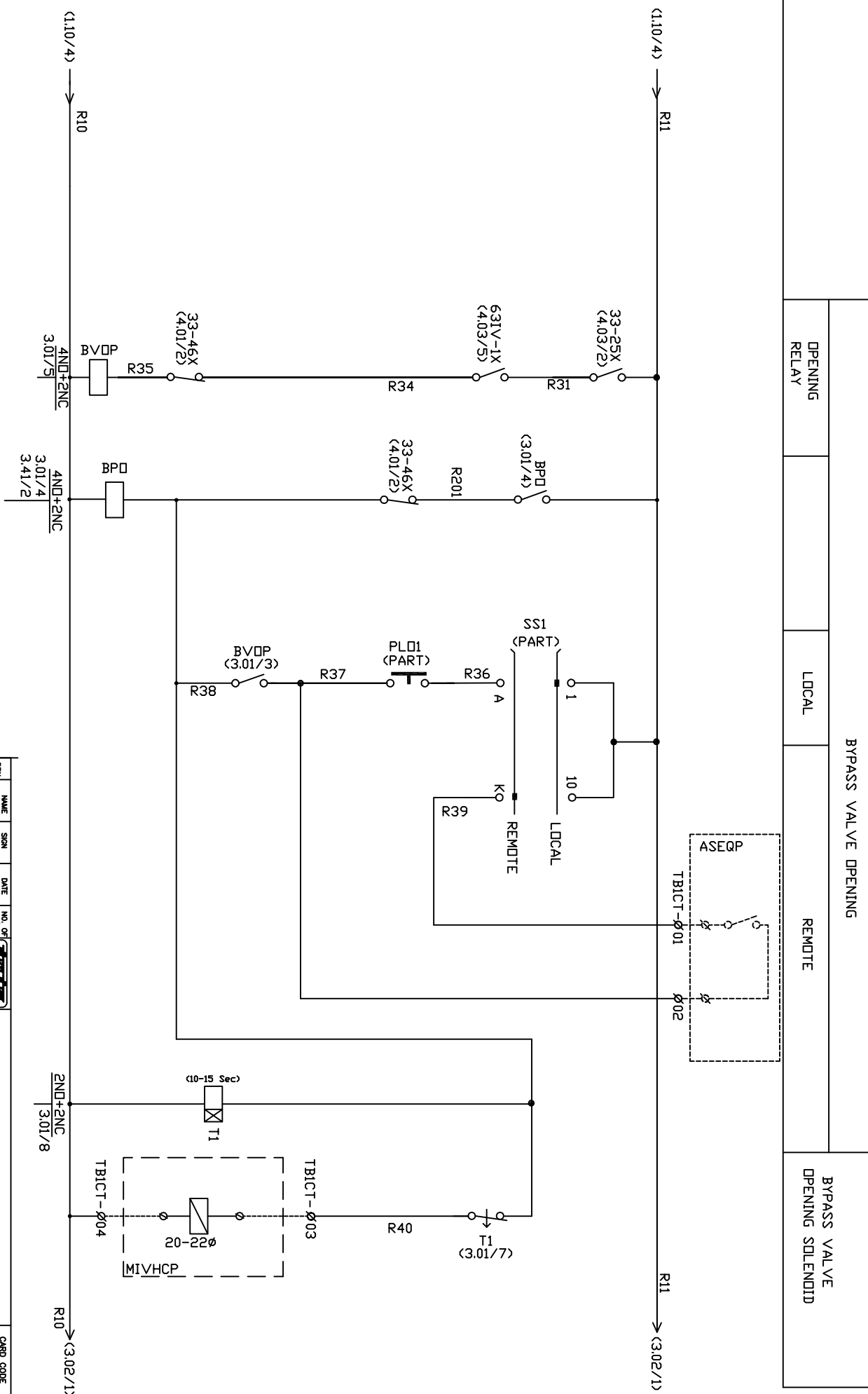
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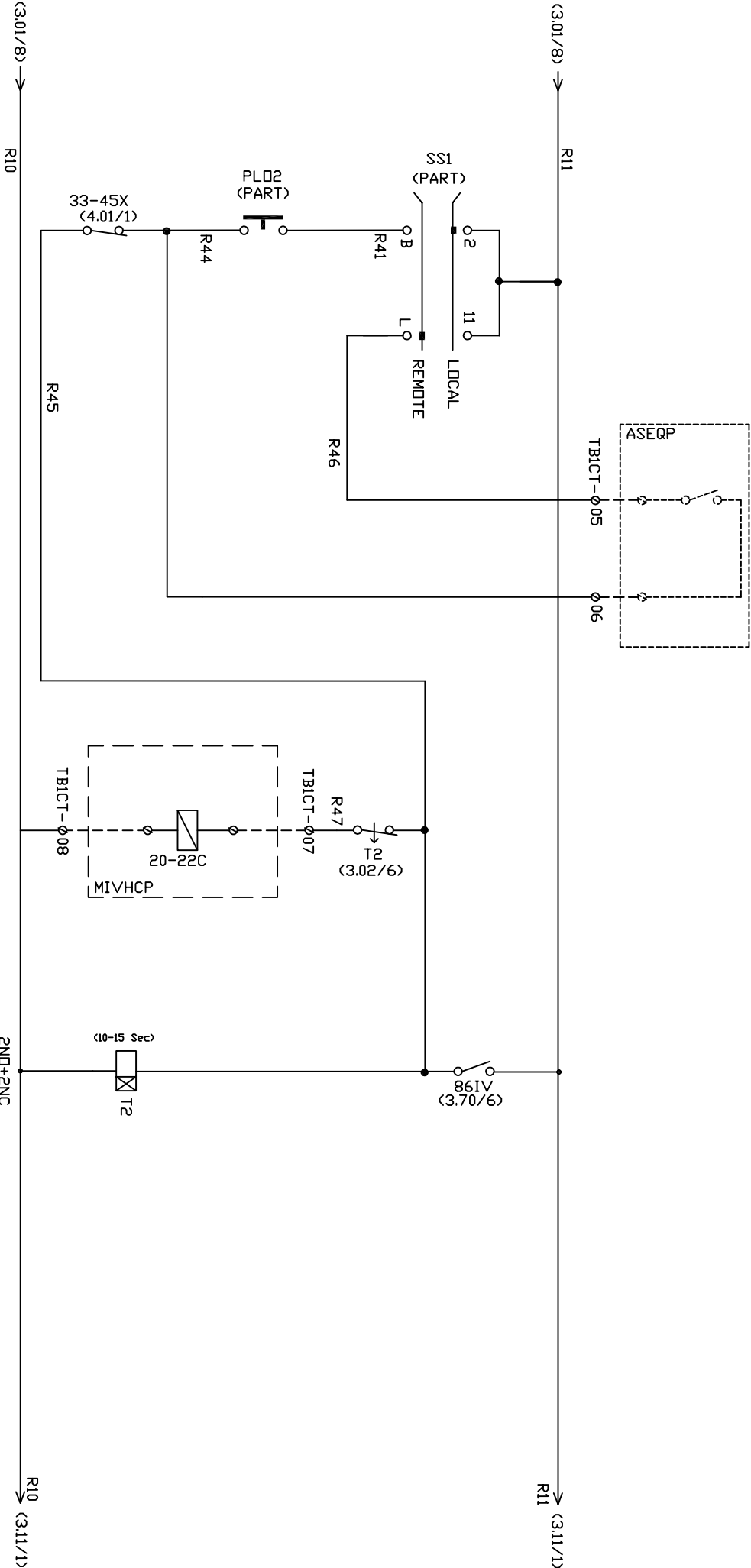
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SP		01.10.18		3.01
VKN		01.10.18		
DH		01.10.18		



BHARAT HEAVY ELECTRICALS LTD.
BHOPAL

APR 89	TITLE		BYPASS VALVE OPEN	
CDC 418	PROJECT		RAMMAM STG-III HEP (3x40MW)	
	DRAWING NO.		3 21305 19801	
	REV.		00	
STANDARD, DIMS. OR CONTROL & INDICATION DATA, RDR. AND		DATE	NO. OF SHEETS	TOTAL
		02		70

BYPASS VALVE CLOSING			BYPASS VALVE CLOSING SOLENOID		TIMER	
LOCAL		REMOTE				



INVENTORY NO. N.A

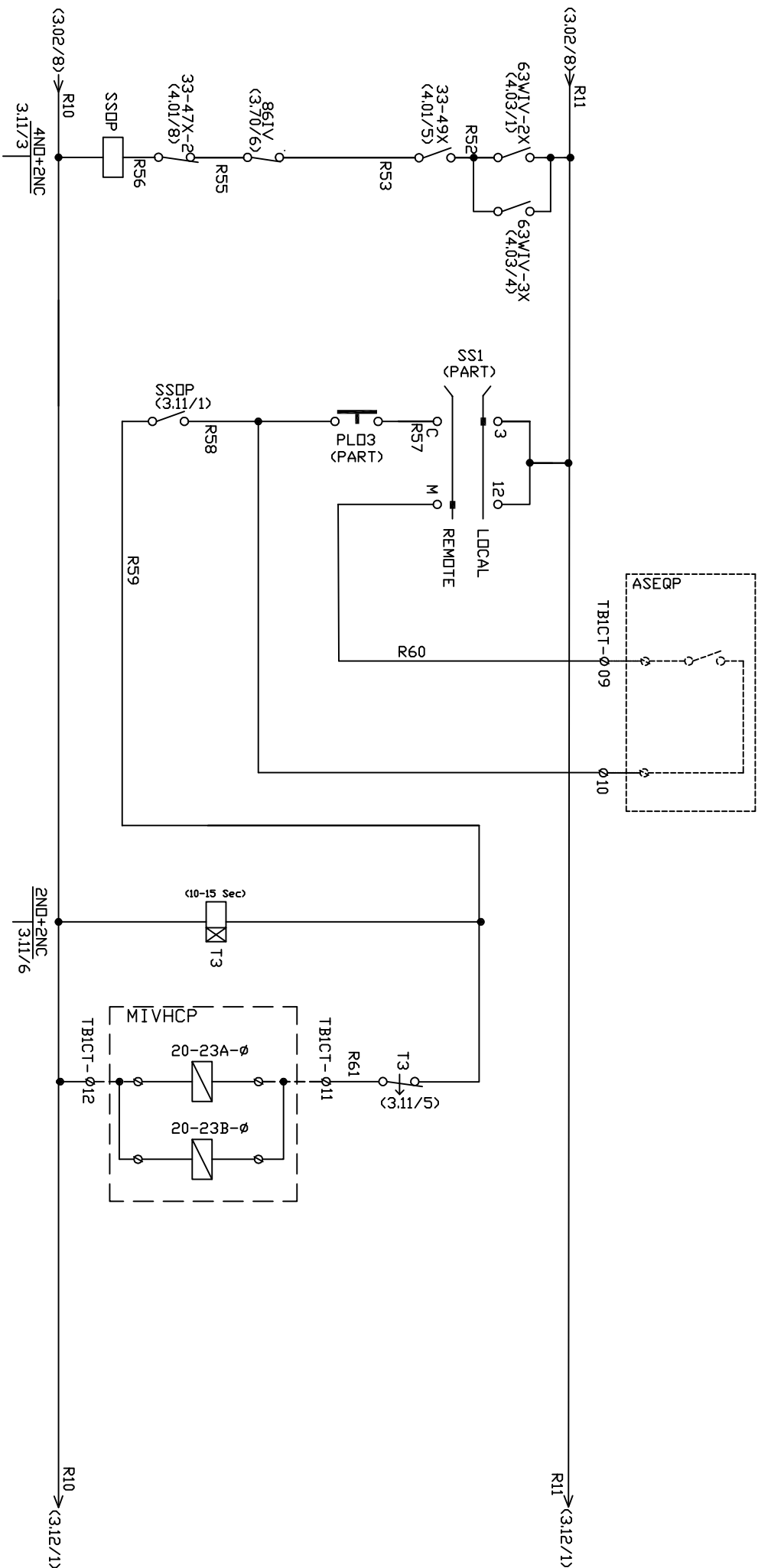
SIGN.& DATE

REF.DRG.NO.

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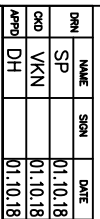
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DRN	NAME	SIGN	DATE	NO. OF VAR		BHARAT HEAVY ELECTRICALS LTD. BHOPAL	CARD CODE 3.02	
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CHKD	VKN		01.10.18					
APPRD	DH		01.10.18					
SUB-SUPPLIER/VENDOR					ISSUED BY DEPT. MGR.	TITLE		
PROJECT					RAMMAM STG-III HEP (3x40MW)			
SCHEMATIC DRG. OF CONTROL & INDICATION PANEL FOR MIV					DRAWING NO. 3 21305 19801			REV. 00
					SHEET NO. 08			NO. OF SHEETS 30



SERVICE SEAL OPENING RELAY	SERVICE SEAL DISENGAGE		SERVICE SEAL DISENGAGE SOLENOID	
	LOCAL	REMOTE		

					CARD CODE	
					3.11	
NAME		SSGN	DATE	NO. OF WKS		
DIN	SP		01.10.18			
ORD	VKN		01.10.18			
APPD	DH		01.10.18			
SUB-SUPPLIER/VENDOR						
ISSUED BY		APPT. DATE		TITLE		
NAME		DATE		PROJECT		
		A15		RAMMAN STG-III HEP (3x40MT)		
DRAWING NO.				REV		
3 21305 19801				00		
SCHEMATIC DIAG. OF CONTROL & INDICATION PANEL FOR MIV						
SHT. NO.		09		NO. OF SHT.		
				30		



**BHARAT HEAVY ELECTRICALS LTD
BHOPAL**

BHARAT HEAVY ELECTRICALS LTD.
BHOPAL

3.12

SERVICE SEAL CLOSE (ENGAGE)

**RAMMAM STG-III HEP
(3x40MW)**

DRAWING NO.
21305 19801

00

SCHEMATIC DRG. OF CONTROL & INDICATION PANEL FOR MIVV

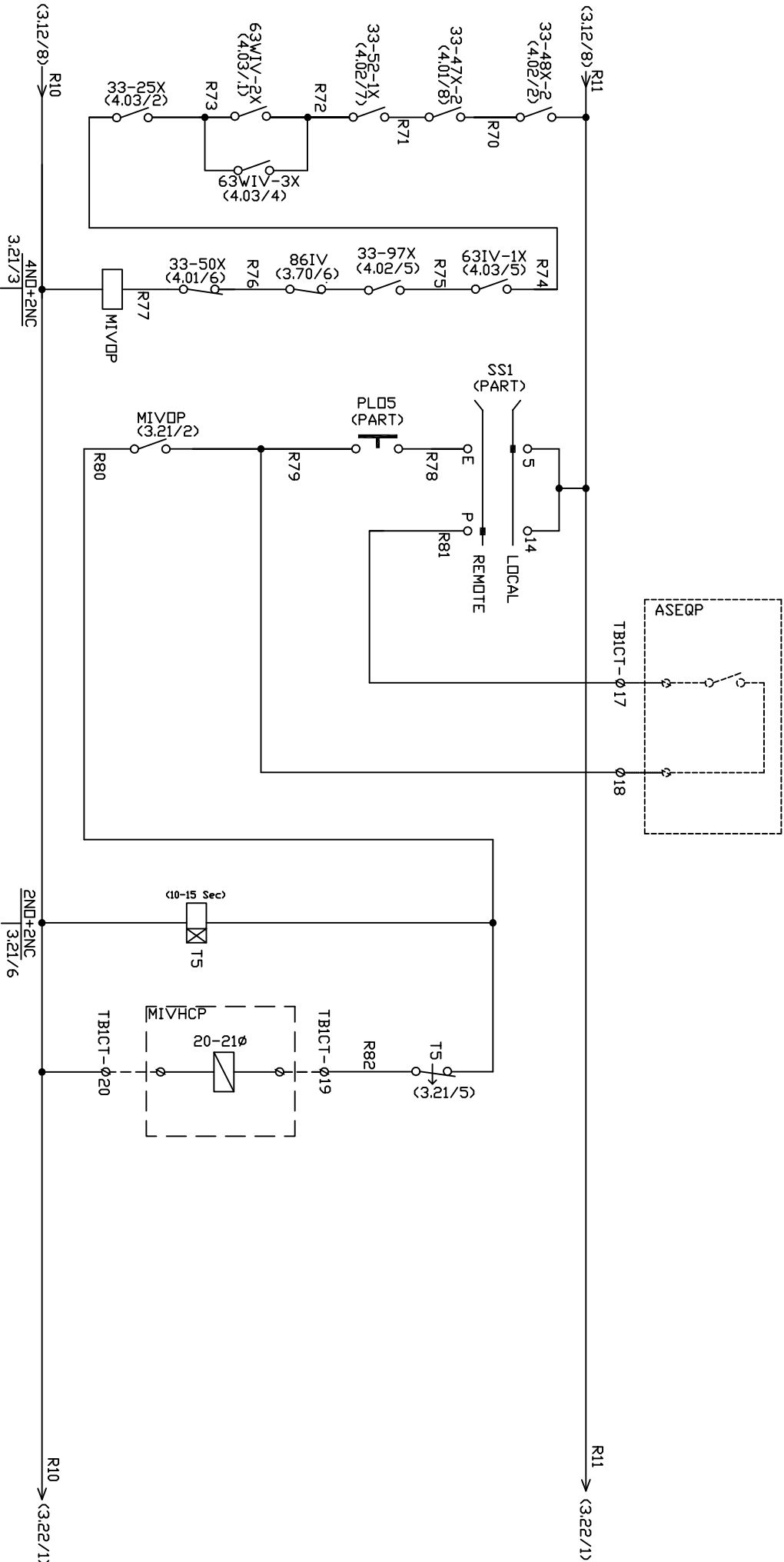
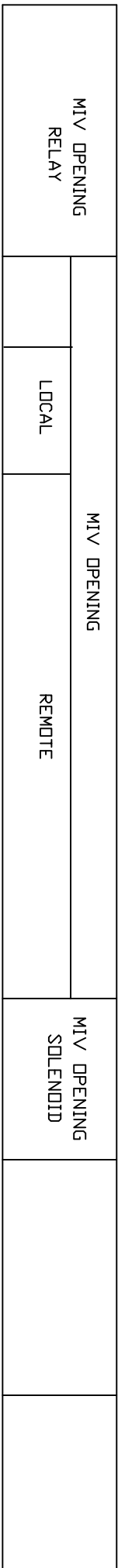
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NO. OF

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INVENTORY NO. N.A
SIGN.& DATE
REF.DRG.NO.



DRN	NAME	SIGN	DATE	NO. OF VIA
SP	SP		01.10.18	
CAD	VKN		01.10.18	
APPD	DH		01.10.18	



BHARAT HEAVY ELECTRICALS LTD.
BHOVAL

CARD CODE
3.21

SUB-SUPPLIER/VENDOR

ISSUED BY
DEPT. HEAD
CODE

MAIN INLET VALVE OPEN

PROJECT
RAMAM STG-II HEP
(3x40MW)

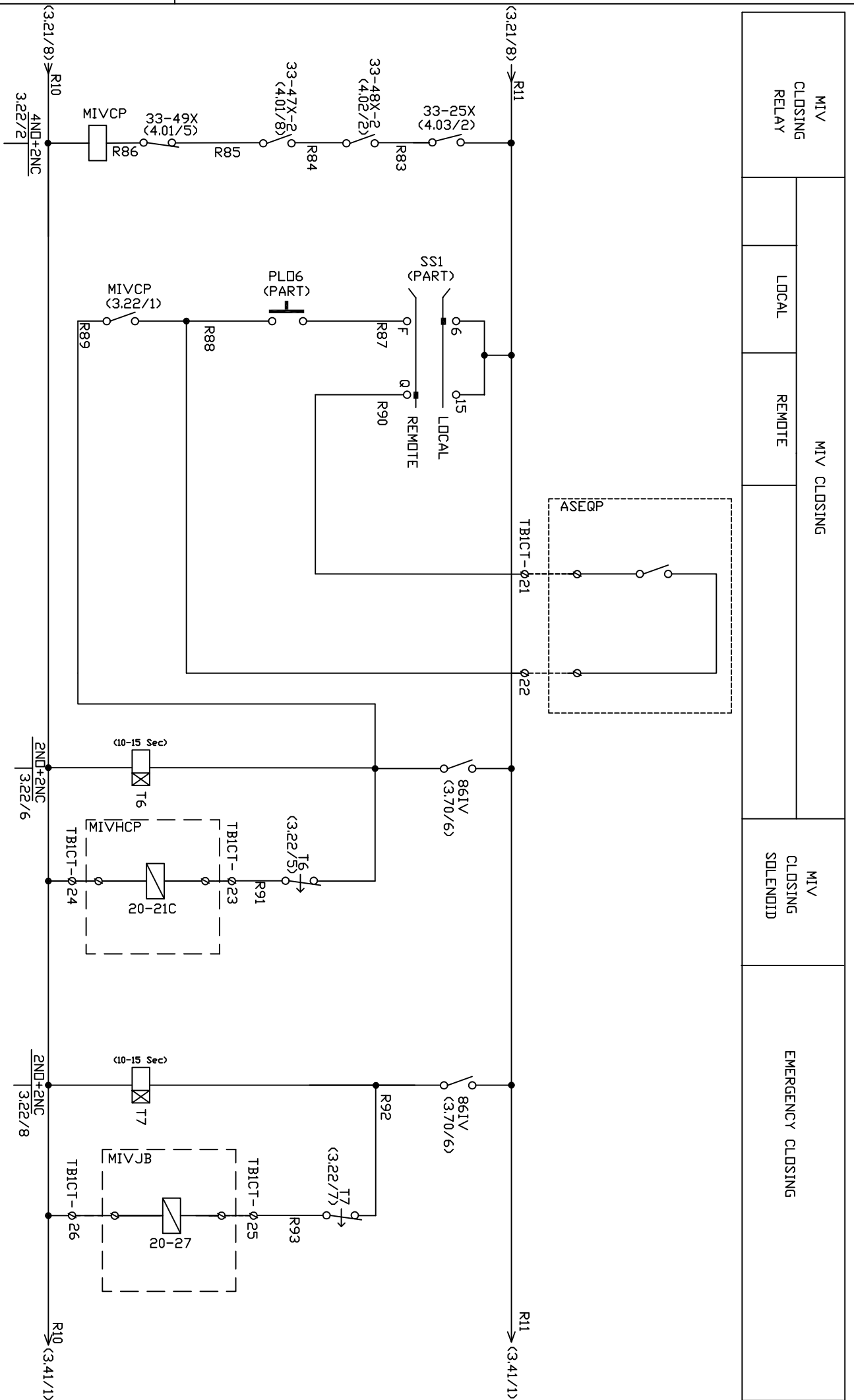
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3 21305 19801

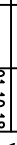
REV.
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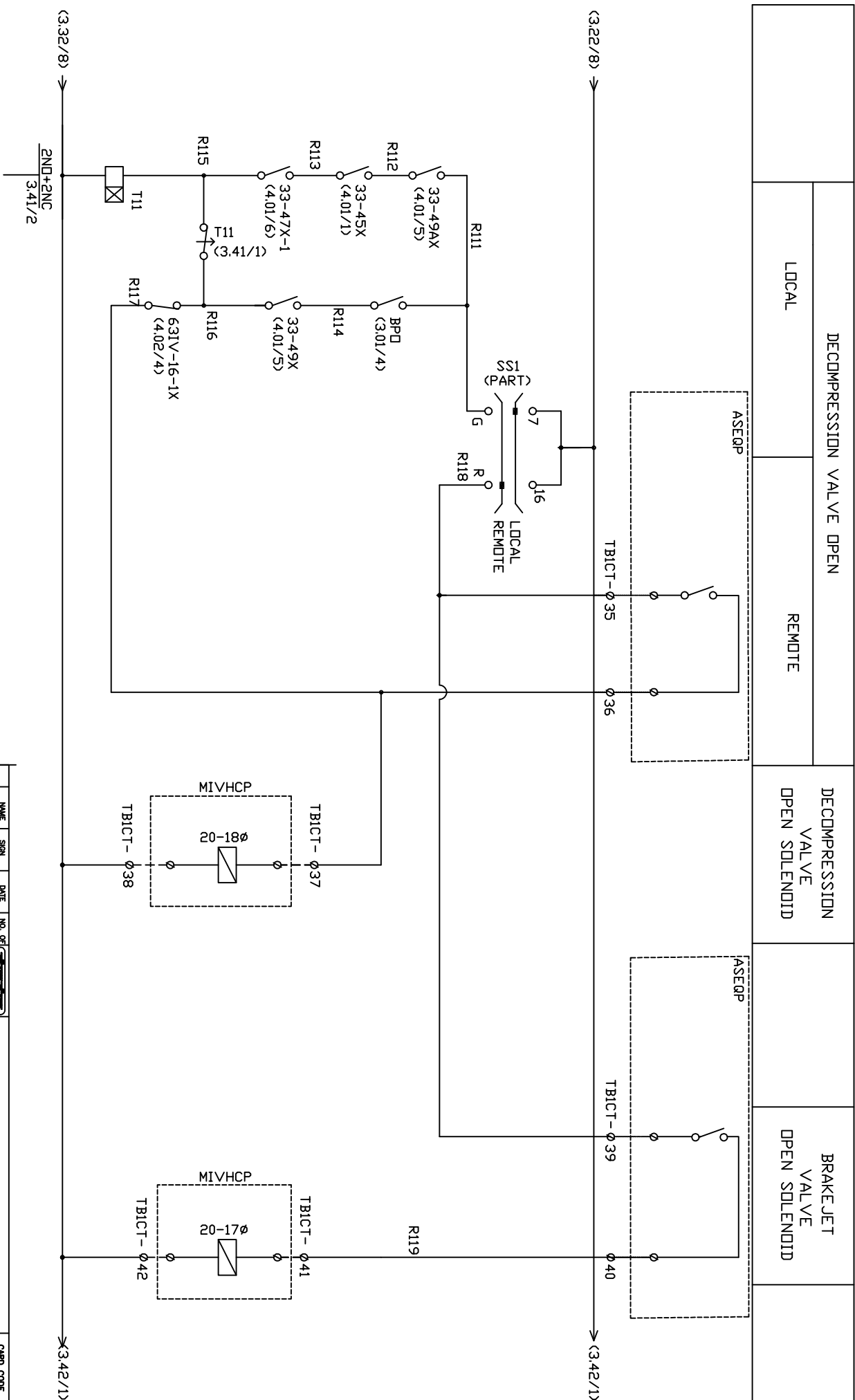
SCHEMATIC DRG. OF CONTROL & INDICATION PANEL FOR MIV

SHEET No. 11

NO. OF SHEET
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NAME	SIGN	DATE	NO. OF WKS		BHARAT HEAVY ELECTRICALS LTD. BHOPAL	CARD CODE 3.22
DRI						
SP		01.10.18				
WKN		01.10.18				
APPO	DH	01.10.18				
SUB-SUPPLIER/VENDOR						
ISSUED BY DEPT. HRS CODE 415				TITLE MAIN INLET VALVE CLOSE		



	NAME	SIGN	DATE	NO. OF VAR
DRN	SP		01.10.18	
OXO	VKN		01.10.18	
APPD	DH		01.10.18	



BHARAT HEAVY ELECTRICALS LTD.
BHOPAL

CARD CODE
3.41

DECOMPRESSION VALVE AND BRAKE JET VALVE OPENING

**RAMMAM STG-III HEP
(3x40MW)**

DRAWING NO.
3 21305 19801

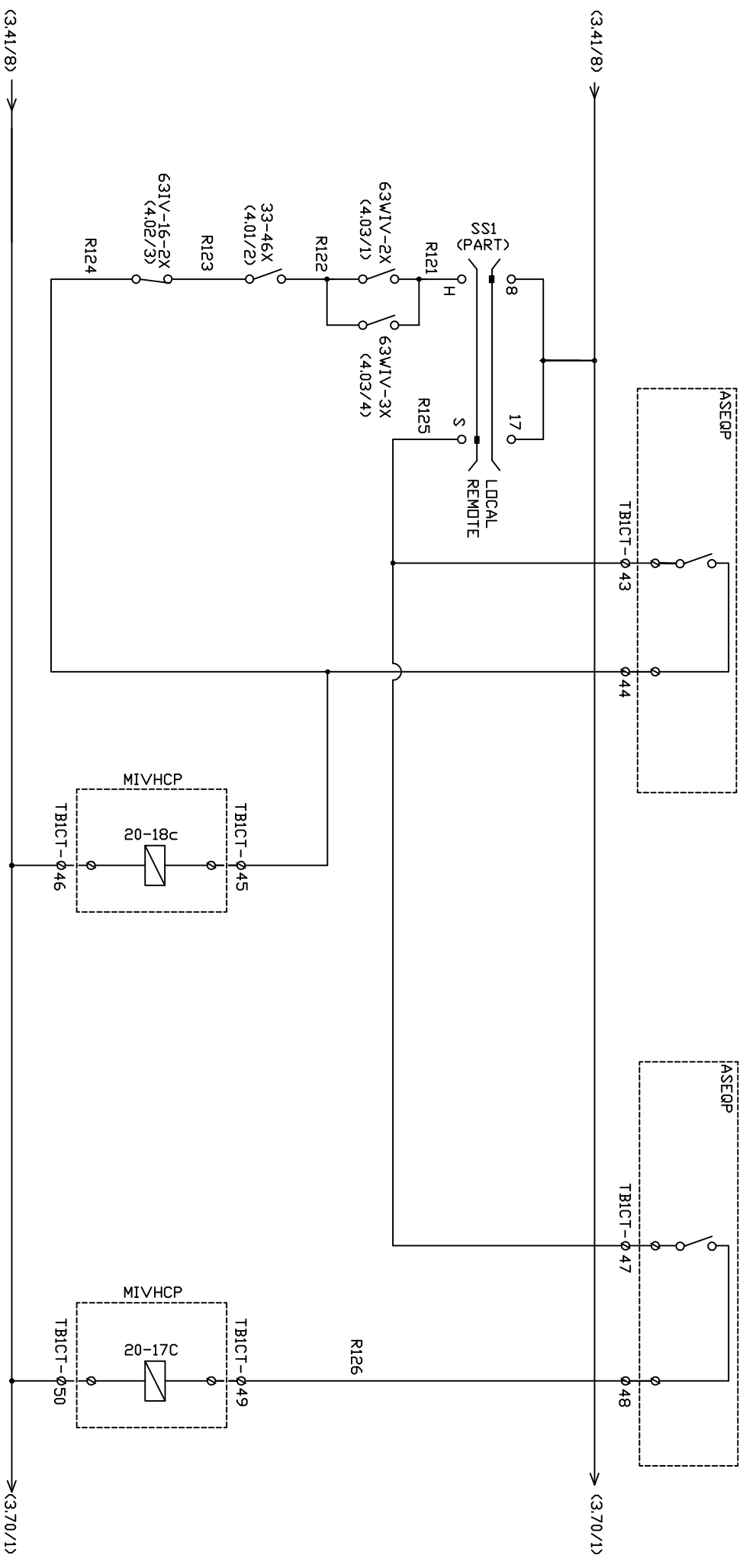
REV: 00

SCHEMATIC DRG. OF CONTROL & INDICATION PANEL FOR MIVV

SMT. No. 13

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DECOMPRESSION VALVE CLOSING		DECOMPRESSION VALVE CLOSE SOLENOID		BRAKE JET VALVE CLOSE SOLENOID	
LOCAL		REMOTE			



DRN	NAME	SIGN	DATE	NO. OF VAR
SP	SP		01.10.18	
CHK	VKN		01.10.18	
APPR	DH		01.10.18	
SUB-SUPPLIER/VENDOR				

ISSUED BY	DATE	TITLE	CARD CODE
SPRT. 418	01.10.18	DECOMPRESSION VALVE AND BRAKE JET VALVE CLOSING	3.42
PROJECT		RAMMAM STG-III HEP (3x40MW)	
SCHEMATIC DIAG. OF CONTROL & INDICATION PANEL FOR MIV		DRAWING NO.	REV.
		3 21305 19801	00
		SHEET No. 14	NO. OF SHEET 30



BHARAT HEAVY ELECTRICALS LTD.
BHOPAL

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INVENTORY NO. SIGN.& DATE REF.DRG.NO.
N.A

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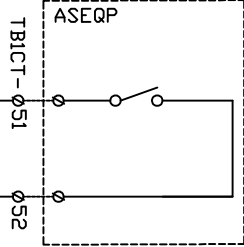
REMOTE
COMMAND

EMERGENCY
CLOSING
(SPARE)

EMERGENCY
CLOSING
LOCAL
COMMAND

DOWNSTREAM PR.
NOT
EQUALIZED

TIMER



TB1CT-Ø51
Ø52

Ø53
Ø54

R11
(3.42/8)

R11
(3.71/1)

PB-7E

R131

861V-1
(3.70/6)

T10
(3.70/8)

33-46X-1
(4.01/2)

R134

63WIV-2X
(4.03/1)

R135

33-47AX-1
(4.01/7)

33-49AX
(4.01/5)

R132

861V

861V-1

63WIV2-T10X

2-3 Min
T10

R10
(3.42/8)

R10
(3.71/1)

4ND+4NC
3.02/6
2.01/4
3.70/7
7.02/2
3.12/8
3.11/1
3.22/5
3.21/2
3.22/7

4ND+2NC
5.03/1

2ND+2NC
3.70/7

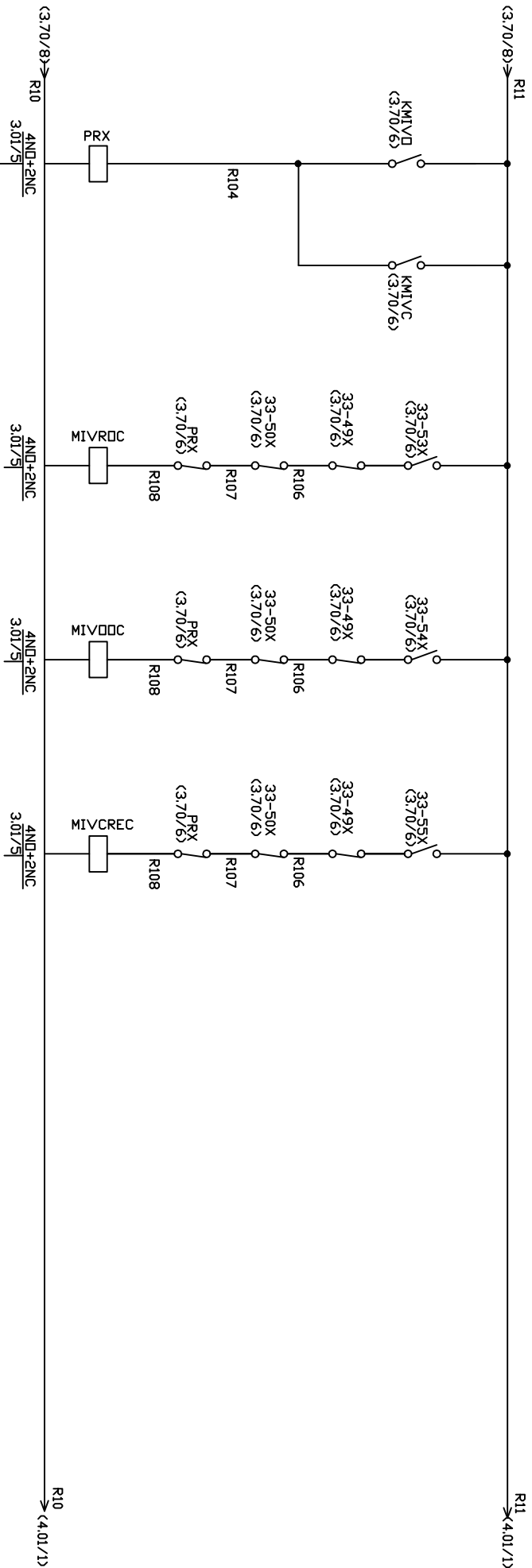
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CHKD	VKN		01.10.18				
APPRD	DH		01.10.18				
SUB-SUPPLIER/VENDOR							

BHARAT HEAVY ELECTRICALS LTD.
BHO PAL

CARD CODE
3.70

PROJECT	DRAWING NO.	REV.
RAMMAM STG-III HEP (3x40MW)	3 21305 19801	00
EMERGENCY CLOSING		
SCHEMATIC DIAG. OF CONTROL & INDICATION PANEL FOR MIV		
SHEET No. 15		
NO. OF SHEET 30		

MIV OPEN / CLOSE COMMAND	MIV REOPEN COMMAND <CREEPED TO 88°>	MIV OUT OF CONTROL ALARM <CREEPED TO 86°>	MIV CREEPED TO 84° <EMERGENCY CLOSING>	
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INVENTORY NO. N.A
SIGN.& DATE
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DRN	NAME	SIGN	DATE	NO. OF VNS	CHD CODE
SP			01.10.18		
CND	VKN		01.10.18		
APRD	DH		01.10.18		

SUB-SUPPLIER/VENDOR		ISSUED BY	TITLE	REV.
		DEPT. 410		
		PROJECT		
		RAMMAM STG-III HEP (3x40MW)		
		DRAWING NO.		
		3 21305 19801		
		REV.		
		00		
		SCHEMATIC DRG. OF CONTROL & INDICATION PANEL FOR MIV		
		SHEET No. 16		
		NO. OF SHEET 30		

BHARAT HEAVY ELECTRICALS LTD.
BHOPAL

3.71

LOGIC CONTROL

RAMMAM STG-III HEP

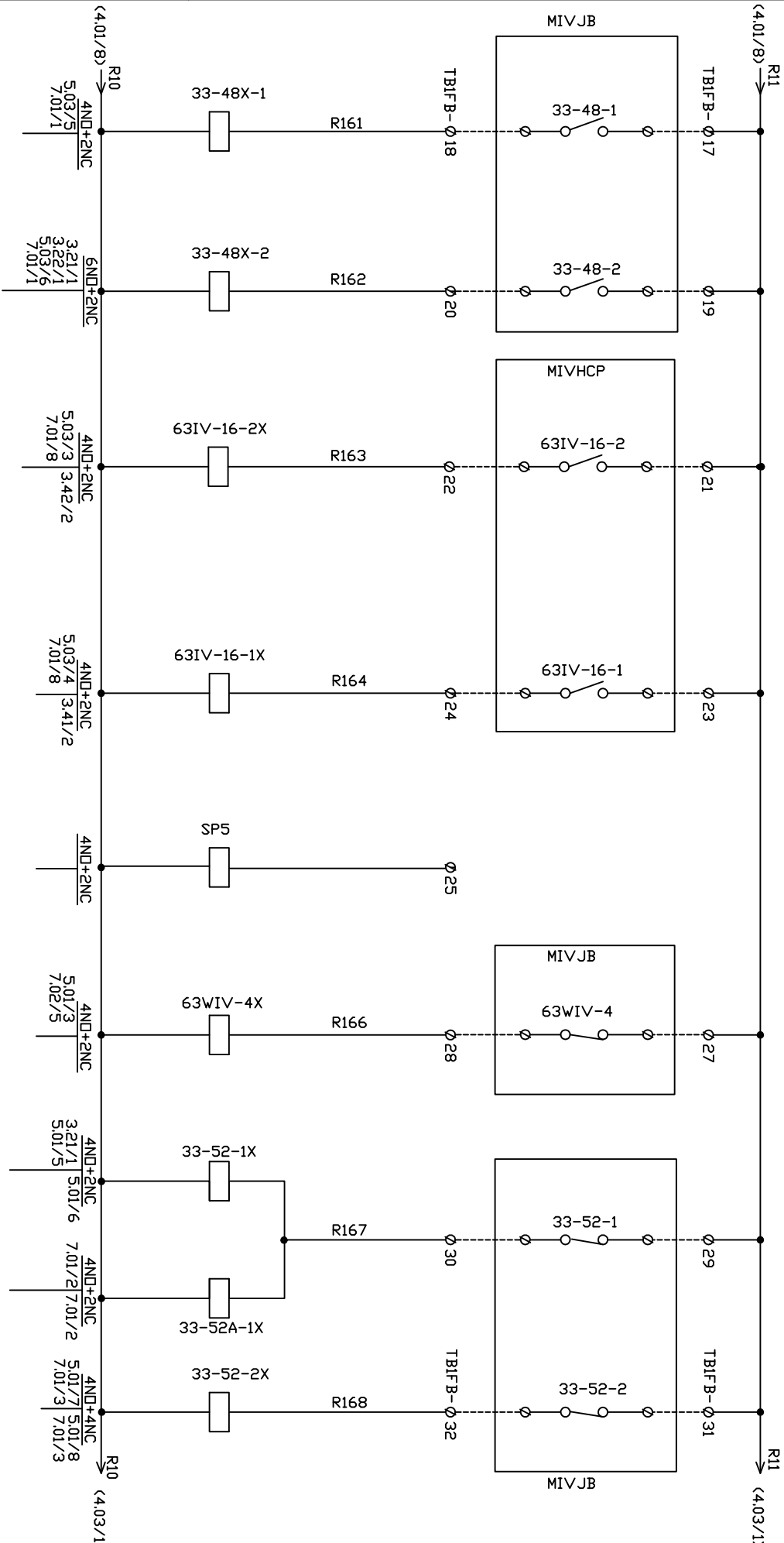
(3x40MW)

SCHEMATIC DRG. OF CONTROL & INDICATION PANEL FOR MIV

SHEET No. 16

NO. OF SHEET 30

MAINTENANCE SEAL		DECOMPRESSION VALVE		SPARE	WATER PRESSURE AT DOWNSTREAM OF STRAINER LOW	MIV LOCKING PIN DISENGAGED	MAINTENANCE SEAL LOCKING PIN DISENGAGED
ENGAGED	DISENGAGED	CLOSED	OPEN				



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INVENTORY NO. N.A
SIGN.& DATE
REF.DRG.NO.

DATE	NAME	SIGN	DATE	NO. OF V/N	CARD CODE
01.10.18	SP		01.10.18		4.02
01.10.18	VKN		01.10.18		
01.10.18	DH		01.10.18		

SUB-SUPPLIER/VENDOR



BHARAT HEAVY ELECTRICALS LTD.
BHOPAL

MULTIPLIER RELAYS-2

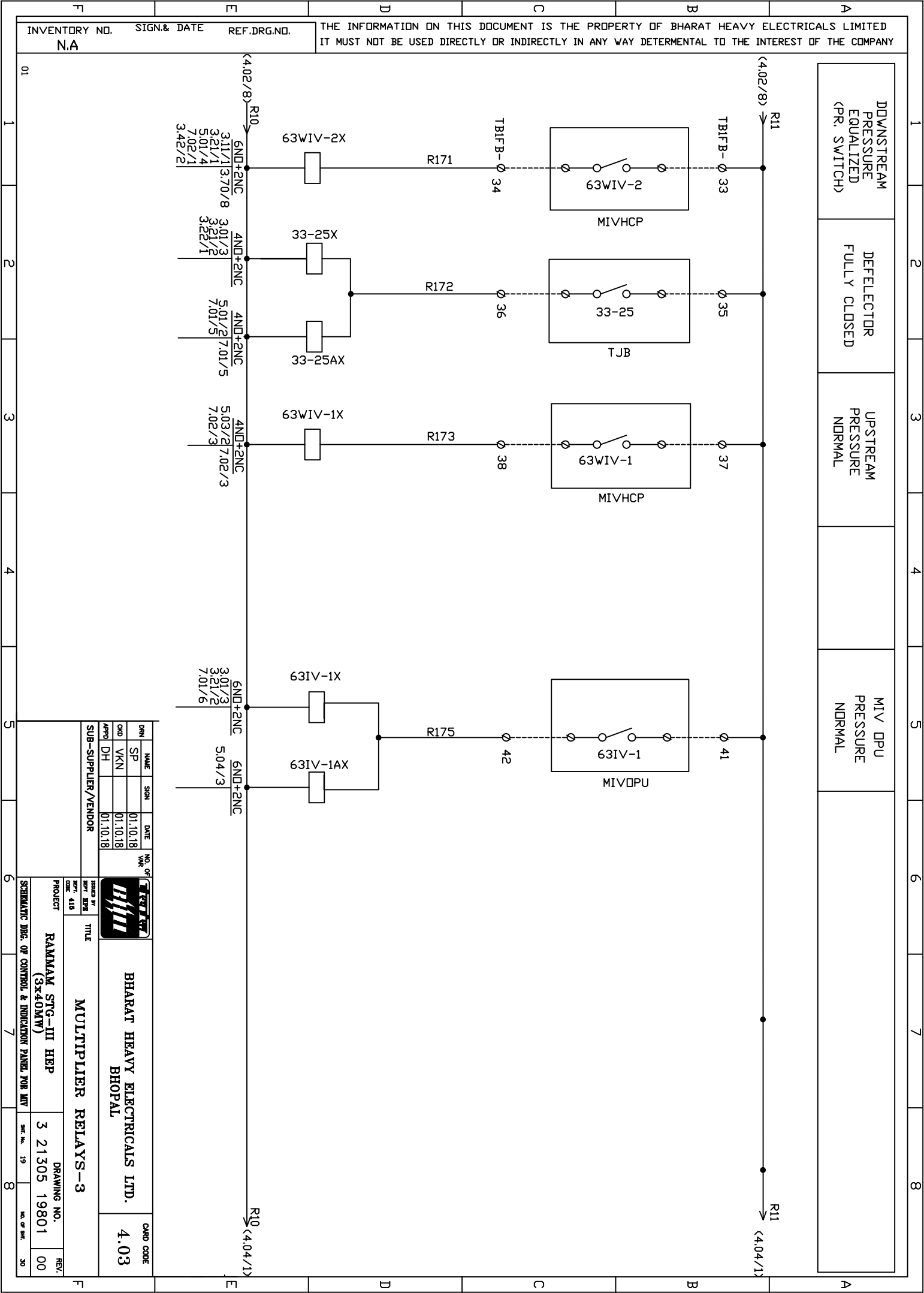
PROJECT RAMAM STG-III HEP
(3x40MW)

SCHEMATIC DRG. OF CONTROL & INDICATION PANEL FOR MIV

DRAWING NO. 3 21305 19801

REV. 00

NO. OF SHEET 30

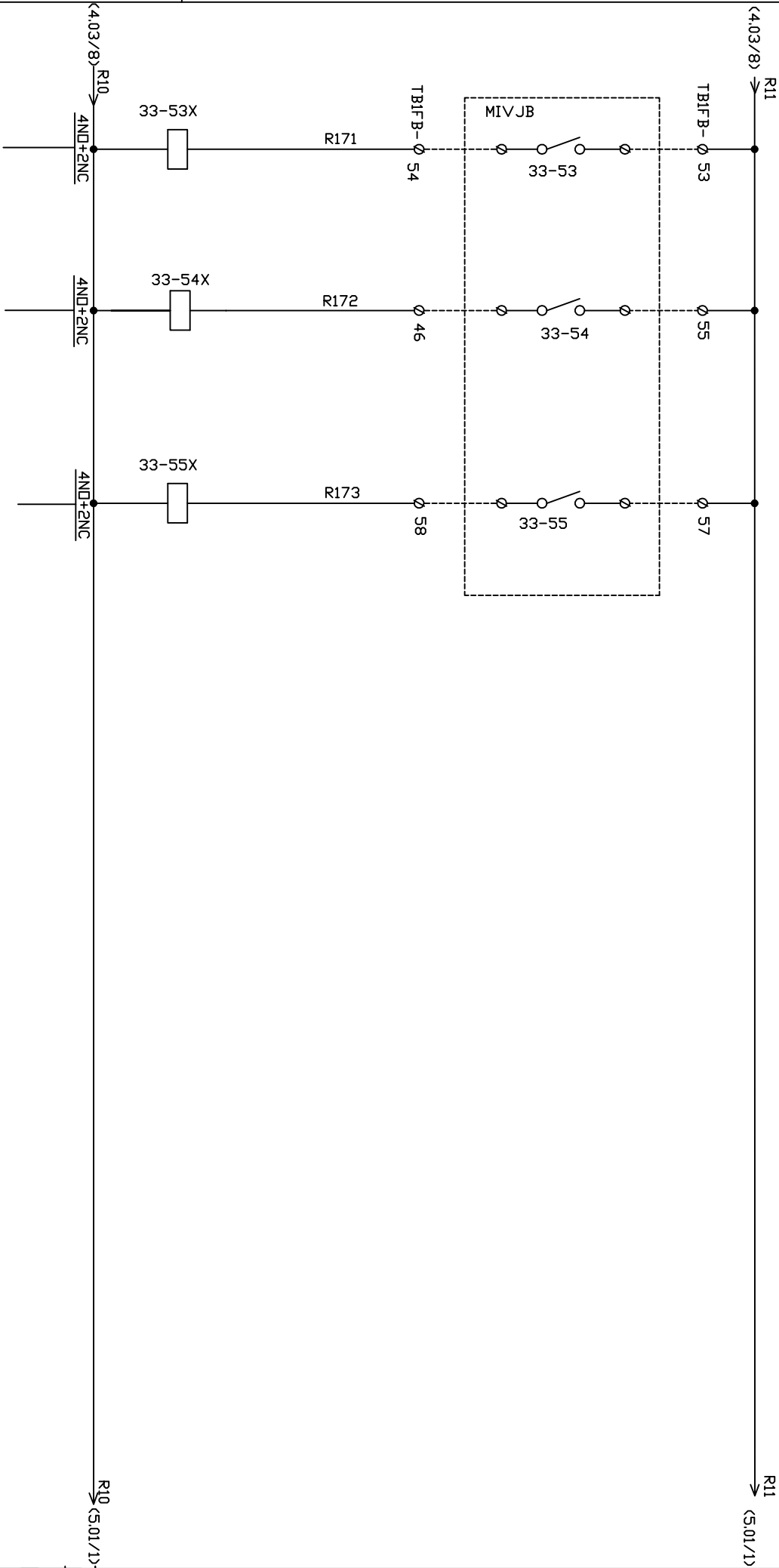


MAIN INLET VALVE

AT 88°
(FOR REDOPENING)

AT 86°
(FOR ALARM)

AT 84°
(FOR ALARM)



INVENTORY NO. SIGN.& DATE REF.DRG.NO. THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETERMENTAL TO THE INTEREST OF THE COMPANY

01 1 2 3 4 5 6 7 8

DRN	NAME	SIGN	DATE	NO. OF VAR
SP			01.10.18	
CHKD	VKN		01.10.18	
APPRD	DH		01.10.18	
SUB-SUPPLIER/VENDOR				



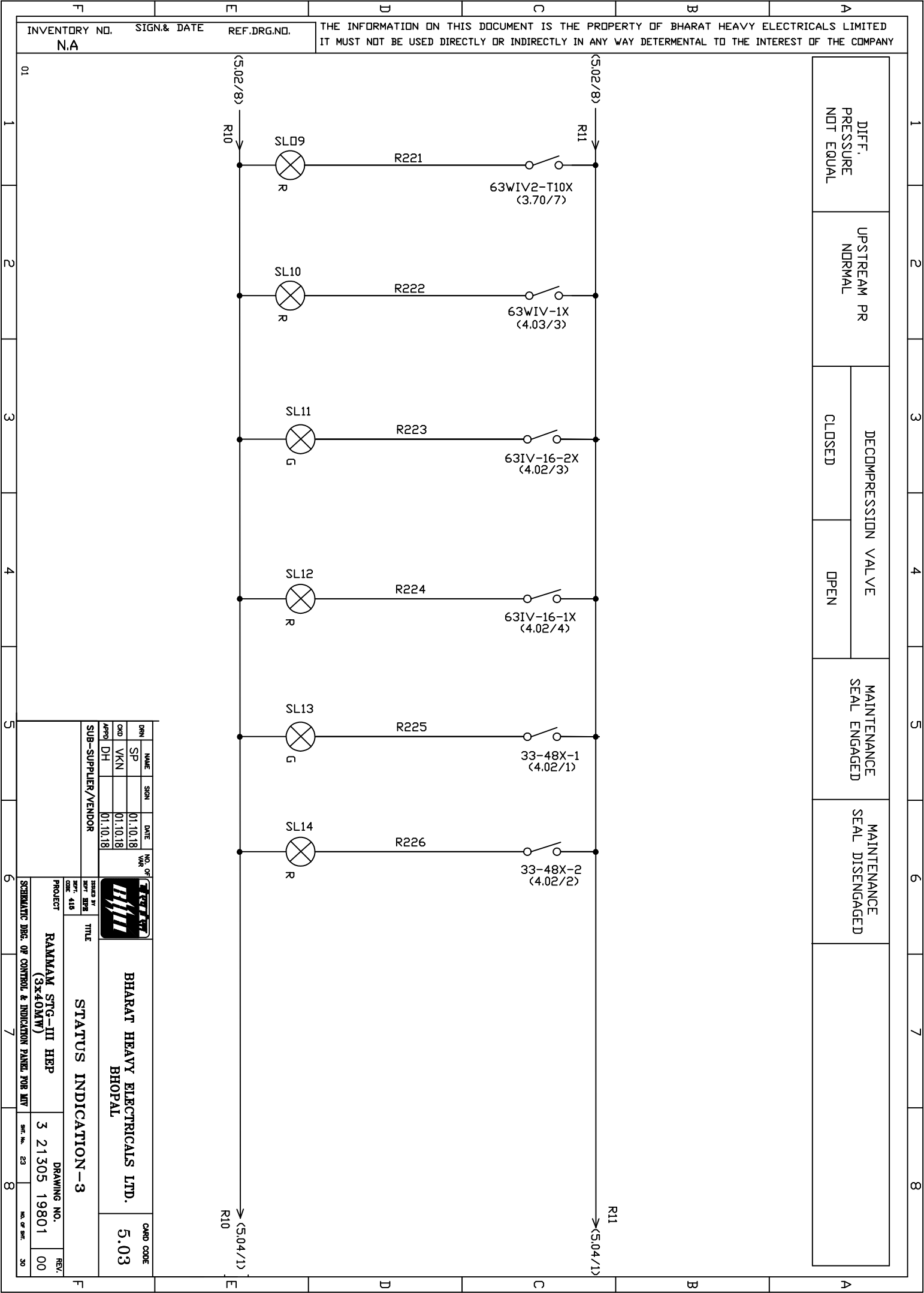
BHARAT HEAVY ELECTRICALS LTD.
BHO PAL

CARD CODE
4.04

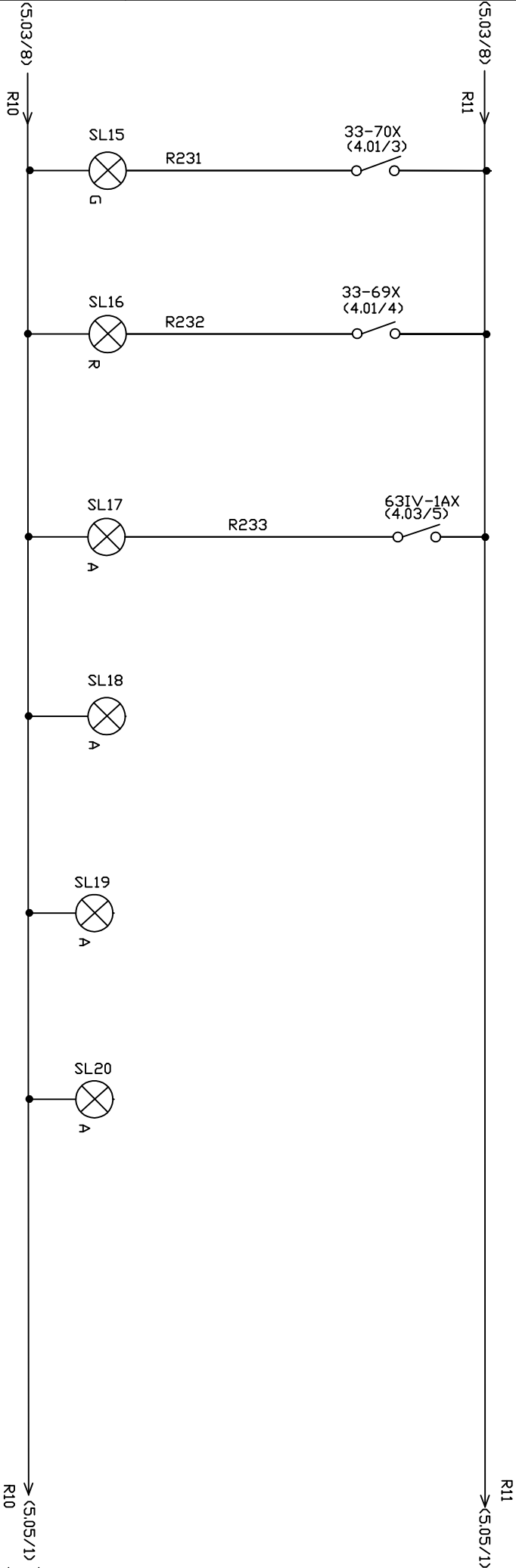
TITLE
MULTIPLIER RELAYS-4

PROJECT	ISSUED BY	DATE	REV.
RAMMAM STG-III HEP (3x40MW)	3	21305	19801
SCHEMATIC DIAG. OF CONTROL & INDICATION PANEL FOR MIV	3	21305	19801

F E D C B A



BRAKE JET VALVE		MTV DPU PRESSURE NORMAL	SPARE	SPARE	SPARE
CLOSED	OPEN				



INVENTORY NO. N.A

SIGN.& DATE

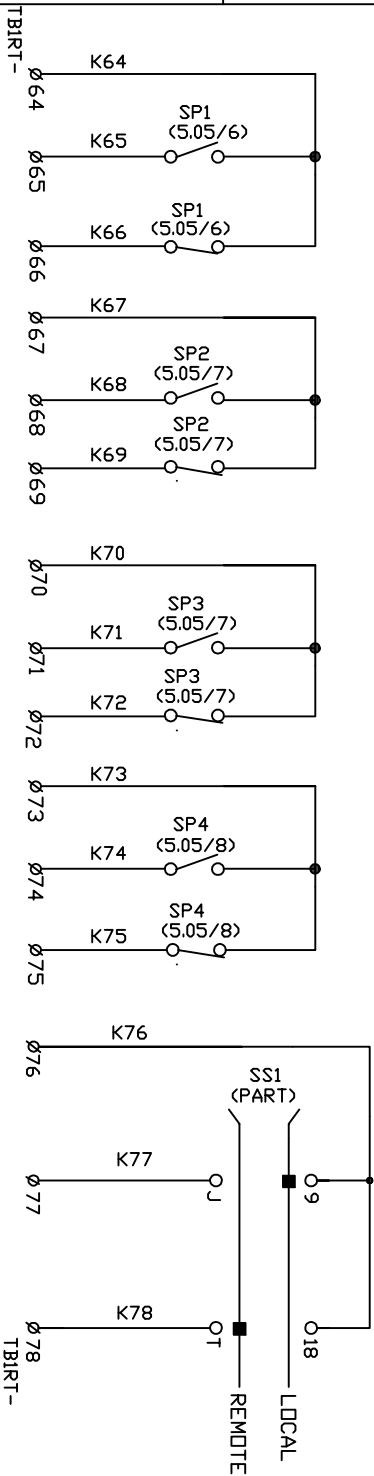
REF.DRG.NO.

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DRN	NAME	SIGN	DATE	NO. OF VAR
SP			01.10.18	
CHKD	VKN		01.10.18	
APPRD	DH		01.10.18	

SUB-SUPPLIER/VENDOR		ISSUED BY SPT. EYB	TITLE STATUS INDICATION-4	CARD CODE 5.04
		PROJECT RAMMAM STG-III HEP (3x40MW)	DRAWING NO. 3 21305 19801	REV. 00
		SCHEMATIC DIAG. OF CONTROL & INDICATION PANEL FOR MTV		

BHARAT HEAVY ELECTRICALS LTD.
BHOPAL



CONTROL SELECTION		
LOCAL	REMOTE	

INTERNAL	EXTERNAL
(SHT. REF.)	PARTICULARS

TB1CT	
31	
32	
(3.32)-	33
	34
	35
(3.41)-	36
	37
	38
(3.41)-	39
	40
	41
(3.41)-	42
	43
(3.42)-	44
	45
	46
	47
(3.42)-	48
	49
	50
(3.70)-	51
	52
(3.70)-	53
	54
	55
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	59
	60

8.01

DRAWING NO.	REV.
3 21305 19801	00

[illegible]

INTERNAL	EXTERNAL
(SHT. REF.)	PARTICULARS

INTERNAL	EXTERNAL
(SHT. REF.)	PARTICULARS

INTERNAL	EXTERNAL
(SHT. REF.)	PARTICULARS

TB1RT

01		
02		
03		
04		220 VDC SUPPLY OK
05		220 VDC SUPPLY FAILED
06		
07		(TO ASEOP)
08		BYPASS VALVE CLOSED
09		BYPASS VALVE OPEN
10		
11		(TO ASEOP)
12		BRAKE JET VALVE CLOSED
13		BRAKE JET VALVE OPEN
14		
15		(TO ASEOP)
16		SERVICE SEAL DISENGAGED
17		SERVICE SEAL ENGAGED
18		
19		(TO ASEOP)
20		MIV CLOSED
21		MIV OPEN
22		
23		(TO ASEOP)
24		DECOMPRESSION VALVE CLOSED
25		DECOMPRESSION VALVE OPEN
26		
27		(TO ASEOP)
28		MAINTENANCE SEAL ENGAGED
29		MAINTENANCE SEAL DISENGAGED

TB1RT

30		
31		(TO ASEOP)
32		MAINT. SEAL LOCKING PIN DISENGAGED
33		MAINT. SEAL LOCKING PIN ENGAGED
34		
35		(TO ASEOP)
36		MIV CLOSED
37		MIV OPEN
38		
39		(TO ASEOP)
40		DEFLECTOR FULLY CLOSED
41		DEFLECTOR NOT FULLY CLOSED
42		
43		(TO ASEOP)
44		MIV OPN PRESSURE NORMAL
45		
46		(TO ASEOP)
47		DOWNSTREAM PRESSURE EQUALIZED
48		(PR. SWITCH)
49		
50		EMERGENCY CLOSING OPERATED
51		EMERGENCY CLOSING NOT OPERATED
52		
53		UPSTREAM PRESSURE NORMAL
54		UPSTREAM PRESSURE NOT NORMAL
55		
56		(TO ASEOP)
57		DOWNSTREAM PRESSURE EQUALIZED
58		(DIFF. PR. SWITCH)
59		
60		(TO ASEOP)

TB1RT

61		
62		
63		
64		
65		(7.02/1)-
66		
67		
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71		
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INVENTORY NO. SIGN.& DATE REF.DRG.NO.
N.A



BHARAT HEAVY ELECTRICALS LTD.
BHOPAL

CARD CODE
8.03

LIST OF TERMINALS (TB1RT)

PROJECT	RAMAM STG-II HEP (3x40MW)	DRAWING NO.	3 21305 19801	REV.	00
SCHEMATIC DRG. OF CONTROL & INDICATION PANEL FOR MIV		SHT. No.	30	NO. OF SHT.	30



**RAMMAM HEP (3X40MW)
TECHNICAL SPECIFICATION FOR
ELECTRICAL CONTROL PANEL**

SPECIFICATION NO. : EPD-TS-CPBG-J052

DATE: 22/04/2019

14. SCHEMATIC DIAGRAM OF PV

SCHEMATIC DIAGRAM FOR PV ELECTRICAL CONTROL PANEL (PVECP)

PROJECT :- RAMMAM HEP

RATING :- 3 X 40 MW (V. PELTON)

DRG.NO. :- 3-21702-198-01

HYDRO SYSTEM ENGG. DIVISION.
BHARAT HEAVY ELECTRICALS LIMITED.
BHOPAL 462 021

INVENTORY NO. N.A			SIGN.& DATE 3 208 39 17901 RWANDA			REF.DRG.NO. THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETERMENTAL TO THE INTEREST OF THE COMPANY											
REV.			DATE			ALTERED			CHECKED			APPROVED			REMARKS		

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETERMENTAL TO THE INTEREST OF THE COMPANY

SHT. NO.	TITLE	CARD CODE
1	COVERING SHEET	0.00
2	INDEX SHEET	0.10
3	SYMBOL & LEGENDS	0.20
4	COMPONENTS & DEVICE LIST	0.30
5	SYSTEM (240 VAC), FIELD POWER (24 VDC)	1.10
6	CUBICLE HEATER & ILLUMINATION CIRCUIT	1.20
7	FUNCTIONAL GROUP-PV	2.01
8	BYPASS VALVE OPEN	3.01
9	BYPASS VALVE CLOSE	3.02
10	PENSTOCK VALVE OPEN	3.11
11	PENSTOCK VALVE CLOSE	3.12
12	PENSTOCK VALVE LOGIC	3.50
13	EMERGENCY CLOSING	3.70
14	MULTIPLIER RELAYS - 1	4.01
15	MULTIPLIER RELAYS - 2	4.02
16	MULTIPLIER RELAYS - 3	4.03
17	STATUS INDICATION-1	5.01
18	STATUS INDICATION-2	5.02
19	STATUS INDICATION-3	5.03
20	STATUS INDICATION-4	5.04

SHT NO.	TITLE	CARD CODE
21	REMOTE CONTACTS-1	7.01
22	REMOTE CONTACTS-2	7.02
23	REMOTE CONTACTS-3	7.03
24	REMOTE CONTACTS-4	7.04
25	LIST OF TERMINALS (TBP, TBP-P, TBFN, TBCT, TBIFB)	8.01
26	LIST OF TERMINALS (TBIFB, TBIRT)	8.02
27	LIST OF TERMINALS (TBRT, TBRCT)	8.03
28	LIST OF TERMINALS (TBRCT, TBISP)	8.04

INVENTORY NO.	SIGN.& DATE	REF.DRG.NO.
NA	3 208 39	17901 RWANDA

[illegible]

SUB-SUPPLIER/VENDOR				CARD CODE	
QDN	NAME	SIGN	DATE	BHARAT HEAVY ELECTRICALS LTD. BHOPAL	0.10
	VKN	-sd-			
QND	AP	-sd-			
APPD	DH	-sd-			
NO. OF WAR					
SIGNED BY DATE				TITLE	

INDEX SHEET		REV.
SHEET NO. 415 DATE	DRAWING NO. 3 21702 19801	00
PROJECT RAMMAM HEP		
SCHEMATIC DIAG. OF PT ELECTRICAL CONTROL PANEL/PROCESS		
SHEET NO.	NO. OF SHEET	28

INVENTORY NO. N/A										SIGN.& DATE 3 208 39 17901 RWANDA										REF.DRG.NO.										THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED										IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETERMENTAL TO THE INTEREST OF THE COMPANY																																																																																									
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1										2										3										4										5										6										7										8																																																											
SYMBOL										DESCRIPTION										SOLENOID OPERATED DEVICE										MINIATURE CIRCUIT BREAKER										SELECTOR SWITCH STAYPUT TYPE										CONTACTOR/AUX. RELAY COIL										DN DELAY TIMER										ILLUMINATED PUSH BUTTON										SIGNAL LAMP										DN DELAY TIMER CONTACTS										NORMALLY OPEN/NORMALLY CLOSED CONTACTS										TB FOR EXTERNAL CONNECTION										LINK									
SYMBOL										DESCRIPTION										HEATER										3 PIN SOCKET										SWITCHED MODE POWER SUPPLY UNIT										DOOR SWITCH										LEGEND										DESCRIPTION																																																											
SYMBOL										DESCRIPTION										PENSTOCK VALVE ELECTRICAL CONTROL PANEL										PENSTOCK VALVE HYDRAULIC CONTROL PANEL										PV DIL PRESSURE UNIT										PV JUNCTION BOX										RTU PANEL IN BF VALVE HOUSE																																																																					
SYMBOL										DESCRIPTION										PVDCP										PVHCP										PVDPU										PVJB										RTU-BFV																																																																					
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SIGN.& DATE REF.DRG.NO.
3 208 39 17901 RWANDA

INVENTORY NO.
N.A

REV.	DATE	ALTERED	CHECKED	APPROVED	REMARKS
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APPD	AP	-sd-		
APPD	DH	-sd-		

SUB-SUPPLIER/VENDOR	
ISSUED BY	DATE
CHKD	
APPD	



BHARAT HEAVY ELECTRICALS LTD.
BHOPAL

CARD CODE
1.10

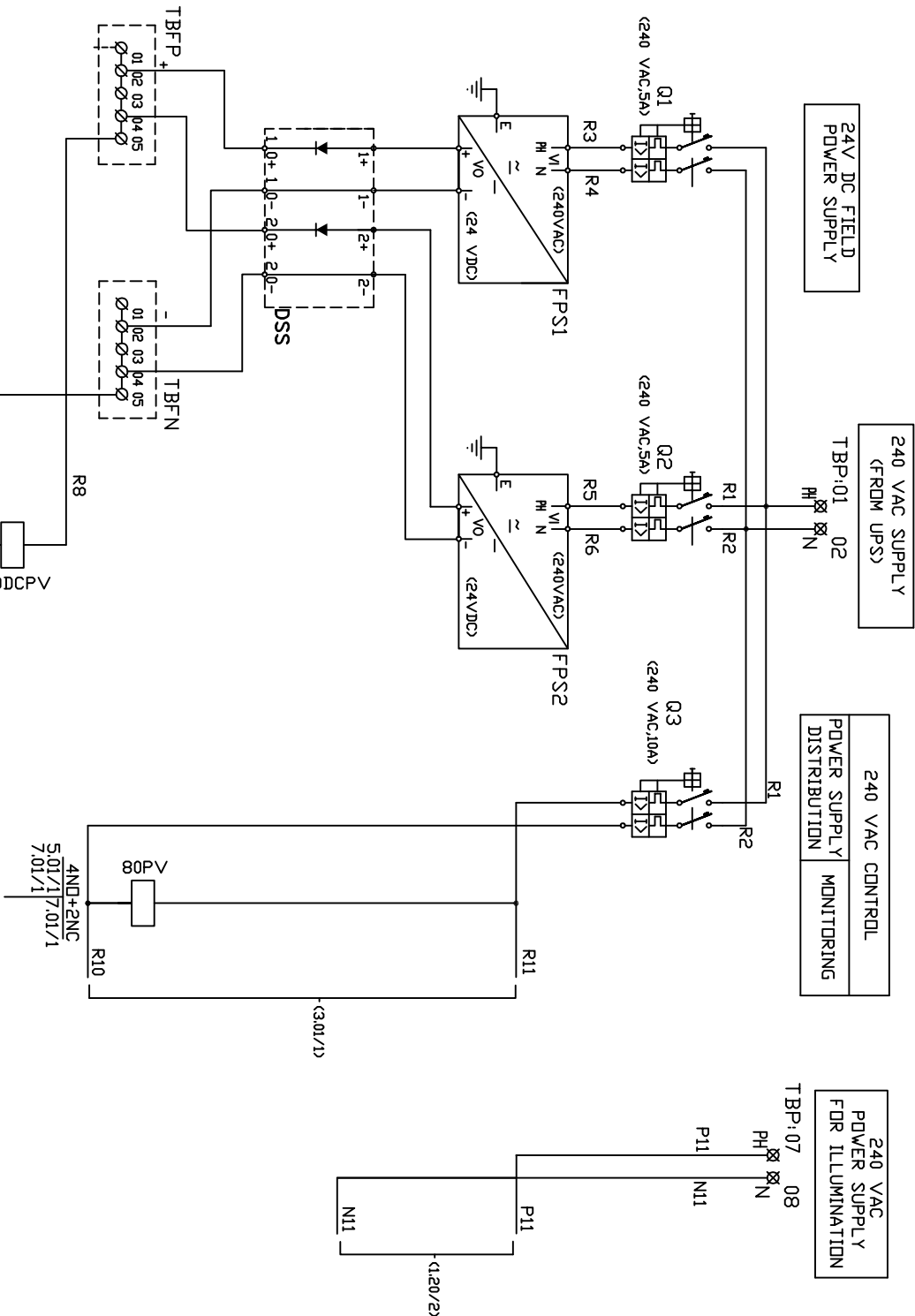
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PROJECT
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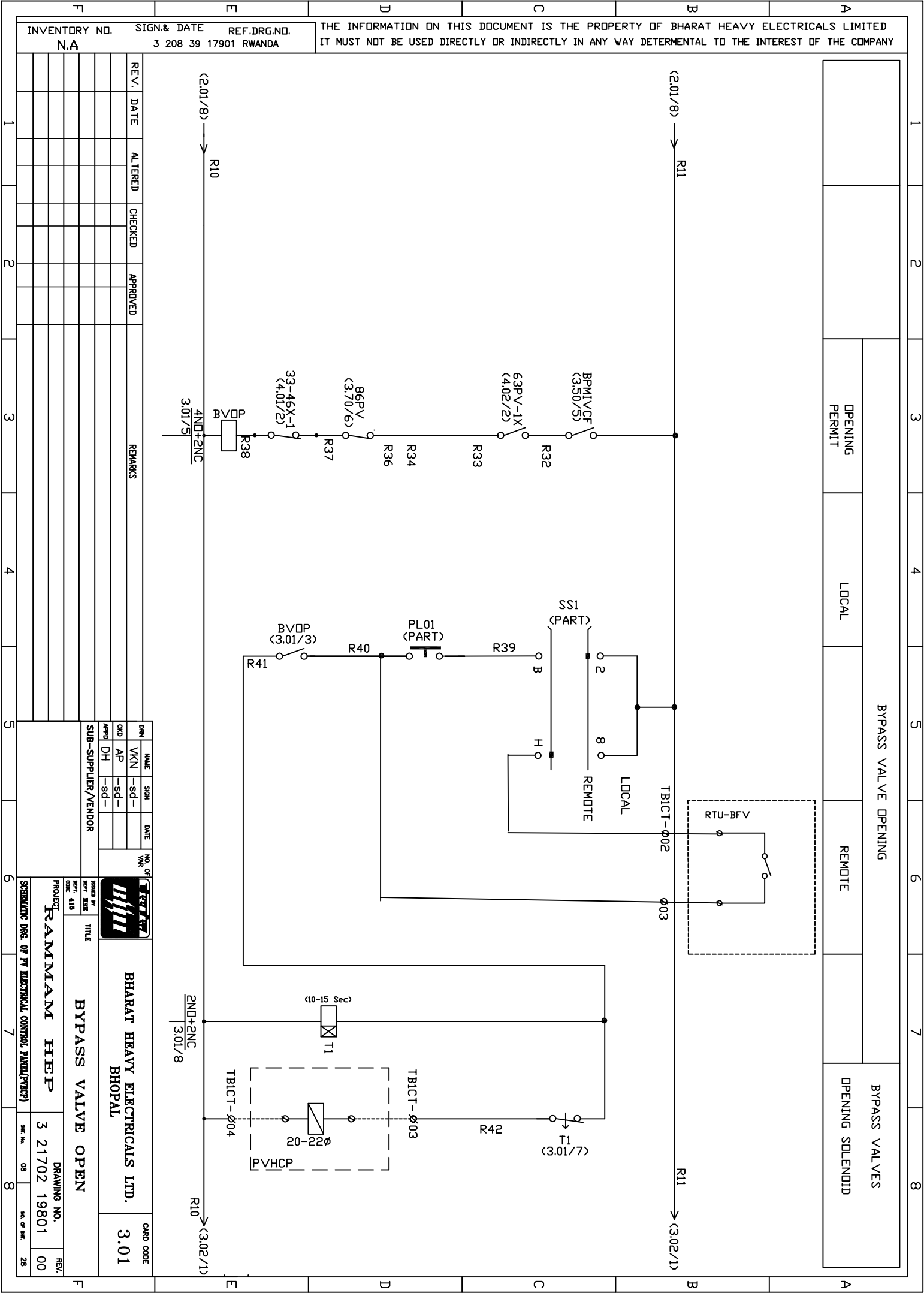
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DRAWING NO.
3 21702 19801

REV.
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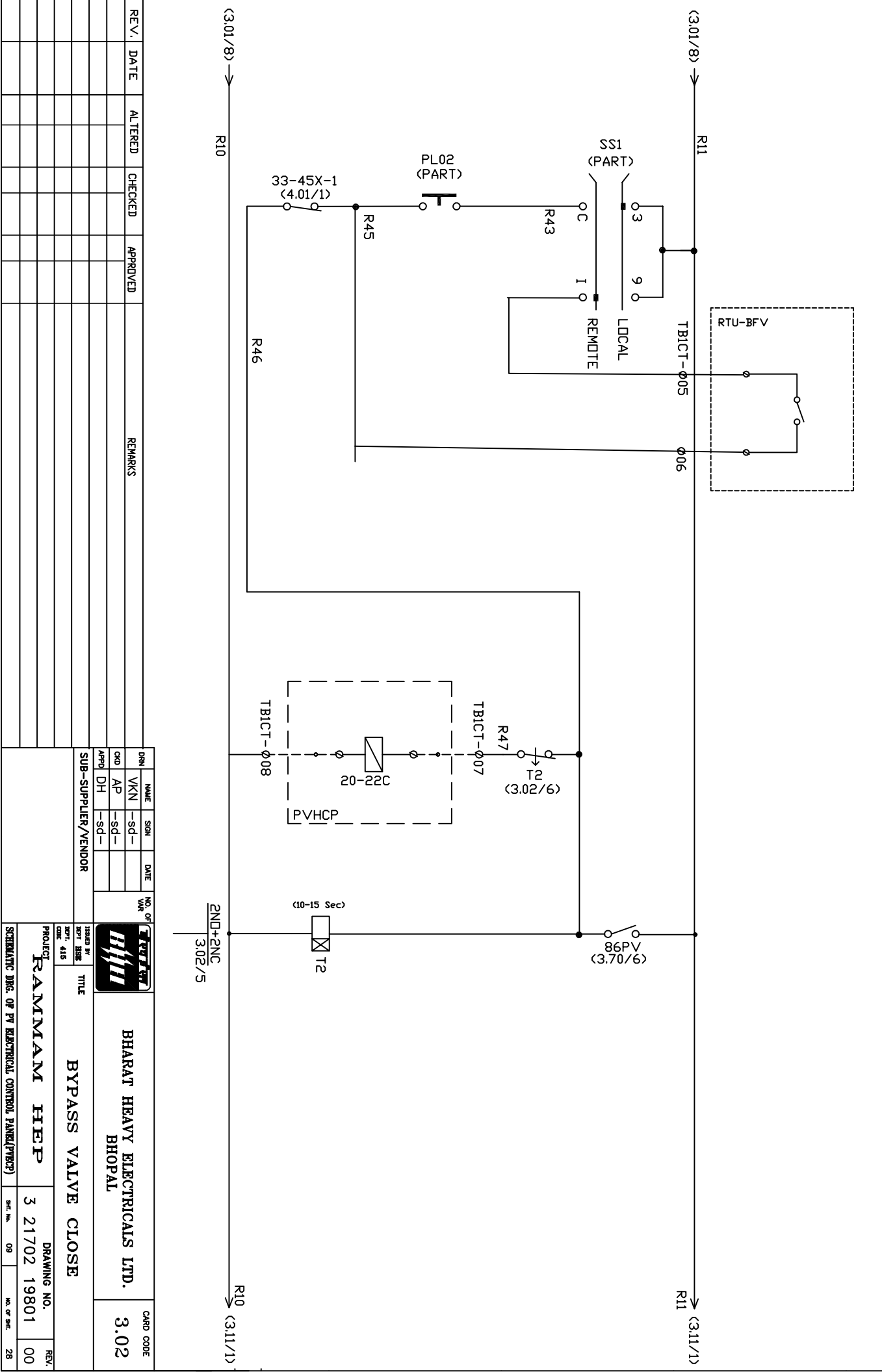
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240V AC 1 PH, 50Hz, SUPPLY (1.10/6)											
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APPD DH SD -											
SUB-SUPPLIER/VENDOR											
PROJECT RAMMAM HEP											
ISSUED BY DEPT. DES. TITLE CUBICLE HEATER & ILLUMINATION CIRCUIT											
CHECK 410											
BPHAT HEAVY ELECTRICALS LTD. 1.20											
BHO PAL											
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SHEET NO. 06 NO. OF SHEET 28											



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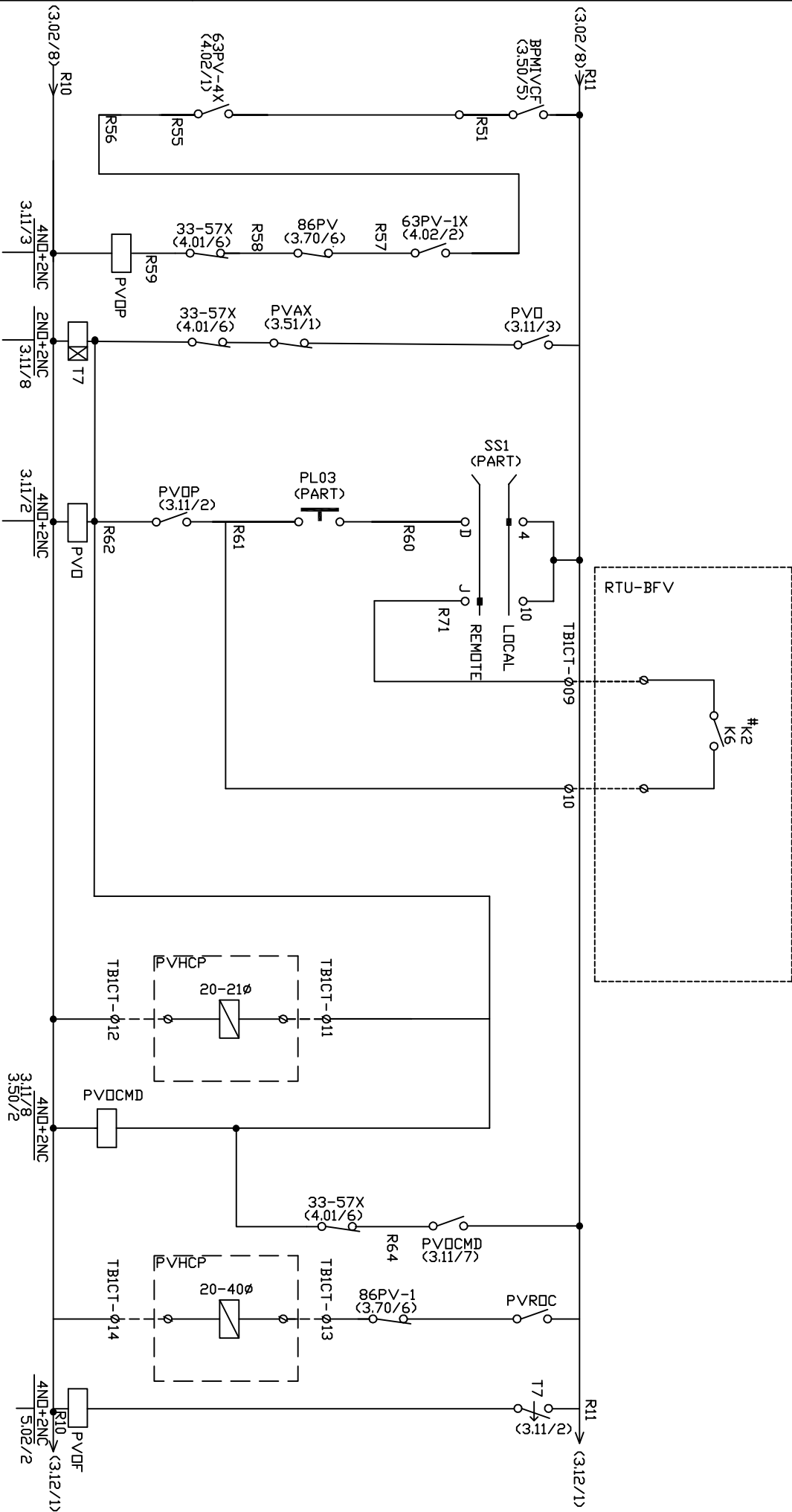
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OF PV ELECTRICAL CONTROL PANEL (VPCP)	SHEET NO. 09	NO. OF SHEET 28



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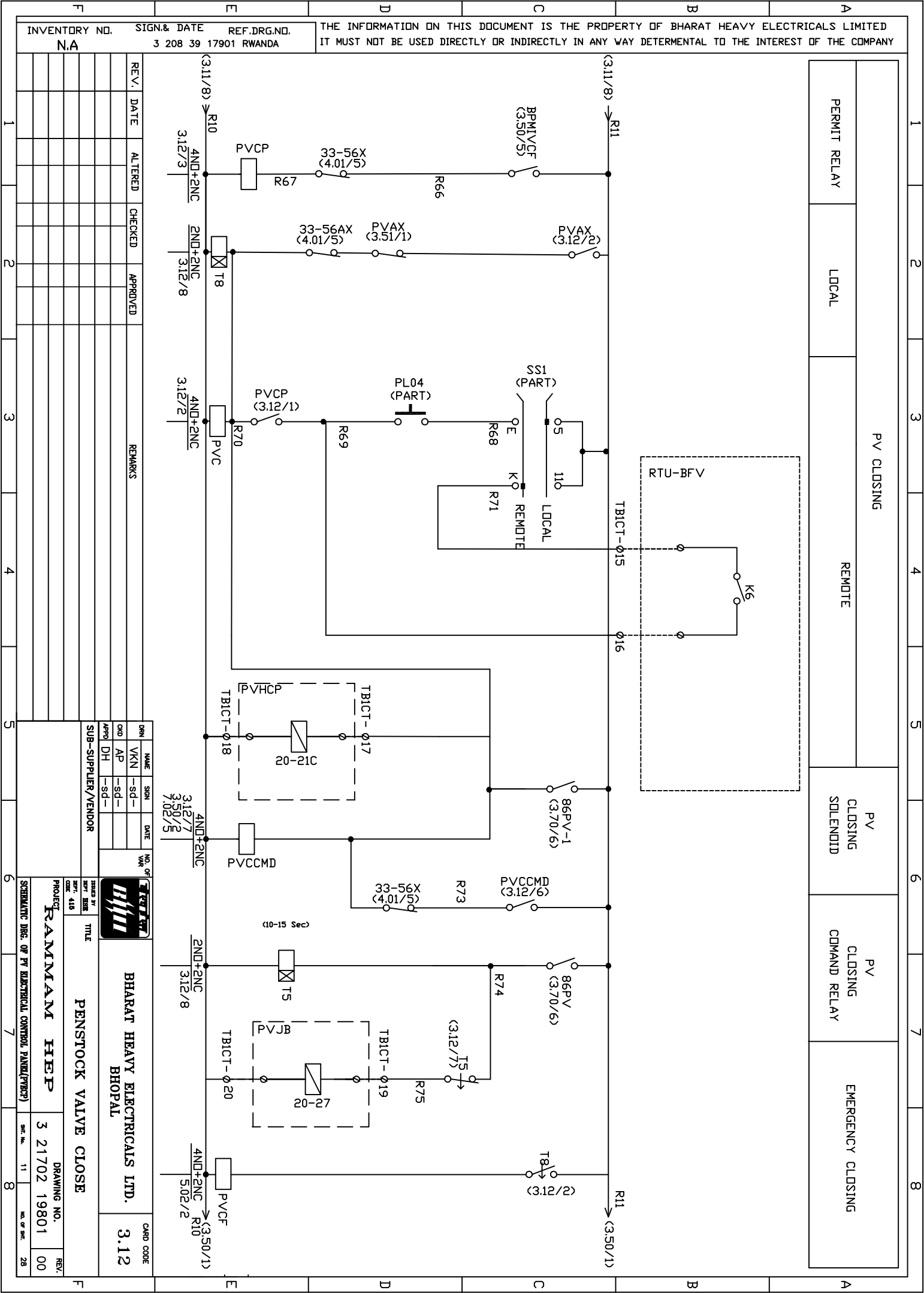
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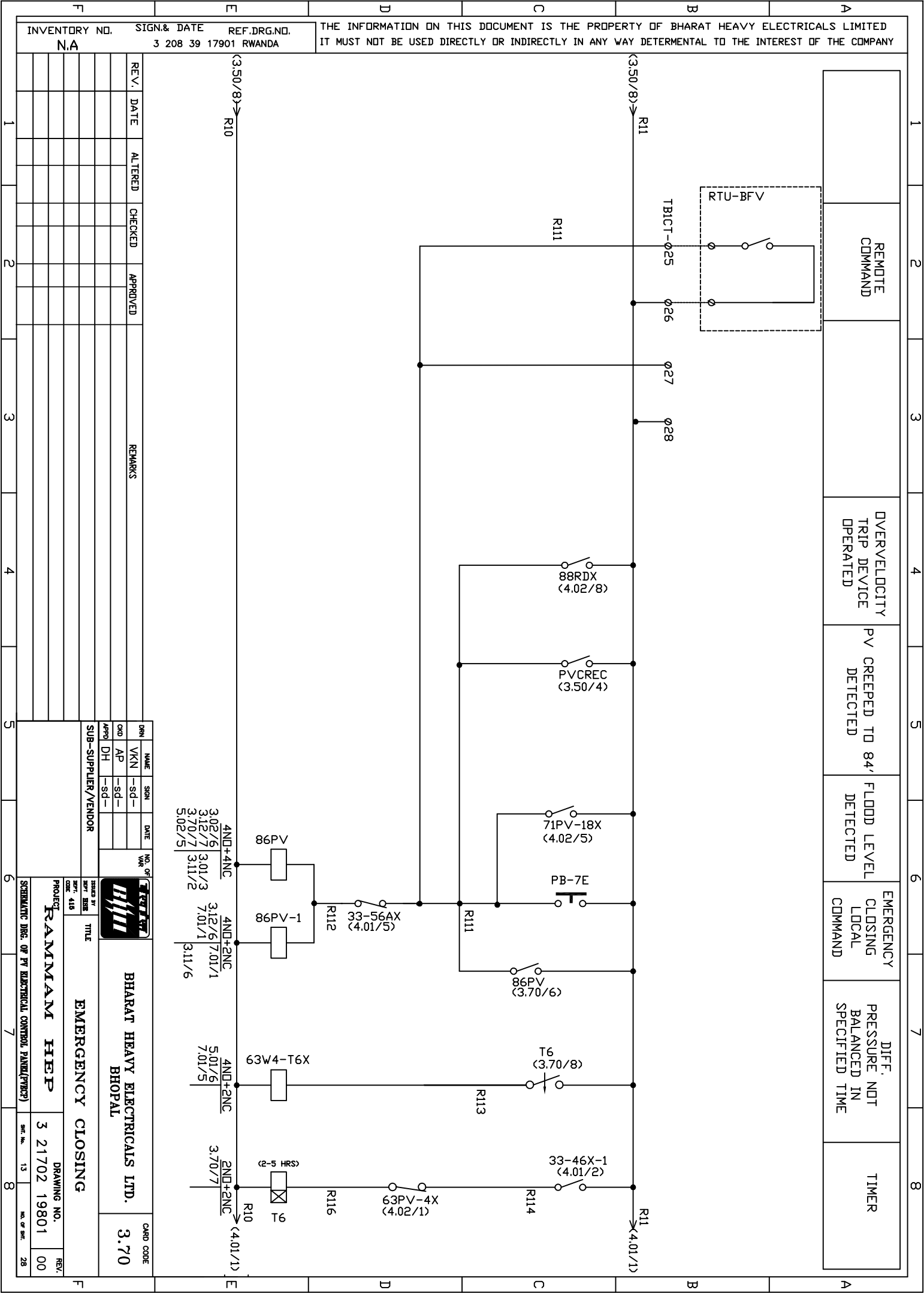
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PERMIT RELAY	LOCAL	REMOTE				

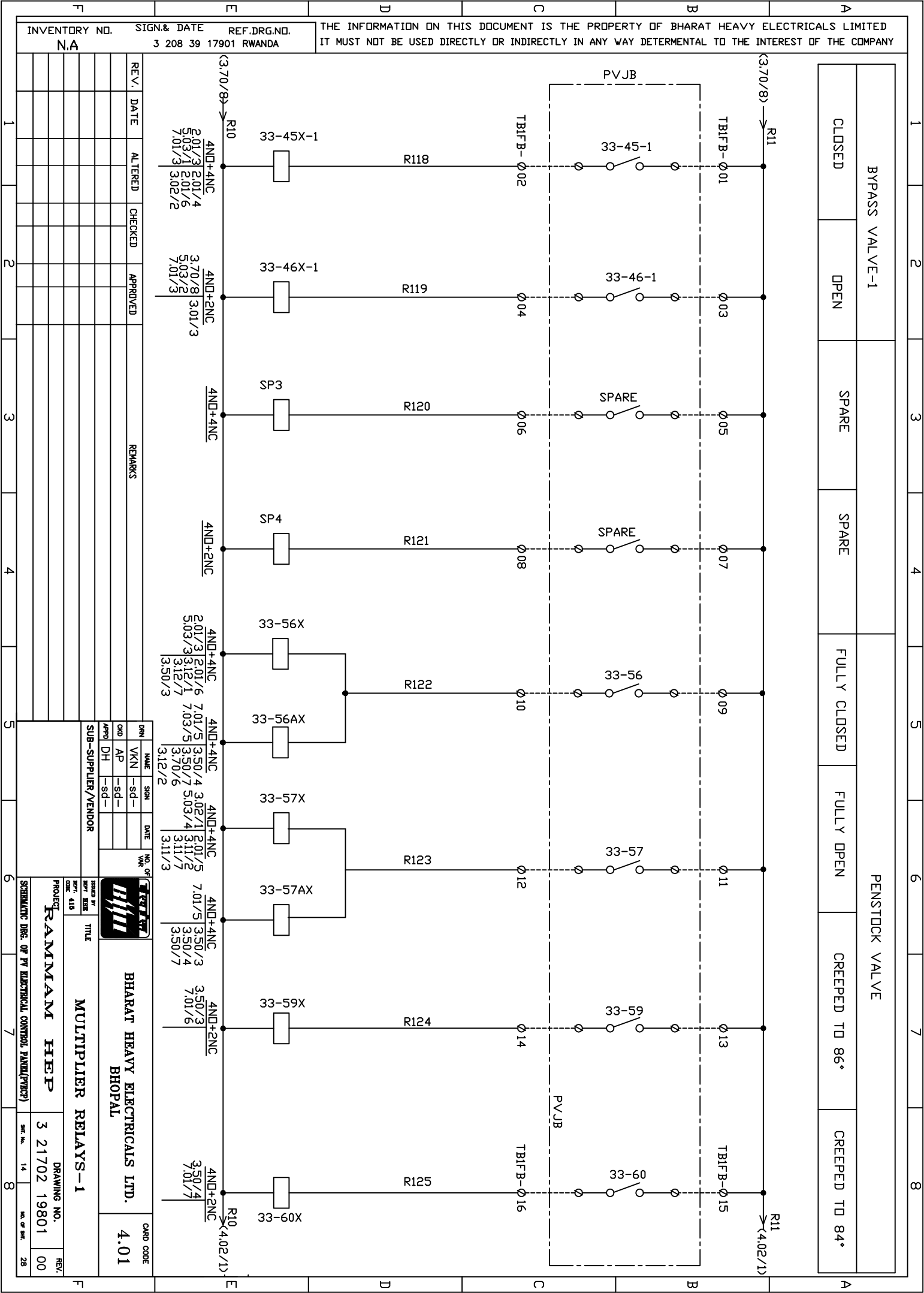


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SCHEMATIC DIAG. OF PV ELECTRICAL CONTROL PANEL(PVPCP)		SHEET NO. 10 NO. OF SHEETS 28







INVENTORY NO. N.A SIGN.& DATE 3 208 39 17901 REF.DRG.NO. RWANDA THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETERMENTAL TO THE INTEREST OF THE COMPANY

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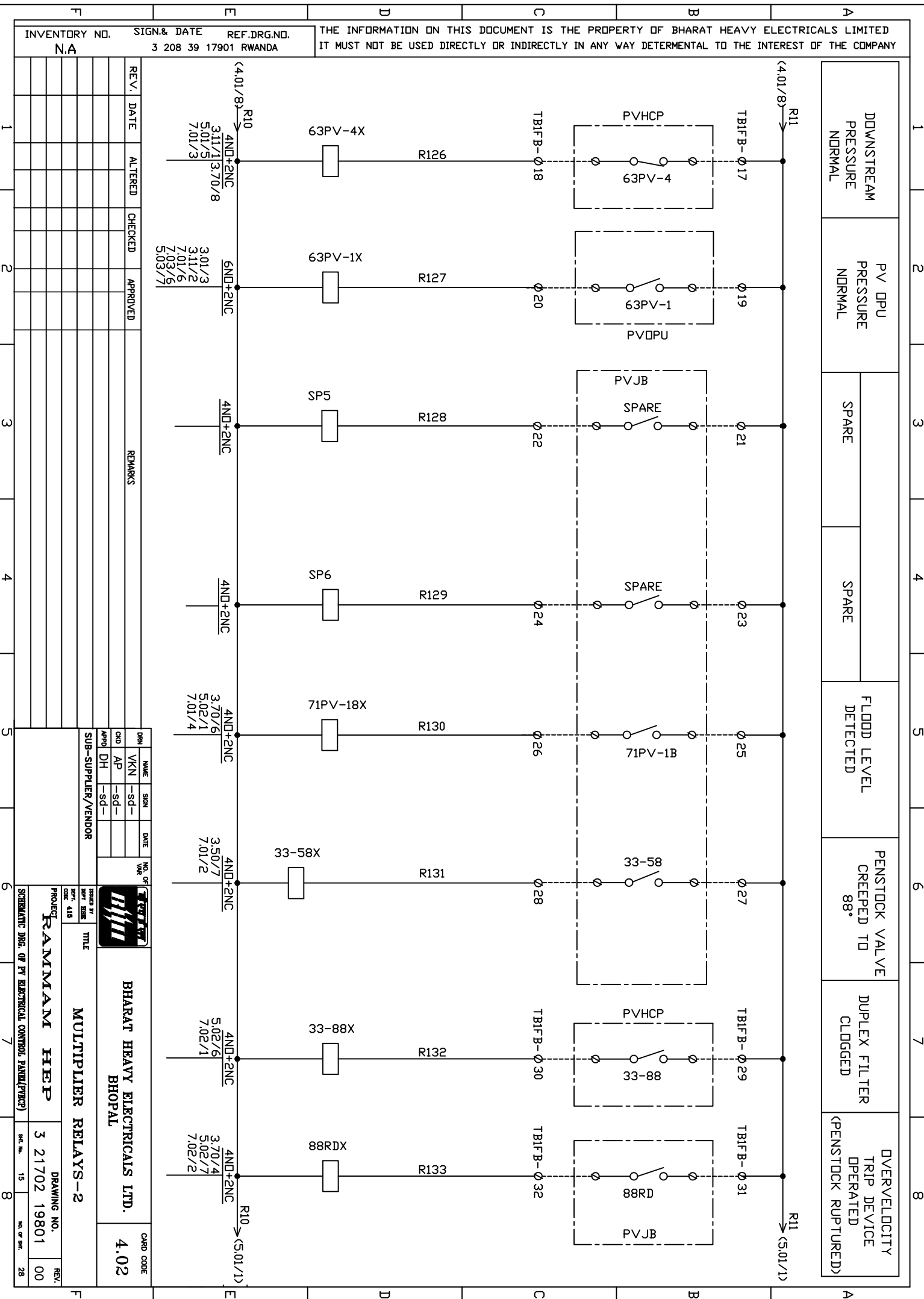
ISSUED BY	CHKD	DATE	TITLE	CARD CODE
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PROJECT	DRAWING NO.	REV.
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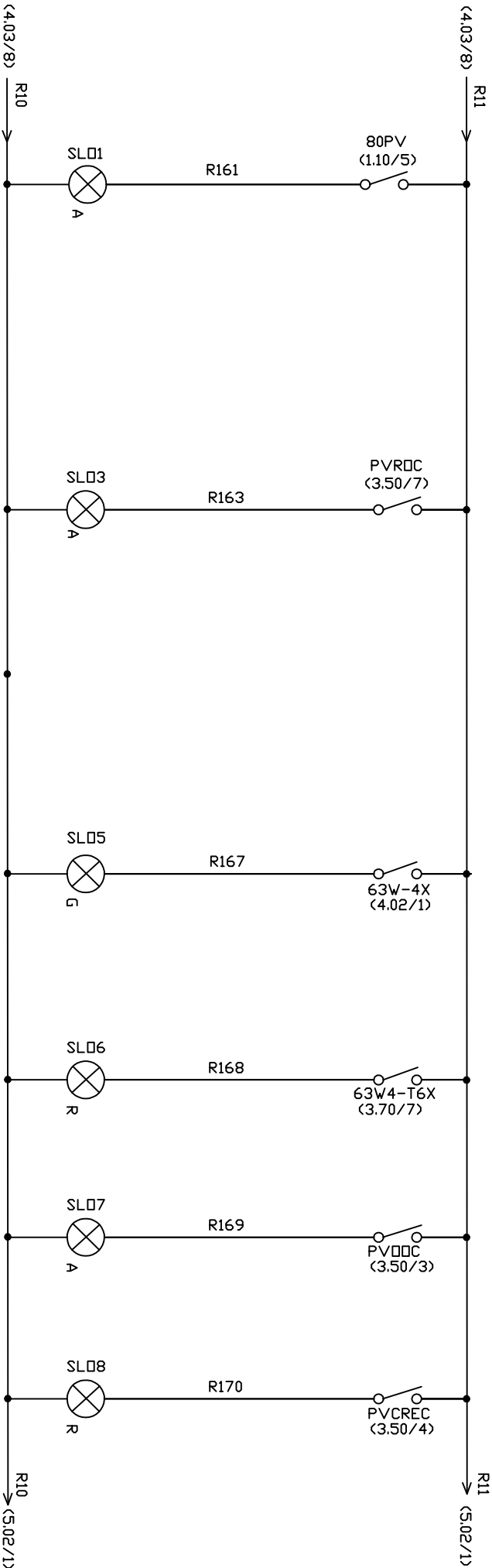
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	14	28

SUB-SUPPLIER/VENDOR

MULTIPLIER RELAYS-1



AC CONTROL SUPPLY DK	PV CREEPED TD 88° (RE-OPENING CMD)	DOWNSTREAM PRESSURE NORMAL	DIFF. PRESSURE NOT BALANCED IN SPECIFIED TIME	PV CREEPED TD 86° (PV OUT OF CONTROL)	PV CREEPED TD 84° (EMERGENCY CLOSING)
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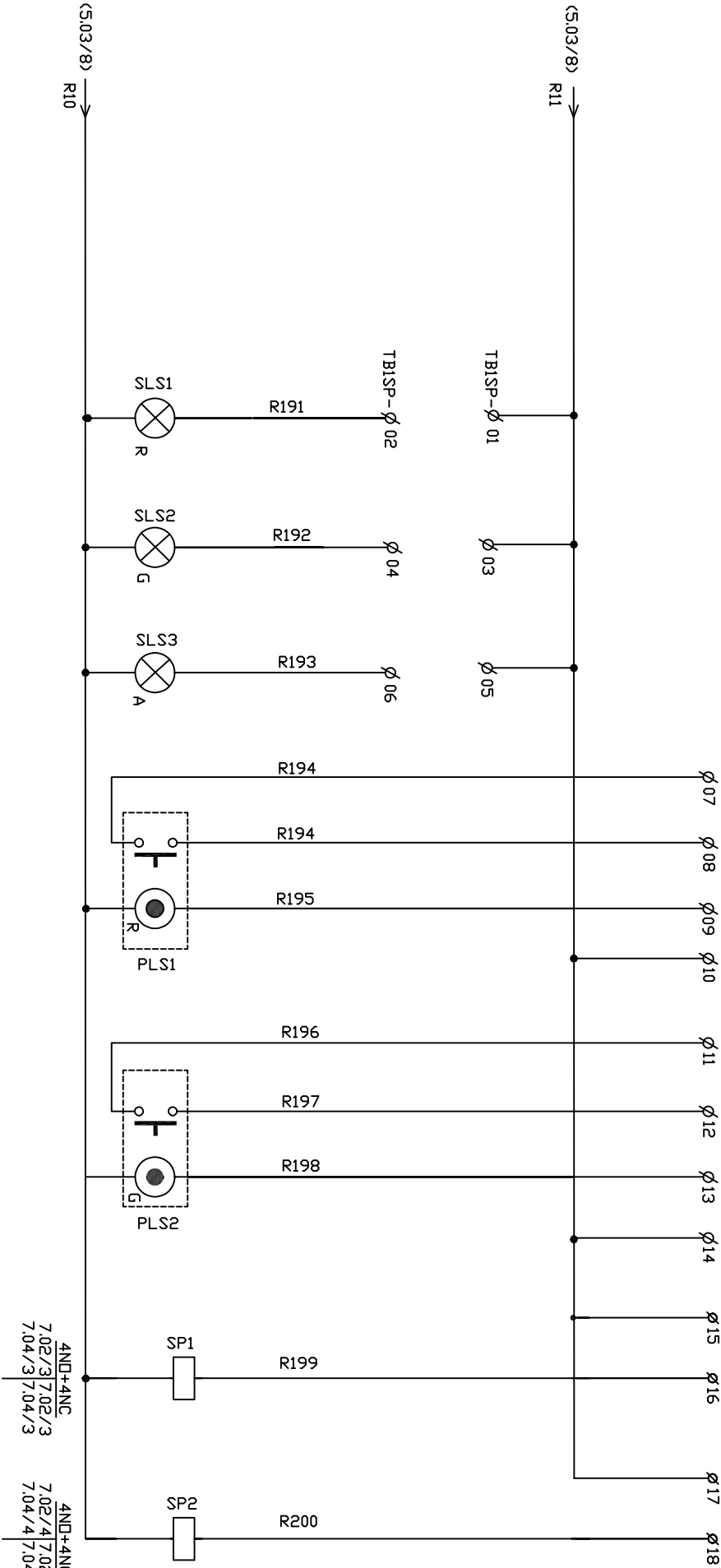


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ISSUED BY				
REV. 001				
CHK. 410				
PROJECT				
RAMMAM HEP				
STATUS INDICATION-1				
BHARAT HEAVY ELECTRICALS LTD.				
BHOPL				
CARD CODE				
5.01				
DRAWING NO.				
3 21702 19801				
REV.				
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SHEET No. 17				
NO. OF SHEET 28				

BYAPPS VALVE LOCKING PIN DISENGAGED	SPARE	SPARE	SPARE	SPARE	SPARE	SPARE	SPARE
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INVENTORY NO. N.A SIGN.& DATE 3 208 39 17901 REF.DRG.NO. RWANDA THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETERMENTAL TO THE INTEREST OF THE COMPANY

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CHKD				
PROJECT				
STATUS INDICATION-4				
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DRAWING NO. 3 21702 19801				
REV. 00				
SCHEMATIC DOC. OF PT ELECTRICAL CONTROL PANEL(WVCP)				
SHEET No. 20				
NO. OF SHEET 28				

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INVENTORY NO. N.A		SIGN.& DATE 3 208 39 17901 RWANDA		REF.DRG.NO.											
240 VAC SUPPLY															
OK		FAIL		BYPASS VALVE-1				PENSTOCK VALVE		PENSTOCK VALVE		PENSTOCK VALVE			
				CLOSED		OPEN		CLOSED		OPEN		CREEPED TD 86'		CREEPED TD 84'	
EMERGENCY CLOSING RELAY															
PENSTOCK VALVE CREEPED TD 88'															
DOWNSTREAM PRESSURE NORMAL															
FLOOD LEVEL DETECTED															
DIFF. PRESSURE NOT BALANCED IN SPECIFIED TIME															
PV DPU PRESSURE NORMAL															
24 VDC FIELD SUPPLY FAIL															
PV CREEPED TD 86' (PV DUT OF CONTROL)															
PV CREEPED TD 84' (EMERGENCY CLOSING)															
REV. DATE ALTERED CHECKED APPROVED REMARKS															
1 2 3 4 5 6 7 8															
SUB-SUPPLIER/VENDOR															
BHARAT HEAVY ELECTRICALS LTD. BHOPAL															
REMOTE CONTACTS-1															
DRAWING NO. 3 21702 19801 REV. 00															
SCHEMATIC DOC. OF PV ELECTRICAL CONTROL PANEL (TRCP)															

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INVENTORY NO. N.A		SIGN.& DATE 3 208 39 17901 RWANDA		REF.DRG.NO.											
REV. DATE ALTERED CHECKED APPROVED REMARKS															
1															
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5															
6															
7															
8															
DUPLX FILTER CLOGGED															
OVERVELOCITY TRIP DEVICE OPERATED															
SPARE-1															
SPARE-2															
TRIP CMD TD															
CONTROL SELECTION															
LOCAL															
REMOTE															
TBIRT- K42 33-88X (4.02/7) K43 ø42 ø43															
K44 88RDX (4.02/8) K45 ø44 ø45															
K46 ø46 SP1 (5.04/6) K47 ø47 SP1 (5.04/6) K48 ø48															
K49 ø49 SP2 (5.04/7) K50 ø50 SP2 (5.04/7) K51 ø51															
K52 ø52 PVCCMD (3.12/6) K53 ø53															
K54 ø54 SS1 (PART) O6 ø12 LOCAL K55 ø55 OF K56 ø56 OL TBIRT- REMOTE															
Bharat Heavy Electricals Ltd. Bhopal															
Remote Contacts-2															
Drawing No. 3 21702 19801 Rev. 00															

INTERNAL		EXTERNAL		INTERNAL		EXTERNAL		INTERNAL		EXTERNAL							
(SHT. REF.)		PARTICULARS		(SHT. REF.)		PARTICULARS		(SHT. REF.)		PARTICULARS							
INVENTORY NO. N.A SIGN.& DATE 3 208 39 17901 RWANDA REF.DRG.NO. THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETERMENTAL TO THE INTEREST OF THE COMPANY																	
TBP (1.10)- 01 + 02 240 VAC SUPPLY (FROM UPS)				TB1CT (3.01)- 03 Ø TB:05 BYPASS VALVE OPEN SOLENOID				TB1FB (4.01)- 01 Ø TB:04 (FROM PVUB) BYPASS VALVE-1 CLOSE FEEDBACK									
(1.10)- 02 - 03				(3.02)- 07 Ø TB:07 (TO PVHCP) BYPASS VALVE CLOSE SOLENOID				(4.01)- 02 Ø TB:05 (FROM PVUB) BYPASS VALVE-1 CLOSE FEEDBACK									
(1.10)- 03 - 04				(3.11)- 11 Ø TB:01 (TO PVHCP) PV OPEN SOLENOID				(4.01)- 03 Ø TB:14 (FROM PVUB) BYPASS VALVE-1 OPEN FEEDBACK									
(1.10)- 04 - 05				(3.12)- 14 Ø TB:04 (TO PVHCP) PV CLOSE SOLENOID				(4.01)- 04 Ø TB:15 (FROM PVUB) BYPASS VALVE-1 OPEN FEEDBACK									
(1.10)- 05 - 06				(3.12)- 15 Ø TB:03 (TO PVHCP) PV CLOSE SOLENOID				(4.01)- 05 Ø TB:24 (FROM PVUB) BYPASS VALVE-2 CLOSE FEEDBACK									
(1.10)- 06 - 07				(3.12)- 16 Ø TB:04 (TO PVHCP) PV CLOSE SOLENOID				(4.01)- 06 Ø TB:25 (FROM PVUB) BYPASS VALVE-2 CLOSE FEEDBACK									
(1.10)- 07 - 08				(3.12)- 17 Ø TB:04 (TO PVUB) PV CLOSE SOLENOID				(4.01)- 07 Ø TB:34 (FROM PVUB) BYPASS VALVE-2 OPEN FEEDBACK									
(1.10)- 08 - 09				(3.12)- 18 Ø TB:15 (TO PVUB) PV EMERGENCY CLOSE SOLENOID				(4.01)- 08 Ø TB:35 (FROM PVUB) BYPASS VALVE-2 OPEN FEEDBACK									
(1.10)- 09 - 10				(3.12)- 19 Ø TB:15 (TO PVUB) PV EMERGENCY CLOSE SOLENOID				(4.01)- 09 Ø TB:44 (FROM PVUB) PV FULL CLOSE FEEDBACK									
(1.10)- 10 - 11				(3.12)- 20 Ø TB:15 (TO PVUB) PV EMERGENCY CLOSE SOLENOID				(4.01)- 10 Ø TB:45 (FROM PVUB) PV FULL CLOSE FEEDBACK									
(1.10)- 11 - 12				(3.12)- 21 Ø TB:15 (TO PVUB) PV EMERGENCY CLOSE SOLENOID				(4.01)- 11 Ø TB:54 (FROM PVUB) PV FULL OPEN FEEDBACK									
(1.10)- 12 - 13																	

INTERNAL	EXTERNAL
(SHT. REF.)	PARTICULARS

TB1R1T		
(7.01/4)-	30	] FLOOD LEVEL DETECTED
	31	
(7.01/5)-	32	] DIF: PRESSURE NOT BALANCED IN SPECIFIED TIME
	33	
(7.01/6)-	34	] TB11.31A - PV-1 (TO RTU-BFV)] TB11.32A PV-2 (TO RTU-BFV)] TB11.31B PV OPU PRESSURE NORMAL] TB11.32B
	35	
(7.01/6)-	36	] 24 DC FIELD SUPPLY FAILED
	37	
(7.01/7)-	38	] PENSTOCK VALVE CREEPED TO 86' (PV OUT OF CONTROL)
	39	
(7.01/8)-	40	] PENSTOCK VALVE CREEPED TO 84' (EMERGENCY OPERATED)
	41	
(7.02/1)-	42	] DUPLEX FILTER CLOGGED
	43	
(7.02/2)-	44	] TB11.07A - PV-1 (TO RTU-BFV)] TB11.07C PV-2 (TO RTU-BFV)] TB11.07B OVER VELOCITY DEVICE OPERATED] TB11.07D
	45	
(7.02/3)-	46	] SPARE-1
	47	
	48	] SPARE-2
	49	
(7.02/4)-	50	] SPARE-2
	51	
(7.02/5)-	52	] TRIP COMMAND TO (U-I, II & III FOR PV-1) (U-IV, V & VI FOR PV-2)
	53	
	54	] CONTROL SELECTION IN LOCAL] CONTROL SELECTION IN REMOTE
(7.02/6)-	55	
	56	
	57	
	58	
	59	
	60	

[illegible]

