Tender

Documents

For

Procurement of 2 NOs. RECTIFIERS

pacl

PUNJAB ALKALIES & CHEMICALS LIMITED

SCO 125-127, SECTOR 17-B,
CHANDIGARH – 160 017

Email: mpsrana@punjabalkalies.com

1. Brief Profile

PUNJAB ALKALIES & CHEMICALS LIMITED ("PACL" or "the Company") is a Public Limited Company formed under the Companies Act, 1956. It was promoted by the Punjab State Industrial Development Corporation Limited (PSIDC), a wholly owned Punjab Government Company. The Company's registered office is located at Chandigarh.

PACL is one of the largest manufacturers of caustic soda (NaoH) in the Northern part of India with an installed capacity of 99000 Tons Per Annum (TPA). The Company is engaged in the manufacture and sale of Caustic Soda (Lye & Flakes), Liquid Chlorine, Hydrochloric Acid, Sodium Hypochlorite and Hydrogen Gas. The Company's plant is located at Naya Nangal, District Ropar, Punjab.

PACL has two manufacturing units viz. Unit-I & II, both located at Nangal-Una Road, Naya Nangal, District, Ropar, Punjab. Both the Units are engaged in manufacture of Caustic Soda, Liquid Chlorine, Hydrochloric Acid and other products such as Sodium Hypochlorite and Hydrogen. Unit –I & II have a capacity of 100 TPD and 200 TPD respectively. Both these units are co-located at the same site, Unit – I & II are spread over an area of Approximately 88.86 acres.

2. General Instructions

Punjab Alkalies & Chemicals Limited invites bids for procurement 2 (Two) Nos., Low Current, High Efficiency, 11KV/450V, 45 KA, Thyristor type DC Rectifier to replace the existing 3 (Three) Nos. 11KV/110 V, 90KA DC Diode Rectifier, to be installed in Unit-II of its Caustic Soda Membrane Cells Technology Plant as set forth in the accompany tender documents.

Punjab Alkalies & Chemicals Limited, hereinafter called "PACL/Purchaser" will receive bids for procurement 2 (Two) Nos., Low Current, High Efficiency, 11KV/450V, 45 KA, Thyristor type DC Rectifier to replace the existing 3 (Three) Nos. 11KV/110 V, 90KA DC Diode Rectifier, to be installed in Unit-II of its Caustic Soda Membrane Cells Technology Plant as set forth in the accompany tender documents. All bids shall be prepared and submitted with these instructions.

Bids received after due date and time for receipt of bids, as set out in the tender documents, are liable to be rejected.

PACL reserve the right to itself to accept any bid or reject any bid or all bids or cancel/withdraw "Tender Notice" at any time without assigning any reason for

such decision. Such decision by PACL shall not be subject to question by any bidder and PACL shall not bear any liability of any kind whatsoever, consequent upon such a decision.

All the costs and expenses incurred by bidder for preparation of bids, technical/commercial discussions if any, in the PACL's office shall be to the account of bidders and PACL shall not bear any liability whatsoever of such costs and expenses.

3. Technical Specifications:

The technical specification for supply of Rectifier Transformer Unit is enclosed at Annexure 'A'.

4. Qualifying requirements of bidders.

The bidder should be a firm or a company or a manufacturing company or a consortium of firms to companies to who alone or as a joint venture have supplied its Rectifier to Caustic Soda Plant of similar or higher capacity for the similar application. The quoted Rectifier shall be designed to give maximum efficiency in converting AC into DC and shall be in commercial use for last minimum 10 years.

In addition to the above, bidder shall provide satisfactory proof concerning the following that he or his consortium members:

a. Has adequate financial stability and status to meet the financial obligations pursuant to the work covered under in the Tender Document.

b. Has adequate capacity and capability to complete the supply of Rectifier properly and expeditiously within the time period specified.

c. Has established quality assurance system.

All the bidders are also requested to confirm the following points:

1. Are they UHDE approved Manufacturers?

2. List of Caustic Soda manufactures in India where the bidder has supplied the quoted Rectifiers.

The above stated requirements are minimum. However, PACL reserve the right to ask for any additional information and also reserves the right to reject the proposal of any bidder, if in the opinion of PACL, the qualification date provided by the bidder is not complete/ satisfying or the bidder is not qualified.

Notwithstanding anything stated above, PACL reserves the right to assess bidder's capability and capacity to perform the work and may relax the qualifying requirement in overall interest of PACL.

5. Submission of Bids:

The bid document is available online on our website (www.punjabalkalies.com) which can be downloaded by the interested bidders.

All the bidders shall quote price for supply of Thyristor Rectifier and Rectifier Transformer separately. PACL shall have right to segregate the order for supply of Thyristor Rectifier and Rectifier Transformer.

Bids shall be received at PACL, Chandigarh Office in the following manner:

The bid shall be submitted in two parts in two separate sealed Envelopes name as below:

Envelope–1: Shall contain Technical Bid complete in all respect including qualifying data for qualifying works, Technical proposal and Bid guarantee and commercial terms and conditions with caption **"Technical Bid"**

Envelope–2: Shall contain Price Bid and marked **"Price Bid"**

Both the Envelopes 1 & 2 should be put in the third envelope with caption **"separate sealed Envelopes of Technical Bid" and Price BID"**

Any bid not accompany with EMD may be rejected by PACL.

The outside of the all the envelopes should also indicate clearly the name of bidder and address.

The bid document complete in all respects should reach in the office of PACL at the address given below before the closing time for submission of bids to the following address on or before the last date of submission:

EXECUTIVE DIRECTOR (MATERIALS & FINANCE)
PUNJAB ALKALIES & CHEMICALS LIMITED
SCO 125-127, SECTOR 17-B,
CHANDIGARH – 160 017

Both Part I and Part II of the tender will not be opened in the presence of the bidders.

The bidders have the option of sending the bid by courier/ registered post or submitting the bid in person, so as to ensure that the bids are received in the specified office of the purchaser, by the date and time indicated in the tender documents. Bids submitted by Fax/ telegram will not be accepted.

If any Bidder needs any clarification/additional information in respect of this Tender, then the same shall be submitted in writing/fax/email to the personnel of PACL mentioned above. The envelopes/ communication shall clearly bear the following identification/ title "Request for Clarification/ Additional Information required for submitting tender for recoating of Anodes". The requests for clarification should be sent before the date specified in the time schedule given in this Tender. PACL shall not respond to any request for clarification received beyond the date so specified. The bidder requiring any clarification on the Tender RFP document may notify PACL in writing, either by post or email, at the following address:

EXECUTIVE DIRECTOR (MATERIALS & FINANCE)
PUNJAB ALKALIES & CHEMICALS LIMITED
SCO 125-127, SECTOR 17-B,
CHANDIGARH – 160 017

Email: mpsrana@punjabalkalies.com

Telephone: 0172 – 4072566/4072567

Fax: 0172 – 2704797

The Bid and all related correspondence and documents should be written in the English language. Supporting documents and printed literature furnished by Bidder with the Bid should also be written in English language only. The original Bid and the supporting materials, which are not written in English, will not be considered by PACL.

6. Last date for Submission of Bid.

Bidders should submit their bid within 16 days from the date of publication of the tender notice i.e. upto 1700 hours IST on the 26th February,2018 at the specified address in the manner as mentioned in the tender documents.

7. Guarantee Clause:

The Bidder shall guarantee that the equipment offered shall meet the rating and performance requirements stipulated in the specifications.

The Guarantee parameters shall be without any tolerance values. All margins required for instrument in accuracies and for all other reasons shall be deemed to be included in the guaranteed figures. No tolerance or allowances on test results will be permitted for instrument error or accuracy or any other cause.

The Bidder shall demonstrate all the guarantees covered during performance acceptance test.

In case during test it is found that the equipment has failed to meet the guarantees, the Bidder shall carry out necessary modification or replacement of the equipment to make the equipment comply with the guaranteed requirements at no extra cost to PACL. However, if Bidder is not able to demonstrate the guarantees, even after modifications/replacement within 15 days of notice by PACL, PACL shall have discretion to reject the equipment OR accept the same with penalty as decided by PACL.

No credit will be given if the actual output is greater than the requirement.

8. Validity of Bid.

Bid shall be valid for a period of 90 days from the last date of submission of bid. In exceptional circumstances, PACL may request Bidders to extend the Validity Period of the bid for a specified additional period, which shall not exceed 180 days. The request and the responses thereto shall be made in writing by post or email.

9. ARBITRATION

In all cases of dispute or disagreement between the parties hereto as to any matter arising out of or relating to this Purchase Order/Work Order whether such dispute or disagreement shall arise during the continuance of this Purchase Order/Work Order regarding interpretation of this Purchase Order/Work Order or any clause or clauses thereof or upon or after the termination hereof and provided no understanding between the parties can be reached for the settlement of the difference such dispute or difference shall be referred to the sole arbitration of the Managing Director of Punjab Alkalies & Chemicals Limited or any other officer appointed by him on his behalf, in accordance with the provisions of Arbitration and Conciliation Act 1996 or any Statutory modifications or substitute thereof and all the provisions of that Act, so far

as are applicable or of any of them for the time being in force shall apply to every reference hereunder.

The award given by such Arbitrator shall be final, conclusive and binding upon the parties to this Purchase Order/Work Order. The Arbitrator may from time to time, with the consent of parties, enlarge the time for making or publishing the award. The arbitration proceedings shall be held at Chandigarh.

Notwithstanding any pending reference to arbitration both parties shall proceed with the execution of their commitments, under the Work Order until the arbitration award is known unless the question of such continuance is a subject matter of such proceedings.

10 LAW & ITS JURISDICTION

You shall be governed by the laws of Government of India in force from time to time and shall be deemed to have been concluded in the Union Territory of Chandigarh. All suits and proceedings shall be subject to jurisdiction of the courts at Chandigarh only.

11 JURISDICTION

All disputes whatsoever that may arise between parties out or in connection with this contract shall always be deemed to have risen in Chandigarh and only Chandigarh Court will have jurisdiction of entertain them.

The Broad scope of supply for 2 X 45 KA, 450 V DC 12 P Thyristor Rectifier System is as below:

S. No.	Description	quantity	Unit Price	Total Price
1.	Thyristor Rectifier, 45kA*450 Vdc, 12 pulse, Bridge configuration Water Cooled 100% online standby for DM water pump and heat Exchanger.	2 Nos.		
2.	Rectifier Transformer, Suitable for 45kA x 450Vdc, bridge configuration.	2 Nos.		
3.	Rectifier Cooling System for cooling the Rectifier.	2 Nos.		
4.	Rectifier Local Control panel for the Rectifier System	2 Nos.		
5.	Cu flexible for connection from Rectifier Transformer Secondary Terminals to Rectifier AC Terminals for Interconnection between the Transformer and Rectifier.	2 Sets		
6.	Interconnecting cables between equipment supplied and OFC cable for Interconnection between Rectifier components/ units supplied, Termination, commissioning & testing of Optical Fiber Cable (if any)	2 Sets.		
7.	Earth Fault Monitoring system	2 Nos.		
8.	Voltage & Current Display Units.	4 Nos.		
9.	PFIC (Harmonic Correction Filter) for achieving target power factor of 0.99.	1 Set		
10.	Rectifier ACDB.	2 Nos.		
11.	DC current Measuring System for measuring the actual current flowing in the DC bus bar.	2 Nos.		
12.	2 years recommended Spares required for 2 yrs operation. (Optional)	1 Lot		

Any other equipment/ system which has not been mentioned above but required to complete the Rectifier Transformer system shall deemed to be included in the scope of supplies.

PUNJAB ALKALIES & CHEMICALS LIMITED

SPECIFICATION FOR RECTIFIER TRANSFORMER UNIT FOR CAUSUTIC SODA PLANT

	Project	:	Caustic Soda Plant
	Designation	:	Rectifier Transformer Unit
	Equipment No.	:	-
	Quantity	:	2 Units
	Supplier	:	-
1.0	This Specification consists of the following pages		

Page No.	Description	Date of Revision			
		1	2	3	4
1	Index	09.02.18			
2	Design Data	"			
2 – 3	List of Equipments & Items	"			
3 – 10	Equipment Specification	"			
10-11	Make of Components	"			
12	Scope of Supply, Exclusions, Painting, Guarantee	"			
12	Documents to be submitted	"			

1.0	GENERAL DATA :		
	Location	:	Nangal, Punjab, India
	Ambient Temperature	:	4 deg C (Min), 38 deg C (Avg), 48 deg C (Max)
	Relative Humidity	:	30% (Avg), 95% (Max)
	Design Barometric Pressure	:	Max-970 mbs, Min. 940MBs
	Wind Velocity (10 m above ground)	:	113km/hours Design wind velocity as per IS875
	Altitude above Mean Seal Level	:	6.5 meter above MSL
	Power Supply to Transformer & PFIC Banks	:	A.C.; 3 Phase, 11 KV ± 5%, 50 Hz ± 1%
	Control Supply for 11 KV Power Supply.	:	110 V DC
2.0	SCOPE		
	This Specification covers Design, Manufacturing, Testing, and Commissioning of the Equipment and components of D.C. Rectifier system, for D.C. Power Supply to the Electrolysis of a Electrochemical Plant. D.C. Rectifier System shall comply with all currently applicable Standards.		
3.0	SYSTEM DESCRIPTION	:	
	The Rectifier System shall consist of Rectifier Transformer, Rectifier Cubicle and its Cooling System, Rectifier Control Panel, D.C. Measuring System, A.C/D.C Distribution Board, Copper Bus Bars and Copper Flexibles.		
4.0	Design Data		
	Name	:	Rectifier Transformer Unit
	Application	:	To supply D.C. Power to Caustic Soda Electrolyzer
	Equipment No.	:	
	Quantity Required	:	2 Units (Each connected in parallel to tantalizer bus bar before electrolyzers)
	Location of Rectifier Unit	:	Indoor
	Location of Harmonic Filter	:	Outdoor
	Type of Rectifier	:	12 Pulse Thyristor Rectifier
	DC Power Output from Rectifier	:	330 to 450 Volts and 0 to 45 KA
	Operation	:	24 hours (continuous)
	DC Power maximum ripple	:	3% RMS at Rated Condition
5.0	List of Equipment & Items for each unit	:	
5.1	Transformer, Power Supply to Transformer: A.C.; 3 Phase, 11 KV ± 5%, 50 Hz + 1%.	:	One No.
5.2	12 Pulse Thyristor Rectifier with n-1 configuration (To supply D.C. Power @ 450 Volts & 45 KA)	:	One No.
5.3	PLC Based Control Panel for the Rectifier – Transformer with digital controller.	:	One No.
5.4	DM Water Circulation Unit for Cooling Thyristors (consisting of Two Plate type Heat Exchangers and Two Nos. DM Water Circulation Pumps)	:	One No.
5.5	DM Water Expansion Tank with mixed base MBSR Resin Cartridge Deionization Unit	:	One No.
5.6	Power Factor Improvement Harmonic Filter Banks Power Supply to PFIC Banks: A.C.; 3 Phase, 11 KV ± 5%, 50 Hz ± 1%	:	One Unit **(Indoor)**

5.7	DC CT (Make: DynAmp – USA). with DC KWH meter. Accuracy of Measurement– 0.25% Current / Signal Output: 0 – 45 KA / 4 – 20 mA Maximum allowable burden of output circuit: 15 V DC. (To measure the Output Current from the Rectifier. Indication shall be at the Rectifier Control Panel)	:	One No.
5.8	AC Bus Bar between Transformer & Rectifier using Electrolytic Copper and including Flexibles Shall be designed for a Current Density of 1 A/mm^2.	:	One Set
5.9	Interconnecting cabling between equipment supplied by vendor	:	One Set
5.10	AC DC Distribution Board where the 415 V Three Phase AC and 110 V DC supplied by client will be terminated in the respective incoming feeders. Subsequent cabling from outgoing feeders for 415 V Three Phase AC, 230 V Single Phase AC and 110 V DC to consumers will be in vendor's responsibility.	:	One No.
5.11	Foundation Bolts for all units supplied by vendor	:	One Set
5.12	Spares for 10 years of trouble free operation	:	One Set

6.0	EQUIPMENT SPECIFICATION	:	
6.1	TRANFORMER	:	
	Design Standard	:	The Transformer shall be designed for Electrochemical Duty as per IEC 60076 and IEC 61378
	Power Supply to Transformer	:	A.C.; 3 Phase, 11 KV ± 5%, 50Hz ± 1% The size of incoming Aluminium cable will be 3 X 300 Sq.mm
	Location of Transformer	:	Indoor
	Vacuum Circuit Breaker for Transformer Incoming Supply	:	11 KV VCB with Digital Relay Protection and Metering Facility will be provided by Client.
	Fault Level in the 11 KV Line	:	** MVA
	Off Load Tap Changer	:	** No of positions
	Primary Side Voltage	:	A.C.; 3 Phase, 11 KV ± 5%, 50 Hz ± 1%
	Primary Side Current	:	** Amps
	Primary KVA	:	** KVA
	Secondary KVA	:	** KVA
	Connection Primary	:	Delta
	Connection Secondary	:	Delta & Star suitable for Double Bridge
	Vector Group	:	** (Shall be different for all the 2 transformers to reduce THD)
	Secondary Voltage	:	** Volts
	Primary Side Windings	:	Copper
	Secondary Side Windings	:	Copper
	Maximum Flux Density	:	1.6 Wb/m^2 at rated voltage.
	Outlet for Secondary Side	:	Side outlet shall be provided from Secondary Side of the Transformer to Rectifier.
			If top outlet is considered, top plate of the Secondary side shall be in SS304 Material.

	COOLING EQUIPMENT		
	Shall include:		
	2 Nos. (1 working + 1 standby) Oil Forced Water Forced (OFWF) Double wall type complete with oil & water pressure gauges, oil & water thermometers, oil & water flow indicators with electric contacts , leakage detectors and Differential pressure gauge b/w oil & raw water for each rectifier cooling system.		
	2 Nos. (1 working + 1 standby) Oil Circulation Pumps		
	2 sets of shut off valves for oil circuit.		
	1 No. Oil Sampling Valve and 1 No. Oil Draining Valve and 1 Set of Valves for Oil Treatment		
	Motor KW of Oil Circulation Pumps	:	** KW
	Cooling Water required for Transformer Unit	:	** m^3/hr
	Cooling Water Pressure	:	3.0 kg/cm^2g
	Cooling Water Supply Temperature	:	33 deg C
	Cooling Water Return Temperature	:	41 deg C
	Accessories required for transformer		
	One No. Oil Conservator for tank complete with filling & draining valves, Air Release Valve.		
	One set of 1 Buchholz type relays double-float gas detector with alarm trip contacts for main transformer tank.		
	One set of thermometer pockets for inlet and outlet oil temperature monitoring		
	One No. Oil Level Indicator with alarm contacts.		
	One No. Silica Gel Dehydrating Breather for Transformer Tank.		
	One No. Tank Pressure Relief Device with alarm contact		
	One Set of wheels bi-directional type for longitudinal and transverse movement.		
	One complete set of LV Bushings for secondary anodic windings		
	One set of Lifting & Jacking Facilities		
	One No. IP65 Main auxiliary terminal box containing auxiliary circuits		
	One No. dial type temperature indicator for top oil temperature with alarm and trip contacts.		
	One No. dial type temperature indicator for winding temperature with alarm and trip contacts.		
	One No. Buchholz Relay with alarm and trip contacts. Buchholz Isolation Valve shall be provided at tank side.		
	Two Nos. CT, ** VA, Class 5P10 for overcurrent protection purpose		
	Two Nos. Earth Terminals for main tank of Transformer.		
	One Set of Lifting Lugs		
	One No. Ladder		
	Oil Required		
	Oil Specification	:	IS – 335 (No external inhibitors are permitted)
	First Fill of Transformer Oil	:	To be supplied by vendor.
		:	Transformer Oil shall be filled upto 50% of conservator and 10% extra oil shall also be supplied.
	Transformer Oil Required	:	** Liters.
	Tests required for Transformer		
	All Routine & Type Tests according to IEC 60076 shall be performed prior to dispatch. This shall include:		
A	Measurement of Winding Resistance		
B	Short Circuit Test		
C	Ratio & Vector Group Test		
D	Overvoltage & Insulation Tests		
E	No Load Test (measurement of Iron Losses)		
F	Calculation of Total Iron & Copper Losses		
G	Induced Source Voltage Test		
H	Separate Source Voltage Test		
I	Measurement of Insulation Resistance		
J	Insulation & Functional Tests of Auxiliary Circuits		
K	Measurement of the power absorbed by motor – pumps, fans and other auxiliary circuits.		

6.2	RECTIFIER		
	Code	:	Shall generally conform to IEC 146-1-1/1973
	Type	:	12 Pulse Thyristor Rectifier with n-1 configuration
	Location of Rectifier	:	Indoor
	Protection Class	:	IP 54
	Method of Control	:	Constant Current Control
	Type of Thyristors	:	Silicon Controlled Rectifier (SCR)
		:	Disc Type Power Thyristors, Double side cooled, mounted on specially extruded Aluminium heatsinks forming a self-supporting Frame work
	No. of Thyristors in parallel per Arm	:	** Nos.
	No. of Phases	:	12
	No. of Thyristors per Group	:	** Nos.
	Total No. of Thyristors	:	** Nos.
	Cooling of Thyristors	:	By circulation of DM Water
	Overvoltage Protection: As a protection against overvoltage, a Varistor Circuit shall be connected at AC Side of Rectifier to protect the Semiconductors from Surge Voltages & Surge Currents. Additionally, Thyristors shall be protected against overvoltage due to hole storage effect by Resistor – Capacitor circuit across each arm.		
	Each fuse used for protecting the Thyristor shall be fitted with a Microswitch and a striker pin for easy identification of faulty fuses.		
	One air conditioning unit shall be provided for the rectifier cubicle panel DM Water Heat Exchanger shall be provided to maintain the temperature of Rectifier Cubicle. Temperature rise in cubicle shall be limited to 15 deg C above Ambient.		
	Capacity of Air Cooling Fan	:	** m^3/hr
	Motor KW of Air Cooling Fan	:	** KW
	Rectifier shall be suitable to prevent inadvertent tripping during voltage fluctuations. Adequate protection shall be provided in the gate control circuit to avoid nuisance trip during voltage dips.		
	Tests required for Rectifier Cubicle		
A	Power losses determination by means of short circuit and no load tests		
B	Light load test		
C	Insulation test of all circuits.		
D	Check of correct operation of auxiliary circuits		
E	Measurement of power absorbed by auxiliary circuits		
F	Visual Inspection		
G	Measurement of Insulation Resistance (without DM Water)		
H	Checking of Protection and indication circuits.		
6.3	DM Water Circulation Unit for Cooling Thyristors		
	Two Nos. Plate Heat Exchangers with SS-316 Plates (one Working and one Standby) are required. Two Nos. DM Water Circulation Pumps (One Working and One standby) are required		
	A deionizer cartridge shall be provided to maintain the DM Water conductivity within prescribed limits (<10 Microsiemens). DM Water Expansion Tank with mixed base MBSR Resin Cartridge Deionization Unit is required.		
	DM Water Flow Rate	:	** m^3/hr
	Make Up DM Water required	:	** Liter
	Frequency of Make up	:	**
	Capacity of DM Water Pump	:	** m^3/hr
	Head of DM Water Pump	:	** mLC
	MOC of DM Water Pump		Casing & Impeller – A743 Gr. CF8M Shaft - – SAE 4140 & Shaft Sleeve – CF8M Shaft Sealing – Mechanical Seal
	Motor KW	:	** KW
	Motor RPM	:	1450

	Plate Heat Exchanger Details	:	
	Make	:	Alfa Laval / Tranter / GEA Ecoflex / Equivalent
	Heat Transfer Area	:	** m^2.
	No. of Plates	:	** Nos.
	DM Water Inlet Temp. to PHE	:	** deg C
	DM Water Outlet Temp	:	** deg C
	Plate Material	:	SS316
	Cooling Water required for cooling DM Water	:	** M^3/ Hour
	Cooling Water Pressure	:	3.0 kg/cm^2g (Normal)
	Cooling Water Supply Temp.	:	33 deg C
	Cooling Water Return Temp.	:	41 deg C
	Piping shall be in such a way that by regulating the valves it is possible to use either of the Heat Exchanger with either of the Pumps. Facility shall be provided for removal of one of the Heat Exchanger (or) Pumps for maintenance, when the Rectifier is working.		
	1 Set of PT100 RTDs for DM Water Inlet, DM Water Outlet, Cooling Water Supply and Cooling Water Return across PHE shall be provided.		
	1 Set of Pressure Gauges for DM Water Inlet, DM Water Outlet, Cooling Water Supply and Cooling Water Return across PHE shall be provided.		
	MOC of Pipes, Valves & Fittings for DM Water Circuit shall be SS316		
	Tests required for Cooling System		
A	Dimensional Check		
B	Hydraulic test at rated pressure		
C	Checking of indicating instruments & meters.		
6.4	Rectifier Breaker Trip	:	
	Transformer Pressure Relief Vent		
	A.C. Over Current. E/f Relays shall be digital with communication facility – Protection Curves are to be matched with the Thyristor and Fuse survival curve.		
6.5	Rectifier Trip & Alarm	:	
A	DM Water Flow Failure, Low – Alarm & Low Low - Trip		
B	Rectifier Cooling Water Flow Failure, Low – Alarm & Low Low - Trip		
C	Transformer Cooling Water Flow Failure, Low – Alarm & Low Low - Trip		
D	Emergency Trip (both at Transformer Location & Plant Control Room).		
E	R-C Snubber		
F	Synchronizing Supply Fail / Under Voltage		
G	Phase Failure / Phase Reversal		
H	Auxiliary Supply failed		
I	Pulse Power Supply failed		
J	Hard Wired Tripped.		
K	Rectifier Cooling Water Supply Temperature High, First Stage: Alarm & Second Stage: Trip		
L	Heat Sink Temperature High		
M	D.C. Isolator Open		
N	Fuse Monitoring Unit with Indication for Individual Thyristor Failure		
O	Capacitor Trip		
P	Cubicle Air Temperature High		
Q	Rectifier Door Open		
R	Transformer OCTC Operated		
S	High & Low Level Switch for DM Water Expansion Tank High – Alarm & Low – Trip with alarm.		
T	DP Switch for differential pressure between DM Water Outlet and Cooling Water Supply across PHE. Low – Alarm & Low Low – Trip.		

6.6	Measurement & Controls for		Transformer	Rectifier
	Rectifier Transformer Unit		AC Overvoltage & Undervoltage	One Thyristor Failed per phase
			Oil Temperature First Stage	Two Thyristors Failed per phase
			Oil Temperature Second Stage	AC Surge Circuit Failure
			Oil Level Low First Stage	DC Bus Bar Temp. High First Stage
			Oil Level Low Second Stage	DC Bus Bar Temp. High Second Stage
			Buchholz Relay First Stage	DM Water Temp. High First Stage
			Buchholz Relay Second Stage	DM Water Temp. High Second Stage
			Oil Pressure High	DM Water Conductivity High
			Oil Flow Failure First Stage	DM Water Pump Failure
			Oil Flow Failure Second Stage	110 V D.C. Control Supply Failure
			Oil Circulation Pump Failure	D.C. Over Current
			Winding Temp. High First Stage	D.C. Over Voltage
			Winding Temp. High Second Stage	D.C. Ground Failure
			Master Trip / Breaker Trip	Rectifier Tripped on Electrical Fault
			415 V AC Auxiliary Supply Failure.	Rectifier Tripped on Process Fault
			110 V AC Synchronizing Supply Failure.	
			A.C. Over Current	
			A.C. Earth Fault	

6.7	PLC Based Rectifier Control Panel for Rectifier Transformer Unit		
	Location of Rectifier Control Panel	:	Indoor
	PLC Make	:	Allen Bradly / Siemens / ABB/800 PEC Controller/Equivalent
	Type of Protection	:	IP 54
	Interfacing with main DCS		PLC shall have provision for PC Interface and necessary adopters and Cables shall be provided for uploading/ downloading the Programs
	Source Code	:	Source Code (for Licensed Programming and Communication Software) shall be provided by the Vendor.
	Parameters required	:	DC Parameters like kAh, KW and KWH shall be implemented in the PLC Panel and displayed.
		:	Shall have AC Energy Meter with 1% accuracy (Suitable for Harmonics)
		:	Digital AC / DC Voltage & Current Meters – PF Meter.
	Door	:	Shall be non-magnetic – FRP or SS.
	Other accessories	:	Indicator Lamps for Breaker on / off, Semaphore for AC Breaker / DC Isolators.
	Terminal Block for Control	:	2.5 sqmm (Control Cable – 1.5 / 2.5 sqmm Stranded Copper Cable)
	Voltage & Current at Rectifier Output	:	Indication of Voltage & Current shall be given in the Rectifier Control Panel as well as Main Control Room.
			Smooth variation of output current of Rectifier unit shall be possible. Output current shall be maintained constant at the set value irrespective of whether the signal is given from DCS or Rectifier Control Panel (Local). The Rectifier Current shall be raised or lowered from the DCS and from the Rectifier Control Panel with the help of Push Buttons.

			Closed Loop Control System shall be used for maintaining the output DC Current. It shall work as follows: The DC CT shall supply the automatic regulator with a feed-back signal proportional to the bridge output dc current. The regulator then compares this signal with Set Point. The difference between these signals is amplified by the regulator which accordingly pilots the Thyristors and automatically maintains the output current within ±1% of set point.
	Communication Facility	:	Ethernet (Modbus) Communication facility for interfacing with existing DCS shall be provided for monitoring all the parameters of Rectifier Transformer Unit.
	Cables for firing Signals	:	Fibre Optic Cables shall be provided for firing signals from Rectifier Control Panel to Rectifier.
	Redundancy		CPU, Power Supply Cards and Communication Cards shall be provided with 100% redundancy. 10% spare I/O Cards shall be provided for each category. I/O Cards shall be removed and changed without shutting down the system.
	Back Up		All events including Trip, Alarms, ON, OFF shall be recorded through an HMI with Event Logging Facility for recording the events with Battery backed date and time stamps and having at least 64 MB Memory.
	Electrical & Emergency Faults	:	All critical trips like electrical faults and emergency trip shall be wired directly through separate lockout relay for tripping of main power supply breaker without involving PLC or DCS (Hardwired tripping). All tripping relays shall have hand reset type contacts with hand reset type flag indication.
	TESTS ON CONTROL PANEL		
A	Checking wiring circuits,		
B	Voltage test of power feeding		
C	Checking the proper function of the Control Equipment (as per IEC 60146-1-1 Cl. 4.2.9)		
D	Checking the protective devices (as per IEC 60146-1-1 Cl. 4.2.10)		
E	Checking the correct operation of all Auxiliary Circuits and Equipment		
F	Checking the Calibration of Protective Relays and Measuring Instruments		
G	Functional simulation of the Rectifier Control Panel.		
6.8	PFIC BANKS (HARMONIC FILTER)	:	Shall consist of Fused Capacitors, Tuning Reactors, Lightning Arrestor, Galvanized Steel Structure and Unbalanced Protection.
	No. of Harmonic Filters		Based on design, suitable Harmonic Bank shall be decided.
	Power Factor to be maintained	:	0.99 Lag at rated load
	Location of PFIC Banks	:	Outdoor (Structure mounting)
	Capacitor Voltage Rating	:	12 KV
	Continuous Withstand Voltage	:	110%
	Total Harmonic Distortion (THD) to be considered in Voltage and Current	:	As per IEEE 519 Standards (≤ 3 %)
	Reactive Power Supplied	:	** MVAR
	Overload Capacity	:	130% of Rated KVAR
	Support Frames	:	Shall be made in Hot Dipped Galvanized Steel and electrically insulated from the ground.
	Interconnecting Bus Bar	:	Shall be of Aluminium - PVC Sleeved. Bus Bar joints shall be shrouded.

	Operation of Harmonic Filters	:	Harmonic Filter Bank shall be switched "ON" only after the Rectifier is switched "ON". In case of tripping of Rectifier, Harmonic Filter Banks shall also be switched OFF automatically.
	Power supply to PFIC Banks	:	A.C.; 3 Phase, 11 KV ± 5 %, 50 Hz ± 1 %
	Neutral current unbalance protection shall be provided		
	If 5^{th} & 7^{th} Harmonic Filter Banks are grouped, Isolators shall be provided.		
	11 KV Vacuum Circuit Breaker for HT Supply to PFIC Banks	:	11 KV, Vacuum Circuit Breaker will be provided by Client.
	11 KV HT Cable for PFIC Banks / Harmonic Filters	:	11 KV HT Cable will be provided by Client.
6.9	PERFORMANCE TEST		
	Following Tests shall be carried out at site during commissioning and performance test		
A	Current Transformer (CT) Ratio & Polarity		
B	Transformer Ratio		
C	Oil Test		
D	No Load Test		
E	Short Circuit Test		
F	Functional Test of Auxiliary Circuit		
G	Interlocking & Annunciation Circuit		
6.10	EFFICIENCY OF RECTIFIER TRANSFORMER UNIT		
	Vendor shall provide guarantee for the efficiency of the Rectifier Transformer Unit and prove it during the performance test. The guaranteed efficiency during performance test at site at operating point i.e. 450 Volts & 45 KA shall be **% subject to IS Tolerance. The efficiency shall include losses in Transformer (Iron + Copper), AC Bus Bar between Transformer & Rectifier, Rectifier (including Thyristor loss, semiconductor fuse loss, internal heat sink loss and overvoltage protection unit loss etc.), and auxiliaries like DM Water Pump, Oil Circulation Pump etc.		
	The efficiency excludes losses in Harmonic Filter and DC busbar up to Isolator		
6.11	DCS CONNECTIVITY		
	Signals to DCS		
A	DC Voltage Signals (0 -** V/4 – 20 mA): 1 point per 1 control section		
B	DC Current Signals (0 – 18 kA / 4 – 20 mA): 1 point per 1 electrolyzer		
C	Rectifier fail signal		
D	Rectifier operation stop signal (Feedback signal of rectifier stopped)		
	Signals from DCS		
A	4 – 20 mA Analog Output signal to control the Current: 1 point per 1 control section		
B	Digital Output signal to stop the Rectifier: 1 point per 1 control section		
6.12	Polarisation Rectifier 06 nos of inputs, 3-Phase, 415V AC and output 8-30 Amp, Output Voltage 25-300V DC.		

	Note: Data marked ** shall be given by the vendor.		

	MAKE OF COMPONENTS		
01.	Rectifier Transformer	:	TRIL(Trafo & Rectifiers India Ltd/ABB/BHEL/ Equivalent
02.	Off Circuit Tap Changer (OCTC)	:	Paragon / Always / Equivalent
03.	Magnetic Oil Level Gauge	:	Revathi Electronics / Sukrut / / Equivalent
04.	Temperature Controller	:	Maasibus / Equivalent
05.	Temperature Indicator (RTDs)	:	General Instruments / Baumer (Warree) / Altop / Pyro / / Equivalent (R1)
06.	Buchholz Relay	:	Prayog / Atvus / / Equivalent
07.	Pressure Relief Valve	:	Fainger Lessor / Nirmal Industries / Tyco / Weir BDK / Sukrut / / Equivalent
08.	Pressure Gauge	:	General Instruments / Baumer (Warree) / / Equivalent
09.	Bushing	:	W.S / CJI / AS Insulators / / Equivalent
10.	Plate Heat Exchanger	:	Alfa Laval / Tranter / GEA Ecoflux / / Equivalent
11.	Motors (Energy Efficient IE2)	:	Siemens / Bharat Bijlee / Crompton Greaves / ABB / / Equivalent
12.	Pumps	:	Kishor / Microfinish / KBL / KSB / Sulzer / Alfa Laval/Equivalent
13.	Semi conductor	:	ABB / Dynex / West Code/ / Equivalent
14.	Semi conductor Fuse	:	Ferraz (or) Bussmann/ / Equivalent
15.	Conductivity Meter	:	Yokogawa / Emerson / Forbes Marshall / ABB / / Equivalent
16.	Flow Meter (Magnetic / Vortex)	:	Yokogawa / E&H / Forbes Marshall / ABB / / Equivalent
17.	Rotameter	:	Yokogawa / E&H / Forbes Marshall / ABB / Eureka// Equivalent
18.	Power Factor Improvement Capacitor Banks	:	Universal Cables Limited / ABB / / Equivalent
19.	D.C. CT	:	DynAmp USA
20.	D.C. Ammeter and Voltmeter	:	AE / MECO / Rishab / Schneider
21.	Surge Arrestor	:	Raychem / Equivalent
22.	Reactors	:	Universal (or) Quality Power (or) Srihans / Equivalent
23.	Signal Isolator	:	SETO / Equivalent
24.	PLC	:	Allen Bradley / Siemens / ABB/ AC 800 PEC/ Equivalent
25.	Solid State Annunciator	:	Minilec / Proton Electronics / Equivalent
26.	DC Earth Leakage Monitoring System	:	Areva / Alstom / ABB / Equivalent
27.	Electronic Controller	:	ABB / AC 800 PEC / Equivalent
28.	Transducers	:	SETO / P&F / Equivalent
29.	AC Ammeter	:	Automatic Electric / Rishabh / Schneider/ Equivalent
30.	AC Voltmeter	:	Automatic Electric / Rishabh / Schneider/ Equivalent
31.	LT Switchgear	:	Siemens / ABB
32.	Switch Fuse Unit	:	Siemens / ABB
33.	AC Power and Auxiliary Contacts	:	Siemens / ABB

34.	Thermal Overload Relay	:	Siemens / ABB
35.	A.C. Over Current Relay	:	ABB
36.	Protective Relays	:	ABB / Alstom / Equivalent
37.	Push Buttons	:	Siemens / Technic / ABB
38.	Breaker Control Switch	:	KAYCEE / Technic / ABB
39.	Control / Selector Switch	:	KAYCEE / Technic / ABB
40.	MCBs	:	Siemens / MDS / Legrands / Havells / ABB
41.	Auxiliary HRC Fuses and Fittings	:	Siemens / L&T / Alstom / EE
42.	Current Transformer	:	Narayana Power Tech / Kalpa / Kappa / Bharati / Pragati
43.	Copper Bus Bars and Heat Sink	:	Electrocopper & Alloys/SRG Metalcrafts/Indian Metals & Alloys / Equivalent
44.	Cables	:	Universal Cables / Finolex / CCI / Ravin/ Equivalent
45.	Clip on type Terminal Blocks	:	Elmex / Connect Well / Phinix/ Equivalent
46.	D.C. Isolator	:	FERRAZ SHAWMUTT (or) RITTER (or) HUNDT & WEBER/ Equivalent

7.0	SCOPE OF SUPPLY and SERVICES	:	LOCAL SERVICE REPORT
	♠ Design, Manufacture, Testing at Works and Supply of One No. Rectifier – Transformer Unit with all Accessories, One Set of Power Factor Improvement Capacitor Banks (Harmonic Filters) as per the Specifications given above.		
	♠ Spare Parts required for Commissioning, Spare Parts required for Three years trouble free Operation and Essential Spares required		
	♠ Supervision of Erection of the Rectifier Unit at PACL, Naya Nangal		
	♠ Commissioning of the Rectifier Unit at PACL, Naya Nangal		
	♠ Performance Testing of the Rectifier Unit at PACL, Naya Nangal. Rectifier Efficiency shall be proved at Meghmani Finechem Ltd. Factory at the operating conditions specified.		
8.0	CLIENT's SCOPE OF SUPPLY and SERVICES	:	Supply of 11 KV, HT Vacuum/ SF6 Circuit Breaker Panel for the Transformer and PFIC Banks
		:	Supply and Termination of 11 KV, HT Cable from Vacuum/ SF6 Circuit Breaker Panel to Transformer and PFIC Banks (Harmonic Filters)
		:	Bus Bars from Rectifier to D.C. Isolator to Electrolyzer
		:	Cable Connections for 415 V 3 Phase AC and 110 V DC upto incoming feeder of AC DC Distribution Board.
		:	Earthing for Transformer, Rectifier, PFIC Banks (Harmonic Filters)
		:	Cooling Water Supply at flange for Rectifier & Transformer Cooling
		:	First Fill of DM Water
9.0	PAINTING	:	
	All Carbon Steel surfaces of the Rectifier, Transformer, Piping Material and Structural Supports, shall be thoroughly cleaned by Wire Brush and Emery Paper and painted with Two coats Epoxy Zinc Rich Primer followed by Two coats of Epoxy Finish Paint. Dry Film Thickness for each coat: 75 microns		
10.0	EXCLUSIONS	:	Equipment Foundations, all Civil and Masonry Works
		:	Erection of the entire system including manpower & tools.
		:	Oil Recovering Tank and Rails for Transformer
		:	All LV Cables external to your package unit
		:	Lighting / Lightning Protection System / Fire Fighting System
11.0	INSPECTION and TESTING	:	
	Stage and Final Inspection will be carried by the Client (or) their Authorized Representative. The Vendor shall offer the Equipment and Items during the course of manufacture for Stage wise Inspection and Final Inspection to the Client (or) their Authorized Representative At the time of Inspection, the Vendor shall provide relevant Material Test Certificates for the materials used in the manufacture of the Equipment and Items.		
12.0	GUARANTEE / WARRANTY	:	
12.1	♠ PERFORMANCE GUARANTEE	:	The Rectifier – Transformer Unit with Accessories shall be guaranteed for the rated Performance at the operating conditions specified above. Rectifier Efficiency shall be guaranteed for **% Minimum and Power Factor shall be maintained at 0.99 Lag.
12.2	♠ PERFORMANCE TESTING	:	After Commissioning of the Rectifier Unit, Performance Testing shall be carried out by the Vendor at PACL's Works.
12.3	♠ EQUIPMENT WARRANTY	:	The Rectifier – Transformer Unit with Accessories shall be guaranteed for Material of Construction and good Workmanship and against Manufacturing Defects for a period of 12 months from the date of commissioning (or) 18 months from the date of supply, whichever is earlier.

Sl. No.	Document Description		With Offer	After Offer
			Soft Copy/ Hard Copy	Soft Copy Hard Copy
1.	Quality Assurance Plan	:	√	√
2.	Data Sheets duly filled in	:	√	√
3.	P & I Diagrams	:	√	√
4.	Vendor List for Bought out Components	:	√	√
5.	Utility Requirements	:	√	√
6.	Motor Details	:	√	√
7.	Base Plate Details	:	√	√
8.	General Arrangement and Dimensional Drawings	:	√	√
9.	Characteristic Curves for Pumps	:		
10.	Foundation Details with Load Data	:		√
11.	Design Calculations (for Filter Capacitors)	:		√
12.	Fabrication Drawings	:		√
13.	Cross Sectional Drawings	:		√
14.	Interlock Diagrams Control Logic Diagrams and Instrument Loop Diagrams	:		√
15.	Terminal Connection Diagram	:		√
16.	Electrical Circuit Diagrams (Single Line Diagrams)	:		√
17.	Layout Plans	:		√
18.	Material Sub-orders	:		√
19.	Material Test Plan	:		√
20.	Hydro Test Procedures	:		√
21.	Pneumatic Test Procedures	:		√
22.	Material Test Certificates and Inspection Reports	:		√
23.	Final Test Procedures	:		√
24.	Performance Test Certificates	:		√
25.	Lubrication Schedule	:		√
26.	Final Inspection Reports	:		√
27.	Heat Treatment Procedures	:		√
28.	Heat Treatment Certificates	:		√
29.	Installation Manual	:		√
30.	Operation and Maintenance Manual for Equipment	:		√

NOTE:- All Final as built Documents and Drawings shall be submitted in Pen Drive and 2 Sets of hard copies.