





Plant CAUSTIC SODA	Client Punjab Alkali	Contract Code PACL	Document ID 0215-ELT-11-EC-0007	Contract No. 66-0215
	TECHNICAL SPECIFICATION POLARISATION RECTIFIER			
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<p>TKIS - India / Vendor</p> <p>Category Codes (Submission Purpose)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input checked="" type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction <hr/> <p>Acceptance Codes (Approval Codes)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit <p>Remarks for AC2 : This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-submitted after revision. This drawing should be revised only to the extent of TKIS - India / Owner / Client comments. Any other changes made by you will not be considered unless clearly highlighted in covering letter asking for approval.</p> <p>This approval / review does not absolve the supplier from the full responsibility for design and fabrication.</p> <p>Date : ___/___/___ Name : _____</p>	<p>TKIS - India / Owner / Client</p> <p>Category Codes (Submission Purpose)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction <hr/> <p>Acceptance Codes (Approval Codes)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit <p>Date : ___/___/___ Name : _____</p>
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INDEX SHEET

The document Cover Sheet indicates revisions made in this document along with the purpose of issue of the revised document. The details of revisions made in the enclosures of this document are listed in the table of *Contents* below and the enclosures listed therein are an integral part of this document.



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Sr. No.	Description	Site Condition
1.	Location	Naya Nangal, Punjab
2.	Altitude	346 meters above MSL
3.	Ambient Temperature - Maximum	48 Deg C
4.	Ambient Temperature – Minimum	4 Deg C
5.	Design Ambient Temperature (For Electrical Equipment)	50 Deg C
6.	Max. Relative Air Humidity	95 % at 50 Deg C
7.	Rainfall (Max.)	50 mm per hour
8.	Seismic Zone	Zone-IV as per Part-4 of IS-1893
9.	Soil Resistivity	** Ohm-meter
10.	Thermal Resistivity of soil	** Deg. K.m/watt
11.	Presence of Corrosive atmosphere	Yes, Highly Corrosive, laden with traces of sulphur di/tri-oxide. Abrasive dust and coal particles (5-100 microns) with traces of Cl ₂
12.	Tropicalizing required	Yes

** : Data to be provided later by tkIS-India

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1.0 INTRODUCTION

This specification covers design, manufacturing, testing at manufacturer's works, packing & forwarding to site, unloading, testing and commissioning at site of equipment and components of Polarisation Rectifier System / ~~Booster Polarisation Rectifier System~~ for DC Power supply to electrolyser of an Electro-Chemical process plant.

The design, manufacture, testing and performance of equipment and components thereof, included in this specification shall comply with all currently applicable standards and specific standards and codes specified under clause 'Codes & Standards' of Part - II of this specification.

Equipments and services to be furnished under this specification shall be as per various parts of this specification and the offer shall be submitted as per Part-III "Notes on method of offer submission". Specific Requirements are covered in Part-II while Standard & Descriptive requirements are covered in Part-I of this specification.

Wherever conflict arises between the various clauses of this specification or with the standards, it shall be clearly brought out to notice of Purchaser / Consultant. Final Decision shall be subjected to purchaser/consultant approval.

2.0 GENERAL DESCRIPTION

2.1 Design

Polarisation Rectifier shall be designed to supply constant DC current (Controlled Rectifier) to electrolyser cells during startup of the Electrolysers & during tripping / non-functioning (switched OFF) of main rectifier with maximum DC current clamping facility irrespective of output voltage. During normal operation, this unit shall operate in parallel with the main rectifier. Typical component details indicating functional requirement shall be as shown in enclosed schematic diagram (refer Part-IV of this specification).



The Polarization Rectifier shall be designed for 2 nos. 6 pulse full wave controlled bridge system, combined to provide a 12 pulse system.

Normally the Polarisation Rectifier shall be designed to operate in Parallel Redundant mode with both Polarisation Rectifiers supplying the polarization current on current sharing basis (i.e. 50%) by sensing the output current from common shunt. However, in case of failure of any one of the Polarisation Rectifiers, the healthy unit shall supply 100% set point current to the Electrolyser, without any interruption.

The faulty Polarisation Rectifier, which fails to deliver the set point current (approx. 50%) during operation in Parallel Redundant mode (due to fault either in power circuit or failure of any control component), shall trip and tripping of this Polarisation Rectifiers shall automatically transfer the 100% set point to the healthy Polarisation Rectifier. The healthy Polarisation Rectifier then shall deliver 100% of the set point current in Parallel Redundant mode.

Additionally 'Low DC Output Current Trip' shall be provided on each Polarisation Rectifier to trip, if output current of one Polarisation Rectifier falls below 10% (approx.) of the rated current of Polarisation Rectifier on sustained basis (for more than 5 seconds) while the other Polarisation Rectifier is still delivering approx. 50% of the set value. Suitable time override for start and bypass arrangement during testing shall be provided.

The control system shall be designed for smooth ramping of current without any sudden jump. The control system shall be designed such that irrespective of the set point, the current fed to the Electrolyser shall not exceed 50 Amps.

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The input isolation transformers of the polarization rectifier shall be provided with four number of Taps (+/-10% in step of 5%) approx. (5 position) on primary side to adjust the DC output Voltage to optimum values. A 5 position off-load tap selector switch shall be provided on the primary of the Transformer. This switch shall be operable only after opening the panel door. A micro-switch shall be provided on the tap selector switch to ensure tripping of the Pol. Rectifier in case the Tap selector switch is operated on system loaded condition.

Isolation transformers shall be sized based on uncompensated power factor of the supplied system.

Optionally, polarization rectifier can be designed as uncontrolled full wave bridge rectifier system with DC-DC converter (with buck-boost arrangement), without primary and secondary taps for isolation transformer.

Selection of output voltage transducer range shall be based on the voltage rating of the main rectifier. The minimum voltage range shall be same as voltage rating of main rectifier.

2.2 Booster Polarisation Rectifier : Not Applicable

~~Booster Polarisation Rectifier system shall be supplied if specified in Part II. This system shall be connected in between the positive and negative ends of the electrolyser cell after leaving some elements. The Exact location of the termination points will be decided at site during commissioning of the system.~~

~~Booster Polarisation Rectifier system shall be single and **not** Dual Redundant (Refer Part IV).~~

2.3 Construction

The Rectifier and associated components shall be housed in metal clad, totally enclosed CRCA sheet steel enclosure as specified in Part - II of this specification.

Neoprene rubber gaskets / gromets shall be provided all around the door and other openings to make the panel vermin and dust proof.

All instruments, switches, meters and push buttons shall be flush mounted on the front door at a height suitable for monitoring and easily accessible for operation.



The component layout shall be modular with proper segregation / space between components / electronic cards / modules. The electronic cards / PCBs for control shall be plug-in type and easily accessible. Each PCB shall have self-diagnostic feature with LED indication to show healthy and faulty state.

Panel shall be provided with cooling fan/ louvers as required. If louvers are provided, same shall be covered with wire mesh & filters, as required.

Removable undrilled gland plate, 3 mm thick shall be provided at the bottom or top of the panel for cable entry as specified in Part -II of this specification.

All other constructional features shall be as detailed under various clauses of Part-II of this specification.

All electronic cards, modules, PCBs etc shall be tropicalized by providing suitable coating. All Printed circuit boards shall have Conformal Coating of thickness of minimum 50 µm, preferably 75µm.

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All control cards shall be mounted on the fixed portion of panel and not on the door or else it shall be perfectly fixed with associated door so as there is no fluctuation of any of the operating parameters problem during door opening.

All live parts directly accessible from front shall be shrouded using acrylic sheets for on-line maintenance of the equipment.

All Components & equipments shall be mounted/ installed such that these can be fully maintained and serviced without removing or dismantling any other component.

All components & Equipments shall be designed for ease of maintenance and for installation with adjoining equipment on either side.

Suitable lifting hooks shall be provided on each shipping section of panel.

Opening of panel shall be Cupboard Type.

All components used in the system shall be of industrial grade or better.

2.4 Input Power Supply

The Polarisation current to the Electrolyser system cannot be interrupted. Hence, the input power supply of the Polarisation Rectifier shall be supplied through an online UPS (Uninterrupted Power Supply). Supply of UPS is **not** in the scope of Polarisation Rectifier supplier. Normally, the power supply to the Polarisation Rectifier shall be fed through the UPS via static switch. Upon interruption of Inverter output supply, the load shall automatically changeover to static bypass mode and Polarisation Rectifier shall continue to feed the polarisation current without any interruption. Upon resumption of inverter supply, the output shall changeover back to inverter mode to maintain the Polarisation rectifier input supply.



~~Supply to Booster Polarisation Rectifier shall be through Non UPS Emergency power supply.~~

Under all the above conditions, input current to electrolyser cells shall not be interrupted.

Purchaser shall provide, 3-phase, 4 wire AC power supply from UPS at only one point for each polarisation rectifier as per details indicated in Part - II. Supplier shall derive the required auxiliary supplies from it.

2.5 Basic Function

The function of Polarisation Rectifier system is to provide polarisation current to the electrolyser during start up and shutdown of the electrolyser. During start up, polarisation rectifier will supply current to the electrolyser and main rectifier will be OFF. When main rectifier is switched ON, polarisation rectifier will supply the current till the output voltage of main rectifier is less than voltage of polarisation rectifier. The moment main rectifier voltage is equal to the polarisation rectifier, the polarisation rectifier may supply current equal to or less than the set point current. Blocking diodes shall be provided in the output circuit of polarisation rectifier to block back feed from main rectifier. These diodes will also prevent reverse feed from electrolyser due to back EMF when main rectifier is tripped or electrolyser is isolated from main rectifier.

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2.6 Current Control

The polarisation rectifier shall be designed to operate in “constant current” mode. Output current control (current set point) of the polarisation rectifier shall be possible with the help of multiturn potentiometer mounted on the panel front. After switching ON, the output current shall be gradually increased automatically to the set point within the set period. It shall be possible to control the output current (current set point) within accuracy of 0.5Amp over the entire range, taking into consideration non-linear characteristics of electrolyser especially at higher voltage of polarisation rectifier. The polarisation rectifier shall be designed to supply the set current/rated current by taking current feed back signal from shunt installed on the common output. The control shall ensure that the total current fed in to the Electrolyser shall not exceed set point or max. 50 Amps, irrespective of whether single or dual polarization rectifier is in operation. Also, the Polarization rectifier shall be designed to supply the set point/rated current at operating conditions of low as well as high voltages, due to different conditions of back EMF as well as variations in the input supply voltage.

2.7 Modes of Operation

The polarisation rectifier shall function in two modes: Auto (Service) and Test.

Test mode is provided to test the rectifier from the local. In this mode the permissive from DCS shall be bypassed. This mode shall be used only for testing the rectifier.

In Auto mode, the polarisation rectifier will be switched / powered ON automatically and Output current shall ramp up to the set point upon switching / powering ON the polarisation rectifier, if the ON / OFF switch is in ON position and the DCS permissive is closed. The ramp up time to full load/set point current shall not exceed 10 sec. in both modes of operation after switching /powering ON the polarisation rectifier.

In case of power supply interruption & subsequent resumption, the Polarisation rectifier shall start on its own without any manual intervention and start delivering the required set current within 10 sec (max.) from the resumption of power supply.



In case of sustained under voltage or loss of supply, no trips shall be generated by polarization rectifier and it shall supply possible output current till the contactor drops on undervoltage.

The system shall be designed for 120% continuous load. All the components in the system shall be designed/rated for this load. Heat run test on the system shall be carried out at 120% rating with cooling fans in off condition, if fans are not required for normal operation. If fans are required, then redundant fan shall be provided and heat run test shall be carried out with redundant fan in off condition. The internal settings of the unit shall be set to 100% load during dispatch.

2.8 Protection

Rectifier equipment shall have its own protective devices, surge protection devices and fast acting semiconductor fuses, HRC fuses etc. The fuses provided shall be provided in each arm of rectifier connection suitable for rectifier protection. Protection shall be provided as per Part – II of this specification. In addition, field adjustable, DC overload, DC over voltage and AC under voltage settings shall be provided. Fast acting current limiting feature shall be built-in in the design which will protect the Polarisation Rectifier from supplying current higher than set value under any circumstances.

HRC/Semiconductor fuses shall be provided for the protection of Rectifier elements. The fuses provided shall withstand the sudden short-circuit of the rectifier output when

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operated under no-load (open circuited condition) as well as full-load conditions. When HRC fuses are used for Rectifier protection it shall be ensured that the I_{2t} of HRC fuse is only 70% of I_{2t} of the Rectifying Element. Necessary calculation in this effect shall be submitted for validation

2.9 Earth Leakage Monitoring Unit

An electronic type earth leakage monitoring unit shall be provided if specified in Part - II for monitoring the leakage current between the positive output terminal and earth and between the negative output terminal and earth. The leakage current shall be displayed on the monitoring device / digital ammeter. This unit shall indicate alarm / trip separately on the above two conditions when the value of leakage current exceeds above the set value as indicated in Part-II. The alarm / trip settings shall be field adjustable without any change in components.

2.10 Specific Requirements

The rectifying element and blocking diode ratings (I avg.) shall be minimum 150 Amps. and minimum PIV 1400 Volts for system Voltage ≤ 500 V DC and 2000 PIV for system Voltage > 500 and < 630 VDC.

In order to reduce the harmonic distortion in the incoming power supply due to controlled rectifying action, DC link inductor shall be provided on both positive and negative limbs. The current distortion (I_{thd}.) shall be limited to < 25 % under 6 pulse operation and < 12% for 12 pulse operation at all operating loads. The input uncompensated PF shall be maintained minimum 0.85 under single as well as dual Pol. Rectifier operation. The compensated pf with pf correction capacitor bank/ Harmonic filter shall be minimum 0.95.

Due to the operation of the main rectifier (at 6-pulse configuration) especially at the low loads, very high level of ripple currents (DC ripples) generates in the electrolyser system. During normal operation of polarisation rectifier in parallel with main rectifier system, load ripple currents shall be returning back to the polarisation rectifier system and shall overload the output switches, DC filter capacitors, shunts etc. of the polarisation rectifier system.

In order to avoid the overloading of the filter capacitors, switches, blocking diode and shunts etc. by high ripple current, suitable filters (Inductance and capacitance combination or Inductance alone on both positive and negative limbs) shall be provided in the output side of the polarisation rectifier. The ripple current shall be measured with a AC clamp/ Clip-On meter (selected to read AC current) when the polarisation rectifier is operating under full load condition connected with the main rectifier operating at low load condition. The ripple current (AC current) in the output circuit shall not exceed 1.5-2.5 Amps i.e. 3-5% of the rated current.



The same shall be tested during factory acceptance test (when a load connected to ripple current source) and during commissioning.

Flux density for Input Isolation transformer shall be limited to 1.6 Tesla (at worst operating condition) considering the harmonic current present in the system.

When operated in dual redundant mode the polarization rectifier will be loaded only < 40%. Hence the ripple content and Harmonic current will be very high. The ripple content with 6 pulse operation shall not exceed 2% at all operating Voltage ranges.

Power factor correction/ Harmonic filter shall be supplied as indicated in the scheme diagram.

The switching operation of the Capacitors shall be through capacitor duty contactors/timers and fuses.

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Iron cored / gapped core, series reactors shall be used with capacitor banks to dampen the effect of transients during capacitor switching and to control the natural frequency of the capacitor bank and system impedance to avoid resonance and to mitigate harmonic current, special care shall be taken while designing of capacitors & reactors.

Bleeder resistor rating shall be such that temperature of the bleeder resistor does not exceed 100 °C when bleeder resistor is in circuit.. Hysteresis based cut-off and cut-in contact with time delay shall be provided for bleeder resistor.

2.11 Wiring

Control wiring shall be carried out with flexible, heat resistant wires of 650/1100V grade, PVC insulated, stranded copper conductor. Minimum conductor sizes shall be 1.5 mm² for control circuits and 2.5 mm² for CT circuits.

Each wire shall be identified at both ends with wire designation in accordance with the wiring diagram developed from approved control schematics. Printed Ferruling shall be used for identification. Vendor drawings shall carry the ferrule nos. / terminal nos. of every termination.

Wires connected to earth shall be of green colour only. For AC & DC control circuits black and grey colour of wires shall be used respectively.

All wire terminations except for clip-on type terminal blocks shall be made with ring / fork tongue compression type connectors. Wires shall not be tapped in between terminal points. Whenever wires cross sheet steel barrier rubber / PVC grommets shall be provided around the hole in sheet steel barrier. A maximum of two wires can be terminated in one terminal. Additional termination if required shall be done on adjacent terminals by shorting links.

Busbar type terminal connectors shall be provided for power cable terminations.

2.12 Name Plate

Material of Name plate & type specified in Part - II held by `Self tapping` screws shall be provided at the top of each flush mounted equipment. All internally mounted components shall be identified with painting marks as per approved scheme drawings. Inscription details on name plate shall be as per Purchaser's requirements and details of name plate will be issued after approval of vendor's GA drawings.

2.13 Earth Bus



Earth bus shall be provided along the full length of each Polarisation Rectifier and each stationary unit/equipment shall be connected directly to this bus by two separate and distinct connections.

Earthing terminal connectors shall be provided at the bottom of the panel at either end for connection to the Purchaser's earth conductor.

Hinged doors shall be earthed through flexible copper braids. All non-current carrying metal parts shall be effectively bonded to the earth bus.

2.14 Painting

Vendor to furnish complete details of painting procedure and painting facilities available along with the offer and final paint shade shall be as indicated in Part - II.

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3.0 FACTORY ACCEPTANCE TEST

Inspection and testing shall be carried out based on the latest revision of this specification released for fabrication (order specification). Purchaser / Consultant have the right to carry out stage inspection and shop visit to review the manufacturing progress. However, manufacturer need not hold any of the manufacturing activity for witnessing of Purchaser / Consultant's stage inspection.

All routine and type tests as specified in Part - V shall be carried out during final inspection. Fifteen days advance notice shall be given for carrying out the inspection.

Vendor shall ensure that all meters and equipments associated with testing of the equipment shall be calibrated by a competent testing laboratory and that the calibration certificates shall be valid at the time of carrying out the testing of equipment.

After completion of inspection and testing, vendor shall furnish all as-built documents, test reports and calibration certificates in required number of sets.

4.0 SITE TESTING, COMMISSIONING AND SITE ACCEPTANCE

After installation of equipment at site, all the pre-commissioning and acceptance tests as required by relevant standards, norms, codes and this specification shall be carried out in the presence of Purchaser and/ or Purchaser's representative. All safety and process Interlocks shall be demonstrated to the satisfaction of the Purchaser / Consultant.

Vendor shall perform and fill up Site Test & Commissioning Plan (as per protocol attached with this specification) for the equipment under his scope of supply for Purchaser's/ Consultant's approval. Purchaser's site testing and commissioning protocols / procedures shall be considered as minimum requirement. Any additional tests required and necessary to be performed for the equipment shall be brought to notice of Purchaser / Consultant before putting equipment to service. Performing of the new tests shall be subjected to Purchaser / Consultant approval.

All special tools, meters, oscilloscope, harmonic analyser, special personals (engineer) and any other equipment required for carrying out the pre-commissioning and site testing activities shall be brought by vendor and only unskilled manual labour shall be provided by Client / Purchaser as a minimum.

Load and interconnecting cables required for the load and performance test shall be arranged by Client / Purchaser.



5.0 GUARANTEE PERFORMANCE

The performance figure indicated in Part - II, shall be guaranteed subject to tolerance permitted by relevant standards.

If the equipment supplied by the vendor fails at site during erection, commissioning or service (within guarantee period), the vendor shall repair and put back into successful operation the failed equipment within the time frame and procedure of repair agreed with the Purchaser depending on nature of failure at no extra cost to purchaser. Vendor shall demonstrate the satisfactory operation & performance of the repaired equipment.

Purchaser reserves the right to reject the equipment in case of failure to meet the guarantee in respect of any of the following performance :



- i. Efficiency dropping more than 5 %, below the guaranteed value.
- ii. Temperature rise exceeding the guaranteed value.



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- iii. Failure of rectifier to give guaranteed performance with respect to current control such as range, speed and sensitivity.


However, the vendor will be given an opportunity to rectify his equipment at his own cost. Also, the purchaser reserves the right to use the rejected equipment till it is rectified.



The period of guarantee of the equipment shall be as per the “Commercial Terms & Conditions “ enclosed along with this specification.



		POLARISATION RECTIFIER PART - II DESIGN DATA SHEET		Code		PACL	
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GENERAL	1	Ton No. (Main Pol. Rect. / Booster Pol. Rect.)	:	PR-A, PR-B, PR-C, PR-D, PR-E, PR-F			
	2	Make	:				*
	3	Application	:	DC Charging to Electrolyser			
	4	Rating of Polarisation Rectifier (Design)	:	300 V DC, 50 A DC			
	5	Quantity	:	As per Part-IIIB			
	6	Type	:	2 x 6 pulse full wave Bridge to form 12 pulse system			
	7	Scheme drawing reference	:	As per Part-IV			
	8	Booster Polarisation Rectifier Required (Y/N)	:	No			
		Rating of Booster Polarisation Rectifeir	:	Not Applicable			
CODES & STANDARDS	9	IS-1885 : Static converters					
	10	IS-3895 : Monocrystalline semiconductor cells and stacks					
	11	IS-6553 : Environmental requirements for semiconductor devices & integrated circuits.					
	12	IS-13703 : Low Voltage fuses for voltages not exceeding 1000V AC or 1500V DC					
	13	IEC 60146-1 : Semiconductor Convertor.					
	14	IS/IEC-60947 : Specification for Low voltage switchgear & controlgear					
	15	IS-1248 : Direct Acting Indicating Analogue Electrical Measuring Instruments and their accessories					
	16	IS-2705 : Current transformers.					
	17						
AC INPUT	18	Voltage	:	415 V ± 10 % (In Bypass Mode)			
	19	Frequency	:	50 Hz ± 5 % (In Bypass Mode)			
	20	Power factor (minimum) uncompensated	:	0.85			
	21	Maximum input kW at rated load (Main PR)	:		kW		*
	22	No load input current (Main PR)	:		A		*
	23	Full load input current (Main PR)	:		A		*
	24	Input Isolation Rectifier Transformer required	:	Yes (Main PR & Booster PR)			
	25	Incoming Cable size (Main PR)	:	Later			**
	26						
DC OUTPUT	27	Voltage (Main Pol. Rect. / Booster Pol.Rect.)	:	300	V		
	28	Current (Main Pol. Rect. / Booster Pol.Rect.)	:	50	A		
	29	Output Voltage Range	:	0 - 100 %			
	30	Output Current Range	:	0 - 100 %			
	31	Output voltage regulation with mains voltage variation & load variation from 0-100%	:	Applicable			
	33	Output Current regulation	:	± 1%	(max)		*
	34	Ripple content in Output DC Current	:	<= 1 %	for Individual Rectifier		
	35	Current limiting feature required	:	Yes, Fast Acting type			
	36	Filters to limit load ripple current	:	Yes, to be provided,			
	37	Ripple current with electrolyser in operation (6 pulse rectifier)	:	1.5 to 2.5 A	of rated current (50A)		*
PERFORMANCE DATA	38	Guaranteed efficiency at rated load (overall at 60A)	:	> 88 %			
	39	Noise level	:	<= 75db	at 1 meter		
	40	Overload capacity continuous	:	120%			
	41	No load losses (of the system) (Main)	:		kW		*
	42	Full load losses (120% load) (of the system)	:		kW		*
	43	Temp. rise of inside air at rated load over design ambient temperature	:	Max. 15 °C.			
	44	Bleeder Resistance Wattage & Temperatur value	:		Watt / °C (<100°C)		*

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SEMI-CONDUCTING DEVICE	45	Type	:	THYRISTOR / DIODE / IGBT	*			
	46	Make	:		*			
	47	Quantity (Main PR)	:		*			
	48	Nominal blocking Voltage (Main PR)	:	V	*			
	49	Peak Inverse Voltage (Main PR)	:	2000 V	*			
	50	Limiting Current (Main PR)	:	A	*			
	51	Nominal rated Current (Iavg min. 150A Main & 90A Booster) (Main PR)	:	A	*			
	52	Losses per element at rated load (Main PR)	:	W	*			
	53	Design Margin (Main PR)	:	%	*			
	54							
RECTIFIER TRANSFORMER	55	Make	:		*			
	56	Type	:	3 phase, Double wound, Dry-type				
	57	Input supply	:	415 V ± 10 %				
	58	Input frequency	:	50 Hz ± 5 %				
	59	Output Voltage	:		*			
	60	kVA rating	:		*			
	61	Max. no load losses (Main PR)	:	kW	*			
	62	Max. load loss (Main PR)	:	kW	*			
	63	Voltage Ratio	:		*			
	64	Type of cooling	:	Natural Air Cooled				
	65	Insulation Class	:	Class F limited to Class B				
	66	Temp.rise at rated load over an ambient Temperature (max.) (Main PR)	:	70 °C				
	67	Location	:	Inside Polarisation Rectifier Panel				
	68	Design Margin	:	10%				
	69	Taps	:	± 10% in steps of 5% (i.e. 5taps) on primary				
70	Design Flux Density	:	<1.6 Tesla (max.)	*				
CABINET DETAILS	71	Degree of protection	:	IP42				
	72	Sheet material of enclosure	:	CRCA sheet				
	73	Sheet thickness	:					
		a) Door	:	2 mm				
		b) Frame	:	2.5 mm				
		c) Gland plate	:	Applicable mm				
	74	Gasket material	:	Neoprene rubber				
	75	Cable entry	:	Bottom				
	76	No. of Cooling Fans (Main PR)	:		*			
	77	Cooling Fans rating (Main PR)	:		*			
	78	Height of terminal block from bottom of the panel (min 300 mm)	:	mm	*			
	80	Note: Cooling Fans if provided shall have redundancy, if not heat run test shall be carried out without cooling fan and devices						
		temperature shall be monitored.						
	81	Ventilating louvers required (Y/N)	:		*			
	82	Material of wire mesh to cover louvers	:	Brass / PVC / Nylon	*			
	83	Type of space heater	:	Thermostat controlled				
	84	250V AC,5A power socket required inside cabinet	:	Yes				
		a) Overall weight (kgs.) (Main)	:		*			
	b) Overall Dimensions (L x B x H mm) (Main)	:		*				
85	Name Plate (Material & Thickness)	:	2 mm thick of Lamicoid					
86	Arrangement & Access	:		*				



		POLARISATION RECTIFIER PART - II DESIGN DATA SHEET		Code		PACL	
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ANNUNCIATION & INDICATION	87	AC mains failure (Y/N)	: Y				
	88	AC control supply fail (Y/N)	: Y				
	89	AC overload (Y/N)	: Y				
	90	Rectifier / SCR fuse blown (Y/N)	: Y				
	91	DC over voltage (Y/N)	: Y				
	92	DC overload (Y/N)	: Y				
	93	DC output fuse blown (Y/N)	: Y				
	94	DC output earth fault (Y/N)	: Y (Positive to Earth & Negative to Earth separate)				
	95	Rectifier trip on fault (Common alarm) (Y/N)	: Y				
	96	Pol. Rect. controller failure trip (Y/N)	: Y				
	97	Pol. Rect. PLC failure trip (Y/N)	: Y				
	98	Pol. Rect. trip on Low Output Current (Y/N)	: Y				
	99	Process trip / Process permissive not available (Y/N)	: Y				
	100	Cooling fan failure (Y/N) (using air flow signal) (Y/N)	: Y				
	Note : Also refer control scheme for additional details.						
PROTECTION	101	Fast acting semi-conductor fuses for all devices (Y/N)	: Y				
	102	Snubber circuit for dv/dt protection (Y/N)	: Y				
	103	HRC fuses for AC side & DC side filter capacitors (Y/N)	: Y				
	104	Relays for sensing mains failure /phase failure (Y/N)	: Y				
	105	Fast acting DC output current limiter(Upto110% F.L.)(Y/N)	: Y				
	106	Protection against O/V & U/V surges (Y/N)	: Y - Provide Surge Arrester				
	107	Protection against voltage/current spikes (Y/N)	: Y - Provide Surge Arrester at the input				
		Note : Also refer scheme for protection for additional details.					
DIGITAL INPUT/OUTPUT	108	1. Input (Potential free) from DCS (for ind. Polarisation Rectifier, :					
		a. Polarisation rectifier start permissive from DCS	: Yes				
	109	2.Output (Potential free) to DCS (For ind. Polariasation Rectifier, :					
		a. Polarisation Rectifier 'ON' & 'OFF'(for ind. Polarisation Rectifier)	: Yes				
		b. Polarisation Rectifier tripped on fault	: Yes				
ANALOG OUTPUT	110	AC Input voltage	: No				
	111	AC Input current	: Applicable				
	112	DC Output voltage (4 - 20 mA)	: Yes				
	113	DC Output current (4 - 20 mA)	: Yes				
	114						
CONTROL TRANSFORMER	115	Make	:				*
	116	Type	: Dry				
	117	kVA rating	:				*
	118	Margin in VA capacity on connected load	: 20%				
	119	Primary Voltage	: 240V +/-10%				
	120	Secondary voltage	:				*
	121						
SWITCH	122	Make	:				*
	123	Category of duty (For AC switch)	: AC 23				
	124	Category of duty (For DC switch)	: DC 23				
	125	Applicable Standard	: IS/IEC 60947				
	126	Rated Current (AC)	:				*
	127	Rated Current (DC)	: 100Amps (std. rating)				
	128	Derating on Nameplate rating for locating inside panel / site conditions	:				*

		POLARISATION RECTIFIER PART - II DESIGN DATA SHEET		Code		PACL	
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FUSE	129	Normal fuse	:				
		a) Make	:				*
		b) Type	:	HRC Indicating type			
	130	Semiconductor fuses	:				
		a) Make	:				*
		b) Type / Rating	:				
CONTACTOR	131	Auxillary Contactor	:				
		a) Make	:				*
		b) Applicable standard	:	IS / IEC 60947			
		c) Coil Voltage	:				*
		d) No.of Contacts	:				*
		e) Minimum Pickup Voltage	:	80 % of Rated			
		f) Minimum Dropout Voltage	:	45 % of Rated			
	132	Power Contactor	:				
		a) Make	:				*
		b) Type	:				*
		c) Current Rating	:	minimum 130 % of rated current			*
	d) Coil Voltage	:				*	
	e) No. of contacts	:				*	
BLOCKING DIODE	133	Make	:				*
	134	Type (Main PR / Booster PR)	:				*
	135	Nominal rated Current (Iavg min. 150A Main & 90A Booster) (Main PR)	:				*
	136	Peak Inverse Voltage (Main PR)	:	2000	V		
	137	Nominal blocking voltage (Main PR)	:				*
	138		:				
OVERLOAD RELAY	139	Make	:				*
	140	Type	:				*
	141	Applicable standard	:	IS 8488 Part-1			
	142	Built in Single Phasing Prot. available (Y/N)	:	Yes			
	143	Change Over Contact required (Y/N)	:	Yes			
	144		:	Applicable			
INDICATING METER	145	Type	:	Digital			
		a) For input AC measurement	:	3.5 Digit			
		b) For output DC measurement	:	3.5 Digit			
	146	Make	:				*
PUSH BUTTONS	147	Make	:				
		a) Element	:				*
		b) Actuator	:				*
	148	Type	:				
		a) ON P.B. (Green)	:	Spring return			
		b) OFF P.B. (Red)	:	Stayput type with mushroom head			

		POLARISATION RECTIFIER PART - II DESIGN DATA SHEET		Code		
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MISC. ITEMS	149	Cubicle Lamp Type	: CFL with acrylic enclosure with door limit switch			
	150	Space Heater	: Thermostat controlled			
	151	Terminal Block	: Clip-on Type			
	152	Indication Lamp	: Chip LED Type			
	153	Power terminals	: Suitable for Bolted type connection.			
		Min. space required between terminals and bottom plate	: 300mm (min.) clear			
PAINTING	154	Type of painting process	: 7 tanks process for surface preparation			
	155	Primer	: 2 coats of epoxy based primer			
	156	Final paint	: 2 coats of epoxy based finish paint, powder coating			
	157	Final paint shade	: RAL 7032			
	158	Minimum thickness of paint	: 60 microns			
MAKE OF COMPONENTS	159	Control card	: *			
	160	Transducers	: Minilec / ABB / Rishabh / Pepperl + FUCHS *			
	161	Annunciator	: Minilec / Piri / Chhabi / AE / Vaishno / Fuji / Digicont *			
	162	Cable glands	: By Purchaser *			
	163	Overload Relay	: Siemens / L&T / Schneider / GE / ABB *			
	164	Semi-Conducting Fuse	: Siemens / L&T / Schneider / GE / ABB *			
	165	Switch	: Kaycee / Siemens / L&T / Areva / Schneider / ABB *			
	166	Fuse	: Siemens / L&T / ABB / Schneider / Mersen (Ferraz) *			
	167	Push Button	: Siemens / L&T / Teknik / Hensel / Vaishno / GE *			
	168	Indicating Lamps	: Teknik / L&T / Siemens / Altos / GE / Vaishno *			
	169	Blocking Diodes	: *			
	170	Capacitor, DC/AC	: DC - Alcon , AC : EPCOS / L and T / ABB / Schneider *			
171	Contactors	: Siemens / L&T / ABB / Schneider *				
DRAWINGS & DOCUMENTS		Description	No of prints with offer	No of prints for approval	No of prints with final/as built	
	172	SLD indicating rating of all components	#	#	##	
	173	G A & foundation drawings indicating Loading details,panel dimensions,foundation details & front & rear clearances required	#	#	##	
	174	List of components & complete bill of material	#	#	##	
	175	Wiring diagrams with descriptive write up	-	#	##	
	176	Transformer, Thyristor and I2t (for HRC fuses) sizing calculation	#	-	-	
	175	Installation,operation and maintenance manual	-	-	##	
	176	Type test & routine test certificates for similar equipments manufactured at works.	#	#	##	
	177	Type test certificates for bought out items.	-	#	##	
	178	List of recommended spares.	#	#	-	
	179	Quality Assurance plan (QAP)	-	-	-	
	180	Bar chart indicating manufacturing schedule.	#	-	-	
181						
182	# : 1 No. of Hard Copy + 1No. Of Soft Copy					
183	## : 5 Nos. Hard copies + 1 Soft copy to Client and 1 No.of Hard copy + 1 Soft copy to tkIS-India					
184	Notes :					
	1) Data marked as '*' thus to be furnished by vendor.					
	2) Routine test & type test certificates for all bought out items to be furnished by the vendor during inspection & as final documents.					
	3) Catalogues for all bought out items indicating all technical details.					
	4) Soft copies shall be given with final documents for all drawings.					
	5) For data as marked '**' thus ,data to be given by purchaser after placement of order.					
	6) Construction of both Pol. Rectifiers shall be identical except common circuitry / components to be installed in Pol. Rectifier -A panel.					
	7) Bleeder resistor shall cut off the bleeder when the load current is > 10 % and cut in when the load current is < 10% of rated current.					
	8) All CTs shall be cast Resin type only.					



Plant CAUSTIC SODA	Client Punjab Alkali	Contract Code PACL	Document ID 0215-ELT-11-EC-0007	Contract No. 66-0215	
	NOTES ON METHOD OF OFFER SUBMISSION PART – III A				
				Rev	00

1. Offer shall be submitted in two parts, Technical part and Price part.
2. Technical part shall consist of following:
 - a) Copy of Part-I of this specification with acceptance of all clauses to be indicated by letter 'A' on right side of the specification sheet with seal of the company and initial of authorised person.
 - b) Copy of Part-II of this specification duly filled in clearly and legibly in the assigned space against items marked thus '*'.
 - c) Copy of Part-IIIB of this specification with mark-up 'quoted' against each item for which the vendor is making an offer.
 - d) Copy of doc. 'Schematic Wiring Diagram for Polarisation Rectifier', duly stamped and signed.
 - e) Copy of doc. Part-VI, duly stamped and signed, with all the technical deviations clearly mentioned.
 - f) Copy of doc. ANNEXURE-I, duly stamped and signed.
 - g) Copy of doc. ANNEXURE-II, duly stamped and signed.
 - h) Covering letter enclosing above document.
3. Price part shall consist of following:
 - a) Copy of Part-IIIB of this specification with unit rate of each item and total price of each item with total price of the tender document, including supply and various services as specified in this specification.
 - b) Covering letter enclosing above price part and deviation on commercial terms if any.
4. Both the parts of offer shall be submitted in separate sealed envelope indicating details of offer such as Technical or Price part, enquiry no. and date of submission.
5. Offer will be evaluated based on above documents only and any other document enclosed with the offer shall not be considered for evaluation of offer.

Plant CAUSTIC SODA	Client Punjab Alkali	Contract Code PACL	Document ID 0215-ELT-11-EC-0007	Contract No. 66-0215	
	SCOPE OF SUPPLY & SCHEDULE OF PRICES PART – III B				
				Rev	00



EQUIPMENT & SERVICES TO BE FURNISHED UNDER THIS SPECIFICATION

Sr. No.	Description	Quantity	Unit Rate	Total
1.	Design, Engineering, Manufacturing, Inspection, Testing, Packing, Forwarding, Transportation, Supply with commissioning spares & other necessary accessories, cabling, wiring etc. which are part of the equipment in accordance with Specification a) Dual Redundant Polarisation Rectifiers [50 Amps, 300 Volts DC]	06 Sets		
2.	Recommended spares for two years trouble-free operation. (Refer the list below)	1 Lot		
3.	Commissioning Spares Commissioning spares as required shall be provided by vendor.	As per requirement	Incl. in basic price (Sr. No. 1 above)	
4. a)	For Site Work: Services of a senior engineer to supervise the erection, testing and commissioning at site (Two visits for four days each – One before start-up & another during start-up of Electrolyser) for all equipment supplied by the vendor.	Lumpsum/ per diem rate		
b)	Services of a senior engineer for additional visits if required.	Per diem	UR	
5.	Testing & Inspection Tests as specified in Part-V of this specification shall be performed in presence of purchaser's representative, if so desired by the purchaser. Extra cost for any of the tests shall be quoted indicating the tests reference item no. and description as per Part-V of this specification.	Lumpsum	Included	
i.	Routine tests		Incl. in basic price	(Sr. No. 1 above)
ii.	Type tests			
	a. Heat run test shall be performed at vendor workshop			
iii.	Special tests (If any, Vendor to indicate)			
iv.	Site Acceptance testing			
TOTAL PRICE OF THIS TENDER INCLUDING ALL ABOVE ITEMS.			Rs.	

Plant CAUSTIC SODA	Client Punjab Alkali	Contract Code PACL	Document ID 0215-ELT-11-EC-0007	Contract No. 66-0215	
	SCOPE OF SUPPLY & SCHEDULE OF PRICES PART – III B				
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List of Recommended Spares for 2 years Trouble Free Operation



Description	Unit	Qty.	Unit Rate in Rs.
AC Input HRC fuse links for switch fuse unit	Nos.	09	
DC Output HRC fuse links	Nos.	06	
Control fuse links	Nos.	15	
Blocking diodes	Nos.	04	
Filter Condenser	Nos.	10	
SCR Controlled Card	Nos.	02	
SCR elements	Nos.	06	
Indicating lamps	Nos.	10	
Semi-conductor fuses	Nos.	09	
Potentiometer	Nos.	03	

Plant CAUSTIC SODA	Client Punjab Alkali	Contract Code PACL	Document ID 0215-ELT-11-EC-0007	Contract No. 66-0215	
	LIST OF DRAWINGS & DOCUMENTS ENCLOSED PART – IV				
				Rev	00

Following are the list of documents to be enclosed:

Sr. No.	Drawing / Document No.	Size	No. of Sheets	Description
1	0215-ELT-11-EC-0007_A	A3	4	Schematic Wiring Diagram for Main

		POLARISATION RECTIFIER PART - V INSPECTION TEST PLAN				Code		PACL	
						Contract no.		66-0215	
						Doc.		0215-ELT-11-EC-0007	
						Rev.		0	
	Tests	Reference documents	Sample size	Scope of Inspection					
				Vendor	Client / TKIS / Third Party	Remark			
I	Type Tests								
i	Temperature rise test (without cooling fan)	-	One of each type	P	W				
ii	Degree of protection	-		P	R				
II	Routine Tests								
i.	Visual check including layout, Tag plates, Paint shade, bus marking, identification & location of components etc.	GA drawings, Vendor documents	100%	P	W	#			
ii	Dimension check	GA drawings		P	W	#			
iii	No load test for the range of output	-		P	W				
iv	Insulation Resistance test	IS/IEC 60947		P	W				
v	High Voltage test at 2kV for 1 min	IS/IEC 60947		P	W	#			
vi	Load test for the range of input / output	Order specification & Vendor dwg.		P	W				
vii	Operational & functional test	Order specification & Vendor dwg.		P	W				
viii	Efficiency test at rated output.	Order specification & Vendor dwg.		P	W	#			
ix	Ripple content measurement in output voltage (individual / combined)	Order specification & Vendor dwg.		P	W	#			
x	Single Phasing Operation test	Order specification & Vendor dwg.		P	W				
xi	Current limit test	Order specification & Vendor dwg.		P	W				
xii	Short circuit (dynamic) test during full load operation	Order specification & Vendor dwg.		P	W				
xiii	Parallel operation, current sharing and load changeover test	Order specification & Vendor dwg.		P	W				
xiv	Open circuit / sudden load throw-off test.(individual / combined)	Order specification & Vendor dwg.		P	W				
xv	Power failure /Auto power walk-in test.	Order specification & Vendor dwg.		P	W				
xvi	Functional checking of transducers	Order specification & Vendor dwg.		P	W				
xvii	Verification of various protections / alarms & indications by circuit simulations from local and remote	Order specification & Vendor dwg.		P	W				
xviii	Current regulation test Time to attain full load (individual / combined)	Order specification & Vendor dwg.		P	W				
xix	Audible noise test	Order specification		P	W	#			
xx	Harmonic measurement (at full load, No load, 6 Pulse,12 pulse) with and without filter bank.	Order specification		P	W	#			
xxi	Testing of Plarisation rectifier under ripple condition (with external ripple source)	Order specification		P	W	#			
III	Testing at site								
All above routine tests except tests marked as # , shall be carried out at site before final commissioning as per attached site testing format (Annexure - I).									
Load shall be arranged by purchaser.									
Notes:									
1) W = Witness, R = Review, P = Perform.									

Plant CAUSTIC SODA	Client Punjab Alkali	Contract Code PACL	Document ID 0215-ELT-11-EC-0007	Contract No. 66-0215
	COMPLIANCE DECLARATION PART - VI			
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Compliance Declaration

Please note that vendor shall indicate his replies to the following points without which the offer shall be liable for rejection.

Deviations if any from this specification shall be listed in the enclosed format (List of Deviations) indicating the applicable specification clause. The vendor will be made liable for full compliance with the specification requirements, if deviations are not listed in "List of Deviations" as it will be deemed as "No deviation".

SR.N	DESCRIPTION	EXPECTED REPLY	CONFIRMATION BY VENDOR	REMARKS
0				
1.	Confirm that all deviations against this specifications are consolidated under "List of Deviations". Deviations mentioned elsewhere will not be taken into consideration.	No Deviation		
2.	Confirm that there is no discrepancy in the technical details outlined in the specification and the technical bid data.	No Discrepancy		
3.	Relevant Catalogues/ literature giving specifications for all models offered including sizing data is enclosed with the offer.	Yes		
4.	Relevant Catalogues/ specifications of all bought out items are enclosed with the offer.	Yes		
5.	Quoted for "Spare parts recommended for 2 years continuous trouble-free operation" along with listing	Quoted		
6.	Quoted and offered recommended Commissioning spares along with listing	Quoted		
7.	Quoted for "Mandatory spares"	Quoted		




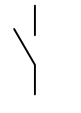


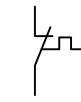





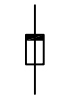





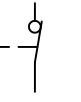












(Signature of Vendor)

Name:

Designation :

Date :

(Company Seal)

1	2	3	4	5	6	7	8
A		CONTACTOR		VOLTAGE TRANSDUCER (4-20mA OUTPUT)		DIODE	<p>NOTES :</p> <p>1. THIS SCHEMATIC SHALL BE REFERED ONLY FOR ESTIMATION OF BILL OF MATERIAL AND UNDERSTANDING THE OVERALL OPERATION OF POLARISATION RECTIFIER SYSTEM. VENDOR SHALL DEVELOP DETAILED SCHEMATIC DRAWING & EXACT BILL OF MATERIAL SHALL BE BASED THE FINAL SCHEMATIC DRAWING.</p> <p>2. ALL ANNUNCIATION/INDICATION CONTACTS FOR REMOTE DCS SHALL BE POTENTIAL FREE.</p> <p>3. THIS SCHEME IS FOR DUAL REDUNDANT POLARISATION RECTIFIER SYSTEM AND SINGLE BOOSTER POLARISATION RECTIFIER SYSTEM.</p> <p>4. COMMON ITEMS SUCH AS VOLTAGE/CURRENT TRANSDUCER,OUTPUT SHUNT, DC OUTPUT TB, ETC. SHALL BE INSTALLED IN POLARISATION RECTIFIER PANEL-A ONLY.</p>
B		SWITCH		CURRENT TRANSDUCER (4-20mA OUTPUT)		TIMER	
		NC CONTACT OF SELF OPERATING THERMAL SWITCH (BREAK CONTACT)		D.C.		OVERLOAD RELAY	
		OPERATING DEVICE (NORMAL CONTACTOR COIL)		A.C.		EARTH	
C		FUSE WITH SUPPLY SIDE INDICATED BY THICK LINE		DC CAPACITOR		CURRENT TRANSFORMER	
		AC CAPACITOR		INDICATING LAMP		CURRENT TRANSFORMER	
		MANUALLY OPERATED SWITCH (STAYPUT TYPE) WITHOUT SPRING RETURN, BREAK CONTACT		SHUNT		SERIES REACTOR / DC LINK INDUCTOR	
D		AMMETER		LINK		RESISTANCE	
		VOLTMETER		THYRISTOR		TERMINALS IN REMOTE DCS OR ISOLATOR	
		AMMETER SELECTOR SWITCH		CONTROL TRANSFORMER		TERMINALS IN POLARISATION RECTIFIER	
E		VOLTMETER SELECTOR SWITCH					

UHL_BO_ISO_A3_L_E_TKISIndia.dwg / AG03_UHL_BO_ISO_A3_L.dwg / 10.10.2014

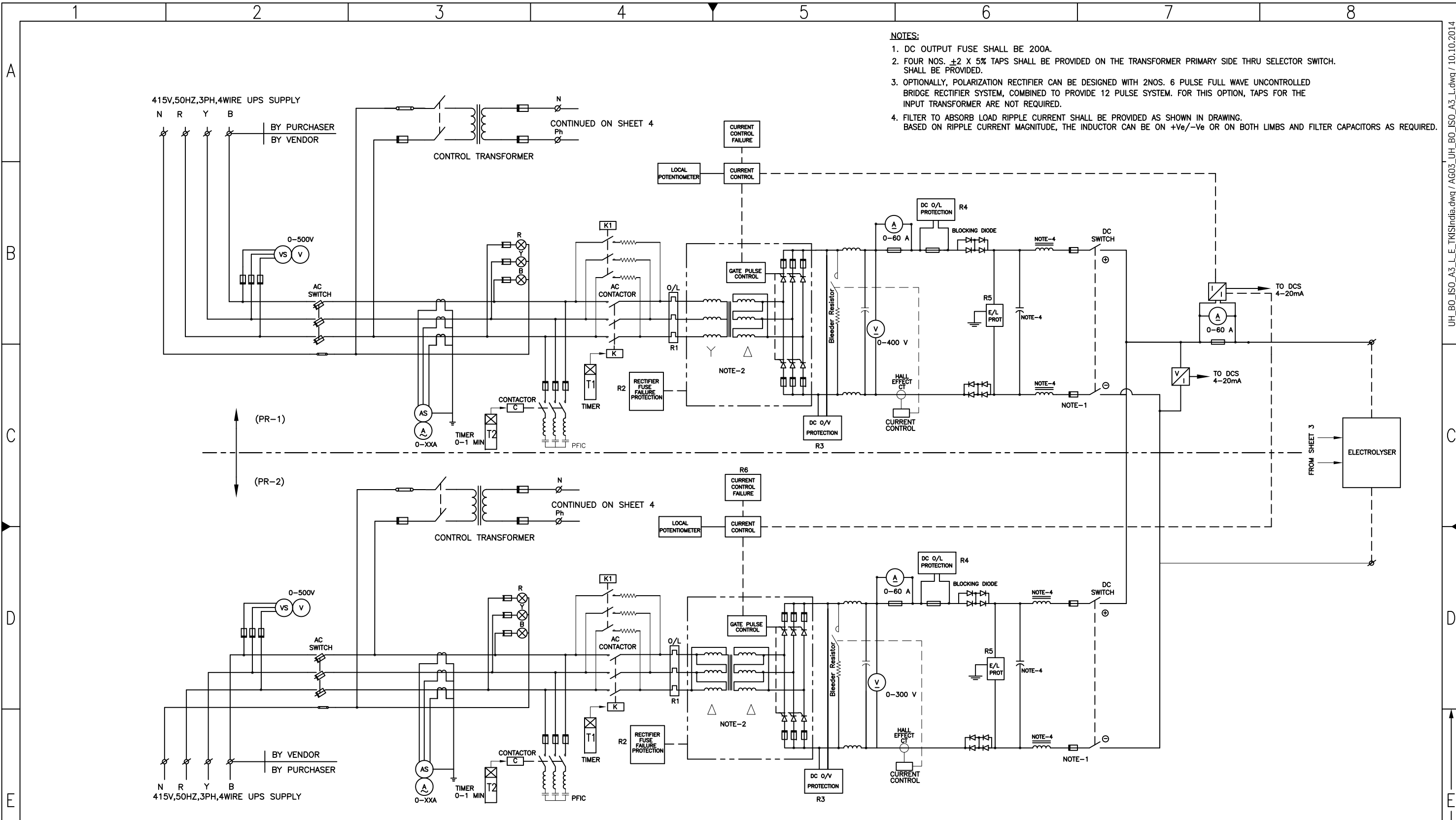
C

D

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BAR-Code		00	05.12.2018	HBC	HBC	05.12.2018	RBU	05.12.2018	CMB	For Enquiry	-	Contract No.	Code	Part	Rev.	<p>ThyssenKrupp Industrial Solutions (India)</p> <p><small>© Copyright 2015. All rights reserved. ThyssenKrupp Industrial Solutions (India) Private Limited</small></p> <p>SCHEMATIC DIAGRAM FOR DUAL REDUNDANT MAIN POLARISATION RECTIFIER AND SINGLE BOOSTER POLARISATION RECTIFIER SYSTEM</p>
Rev.	Date	Name	Date	Name	Date	Name	Description	Acc. Code	Contract No.	Document ID	Part	Rev.	00			
Pro. Unit	TON	Group	Cat. Code	Acc. Code	Status	Date	Name									
Con. Unit	Type of Document	Order No.	Scale	Sheet	1 / 3	Drawn	05.12.2018	HBC								
						Prepared	05.12.2018	HBC								
						Checked	05.12.2018	RBU								
						Approved	05.12.2018	CMB								
Store Location: Server/Share		Store Location: Folder		Store Name												
1	2	3	4	5	6	7	8									



- NOTES:**
- DC OUTPUT FUSE SHALL BE 200A.
 - FOUR NOS. $\pm 2 \times 5\%$ TAPS SHALL BE PROVIDED ON THE TRANSFORMER PRIMARY SIDE THRU SELECTOR SWITCH. SHALL BE PROVIDED.
 - OPTIONALLY, POLARIZATION RECTIFIER CAN BE DESIGNED WITH 2NOS. 6 PULSE FULL WAVE UNCONTROLLED BRIDGE RECTIFIER SYSTEM, COMBINED TO PROVIDE 12 PULSE SYSTEM. FOR THIS OPTION, TAPS FOR THE INPUT TRANSFORMER ARE NOT REQUIRED.
 - FILTER TO ABSORB LOAD RIPPLE CURRENT SHALL BE PROVIDED AS SHOWN IN DRAWING. BASED ON RIPPLE CURRENT MAGNITUDE, THE INDUCTOR CAN BE ON $+V_e/-V_e$ OR ON BOTH LIMBS AND FILTER CAPACITORS AS REQUIRED.

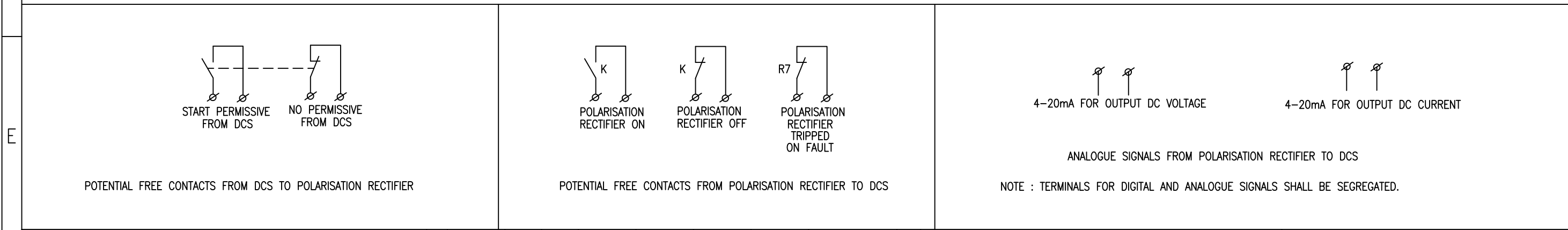
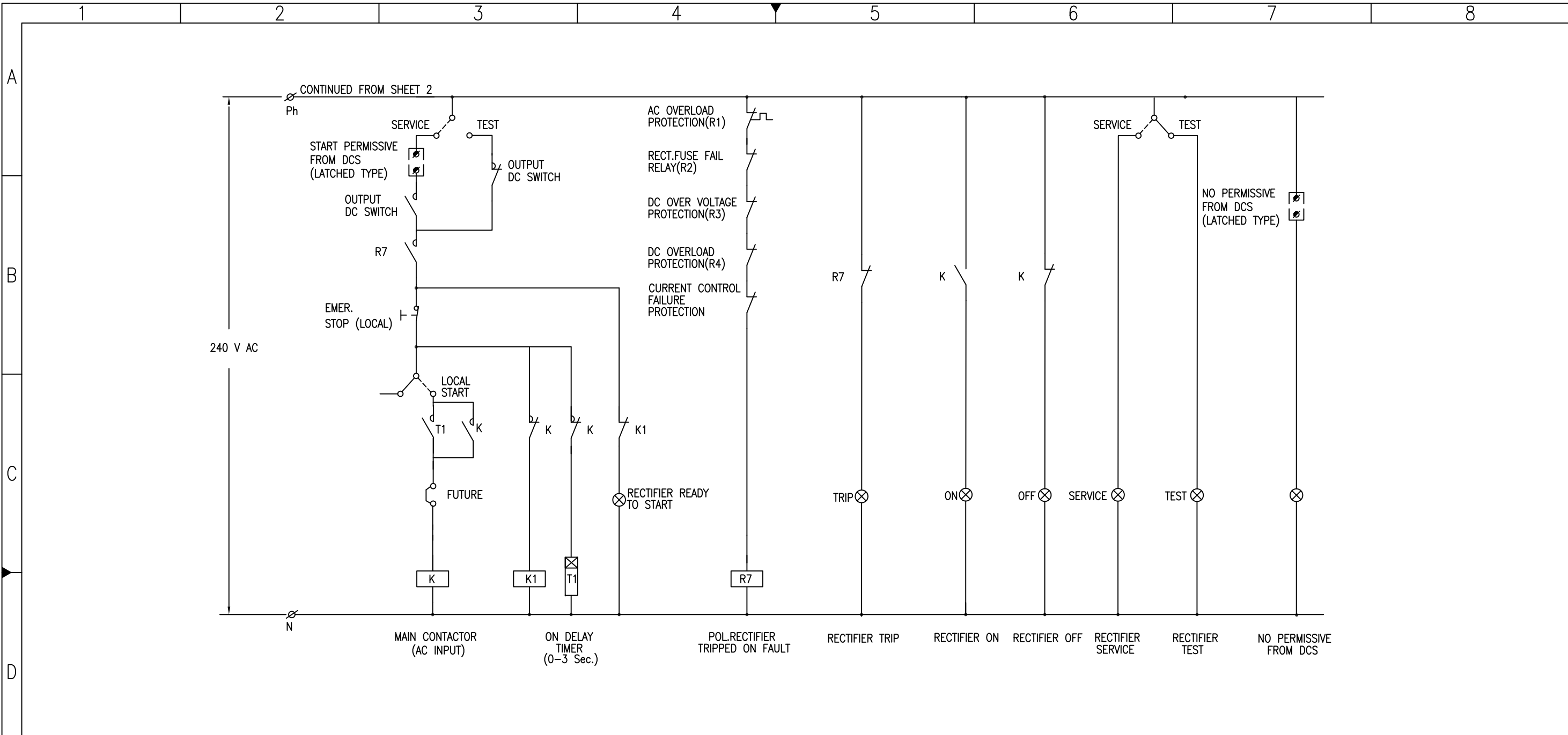
MAIN POLARISATION RECTIFIER SYSTEM

BAR-Code		00	05.12.2018	HBC	HBC	05.12.2018	RBU	05.12.2018	CMB	For Enquiry	-	Code		Contract No.		Document ID		Part	Rev.	ThyssenKrupp Industrial Solutions (India)	
		Rev.	Date	Name	Name	Date	Date	Date	Name	Description	Acc. Code	66-0215		0215-ELT-11-EC-0007_A				00	Description		
		Pro. Unit	TON		Group	Cat. Code	Acc. Code	Status			Date	Name								SCHEMATIC DIAGRAM FOR DUAL REDUNDANT MAIN POLARISATION RECTIFIER AND SINGLE BOOSTER POLARISATION RECTIFIER SYSTEM	
		Con. Unit	Type of Document	Order No.	Scale	Sheet	2 / 3		Drawn	05.12.2018	HBC										
		Store Location: Server/Share		Store Location: Folder		Store Name		Checked	05.12.2018	RBU											
								Approved	05.12.2018	CMB											

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BAR-Code		00	05.12.2018	HBC	HBC	05.12.2018	RBU	05.12.2018	CMB	For Enquiry	-	Contract No.	Code	Part	Rev.	ThyssenKrupp Industrial Solutions (India) <small>© Copyright 2015. All rights reserved. ThyssenKrupp Industrial Solutions (India) Private Limited</small>	
Rev.	Date	Name Drawn/Prepared		Date	Name Checked		Date		Name Approved		Description	Acc. Code	66-0215	Document ID			0215-ELT-11-EC-0007_A
Pro. Unit	TON			Group	Cat. Code	Acc. Code	Status	Date	Name								
Con. Unit	Type of Document	Order No.		Scale	Sheet		3 / 3		Drawn	05.12.2018	HBC						
Store Location: Server/Share		Store Location: Folder		Store Name				Prepared	05.12.2018	HBC							
								Checked	05.12.2018	RBU							
								Approved	05.12.2018	CMB							

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