





Plant <b>CAUSTIC SODA</b>	Client <b>Punjab Alkali</b>	Contract Code <b>PACL</b>	Document ID <b>0215-ELT-22-EC-0001</b>	Contract No. <b>66-0215</b>
	<b>TECHNICAL SPECIFICATIONS: ELECTRICAL</b> <b>22K001: CHLORINE COMPRESSOR</b>			
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PIN-QMC-03-F101 09-2016

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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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	<b>SITE CONDITIONS</b>				
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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 <b>48</b> 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 <sub>2</sub>
12.	Tropicalizing required	Yes

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

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## 1.0 INTRODUCTION

This specification covers the electrical requirements of the package unit (PU), such as design, manufacturing, inspection and testing, packing and forwarding, transportation to site, erection, testing and commissioning of electrical equipment in the package unit. Equipment to be supplied shall comply with latest revision of applicable Indian Standards (IS) and specific codes and standards.

Scope of supply and services covered under this specification shall be as per various parts of this specification. Standard and descriptive requirement is covered in Part-I while specific requirement is covered in Part-II. Requirements for testing at vendor's works are also covered in Part-II.

This specification is the part of package unit specification. Other details such as scope of supply for other items, commercial terms and conditions, performance guarantees of main equipment etc., are covered elsewhere in this specification.

It will be the supplier's responsibility to bring to the notice any irreconcilable conflict in the package unit documents as a part of offer. Supplier shall bring out such discrepancies very clearly in the offer. Purchaser shall provide solution to such conflicts. Resolution to conflicting requirement during Project execution shall be provided by Purchaser and same shall be binding on the supplier without any cost or time implication to the Purchaser.

## 2.0 DEFINITION

A	:	For Approval
I	:	For Information
P	:	Purchaser
IFC	:	Issued for Construction
S	:	Supplier (Packaged Units)
TPI	:	Third Party Inspector
FAT	:	Factory Acceptance Test
SAT	:	Site Acceptance Test



## 3.0 SCOPE OF WORK

The scope of work includes the Design, Engineering, Manufacture, Fabrication, Assembly, Packing, Forwarding, Transportation to site, ~~Unloading, Handling, Storage~~, Erection, Testing and Commissioning of various electrical equipment in the package unit, as indicated in Table-1. Spare parts, special tools, documentation, manuals and other services shall also be part of this supply.

Additionally, engineering services and other activities as indicated in Table-2 also shall be considered in the scope of work.

Electrical equipment shall be complete in all respects. Any materials or accessories which may not have been specifically mentioned, but which are usual or necessary for satisfactory and trouble free operation and maintenance of the equipment, shall be furnished by Supplier without any extra charge to the Purchaser.

Attached block diagram (Part-III) reflects the battery limit for complete scope and split of work, for further clarity.



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**TABLE-1 : SUPPLY, ERECTION, TESTING / COMMISSIONING OF ELECTRICAL EQUIPMENT**

EQUIPMENT	SUPPLY BY	FACTORY ACCEPTANCE TEST (FAT)		ERECTION BY	SITE TESTING & COMMISSIONING		SPEC. REF.	REMARKS
		BY	WITNESS		BY	SUPERVISION BY		
LV Induction Motors (Industrial / Flameproof)	S	S	P / TPI	P	P	S	E1	
LV cables (power and control) (from Purchaser's switchgear to Local Control Panel / Field consumers)	P	P	P / TPI	P	P	P	E2	
LV cables (power and control) (within battery limit - from Local Control Panel to Field equipment)	S	S	P / TPI	P	P	S	E2	
Local Control Station (LCS)	S	S	P / TPI	P	P	S	E3	
Local Starter Panel	S	S	P / TPI	P	P	S	E4	Skid mounted
Bulk Material (e.g. Glands, Lugs, Earthing, Tray within battery limit etc.)	S	S	P / TPI	P	P	S	E5	
<del>Variable Speed Drives</del>	<del>P</del>	<del>P</del>	<del>P / TPI</del>	<del>P</del>	<del>S</del>	<del>S</del>	<del>E6</del>	
<del>HV Induction Motors</del>	<del>P</del>	<del>P</del>	<del>P / TPI</del>	<del>P</del>	<del>P</del>	<del>S</del>	<del>E7</del>	
<del>Low Voltage Switchgear (MCC)</del>	<del>P</del>	<del>P</del>	<del>P / TPI</del>	<del>P</del>	<del>P</del>	<del>S</del>	<del>E8</del>	
Spares - For Commissioning	S	-	-	-	-	-	-	
Spares - For 2 yrs Operation	S	-	-	-	-	-	-	

**TABLE-2 : ENGINEERING ACTIVITIES AND OTHER SERVICES**

DESCRIPTION	ACTIVITY BY	REMARKS
Electrical Consumer list / Load List	S	
Electrical Cable List, Local Control Stations List	S	
Motor control philosophy	S	
Design Calculations, Sizing Calculation for various equipment, application checks for the electrical motors as required	S	
Selection of various equipment conforming to the specifications referred in Table-1	S	
Power, Earthing & Lighting layouts, Lightning protection layouts, Cable Tray Layouts	S	
Bill of Quantity for Bulk Material to be supplied	S	
Electrical room layout, as applicable	P	

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Control schemes for electrical consumers, interconnection diagrams	S	
Hazardous Area Classification drawings	P	
Equipment selection as per Hazardous Area Classification drawings	S	
Electrical inputs for civil / instrumentation design	S	
Review of vendor's / sub-vendor's drawings & documents	S	
Electrical Inspector's & other statutory Approvals	S	
Documentation as per Table-3	S	

#### 4.0 SITE CONDITIONS

All electrical equipment shall be capable of continuous operation under operating conditions specified in 'Site Conditions' enclosed elsewhere in this specification.

#### 5.0 CODES & STANDARDS

The design, material, construction, manufacture, inspection testing, commissioning and performance of equipment shall comply with latest revisions of relevant International standards or relevant IS as applicable.



The electrical equipment and installation shall comply with the requirement of the following rules and regulations as amended up to date (given in order of precedence):

- CEA Regulations and codes & regulations of Indian applicable state
- This Specification.
- Indian Standards.
- IEC Standards.

#### 6.0 POWER & AUXILIARY SUPPLY DETAILS

The various power and control supply voltages generally followed in the plant will be applicable for the package unit also. These will be made available at battery limit and are as stated below. However, in case any other power supply is required, Supplier shall arrange the same by suitable converter or transformer of suitable rating. Supplier to specify clearly the Power supply requirement.

SR. NO.	VOLTAGE V	FREQUENCY HZ	SYSTEM	EARTHING	FAULT LEVEL kA	PURPOSE
1.	6.6kV ± 10 %	50Hz ± 3%	3Ph, 3W	RESISTANCE GROUNDED	40kA	HV Motor
2.	415 ± 10 %	50Hz ± 3%	3Ph, 4 W	SOLID	65kA	Local starter Panel Motors, Heaters etc.
3.	240± 10 %	50Hz ± 3%	1Ph, 2 W	SOLID	10kA	Lighting, General Control
4.	110± 10 %	50Hz ± 3%	1Ph, 2 W	SOLID	10kA	Critical Control

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## 7.0 GENERAL REQUIREMENTS

Electrical equipment supplied with package unit (PU) shall be new and designed for minimum 20 years of service life unless otherwise specified in data sheet.

All electrical equipment supplied with PU shall be heavy duty industrial type and robust.

Electrical equipment like motors, Junction boxes, electrical control panel, LCS, etc. shall be provided with permanently secured nameplate mentioning equipment Tag number & Description. PU vendor to ensure that all tags numbers shall be approved by Purchaser.

To ensure consistency of electrical material, the package unit vendor shall select sub-suppliers of electrical equipment and materials from the vendor list, enclosed. Any deviation has to be justified and is subject to approval by Purchaser. Similar parts or equipment shall be interchangeable wherever possible.

First fill of lubricants (oil / grease), cooling medium, insulation oil etc. required for all electrical equipment (supplied by Supplier - Package unit), as applicable, shall be in Supplier's scope.



## 8.0 SPARES

List of electrical spares (as indicated in equipment specifications referred in Table-1) required for commissioning and 2 years of trouble free operations of all electrical equipment supplied by Supplier shall be enclosed with the offer.

## 9.0 DRAWINGS AND DOCUMENTS TO BE FURNISHED BY SUPPLIER

**TABLE-3 : DRAWINGS AND DOCUMENTS TO BE FURNISHED BY SUPPLIER**

DRAWING / DOCUMENT	WITH OFFER	POST ORDER	RFC	FINAL DOC. *	REMARK
Electrical Consumer list / Load List **	S	S / A	S	S	
Electrical Cable List, Feeder List, Local Control Stations List		S / I	S	S	
Design Calculations, sizing calculation for various equipment, application checks for the electrical motors as required	S	S / A	S	S	
Concept block diagrams as required		S / I	S	S	
Power, Earthing & Lighting layouts, Lightning protection layouts, Cable Tray Layouts		S / I	S	S	
Electrical room layout as applicable		S / A	S	S	
Control schemes and interconnection diagram or motors		S / A	S	S	
Equipment specific documentation, as indicated in equipment specifications referred in Table-1	S	S / I or A	S	S	
Bill of Material for Bulk material to be supplied		S / I	S	S	
Any documents required for obtaining Electrical Inspector's & other statutory Approvals		S / I	S	S	

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**NOTES :**

1. \* In the final documentation, 4 nos. hard copies along with the soft copy of the documents shall be furnished. In all the other cases, soft copy of the document shall be furnished.
2. For equipment specific documentation, equipment specification referred in Table-1 shall be referred.
3. \*\* Electrical Consumer / Load List – Supplier to submit preliminary load list.
4. Installation standards for power, earthing & lighting shall be furnished during detailed engineering)
5. Documents for review and approval shall be submitted in soft copy / editable pdf format.
6. IEC symbols shall be used for preparation of Drawings/ documents.
7. Only English language shall be used for communications / Drawings/ documents.

**10.0 INSPECTION & TESTING**

**10.1 At Manufacturer's works**

Supplier (Package Unit) himself or through TPI shall carry out all routine tests on all equipment in his scope of supply. Type tests shall be carried out, if specified in equipment specifications referred in Table-1.

Supplier (Package Unit) shall provide inspection and test plan covering all tests specified in Part-II as minimum, for approval of Purchaser/ TPI.

All routine, type and special tests shall be carried out in the presence of Purchaser/ Purchaser's representative/ TPI, if so desired by the Purchaser. (Refer Equipment specific documentation, as indicated in equipment specifications referred in Table-1.) Minimum fifteen days advance notice shall be given for carrying out final testing & inspection.

Supplier (Package Unit) shall ensure that all meters and instruments associated with testing of the equipment are calibrated by a competent testing authority and the calibration certificates are valid at the time of carrying out the testing of equipment.

In case testing and inspection is not witnessed by the Purchaser/ Purchaser's representative, test certificates shall be furnished for review/ approval prior to dispatch.

**10.2 Inspection, Testing & Commissioning at site**

**Inspection**



After completion of erection/ installation, all equipment shall be thoroughly inspected as per approved Site QAP in presence of Purchaser/ Purchaser's representative, for correctness and completeness of erection and acceptability for start-up.

**Testing and Commissioning**

After completion of erection and inspection work, site tests shall be conducted by the Supplier/ Purchaser as per Site Acceptance Test format (to be furnished for approval).



Supplier/ Purchaser shall provide all tools, materials, testing equipment, labour and supervisory personnel for carrying out field tests on the equipment and materials, under his scope of work.







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### 11.0 GUARANTEED PERFORMANCE



The performance figures quoted in the Technical Particulars sheets (data sheets) shall be guaranteed within the tolerance permitted by relevant standards. In case of failure of the equipment to meet the guarantee, Purchaser reserves the right to reject the equipment. However, Purchaser reserves the right to use the rejected equipment until the new equipment meeting the guarantee requirement is supplied. However Supplier will be given an opportunity to rectify his equipment at his own cost. Also, Purchaser reserves the right to use rejected equipment till it is rectified. The period of guarantee of the equipment shall be as per agreed 'Commercial Terms & Conditions'.

		<b>LOW VOLTAGE INDUCTION MOTORS</b>		Code	Caustic Soda Plant			
				Contract no.	66-0215			
		<b>PART - E1</b> <b>DESIGN DATA SHEET (REQUIREMENT)</b>		Doc.	0215-ELT-22-EC-0001			
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GENERAL	001	Make :						*
	002	Voltage and frequency						
		a) Rated voltage (Vr)	: 415 V +/- 10% (see note 6 below), solidly earthed					
		b) Frequency (f)	: 50 Hz +/- 5%					
		c) Combined variation	: The sum of absolute percent variations of a) & b) not exceeding 10%					
	003	Number of phases : 3 phase						
	004	Design ambient temperature : 50°C (See Note-4)						
	005	Type of rotor : Squirrel cage						
	006	No. of body earth terminals : 2 Nos.						
007	Energy efficiency class : IE2 as per IS 12615-(See Note-3)							
008	Enclosure construction & Degree of encl. protectio : Cast iron and IP-55							
CODES	009	IS-325, IS-8789, IS-4889, IS-4029,	010	IS-12615, IS-15999				
		IS/IEC 60034	011					
	012		013	IEC-60079-0, IEC-60079-7, IEC-60079-1, IS-9628				
	014	IS-1231, IS-2223, IS-7816, IS-12065,	015	IEC-60738-1-3				
		IS-12075, IS-6362, IEC-60034	016					
	017		018					
	019	ATEX 1999/92/EC						020
	021	ISO 21940-11, NEMA-MG-1, IEEE-112						022
	023							024
	025							026
027							028	
CHARACTERISTICS	029	<b>Stator Winding</b>						
		a. Winding Connection	: Star or Delta ≤100L, Delta >100L					
		b. Insulation	: Class-F, temperature rise limited to class B limits					
		c. Temperature Rise (by resistance method)						
		i) For Industrial/ Ex-'d'/ Ex-'n' motors	: 70°C over an ambient of 50°C resp.					
		ii) For Ex-'e' motors	: 70°C over an ambient of 50°C for single layer					
			and 60°C for other insulated windings, resp.					
	030	Winding Treatment (non-VFD) : Vacuum pressure impregnated for frame 315 & above						
			otherwise varnished-baked					
	031	Tropical Protection : Antifungus, Moisture resistant (Epoxy gel coating on winding overhang)						
	032	Temperature rise of bearings (skin temperature) & lubricant						
		i) At full load	: To suit the withstand temperature of lubricant but					
			final temperature not exceeding 120 Deg C					
		ii) At no-load	: 15 Deg C above ambient of 50° C					*
		iii) Lubricant	: UNIREXN-3 (Suitable for operation at temperature of 130 Deg C minimum)					
	033	Cooling Designation as per IS 6362 : IC411						
	034	Overvoltage withstand capacity, for Changeover of Power Supply : 150 % of rated voltage						
	035	<b>Minimum Permissible Voltage for -</b>						
		a. Starting at full load	: 80 % of rated voltage					
		b. 5 minute running without overheating	: 75 % of rated voltage (Occasionally)					
036	Max. starting current : 8.4 times rated full load current (including tolerance)							
037	Maximum slip at full load : %						*	
038	<b>Shaft voltage for frame &lt; 280</b> : Max. 200 mV						*	
039	<b>Min. starting torque</b> : As per IS 12615							
040	<b>Noise Level</b> : 85 dB at 1 meter upto 315 frame, > 315 frame **							
041	<b>Class of Vibration severity</b> : Grade 'A' of IEC 60034-14							
042	<b>Balancing of rotor</b> :							
	a. Up to 160 kW	: To meet vibration severity requirement					*	
	b. Above 160 kW	:						
	i) Speed 3000 rpm & above and turbo compressor motor	: To meet vibration severity requirement					*	
	ii) Other motors	: To meet vibration severity requirement					*	



		<b>LOW VOLTAGE INDUCTION MOTORS</b>  <b>PART - E1</b>  <b>DESIGN DATA SHEET (REQUIREMENT)</b>				Code		Caustic Soda Plant		
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<b>CHARACTERISTICS</b>	043	<b>Thermistor</b>								
		a. Shall be provided for motors								
		i) non-VFD : 132 kW and above								
		ii) VFD driven : All ratings								
		b. Type : PTC embedded in overhang portion of stator winding								
		c. Rated Operating Temperature T <sub>ROT</sub> : 150 °C, + / - 5 °C								
		d. No. of thermistors : 1 No./ phase. All 6 terminals shall be brought into separate TB								
		044	<b>Space heater</b>							
			Space heater to be provided for motors & Voltage : 30 kW and above, 230V, 1-Ph							
		045	Bi-Direction Rotation Required : Yes							
	046	On-line greasing facility for frame size 225 & above : Required								
	047	Shaft design : Suitable to withstand 10 times the rated torque (for transient conditions in case of reacceleration requirements)								
<b>NO. OF</b>		<b>Starting Duty Cycle</b>			<b>Up to 160 kW</b>		<b>Above 160 kW</b>			
	048	Equally Spaced Starts per Hour			4		3			
	049	Successive Starts From Cold Condition			3		2			
	050	Successive Starts From Hot Condition			2		1			
<b>THERMAL CAPACITY</b>	051	Minimum Hot thermal withstand time ( rated voltage) : 8 seconds								
	052	Minimum Margin between starting time with motor coupled to load & Hot thermal withstand time for (rated voltage):								
		i. Starting time ≤ 5 s : 3 s								
		ii. Starting time > 5 s : 5 s								
	053	Requirement of starting duty cycle as specified elsewhere shall be complied								
<b>TERMINAL BOX</b>	054	Fault Withstand Capacity : 65 kA for 0.25 s for 75 kW & above								
	055	Location of TB : Top or RHS while viewed from DE, Rotatable by 90°								
	056	Winding Leads & Terminals : All 6 leads brought out for frame > 100L								
	057	Insulators : Non Hygroscopic, Non-Flammable								
	058	End connection : Studs & lugs (crimped or brazed)								
	059	Separate terminal boxes for space heater & thermistor terminals shall be provided								
	060	Cable Glands: By Purchaser, Type: Nickel plated Brass, Double comp., ISO metric, 1.5 mm thread pitch Terminal blocks shall be suitable for Purchaser's cable sizes which shall be specified after order								
<b>PAINTING</b>	061	Primer : 2 coats of epoxy based primer, spray painted								
	062	Final Paint : 2 coats of epoxy based finish paint (acid alkali proof)								
	063	<b>Final paint shade</b>								
		a) For outdoor motors : RAL-7032								
		b) For indoor motors : Shade 632 of IS-5								
	064	Minimum Paint Thickness : 60 Microns								
<b>BEARING</b>	065	One side insulated frame / bearing : Frame 280 and above								
	066	Minimum Life : 40,000 hrs at rated operating conditions								
	067	Online Greasing Facility : Required (except for pre-lubricated sealed bearings)								
	068	Radial Clearance for Antifriction bearing : C3 Class								
	069	Seals : Seals to prevent grease entering the motor cavity								
	070	Make : SKF/FAG *								
		Bearing for special application : Vertical & Flange Mounted : Suitable for vertical thrust, Thrust Bearing is preferred *								
	V-Belt/ Toothed Belt Application : Roller bearing at Driving end									
<b>APPLICATION CHECK</b>	071	Application check to be carried out : i. All motors >75 kW including centrifugal pumps for Non-VFD motors for ii. Fans, Blowers, Compressors (reciprocating/ centrifugal), conveyors and agitators of all ratings								
	072	Application check procedure : Superimposed torque Vs speed curves for load and motor								
	073	Criteria for acceptance : Torque developed by motor shall be more than that required by driven equipment by at least 10% at all speeds in pull up region								
	074	Special requirement for pulsating load : i. Pull out torque at min. voltage shall be more than peak value of pulsating torque by at least 10%								
		ii. Current pulsation shall not be more than 40%								

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VFD CONTROLLED MOTORS	075	Winding : Dual enamel coated wires & vacuum pressure impregnated insulation						
	076	Bearing : One side insulated frame/ insulated bearing for frame ≥ 280						
	077	Cooling : Special design for reduced cooling at low speeds or separate motor driven fan for constant torque application						
	078	Design Basis : Stator critical						
	079	Combined testing of motor & VFD at motor works : For Ex 'e', Ex 'n' ( mandatory ) & Ex 'd' motors (if required based on vendor confirmation) (Also See Note-5)						
		Note : VFD application motors shall be suitable for stress category <b>B</b> as per IEC 60034-18-41. Test Certificate for same shall be provided.						
NAME PLATE	080	Content : As per standard						
		Additional Information						
		'E' for increased safety motor	Class for energy efficient motor					
		Certificate no., temperature class & Gas group for Hazardous area application if applicable						
		Direction of Rotation						
		Separate nameplate for motor tag no. & service						
DOCUMENTS / DRAWINGS		<b>Description</b>			<b>Prints with offer</b>	<b>Prints for Review</b>	<b>Final/ As-Built</b>	
	081	<b>TEST CERTIFICATES</b>						
		a) Routine & Type Test Certificates			-	4	6	
		b) Certificates as mentioned in Part-IV, Section D			-	4	6	
	082	<b>PERFORMANCE CURVES / GRAPHS</b>						
		a) For motors rated 75 kW & above						
		i.	Hot & Cold withstand curves with heating & cooling time constants (Tabulated values shall be provided for 100-200% of rated current)		-	4	6	
		ii.	Starting Current vs Time Curves for 80%, 100% & 110% Vr		-	4	6	
		iii.	Negative Phase Sequence Withstand Current vs Time Curves		-	4	6	
		iv.	Torque vs Speed curve of motor at 100% & 80% of rated voltage		-	4	6	
			superimposed on equipment torque vs speed curve					
		b)	Application check for screw compressor, reciprocating pumps, fans, blowers, agitators & conveyors of all ratings by plotting		-	-	-	
			Torque vs Speed curve of motor at 100% & 80% of rated voltage		-	4	6	
			superimposed on equipment torque vs speed curve					
	083	<b>DRAWINGS</b>						
		a)	GA Drawing Showing Mounting Details/ Dimensions of Motor		-	4	6	
		b)	Detailed Drawing for Each Terminal Box		-	4	6	
		c)	Design Data Sheet PART-I		-	4	6	
		d)	Design Data Sheet PART-II		2	4	6	
		e)	Quality Assurance Plan and Inspection Test Procedure		-	4	6	
	084	<b>MANUAL / DOCUMENTS</b>						
	a)	Installation, Operation & Maintenance Manuals		-	-	6		
084	<b>Notes:</b>							
	1) For items marked "***" thus, data to be furnished / confirmed by vendor.							
	2) For items marked "****" thus, data will be furnished / confirmed by Purchaser after placement of order.							
	3) In case IE2 motors are not available, EFF1 shall be offered.							
	4) The ambient temperature shall be rounded off to the nearest higher value in steps of 5°C.							
	5(a) Combined testing shall be carried out at Motor vendors work and shall be witnessed by certifying authorities. Switching frequency shall be 4 kHz. Motor temperature rise shall be as per this Specification.							
	Motor vendor shall obtain necessary certification for installation of motor in Hazardous area as defined in this specification.							
	5(b) VFD application Motors which are not tested in combination with VFD, shall be fed with additional 15% of total losses (as Harmonic loading), during heat run test without VFD.							
	6) For 690 V Motors, PTR shall be provided for Motors operating at least for 5 years with similar rating and design/ application. 690 V Motors shall be strip wound.							



		<b>LOW VOLTAGE INDUCTION MOTORS</b>  <b>Part E1</b> <b>INSPECTION TEST PLAN</b>			Code		Caustic Soda Plant	
					Contract no.		66-0215	
					Doc.		0215-ELT-22-EC-0001	
					Rev.		00	Page
Sr. No.	Tests	Reference documents	Sample size	Scope of Inspection				
				Vendor	Client / tkIS India / Third Party	Remark		
<b>A Type Tests</b>								
i	Full load test to determine efficiency, power factor & slip	IS 12615, IS-325, IS 4029, IS/IEC-60034, IS 15999	On one motor of each rating	P <sub>PROTO</sub>	R			
ii	Temperature rise test	IS 12615, IS-325, IS 4029, IS/IEC-60034, IS 15999		P <sub>PROTO</sub>	R			
iii	Momentary overload test	IS 12615, IS-325, IS/IEC-60034, IS 15999		P <sub>PROTO</sub>	R			
iv	Overspeed test (120% of rated speed for 2 min.)	IS 12615, IS-325, IS/IEC-60034		P <sub>PROTO</sub>	R		Optional test	
<b>B Routine Tests &amp; Optional Tests</b>								
i	Visual inspection & dimensional checks	Approved GA drawings	One of each kW/ Frame/ Type	P	W			
ii	Measurement of resistance of windings of stator & wound rotor	IS 12615, IS-325, IS 4029, IS/IEC-60034, IS 15999	100%	P	W			
iii	No load test at rated Voltage	IS 12615, IS-325, IS 4029, IS/IEC-60034, IS 15999		P	W			
iv	Locked rotor test	IS 12615, IS-325, IS 4029, IS 15999		P	W			
v	Reduced voltage running up test (for squirrel cage motor)	IS 12615, IS-325, IS 15999		P	W			
vi	Open circuit voltage ratio of stator & rotor windings (for slip ring motors)	IS-325, IS 4029, IS/IEC-60034		P	W			
vii	Resistance measurement of space heaters, RTD's & BTD's and Thermistors	-		P	W			
viii	High Voltage test (HV) on Stator, RTD/BTD, Thermistor and Space Heater	IS 12615, IS-325, IS 4029, IS/IEC-60034		P	W			
ix	Insulation Resistance test before & after HV Test	IS 12615, IS-325, IS 4029, IS 7816		P	W			
x	Test for vibration severity of motor (for rating 55 kW & above)	IS 12615, IS-325, IS 12075, IS/IEC-60034-14		P	W			
xi	Test for noise level of motor (for rating 55 kW & above)	IS 12615, IS-325, IS 12065, IS/IEC-60034-9		P	W			
<b>C Additional Tests</b>								
i	No load running for ½ hr. after completing all tests for all motors	IS-325, IS 4029, IS/IEC-60034	100%	P	W		Refer Note-2	
ii	Shaft voltage measurement for motors of rating 55 kW & above	IS 4029		P	W			
iii	Balancing of Rotor	ISO-1940		P	R			
<b>D Certificates</b>								
i	Certificate from approved testing authority like CMRI/ CPRI/ BASEEFA/ PTB/ UL/ FM/ LCIE for installation in hazardous area	-	100%	P <sub>PROTO</sub>	R			
ii	Approval from statutory authority like PESO for use in hazardous area	-		P <sub>PROTO</sub>	R			
iii	Certificate for short-circuit withstand capability of main terminal box	-	Each size/ type/ model	P <sub>PROTO</sub>	R			
iv	Certificate for test for degree of protection for enclosure	IS-325, IS/ IEC-60034-5	Each type	P <sub>PROTO</sub>	R			
E	Combined testing for motor and VFD (if applicable)	As per Part VA of VFD spec	One of each kW/ Frame/ Type	P	W			
<b>Notes:</b>								
1) R = Review of test certificates; W = Witness, P = Perform (on project equipment), P <sub>PROTO</sub> = Perform (on prototype)								
2) To be carried out for motors for which temperature rise test has not been performed.								



		<b>LOW VOLTAGE CABLES</b>		Code		Caustic Soda Plant	
				Contract no.		66-0215	
		<b>PART - E2 DESIGN DATA SHEET</b>		Doc.		0215-ELT-22-EC-0001	
				Rev.		00	Page
<b>GENERAL</b>	001	Make	: <i>KEC / Polycab / RPG / Reputed make</i>				
	002	Voltage Grade	: 1100 V				
	003	Power Cable	: Stranded Al/ Cu Conductor, XLPE Insulation, Round/ Flat GI Armoured *				
	004	Lighting Cable	: Solid Cu Conductor, PVC insulated, Round GI Armoured *				
	005	Control Cable	: Stranded Cu Conductor, PVC Insulation, Round GI Armoured *				
	006	Earthing Cable	: Unarmoured Cu / GI wire rope *				
<b>CODES &amp; STANDARDS</b>	007	IS-8130 : Specification for conductors for insulated electric cables and flexibles cords					
	008	IS-5831 : Specification for PVC insulation & sheath of electric cables					
	009	IS-7098 : Specification for cross linked polyethylene insulated PVC sheathed cables Part 1: for working voltage up to and including 1100 V					
	010	IS-1554 : Specification for PVC insulated (heavy duty) electric cables Part 1: for working voltages up to and including 1100 V					
	011	IS-3975 : Specification for low carbon galvanised steel wires, formed wires and tapes for armouring of cables					
	012	IS-10810 : Methods of test for cables					
	013	IS-10418 : Specification for drums for electric cables					
	014	CEA Regulations					
	015	Fire Insurance Authority Regulations					
<b>CONSTRUCTION</b>	016	<b>Conductor</b>	:				
	017	Material	: Cu for < 6 sq. mm, Al for >= 6 sq. mm				
	018	<b>Aluminium Conductor details</b>	:				
		a) Type	: Circular/ sector shaped				*
		b) Grade	: H2 / H4				*
		c) Class	: Class 2 (Stranded) as per IS 8130				
		d) Stranded Conductor	: 6 sq. mm and above				
		e) Solid Conductor	: NA				
	019	<b>Copper Conductor details</b>	:				
		a) Type	: Circular/ sector shaped				*
		b) Class	: Class 1 (Solid) / Class 2 (Stranded) as per IS 8130				
		c) Stranded Conductor	: 2.5 sq. mm and above				
		d) Solid Conductor	: Up to 2.5 sq. mm for lighting application only				
		e) Tin coating required	: No				
	020	<b>Insulation</b>	: XLPE				
	021	Type	: Extruded				
	022	Conductor Temperature	:				
		a) Rated	: 90 <sup>0</sup> C (XLPE) / 70 <sup>0</sup> C (PVC)				
		b) During short circuit	: 250 <sup>0</sup> C (XLPE) / 160 <sup>0</sup> C (PVC)				
	023	<b>Inner sheath</b>	:				
		a) Material	: PVC Type ST1 for PVC cables				
			: PVC Type ST2 for XLPE cables				
		b) Type	: Extruded				
		c) Colour	: Black				
	024	<b>Core Identification</b> for cables with no. of cores < 5	: By Different Color of PVC/ XLPE insulation				
		For Multi-core cables with no. of cores > 5	: By nos., neutral conductor core no. 0				
	025	<b>Armour</b>	:				
026	<b>Single core cables</b>	:					
	a) To be provided	: Yes					
	b) Material	: Aluminium					
	c) Type	: Single layer round wire armour					
027	Multi-core cables	:					
	a) To be provided	: Yes					
	b) Material	: Galvanised steel					
	c) Type	: Galvanised round steel wire for OD <=13 mm					
		: Galvanised round steel formed wire/ strip for OD >13 mm					
028	<b>Outer Sheath</b>	:					
	a) Material	: PVC Type ST1 for PVC cables					
		: PVC Type ST2 for XLPE cables					
	b) Type	: Extruded					
	c) Colour	:					
	i) For single core power cables	: Black					
	ii) For single core earthing cables	: Green					
	iii) For twin, three & multicore cables	: Black					
	d) Embossment / Printing interval	: Every 1 m					
	Info. to be embossed/ printed	: No. of cores/ Size of cable; Manuf. Identification, Year of Manuf.,					
		: Voltage Grade, Length Marking					



 		<b>LOW VOLTAGE CABLES</b>  <b>PART - E2</b> <b>DESIGN DATA SHEET</b>		Code		Caustic Soda Plant	
				Contract no.		66-0215	
				Doc.		0215-ELT-22-EC-0001	
				Rev.		00	Page
<b>CONSTRUCTION</b>		e) Special requirements for outer sheath to suit chemicals or fumes handled in plant	:	Yes			
		f) Anti-rodent and Anti-termite treatment	:	Yes			
	029	g) UV rated	:	Yes			
<b>FRLS/FR DATA</b>	030	<b>Fire retardant properties</b>	:				
		i) Fire retardant (FR)	:	No			
		ii) Fire retardant low smoke (FRLS)	:	No			
	031	Data for FRLS / FR cables	:				
		a) Minimum oxygen index	:	29 at 27±2°C			
		b) Minimum Temperature index	:	21 at 250°C			
	032	Data for FRLS cables only	:				
		a) Maximum acid gas generation	:	20 % by weight			
	b) Smoke density rating	:	60% maximum				
	e) Light transmittance	:	> 60%				
<b>VOLTAGE DROP</b>		Voltage Drop between PMCC / Starter Panel & Motor					
	033	Max. drop during normal running	:	5%			
	034	Max. drop During Motor Starting	:	15%			
		Derating Factor shall be considered as per Cable Vendor Recommendation					
<b>DRUM</b>	035	Material	:	Wooden; Ends sealed			
	036	Information to be stenciled on Drum	:	Reference to the relevant standards.			
				Manufacturer's name or trade mark.			
				Type of Cable & Voltage Grade			
				No. of Cores			
				Nominal cross-sectional area of conductor			
				Cable code.			
				Length of cable on the drum.			
				Number of lengths on the drum (if more than one).			
				Direction of rotation of drum (by means of an arrow).			
				Gross wss weight.			
				Country of manufacture.			
				Year of manufacture			
<b>DOCUMENTS</b>	037	a	Cable Catalogue				
	038	b	Type Test Certificates				
	039	c	Routine, Acceptance & Optional test certificates.				
	040	d	Quality assurance plan and Inspection Test Procedure				

**Notes:**

- a) For items marked " \* ", data to be furnished / confirmed by supplier
- b) For items marked `\*\*\*` thus, data to be given / confirmed by Purchaser.





 		<b>LOCAL CONTROL STATIONS</b>  <b>PART : E3</b> <b>DESIGN DATA SHEET</b>		Code		Caustic Soda Plant		
				Contract no.		66-0215		
				Doc.		0215-ELT-22-EC-0001		
				Rev.		00	Page	1 OF 2
<b>GENERAL</b>	001	Material of Construction , Degree of Protection :						
		a) Industrial	: FRP, IP55					
		b) Flameproof IIA, IIB, IIC	: Die Cast Aluminium (LM6), IP55					
	002	Make						
		FRP Industrial	: Shrenik, Hansu, ELM, Flexpro, Hensel					
	003	Location : OUTDOOR						
	004	Canopy Material : Same as Enclosure Material / sheet steel painted *						
	005	Final Paint Shade : Shade 632 of IS 5						
006	Hardware Material : Stainless Steel							
007	Hazardous area classification : As per main Package spec							
008	Cable Entry : Bottom							
<b>TYPE</b>		<b>TYPE OF LCS, COMPONENTS AND APPLICATION</b>						
	009	TYPE A : START PUSH BUTTON, STOP PUSH BUTTON (for Motors < 30 kW)						
	010	TYPE B : START PUSH BUTTON, STOP PUSH BUTTON AND AMMETER						
	011	TYPE C: TNC SWITCH, READY TO START AND RUN IND. LAMP (for Breaker fed Motors)						
<b>CODES</b>	012	IS/IEC: 60947 (Relevant parts) Low voltage switchgear and controlgear						
	013	IS: 4794 Push-button switches						
	014	IS/ IEC: 60079 (Relevant parts) Explosive Atmospheres						
	015	CEA Regulations						
	016	Fire Insurance Authority Regulations						
	017							
<b>COMPONENTS</b>		<b>PUSH BUTTON</b>						
	018	Make : GE,Siemens,L&T,Vaishno,Tecknik,Hensel,RS Controls *						
	019	Type : Start - Spring Return; Stop - Mushroom head Stayput Type						
	020	Locking facility to be provided for Stop PB : Yes						
		<b>SELECTOR SWITCH</b>						
	021	Make : Kaycee,GE,Siemens,Recom,L&T,Schneider,Vaishno,Fuji,GEM,Switron *						
	022	No. of positions : *						
	023	Type of handle : *						
	024	Integral legend plate to be provided : Yes						
		<b>BREAKER SWITCH</b>						
	025	Make : Schneider, Recom, Kaycee, Vaishno, GEM Telergon						
	026	Type & No. of positions : 3 Position , Momentary, Trip-Neutral-Close						
	027	Type of handle : *						
	028	Integral legend plate to be provided : Yes						
		<b>INDICATING LAMPS</b>						
	029	Make : GE,Siemens,L&T,Vaishno,Teknic,Altos,Fuji						
030	Type & Wattage : Clustered LED, _____ W *							

 		<b>LOCAL CONTROL STATIONS</b>  <b>PART : E3</b> <b>DESIGN DATA SHEET</b>		Code		Caustic Soda Plant		
				Contract no.		66-0215		
				Doc.		0215-ELT-22-EC-0001		
				Rev.		0		Page 2 OF 2
<b>COMPONENTS</b>		<b>AMMETER</b>						
	031	Make	: AE,MECO,SIMCO,RISHABH, HAGER,VAISHNO,NIPPEN					
	032	Type / Dimensions	:					*
	033	Accuracy class	: CL-1					
	034	CT secondary current range	:					*
		<b>Scale graduation</b>						:
	035	a) Upto 1.2 FLC	: Linear					
	036	b) Beyond 1.2 FLC	: Suppressed scale upto eight times					
		<b>Special requirement</b>						:
	037	a) Red mark at FLC to be provided	: Yes					
	038	b) Ammeter indication range	: As per Primary rated current of CT					
		<b>TERMINAL BLOCK</b>						
	039	Make	: ELMEX, CONNECTWELL , ALLEN, BRADLEY,WAGO, GEWISS, FUJI					
	040	Type & Size	: Clip-on, 2.5 sq. mm					
	041	Minimum distance between TBs & cable entry	: 50 mm					
		<b>INTERNAL WIRING</b>						
	042	Voltage grade	: 650V					
	043	Conductor & Size	: Electrolytic grade stranded copper, min. 2.5 mm <sup>2</sup>					
044	Termination	: With tinned copper lugs						
045								
<b>OTHER DETAILS</b>		<b>NAME PLATE</b> : Rear Engraved, white letter of size 3mm on black background with below information						
	046	Tag no., Service, KW Rating, Switchgear Name and Feeder no.						
	047	<b>Cable Entry</b> : 2 nos., One plugged						
	048	<b>Earthing</b> : 2 nos., one internal one external						
	049							
<b>FACTORY ACCEPTANCE</b>		<b>Routine test</b>						:
	050	a) Physical & dimensional checks						
	051	b) Insulation resistance test before & after HV test with 1000 V megger						
	052	c) Continuity & operation test						
	053	d) HV test at 2 KV for one minute						
		<b>Type test</b>						:
	054	a) Hydrotesting :On one sample flameproof LCS casting of each type / Type test certificate.						
055	b) IP-55 test : On one sample of each type of LCS / Type test certificate.							
<b>DOCUMENTS</b>	056	GA Drawing along with Wiring Diagram and Bill of Material						
	057	QAP and ITP along with Type test certificates ( including CMRI certificate for FLP type)						



**Notes:**

- a) For items marked " \* ", data to be furnished / confirmed by vendor
- b) For items marked " \*\*\* " thus, data to be given / confirmed by purchaser.
- c) Control wiring shall be carried out with flexible heat resistant switchboard wires of minimum size 1.5 sq. mm for control circuits and 2.5 sq. mm for CT circuits. Wires connected to earth shall be of green colour only. HRPVC wires shall be used for potential tapplings from busbar for PT, Voltmeter etc. Each wire shall be identified at both ends with wire designation in accordance with the wiring diagram developed from approved control schematics. Inter-locking type plastic ferrules of yellow colour with black lettering shall be used for identification.

 		<b>STARTER PANEL</b>  <b>PART : E4</b> <b>DESIGN DATA SHEET</b>		Code	Caustic Soda Plant		
				Contract no.	66-0215		
				Doc.	0215-ELT-22-EC-0001		
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<b>GENERAL</b>	001	Nominal System Voltage & Variation	:	415V	+/- 10%		
		Nominal System Frequency & Variation	:	50 Hz	+/- 5%		
		Power System & Neutral Grounding	:	3Ph 4W ; Solidly Earthed			
	002	Material of Construction, Degree of Protection :	a) Industrial : FRP, IP55 (DOL upto 75kW & star delta for 90kW & above)				
	003	Make	:	*			
	004	Final Paint Shade	:	Shade 632 of IS 5			
	005	Cable Entry	:	Bottom			
<b>COMPONENTS (see Note d)</b>	006	Auxiliary Supply	:	230V AC +/- 10%			
		<b>Switch^</b>					
		007	Make	:	*		
		008	Model No.	:	*		
		009	Duty & type	:	AC23 for motor / power / off load isolation		
			<b>Fuse^</b>				
		010	Make	:	*		
		011	Model No.	:	*		
		012	Type / Rupturing Capacity	:	HRC / 80 kA		
			<b>Power contactor^</b>				
		013	Make	:	*		
		014	Model No.	:	*		
		015	Operating / Min. drop out Voltage	:	85 to 110 % of rated Voltage / 75% of rated Voltage		
		016	Category of duty	:	AC3 for motor/ power feeders / AC6b for Capacitor feeder		
			<b>Auxiliary contactor</b>				
		017	Make	:	*		
		018	Model No.	:	*		
		019	Operating / Min. drop out Voltage	:	85 to 110 % of rated Voltage / 75% of rated Voltage		
			<b>Overload relay^</b>				
		020	Type	:	Bimetallic / Electronic		
		021	Make	:	*		
		022	Model No.	:	*		
			<b>Auxiliary relays</b>				
		023	Type	:	Electromechanical		
		024	Make	:	*		
		025	Model No.	:	*		
			<b>Timers</b>				
		026	Type	:	static		
		027	Make	:	*		
		028	Model No.	:	*		
			<b>AMMETER</b>				
		Make	:	AE,MECO,SIMCO,RISHABH, HAGER,VAISHNO,NIPPEN			
		Type / Dimensions	:				
		Accuracy class	:	CL-1			
		<b>Scale graduation</b>					
		a) Upto 1.2 FLC	:	Linear			
		b) Beyond 1.2 FLC	:	Suppressed scale upto eight times			
		<b>Space Heater</b>					
	029	Type of control	:	Thermostat with MCB			
	030	Location	:	Cable chamber / Bus bar chamber			
	031	Rating	:	As per space heating requirement			
<b>FACTORY ACCEPTANCE TEST</b>	032	<b>Routine tests</b>	:				
		a) Physical & dimensional checks					
		b) Insulation resistance test before & after HV test with 1000 V megger					
		c) Continuity & operation test					
		d) HV test at 2 kV for one minute					
	033	<b>Type tests</b>	:				
		a) Hydrotesting : On one sample flameproof starter panel casting of each type / Type test certificat	:	**			
		b) IP-55 test : On one sample of each type of Starter panel / Type test certificate.	:	**			
<b>PURCHASER INTERFACE</b>		Run Potebtial free contact					
		Fault Potebtial free contact					
		Auto manual status contact					

**Notes:**

- a) For items marked " \* ", data to be furnished / confirmed by vendor
- b) For items marked " \*\* " thus, data to be given / confirmed by Purchaser.
- c) For Items marked " ^ ", type II coordination shall be achieved.
- d) For specification of components like Push Button, Selector Switch, Ind. Lamps, Breaker Control Switch Ammeter TB, Internal wiring and name plate; refer LCS specification Sheet E3.

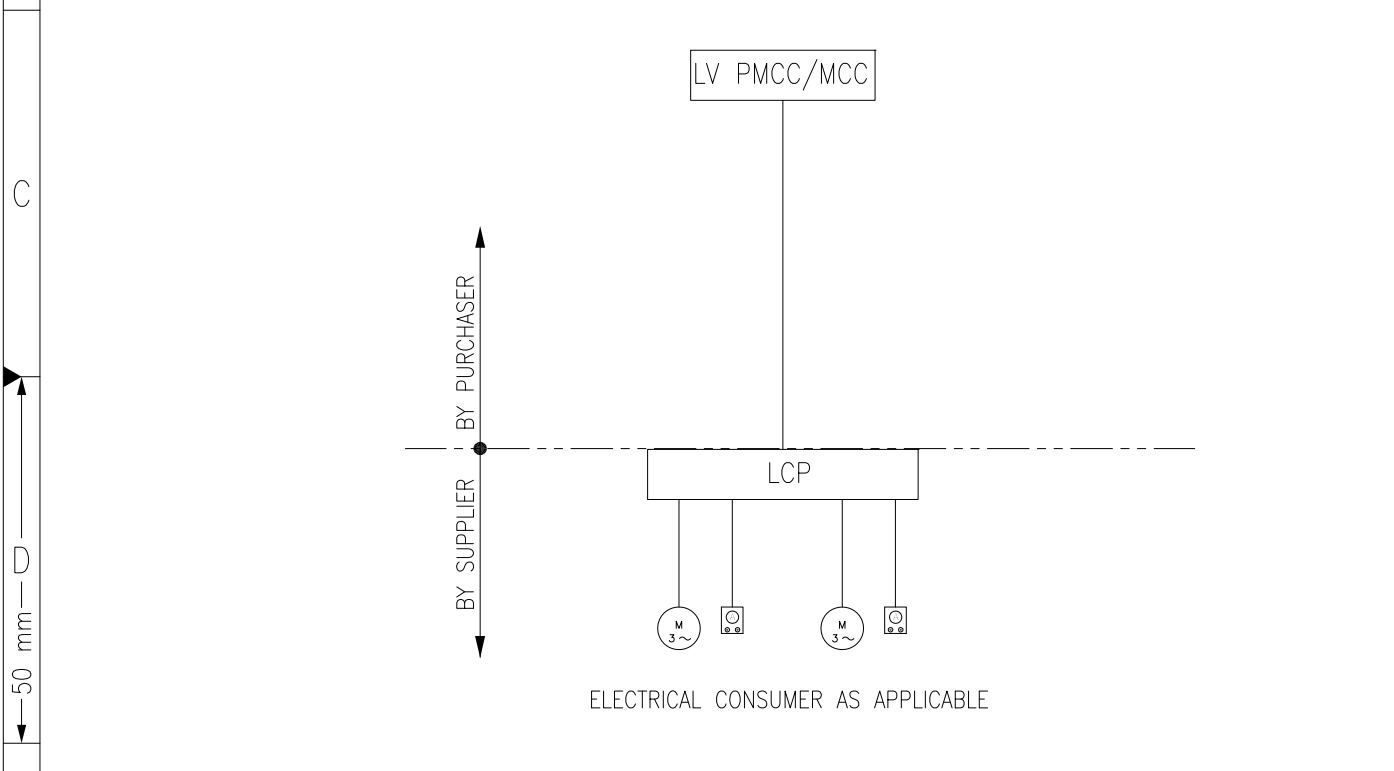
 		<b>PART E5</b> <b>MISCELLANEOUS ITEMS</b>		Code		Caustic Soda Plant	
				Contract no.		66-0215	
				Doc.		0215-ELT-22-EC-0001	
				Rev.		00	Page
CABLE GLANDS	001	Make	: Baliga, CEAG, Comet, Flexpro, Cosmos, Metro. Jaykris				
	002	Type	: Industrial, Weatherproof				
	003	Construction	: Double Compression with double-seal cone grip arrangement				
	004	Ingress Protection	: IP55 Min.				
	005	Material	: Nickel plated Brass, ISO metric thread, #1.5 mm thread pitch				
	006	Accessories	: a. UV resistant PVC hood, suitable for covering the entire gland body after				
			: b. 1 No. Check Nut				
			# Threads of glands to match supplied equipment cable entry thread				
	007						
LUGS	008	Make	: Dowells, Jainson, Comet				*
	009	Type	: Crimping Type				
	010	Material	: Aluminium for Al cables, Tinned Cu for copper cables				
			Vendor shall select suitable type of lugs for termination depending on type of terminals provided				
			Note: For bolted connection, heavy duty, long barrel type Al or Cu lugs to be used.				
BLANKING PLUGS	011	Make	: Baliga, CEAG, Comet, Flexpro, Cosmos, Metro. Jaykris				*
	012	Type	: Industrial, Weatherproof				
	013	Construction	: Nickel-plated Brass, ISO metric thread, #1.5 mm thread pitch				
	014	Ingress Protection	: IP55 Min.				
	015	Accessories	: 1 No. Check Nut				
			# Threads of Plugs to match the supplied equipment cable entry threads.				
EARTHING MATERIAL	017	Earth Bus -	: MS HDG				
	018	Main Earth Grid Size	: 75 mm x 10 mm				
	019	Equipment Earthing size	: 50 mm x 6 mm				
	020	Cable Type: Single core, Al, Stranded, PVC Insulated, Green / Yellow Cable					
			<i>If required project earthing schedule shall be attached.</i>				
Cable Trays	021	To be supplied by package Vendor	: Yes				
	022	Material	: FRP				
	023	Type	: Perforated 100/ 150 mm Wide, Ladder 300/ 600 mm Wide				
	024	Thickness	:				*
	025	Support Span	: 3 m				
	026	Height	: 50 mm for perforated and 100 mm for ladder type				
	027	Coupler Plate Material & Thickness	: MS HDG, 2.5mm thk				
Documents			GA Drawing along with Wiring Diagram and Bill of Material				
			QAP and ITP along with Type test certificates ( including CMRI certificate for FLP type)				

**Notes:**

- a) For items marked " \* ", data to be furnished / confirmed by supplier
- b) For items marked `\*\*` thus, data to be given / confirmed by Purchaser.
- c) QAP and Inspection Certificate shall be submitted for all bulk Materials as per relevant IS/IEC.

	1	2	← 50 mm →	3	4
A	LEGEND				SUPPLY BY
		MOTOR			SUPPLIER
		LOCAL CONTROL STATION			SUPPLIER
	-	MOTOR STARTER (IN LCP)			SUPPLIER
	-	CABLE BETWEEN PMCC/MCC & LCP			PURCHASER
	-	EARTHING, GLANDS, LUGS ETC. WITHIN PACKAGE UNIT BATTERY LIMIT			SUPPLIER
	-	CABLE BETWEEN LCP & MOTOR/LCS			SUPPLIER
	-	CABLE TRAY BETWEEN LCP & MOTOR/LCS			SUPPLIER

- NOTES:**
- SEPARATE LOCAL CONTROL STATION IS NOT REQUIRED IF LOCAL STARTER PANEL INCLUDES START, STOP PUSH BUTTON ALONG WITH LOCAL ANALOGUE AMMETER.
  - IF PROCESS INTERLOCK DEMANDS LOAD CURRENT SENSOR, VENDOR SHALL PROVIDE DUAL CHANNEL CURRENT TRANSDUCER FOR LOCAL INTERLOCK & REMOTE LOAD CURRENT INDICATION.
  - LOCAL STARTER PANEL SHALL COMPRISE OF CONTROL TRANSFORMER.



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Code		Contract No. 66-0215-700			Document ID 0215-ELT-22-FS-0001			Part 000	Rev. 00		
00	07.09.18	PPK	PPK	07.09.18	HGG	07.09.18	RBU	ISSUED FOR ENQUIRY	Cat. Code 5	Acc. Code -	Status IFI
Rev.	Date	Name Drawn/Prepared		Date	Name Checked	Date	Name Approved	Description	Acc. Code		
BAR-Code								Store Location: Server/Share \\p660215-MPE Store Location: Folder \\p660215\660215-mpe\AP_0_60.00_0_Electrical\AP_0_60.04_0_Specifications\ Store Name 08. PIN-LES-ELT-1003-A01.dwg			
Pro. Unit -		TON -		Group -		Type of Document FS		Sheet 1 / 1			
Con. Unit -		Scale -		Order No.		thyssenkrupp					

ISO A4	Date	Name	PUNJAB ALKALIES & CHEMICAL LIMITED NAYA NANGAL	Description BLOCK DIAGRAM FOR SCOPE SPLIT
	Drawn	07.09.2018 PPK		
	Prepared	07.09.2018 PPK		
	Checked	07.09.2018 HGG		
	Approved	07.09.2018 RBU		

PROJECT: 300 TPD CONVERSION PROJECT