

NTPC Limited

(A Government of India Enterprise)



**EPC PACKAGE FOR SETTING UP 700 TPD (2 X 350 TPD)
WASTE TO ENERGY PROJECT AT KAWAS, SURAT**

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

PART – B (ELECTRICAL)

(BOOK 2 OF 5)

SECTION - VI

BID DOC. NO.: CS-2600-001-9

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SECTION - VI

BID DOC. NO.: CS-2600-001-9

CLAUSE NO.	TECHNICAL REQUIREMENTS												
1.00.00	General Requirements												
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment. However, for equipment in air conditioned areas, design ambient temperature shall be 35 deg.C, if 2x100% air conditioning system is provided.												
1.02.00	All equipments shall be suitable for rated frequency of 50Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification. The turbo generator unit will be connected to its own step-up transformers for feeding power into the HV grid. The overall system shall be designed considering voltage variation of +/- 5% and fault level of 40kA for 11KV system.												
1.03.00	Contractor shall provide fully compatible electrical system, equipments, accessories and services for the entire station/plant in his scope as well as those specifically required by the Employer.												
1.04.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and International Codes & Standards, especially the Indian Statutory Regulations.												
1.05.00	The auxiliary AC voltage supply arrangement shall have 11 kV, 6.6KV, 3.3KV and 415V systems. It shall be designed to limit voltage variations as given below under worst operating condition: <table><tr><td>a)</td><td>11KV/6.6/3.3KV</td><td>+/- 6%</td></tr><tr><td>b)</td><td>415 V/240 V</td><td>+/- 10%</td></tr><tr><td>c)</td><td>220V/110V/48 V DC</td><td>-15% to +10%</td></tr></table>				a)	11KV/6.6/3.3KV	+/- 6%	b)	415 V/240 V	+/- 10%	c)	220V/110V/48 V DC	-15% to +10%
a)	11KV/6.6/3.3KV	+/- 6%											
b)	415 V/240 V	+/- 10%											
c)	220V/110V/48 V DC	-15% to +10%											
1.06.00	The preferred AC control supply voltage shall be 110V for all 415 V non breaker controlled feeders. Control supply voltages other than above may be offered by bidder based on the bidder's standard proven practice.												
1.07.00	The designed fault levels for various voltage level shall be restricted to the following values: 33 KV systems - 25KA rms for 1 second 11 KV systems - 40KA rms for 1 second 6.6 KV systems - 40KA rms for 1 second 3.3 KV systems - 40 kA rms for 1 second 415 V systems --50 kA rms for 1 second												
1.08.00	The nominal voltage of main DC system shall be 220V. DC batteries shall be designed for continuous float operation with trickle charge, hence all the associated components like batteries, battery chargers, DC motors, relays, contactors, timers etc shall be suitable for continuous operation at the maximum continuous battery float voltage including suitable temperature correction factors. In addition, the bidder may propose 110V, 48V or 24V systems as per requirements of control and instrumentation of his equipment and design.												
1.09.00	The Contractor shall furnish calculations of maximum loading and fault levels under the most onerous conditions for the various equipment/systems as defined else where in the												
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 1 OF 126									

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.10.00	specification to prove adequacy of their parameters. In case any equipment or system is found to be inadequate, it shall be changed/ modified without any additional liability to the Employer. The Contractor shall submit drawings/documents for Employer's approval in format furnished by Employer during detailed engineering. Transformer voltage ratios, taps, impedances and tolerances thereon, shall be so optimised so that the auxiliary system voltages under various grid and loading conditions are always within permissible limits and equipment are not subjected to unacceptable voltages during operation and starting of motors such as MDBFP etc. The vector groups of the transformers shall be so selected that all the buses of particular voltage level have same vector within the plant.			
1.11.00	Sizing & Design Generator Generator and its excitation system shall have a capability at least matching the declared maximum continuous rated output of the associated steam turbine at all power factors between 0.85 lagging and 0.95 leading with +3% to -5% frequency variation, terminal voltage variation of +/- 5% and combined voltage & frequency variation of 5%. It shall be ensured that when the Generator is working at this capability, no part of the Generator shall attain a temperature in excess of the temperature limits specified for Thermal Class 130 (B) insulation as per IEC-60034. Generator Transformer The rating of the Generator Transformer shall be suitable for continuous stable operation of unit at the rated nominal output at all power factors between 0.85 lagging and 0.95 leading. The minimum rating of the GT shall be 25 MVA. VCB for generator switching The Circuit Breaker shall be suitable for generator switching and shall have interrupting capability conforming to IEEE std C37.013 under most onerous fault condition i.e. system source or Generator source for the offered unit configurations. Generator Busduct The continuous rating of the Generator busducts shall be such that the maximum continuous peak output of the steam turbine unit under most onerous condition of operation at any ambient temperature between 0 deg C and 50 deg. C can be delivered at the rated power factors and allowable generator voltage variations without exceeding the permissible temperature rise limits as specified. Transformers All the transformers shall be sized based on the maximum load expected to be fed by them under most onerous conditions or as per the rating indicated in the Aux Power Supply system SLD. All transformers, except Generator Transformer (GT) are classified as Auxiliary transformers. All Auxiliary transformers (unless their ratings have been indicated in Single line Diagram or for which sizing criteria has been indicated in the specification), shall be sized so as to have 10% margin at design ambient conditions after considering final load requirements, including owner's load (if applicable), at peak load conditions and the No Load Voltage Correction Factor.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 2 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	No Load Voltage Correction Factor (= Transformer No Load voltage/ rated bus Voltage) shall be used for sizing of all transformers i.e. The transformer size = the calculated size X no load voltage correction factor (11.5/11, 3.45/3.3, 0.433/0.415). Adequate number of auxiliary transformers shall be provided to meet the demand on 11KV, 3.3KV and 415V systems under most onerous conditions, with the criteria that each 3.3KV / 415 V switchgear / MCC / DB shall be fed by 2x100% or 3 X 50 %, transformers / feeders, and these shall be rated to carry the maximum load including owner's load (if applicable) expected to be imposed. MV Switchgears Sizing of HT Switchgears (33/11kV/6.6/3.3kV) shall be in accordance with relevant clause and its sub-clauses covering sizing criteria, performance / reliability criteria, layout criteria, spare capacity requirements, standardization, etc. The switchgear boards shall have a single front, single tier, fully compartmentalized, metal enclosed construction complying with clause No. 3.102 of IEC 62271-200, comprising of a row of free standing floor mounted panels. The Service Class Continuity of Switchgears shall be LSC 2B-PM (as per IEC 62271-200). The Circuit Breakers / Contactors / Bus VTs shall be mounted on withdraw able trucks which shall roll out horizontally from service position to isolated position. The Switchgear shall have an Internal Arc Classification of IAC FLR 40kA 1 sec. The Circuit Breakers / Contactors shall be of Vacuum type. LV Switchgears Sizing of LT Switchgears shall be in accordance with relevant clause and its sub-clauses covering design considerations, performance / reliability criteria, spare capacity requirements, standardization, etc. All switchboards shall be of double front, draw out, metal enclosed, indoor, floor-mounted, free-standing type of bolted design. Entire bus bar system shall be insulated with PVC sleeves. Cable terminations located in cable alley shall be designed to meet the Form IVb Type 7 (as per IEC 60439) for safety purpose. All ACDBs, DCDBs, Solenoid Valve DBs and MCCs located on Stacker Reclaimer, Paddle feeders and Travelling trippers shall be of Fixed Module type. All 415V Circuit breaker modules and other MCC modules shall be fully draw out type. The Circuit Breakers / Contactors shall be of air break type & should conform to the requirements of IS / IEC 60947. MCCB shall be provided for 100A, 125A, 160A, 250A & 400A supply feeders. The motor feeders for 110kW & above shall be Air Circuit Breaker controlled. For 415V system, busduct assemblies shall be used for incoming connection from transformers to the switchboard and interconnecting sections between switchboards wherever transformer rating is 1000KVA or above. Cables and Bus Ducts The minimum rating of cable/ bus ducts shall meet the following criteria: All the cables and bus ducts feeding switchboards from transformers shall be sized based on transformer rating and considering the maximum negative voltage variations envisaged in the specifications. All the cables and bus ducts feeding transformers shall be sized based on current ratings of transformer at the minimum voltage tap of the transformer. All other		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 3 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	cables/bus-ducts shall be sized based on the load demand under most onerous conditions. Cables shall be selected to so as to limit maximum voltage drop at equipment terminals during normal operation and starting conditions well within permissible values. Cables shall be derated for the site ambient and ground temperatures, grouping and soil resistivity and cable laying configuration. All HT cables (except 33 KV voltage class) shall be of unearthed grade. The bidder shall furnish detailed cable selection/sizing criteria for Employer's approval. Earthing & Lightning Protection System The earthing system for plant shall be designed for a life expectancy of at least forty (40) years, for a system fault current of 40 kA for 1.0 sec. The minimum rate of corrosion of steel for selection of earthing conductor shall be 0.12mm per year. Grounding and lightning protection for the entire power plant, switchyard and other areas or buildings covered in the specification shall be provided in accordance with IS 3043, IS 2309, IEC 62305, IEEE 80 and IEEE 665. D.C. Systems Complete DC system, comprising of batteries, battery charges, relays, contactors, timers etc shall be suitable for continuous operation at the maximum continuous float voltage including suitable temperature correction factors. The battery sizing shall be done based on different types of continuous and intermittent loads including motor starting (wherever applicable) under complete blackout condition, for the duration specified so as to meet the system requirement. All intermittent loads shall be considered with minimum 1 minute duration. The battery shall be sized considering a minimum electrolyte temperature of 15 °C along with temperature correction factors as per relevant standard. An ageing factor of 1.25 shall be considered. The no. of cells, end cell voltage shall be considered based on the minimum and maximum voltage window and cable drop etc as per system requirement. Each system shall comprise of two nos. of batteries and two nos. of float-cum-boost chargers each rated for 100% capacity. DC scheme shall ensure that each critical consumer is fed from two different bus sections. DCDBs shall provide adequate number of feeders on each section. Boost/ fast charging time shall be as per worst operating condition and would satisfy technical requirements recommended by battery manufacturer. Each battery charger must be capable of supplying all the continuous D.C. loads (fed through both section of DCDB) plus the trickle charging current of both the batteries. In addition, each charger must have sufficient surplus capacity for running of the largest D.C auxiliary so that the battery is not drained during testing of the same. Battery charger should also be capable of boost/ fast charge the battery from completely discharged condition to fully charged condition without imposing any limitations under worse operating conditions.			
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 4 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
	The various DC Systems envisaged are:				
	Area	DC Voltage	Load	Minimum Battery Bank Rating	
	Unit	220 V	Total DC load of the unit at an acceptable voltage for at least 30 minutes	90AH NI Cd or 150AH Lead Acid Plante	
	Diesel Generator Set				
	For safe shut down of the plant under emergency condition and in case of total power failure, minimum one Diesel Generating set per unit shall be provided. DG set shall be capable of meeting 100 % of essential load requirements of generating unit including starting of the largest motor (DOL) with other loads connected without exceeding the permissible starting voltage drop. During Grid black-out condition, it shall be ensured that only the essential auxiliaries of unit are fed from Diesel generator & non- essential loads are automatically tripped.				
	INSULATION LEVEL				
	The insulation level for the transformer windings and bushings shall be as follows:				
		WINDING		BUSHING	
	Highest System Voltage	Rated Power Freq. withstand Voltage (kVrms)	Rated lightning impulse withstand voltage (kVp)	Rated Power freq. withstand voltage (kV rms)	Rated lightning impulse withstand voltage (kVp)
	0.433 KV	3	-	3	-
3.6 kV	10	40	11	40	
7.2 kV	20	60	22	60	
12 kV	28	75	30	75	
17.5 kV	38	95	42	95	
24kV	50	125	55	125	
36kV	70	170	77	170	
FAULT LEVEL					
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01	PAGE 5 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS																					
	Equipment through fault withstand capabilities under worst operating conditions duly taking into account negative tolerances on transformer, generator & maximum fault levels of source etc. shall be as follows : <table><tr><td>i)</td><td>All other transformers</td><td>- 2 seconds</td></tr><tr><td>ii)</td><td>Switchgears</td><td>- 1 second</td></tr><tr><td>iii)</td><td>Cables to the feeders protected by breakers</td><td>Main protection fault clearing time with 0.12 second minimum</td></tr><tr><td>iv)</td><td>Cables of all other feeders</td><td>As per fuse operating time</td></tr><tr><td>v)</td><td>11KV & 3.3KV cable screen</td><td>- 2 seconds for the adopted ground fault current,</td></tr><tr><td></td><td></td><td>- 1 second for the adopted ground fault current, for cables connected to SOLIDLY EARTHED SYSTEM</td></tr></table>				i)	All other transformers	- 2 seconds	ii)	Switchgears	- 1 second	iii)	Cables to the feeders protected by breakers	Main protection fault clearing time with 0.12 second minimum	iv)	Cables of all other feeders	As per fuse operating time	v)	11KV & 3.3KV cable screen	- 2 seconds for the adopted ground fault current,			- 1 second for the adopted ground fault current, for cables connected to SOLIDLY EARTHED SYSTEM
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1.12.00	NEUTRAL GROUNDING																					
1.12.01	Neutral earthing equipment shall be designed duly taking into account the maximum permissible operating voltage of the generator, voltage rise on load throw off (subsequent to detection of earth fault) field suppression time, ferro-resonance, etc. The generator shall be grounded through distribution transformer(if applicable) with secondary loading resistor, limiting the earth fault current to not less than capacitive current so as to restrict the over voltages caused due to capacitive currents. The neutral earthing equipment shall be rated to carry this current for at least 5 minutes considering the Generator Terminal Voltage under maximum field forcing conditions.																					
1.12.02	11KV/6.6/3.3KV system earthing shall be low resistance earthed type to limit earth fault current to 600A. The resistor shall be rated to carry this current at least for 10 seconds.																					
1.12.03	Neutrals of Generator Transformers and all LT Transformers (415V) shall be solidly earthed through bolted links..																					
1.12.04	220V DC system shall be kept ungrounded. However, 48V PLCC DC system (if applicable) shall be grounded type.																					
1.12.05	Diesel generator shall also be kept ungrounded (earthing through PT).																					
1.13.00	In fire hazardous areas like gas/ liquid fuel storage/ handling areas, lighting fixtures, switchgears shall be flame proof.																					
1.14.00	The responsibility of coordination with electrical agencies /TAC/Pollution control board and obtaining all necessary clearances shall be of the contractor.																					
1.15.00	Provenness of the Equipment, system, being offered by the bidder should satisfy the criteria Indicated in the “Provenness criteria” indicated elsewhere in the specification.																					
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 6 OF 126																		

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.16.00	The overall system shall be such that failure of any one auxiliary like transformer, DC battery, Battery charger and DG set shall not reduce the plant's generating capability or affect the safe shut down requirements of the unit.		
1.17.00	TYPE TESTS AND TEST REPORTS GENERAL (a.) All equipment to be supplied shall be of type tested design. The Contractor shall submit for Owner's approval the reports of all the type tests (as listed out in relevant clauses) carried out within last ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. (b.) In case the Contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost either at third party lab or in presence of client/owners's representative and submit the reports for approval. (d.) All routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price. (e.) The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01 PAGE 7 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	TECHNICAL REQUIREMENTS A. GENERATOR & AUXILIARIES B. MOTORS C. LT SWITCHGEAR D. HT & LT POWER CABLES & CONTROL CABLES E. STATION LIGHTING F. CABLING, EARTHING AND LIGHTNING PROTECTION G. HT SWITCHGEARS H. VFD I. BATTERY J. BATTERY CHARGER K. DIESEL GENERATORS L. FIRE PROOF CABLE SEALING PROTECTION SYSTEM M. POWER TRANSFORMERS & AUXILLARY OIL FILLED TRANSFORMERS N. DRY TYPE TRANSFORMER (LT INDOOR)			
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 8 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
	TECHNICAL REQUIREMENTS A. GENERATOR & AUXILIARIES 1.01.00 Contractor shall provide fully compatible electrical system, equipment, accessories and services. 1.02.00 Standard : IEC-60034 1.03.00 Paint shade : RAL 5012 1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations. 2.00.00 TYPE AND RATING 2.01.00 Type : Three phase, horizontal mounted, indoor installed, Thermal Class 155 (F) for Stator and Rotor winding insulation, cylindrical rotor type conforming to IEC-60034. 2.02.00 GENERATOR RATING 2.02.01 Generator and its excitation system shall have a capability at least matching the declared maximum continuous rated output of the associated steam turbine 2.02.02 Also the generator and its excitation system shall be capable of continuous stable operation without any excessive temperature rise at the peak output of the associated steam turbine under VWO condition, etc. and temperature rise shall be lower than those permissible for Thermal Class 130 (B) insulation as per IEC-60034. 2.02.03 Rated Parameters: 1. Power Factor 0.85 (lagging) 3. Frequency 50 Hz 3.00.00 OPERATIONAL REQUIREMENTS FOR GENERATOR 1. Voltage Variation +/-5% continuously at rated power factor. 2. Frequency Variation 47.5 Hz to 51.5 Hz. 3. Combined voltage and frequency variation 5% 4. Operation under unbalanced load As specified in IEC 60034-1 5. Operation under unsym- Negative sequence current I_2 expressed in per		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 9 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
4.00.00		metrical short circuit unit of rated current for a duration of 't' second such that the value of I_2^2t shall comply to IEC 60034-1 6. Voltage Wave form The Total Harmonic Distortion (T.H.D) shall be within the limit specified in IEC 60034-1. 7. Short Circuit withstanding capacity Capable of withstanding of 3 phase short circuit at the generator terminals when operating at rated MVA and power factor with 5 % over voltage for a period of not less than 3 seconds. 8. Impulse level & Surge Protection To be suitable for test voltage of 4U+5 KV. (where U is rated line to line voltage in KV). Lightning arrestor and surge capacitors of suitable rating shall be provided for the protection of generator winding.		
	CONSTRUCTIONAL FEATURES 1) General a) All components of the generator to be designed to avoid resonance at any of the frequency in the operating range and their multiples. b) Earthing brushes shall be provided at the turbine end bearing pedestal. It should be possible to increase the brush pressure while generator is working. In case any other arrangement for shaft earthing offered by Contractor, the same shall be accepted. Rotor earth fault monitoring shall be provided. c) Suitable generator drying arrangement shall be provided. 2) Generator Instrumentation The following minimum instruments shall be provided for each generator. For the requirements regarding type, make etc. of instruments and sensors, refer stipulations under relevant Sub-sections of Control & Instrumentation. A) Resistance temperature detectors (RTD) a) Temperature Detectors Resistance temperature detectors (RTD) to be duplex four / three wire type 100 ohms platinum, calibrated as per DIN standard and located at points where highest temperature is likely to occur during operation. In case simplex RTDs are provided they shall be double in quantity of those specified as below. b) Number and location i) Atleast Six (6) detectors-two (2) per phase uniformly distributed along the			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 10 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	circumference of the stator and located at the hottest possible zones. ii) Atleast Two (2) detectors per bearing for measurement of temperature. c) Interface All the above temperature measurement devices shall be connected to DDCMIS.		
5.00.00	GENERATOR EXCITATION SYSTEM		
5.01.00	A complete generator excitation and voltage regulating system shall be provided with the generator. The Generator excitation system shall be standalone system. All panels of excitation system shall be in single suite. It shall have provision of connection to TG MMI through network interface. However it shall also be able to operate the Generator excitation system without this interface.		
5.02.00	Characteristics The excitation system shall have matching characteristics suitable for satisfactory parallel operation with other generators in the plant.		
5.03.00	Fail safe requirement The various change over relays and other equipment associated with supply system other than AVR control supply, electronic circuits of either channel etc., shall be such that the loss of their control supply does not lead to the excitation system outage.		
5.04.00	Equipment design & sizing criteria		
5.04.01	Redundancy The excitation system shall have two (2x100%) AVR channels including complete independent power supplies and controls. Each channel shall be equipped for 'Auto Operation' with the facility for selecting either channel in 'Auto' or 'Manual' mode.		
5.04.02	Margin Each excitation system channel shall be designed to continuously carry currents of at least 10% above the field current requirement at generator MCR condition.		
5.05.00	Excitation system ceiling voltage > 1.5 times rated load excitation voltage.		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 11 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.06.00	Technical features	Voltage regulator shall have the provision of limiters to ensure the machine operation within the defined capability limits.		
5.07.00	In addition, one (1) 15 inches or more laptop shall also be supplied per unit to facilitate programming of DAVR and downloading of records locally. Suitable communication port, cables, interfacing software etc shall be provided. The configuration of the laptop shall be finalized during detailed engineering. The requisite license/ dongles shall be provided.			
6.00.00	General Requirements of Numerical Relays and Auxiliary Relays i. All numerical relays, auxiliary relays and devices comprising the Generator & Generator Transformer Protection Units shall be of types, proven for the application, satisfying the requirements specified else where and shall be subject to the Owner's approval. ii. The necessary auxiliary relays, trip relays, etc. required for complete scheme, interlocking, alarm, logging, etc. shall be provided. No control relay, which shall trip the circuit breaker when the relay is de-energized, shall be employed in the circuits. iii. Relays shall be provided with self-reset contacts except for the trip lockout, which shall have contacts with a manual reset feature. iv. Transients present in CT & VT connections due to extraneous sources in the HV system shall not cause damage to the numerical and other relays. CT saturation/ transients shall not cause mal-operation of numerical relays. v. Only DC/DC converters shall be provided in the solid state devices / numerical relays wherever necessary to provide a stable auxiliary supply for relay operation. Except for event logging, alarm and annunciation type of non-trip functions, protective relay contact multiplication shall be done through high speed trip relay only. vi. DC batteries inside protective relays necessary for relay operation shall not be acceptable. Equipment shall be protected against voltage spikes in the auxiliary DC supply. vii. Each numerical relay shall have a serial interface on the front for local communication to a Personal Computer and Printer. Facilities shall be provided to access each discrete protection function including modification in relay settings and monitoring of the relay from engineering /DR work station and same has to be provided in Control Equipment Room (CER) and permanently wired to all the numerical relays. The display of various measured parameters during normal as well as fault conditions on a segregated phase basis shall be provided. LEDs and a backlit LCD screen shall be provided for visual indication and display of messages related to major trips / alarms. Necessary multilevel password protection shall be provided. viii. The Protection Units shall be arranged to provide two independent, high performance and reliable systems housed in different panels with separate DC supplies, separate CT/VT cores, separate cables and trip relays to obtain 100%			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 12 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.01.00	redundancy. Associated trip relays of the two systems shall be separate, having a sufficient number of contacts for all the functions. ix. The numerical relays shall be provided with built-in disturbance recording functionality. The data from DR function shall be available in IEEE/COMTRADE format and shall be compatible with the dynamic relay test system being supplied under this contract. x. The manufacturer of the numerical protection system offered shall carry out the complete engineering, testing and commissioning on site of the offered protection equipment including the associated relays and protection panels. The testing and commissioning protocols for the numerical protection systems offered shall be approved by the Owner before commissioning on site. xi. Pick up range of the Binary inputs shall be minimum 70 V DC/AC. xii. All the numerical relays shall have adequate processor capability to carry out programmable scheme logics (PSL) required for implementing approved protection and control schemes over and above its inbuilt protection functions algorithm. xiii. All numerical relays shall be supplied with all the protection function/features in disabled condition. Relevant features/protection function shall be enabled at the time of commissioning at site as per approved logic and relay settings. xiv. Protection Units offered shall have adequate I/Os for function realization. Use of auxiliary relays (contact multiplication) shall be permitted only when the entire product range does not support any further hardware augmentation for additional I/Os. xv. Configuration/ scheme logics /relay settings shall be submitted by the Contractor for approval during detailed engineering.			
	Protection for Main Generator Circuit i.. For protection purpose, each Main Generator Circuit comprises the Generator, associated Generator Transformer, Dedicated Protection Units (PUs), comprising numerical relays for various protection functions, shall be provided for Main Generator Circuit to achieve comprehensive protection for all types of faults and abnormal operating conditions. Numerical relays constituting the PUs shall meet the requirements of clause 6.00.00 above. ii. The PU for each Generator Circuit shall be mounted in Generator Relay Panels to be located in the Main Control Equipment Room (CER) / Main Control Room. iii. The Engineering Stations shall allow following functionality related to Numerical Relays for all the Generator Circuits: a) Extract all the alarms, events and fault data captured by numerical relays. b) Change / upload Relay Settings for various numerical relays. iv. The numerical relays constituting the PU for Main Generator Circuit, shall be configured into two independent (i.e Duplicated) Numerical Protection Systems, each fed from a separate DC supply, such that one numerical protection system shall be always available to detect and operate for any type of fault in the Generator Circuit, under condition of failure of the other numerical protection system AND/OR on failure of the associated DC supply systems of			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 13 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.02.00	other numerical protection system. Group II of Generator protection shall be on a different hardware platform than Group I protection. The individual protection systems shall be connected to independent set of hand re-set trip relays. Trip circuit supervision shall be provided for continuous monitoring of trip relays, trip circuit and associated trip coils and the discontinuity shall be annunciated in Unit Further the system shall have facilities to accept digital input signals of various alarms and trip conditions of the Generator transformer, with complete galvanic separation. v. The alarm/status of each individual protection function and trip operation shall be communicated to Main Plant DDC. The numerical system shall have built-in features/ hardware interface to provide such inputs to DDC for analogue/digital values. vi. Protection function of two different equipment shall not be clubbed except 87GT			
	Relays / transducers for Main Plant DDC interface i. Required Interposing relays and one as mandatory spare shall be provided for each generator circuit breaker in respective Generator relay panels for closing and tripping of the generator breaker / VCB from Unit Control Room. These relays shall be energized main plant DDC system. ii. Following transducers shall be provided in generator relay panel for: a) Generator phase Currents and Phase Voltages b) Generator Frequency c) Generator power factor d) Generator Active and reactive power.			
	6.03.00 Time Synchronization of Equipments i). The Workstations, Protection units (PUs) and all numeric protection relays shall be synchronized with Time synchronization equipment an accuracy of 1ms.			
	6.04.00 Generator Disturbance Recorder i. One Disturbance / Fault Recorder (DFR) shall be provided for generator. ii. Offered DFR shall be Microprocessor based used to record the graphic form of instantaneous values of voltage and current in all three phases and neutral, open and closed positions of relay contacts and breaker during disturbances. iii. It shall have the facility of fast scan as well as slow scan to record transient as well as dynamic performance of the system. iv. The DFR for generator circuit shall have 8 analog/16 digital inputs in both slow scan and fast scan. v. Slow Scan Feature a) The input for slow scan rate shall at least be MW, MVAR, field voltage, frequency and generator terminal voltage. Any transducers, if required, shall be supplied.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 14 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	b) Shall be suitable to record the frequency excursions and response of generator field and governor control on system fluctuations. c) Shall have scan rate in the range of 2.0 to 50.0 Hz d) The Non-volatile memory in the DR shall be suitable for recording for a minimum of 15 minute at scan rate corresponding to the offered lowest scan rate with possibility to dedicate 10% of the memory space in pre-fault zone of recording. e) The frequency response of analog signals shall be 25 Hz or better. vi. Fast Scan Feature : a). Shall be used to record the graphic form of the instantaneous values of analog inputs such as voltages and currents in all the three phases, open delta voltage and neutral current in the primary circuits in the case of a short circuit (fault) and a disturbance in the Power System, as per the required technical parameters. b). Shall be provided with a self-monitoring facility. c). Fault / disturbance logs shall be clearly identified by Fault ID, Fault date and time (hour, minutes, seconds and ms). Time stampings on fault records shall be synchronized with a GPS clock. d). Shall have Scan rate of 1000 Hz or better for sampling each of the analog channels having a fundamental frequency of 50 HZ. The frequency response for these channels shall be DC on the lower side to 500 HZ or better on the upper side. Any interposing devices provided with the DFR system shall not compromise this frequency response. e). Shall be provided with sensors based on threshold values of voltage, current and frequency and rate of change of system frequency. External signals if required can also be used for triggering the DR. The starting sensors of the DFR, and pick-up, shall preserve the disturbance/fault data on the non-volatile solid state memory of the acquisition unit. The setting of the starting sensors shall be flexible, and shall have reasonable range/steps. The settings of the starting sensors shall be field programmable. f). The fault data from the Digital Fault Recording feature shall be available in IEEE / COMTRADE format. The data format shall be compatible for dynamic protection relay testing with the relay test kit to be supplied by the Contractor. The necessary equipment for interfacing and transfer of data shall also be supplied by the Contractor. g). The software shall be capable of the complete analysis of fault data, including the display of RMS/Peak envelop of any voltage / current, fundamental power frequency deviation, display of instantaneous values of Real Power (computed value), Reactive Power (computed value), power factor angle etc. A facility to edit the fault data shall also be provided. h). Following analogue values shall be recorded – ▪ Currents (R-phase, Y-phase, B-phase and Neutral), Voltages (V_{RY}, V_{YB}, V_{RB}, Open Delta)			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 15 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	▪ The pre-fault recording time shall be at least 200 ms and the post-fault recording time shall be at least 5.0secs. ▪ 8 Analogue channels (IR, IY, IB, IN, VRY, VYB, VBR AND OPEN DELTA) ▪ 16 Nos. Digital Channel ▪ Amplitude Résolution of Analogue Channel (minimum): 16 bit ▪ Event Resolution of Digital Channel (minimum): 1 milli sec ▪ Aux. voltage: 220VDC (+10%,-20%) vii. The DFR provided for generator circuits shall be wired to an Engineering / Fault Recording Station to be located in the respective CER./CCR. It shall be possible to extract the DFR records from this Engineering and Fault Recording Station for review and analysis. In addition, a laptop shall also be supplied to facilitate downloading of DFR records locally. Suitable communication port shall be provided for this in each of the DFRs. The minimum configuration of the laptop shall be i5, 8GB RAM, 500GB Hard disk. Same shall be finalized during detailed engineering.		
6.05.00	ABT Based Energy Meters : ABT-TOD Metering 0.2S accuracy class energy meters as per Discom specification suitable for ABT requirement shall be provided at each location indicated in respective tender Electrical Single line diagram for WTE Project (Drawing no:8011-999-POE-J-001) in a metering cubicle with Padlock arrangement. All ABT type meters shall be fed from accuracy class 0.2s CT and accuracy class 0.2 VT/PT.		
06.06.00	Panels i. All panels shall be free standing, floor mounting type and completely metal enclosed. Cable entries shall be from the bottom. Panels shall be of IP 31 class or better. ii. Panels shall have removable gland plates with glands made of brass and shall be suitable for armoured cables. iii. Thickness of panel sides shall be 2mm for Cold Rolled Sheet Steel, 2.5mm for Hot Rolled Sheet Steel. iv. Panels shall be painted. The colour of paint for exterior of the panel shall be as follows: I. Ends: Colour-Blue, Shade-RAL5012 II. Front and Rear: Colour-Grey, Shade-RAL9002		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01
			PAGE 16 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
06.09.00	iv) All equipment mounted on front and rear side of the panels shall have individual name-plates with equipment designation engraved. Each panel shall also have circuit/feeder designation name plate. v) All wiring shall be with 660V grade, single core, PVC insulated stranded copper conductor. 660V grade Terminal Blocks shall be provided. vi) Wires shall be vermin proof. Minimum size of conductor shall be 1.5 mm² in general, but for CT & VT circuits it shall be 2.5 mm². Minimum number of strands shall be three. vii) Contractor shall be solely responsible for completeness and correctness of all the wiring, and for proper functioning of the connected equipment.			
	Control Cabling Philosophy: i. Each three phase secondary core of each CT/CVT shall be brought to the associated relay panel from the marshalling box through independent cables. ii. Minimum 2.5 sq mmc able shall be used for realising Control and protection scheme. Further, Duplicated cores with at least 2 x 2.5 sq.mm CU/equivalent core cross-sectional area per connection shall be used for connection of all CT/CVT circuits. iii. VT leads used for tariff metering shall have an equivalent core cross-sectional area of at least 10 mm² CU/equivalent per phase/neutral connection. iv. All the interconnections (both AC/DC) between GRP, HT SWGRs and other systems required for the successful implementation of the control, interlocks and protection schemes for protection, control philosophy shall be in the scope of the bidder. v. Spare cores shall be provided as per following norms: a) Up to 3-core cable - Nil b) 5 Core Cable - Min. 1 core c) 7 to 14 core cables - Min. 2 cores d) More than 14 core - Min. 3 cores			
6.10.00	Relay Test Equipment i. The required relay test equipment shall comprise the following: a) Dynamic portable relay test system for allowing dynamic and steady state testing of IEC 61850 compatible IEDS also. b) Any other auxiliary items like phantom loads, etc. required for testing all the protection relays supplied under this contract. ii. It shall have the capability to replay the Disturbance / Fault records acquired by the numerical relays / stand-alone DR in IEEE / COMTRADE format or EMTP simulations, to facilitate dynamic testing of all the numerical relays supplied under this contract. The required software for steady state/dynamic testing of all the			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 18 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
06.11.00	numerical protection relays, energy meters and transducers, along with a laptop PC, shall also be supplied. iii. All commissioning tests on protection relays, energy meters and transducers shall be carried out with this relay test equipment being supplied under this contract and test reports shall be maintained as per the agreed protocols Type Test Requirements Test reports shall be submitted for PUs . Certificates of tests conducted in accredited Laboratories (accredited by the national accrediting body of the country where the lab is located) are also acceptable. i) Insulation Tests ii) Electrical Environment Tests iii) EMC tests iv) Atmospheric Environment tests v) Mechanical Stress tests Disturbance Recorder: Type test reports for the following tests shall be submitted i. High Voltage Impulse Test, class III as per IEC 60255-27 ed2.0 ii. High Frequency Disturbance as per IEC 60255–26 ed3.0, class III iii. Fast Transient Disturbance as per IEC 60255-26 ed3.0, class IV		
7.00.00	TYPE TESTS Type test report for the following test shall be furnished:		
7.01.00	LIST OF TYPE TESTS		
7.01.01	GENERATOR a) Instantaneous short circuit test to determine transient and sub-transient reactance parameters and to ensure stability of winding during sudden short circuit condition. b) Determination of negative sequence and zero sequence impedance.		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 19 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS											
7.01.02	c) Determination of voltage waveform factor and Total Harmonic Factor. d) Short circuit heat run test Excitation system (a) Exciter (If applicable) Temperature rise test at peak rating of excitation system. Ceiling duty condition shall also be demonstrated (b) Converter Assembly Temperature rise test at peak rating of excitation system. Ceiling duty condition shall also be demonstrated. (c) Input and output surge withstand capability test: The Oscillatory SWC tests shall be conducted as per ANSI / IEEE C37.90.1-2002 and/or The Fast transient SWC tests shall be conducted as per ANSI / IEEE C37.90.1-2002 / IEC 60255-22-04-2008.											
1.00.00	GENERATOR BUSDUCT CODES & STANDARDS <table><tr><td>ANSI</td><td>C 37.20, 37.23, 37.24</td></tr><tr><td>BS</td><td>3815, 3816</td></tr><tr><td>IS</td><td>2544, 2705, 3070, 3156, 5082, 8084, 9431</td></tr><tr><td>IEEE</td><td>298, 32</td></tr></table>				ANSI	C 37.20, 37.23, 37.24	BS	3815, 3816	IS	2544, 2705, 3070, 3156, 5082, 8084, 9431	IEEE	298, 32
ANSI	C 37.20, 37.23, 37.24											
BS	3815, 3816											
IS	2544, 2705, 3070, 3156, 5082, 8084, 9431											
IEEE	298, 32											
2.00.00	TYPE Metal enclosed, phase segregated and natural air cooled.											
3.00.00	RATING The Generator Busduct ratings shall be as per system requirements. Rated Voltage Corresponding to maximum continuous Generator terminal voltage Rated Current As per system requirement.											
4.00.00	TEMPERATURE LIMITS (considering effect of solar radiations) Generator Busduct Conductor/ Joints : 105 deg. C for silver plated joints, 90 deg. C for other joints Enclosure : 80 deg. C											
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 20 OF 126								

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	For outdoor portion the above limits shall be reduced to 97.5 deg. C, 82.5 deg. C and 72.5 deg. C respectively.			
5.00.00	DESIGN AND CONSTRUCTIONAL REQUIREMENTS			
1.01.01	Enclosure	Aluminum alloy with minimum thickness of 3mm, naturally cooled. Each section shall be welded construction. Sections may be joined through bolted connections. Suitable rain hoods for outdoor joints shall be provided. Adequate number of thermostat controlled space heaters or any other proven arrangement to prevent condensation to be provided.		
1.01.02	Phase barriers	Busduct phase barriers shall be made of Aluminum alloy of minimum thickness of 3.0 mm.		
1.01.03	Conductor	Shall be of high conductivity, aluminum alloy or Copper, sections shall be welded or bolted.		
1.01.04	Flexibles for Conductors	to be provided at all equipment termination and in bus duct run to accommodate thermal expansion / contraction, vibration and misalignment as also for providing adequate clearances for independently testing the equipment being connected.		
1.01.05	The busduct shall be provided with adequate number of thermostatically controlled space heaters of adequate capacity to maintain the internal temperature above the dew point to prevent moisture condensation within the busduct. Space heaters shall be rated for 240V, single phase, 50Hz AC supply. Bus Duct routings below ground level shall not be provided.			
1.01.06	Joints	Shall be bolted and flexible joints for conductor and enclosures.		
1.01.07	Painting	Conductors and inside surface of enclosures to be treated with mat black paint for efficient heat dissipation		
1.01.08	Bimetallic connectors	Shall be provided in case equipment terminals and material of bus conductor are different for the non silver plated joints.		
1.01.09	Insulators	Glazed porcelain/ high strength epoxy cast resin with a minimum creepage distance of 20 mm/kV. The insulators shall be designed and mounted to facilitate easy inspection, removal & inspection along with provision of conductor fastening by fixed and sliding joints.		
1.01.10	Seal Off Bushing	Shall be provided at terminations and wall crossing and at each of the switchgear terminations.		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 21 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS																				
1.01.11	Wall Frame Assembly Shall be provided wherever bus-duct penetrates plant walls Expansion bellows Neoprene/EPDM or metallic expansion bellows shall be provided on enclosures for thermal expansion, vibrations and misalignment. To be provided at terminations and as required.																				
1.01.12	Enclosure supports Shall be provided Hot dip galvanised mild steel support structures to withstand normal operation, vibration, thermal expansion and short circuit forces.																				
1.01.13	Minimum clearances shall be : <table><tr><td>Phase to phase</td><td>:</td><td>100 mm (for 6.6KV)</td></tr><tr><td></td><td></td><td>130 mm (for 11KV)</td></tr><tr><td></td><td></td><td>70 mm (for 3.3 kV)</td></tr><tr><td>Phase to earth</td><td>:</td><td>90 mm (for 6.6KV)</td></tr><tr><td></td><td></td><td>120 mm (for 11KV)</td></tr><tr><td></td><td></td><td>60 mm (for 3.3 kV)</td></tr></table>			Phase to phase	:	100 mm (for 6.6KV)			130 mm (for 11KV)			70 mm (for 3.3 kV)	Phase to earth	:	90 mm (for 6.6KV)			120 mm (for 11KV)			60 mm (for 3.3 kV)
Phase to phase	:	100 mm (for 6.6KV)																			
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Phase to earth	:	90 mm (for 6.6KV)																			
		120 mm (for 11KV)																			
		60 mm (for 3.3 kV)																			
1.01.14	Openings covered with louvers backed up with removable dust filters shall be provided at appropriate location to enable the busduct enclosure to breathe in a manner so that possibility of condensation is minimised.																				
1.01.15	Earthing Adequately sized galvanised mild steel or aluminum earthbar shall run along the length of busduct. Each enclosure section to be connected to the earthbar at both ends. Both ends of earthbar to be connected to plant earthmat. Alternatively the ground bus may be the enclosure itself, if a continuous electrical path can be provided of the same momentary withstand current rating as the main bus conductors.																				
6.00.00	Current Transformer The current transformers shall be epoxy cast-resin. All measuring CTs shall be 0.2 accuracy class and ABT type metering CT shall be 0.2s accuracy class. Protection CTs shall be PS/5P20 as applicable. CT secondary leads shall be brought out through non-magnetic metallic conduits to a marshalling box (MB) with degree of protection IP-55 (IS:13947 Pt.1). The MB shall be provided with removable aluminum gland plant. The facility for shorting and grounding shall be provided at the terminal blocks.																				
7.00.00	Voltage Transformer, Lightning arrester and Surge protection Cubicles a) The VT, LA and S.P cubicles shall be metal clad, dust and vermin proof, free standing, dead front assemblies housing VTs, surge capacitor, lightning arrester, V.T. L.V. side fuses etc. VTs shall be dual accuracy class (3P/0.2). b) Each VT, LA and SP cubicle shall have seal off busing. Lightning arrester shall be																				
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01																		
			PAGE 22 OF 126																		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	c) d) e) f) g) h)	Gapless type station class, hermetically sealed, connected between line and ground, specifically suitable for generator protection. A discharge counter shall be provided for each lightning arrester. The discharge counter register shall be visible without having to open the compartment door. Mineral oil filled/Askarel (PCBS) filled surge capacitor shall not be acceptable. The voltage transformer shall be epoxy cast-resin type, suitable for nominal voltage operation, connected from line to ground. The voltage transformer along with secondary fuses shall be mounted on draw out type carriage. Suitable guide slots and stops shall be provided to ensure easy withdrawal and positioning. The fixed and draw out contacts of voltage transformer primary shall be tinned or silver plated. In the disconnected position, the voltage transformer primary and secondary circuits shall be automatically disconnected. The draw out frame shall be grounded at all times. A reliable automatically operated shutter mechanism shall be provided for isolating and shrouding the bus bar live parts when the VT is in drawn out position. The secondary leads from the voltage transformer shall be extended to two separate fuses for dual accuracy PT and terminal cabinet flush mounted in the compartment. VT secondary leads shall be brought to marshalling box having sufficient number of terminals with 20% spare, to accommodate all VT leads. VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks, provided in the instrument transformer marshalling boxes. The facility for connecting to earthing grid shall be provided by the contractor through suitable connectors in the marshalling box with isolating links for testing of instrument transformers.		
8.00.00	Neutral Grounding Cubicle The transformer and resistor shall be located in separate cubicles/compartment adjacent to each other. The cubicles shall have hinged access doors capable of being pad locked. The transformer cubicle shall be made of angle frame steel construction with formed sheet sides. The resistor cubicle shall be made of angle frame steel construction with hot dip galvanised screen sides. Alternatively it can be painted with heat resistant paint suitable for 250 deg.C. The neutral grounding equipment shall be completely assembled, wired and connected to the neutral bus tap through seal-off bushing. The neutral grounding transformer shall be cast epoxy resin type natural air cooled single phase connected between generator neutral and ground. The loading resistor shall be formed of non-aging, corrosion resistant punched stainless steel grid element provided with necessary insulation and designed for indoor service for a temperature rise not exceeding 300 deg.C. All alarm, protection and indication leads shall be wired up to terminal blocks that shall be mounted in a IP:52 enclosure suitable for flush mounting and having a fully hinged cover with lock.			
9.00.00	Cubicle Construction (V.T., LA & S.P., N.G. Cubicle Etc.) All cubicles shall be fabricated from cold rolled sheet steel for minimum 2mm thick suitably reinforced to ensure structural rigidly. The degree of protection for all indoor cubicle shall be IP:52 except for neutral grounding resistor enclosure which shall be			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 23 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
10.00.00	minimum IP:23. Space heater, Illumination and Grounding Each cubicle shall be equipped with space heater with thermostat, internal illumination lamp, 240 V AC, 5A receptacle. Ground bus suitable for receiving two (2) numbers of 50x6mm galvanised steel flats shall be provided on each cubicle. Wiring All wiring shall be done with insulated stranded copper conductor of not less than 2.5 sq.mm cross-section with suitable lugs on both sides. The wiring inside the bus duct enclosure (i.e. for CT etc.) shall be suitable for operating in the ambient temperature existing inside the bus duct. Not more than two wires shall be connected to a terminal. Spare terminals equal in number to 20% of active terminals shall be furnished and these shall be uniformly distributed throughout the cubicle CT terminal blocks shall be of stud type and suitable for round type lugs with a facility for isolation, shorting and grounding. It shall be Elmex type CATD or equivalent. Name Plate Name plates shall be furnished for each equipment, disconnect link, voltage transformer compartment, lightning arrester compartment and fuse block, current transformer TB, Air pressurisation cubicles etc. Material for name plate shall be plastic / lamicoide 3mm thick using white letters on black background. Finish Except for supporting steel structures which shall be galvanised, all equipment including bus duct enclosure shall be finished with an under coats of high quality primer followed by two coats of synthetic enamel paint which shall have a thickness not less than 50 microns. The interior surface finish of bus duct enclosure shall be as per manufacturer's standard. The shade of exterior surface shall be shade RAL 5012 for busduct and equipment. The shade of interior surface of cubicles shall be glossy white. The identification tag shall be signal red shade ISC 537 or RAL 3001 Pre-treatment consisting of degreasing, de-rusting etc. shall be done on all fabricated parts before painting of cubicles, cabinets, marshalling boxes and galvanization of steel structures.		
	TYPE TESTS The following type tests reports to be submitted on each rating of bus ducts: (a.) Heat run test (the set up shall include 3 phase straight run, 90 deg. bend, set of flexible connection of each type, and necessary inspection covers). (b.) Short circuit withstand test (set up same as for heat run).		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 24 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	(c.) Impulse withstand test (set up shall include typical X-section with flexible connections, 90 degree bend, seal off bushing and inspection cover). (d.) Air leakage rate and Water tightness test (set up shall include inspection cover, flanged joint and bellow).	
	B. MOTORS	
1.01.00	CODES AND STANDARDS 1) Three phase induction motors : IS/IEC:60034 2) Single phase AC motors : IS/IEC:60034 3) Crane duty motors : IS:3177, IS/IEC:60034 4) DC motors/generators : IS/IEC:60034 5) Energy Efficient motors : IS 12615, IEC: 60034-30	
1.02.00	AC Motors: a) Squirrel cage induction motor suitable for direct-on-line starting. b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30. c) Crane duty motors shall be squirrel cage Induction motor as per the requirement. d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.	
1.03.00	DC Motors Shunt wound The voltage level for motors shall be as follows: a) Upto 0.2 KW : Single phase 240V AC / 3 phase	
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01 PAGE 25 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.04.00	415V AC			
	b) Above 0.2 KW and upto 200 KW	:	3 phase, 415V AC	
	c) Above 200 KW	:	3 phase, 11/6.6/3.3 kV AC	
	The bidder may adopt 415V or any MV level as mentioned above for the drives rated in the range of 160-210 KW. The voltage rating of the drives indicated above is for basic guideline. Minor variations in above can be accepted on case to case basis based on techno-economic considerations of the various sub-systems. Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard.			
	RATING			
1.05.00	(a)	Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.		
	(b)	Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.		
	(d)	The starting current for the DC motors shall be restricted to 3 times of the full load current.		
	TEMPERATURE RISE			
	Air cooled motors			
1.06.00	70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.			
	Water cooled			
	80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.			
	All the motors shall be painted with epoxy based paint of RAL 5012 (blue) shade. The thickness of finish coat shall be minimum 50 microns (with minimum total DFT of 100 microns).			
1.07.00	Degree of protection for various enclosures as per IS:4691, IEC60034-05 shall be as follows :-			
	i)	Indoor motors & cable box	- IP 54	
	ii)	Outdoor motors & cable box	- IP 55	
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 26 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.08.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Winding and Insulation (a) Type : Non-hygroscopic, oil resistant, flame resistant (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. (c) 11, 6.6 & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Pressure Impregnated i.e. resin poor method. The lightning Impulse & intertern insulation surge withstand level shall be as per IEC-60034 part-15. (d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters shall be provided.			
1.09.00	Noise level for all the motors shall be limited to 85dB(A).Vibration shall be limited within the limits prescribed in IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment			
1.10.00	Torque Requirements			
1.10.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.			
1.10.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.			
1.11.00	Starting voltage requirement (a) Up to 85% of rated voltage for ratings below 110 KW (b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW (c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 27 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.12.00.	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.			
	(a) Below 110KW	:	11.0	
	(b) From 110 KW & upto 200 KW	:	9.0	
	(c) Above 200 KW & upto 1000KW	:	10.0	
1.13.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and preferably 2 numbers duplex platinum resistance type temperature detectors.			
	11 KV & 6.6KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.			
1.14.00	3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material for single core cables) shall be provided.			
1.15.00	LIST OF TYPE TESTS			
	The following type test reports shall be submitted for each type and rating of HT motor			
	(a)	Degree of protection test for the enclosure followed by IR, HV and no load run test.		
	(b)	Terminal box-fault level withstand test for each type of terminal box of HT motors only.		
	(c)	Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15		
	(d)	Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15		
	LT Motors			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01
				PAGE 28 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Full load test to determine efficiency power factor and slip. 5. Temperature rise test. 6. Momentary excess torque test. 7. High voltage test. 8. Test for vibration severity of motor. 9. Test for noise levels of motor(Shall be limited as per clause no 2.01.07 of this section) 10. Test for degree of protection and 11. Overspeed test. 12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1			
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 29 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
	C. LT SWITCHGEAR & BUSDUCT 1.00.00 CODES AND STANDARDS IEC: 60947, IS: 8623 / IEC: 61439-1/2 2.00.00 TYPE Circuit Breakers Shall be air break, three pole, spring charged, horizontal drawout type, suitable for electrical operation. Switchgear Fully drawout type single front MCC Fully drawout type single front/Double front. ACDB/DCDB Fixed type single front/Double front 3.00.00 SYSTEM PARAMETERS 415VAC +/- 10 %(SOLIDLY GROUNDED) 50 Hz +3%/-5% 50KA RMS/ 1SEC (FAULT LEVEL) Internal arc fault containment-50 kA for 0.3s 220V/110V DC -15% to +10% 4.00.00 TEMPERATURE RISE The temperature rise of the horizontal and vertical busbars and main bus link including all power drawout contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg. C with silver plated joints and 40 deg. C with all other types of joints over an ambient of 50 deg C. 5.00.00 OPERATIONAL REQUIREMENTS 5.01.00 Breakers		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 30 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
5.01.01	Breakers shall have anti-pumping feature.			
5.01.02	The incomer and bus coupler breakers for switchgear shall be electrically operated with numerical relays. Motor feeders having rating of 110kW and above shall also be provided with breaker & numerical relay.			
5.01.03	Breakers shall have inherent fault making and breaking capacities. They shall have shunt trip coils. All breakers shall have built in interlocks for equipment and personnel safety.			
5.01.04	Paralleling of two supplies shall be avoided by interlocking except for switchgear where auto-changeover is provided. Breaker contact multiplication, if required, shall be through latch relay.			
5.01.05	Mechanical tripping shall be through red 'Trip' push button outside the panels for breakers, and through control switches for other circuits.			
5.01.06	Provision of mechanical closing of breaker only in 'Test' and 'Withdrawn' position shall be made. Alternatively, mechanical closing facility should be normally inaccessible, accessibility rendered only after deliberate removal of shrouds. It shall be possible to close the door with breaker in test position.			
5.01.07	Clear status indication for each circuit shall be provided through lamps, switch positions or other mechanical means.			
5.01.08	Trip Circuit Supervision shall be provided for trip coil monitoring.			
5.02.00	Switches, MCCB, Contactors and Fuses			
5.02.01	For I/C, B/C, Outgoing Feeder rating of 100A and above upto 400A, MCCB shall be provided. For feeder ratings below 100A, Switch fuse units shall be provided. Above 400A, Breaker shall be provided.			
5.02.02	Motor starter contactors shall be of air break, electromagnetic type suitable for DOL starting of motor, and shall be of utilisation category AC-3 for ordinary and AC-4 for reversing starters. For conveyor motors, minimum rating of power contactors shall be 200% of the full load current of the motors. DC contactor shall be of DC-3 utilisation category.			
5.02.03	Fuses shall be HRC type with operation indicator. Isolating switches shall be of AC 23A category when used in motor circuit, and AC 22A category for other applications. Fuse switch combination shall be provided wherever possible.			
5.03.00	Panels			
5.03.01	All switchgears, MCCs, DBs, panels, modules, local starters and push buttons shall have prominent engraved identification plates. Letter size shall be at least of 10mm height.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 31 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
5.03.02	Local push button stations shall have metal enclosure of die cast aluminium or rolled sheet steel of 1.6mm thickness & shall be of DOP IP55. The DOP shall be IP-65 in case the same are located in dusty areas. Push buttons shall be of latch type with mushroom knobs.			
5.03.03	Where breaker/starter module front serves as compartment cover, suitable blanking covers, one for each size of modules per switchboard shall be supplied for use when carriage is withdrawn.			
5.03.04	All non-current carrying metal work of boards/panels shall be effectively bonded to earth bus of galvanised steel, extending throughout the switchboard/MCC/DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.			
5.03.05	Suitable trolley arrangement shall be provided for breaker/starter modules. Two trolleys per switchgear room shall be provided so that top most breaker module of all types, sizes and rating can be withdrawn on trolley and lowered for maintenance purpose.			
5.03.06	The incoming connection to transformer of more than 1000KVA and inter-connecting sections between switchboards shall preferably be of busducts. The busduct enclosure shall be made of minimum 3mm thick aluminium alloy. The section of the busduct should have adequate strength to withstand internal and external forces resulting from the various operating conditions. Aluminium sheet hood shall be provided for outdoor busduct enclosure joints to provide additional protection against water ingress. The busduct top shall be sloped to prevent retention of water. The busduct enclosure shall have DOP of IP55 and paint shade RAL 5012.			
5.03.07	All draw-out modules shall be provided with "Closed door operation" feature wherein movement of the module from "Isolated" position to "Service" position & vice-versa and power ON / OFF operation of the module shall be possible only with the module door closed condition.			
5.03.08	DC fuse board shall consist of: -1 no.63A switch as incomer with meters, lamps and auxiliary contactors. -8 nos.outgoing feeders with 16A HRC fuses.			
5.03.09	AC fuse board shall consist of: -1 no 63A TPN SFU as incomer with lamps and meters. -9 nos.16A SPN SFU & 3 nos.16A TPN SFU as outgoing.			
5.03.10	Main lighting distribution board (MLDB) to be located in MCC room shall consist of:- a) Two(2) nos. x 100% rated, lighting transformers (415V/433V, delta/star, epoxy insulated, air cooled, dry type). Transformer shall be 50KVA(min.) rating. b) TPN SFU on primary and secondary side of the transformer c) 63A TPN SFU as outgoing feeders including 20% spare. d) Voltmeter, ammeter with selector switches, indicating lamps.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 32 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	e) The two incomers (One from Bus-A and One from Bus-B of the MCC) for the power supply to each MLDB shall be provided.			
5.04.00	Control, Protection & Metering Requirements			
5.04.01	Control circuits shall operate at suitable voltage of 110V AC or 220V DC/110V DC. Necessary control supply transformers having primary and secondary fuses shall be provided for each MCC, 2 x 100% per bus section. However the breakers shall operate on 220V DC The auxiliary bus bars for control supply shall be segregated from main bus bars. The control supplies shall be monitored.			
5.04.02	Contractor shall fully co-ordinate overload and short circuit tripping of breaker with upstream and down stream breakers/fuses/MCCBs motor starters. Various equipments shall meet requirement of Type-II class of coordination as per IEC.			
5.04.03	The protective relays shall be communicable numerical relays. These numerical relays shall be of types as proven for the application and shall be subject to Employer's approval. Numerical relays shall have appropriate setting ranges, accuracy, resetting ratio and other characteristics to provide required sensitivity.			
5.04.04	All equipments shall have necessary protections. However, following minimum protections shall be provided: 1) Contactor controlled motor feeders (Motors below 110 kW) a) Instantaneous short circuit protection on all phases through HRC cartridge type fuses rated for 80 kA rms (prospective breaking capacity at 415V). b) Thermal overload protection c) Single phasing protection for motors protected by fuses 2) Incomers / buscoupler / outgoing breaker feeders other than motor feeders. a) Three phase overcurrent protection (50) b) Three phase earthfault protection (50N) 3) Breaker Controlled Motor feeder a) Three phase short circuit protection (50) b) Three phase earthfault protection (50N) c) Thermal Overload protection(49) d) Under Voltage Trip Protection			
5.04.05	Meters / instruments All meters/ instrument shall be flush mounted on front panel, at least 96 sq.mm. size with 90 degree linear scales and accuracy class of 1.0.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 33 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.04.06	All motors feeders of rating $\geq 30\text{kW}$ & $< 100\text{kW}$ shall be provided with Ammeter. Each bus-section shall have bus VT, voltmeter with selector switch, and other relay and timers required for protection. Adequate control and selector switches, push buttons and indicating lamps shall be provided. Thermostatically controlled space heaters with switches shall be provided to prevent condensation.			
5.04.07	For all motor feeders having rating $\geq 30\text{ kW}$ and $< 110\text{ kW}$, contractor shall provide multifunction Digital Energy Meter with communication facility to display the current, voltage, power factor, power, energy related data locally and shall communicate these for remote metering /audit/analysis purposes. The technical specification for Digital indicating energy meter shall be as follow: a) Input Voltage: 110 V AC/220 V DC/110 V DC b) Input Current:1A c) Size: 96X96 SQ.MM d) Accuracy:0.5% for power & energy e) Mounting: Flush mounting f) Type:True RMS 3-PHASE V, I,KW,PF & KWHr indication g) 4 Digit, seven segment LED display/LCD display, with floating decimal h) Communication: In built RS 485 serial bus port i) Operating Frequency: 45 HZ-65HZ j) Dielectric Test: 2KV RMS for 1 minute k) Over current: 10 times for 3 sec. l) Aux. supply: 90V-300V AC/DC m) Compliance: EMC/EMI n) Field programmable CT ratio o) Analog Current Output (4-20 mA)			
5.04.08	In case of remote controlled breaker panels, following shall be ensured. Each feeder shall have local/remote selector switch. Closing from local shall be possible only in test position whereas closing from remote shall be possible in either service or test position. Tripping from local shall be possible only when local/remote selector switch is in local position. Tripping from remote shall be possible either			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 34 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	breaker in service position or selector switch in remote position.			
5.04.09	Hardwired contacts from the relay shall be wired to PLC / DCS system. The numerical relay shall be capable of measuring and storing values of a wide range of quantities, events, faults and disturbance recordings.			
5.04.10	The alarm / status of each of protection function and trip operation shall be communicated to PLC/DCS. The numerical relays shall have built in feature / hardware interface to provide such inputs to PLC / DCS for analog / digital values.			
5.05.00	Control from Remote Necessary hardware shall be provided in the switchgear panel like coupling relays (24V DC, with max. burden of 2.5VA), auxiliary relays, current/voltage transducers (4-20 mA, dual output) etc. to effect interlocks, exchange information / status and exercise control from remote.			
6.00.00	DESIGN AND CONSTRUCTIONAL FEATURES			
6.01.00	All 415V switch gear motor control centers (MCCs), AC & DC distribution boards (DB s), etc shall have following features :			
	1)	Shall be of metal enclosed, indoor, floor mounted and free standing type.		
	2)	All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2mm.		
	3)	Frame shall be enclosed in cold rolled sheet steel of thickness not less than 1.6mm.Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material) shall be provided for all panels.		
	4)	All switchboards/panels shall be of dust and vermin proof. All cutouts shall have synthetic rubber gaskets.		
	5)	All switchboards, MCCs and DB s shall have following distinct vertical sections.		
	a)	Completely enclosed bus bar compartment for horizontal and vertical bus bars.		
	b)	Completely enclosed switchgear compartments (one for each circuit housing circuit breakers, motor starter or switch-fuse feeder).		
	c)	A full-height vertical cable alley of adequate width shall be provided for power and control cables. Cable alley		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 35 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations located in cable alley shall be designed to meet the Form 4b as per IEC 61439 for safety purpose. Necessary grommets shall be provided at the cable entry of individual modules. In case of cable box, they shall be segregated with complete shrouding for individual feeders at the rear for direct termination of cables. d) For cable connection to circuit breaker, a separately enclosed cable compartment shall also be acceptable. e) Compartment for relays and other control devices associated with a circuit breaker, wherever necessary. f) The switchboards/MCC/DBs of 1600A & above rating shall be of DOP IP42 & of IP5X for less than 1600A rating. g) All 415V switchgears, MCC's, AC & DC distribution boards etc. shall be painted by powder coating process. Paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards. h) All draw out modules shall have distinct service, test and isolated positions with provision of external pad locking facility in each position. Power contacts shall get disconnected in both test and isolated positions whereas the control contacts shall get disconnected in isolated position only. 6) Busbars shall be of high conductivity aluminium alloy or copper. 7) The cross section of the horizontal bus bars shall be uniform through out the length of the switchboard and both horizontal as well as vertical bus bars shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral bus bar short circuit strength shall be same as the main bus bars. 8) Minimum air clearance in air between phases and phase-earth shall be 25 mm for busbars and cable terminations. For all other components, the Clearances shall be at least 10mm. Wherever above is not possible except for horizontal and vertical busbars, insulation shall be provided by anti tracking sleeving or barriers. However for horizontal and vertical busbars, clearances specified above shall be maintained even when busbars are insulated/sleeved. In case of DC DBs/ fuse boards, the busbar system shall be insulated or physically			
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 36 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS														
	segregated with barriers to prevent interpole short circuit. 9) Busbar insulators shall be of track-resistant high strength non-hygro- scopic, non-combustible type and suitable to withstand stresses due to over-voltages and short circuit current. Insulators and barrier of inflammable material such as Hylam shall not be accepted. 10) All types of relays and timer shall be subject to Employer's approval. They shall be flush mounted with connections from inside, and shall have transparent & dust tight cover, removable from front, drawout construction for easy replacemernt and testing facility. The auxiliary relays and timer may be provided in fixed cases. 11) Maxi terminal /cage clamp type terminal blocks shall be provided for signals to be interfaced with DCS/PLC. 12) The switchgears/MCC shall be designed to offer adequate level of safety to operating/ maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Bidder shall bring out the safety means provided to achieve above. A detailed instruction plate suitable for wall mounting shall be provided for each switchgear/MCC room describing various safe operating procedure/safety precautions for safe operation and maintenance of switchgear/MCC. 13) All current and voltage transformers as required for metering & protection specified shall be completely encapsulated cast resin insulated type. Incomers from transformers shall have CTs for transformer REF protection. The accuracy shall be as follows: <table><tr><td></td><td>CTs</td><td>PTs</td></tr><tr><td>Protection</td><td>5P20</td><td>3P</td></tr><tr><td>Metering</td><td>1.0</td><td>1.0</td></tr><tr><td>REF</td><td>PS</td><td></td></tr></table>				CTs	PTs	Protection	5P20	3P	Metering	1.0	1.0	REF	PS	
	CTs	PTs													
Protection	5P20	3P													
Metering	1.0	1.0													
REF	PS														
6.02.00	Indicating lamps shall be cluster LED type.All overload relays shall have overload reset push button.														
6.03.00	Switchgear/MCC shall have bottom cable entry.														
6.04.00	Contractor shall provide twenty (20) % or minimum one spare feeder for each type and rating of the out going feeders provided on each Bus section of that MCC.														
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01 PAGE 37 OF 126												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.00.00	TYPE TESTS			
7.01.00	L. T. SWITCHGEAR			
	(A) The following type test certificates of LT Switchgear and MCC panels shall be submitted.			
	1)	Circuit breaker of each rating		
	a)	Test sequence 1		
	b)	Combined test sequence (With Circuit breakers mounted inside the Switchgear panel)		
	2)	Complete design verification of Switchgear/MCC Panels as per IEC 61439 Part-1, Annexure-D		
	3)	Internal arc test for Personnel and Assembly Protection as per IEC/TR 61641		
	4)	MCC modules of any three ratings, as selected by the Employer, for class - II protection Co-ordination.		
	5)	Test for single phasing protection feature on 3 nos. bimetallic thermal overload relay selected by Employer. The relay shall be tested for compliance with manufacturer's printed / declared characteristic curve.		
	(B) Type test Reports for numerical relays.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01
				PAGE 38 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	D. HT & LT POWER CABLES & CONTROL CABLES			
	CODES AND STANDARDS			
	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes :			
	IS:7098 (Part -II)	Specification for Cross linked polyethylene insulated PVC sheathed cables. Part-II: For working voltages from 3.3 KV upto and including 33 KV.		
	IS : 3975	Low Carbon Galvanized steel wires, formed wires and tapes for armouring of cables.		
	IS : 4905	Methods for random sampling.		
	IS : 5831	PVC insulation and sheath of electrical cables.		
	IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.		
	IS : 8130	Conductors for insulated electrical cables and flexible cords.		
	IS : 10418	Specification for drums for electric cables.		
IS : 10810	Methods of tests for cables.			
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.			
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 39 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.00.00	IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.		
	IS : 3961	Recommended current ratings for cables		
	IEC- 332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).		
	TECHNICAL REQUIREMENTS			
	2)	All cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.		
	3)	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.		
	4)	Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.		
	5)	XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.		
	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.			
	For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanized steel as follows :			
Calculated nominal dia. of cable under armour		Size and Type of armour		
Upto 13 mm		1.4mm dia GS wire		
Above 13 & upto 25mm		0.8 mm thick GS formed wire / 1.6 mm dia GS wire		
Above 25 & upto 40 mm		0.8mm thick GS formed wire / 2.0mm dia GS wire		
Above 40 & upto 55mm		1.4 mm thick GS formed wire /2.5mm dia GS wire		
Above 55 & upto 70 mm		1.4mm thick GS formed wire / 3.15mm dia GS wire		
Above 70mm		1.4 mm thick GS formed wire / 4.0 mm dia GS wire		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01
				PAGE 40 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5)	The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm-sq.mm/mtr at 20 deg.C. The types and sizes of aluminium armouring shall be same as mentioned for galvanised steel at 2.06.00 above.			
6)	Distinct extruded PVC inner sheath of black colour as per IS:5831 shall be provided for the cables as follows:			
a).	For all multicore cables.			
b).	For single core armoured cables, where armouring is not being used as metallic screen.			
	Outer sheath shall be of PVC black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.			
	(a.) Oxygen index of min. 29 (Test method as per IS 10810 Part-58)			
	(b.) Acid gas emission of max. 20% as per IEC-754 (Part-I)			
	(c) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM-D-2843.			
	Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:			
	1 core - Red, Black, Yellow or Blue			
	2 core - Red & Black			
	3 core - Red, Yellow & Blue			
	4 core - Red, Yellow, Blue and Black			
	For reduced neutral conductors, the core shall be black			
	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.			
	(a.) Cable size and voltage grade - To be embossed			
	(b.) Word 'FRLS' at every 5 metre - To be embossed			
	(c.) Sequential marking of length of the cable in metres at every one metre -To be embossed / printed			
	The embossing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.			
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.			
2.12.00	Allowable tolerances on the overall diameter of the cables shall be +\2 mm maximum, over the declared value in the technical data sheets.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 41 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC										
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.													
8)	Allowable tolerances on the overall diameter of the cables shall be +\2 mm maximum over the declared value in the technical data sheets.													
9)	Cable lengths shall be considered in such a way that straight through cable joints is avoided.													
10)	All Cables shall be armoured type													
11)	All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.													
12)	All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and sizes shall be of 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm However for cable sizes upto 120 sq.mm. both XLPE insulated & PVC insulated LT power cables are acceptable													
3.00.00	Cable selection & sizing													
3.00.01	Cables shall be sized based on the following considerations: a) Rated current of the equipment b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage c) Short circuit withstand capability Control cables shall be sized based on the following considerations: (a) The minimum conductor cross-section shall be 1.5 sq.mm. (b) The minimum number of spare cores in control cables shall be as follows: <table><tr><td>No. of cores in cable</td><td>Min. No. of spare cores</td></tr><tr><td>2C, 3C</td><td>NIL</td></tr><tr><td>5C</td><td>1</td></tr><tr><td>7C-12C</td><td>2</td></tr><tr><td>14C & above</td><td>3</td></tr></table>				No. of cores in cable	Min. No. of spare cores	2C, 3C	NIL	5C	1	7C-12C	2	14C & above	3
No. of cores in cable	Min. No. of spare cores													
2C, 3C	NIL													
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Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 42 OF 126										

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.00.02	Derating Factors Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes: a) Variation in ambient temperature for cables laid in air b) Grouping of cables a) Variation in ground temperature and soil resistivity for buried cables. The bidder shall furnish detailed cable selection/sizing criteria for Employer's approval		
	4.00.0 CONSTRUCTIONAL FEATURES 19/33 KV Grade Power Cables: Cables shall conform to IS 7098 Part-II. These cables shall be multi-stranded, compacted circular aluminium conductor, XLPE-insulated, metallic screened PVC outer sheathed. The conductor screen and insulation screen shall both be of extruded semiconducting compound and shall be applied along with the XLPE insulation in a single operation of triple extrusion process so as to obtain continuously smooth interfaces. Method of curing for 19/33 KV Cables shall be "dry curing / gas curing ". The metallic screen for each core shall be capable of carrying the system earth fault current and shall consist of copper wires or tape with minimum overlap of 20%. However, for single core armoured cables, the armouring shall constitute the metallic part of the screening. 11/11KV, 6.6/6.6KV Grade Power Cables: Cables shall conform to IS-7098 Part-II. These cables shall be multi-stranded, compacted circular aluminium conductor, XLPE-insulated, metallic screened, PVC outer sheathed. The conductor screen and insulation screen shall both be of extruded semiconducting compound and shall be applied along with the XLPE insulation in a single operation of triple extrusion process so as to obtain continuously smooth interfaces. Method of curing shall be "dry curing / gas curing / steam curing ". The metallic screen for each core shall be capable of carrying the system earth fault current and shall consist of copper wires or tape with minimum overlap of 20%. However, for single core armoured cables, the armouring shall constitute the metallic part of the screening . 3.3/3.3kV Grade Power Cables: Cables shall conform to IS: 7098 Part - II. These cables shall be multi- stranded, compacted circular aluminium conductor, XLPE insulated, metallic screened, PVC outer sheathed. The metallic screen of each core shall consist of copper wires or tape with minimum overlap of 20%. However, for single core armoured cables, the armouring shall constitute the metallic part of the screening. The metallic screen of each core shall be capable of carrying the system earth fault current Method of curing for cables shall be "dry curing / gas curing / steam curing". 1.1 KV Grade Power Cables		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 43 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.00.00	(a) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured, PVC outer-sheathed conforming to IS: 7098. (Part-I). (b) 1.1KV grade PVC power cables shall have aluminium conductor (compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured, PVC outer-sheathed conforming to IS:1554 (Part-I). (c) 1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968 1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I). 1.1 KV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968. Minimum conductor size shall be 2.5 sqmm.			
	CABLE DRUMS (a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418. (b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled. (c.) The standard drum length of LT power cable with a maximum tolerance of +/- 5% may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter for single core cable excluding 630 sqmm size, and 750 meter for multicore cable & single core 630 sqmm.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 44 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
6.00.00	TYPE, ROUTINE AND ACCEPTANCE TESTS			
6.01.00	The reports for the following type tests shall be submitted for one size each of 19/33kV, 11/11KV, 6.6/6.6KV and 3.3/3.3KV cables, LT XLPE and LT PVC Power and control cables. Size shall be decided by the employer during detailed engineering			
	S. No	Type Test Conductor	Remarks	
	1.	Resistance test		
		For Armour Wires / Formed Wires		
	2.	Measurement of Dimensions		
	3.	Tensile Test		
	4.	Elongation test		
	5.	Torsion test	For round wires only	
	6.	Wrapping test		
	7.	Resistance test		
	8(a)	Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.	
	8(b)	Adhesion test	For GS wires/formed wires only	
		For XLPE insulation & PVC Sheath		
	9.	Test for thickness		
	10.	Tensile strength and elongation test before ageing and after ageing		
	11.	Ageing in air oven		
	12.	Loss of mass test	For PVC outer sheath only.	
	13.	Hot deformation test	For PVC outer sheath only.	
	14.	Heat shock test	For PVC outer sheath only	
	15.	Shrinkage test		
	16.	Thermal stability test	For PVC outer sheath only	
	17.	Hot set test	For XLPE insulation only	
	18.	Water absorption test	For XLPE insulation only	
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 45 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
6.02.00	S. No	Type Test	Remarks
	19.	Oxygen index test	For PVC outer sheath only
	20.	Smoke density test	For PVC outer sheath only
	21.	Acid gas generation test	For PVC outer sheath only
	22	Flammability test as per IEC-332	For completed cable only
	Part-3 (Category -B)		
	The following type tests reports shall be submitted for each type (voltage grade) & size of the cable:		
	S. No.	Type Test For all cables	
	1.	Insulation resistance test (Volume Resistivity method)	
	2.	High voltage test	
For cables of 19/33kV, 11/11KV & 6.6/6.6KV Grade only.			
3.	Partial discharge test		
4.	Bending test		
5.	Dielectric power factor test		
	a) As a function of voltage		
	b) As a function of temperature		
6.	Heating cycle test		
7.	Impulse withstand test		
Indicative list of tests/ checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of H.T. Cables enclosed.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01
			PAGE 46 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
1.00.00 1.01.00 1.02.00 1.03.00 1.04.00	E. STATION LIGHTING GENERAL This specification covers the general description of design, manufacture and construction features, testing, supply, installation and commissioning of the Station Lighting system equipment. Lighting Panels, Switch-boxes, Receptacles and Junction Boxes IS:2147 Degree of protection provided by enclosures for low-voltage switchgear and control gear. IS:1293 Plugs & socket outlets of rated voltage upto and Including 250volts & rated current upto and including 16 Amps. IS:2551 Danger notice plates. IS:13947 Low voltage switchgear and controlgear IS:3854 Switches for domestic and similar purposes. IS:6875 Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto and including 1000 V AC and 1200 V DC. IS:13703 Low voltage fuses for voltages not exceeding 1000V AC or 1500 V DC. Lighting Wires/Cables IS:694 PVC insulated cables for working voltages upto and including 1100 V IS:3961 Recommended current ratings for cables.(PVC Insulated and PVC sheathed heavy duty cables and light duty cables). IS:8130 Conductors for insulated electric cables and flexible cords. IS:10810 Methods of tests for cables. LED Luminaries 16101:2012 General Lighting. LEDs and LED modules Terms and definitions 16102(Part 1):2012 Self Ballasted LED Lamps for General Lighting Services. Part-1 Safety Requirements. 16102(Part 2):2012 Self Ballasted LED Lamps for General lighting Services. Part-2 Performance Requirements. 16103(Part I):2012 LED modules for General lighting Safety Requirements.			
	Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	
	Electrical specification IIIB-01		PAGE 47 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	15885(Part 2/Sec. 13) :2012	Lamp control gear Part 2 particular Requirements Section 13 d.c. or a.c.	
	16104:2012	Supplied Electronic control gear for LED modules d.c. or a.c. Supplied Electronic control gear for LED modules - Performance Requirements.	
	16105:2012	Method of Measurement of Lumen maintenance of Solid-state Light (LED) Sources.	
	16106:2012	Method of Electrical and photometric Measurements of Solid State Lighting (LED) Products	
	16107:2012	Luminaires Performance	
	16108:2012	Photobiological safety of Lamps and Lamp Systems	
	IS 513	Cold rolled low carbon steel sheets and strips	
	IS 12063	Classification of degree of protection provided by enclosures.	
	IS 14700	Electro magnetic compatibility (EMC) – Limits (Part 3/Sec. 2) for Harmonic current emission – THD < 15% (equipment, input current < 16 Amps. per phase.	
	IS 9000 (Part 6)	Environment testing: Test Z – AD: composite temperature/humidity cyclic test.	
	IS 15885	Lamp control gear: particular requirements for (Part 2/Sec. 13) DC or AC supplied electronic control gear IS 16004 – 1 and 2) for LED modules.	
	IS 4905	Method for random sampling	
2.00.00	LIGHTING SYSTEM DESCRIPTION		
2.01.00	The illumination of various indoor and outdoor areas in the main plant & offsite area shall be provided as described here. The lighting system of various areas shall comprise of the following systems as identified in Annexure-B:		
	(a)	Normal AC Lighting System	
	(b)	Emergency AC Lighting System	
	(c)	DC Lighting System	
2.02.01	Normal AC Lighting System		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01 PAGE 48 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.02.02	Normal AC lighting system 415V, 3Phase, 4wire, will be fed from lighting panels (LPs) which in turn will be fed from the lighting distribution boards (LDBs)/Switch board MCC. Emergency AC Lighting System This system shall be provided for certain important areas in the main plant. The lighting fixtures connected to this system shall be normally "ON" along with the normal AC system. These will be fed from emergency lighting panels (ELPs) which in turn will be fed 3-phase, 4-wire supply from the emergency lighting distribution boards (ELDB'S). These lights will go off for a few seconds in case of AC supply failure at Emergency Switchgear, but shall be automatically restored when Emergency Switchgear is energised by Diesel generator set.			
2.03.00	DC Lighting System			
2.03.01	At strategic locations in the main plant, a few lighting fixtures fed from 220V, DC supply, shall be provided to enable safe movement of operating personnel and access to important control points during an emergency, when both the normal AC and Emergency Lighting system fail. These lighting fixtures will be fed from 220V DC LDBs which in turn will be fed from DC lighting panels.			
2.03.02	The supply to the DC lighting panels shall be automatically switched ON in case of loss of AC supply at station service switchgear as well as Emergency switch-gear. The DC supply will be automatically switched OFF after about 3 minutes following the restoration of supply to normal AC or emergency AC lighting system.			
2.03.03	Emergency DC lighting is to be provided, through self-contained DC emergency fixtures with four hours back-up duration, at strategic locations, in auxiliary/offsite buildings wherever DC supply system is not available. The fixtures shall be switched 'ON' automatically in case of failure of AC supply.			
3.00.00	DESIGN PHILOSOPHY 1. A comprehensive illumination system shall be provided in the entire project areas under bidder's scope. 2. All outdoor lighting system shall be automatically controlled by synchronous timer. Provision to bypass the timer shall be provided in the panel. 5. Different Lighting Systems envisaged for various plant areas are indicated in Annexure-B: While finalizing the detailed layout of lighting fixtures, the position/location and layout of equipments should be taken into account to have adequate illumination at desired locations. 6. LED Luminaires: LED Luminaires shall be used for the lighting of all the indoor & outdoor areas in bidder's scope. However for DC lighting, hazardous areas & aviation lighting etc. conventional type luminaires shall be used. However, aviation light in Lighting Mast shall be of LED type. In false ceiling area LED luminaires shall be recessed mounting type & in non-false ceiling area the LED luminaires shall be surface mounting type. The individual lamp wattage for LED shall be upto 3 watt. Fractional wattage LEDs are also acceptable. The LED chip efficacy shall be min 120 Lm/W. The luminaire efficacy shall be not less than 80 Lm/W. Suitable heat sink shall be designed & provided in the luminaire. The LED used in the luminaires shall have colour rendering index (CRI) of Min 80. Colour designation of LED shall be "cool day light" (min 5700K) type for indoor areas. However for outdoor areas, the colour			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 49 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	temperature of LED shall be min. 4000K, including rough & dust prone areas. LED shall conform to the LM 80 requirements. The max. junction temperature of LED shall be 85 deg C. Further the lumen maintenance at this temperature shall be min 90%. The THD of LED Luminaires shall be less than 10%. Further the EMC shall be as per IS 14700. The power factor of the luminaire shall not be less than 0.9. The marking on luminaire & safety requirements of luminaire shall be as per IS standards. Suitable heat sink with proper thermal management shall be designed & provided in the luminaire. The connecting wires used inside the system, shall be low smoke halogen free, fire retardant type and fuse protection shall be provided in input side specifically for LED luminaires. The entire housing shall be dust and water proof protection as per IS 12063. 7. Driver Circuit LED modules and drivers shall be compatible to each other. The LED module driver's ratings and makes shall be as recommended by corresponding LED chip manufacturer. LED Drivers shall have following control & protections:- • Suitable precision current control of LED. • Open Circuit Protection • Short Circuit Protection • Over Temperature Protection • Overload Protection • Surge Protection 8. 9. All lighting fixtures and control gears shall be powder coated. All outdoor fixtures shall be weather proof and of min. IP55 degree of protection. 10. (a) Lighting panels shall be powder coated with color shade RAL9002. Lighting panels shall have min. IP55 degree of protection. (b)Lighting panels shall be constructed out of 2 mm thick CRCA sheet steel. The door shall be hinged and the panel shall be gasketted to achieve specified degree of protection (d) Terminal bocks shall be 1100 V grade, clip-on stud type, made up of polyimide 6.6 or better suitable for terminating multicore 35 or 70 Sq. mm. stranded aluminium conductor incoming cable and 10 Sq. mm. stranded aluminium conductor for each outgoing circuits voltage. All terminals shall be shrouded, numbered and provided with identification strip for the feeders. (e) MCB's shall be current limiting type with magnetic and thermal release suitable for manual closing and automatic tripping under fault condition. MCB's shall have short circuit interrupting capacity of 9 KA rms. (f) Contactors of AC lighting panels shall be 3 no's, 32 A, 3 pole continuous duty MCB, load make-break type suitable for 415 V, 3 phase 4 wire system. HRC fuses with suitable mounting base of 125A shall be provided in the incomer of Contactors in the LP.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 50 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS														
	(g) DC switches shall be rotary type, 2 pole, continuous duty, load break type, quick make quick break, suitable for 220 V DC, 2 wire system. Switch knob shall be provided with ON/OFF indication. (h) Programmable Digital Timer shall be Electronic Astronomical Almanac Time switch with battery back up of min. TEN years, 4 Digit LED display, 24 hours range, manual override facility, 10 Amp 3 relay output, with NO/NC Contacts suitable for operation on 240V single phase AC supply. (i) Each lighting panel (LP-3) shall be fed from a 415V/42V, 3 phase-4 wire, 3 KVA transformer. The transformer shall be located inside the lighting panel itself. Transformers shall be dry type, natural air cooled with class F insulation or better. Impedance of transformer shall be 5%. Transformers shall be tested as per IS:11171. Off-circuit tap changer with +/- 5% in steps of +/- 1.25% tapping shall be provided. One minute power frequency withstands voltage for lighting transformer shall be 2.5 KV. 11. Wires of different phase shall normally run in separate conduit. 12. Power supply shall be fed from 415 / 240 V normal AC supply, emergency AC supply and 220V DC supply through suitable number of conveniently located lighting distribution boards (LDB) and lighting panels (LP). AC lighting supply shall be isolated from main supply by isolation transformers of max. rating of 100KVA and fault level restricted to 3 KA at Lighting Panels. 13. Atleast one 6/16A, 240V AC universal socket outlet with switch shall be provided in offices, cabins, etc. Further 20A, 240V AC industrial receptacle with switch shall be provided strategically in all industrial areas. Suitable number of 63A, 3ph, 415V AC industrial receptacles shall be provided for entire plant for welding purposes, particularly near all major equipment and at an average distance of 50m. Atleast one 63A, 3ph, 415V AC receptacle shall be provided in each floor of off-site buildings/ structures. Receptacles shall be of following types : <table><tr><th>Type</th><th>Switch rating</th><th>Socket & plug rating</th><th>Type & make of plug & Socket</th><th>Terminal Block size</th></tr><tr><td>RA</td><td>20 A, SP240V AC(Industrial)</td><td>20A, 3 pin240 V AC</td><td>NTPC appd. make</td><td>1-4 way, suitable for loop-in loop- out of 10 sq.mm. Al. Conductor</td></tr></table>					Type	Switch rating	Socket & plug rating	Type & make of plug & Socket	Terminal Block size	RA	20 A, SP240V AC(Industrial)	20A, 3 pin240 V AC	NTPC appd. make	1-4 way, suitable for loop-in loop- out of 10 sq.mm. Al. Conductor
Type	Switch rating	Socket & plug rating	Type & make of plug & Socket	Terminal Block size											
RA	20 A, SP240V AC(Industrial)	20A, 3 pin240 V AC	NTPC appd. make	1-4 way, suitable for loop-in loop- out of 10 sq.mm. Al. Conductor											
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01	PAGE 51 OF 126										

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	RB	16A, S.P240V AC	6A+16A6 Pin decorative Piano-key Type Switch	NTPC appd.make	1-4 way, suitable for loop-in loop- out of upto 10 sq.mm. Al. Conductor
	RC	20 A, SP24 V AC(Industrial)	20A, 3 pin24 V AC	NTPC appd. make	1-4 way, suitable for loop-in loop- out of 2 core -16 sq.mm. Al. Cable.
	17.	Aviation warning lights shall be provided as per the recommendations of ICAO and Director general of civil aviation, India. The arrangement of light should be marked such that the object is indicated from every angle in azimuth. The aviation warning lighting system shall also conform to the latest Indian standard IS 4998.			
	18.	Contractor shall demonstrate the average lux level achieved for different areas as per specification requirements, after completion of the lighting work, at site to the satisfaction of engineer-in-charge.			
3.01.00	Ballasts				
3.01.01	All fluorescent fixtures except for Class-I, Div-II fittings/ increased safety fittings (Div-II/Hazardous Area) shall be provided with electronic ballasts.				
3.02.00	All luminaires and their accessories and components shall be of type readily replaceable by available Indian makes.				
3.03.00	Fans & Regulator				
3.03.01	Ceiling Fans, to be provided in non air-conditioned office/control room area. Further tentatively one (1) no. ceiling fan shall be provided for 10 sq.m area, at suitable mounting height.				
3.04.00	Lighting Wires				
3.05.01	Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminium wire for fixed wiring installation. Minimum size of wire shall not be less than 1.5.sq.mm. for copper and 4 sq.mm. for aluminium.				
3.06.00	Lighting Poles				
3.06.01	The Street Light system and peripheral lighting shall be designed generally in line with design guidelines. The Poles shall be mounted above ground using base plate and minimum height of pole shall be 8 mtrs The poles shall be hot-dip galvanized as per IS2629/ IS2633/ IS4759. The average coating thickness of galvanizing shall be min. 70 micron. The System shall be capable of withstanding the appropriate wind load etc as per IS 875 considering prevailing soil/ site condition considering all accessories mounting on pole.				
3.07.00	Lighting Masts				
Kawas WTE Project (2× 350 TPD) EPC Package			TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01
					PAGE 52 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC																														
3.07.01	Suitable number of lighting masts shall be provided for entire plant. Lighting Mast shall be of continuously tapered polygonal cross section hot dip galvanised. The Mast shall be of 30 M or suitable height with lantern carriage to enable raising/lowering for ease of maintenance, including the Head Frame, Double Drum Winch, continuous stainless steel wire rope, in built power tool, luminaires, suitable aviation warning light, lightning alongwith necessary power cables within the mast. The mast shall be delivered in not more than three sections & shall be joined together by slip stressed fit method at site. No site welding or bolted joints shall be done on the mast. The Mast together with the fixtures shall be capable of withstanding the appropriate wind loads as per IS: 875. The Mast shall be fabricated from special steel plates conforming to BS-EN10-025 and folded to form a polygonal section.																															
4.00.00	TESTS																															
4.01.00	For LED Fixture																															
4.01.01	Type test reports of the following items as per technical specification requirements/ standards shall be submitted for approval. <table><thead><tr><th>SL NO.</th><th>DESCRIPTION</th></tr></thead><tbody><tr><td>i.</td><td>Lighting fixtures of each type</td></tr><tr><td>ii.</td><td>Lighting panel of each type (Degree of Protection)</td></tr><tr><td>iii.</td><td>Junction Box of each type.</td></tr></tbody></table> Type test reports for LED as per standards for following shall be submitted for approval. <table><tbody><tr><td>1. Visual and Dimension check</td></tr><tr><td>2. Proof of procurement of LEDs</td></tr><tr><td>3. Safety tests</td></tr><tr><td> a) Marking</td></tr><tr><td> b) Construction</td></tr><tr><td> c) Provision for Earthing</td></tr><tr><td> d) External and Internal wiring</td></tr><tr><td> e) Protection against electrical shock</td></tr><tr><td> f) Endurance and Thermal</td></tr><tr><td> g) Insulation resistance & electrical strength</td></tr><tr><td> h) Resistance to heat fire & tracking</td></tr><tr><td> i) Resistance to Humidity</td></tr><tr><td>4. Fire Retardant test</td></tr><tr><td>5. Performance tests (electrical, Photometric color and Life)</td></tr><tr><td>6. Burn-in Test</td></tr><tr><td>7. Power Cycling</td></tr><tr><td>8. Temperature rise test</td></tr><tr><td>9. Emission Tests</td></tr><tr><td> a) Radiated & conducted emission</td></tr><tr><td> b) Harmonics & flickers</td></tr><tr><td>10. Immunity tests</td></tr></tbody></table> In addition, following test reports to be submitted for LED chip/LED luminaire: a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer.	SL NO.	DESCRIPTION	i.	Lighting fixtures of each type	ii.	Lighting panel of each type (Degree of Protection)	iii.	Junction Box of each type.	1. Visual and Dimension check	2. Proof of procurement of LEDs	3. Safety tests	a) Marking	b) Construction	c) Provision for Earthing	d) External and Internal wiring	e) Protection against electrical shock	f) Endurance and Thermal	g) Insulation resistance & electrical strength	h) Resistance to heat fire & tracking	i) Resistance to Humidity	4. Fire Retardant test	5. Performance tests (electrical, Photometric color and Life)	6. Burn-in Test	7. Power Cycling	8. Temperature rise test	9. Emission Tests	a) Radiated & conducted emission	b) Harmonics & flickers	10. Immunity tests		
SL NO.	DESCRIPTION																															
i.	Lighting fixtures of each type																															
ii.	Lighting panel of each type (Degree of Protection)																															
iii.	Junction Box of each type.																															
1. Visual and Dimension check																																
2. Proof of procurement of LEDs																																
3. Safety tests																																
a) Marking																																
b) Construction																																
c) Provision for Earthing																																
d) External and Internal wiring																																
e) Protection against electrical shock																																
f) Endurance and Thermal																																
g) Insulation resistance & electrical strength																																
h) Resistance to heat fire & tracking																																
i) Resistance to Humidity																																
4. Fire Retardant test																																
5. Performance tests (electrical, Photometric color and Life)																																
6. Burn-in Test																																
7. Power Cycling																																
8. Temperature rise test																																
9. Emission Tests																																
a) Radiated & conducted emission																																
b) Harmonics & flickers																																
10. Immunity tests																																
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 53 OF 126																												

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
4.02.00 4.03.00	b) LM 80/IS: 16105 report. c) LM 79/IS: 16106 report. Acceptance Test and Routine Test All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards.		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 54 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	F. CABLING, EARTHING AND LIGHTNING PROTECTION			
1.00.00	Cabling			
1.01.00	Cable trays shall be ladder type for power & control cables & perforated type for instrumentation cables complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be minimum 3 mm. Cable tray & cable tray supporting arrangement shall be hot dip galvanized. Support system shall be able to withstand • Weight of the cable trays • weight of the cables (75 Kg/Metre run of each cable tray) • Concentrated load of 75 Kg between every support span. • Factor of safety of minimum 1.5 shall be considered.			
1.02.00	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.			
1.03.00	Cable trays shall be supported at an interval of 2000 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm.			
1.04.00	Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every 2mtr. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with self locking type nylon cable straps with de-interlocking facilities. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by aluminium strips at every five meter interval and at every bend. 3.05.01			
1.05.00	TERMINATION AND STRAIGHT THROUGH JOINTS Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 55 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.00	IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables. Straight through joint and termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec. with dynamic peak of 52 KA for 33 KV system & of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV & 3.3 KV system. Straight through joints shall have provisions for shield connection and earthing wherever required and complete with all accessories and consumables suitable for storage without deterioration at a temperature of 50 deg. C with shelf life of more than five years. 1.1 kV grade straight through joints shall also be of proven design			
1.07.00	Welding Receptacles Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break,AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. The welding receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity.			
(A)				
(B)	TPN 63A welding sockets with switch having degree of protection of IP-55 shall be provided in the following areas. 1) 1 no. in each Switchgear/MCC rooms and Pump house. 2) Maximum three (3) nos. of receptacles can be connected to one circuit. These receptacles shall be energised from MCC.			
2.00.00	Earthing System			
2.01.00	Earthing system shall be in strict accordance with IS: 3043 and Indian Electricity Rules/Acts.Scope of the Bidder shall also include supply and laying of 40mm dia. MS Rods as earthing mat, placed at a distance of 1.0M away and at depths between 0.60M and 1.00M, all around the periphery of buildings, structures, and outdoor equipments, as per the approved drawings. Risers of 40mm dia. MS Rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Bidder, as per the approved drawings. Risers shall be laid upto a height of 300mm above the local Ground level, at each of the columns of the buildings on outside of the buildings. The Bidder's scope shall also include supplying and laying of necessary number of 3.0M deep vertical 40mm dia. MS Rods Earthing electrodes and connecting them to the Earthing mat, as per the approved drawings and the supplying and laying of 40mm dia. MS Rods, The material of the earthing conductors shall be as follows :			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 56 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.02.0	Conductors above ground level and in built up trenches. - Galvanized steel			
	Conductors buried in earth - Mild steel			
	Earth electrodes - Mild steel rod			
	The sizes of earthing conductors for various electrical equipments shall be as below:			
	Equipment	Earth conductor above ground level & in built-up trenches		
	a) Main earth grid			
	i) Earth conductor buried in earth around buildings.	40 mm dia. MS ROD		
	ii) Earth conductor above ground level & in built up trenches.11KV/6.6KV/3.3KV SWGR/EQUIP and 415V SWGR	65x8 mm GS flat		
	b) 415 V MCC/ Distribution boards / Transformers	50x6mm GS flat		
	LT Motors above 125 KW	50 x 6mm GS flat		
2.03.00	25 KW to 125 KW	25 x 6mm GS flat		
	1KW to 25 KW	25 x 3mm GS flat		
	c) Fractional House power motor	8 SWG GS wire		
	d) Control panel & control desk	25 x 3 mm GS flat		
	e) Push button station / Junction Box	8 SWG GI wire		
	f) Columns, structures, cable trays	50x6mm GS flat		
	Crane, rails, rail tracks & other non-current carrying metal parts	25x6mm GS flat		
	Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise approved. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected			
	Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 57 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable.		
2.04.00	Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground		
2.05.00	Neutral points of HT transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to earth electrodes by suitable earth conductors.		
2.06.00	Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.		
2.07.00	Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.		
2.08.00	Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.		
2.09.00	Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.		
3.00.00	LIGHTNING PROTECTION SYSTEM		
3.01.00	Lightning protection system shall be in strict accordance with IS:2309 & IEC 62305		
3.02.00	Lightning conductor shall be of 25x6mm GS strip when used above ground level and shall be connected through test link with earth electrode/earthing system		
3.03.00	Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings		
3.04.00	Down Conductors		
	1. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode. 2. Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. 3. All joints in the down conductors shall be welded type. 4. Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval.		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01
			PAGE 58 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	5. Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm. 6. All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system. 7. Lightning conductors shall not pass through or run inside GI Conduits. 8. Testing link shall be made of galvanized steel of size 25x 6mm.			
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 59 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	G. HT SWITCHGEARS 1.00.00 CODE AND STANDARDS IS/IEC: 62271-200, IEC: 62271-100, IS:13118 and IS:3427 2.00.00 TYPE 2.01.00 Switchgear Single Front, Single Tier, Free standing, Floor mounted, metal clad, fully compartmentalized draw-out type 2.02.00 CIRCUIT BREAKER Vacuum type, restrike free, trip free, stored energy operated and with electrical anti-pumping features 3.00.00 SYSTEM PARAMETERS 3.01.00 System Voltage : 33KV/11KV/6.6KV/3.3KV +/-6% 3.02.00 System Frequency : 50Hz, 3%, -5% 3.03.00 Fault level : For 11kv/6.6KV/3.3kv:40KA RMS for 1 Sec. For 33KV: 25kA RMS for 1 sec 3.04.00 Internal Arc Classification of IAC FLR 40KA, 1 sec. For 33kV , IAC rating shall be as per manufacturer's standard. 3.05.00 Temperature Rise Temperature rise of busbars shall not exceed 55 deg. C for silver plated joints and 40 deg. C for other joints, over an ambient temperature of 50 deg. C under any condition. 4.00.00 OPERATIONAL REQUIREMENT 4.01.00 Each breaker panel shall be provided with the following devices for control, indication and inter locking (a.) The circuit breaker will normally be controlled from remote control panels (DDCMIS) via Numerical Relays through closing and shunt trip coils. The Local control console of the relay flush mounted on the switchgear would normally be used only for testing of circuit breaker in isolated position. Provision for closing & tripping of the circuit breaker shall be made locally from laptop / relay HMI through serial port to facilitate commissioning activities.			
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 60 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS				
4.02.00	(b.)	4-20mA analog output (current signal) for use in DDCMIS shall be provided in all breakers. This may be provided as analog output from the Numerical relay or may be generated using a suitable CT & Current transducer.			
	(c.)	Thermostatically controlled space heater with switch, illumination and power plug point.			
	The circuit breaker shall meet the following requirements				
	(a.)	The breaker shall be controlled locally and/ or remotely as required. Facilities shall be provided for mechanical tripping of breaker and manual charging of closing spring to cater to emergency condition.			
	(b.)	Surge arrestor shall be provided for each motor feeder.			
	(c.)	Shall have an Operation duty O-3 min. -CO - 3min. - CO.			
	(d.)	Closing coil shall be operable with control supply voltage variation in the range of 85-110% and tripping coil shall be operable in the range of 70-110%.			
	(e.)	Trip circuit Supervision shall be provided for trip coil monitoring.			
	(f.)	Suitable mechanical interlock shall be provided to prevent inadvertent earthing of any live part.			
	(g.)	Castle key interlocks shall be provided to prevent opening of cable compartment door when breaker is closed and bus bar compartment when any of the incomers to bus are closed.			
4.03.00	(h.)	Testing of circuit breaker shall be possible in isolated position by keeping the control plug connected.			
	(i.)	Only motor wound closing spring charging arrangement is acceptable.			
	(j.)	Core balance CTs shall be provided for outgoing motor and transformer feeders having CT ratios greater than 50/1A.			
	(k.)	Each breaker truck shall have Service - Isolated - Withdrawn Position.			
	(l.)	Primary fuse replacement shall be possible with VT in isolated position.			
	Numerical Relays and Protections				
	(a.)	All Numerical relays shall be of types, proven for the application requirements and shall be subject to Employer's approval. Numerical Relays shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach and other characteristics to provide required sensitivity.			
	(b.)	All IEDs shall have required no. of freely programmable optically isolated binary inputs (BI) and potential free binary output (BO) contacts.			
	Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 61 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.03.01	(c.) Relays shall have event recording feature, recording of abnormalities and operating parameters with time stamping. (d.) Master trip (86) and non-86 trips shall be software configurable to output contacts and no separate master trip relay shall be used. (e.) All numerical relays shall have provision of both current (CT) and voltage (VT) inputs. Relays shall be suitable for both residually connected neutral CT input as well as CBCT input. Relays shall be suitable for CT secondary current of 1A. Relays for transformer feeders without differential shall have 5 CT inputs (3 – Phase, 1 – CBCT, 1 – REF). Relays for transformer feeders with differential protection shall have 9 CT inputs (6 – Phase, 1 – CBCT, 1 – REF, 1 – Standby Earth Fault). Motor relays shall have 4 & 7 CT inputs for non-differential & differential application respectively. Relays for Incomers, Bus-couplers & Ties shall have 4 CT inputs. All relays except incomers, ties and bus-couplers shall have 3 Nos of VT inputs. Relays used in incomers, ties and bus couplers shall have provision of two sets of voltage inputs (3Nos for bus voltage & 1No. for line voltage) for the purpose of synchronization. (f.) All CT terminals on the relays shall be of fixed type suitable for connection of ring-type lugs to avoid any hazard due to loose connection leading to CT open-circuit. In no circumstances Plug In type connectors shall be used for CT / VT connections. (g.) Design of the relay must be immune to any kind of electromagnetic interference. Vendor to submit all related type test reports for the offered model. (h.) Reverse blocking principle shall be adopted to cut down the grading time of upstream breaker for HT stream. The downstream protection when operated on a fault shall block upstream protection. For this, one contact of short circuit & earth fault protection of each outgoing feeder on one switchboard shall be paralleled, and connected to input of Numerical relay in incomer panel. The input of Incomer relay if not energised, allows the fast operation of the upstream protection. However, delayed protection shall always be available. All equipments shall have necessary protections. However, following minimum protections shall be provided.			
	Motor Feeders (a.) Differential protection for motor rated 2MW and above. (b.) Short circuit protection (50). (c.) Thermal Overload protection (49). (d.) Instantaneous earth fault protection (50N). (e.) Negative Phase Sequence Protection (46).			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 62 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	(f.) Locked rotor (50LR). (g.) Motor start monitoring & Restart inhibit feature (h.) Number of starts limitation (66) (i.) Under Voltage protection with time delay (27M) (j.) VT Fuse-fail Monitoring (60)		
4.03.02	Transformer Feeders (a.) Transformer Differential protection (87T) for transformers rated 5MVA and above. (b.) Three Phase Over current and Earth Fault protection (50 & 50N). (c.) Restricted Earth Fault protection (64R) (d.) Time delayed Three Phase Over current and Earth Fault protection (51) (e.) Stand by earth fault protection (51N) (f.) Transformer trouble trips-Buchholz, Winding temperature, Oil temperature & Pressure Relief Device trips shall be wired to separate binary inputs of the relay and shall be configured to issue trip command to the breaker. (g.) Transformer trouble Alarm-Alarm contacts of the above transformer troubles shall be wired to separate binary inputs of the relay for communication to DDCMIS.		
4.03.03	Incomers, Bus-couplers and Tie feeders (a.) Three Phase Over current and Earth Fault protection (50 & 50N) (b.) Synchronizing Check (25). (c.) Bus No-volt		
4.04.00	Control Supply Each switchgear shall be provided with necessary arrangement for receiving, isolating, distributing and fusing of 240V AC and 220V/110V DC supplies for various control, lighting, space heating and spring charging circuits. DC supply for control shall be duplicated for each board.		
5.00.00	DESIGN AND CONSTRUCTION FEATURES All HT switchgear panels and circuit breakers shall have the following features:		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01
			PAGE 63 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	a) Conductor High conductivity aluminium alloy or copper for the horizontal busbars, vertical droppers and connectors to the fixed end of isolating contacts. b) Height of the Switchgear Panel Not to exceed 2600 mm. c) Insulators Shall be track-resistant, high strength, non-hygroscopic, non-combustible type and suitable withstand stresses due to over-voltages and short circuit current. interpole barrier of inflammable material like hylam not acceptable. d) Sealing Bushing or other sealing arrangement shall be provided between breaker and busbar / cable compartments to avoid air communication around isolating contacts in the safety shutter area with truck in service position. e) Construction i) The switchgear assembly shall be dust, moisture, rodent and vermin proof. ii) In switchgear design where the breaker front itself serves as a door suitable blanking covers one for each size of panel per switch board shall be included. iii) The switchgear enclosure shall be constructed with rolled steel section of rolled sheet steel of at least 2.0 mm thickness. iv) The Switchgear shall have an Internal Arc Classification of IAC FLR 40KA, 1 sec. The switchgear construction shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panels shall be specially designed to withstand these. Pressure relief device shall be provided in each high voltage compartment of a panel, so that in case of a fault in a compartment, the gases produced are safely vented out, thereby minimizing the possibility of its spreading to other compartments and panels. The pressure relief device shall not however reduce the degree of protection of panels under normal working conditions. v) Breaker trucks shall have a secure locking in SERVICE position so that they are not displaced during a short circuit. vi) Current ratings of all switchgears, circuit breakers, CT's etc. shall be sufficient for carrying the connected load currents without exceeding the permissible temperature limits or reduction in service life. Use of two breakers in parallel to meet the required rating shall not be acceptable. viii) Suitable trolley arrangement, if required, shall be provided. One trolley per switchgear room shall be provided suitable for each type of rating of breakers. f) Earthing Arrangement i) Internal earthbus shall be provided which has a capacity to withstand short circuit currents for one second and all enclosures shall be connected to this bus. ii) Earthing arrangement through an integral earth switch or through separate earthing truck shall be provided. Suitable mechanical interlocks shall be provided to prevent the closing of			
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 64 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC																	
	earth switch circuit on live circuit. In case of later arrangement one set of different types of earthing trucks per switch board shall be provided. (iii) Earthing switch/Earthing truck shall be short time (One second) current withstand capability equal to the breaker. iv) A clearly visible warning label "ISOLATE ELSEWHERE BEFORE EARTHING" shall be provided on shutters of incoming and other connections which could be energised from other end. g) Cable Entry Switchgear panel shall be suitable for bottom entry and provided with removable gland plates. h) Instrument transformer CTs and VTs shall be provided for protection and metering and shall be cast-resin encapsulated type. Insulation class 'E' or better. VTs shall have suitable HRC current limiting fuses to both primary and secondary sides, under voltage relays, timers, etc. for motor tripping and remote annunciation on supply failure. Each switchgear section shall have a three phase VT. Accuracy class of CTs and VTs shall be as follows <table><tr><td></td><td>CTs</td><td>VTs</td><td>Core balance CTS</td></tr><tr><td>Protection</td><td>5P 20</td><td>3P</td><td>PS</td></tr><tr><td>Metering</td><td>1.0</td><td>0.5</td><td></td></tr><tr><td>Differential/REF</td><td>PS</td><td></td><td></td></tr></table> i) Identification plates Each panels to be identified on front as well as back side by large engraved plate giving detailed feeder description. On the fixed portion of the panel Identification labels/painted (Not stickers) plates to be provided inside each panel.Letter Size shall be of at least 10mm height. Safety Requirements j) The switchgears shall be designed to offer adequate level of safety to operating/ maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Bidder shall bring out the safety means provided to achieve above. A detailed instruction plate shall be provided for each switchgear room mounting on wall describing various safe operating procedure / safety precautions for safe operation and maintenance of switchgear. Rubber mats shall be provided in front of each panel. k) Degree of protection for various enclosures: i) VT/Relay Compartment : IP-5X ii) Other compartments : IP-4X l) Paint shade : i) Complete panels excluding end covers : RAL 9002 ii) Extreme end covers of all boards : RAL 5012		CTs	VTs	Core balance CTS	Protection	5P 20	3P	PS	Metering	1.0	0.5		Differential/REF	PS				
	CTs	VTs	Core balance CTS																
Protection	5P 20	3P	PS																
Metering	1.0	0.5																	
Differential/REF	PS																		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 65 OF 126																

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
6.00.00	Type Tests a) The following type test reports on circuit breaker / circuit breaker panels, of each voltage class and current rating shall be submitted 1) Short circuit duty test on circuit breaker, mounted inside the panel offered along with CTs, bushing and separators. 2) Short time withstand test on circuit breaker, mounted inside panel offered together with CTs, bushings and separators. 3) Power frequency withstand test on breaker mounted in side panel. 4) Lightning impulse withstand test on breaker mounted in side panel. 5) Temperature rise test on breaker and panel together. For this test, the test set up shall include three panels with breakers, the test breaker and panel being placed in the centre. The adjacent panels shall also be loaded to their rated current capacity. Alternatively the test panel may be suitably insulated at the sides, which will be adjoining to other panels in actual site configuration 6) Internal Arc Test as per IEC 62271-200 7) Measurement of resistance of main circuit. 8) Mechanical operation test. b) Short circuit withstand test of earthing device (truck / switch).		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 66 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	H. VFD			
1.00.00	CODES AND STANDARDS			
	DC Reactor	IEC: 60289		
	Motor	IS: 4722/IS: 325/IEC: 60034/NEMA 30 & 31		
	Transformer	IEC: 60076/IS: 2026, IEC: 61378		
	Dry transformer	IS: 11171		
	VFD	IEC: 60034/ IEC: 61800		
	Harmonics & EM compatibility	IEEE: 519/IEC: 61000		
	Contactor/Switches/Fuses etc.	IEC: 60947, IS: 13947		
2.00.00	OPERATING CONDITIONS			
2.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered.			
2.02.00	All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.			
2.03.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.			
	The voltage level for the VFD shall be as follows:-			
	1. Upto 400 kW AC	: 415V/690V, Low Voltage, Three Phase		
	2. Above 400kW and upto 700 KW	: 690V, Low Voltage, Three Phase AC		
	3. Above 700KW and upto 1500 KW	: Medium Voltage, Three Phase AC		
	Note: The voltage level mentioned above is the Nominal Voltage which is fed to the motor from the VFD.			
3.00.00	SYSTEM DESCRIPTION			
3.01.00	The VFD System shall include the following equipment for each drive.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 67 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	a) Power/control panels consisting of line converters, inverters and control system for drive including complete control & protection of drive and the motor. b) VFD transformer on the source side, as per system requirement. c) Breaker/Contactor on the VFD/Motor/Transformer/CT/PT/Meters/Bypass (if applicable) side with complete Control, Protection and Diagnostics features of the VFD, as per system requirement. d) Bypass Arrangement of the VFD system if specified. e) DC air core reactor or capacitor, as per the system requirement.			
4.00.00	GENERAL REQUIREMENTS			
4.01.00	Medium Voltage VFD: The Variable frequency drive (VFD) system shall be of a modern proven design for similar applications in power plants/industry. The system shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum eighteen (18) pulse design.			
4.02.00	415 V/690 V LV VFD: The Variable frequency drive (VFD) system shall be of a modern proven design for similar applications in power plants/industry. The system shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum Twelve (12) pulse design. For drives less than 100 KW Six (6) pulse can be offered meeting all other requirements.			
4.03.00	The system shall be fully digital, PLC/Microprocessor based, energy efficient, and shall provide very high reliability, high power factor, low harmonic distortion and low vibration and wear and noise. It shall be easy to install in minimum time and expense and no special tools shall be required for routine maintenance.			
4.04.00	VFDs shall comply with the latest edition of IEEE 519 & IEC 61000 for both individual as well as total harmonic voltage and current distortion limits. The Voltage and Current limits shall be applicable at the Point of Common Coupling (PCC), which shall be the MCC/ Switchgear/ from which the VFD system is fed.			
4.05.00	The overload capacity of the controller shall be 150% of the rated current of the motor for one minute for constant torque applications and 110% of rated current for one minute for variable torque applications at rated voltage.			
4.06.00	Enclosure frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 68 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.07.00	The cable entry shall be from the bottom of the panel and a removable bolted un-drilled gland plate.			
4.08.00	All Panels shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 4X as per IS/IEC 60947.			
4.09.00	Provision shall be kept for exchange of information between different VFD control system parameters thru PLC/DDCMIS.			
4.10.00	The system offered shall incorporate adequate protection features, properly coordinated for the drive control and for motor			
4.11.00	PAINTING Paint shade shall be as follows a) VFD transformer : RAL 9002 (Grey), legend in black letter b) Motors : RAL 5012 (Blue) c) VFD Panels : Front and rear panels in Grey (RAL9002). End panel sides in blue (RAL 5012)			
4.12.00	LIST OF TYPE TESTS a) VFD panels (For LV VFD) i. Rated Current/ Output ii. Temperature rise test iii. Surge withstand capability test iv. Noise level test v. Power Loss Determination Test vi. Power factor measurement. vii. Degree of Protection Test viii. EMC Test b) VFD Panels (For MV VFD) i. Rated Current/ Output ii. Current Sharing iii. Voltage Division iv. Temperature rise test v. Surge withstand capability test vi. Noise level test vii. Power Loss Determination Test viii. Power factor measurement. ix. Degree of Protection Test c) AC/DC Reactor (If applicable) i. Lightning impulse test ii. Heat run test iii. Short time current test iv. Noise level test d) VFD transformers			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 69 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.00.00	i. As per requirements mentioned in subsection for Transformer/ IEC 60076/IS 2026		
	I. BATTERY		
	BATTERY RATINGS		
	1. For Ni-Cd Type Battery		
	a)	Battery Voltage	220V/125/110V/48 V DC
	b)	No. of Cells	As per Sizing Calculations
	c)	Battery type	Stationary Nickel-Cadmium Pocket Plate High discharge type (KPH)
	d)	Capacity for five(5)hour rate	As per requirement
	e)	Nominal discharge voltage per Cell	1.2 V
	f)	Float voltage	As per manufacturer's standards for float application
	2. For Lead Acid Plante type Battery		
	a)	Battery Voltage	220V/125/110V/48 V DC
	b)	No. of Cells	As per Sizing Calculations
	c)	Battery type	Stationary Lead Acid Plante high discharge type
	d)	Capacity for ten(10)hour rate	As per requirement
e)	Nominal voltage per cell discharge	2.0 V	
f)	Float Voltage	As per manufacturer's standards for float application	
1.01.00	Commissioning of Battery Commissioning of each battery at site shall only be carried out either by the battery manufacturer himself or under the supervision of the battery manufacturer.		
PART-A:	NICKEL-CADMIUM BATTERY		
4.00.00	CODES AND STANDARDS		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01
			PAGE 70 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1)	All standards, specifications and codes of practice referred to herein, shall be the latest editions including all applicable official amendments and revisions as on date of opening of techno-commercial bid. In case of conflict between this specification and those (IS codes, Standards etc.) referred to herein, the former shall prevail. All works shall be carried out as per the following standards and codes: IEC 60623 / IS 10918 Specification for vented type Nickel Cadmium Batteries. IS 1069 Quality tolerances for water for storage batteries IEC 60993 Electrolyte for vented Nickel-Cadmium cells Indian electricity rules Indian Electricity Acts			
2)	Equipment complying with other internationally accepted standards such as IEC., BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of techno-commercial bid and shall clearly bring out the salient features for comparison.			
5.00.00	GENERAL TECHNICAL REQUIREMENT			
1)	Equipments (a.) DC Batteries shall be stationary Nickel Cadmium Pocket plate type (KPH)/ (KPL) conforming to IS 10918. The batteries shall be high discharge performance type as specified. For the purpose of design an ambient temperature of 50 degree centigrade and relative humidity of 85% shall be considered. (b.) DC batteries shall be suitable for standby duty. The batteries shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 1.54 to 1.7 volts per cell maximum and float charged at about 1.42 V/cell. (c.) Batteries should be suitable for continuous operation for the maximum ambient temperature as defined in technical parameters.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 71 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनडीपीसी NTPC	
2)	Construction Features		
a)	Containers		
	Containers shall be made of polypropylene plastic material. Containers shall be robust, heat resistance, leak proof, non absorbent, alkali resistant, non-bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of translucent containers.		
b)	Vent Plugs		
	Vent plugs shall be provided in each cells. They shall be anti-splash type, having more than one exit hole shall allow the gases to escape freely but shall prevent alkali from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition the ventilator shall be easily removed for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte samples.		
c)	Plates		
	The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS 10918.		
	The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion.		
	The positive and negative terminal posts shall be clearly marked.		
d)	Sediment Space		
	Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.		
e)	Electrolyte		
	The electrolyte shall be prepared from battery grade potassium hydroxide conforming to IEC 60993.		
	The cells can be shipped either in charged condition or in dry condition.		
	Necessary electrolyte for make-up shall be supplied separately.		
f)	Connectors and Fasteners		
	Nickel plated copper connectors shall be used for connecting adjacent cells and PVC insulated flexible copper cables shall be used for inter-row / inter-tier / inter-bank connections. Bolts, nuts and washers shall be Stainless Steel / Nickel coated steel to prevent corrosion. The thickness of Nickel coating of connectors should be not less		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01
			PAGE 72 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
g) h) 6.00.00	than 0.02 mm. All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds. End take off connections from positive and negative poles of batteries shall be made by single core cables having stranded AL conductors and XLPE insulation. Necessary supports and lugs for termination of these cables on batteries shall also be supplied by the contractor. All connectors and lugs shall be capable of continuously carrying the 30 minutes discharge current of the respective batteries and through fault short circuit current which the battery can produce and withstand for the period declared. Contractor shall furnish necessary sizing calculations to prove compliance to the same. Suitable number of Inter-rack connectors shall be supplied by the Bidder to suit the battery room layout during detailed engineering. Battery racks Mild steel racks for all the batteries shall be provided. They shall be free standing type mounted on porcelain/hard rubber/PVC pads insulators/High impact plastic insulators. Batteries shall preferably be located in the single tier arrangement. However, batteries having a complete cell weight of lower than 50 Kg could be located in the double tier arrangement. The batteries racks and supports for cable termination shall be coated with three (3) coats of anti-alkali paint of approved shade. Name plates, resistant to alkali, for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor. Wherever racks are transported in dismantled conditions, match markings shall be provided to facilitate easy assembly. Manufacturer's Identification System The following information shall be indelibly marked on outside of each cell. (a.) Manufacturers' name and trade marks (b.) Country and year of manufacture. (c.) Manufacturer type designation. (d.) AH capacity at 5 hour discharge rate. (e.) Serial number THE FOLLOWING INFORMATION SHALL BE GIVEN ON THE INSTRUCTION CARDS SUPPLIED WITH THE BATTERY: (a.) Manufacturer's instructions for filling and initial charging of the battery together with starting and finishing charging rate. (b.) Maintenance instructions.		
	Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01 PAGE 73 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
7.00.00 1) 2) 3) PART-B: 8.00.00 1)	<div> <div>(c.) Designation of cell in accordance with IS 10918.</div> <div>(d.) Storing conditions of electrolyte.</div> <div>TESTS</div> <div>GENERAL</div> <div>The Contractor shall submit for Owner's approval the reports of all the type tests carried out as per latest IS-1146 (for all applicable tests for containers) / IS-10918 (for Ni-Cd batteries). The complete type test reports shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.</div> <div>Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of battery.</div> <div>Commissioning Checks:</div> <div>All tests as listed below shall be carried out on sample cell selected at random by the employer at site after completion of installation.</div> <div>(a.) Physical Examination</div> <div>(b.) Dimensions, Mass & layout</div> <div>(c.) MARKING</div> <div>(d.) Polarity and absence of short circuit.</div> <div>(e.) Ampere - hour capacity--4 Cycles</div> <div>(f.) Retention of charge</div> <div>(g.) Insulation resistance</div> <div>The Contractor shall arrange for all necessary equipment, including the variable resistor, tools, tackles and instruments.</div> <div>LEAD –ACID PLANTE BATTERY</div> <div>CODES & STANDARDS</div> <div>All standards, specification and codes of practice, referred to herein, shall be the latest edition including all applicable official amendments and revisions as on date of opening of techno-commercial bid.</div> </div> <div data-kind="ghost"></div> <div data-kind="ghost"></div>		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 74 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	In case of conflict between this specification and those (IS Codes Standards etc.) referred to herein, the former shall prevail. All works shall be carried out as per the following standards and codes: IEC Stationary Lead-Acid Batteries 60896 IS 266 Specification for sulphuric acid IS 1069 Specification for water for storage batteries IS 1146 Specification for rubber & plastic containers for lead acid storage batteries. IS 1652 Specification for stationary cells and batteries, lead acid type (with plante positive plates). IS 3116 Specification for sealing compound for lead acid batteries. IS 8320 General requirements and methods of tests for lead acid storage batteries. IS 6071 Specification for synthetic separators for lead acid batteries. Indian Electricity Rules Indian Electricity Acts 2) Equipment complying with other internationally accepted standards such as IEC, BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of techno-commercial bid and shall clearly bring out the salient features for comparison.		
	9.00.00 GENERAL TECHNICAL REQUIREMENTS 1) Equipments DC Batteries shall be stationary lead acid Plante positive plate type conforming to IS 1652. The battery shall be high discharge performance type. For the purpose of design an ambient temperature of 50 degree centigrade and relative humidity of 85% shall be considered.		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 75 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	DC Batteries shall be suitable for standby duty. The Batteries shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 2.7 volts per cell maximum and float charged at about 2.25 V/cell: Batteries should be suitable for continuous operation for the maximum ambient temperature as defined in technical parameters.			
2)	Construction Features			
a)	Containers			
	Containers shall be made of transparent glass, hard rubber, suitable robust, heat resistance, leak proof, non absorbent, acid resistant, non-bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of transparent containers. Float type level indicator shall be provided in case of opaque containers. The stem portion of the float should be long enough to prevent falling of the float inside the container even if there is no electrolyte in the container. The marking for the electrolyte level should be for the upper and lower limits. The material of level indicator shall be acid proof and oxidation proof. Container shall be closed/sealed lid type. Lid and sealing compound shall be non-cracking type. The container made of hard rubber and plastics shall be type tested as per IS 1146. All type tests shall be carried out for sealing compound as per IS 3116. The pole sealing arrangement should be such that no acid particle get entrapped due to acid creep as a result of capillary action and it should be possible to remove and refix the sealing to carry out the maintenance.			
b)	Vent Plugs			
	Vent plugs shall be provided in each cells. They shall be anti-splash type, having more than one exit hole shall allow the gases to escape freely but shall prevent acid from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition the ventilator shall be easily removed for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte sample.			
c)	Plates			
	The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS 1652 as applicable. The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion. The positive and negative post shall be clearly marked.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 76 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
d)	Sediment Space			
	Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.			
e)	Cell Insulator			
	Each cell shall be separately supported on PVC/porcelain/hard rubber insulators fixed on the racks with adequate clearance between adjacent cells. Minimum distance between adjacent cells shall be more than the bulge allowed for two cells in accordance with IS 1146.			
f)	Electrolyte			
	The electrolyte shall be prepared from battery grade sulphuric acid conforming to IS 266 and distilled water conforming to IS 1069. The cells shall be shipped dry uncharged. The electrolyte shall be supplied separately.			
g)	Connectors and Fasteners			
	Lead or Lead coated copper connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion. The thickness of lead-coating of connectors should not be less than 0.025 mm. The lead coating thickness shall be measured in accordance with APPENDIX F of IS 6848 (latest edition). All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds. End take off connections from positive and negative poles of batteries shall be made by single core cables having stranded copper conductors and PVC insulation. Necessary supports and lugs for termination of these cables on batteries shall also be supplied by the contractor. All connectors and lugs shall be capable of continuously carrying the 30 minutes discharge current of the respective Batteries and through fault short circuit current which the battery can produce and withstand for the period declared. Contractor shall furnish necessary sizing calculations to prove compliance to the same.			
h)	Battery racks			
	Wooden racks for all the batteries shall be provided. These racks shall be made of good quality first class seasoned teak wood in line with CPWD specification. They shall be free standing type mounted on porcelain/hard rubber/PVC pads insulators/High impact plastic insulators. Batteries shall preferably be located in the single tier arrangement. However, batteries having a complete cell weight of lower than 50 Kg could be located in the double tier arrangement. The batteries rack and wooden support for cable termination shall be coated with three (3) coats of anti-acid paint of approved shade. Numbering tags, resistant to acid, for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor. Wherever racks are transported in dismantled condition, suitable match markings shall be provided to facilitate easy assembly.			
i)	Manufacturer's Identification Systems			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 77 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.00.00	The following information shall be indelibly marked on outside of each cell.			
	(a.) Manufacturer's name and trade marks			
	(b.) Country and year of manufacture.			
	(c.) Manufacturer type designation.			
	(d.) AH capacity at 10 hour discharge rate.			
	(e.) Serial number			
	TESTS			
	1) GENERAL			
	The Contractor shall submit for Owner's approval the reports of all the type tests carried out as per latest IS-1146 (for rubber & plastic containers for lead-acid storage batteries)/IS 1652 (for lead-acid plante batteries). The complete type test reports shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.			
	2) Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of battery.			
3) Commissioning Checks:				
All tests as listed below shall be carried out on sample cell selected at random by the employer at site after completion of installation.				
1) Verification of markings.				
2) Verification of dimensions.				
3) Test for capacities for 10 hrs discharge rate alongwith the test for voltage during discharge.				
The Contractor shall arrange for all necessary equipment, including the variable resistor, tools, tackles and instruments.				
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01
				PAGE 78 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																																																				
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1.00.00	CODES AND STANDARDS																																																							
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of techno-commercial bid. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards and codes. <table><tr><td>ANSI-C 37.90a</td><td colspan="3">Guide for surge withstand capability tests</td></tr><tr><td>IS:5</td><td colspan="3">Colours for ready mix paints.</td></tr><tr><td>IS : 694</td><td colspan="3">PVC Insulated Cable for working voltages upto and including 1100 V.</td></tr><tr><td>IS : 1248</td><td colspan="3">Specification for Direct acting indicating analogue electrical measuring instruments.</td></tr><tr><td>IS:13947 Part-1</td><td colspan="3">Degree of protection provided by enclosures for low voltage switch gear and control gear.</td></tr><tr><td>IS : 13947</td><td colspan="3">Specification for low voltage switch gear and control gear</td></tr><tr><td>IS : 3231</td><td colspan="3">Electrical relays for power system protection.</td></tr><tr><td>IS : 3842</td><td colspan="3">Application guide for Electrical relays for AC System</td></tr><tr><td>IS : 3895</td><td colspan="3">Mono-crystalline semi-conductor Rectifier Cells and Stacks</td></tr><tr><td>IS : 4540</td><td colspan="3">Mono crystalline semi-conductor Rectifier assemblies and equipment.</td></tr><tr><td>IS:6005</td><td colspan="3">Code of practice for phosphating of Iron and Steel.</td></tr><tr><td>IS:6619</td><td colspan="3">Safety Code for Semi-conductor Rectifier Equipment.</td></tr><tr><td>IS:6875</td><td colspan="3">Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto 1000 V AC or 1200 V DC.</td></tr></table>				ANSI-C 37.90a	Guide for surge withstand capability tests			IS:5	Colours for ready mix paints.			IS : 694	PVC Insulated Cable for working voltages upto and including 1100 V.			IS : 1248	Specification for Direct acting indicating analogue electrical measuring instruments.			IS:13947 Part-1	Degree of protection provided by enclosures for low voltage switch gear and control gear.			IS : 13947	Specification for low voltage switch gear and control gear			IS : 3231	Electrical relays for power system protection.			IS : 3842	Application guide for Electrical relays for AC System			IS : 3895	Mono-crystalline semi-conductor Rectifier Cells and Stacks			IS : 4540	Mono crystalline semi-conductor Rectifier assemblies and equipment.			IS:6005	Code of practice for phosphating of Iron and Steel.			IS:6619	Safety Code for Semi-conductor Rectifier Equipment.			IS:6875	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto 1000 V AC or 1200 V DC.		
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Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 79 OF 126																																																				

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	IS : 9000	Basic environmental testing procedures for electronic and electrical items.		
	IS:13703	Low voltage fuses for voltages not exceeding 1000 V AC or 1500 V DC.		
	EEUA-45D	Performance requirements for electrical Alarm Annunciation System		
		Indian Electricity Rules		
		Indian Electricity Act.		
1.02.00	Equipment complying with other internationally accepted standards such as IEC, BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of techno-commercial bid and shall clearly bring out the salient features for comparison.			
2.00.0	EQUIPMENT DESCRIPTION			
2.01.00	PART-I BATTERY CHARGER FOR LEAD ACID PLANTE TYPE BATTERY			
	(a.) The Battery Chargers as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC lead-acid Batteries while supplying the D.C. loads. The Batteries shall be Trickle charged at 2.25 Volts per cell. All chargers shall also be capable of Boost Charging the associated D.C. Battery at 2.3 to 2.7 Volts per cell at the desired rate. The Chargers shall be designed to operate, as mentioned above, at an ambient air temperature of 50°C. (b.) Battery Chargers shall have a selector switch for selecting the battery charging mode i.e. whether Trickle or Boost charging. (c.) All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. Means shall be provided to avoid current/voltage surges of harmful magnitude/nature which may arise during changeover from Auto to Manual mode or vice-versa under normal operating condition. (d.) Soft start feature shall be provided to build up the voltage to the set value slowly within fifteen seconds. The chargers shall have load limiters which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 80 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	DC load current exceeds the load limiter setting of the Charger. The load limiter characteristic shall be such that any sustained overload or short circuit in DC system shall neither damage the Charger nor shall it cause blowing of any of the charger fuses. The Charger shall not trip on overload or external short circuit. After clearance of fault, the Charger voltage shall build up automatically when working in automatic mode. (e.) When on automatic control mode during Trickle charging, the Charger output voltage shall remain within +/-1% of the set value for AC input voltage variation of +/-10%, frequency variation of +3/-5%, a combined voltage and frequency (absolute sum) variation of 10% and a continuous DC load variation from zero to full load. Uniform and step-less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire Trickle charging output range specified & shall be capable of matching the float voltage correction recommendations(w.r.t. temperature) as suggested by the respective battery manufacturer. Step-less adjustment of the load limiter setting shall also be possible from 80% to 100% of the rated output current for Trickle charging mode. (f.) During Boost charging, the Battery Chargers shall operate on constant current mode (When automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode. The charger output voltage shall automatically go on rising, when it is operating on boost mode, as the battery charges up. For limiting the output voltage of the charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for boost charging mode. All voltage and current setting potentiometers shall be vernier type. (g.) Energizing the Charger with fully charged battery connected plus 10% load shall not result in output voltage greater than 110% of the voltage setting. Time taken to stabilize, to within the specified limits as mentioned elsewhere, shall be less than fifteen seconds. (h.) Momentary output voltage of the Charger, without the Battery connected shall be within 94% to 106% of the voltage setting during sudden load Change from 100% to 20% of full load or vice-versa. Output voltage shall return to, and remain, within the limits specified as mentioned elsewhere in less than 2 seconds after the above mentioned change. (i.) The Charger manufacturer may offer an arrangement in which the voltage setting device for Trickle charging mode is also used as output voltage limit setting device for			
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 81 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.02.00	Boost charging mode, and the load limiter of the trickle charging mode is also used as Boost charging current setting device. (j.) Suitable filter circuits shall be provided in all the Chargers to limit the ripple content (peak to peak) in the output voltage to 1% irrespective of the DC load, even when they are not connected to a battery. (k.) The DC System shall be ungrounded and float with respect to the ground potential when healthy. An earth fault relay shall be provided by the Employer in the DC distribution board for remote annunciation.			
	PART-II BATTERY CHARGER FOR NICKEL-CADMIUM TYPE BATTERY (a) The Battery Chargers as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC Nickel-Cadmium Batteries while supplying the D.C. loads. The Batteries shall be Trickle charged at 1.4 to 1.42 Volts per cell. All chargers shall be capable of Boost Charging the associated D.C. Battery at 1.53 to 1.7 Volts per cell at the desired rate. The Chargers shall be designed to operate, as mentioned above, at an ambient air temperature of 50°C. (b) Battery Chargers shall have a selector switch for selecting the battery charging mode i.e. whether Trickle or Boost charging. (c) All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. Means shall be provided to avoid current/voltage surges of harmful magnitude/nature which may arise during changeover from Auto to Manual mode or vice-versa under normal operating condition. (d) Soft start features shall be provided to build up the voltage to the set value slowly within fifteen seconds. The chargers shall have load limiters which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the Charger. The load limiter characteristic shall be such that any sustained overload or short circuit in DC system shall not damage the Charger, nor shall it cause blowing of any of the charger fuses. The Charger shall not trip on overload or external short circuit. After clearance of fault, the Charger voltage shall build up automatically when working in automatic mode. (e) When on automatic control mode during Trickle charging, the Charger output voltage shall remain within +/-1% of the set value for AC input voltage variation of +/-10%,			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 82 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	frequency variation of +3 to -5%, a combined voltage and frequency (absolute sum) variation of 10% and a continuous DC load variation from zero to full load. Uniform and stepless adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire Trickle charging output range specified & shall be capable of matching the float voltage correction recommendations(w.r.t. temperature) as suggested by the respective battery manufacturer. Stepless adjustment of the load limiter setting shall also be possible from 80% to 100% of the rated output current for Trickle charging mode. (f) During Boost charging, the Battery Chargers shall operate on constant current mode (When automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode. The charger output voltage shall automatically go on rising, when it is operating on boost mode, as the battery charges up. For limiting the output voltage of the charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for boost charging mode. All voltage and current setting potentiometers shall be vernier type. (g) Energising the Charger with fully charged battery connected plus 10% load shall not result in output voltage greater than 110% of the voltage setting. Time taken to stabilise, to within the specified limits as mentioned elsewhere shall be less than fifteen seconds. (h) Momentary output voltage of the Charger, without the Battery connected shall be within 94% to 106% of the voltage setting during sudden load Change from 100% to 20% of full load or vice-versa. Output voltage shall return to, and remain, within the limits specified as mentioned elsewhere in less than 2 seconds after the above mentioned change. (i) The Charger manufacturer may offer an arrangement in which the voltage setting device for Trickle charging mode is also used as output voltage limit setting device for Boost charging mode, and the load limiter of the trickle charging mode is also used as Boost charging current setting device. (j) Suitable filter circuits shall be provided in all the Chargers to limit the ripple content (peak to peak) in the output voltage to 1% irrespective of the DC load, even when they are not connected to a battery. (k) The DC System shall be ungrounded and float with respect to the ground potential when healthy. An earth fault relay shall be provided by the Employer in the DC distribution board for remote annunciation.			
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 83 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS 	
2.03.00	Printed Circuits Boards (PCB) PCB shall be made of glass epoxy of 1.6 mm thick, fire resistant, bonded with 99.8% pure copper foil, free of wrinkles, blisters, scratches and pinholes. The contact surface of the edge connectors of the PCBs shall be plated with hard gold to a minimum thickness of 5 microns. Component identification shall be printed on PCB by silk screen method. All PCBs shall be tropicalised and masked.	
2.04.00	CONTACTORS All Battery Chargers shall have an AC contactor on the input side. It shall be of air break type and suitable for continuous duty. The operating coil shall be rated for 415 Volts AC.	
2.05.00	Thermal Overload Relay A thermal overload relay incorporating a distinct single phasing protection (using differential movement of bimetal strips) shall also be provided for the AC input. The relay shall trip the above contactor.	
2.06.00	Rectifier-Transformers and Chokes The rectifier transformer and chokes shall be dry and air cooled (AN) type. The rating of the rectifier-transformers and chokes shall correspond to the rating of the associated rectifier assembly. The rectifier-transformers and chokes shall have class-B insulation with temperature rise limited to class-A insulation value.	
2.07.00	Rectifier Assembly The rectifier assembly shall be full wave bridge type and designed to meet the duty as required by the respective Charger. The rectifier cells shall be provided with their own heat dissipation arrangement with natural air cooling for up to 400A rating chargers. However, the rectifier cells shall be provided with their own heat dissipation arrangement along with forced air cooling for above 400A rating chargers and fan shall be temperature controlled with 100% standby redundancy. The rectifier shall utilise diodes/thyristors and heat sinks rated to carry 200% of the load current continuously and the temperature of the heat sink shall not be permitted to exceed 85°C absolute duly considering the maximum charger panel inside temperature. The Contractor shall submit calculations to show what maximum junction temperature will be and what the heat sink temperature will be when operating at 200% and 100% load current continuously duly considering the maximum surrounding air temperature for these devices inside the charger panel assuming air ambient temperature of 50°C outside the panel. Necessary surge protection devices and rectifier type fast acting fuses shall be provided in each arm of the rectifier connections.	
2.08.00	DIGITAL INDICATING INSTRUMENTS Digital indicating instruments with built in communication port for remote data transfer shall be provided for all chargers. The instruments shall indicate DC current, DC voltage & AC voltage and instrument shall be 96 x 96 mm², with display accuracy 0.5%, 4 digit-7 segment LED/LCD display and RS 485 Serial Bus port.	
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01 PAGE 84 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS 
2.09.00	AIR BREAK SWITCHES All Chargers shall have AC input and DC output switches of air break, single throw, load break and fault make type. The contacts of the switches shall open and close with a snap action. Switches shall be rated for 120% of the maximum continuous load. 'ON' & 'OFF' position of the switch shall be clearly indicated.
2.10.00	CONTROL AND SELECTOR SWITCHES Control and selector switches shall be of rotary stayput type with escutcheon plates showing the functions and positions. The switches shall be of sturdy construction and suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred. The contact ratings shall be atleast the following: Make and carry continuously – 10 Amps. Breaking current at 220 V DC – 0.5 Amp. (inductive) Breaking current at 240 V AC – 5 Amp. At 0.3 p.f.
2.11.00	FUSES Fuses shall be of HRC cartridge fuse link type. Fuses shall be mounted on fuse carriers which are mounted on fuse bases. Wherever it is not possible to mount fuses on fuse carriers, fuses shall be directly mounted on plug in type bases. In such cases one insulated fuse pulling handle shall be supplied for each charger. Kick-off fuses (trip fuses) with alarm contacts shall be provided for all D.C. fuses.
2.12.00	Indicating Lamps Three (3) indicating lamps shall be provided to indicate A.C. supply availability. The indicating lamp shall be of panel mounting, filament type low wattage or LEDs and capable of clear status indication under the normal room illumination. The lamps shall be provided with series resistors (non-hygroscopic) preferably built in the lamp assembly and replaceable from front. The lamp covers shall be preferably screwed type, unbreakable and moulded from heat resistant material
2.13.00	Blocking Diode Blocking diode shall be provided in the output circuit of each Charger to prevent current flow from the D.C. Battery into the Charger.
2.14.00	Annunciation System Visual indications through indicating lamps/LEDs or annunciation fascia shall be provided in all Chargers for the following: (a) A.C. supply failure
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9 Electrical specification IIIB-01 PAGE 85 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
	(b) Rectifier fuse failure (c) Surge circuit fuse failure (d) Filter fuse failure (e) Load limiter operated (f) Charger trip (g) Battery on Boost Potential free NO contacts of all above conditions shall be provided for following remote alarms in the Employer's Unit Control Board: (a) Battery on Boost (b) Charger trouble (this being a group alarm initiated by any of the faults other than 'Battery on Boost')		
2.15.00	Name Plates and Marking		
	The name plates shall be made of non-rusting metal/3 ply Lamicoid and shall have black back-ground with white engraved letters and secured by screws. These shall be provided near top edge on the front as well as on rear side of Charger. Name plates with full and clear inscriptions shall also be provided on and inside the panels for identification of the various equipments.		
3.00.00	CONSTRUCTION		
3.01.00	The Chargers shall be indoor, floor mounted, self supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Charger shall be fabricated using cold rolled sheet steel shall not less than 1.6 mm and shall have folded type of construction. The panel frame shall be fabricated using cold rolled sheet steel of thickness not less than 2.0 mm. Removable undrilled gland plates of at least 3.0 mm sheet steel and lugs for all cables shall be supplied by the Contractor. The lugs for cables shall be made of electrolytic copper with tin coat. Cable sizes shall be advised to the Contractor at a later date for provision of suitable lugs and gland plates. The Charger shall be tropicalised and vermin proof. Ventilation louvers shall be backed with fine brass wire mesh. All doors and covers shall be fitted with synthetic rubber gaskets. The Chargers shall have hinged double leaf doors provided on front and/or backside for adequate access to the Charger internals. All the Charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be atleast IP-42.		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 86 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS														
3.02.00	All indicating instruments, control & selector switches and indicating lamps shall be mounted on the front side of the Charger. Design of panels shall be based on the following dimensions. <table><tr><td>1)Overall height -</td><td>Maximum 2350 mm</td></tr><tr><td>2)Operating handles</td><td>- Maximum 1800 mm</td></tr><tr><td>(highest and lowest positions reached by operator's hands),</td><td>Minimum 350 mm</td></tr><tr><td>protective mechanical indicators</td><td></td></tr><tr><td>3)Doors and panel</td><td>- Maximum 1800 mm</td></tr><tr><td>handles and locks</td><td>Minimum 300 mm</td></tr></table>			1)Overall height -	Maximum 2350 mm	2)Operating handles	- Maximum 1800 mm	(highest and lowest positions reached by operator's hands),	Minimum 350 mm	protective mechanical indicators		3)Doors and panel	- Maximum 1800 mm	handles and locks	Minimum 300 mm
1)Overall height -	Maximum 2350 mm														
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(highest and lowest positions reached by operator's hands),	Minimum 350 mm														
protective mechanical indicators															
3)Doors and panel	- Maximum 1800 mm														
handles and locks	Minimum 300 mm														
3.03.00	The layout of Charger components shall be such that their heat losses do not give rise to excessive temperature within the Charger panel surface. Location of the electronic modules will be such that temperature rise of the location, in no case, will exceed 10°C over ambient air temperature outside the Charger.														
3.04.00	Each Charger panel shall be provided with an illuminating lamp and one 5 Amp. Socket. Switches and fuses shall be provided separately for each of the above.														
3.05.00	Locking facilities shall be provided as following: - For locking Trickle/Boost selector switch in the respective position. - The Charger enclosure door locking requirements shall be met by the application of padlocks. Padlocking arrangement shall allow ready insertion of the padlock shackle but shall not permit excessive movement of the locked parts with the padlock in position.														
3.06.00	Wiring														
3.06.01	Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks ready for external connection. The power wiring shall be carried out with 1.1 KV grade PVC insulated cables conforming to IS:1554 (Part-I). The control wiring shall be of 1.1KV grade PVC insulated stranded copper conductors of 2.5 sq.mm. conforming to IS:694. Control wiring terminating at electronic cards shall not be less than 1.0 sq. mm. Control terminal shall be suitable for connecting two wires with 2.5 sq.mm. stranded copper conductors. All														
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01												
			PAGE 87 OF 126												

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	terminals shall be numbered for ease of connections and identification. At least 20% spare terminals shall be provided for circuits.		
3.06.02	Power and control wiring within panels shall be kept separate. Any terminal or metal work which remains alive at greater than 415 V, when panel door is opened, shall be fully protected by shrouding.		
3.06.03	An air clearance of at least ten (10) mm shall be maintained throughout all circuits, except low voltage electronic circuits, right upto the terminal lugs. Whenever this clearance is not available, the live parts should be insulated or shrouded.		
3.07.00	PAINTING Treatment as per IS:6005. Two coats of lead oxide primer followed by powder painting with final shade of RAL9002 for complete panel except end covers & RAL 5012 for end covers.		
4.00.00	TESTS GENERAL 1. For chargers of rating more than 60A, the contractor shall furnish the following type tests reports for each rating of the equipment to be supplied under this contract. a) Complete physical examination b) Temperature rise test at full load. (For chargers of up to 400A rating, Temperature rise test report for rectifier assembly at 200% of full load shall also be submitted.) c) Insulation resistance test. d) High voltage (power frequency) test on power and control circuits except low voltage electronic circuits. e) Ripple content test at i) No load ii) Half load iii) Full load		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01
			PAGE 88 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	f) Automatic voltage regulator operation test at specified A.C. supply variations at i) No load ii) Half load iii) Full load g) Load limiter operation test h) Efficiency and power factor measurement. i) Surge withstand capability test at the following points of the Charger: i) Across each A.C. input phase ii) Across AC input line to ground. iii) Across D.C. output terminals. iv) Across each D.C. output terminal to ground The Charger shall not exhibit any component damage and there shall be no change in performance as per (g) and (h). j) Environmental Tests Steady state performance tests (f) and (g) shall be carried out before and after each of the following tests. i) Soak Test The electronic modules shall be subjected to continuous operation for a minimum period of 72 hours. During last 48 hours, the ambient temperature shall be maintained at 50 deg. C. The 48 hour test period shall be divided into four equal 12 hour segments. The input voltage during each 12 hours shall be nominal voltage for 11 hours followed by 110% of nominal voltage for 30 minutes, followed by 90% of nominal voltage for 30 minutes. ii) Degree of protection test.			
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 89 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
5.00.00	2. Dynamic response test and Temperature rise test at full load shall be carried out on each charger before dispatch at manufacturer's works. COMMISSIONING The contractor shall carryout the following commissioning tests and checks after installation of the equipment at site: a) Complete physical examination. b) Checking of proper operation of annunciation system. c) Insulation resistance test. d) Automatic voltage regulator operation. e) Load limiter operation.		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 90 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS	
1.00.00	K. DIESEL GENERATORS	
	CODES AND STANDARDS	
	DIESEL ENGINE	IS -10000, BS- 5514
	INTERNAL COMBUSTION ENGINES (12 PARTS)	IS -10000
	SPEED OF DIESEL GENERATOR	BS649 / 195B
1.01.00	ALTERNATOR	IS-4722/IEC-60034,IS12065, IS12075
	PERMISSIBLE LIMITS OF NOISE LEVEL OF ROTATING MACHINES	IS 12065
1.02.00	MEASURE, EVALUATION AND LIMIT OF VIBRATION SEVERITY OF ROTATING ELECTRICAL MACHINES SHAFT 65 MM DIA OR HIGHER	IS 12075
	DIESEL FUELS – SPECIFICATIONS	IS1460
2.00.00	RECOMMENDED PRACTICE FOR HOT-DIP GALVANIZING OF IRON AND STEEL	IS 2629
	METHODS FOR TESTING UNIFORMITY OF COATING OF ZINC COATED ARTICLES	IS 2633
1.01.00	CODE OF PRACTICE FOR FIRE – SAFETY	IS 3034
	RECIPROCATING INTERNAL COMBUSTION ENGINES	ISO 3046
1.02.00	OSID STANDARD ON LIGHTENING PROTECTION	OISD-GDN-180
	The installation work shall conform to Indian Electricity Act and Indian Electricity Rules as amended up to the date this specification is issued. Any approval required from statutory authorities shall be obtained by the Contractor. Nothing in this specification shall be construed to relieve the Contractor of this responsibility.	
1.02.00	Equipment complying with other internationally accepted standards such as ASA, IEC, BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent to or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted and also furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments in force as on date of opening of bid. Bidder shall clearly bring out the salient features for comparison.	
	TYPE	
2.00.00	Diesel Engine	Stationary type, turbo charged and water cooled.
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01 PAGE 91 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.00.00	TECHNICAL REQUIREMENTS		
	a)	Ambient temperature	50 degree. (to be considered for deration of alternator)
	b)	Relative Humidity	100%
	c)	Fuel	HSD Fuel as per IS 1460
	d)	Rated Speed	1500 rpm
	e)	Governor(Electronic Type)	A1 type as per BS:5514
	f)	Vibrations	Max. 250 microns peak to peak with anti-vibration pads
	g)	Starting	Electrical self starting
	h)	Fuel service tank	990 litres
	i)	Air intake system	Dry type air filter, 15 micron size or better with 90% efficiency or better
	j)	Cooling	Forced water cooled for Engine & Air cooled for Alternator.
	k)	Paint Shade	Grey RAL9002
4.00.00	GENERAL		
4.01.00	The sizing criteria for the emergency DG set is given in General electrical requirement in General Specification.		
4.02.00	The emergency DG set shall come in to operation in the event of total power failure in the station.		
4.03.00	DG set including stack height, acoustics, air emission and fuel oil installation shall meet the requirement given by gazette notifications of Ministry of Environment & Forest time to time , CPCB guidelines, all statutory requirement of Govt. of India and State Pollution Board Guidelines & as updated as on date of bid opening. Necessary lightening protection shall be provided by the bidder for the stack as per statutory and safety requirements. Bidder shall furnish the detailed break-up for arriving at the capacity of the DG set and also furnish overload capacity with a variation in ambient temperature.		
4.04.00	DG Set shall be located inside acoustic enclosure and suitable for outdoor duty .The exhaust shall be discharged through a silencer & stack at a sufficient height.		
4.05.00	The generating set shall be suitable placed and enclosed so as to meet the technical, functional and statuary requirement like Noise level, IP protection etc.		
4.06.00	Critical speed of the machine shall not be lesser than 120% of the normal speed.		
4.07.00	All couplings shall be capable of withstanding the maximum generator sudden short circuit torque.		
4.08.00	Necessary ducting, piping, valves, drains, etc. shall also be provided.		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01
			PAGE 92 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.09.00	Maintenance and erection tools and tackles for all the equipment shall be provided by the bidder.			
4.10.00	The DG set shall be capable of starting largest size of emergency 415 V drive (motor) having starting KVA/rated KW ratio of 8 (higher if starting current is more than 8) and starting power factor of 0.2 with terminal voltage drop being restricted to 15%. Generator loading before starting of this motor shall be considered as 50% of generator rating.			
4.11.00	The DG set shall also be able suitable for 12 hours continuous running of which one hour at 10% overload at rated speed.			
4.12.00	BHP rating of the engine shall be Limited-time running Power (LTP) as per ISO 8528-1 considering deration for 50 deg C ambient temperature			
5.00.00	DUCTING, PIPING VALVES AND FITTINGS			
5.00.01	The engine shall be supplied with all necessary silencer, exhaust, piping, valves and fittings the fuel oil, lubricating oil, engine starting, air inlet and engine exhaust system, along with expansion joints, drain plugs, flanges and their support structure etc.			
5.00.02	Necessary starters for ventilation fans/ exhaust fans / accoustic enclosure and priming pump motors etc. shall be in the scope along with necessary AC distribution board, cables and cabling. Distribution board shall be metal enclosed, compartmentalised, wall/structure mounted and shall be fabricated out of cold rolled sheet steel of thickness 1.6mm with degree of protection of IP-54. The same shall be provided inside the acoustic enclosure			
6.00.00	OPERATIONAL REQUIREMENTS			
6.01.00	Starting and Control.			
a)	All DG Sets shall be controlled independently through separate control panel. It shall also have auto initiation through a 'No volt relay 'and' Auto position of auto/manual selector switch. It shall also have auto initiation through command from remote panel/ central control room.			
b)	The starting time required from the initiating signal until the operating speed and voltage is attained and the engine and generator are ready to take load, shall not be greater than 30 seconds. Three attempt starting facility shall be provided either by using two impulse timer and a summation timer or by using microprocessor based controller along with auxiliary panel if any. The DG set shall lockout automatically in case of failure of above. The DG shall be capable of being stopped manually from remote as well as local. Interlock shall be provided in DG control panel to prevent shutting down operation (when in auto mode) as long as the circuit at generator output is closed.			
c)	For electrical self starting system, the source of energy shall be batteries backed up by battery chargers which shall be supplied			
d)	The starter motor shall conform to IS: 4722.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 93 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
e)	The fuel oil system and the lubricating oil shall also start operating simultaneously and automatically as soon as a starting impulse is received to obviate any chance of seizure of the piston and bearing as well as air locking in fuel supply system.			
6.02.00	Battery and Battery Charger			
6.02.01	The battery for starting the engine shall be capable of performing six (6) normal start without recharging Battery and battery charger shall also feed the control supply of DG control panel. The minimum voltage at the end of load cycle shall not be less than 1.75 volts per cell.			
6.02.02	A suitable battery charger shall be housed inside the panel to recharge the battery within ten hours. The battery charger shall be SMPS based automatic and shall be complete with DC voltmeter and Ammeter, Float / Boost selector switch Auto / Manual selector switch for Boost to float change over. The charger shall have necessary filters to reduce the ripple factor less than three (3) and suitable dropping characteristics by means of choke and/ or suitable input transformer impedance to automatically reduce the charging current as the battery gradually charges up.			
6.02.03	The battery shall be of at least 24V 360 AH or 2 sets of 2 numbers of 12 V, 180 AH battery connected in parallel and shall conform to the requirements of IS : 7372 /IEC:60095. The battery with Polypropylene containers meeting the other technical requirements of IS: 7372 may be acceptable			
7.00.00	DIESEL GENERATOR CONTROL PANEL			
	i. The local control panel shall be of robust construction, floor mounting, free standing type made of 2.0 mm thick CRCA sheet steel including doors and Partition. The control panels shall have IP-54 degree of protection as per IS: 13947 Part-I. ii. The Gland plate shall be of at least 2.5mm thick sheet steel. iii. Control panel with provision for local starting shall be provided. This shall incorporate all controls required for starting, monitoring, regulating and stopping DG set- iv. All cables shall be bottom entry. Enough space shall be provided in the control panel for easy access during maintenance and repairs. v. A tinned copper/ aluminium busbar of adequate dimension shall be provided for earth connection complete with nuts and bolts as required for external connection to earth grid. vi. The identification tag shall be white in colour shade RAL 9010. vii. CT shorting links, test terminal blocks etc. shall be provided. Panel shall be provided with panel illumination lamp operated by the door switch and thermostat-controlled space heater. Control panel shall be furnished complete with all accessories and wiring for safe and trouble free operation of the system.			
7.01.00	The Control panel shall be complete with the following			
	(i) Microprocessor base control unit			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 94 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	Microprocessor base control unit with following. (a.) Voltage sensing mains supply failure monitor (b.) Auto engine start / stop & failure to start lock out. (c.) Generator voltage & frequency sensing (d.) Selector switch and push button to facilitate remote starting/stopping, speed & voltage control (e.) Manual / Auto / Test selector switches (f.) DG start /stop push button (g.) DG Incomer Breaker close / trip push button (h.) Mains breaker close / trip push button (i.) Auto manual Speed adjustment (j.) Auto manual Voltage adjustment (k.) Auto manual selector switch for priming pump motor (if required) (ii) LED indication lamps LED indication lamp shall be provided for the following:- 'DG ON' indication lamp', DG Breaker ON' indication lamp, 'Mains ON' indication lamp, 'Mains Breaker ON' indication lamp, Charger ON indication lamp. (iii) Annunciation Annunciation for the following shall be provided with fault indication, alarm & trip contact, accept, reset and test facility. Any one or more of the following defects shall cause the alarm or running diesel generator to be tripped. In case of tripping, re-start shall be prevented until the fault(s) are removed and manual resetting is done. Separate indicators shall be provided for each of the following in control panel: (a.) Engine fails to start(Alarm) (b.) Low lube – oil pressure.(Trip) (c.) High cooling water temperature.(Trip) (d.) D.G. overload.(Alarm) (e.) DC failure (f.) DG over speed(Trip) (g.) Fuel level low in0 day tank(Alarm) (h.) Fuel level very low in day tank(Trip). (i.) Generator stator temperature high.(Alarm) (j.) Electrical protection operated.(Trip) (k.) Incomer to emergency switchgear from DG closed.		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 95 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(l.) Earth fault (alarm) input from switchgear. (m.) Lub Oil Priming Pump 'Fault' indication (if applicable) (iv) Metering Following meters shall be provided in the panel: AC voltmeter, AC Ammeter, Frequency meter, Electronic Kwh meter with counter display, KW meter, PF Meter			
7.03.00	Suitable 4-20mA transducers with dual output shall be provided in the control panel for voltmeter & frequency meter readings at remote use.			
7.04.00	In addition, coupling relays (with diodes) having 24V DC or suitable energising coil in the control panel shall be provided for remote application for the followings: DG Start, DG Stop, DG Voltage raise, DG voltage lower, DG speed raise, DG speed lower, DG auto start			
7.05.00	For issuing simultaneous start command to standby DG set, there shall be set of three (3) aforesaid coupling relays in case of standby DG set.			
7.06.00	Provision for following status/ signal shall also be provided in the DG control panel: DG fail to start, DG start command actuated/ reset, DG working/ stop signal, DG trouble/ normal signal, DG control supply failure/ normal signal.			
7.05.00	The requirement of CT, VTs, relays, timers, auxiliary contacts shall be as per the system requirement.			
7.06.00	The bidder shall supply any other controls and indications for diesel generator set though not specifically mentioned here but which the supplier may recommend and are required to make system complete for satisfactory operation of DG sets.			
7.07.00	Necessary pressure switches, level switches, thermostats, flow switches, auxiliary relays, etc. required for the above alarm and annunciation system shall be furnished under the scope of this specification.			
8.00.00	DIESEL ENGINE			
8.01.00	Construction Features			
	(a) Diesel engine shall be mounted on visco damper type vibration dampening system or equivalent anti-vibration mounting system (as recommended by Engine manufacturer) and shall be complete with integral air intake through dry type air filters and exhaust systems, metering facility, speed regulation system, fuel injection system, lube oil system, primary cooling water system along with necessary filters, silencers, ducts, exhaust, piping and fittings, valves, instruments, etc. as required. (b) The generating unit shall be complete with all auxiliaries and its performance, torsional vibration, materials and workmanship, etc. shall be in accordance with the standard practices of diesel engine manufacturer's association in USA. IS-10000, BS-5514. The engine shall be properly balanced so as to transmit only small unbalanced forces to the foundation.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 96 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.02.00	DIESEL OIL SYSTEM (a) The diesel oil system as provided shall be complete with simplex type filters, hoses, piping, fittings, relief valves, supports, control and instrumentation and all other accessories to make it complete. (b) The fuel consumption of the engine at full and three quarters of its rated power output shall be indicated. (c) A day oil tank of 990 litres fuel capacity shall be provided, mounted on fabricated steel platform outside the acoustic enclosure. The tank shall be complete with level indicator marked in Litres, two nos. of level switches, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. All pipe joints shall be brazed/ welded.			
8.03.00	Lubricating oil System (n.) Automatic pressure lubrication shall be provided by a shaft driven gear type pump through an oil cooler and fin mesh filters to the end bearing, camshaft bearings, camshaft chain and gear drives, governor, air starting, distribution, auxiliary drive gears etc. (o.) Hand driven and/ or A.C. motor driven lube oil priming pump (if applicable) along with starter is to be provided as recommended by the engine manufacturer. (p.) All necessary accessories like pressure gauges, temperature and oil level indicators, pressure relief valves, bypass valves, pressure switches for alarm and control shall be furnished together with all inter connecting piping, fittings, supports, valves, etc. (q.) A lubricating oil filter shall be provided for operation under normal conditions for period of a more than 250 hours without the necessity of its replacement or cleaning.			
8.04.00	Cooling System In case, Jacket water cooling system is offered, same be in closed cycle and shall have radiator located in front of the engine with a fan driven mechanically from the engine shaft. Forced water circulation by means of pump driven by the engine shaft shall be employed. The radiator tubes shall be of copper with sufficient heat transfer area.			
8.05.00	Governing System (a) The governor shall be electronic type with class A1 type as per BS-5514. (b) The governor shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However a tripping shall be provided even if speed exceeds the maximum permissible limit.			
8.06.00	Ancillary Equipment			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 97 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.00.00	All ancillary equipment which are necessary for proper operation and maintenance of the set and safety of operating personnel shall be provided as per system requirements.			
	GENERATOR			
	i)	The generator shall be of totally enclosed or screen protected drip proof and self air cooled type. The generator shall be driven by the Diesel engine in this specification and shall match the same in all respects. The generator shall conform to IEC-60034.		
	ii)	AC generator shall be supplied along with it's excitation system, AVR and include all necessary auxiliaries.		
	iii)	Rating		
	The Generator shall be star connected 3-phase, 50 Hz synchronous generator and shall have a continuous rating. The operating condition for each electric generator shall be as follows:			
	a)	Voltage	:	415V
	b)	Frequency	:	50 C/S (+3 to-5%)
	c)	Power factor	:	0.8
	iv)	Insulation and Temperature Rise of Windings and Core		
All insulated winding conductors of alternator shall be of copper. The generator stator and rotor windings core insulation and all connections including main and neutral leads shall have insulation conforming to IEC-60034-Pt1. The winding shall be given power house treatment (i.e. two coats of varnish and backing followed by final coat of resin). The total insulation shall be non hygroscopic. The temperature rise of the stator core and mechanical parts in contact with or adjacent to winding shall not exceed the specified limits of IEC-60034-Pt1.				
v)	Space heaters of suitably rated 240 V, single phase, 50 Hz,located in lower part of alternator shall be provided..			
vi)	Separate terminal boxes shall be provided for phase and neutral side of leads. The terminal boxes shall having degree of protection of IP-54 as per IS: 13947.			
viii)	Alternator vibration level shall not exceed the values as defined in IS:12075. Alternators in case driven by Diesel engine shall be able to withstand vibration level of 9mm/sec. as per BS 5000 Part III. Vibration level shall not exceed the permissible levels for Generator however the same shall in any case not exceed 250 micron peak to peak.			
ix)	Resistance element temperature detector shall be installed in stator windings and in each bearing. The RTD's shall comply with the latest edition of IS:2828.			
x)	The generator shall be complete with voltage transformers necessary for AVR/ Synchronisation			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 98 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS		
9.01.00	xi) The Main Phase side terminal box shall be suitable for terminating LT bus ducts/cable. The sizing of the same shall be as per system requirements. xi) The neutral point shall be brought to DG control panel and shall be connected to 300/110V VT, to be supplied and mounted inside the DG control panel by the bidder for earth fault detection. Excitation System The generator shall be provided with complete excitation system capable of supplying the excitation current of the generator under all conditions of output from no load to full load and capable of maintaining voltage of the generator constant within +/- 1% of set value. The setting range available on voltage regulator shall be at any value with +/- 10% of the rated voltage. It shall be possible to set the same from remote also.		
10.00.0	SOUND PROOFING SYSTEM 1) The sound absorptive layer shall comprise of bonded type mineral wool/glass wool of adequate thickness and density to comply the design requirements. 2) DG shall be placed in acoustic enclosure. The requirements of acoustic enclosure are as following: a. The acoustic enclosure shall be fabricated from 2.0 mm thick CRCA sheet with steel section & frame of suitable size. The enclosure shall be suitable for outdoor duty. The sheet and all sections shall be powder coated shade of grey RAL9002. A minimum clear space of 800mm shall be kept inside the enclosure. Necessary acoustic sealing shall be done in the panels/modular unit joints. b. Enclosure shall be provided with adequate lighting. Enclosure shall be provided with adequate number of door and viewing glass. c. Suitable louvers with acoustic treatment shall be provided as required. d. Ventilation system of adequate capacity shall be provided. The construction of ventilation duct shall be from 1.6 mm thick CRCA perforated sheet. The ventilation system shall be design to prevent leakage of sound and temperature shall not increase by more than 5 degree centigrade when DG is running continuously at specified rating e. The acoustic enclosure shall have suitable opening for routing out of cable/bus ducts from alternator terminal box. Further suitable acoustic treatment of the opening shall be done to achieve the desired acoustic level. TESTS: TYPE TESTS		
11.00.0			
Kawas WTE Project (2x 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01 PAGE 99 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
11.01.00	Type test reports for the following type tests shall be submitted:			
11.01.01	Type test reports on Engine			
	This shall be as per ISO 3046 (Table-1)			
11.02.0	Type test reports on Alternator			
	1. Measurement of resistance 2. Phase sequence test 3. Regulation test 4. Measurement of open circuit and short circuit characteristics 5. Efficiency test 6. Temperature Rise Test 7. Momentary overload test 8. Over speed test 9. High Voltage test 10. Insulation resistance test (both before and after High Voltage Test) 11. Noise level as per IS:12065 12. Vibration as per IS: 12075. 13. Determination of Deviation of voltage waveform from sinusoidal. 14. Degree of protection test on control panel for IP-52			
12.00.0	COMMISSIONING CHECKS			
	In addition to the checks and test recommended by the manufacturers, the contractor shall supervise the following commissioning test to be carried out on each set at site.			
	The battery or compressed air system for starting the engine shall be capable of performing six (6) normal start without recharging.			
12.01.00	Load Test			
	The engine shall be given test run for a period of at least 6 hours. The set shall be subjected to the maximum achievable load as decided by Project Manager without exceeding the specified DG set rating.			
	During the load test half hourly records of the following be taken:			
	15. Ambient temperature. 16. Exhaust temp. if exhaust thermometer is fitted. 17. Cooling water temp. at a convenient point adjacent to the water output from the engine jacket. 18. Lubricating oil pressure.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 100 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	19. Speed. 20. Voltage, wattage and current output. 21. Oil tank level.			
12.02.00	Insulation Resistance Test for Alternator Insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with a 500 V megger shall not be less than $IR= 2x$ (rated voltage in KV) + 1.			
12.03.00	Check of fuel consumption A check of the fuel consumption shall be made throughout the load run test. The fuel consumption should not exceed the design values.			
12.04.00	Insulation Resistance of Wiring Insulation resistance of control panel wiring shall be checked with 500V megger. The IR shall not be less than one mega ohm.			
13.00.00	FUNCTIONAL TESTS Following functional tests are to be carried out at site:			
13.01.00	Functional tests on control panel.			
13.02.00	Functional tests on starting provision on the engine.			
13.03.00	Functional tests on all field devices.			
13.04.00	Functional tests on DG Set complete with AVR and speed governor.			
14.00.00	MEASUREMENT OF VIBRATION The vibration shall be measured at no load and at load as close to maximum achievable load and shall not exceed 250 microns. Any modification/rectification required to bring down the vibration level with in allowable limits specified by the manufacturer shall be done by the bidder. Vibration test is to be carried out at site.			
15.00.00	Noise Level (Sound Pressure Level) Check Noise level measurement shall be done generally following the guidelines given in IS: 12065. The measurement shall be carried out with a calibrated integrating sound level meter as per IS: 9779. This test is to be carried out at site.			
16.00.00	INSTALLATION OF DG SETS The installation, testing and commissioning of Diesel-Generator sets including all the accessories/equipment as required shall be carried out strictly in accordance with the			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 101 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	applicable Codes of practice, statutory requirements the manufacturer's instructions, drawings etc., The Contractor shall provide all tools, equipments and instruments required for installations, testing and commissioning. L. FIRE PROOF CABLE SEALING PROTECTION SYSTEM			
1.00.00	CODES AND STANDARDS			
1.01.00	The fire proof cable penetration (FPCP) sealing system shall conform to the requirement of latest edition including amendments of BS:476 Part-20 Fire tests on Building materials and structures and any other international standards.			
1.01.00	The Bidder shall clearly indicate the standards adopted and furnish a copy of the English version of the latest editions of standards along with the bid, and shall clearly bring out the salient features for comparison.			
2.00.00	SYSTEM DESCRIPTION			
2.01.00	The fire proof cable penetration sealing system shall be of the following types; i) Type - A Type A fire sealing system is either Silicone foam or equivalent foam system or using individual blocks for each cable along with suitable frame work rated for one hour. Type A is to be implemented at floor openings below C&I panels, control panels/Boards etc. in CER & CCR. ii) Type-B Type B fire sealing system is any proven fire sealing system rated for one hour. This will comprise of rest of wall and floor crossings of cables/cable trays, opening below HT/LT Switchgears/board other than those covered under Type A.			
2.02.00	The penetration system, shall be installed immediately after the completion of cable termination in a particular switchboard/control panel/area after clearance from the Project Manager.			
3.00.00	GENERAL INFORMATION			
3.01.00	The cables shall generally be laid in cable trays/racks, conduits, ducts. The fire proof cable penetration system shall be designed in such a way that the existing supporting structure/cable is not disturbed.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 102 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.02.00	The penetration system shall be suitable for site condition at 50 ⁰ C ambient temperature and relative humidity of 100%.			
3.03.00	The penetration system of each wall/floor crossing shall be adequately designed/sized such that 20% addition of cables is possible at any later date without disturbance/wastage of material in the penetration system.			
	Fire sealing material to be supplied shall be based on the net area to be sealed, wastage, thickness, density and other parameters as per the type test report approved under this contract.			
4.00.00	TECHNICAL REQUIREMENTS			
4.01.00	The fire proof cable penetration system shall fully comply with the requirements of BS:476 Part-20 and also to the requirements specified in this specification.			
4.02.00	The penetration system shall prevent spreading of fire in cable beyond the seal system in case of fire and shall have minimum 1 hour fire resistance rating.			
4.03.00	The penetration system shall be physically, chemically, thermally stable and shall be mechanically secure to the masonry/concrete/structural members. The system shall be mechanically robust and capable of giving satisfactory performance under vibrations encountered in power stations.			
4.04.00	The penetration system shall be capable of withstanding mechanical loads, foot traffic drop loads, vibrations, wind pressure, etc.			
4.05.00	The penetration system shall be completely gas and smoke tight.			
4.06.00	The penetration system shall retain integrity and perform satisfactorily even after remaining in water for long period.			
4.07.00	The materials used in FPCP sealing system shall be non-toxic and harmless to the working personnel.			
4.08.00	The penetration materials shall have no reaction with cable sheath/galvanising/painting of structural steel.			
4.09.00	The penetration materials shall have anti-rodent and anti-termite properties.			
4.10.00	The penetration materials shall have no shrinkage or cracking after the setting for the complete life of the power Plant.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 103 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
4.11.00	Under normal load, short circuit and fire conditions, cables may be subjected to movement and vibration. The FPCP sealing system shall be designed to withstand and perform satisfactorily under these conditions.			
4.12.00	The penetration system shall not affect the current carrying capacity of cables passing through it.			
4.13.00	Asbestos shall not be used in the construction of fire penetration seal system.			
4.14.00	The penetration system shall have life expectancy of 40 years.			
4.15.00	The penetration system shall not emit any corrosive or toxic fumes or smoke on the unexposed face of the barrier.			
4.16.00	For foam type of systems, only the foam shall form the penetration seal of specified rating, having the damming board removed after curing of the foam.			
5.00.00	PACKING AND STORAGE			
5.01.00	All materials and components of penetration system shall be supplied in packing to avoid contamination of materials due to dust/moisture and temperature during transit and storage. All packing shall be of durable quality and the date of expiry and the date of manufacture shall be printed on it.			
6.00.00	INSTALLATION			
6.01.00	The contractor shall take adequate care to ensure that cables are not damaged in any manner during penetration system installation.			
6.02.00	Wherever the floor/wall opening provided in the vicinity of penetration seals larger or smaller than that required for the cable fire penetration, these opening size can be reduced or increased in an approved manner by the contractor using the same materials as provided around the opening and of the same thickness. Generally the walls in the power station comprises of brickwork and the floors are made of RCC/steel work.			
6.03.00	All work shall be carried out in accordance with the agreed “field quality plan” and approved drawings. The “field quality plan” shall additionally specify the fire sealing material thickness, minimum cured density and other related parameters achieved in the approved type tests for the contract. The work shall be done to the satisfaction of the Project Manager and the same shall be subject to Project Manager’s approval for acceptance.			
7.00.00	TYPE TESTS, ROUTINE & ACCEPTANCE TESTS			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 104 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.01.00	Following Type test reports as per the setup and procedures given in subsequent clauses for the Fire proof cable penetration sealing system shall be submitted: a) The accelerated ageing test b) Water absorption test c) Fire rating test d) Hose stream test e) Vibration test followed by fire rating test			
7.02.00	Tests a, b, c and d should have been carried out on same test sample subsequently one after the other without any touching up/repair/modifications in the same sequence and in accordance with the clause 7.01.00. The test sample shall be assembled as per clause 8.00.00.			
7.03.00	Test indicated in clause 7.01.00 (e) above should have been carried out on a separate sample and as per the procedure indicated under clause 8.00.00.			
7.04.01	Physical, chemical and mechanical properties of various components/ingredients used should have been also be tested as a part of type tests.			
7.05.01	Test reports shall contain the following information: 1. Type of penetration material tested 2. Details of various components/ingredients used alongwith their catalogue. 3. Physical, chemical and mechanical properties of various components/ ingredients used. 4. Description of the various test assemblies tested. 5. Details of method of conditioning. 6. The observations as called for in BS:476 Part-20 and technical specification.			
7.06.00	ROUTINE & ACCEPTANCE TESTS Routine and acceptance tests to be carried out on Type-A and Type-B cable fire sealing system shall be mutually agreed based on the type of fire sealing material offered before placement of award.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 105 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.07.00	TEST SPECIMEN ASSEMBLY			
7.07.01	The test specimen shall be assembled as per enclosed drawing and shall resemble typical floor crossing cable penetration system.			
7.07.02	The test specimen shall be designed to seal an opening of adequate size in a concrete slab of 200 mm thickness. Two lengths of 300/600 mm wide ladder type cable tray shall be assembled with required layer of XLPE/PVC insulated, PVC sheathed unarmoured cables in touching formation. Type and number of cables in the cable tray shall be as per enclosed drawing. Cables shall be adequately clamped with tray at both the sides of the penetration as shown in the drawings. However, for penetration system with blocks which require staggered arrangement, cables can be clamped at an adequate distance from the penetration and the tray need not pass through the penetration seal.			
7.07.03	The opening in the test specimen then shall be sealed with fire proof cable penetration sealing materials.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 106 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
1.01.01	N. POWER TRANSFORMERS & AUXILLARY OIL FILLED TRANSFORMERS			
	TYPE & RATINGS (for continuous duty)			
	Sr. No.	TRANSFORMER	Generator Transformer (GT)	Auxiliary Transformers
	a)	Rating	As per system requirement/SLD/Sub section B-19	
	b)	Voltage Ratio (KV)	Gen. Volt/ 6.9KV	As per system requirement/SLD
	c)	Winding	2	2
	d)	Nos. of Phase	Three	
	e)	Vector Group	As per system requirement / SLD	
	f)	Cooling	ONAN	ONAN
	g)	Tap Changer	OLTC	OCTC
	h)	Impedance at 75°C	As per system requirement/ SLD	
		a) Principal Tap		
		b) Other Taps		
	i)	Permissible Temperature rise over an ambient of 50 deg C (irrespective of tap)		
		a)Top Oil by thermometer	35 °C*	50 °C(40 deg.C for upto 2.5MVA ,33KV)
		b)Winding by resistance	40 °C*	55 °C(45 deg.C for upto 2.5MVA ,33KV)
	j)	Earthing (Copper Flat)	Solidly Earthed	As per system requirement/SLD
	k)	Termination, SC withstand time & Fault Level	System Fault levels – as per SLD a) Generator Transformer - 3 seconds (**) b) All other transformers - 2 seconds (**) - The indicated values of time durations are used in transformer design for ensuring thermal stability of the transformers and are to be proven through calculations.	
	l)	Noise level	As per NEMA TR-1	
	m)	Loading Capability	Continuous operation at rated MVA on any tap with voltage variation of +/-10%, also transformer shall be capable of being loaded in accordance with IS : 6600/ IEC60076-7. In addition GT shall be able to operate at full load for at least ten (10) minutes without exceeding the calculated winding hot spot temperature of 140°C in the event of complete failure of power supply to cooling equipment applicable.	
	n)	Air Core Reactance	As per system requirement	
	o)	Flux density	Not to exceed 1.9 Wb/sq.m. at any tap position	
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01 PAGE 107 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS						एनटीपीसी NTPC
			with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following over-fluxing conditions due to combined voltage and frequency fluctuations: a) 110% for continuous rating. b) 125% for at least one minute. c) 140% (for all transformers except GT)/150% (for GT) for at least five seconds. Bidder shall furnish over fluxing char. Up to 150% &170 % for GT.				
	Note:-						
	1) LT Auxiliary transformers shall be 3 phase, 4 wire system with additional LVN bushing for equipment earthing. .						
	2) Minimum total Creepage for bushings shall be 25 mm/kV (Voltage corresponding to system).						
	(a) Winding						
	1.	Highest System Voltage(kV)	36	12	7.2	3.6	0.433
	2.	Lightning impulse withstand voltage, kVp	170	75	60	40	-
	3.	One min power frequency withstand voltage, kVrms	70	28	20	10	3
	4.	Insulation	uniform	uniform	uniform	uniform	uniform
	Tap changer details:						
i) Tap range		As per system requirement					
ii) Tap Control		As per system requirement					
(b) Bushing Parameters							
	Parameters	36 KV	12 KV	7.2KV	3.6kV	433 V	
(1 .)	Rated Voltage(kV)	36	12	7.2	3.6	1.1	
(2 .)	Lightning impulse withstand voltage, kVp	170	75	60	40	-	
(3 .)	One min power frequency withstand voltage , kV (rms)	77	30	22	11	3.0	
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01		PAGE 108 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC		
	(4 .)	Minimum total creepage distances (mm)	25mm/kV x Rated Voltage of Bushing.			
	(5 .)	Mounting	Tank / Transformer body			
		Parameters	36 KV			
(c)	Minimum Clearance in air (mm)					
	System voltage	33 kV	11 kV	6.6 kV	3.3 KV	433 V
	Phase to Phase	350	130	100	70	25
	Phase to Earth	320	120	90	60	25
1.02.00	CODES AND STANDARDS					
	Transformers		IS:2026, IS:6600, IEC:60076, IS 1180			
	Bushings		IS:2099, IEC:60137			
	Insulating oil		IEC:60296			
	Bushing CTs		IS:2705, IEC 60185			
	Indian Electricity Act 2003, BEE Guideline & CEA notification					
1.03.00	OPERATIONAL REQUIREMENT					
1.03.01	Transformers					
	a) Generator transformers shall be suitable for back charging. It shall be capable of being charged from HV side and kept charged continuously with no load on the LV side without any adverse impact on the transformer life.					
	b) Cooling requirements					
	• Generator Transformers:- GT shall be provided with detachable type tank mounted radiator banks with 100% cooling capacity. Each radiator bank shall have lifting lug, air release plug, top & bottom filling/shut-off valves, filter					
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01		
				PAGE 109 OF 126		

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC						
	valves, drain valve/plug etc. • For Auxiliary Transformers the radiators (if applicable) shall be detachable type, mounted on the tank. Each radiator shall be provided with a drain plug/valve at the bottom, an air release plug at the top, shut off valve at each point of connection to the tank. c) OLTC (as applicable) a) Local control, both manual and electrical b) Remote electrical control with necessary relays (as required) c) Safety interlocks and protection d) Remote Tap position signal e) Tie-in resistors requirement, if any, may be confirmed and provided. (d) Auxiliary transformers shall have energy efficiency level 3 as per IS 1180.									
1.04.00	DESIGN AND CONSTRUCTIONAL FEATURES									
1.04.01	NTPC may at their discretion have design review done to check the design of the transformer by NTPC/their consultant.									
1.04.02	Tank a) Tank shall be of welded construction & fabricated from tested quality low carbon steel of adequate thickness. b) The main tank body including tap changer, radiators (except for Auxiliary transformers) shall be capable of withstanding full vacuum. Tank shall be provided with suitable lifting lugs, minimum 4 jacking pads & haulage holes for wheeling in all four directions. c) GT & auxiliary transformers located at Transformer yard shall be mounted on detachable type bi-directional rollers for rail gauge. Auxiliary transformers shall have suitable bi-directional skids, however auxiliary transformers above 2 MVA shall be provided with four no. of bi-directional detachable flat rollers. Suitable locking arrangement shall be provided to prevent accidental movement of transformer. d) At least two adequately sized inspection openings, one at the each end of the tank for easy access to bushings and earth connections & suitable manhole shall be provided.									
1.04.03	Core <table><tr><th>Transformer</th><th>Requirement</th></tr><tr><td>GT</td><td>Core shall be high grade, non-ageing, cold-rolled, super grain oriented silicon steel laminations known as Hi B grade steels or equivalent. The insulation of core to tank, tank to clamp and clamp to core shall be able to withstand a voltage of 2 KVrms for 1 min in air. To facilitate testing of above during pre-commissioning stage, the core/clamp earthing has to be done outside the tank with suitable bushings.</td></tr><tr><td>Auxiliary Transformers</td><td>Core shall be high grade non-ageing cold rolled super grain oriented silicon steel laminations of M4 grade or better quality. The core</td></tr></table>				Transformer	Requirement	GT	Core shall be high grade, non-ageing, cold-rolled, super grain oriented silicon steel laminations known as Hi B grade steels or equivalent. The insulation of core to tank, tank to clamp and clamp to core shall be able to withstand a voltage of 2 KVrms for 1 min in air. To facilitate testing of above during pre-commissioning stage, the core/clamp earthing has to be done outside the tank with suitable bushings.	Auxiliary Transformers	Core shall be high grade non-ageing cold rolled super grain oriented silicon steel laminations of M4 grade or better quality. The core
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Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 110 OF 126						

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
1.04.04		isolation shall be able to withstand a voltage of 2 kV (rms.) for 1 minute in air.		
	Insulating oil			
	No inhibitors shall be used in the transformer oil. The oil supplied with transformers, shall be new and previously unused and must conform to following while tested at supplier's premises and shall have following parameters.			
	S.No.	Property	Permissible values	
	1.	Kinematic Viscosity, mm ² /s	≤ 12 at 40 ° C ≤ 1800.0 at (-)30 ° C	
	2.	Flash Point, ° C	≥ 140° C	
	3.	Pour point, ° C	≤ (-)40 ° C	
	4.	Appearance	Clear , free from sediment and suspended matter	
	5.	Density kg/dm ³ at 20 ° C	≤ 0.895	
	6.	Interfacial Tension N/m at 25° C	≥ 0.04	
7.	Neutralisation value, mgKOH/g	≤ 0.01		
8.	Corrosive sulphur	Non Corrosive		
9.	Water content mg/kg	≤ 30 in bulk supply ≤ 40 in drum supply		
10.	Anti oxidants additives	Not detectable		
11.	Oxidation Stability -Neutralization value, mgKOH/g -Sludge, % by mass	≤ 1.2 ≤ 0.8		
12.	Breakdown voltage As delivered, kV After treatment, kV	≥ 30 ≥ 70		
13.	Dissipation factor, at 90° C And 40 Hz to 60 Hz	≤ 0.005		
14.	PCA content	≤1%		
15.	Impulse withstand Level, kVp	≥ 145		
16.	Gassing tendency at 50 Hz after 120 min, mm ³ /min	≤ 5		
Subsequently oil samples shall be drawn at:				
Sr. No.	Parameters	Before filling in main tank at site/works & tested for	Prior energization to site for following properties & acceptance norms:	Applicability
i)	BDV	60 kV (min)	60 kV (min)	Applicable for all Transformers
ii)	Moisture content	10 ppm (max.)	10 ppm (max.)	
iii)	Tan delta at 90 deg. C	0.005 (max.)	0.05 (max.)	Applicable for Transformers (16
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 111 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	iv)	Interfacial tension	0.04 N/m(min)	0.035 N/m (min) MVA & above)
1.04.05	Windings The conductors shall be of Electrolytic grade copper. All Windings of 66kV and below shall have uniform insulation. The contractor shall ensure that windings are made in dust proof & conditioned atmosphere. For GT winding paper moisture shall be less than 0.5%.			
1.04.06	Oil preservation Main tank and OLTC (if applicable) shall be provided with conservator tanks of adequate capacity for expansion of oil from minimum ambient to 100 deg.C. GT shall be provided with air bag breathing through indicating type cobalt free silica gel breather with transparent. However conventional type conservator with indicating type cobalt free breather (transparent enclosure) shall be offered for auxiliary transformer.			
1.04.07	Bushings a) Bushings below 52 kV shall with porcelain insulator and shall be of oil communicating / OIP(non-oil communicating type) / epoxy RIP type. 1.00.00 Bushings from 52kV upto 420 kV class (including 52 kV and 420 kV class), shall be RIP (Resin Impregnated Paper) Type with composite insulator. It shall be provided with Tap for Capacitance and Tan delta test. All composite resin impregnated bushings (RIP) shall be provided with provision for long term storage to protect from moisture and rodents. The oil side shall be provided with tank which can be filled with oil. Tank shall have necessary provision for oil filling, level gauge etc. Suitable covering to be provided on air side to protect from any damage. The arrangement shall be suitable for storage in horizontal/ vertical direction in outdoor location. 2.00.00 All condenser bushings shall be non-communicating type. 3.00.00 No arcing horns to be provided on the bushings 4.00.00 LV bushing palms shall be silver/tin plated.			
1.04.08	Bushing CTs Shall be of adequate rating for protection as required, WTI etc. All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted. All CT terminals shall be provided as fixed type terminals on the M. Box to avoid any hazard due to loose connection leading to CT opening or any other loose connection in power circuit. In no circumstances Plug In type connectors shall be used for CT & Power connection.			
1.04.09	Tap changer (as applicable) i) The OLTC chamber oil shall not come in contact with main tank oil. ii) Tap Changer drive marshalling box shall be provided for GT and on transformers as applicable. iii) For GT shall be provided with an analog signal (4-20 mA) for tap position of transformer.			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01 PAGE 112 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
1.04.10 1.04.11 1.04.12	Marshalling box: i) Each GT and auxiliary transformer shall be provided with a box for housing OTI, WTI, CT signals & Protective equipment signals etc. named as Marshalling Box (MB). ii) M. Box shall be of stainless steel (SS-316 or better), at least 2.5 mm thick, dust and vermin proof provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. Marshalling Box of all transformers shall be preferably Tank Mounted. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber. Also Marshalling Box gland plate shall be at least 450 mm above ground level. iii) GT shall be provided with an auxiliary power supply, 230V, single phase shall be drawn from two separate boards for the M. Box. In case of one power supply failure, loads shall be automatically transferred to other. The supplier shall derive AC feeders for OLTC cabinet (if applicable) after suitable selection at M. Box. iv) For auxiliary transformer, wiring scheme shall be engraved in a stainless steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door. v) TB shall be stud type for all CT & Power connections with ring type lugs. vi) For GT following is also applicable:- (a.) Terminal board rows shall be spaced adequately not less than 100mm apart to permit convenient access to wires and terminations. No components (except heater & it' switch, light & sockets) shall be mounted on side & top wall of Marshalling Box, e.g. relay, timer, contactors, MCBs. TBs etc. Valves (a.) All valves upto and including 50 mm shall be of gun metal or of cast steel. Larger valves may be of gun metal or may have cast iron bodies with gun metal fittings. (b.) Sampling & drain valves should have zero leakage rate. Gaskets a) For GT all the gasket shall be weather proof & hot oil resistant of 'O' ring of Nitrile rubber for all valves, flanges, HV, LV & Neutral Turrets, Bushings, Tank rim, etc. For this, all the flanges shall be machined. However GT, LV turret to Tank joint shall be provided with "Fluoro-elastomers" cord gasket. b) For Auxiliary Transformers, gasket shall be fitted with weather proof, hot oil resistant, rubberized cork gasket.		
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 113 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC	
1.04.13	c) If gasket is compressible, metallic stops shall be provided to prevent over compression.				
	d) The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer. The quality of these joints is considered established, only if the joints do not exhibit any oil leakage or sweating for a continuous period of at least 3 months during the guarantee period. In case any sweating / leakage is observed, contractor shall rectify the same & establish for a further period of 3 months of the same. If it is not established during the guaranteed period, the guaranteed period shall be extended until the performance is established.				
	Transformer Transportation				
	Transportation shall be Oil filled. GT shall be transported with sufficient number (minimum 02 nos.) of impact recorders with necessary arrangement to maintain N2/Dry air pressure (as applicable) during transit and storage.				
	1.04.14	PAINTING			
		PARTS NAME	TYPE OF PAINT	NO.OF COATS	TOTAL DFT
		Inside of tank and accessories (except M Box)	Oil & heat resistant fully glossy white	One coat	Atleast 30 micron
		External surface of transformer and accessories (except coolers & radiators)	Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue)	One coat each	Atleast 100 micron
		External Cooler, Radiator surface	Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue)	Two coats each	Atleast 100 micron
		Internal Radiator surface	Hot oil proof, low viscosity varnish and subsequent flushing with transformer oil	---	---
1.05.00	Neutral Earthing Arrangement				
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 114 OF 126	

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
1.06.00	(i)	In case of Generator Transformers, neutral shall be solidly grounded via 2 nos. copper flats.	
	(ii)	The neutral of three phase Transformers shall be brought through insulated support from tank to the ground level at a convenient point with copper flat, for connection to ground network (as applicable). However neutral may be connected to NGR as per system requirement. Grounding connection shall be done via 2 nos. copper flats.	
	Neutral Grounding Resistance (NGR) (as applicable)		
	1.	Resistance at 50°C	As per system requirement
	2.	Rated current	600A for 10 seconds
	3.	Application	Neutral Grounding of Transformers as per system requirement
	4.	Service	Outdoor
	5.	Resistor material & connection	Punched stainless steel grid element type
	6.	Max allowable temp rise over amb 50°C	350 deg. C
	7.	Mounting	Insulators
	8.	Power frequency level	As per system requirement
	9.	Stacking	Various sections comprising the neutral grounding resistor shall be capable of being stacked one above the other.
10.	Enclosure	NGR shall be housed in a 2.5 mm thick sheet steel enclosure & DOP IP-33. A heating circuit with Thermostat to be provided inside the enclosure to control humidity.	
11.	Mounting Structure	The Contractor shall supply and erect a galvanized structure to support the NGR enclosure so that the base of the enclosure shall be at a minimum height of 2.4M above ground level.	
1.07.00	FITTINGS		
	Following fittings shall be provided with Transformers covered under this specification.		
	a)	-Conservator for main tank with MOG (with low oil level alarm contact), drain valve & indicating type free Cobalt free breather with transparent enclosure (maximum height 1400 mm above rail level) etc.	
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01
			PAGE 115 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
1.08.00		-Conservator for OLTC tank with Oil level gauge, indicating type Cobalt free Breather & drain valve.	
	b)	Bucholz relay, magnetic reed type with alarm and trip contacts, along with suitable gas collecting device. - Oil surge relay to be provided for OLTC.	
	c)	- For 2 MVA & above rating transformer, minimum two numbers of spring operated PRD (with trip contacts) with suitable discharge arrangement for oil shall be provided. PRD to conform with IP67. - For transformers below 2 MVA, diaphragm type explosion vent shall be provided.	
	d)	OTI & WTI shall be 150 mm dial type with alarm and trip contacts with max. reading pointer & resetting device. (maximum height 1500 mm above rail level) For GT WTI shall be provided for all windings, also PT-RTD with 4-20 mA signals shall be provided with OTI & WTI of these transformers.	
	e)	Top & bottom filter valves with threaded male adapters, bottom sampling valve, drain valve/sludge removal valve at the bottom most point of the tank.	
	f)	Air release plug, bushing with metal parts & gaskets, terminal connectors on bushings (as applicable) & surge arrestor (as applicable).	
	g)	Prismatic/toughened glass oil gauge for transformers and OLTC chamber.	
	h)	Followings items are as applicable:- Bi-directional wheel & skids, M. Box, OLTC, OCTC, Bushing CTs, Insulating Oil, Fans, pumps & oil flow indicator, Cooling equipment, Valve Schedule Plate.	
	i)	Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs, additional 4 nos. lifting lugs for bell tank cover, inspection cover, manhole, Bilingual R&D Plate, Terminal marking plates, two earthing terminals etc.	
	j)	Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS.	
	k)	Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed.	
		The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the Transformers.	
	Testing Requirements The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last Ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In case the Contractor is not able to submit report of the type test(s) conducted within last Ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval. Type test report of following is also need to be submitted: (a) All type test on OLTC as per IEC 60214 (wherever applicable) (b) Neutral Grounding Resistors (c) Tank Vacuum and Pressure test		
1.08.01	All acceptance and routine tests as per the specification and relevant standards shall		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01 PAGE 116 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																																																								
1.08.02	be carried out. Charges for these shall be deemed to be included in the equipment price.																																																											
	Each transformer shall be completely assembled with all fittings & accessories meant for the particular transformer before offering for inspection & testing by Employer.																																																											
1.08.03	ROUTINE / TYPE TESTS ON TRANSFORMERS :																																																											
	<table><tr><th>S.N.</th><th>Transformer Type</th><th>GT</th><th>Auxiliary Trans.</th></tr><tr><td>1.</td><td>All routine test in accordance with IEC 60076 shall be carried out in all the transformers.</td><td>√</td><td>√</td></tr><tr><td>2.</td><td>Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)</td><td>√</td><td>√</td></tr><tr><td>3.</td><td>Measurement of winding resistance on all the taps (as per IEC 60076-1)</td><td>√</td><td>√</td></tr><tr><td>4.</td><td>Vector group and Polarity Check (as per IEC 60076-1)</td><td>√ (polarity only)</td><td>√</td></tr><tr><td>5.</td><td>Magnetic Balance and Magnetising Current Test</td><td>√</td><td>√</td></tr><tr><td>6.</td><td>Measurement of no load current with 415 V, 50 Hz AC supply</td><td>√</td><td>√</td></tr><tr><td>7.</td><td>Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)</td><td>√</td><td>√</td></tr><tr><td>8.</td><td>Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps</td><td>√</td><td>√</td></tr><tr><td>9.</td><td>IR measurement (As per IEC 60076-1)</td><td>√</td><td>√</td></tr><tr><td>10.</td><td>2KV core isolation (core-clamp, clamp-tank, core-tank)</td><td>√</td><td>X</td></tr><tr><td>11.</td><td>Measurement of capacitance & tan delta to determine capacitance between winding & earth. (for 132 kV & above class transformer, tan delta should not exceed 0.5% at 20 °C, also refer Note-iii below)</td><td>√</td><td>√</td></tr><tr><td>12.</td><td>Separate Source Voltage Withstand Test (as per IEC 60076-3)</td><td>√</td><td>√</td></tr><tr><td>13.</td><td>Repeat no load current/loss measurement & IR after completion of all electrical test</td><td>√</td><td>√</td></tr></table>	S.N.	Transformer Type	GT	Auxiliary Trans.	1.	All routine test in accordance with IEC 60076 shall be carried out in all the transformers.	√	√	2.	Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)	√	√	3.	Measurement of winding resistance on all the taps (as per IEC 60076-1)	√	√	4.	Vector group and Polarity Check (as per IEC 60076-1)	√ (polarity only)	√	5.	Magnetic Balance and Magnetising Current Test	√	√	6.	Measurement of no load current with 415 V, 50 Hz AC supply	√	√	7.	Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)	√	√	8.	Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps	√	√	9.	IR measurement (As per IEC 60076-1)	√	√	10.	2KV core isolation (core-clamp, clamp-tank, core-tank)	√	X	11.	Measurement of capacitance & tan delta to determine capacitance between winding & earth. (for 132 kV & above class transformer, tan delta should not exceed 0.5% at 20 °C, also refer Note-iii below)	√	√	12.	Separate Source Voltage Withstand Test (as per IEC 60076-3)	√	√	13.	Repeat no load current/loss measurement & IR after completion of all electrical test	√	√			
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Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 117 OF 126																																																								

CLAUSE NO.		TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
S.N.	Transformer Type	GT	Auxiliary Trans.	
14.	Oil leakage test on completely assembled transformer along with unit coolers/ radiators (as per relevant clause of this sub section)	√	√	
15.	Jacking test followed by D.P. test	√	√	
16.	Frequency Response Analysis test	√	X	
17.	Marshalling Box/Cable box: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.	√	√	
18.	IR measurement on wiring of Marshalling Box.	√	√	
Type tests				
	Transformer Type	GT (3-PH)	Auxiliary Trans.	
S. N.				
4.00.00	Lightning impulse(Full & Chopped Wave) test on windings (as per IEC 60076-3)	√ (Full & Chopped Wave)	√ (Full & Chopped Wave)	
5.00.00	Lightning impulse test on Neutral	X	√*	
6.00.00	Short circuit test (special test) as per IEC 60076-5. In addition, For GT:- i) DGA & FRA shall also be conducted before & after S.C. test. ii) Physical inspection of transformer to be done before S.C. Test in presence of NTPC inspector and photographs to be taken for reference.	√	√	
7.00.00	Temp. rise test at a tap corresponding to maximum losses. DGA shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599).	√	√	
8.00.00	Zero sequence impedance measurement test	√	X	
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 118 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																	
1.08.04		Transformer Type	GT (3-PH)	Auxiliary Trans.																	
	9.00.00	Measurement of harmonics of no load current	√	X																	
	10.00.00	Measurement of acoustic noise level as per NEMA TR-1	√	√																	
	NOTE:-																				
	i) (#) All the type/special tests & temperature rise test shall be conducted after performing Short Circuit Test. If Tank Vacuum & Pressure Test is to be carried out then it shall be conducted before SC test.																				
	ii) (√) mark indicates test to be carried out and (X) mark indicates test need not to be carried out.																				
	iii) The power factors should not exceed 0.5% (at 20 °C). However in case of deviation from limiting values the same shall be resolved in line with IEEE Std-62.																				
	iv) (*) this test is applicable on Transformer neutral earthed thru Neutral Grounding Resistor.																				
	TANK TYPE TESTS																				
	(a) Routine tests																				
(1) Oil leakage test on assembled transformer																					
All tank and oil filled compartment shall be tested for oil tightness by being completely filled with oil of viscosity not greater than that of specified oil at the ambient temperature and applying pressure equal to the normal pressure plus 35 kN/m2 measured at the base of the tank. The pressure shall be maintained for a period of not less than 6(six) hours during which time no sweating shall occur.																					
(b) Type Tests																					
(1) Vacuum test																					
For GT tank of each type shall be subjected to the specified vacuum. The tank designed for full vacuum shall be tested at an internal pressure of 3.33 kN/m2 absolute (25 torr) for one hour. The permanent deflection of the plate after the vacuum has been released shall not exceed the values specified below:																					
<table><tr><th>Horizontal Length of Flat Plate (in mm)</th><th>Permanent deflection(in mm)</th></tr><tr><td>Up to and including 750</td><td>5.0</td></tr><tr><td>751 to 1250</td><td>6.5</td></tr><tr><td>1251 to 1750</td><td>8.0</td></tr><tr><td>1751 to 2000</td><td>9.5</td></tr><tr><td>2001 to 2250</td><td>11.0</td></tr><tr><td>2251 to 2500</td><td>12.5</td></tr><tr><td>2501 to 3000</td><td>16.0</td></tr><tr><td>Above 3000</td><td>19.0</td></tr></table>				Horizontal Length of Flat Plate (in mm)	Permanent deflection(in mm)	Up to and including 750	5.0	751 to 1250	6.5	1251 to 1750	8.0	1751 to 2000	9.5	2001 to 2250	11.0	2251 to 2500	12.5	2501 to 3000	16.0	Above 3000	19.0
Horizontal Length of Flat Plate (in mm)	Permanent deflection(in mm)																				
Up to and including 750	5.0																				
751 to 1250	6.5																				
1251 to 1750	8.0																				
1751 to 2000	9.5																				
2001 to 2250	11.0																				
2251 to 2500	12.5																				
2501 to 3000	16.0																				
Above 3000	19.0																				
(2) Pressure Test																					
For GT tank of each type shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35 kN /m2 whichever is lower, measured at the base of the tank and maintained for one hour. The permanent deflection of																					
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 119 OF 126																	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	the plates after the excess pressure has been released shall not exceed the figure specified above for vacuum test. For auxiliary transformers each type of transformer tank shall be subjected to the vacuum & pressure tests as per CBIP norms.		
1.08.05	Neutral Grounding Resistance(NGR) Testing - The following routine tests shall be conducted on each resistor provided with transformer covered in this section. - Ohmic value measurement (For resistance & reactance separately). - Insulation resistance measurement before & after HV test - HV test for 1 min. at a voltage corresponding to the insulation level of the resistor. - DOP test on enclosure (routine test): It shall not be possible to insert a 2.5mm dia steel wire into the enclosure from any direction without using force. - Short time current test along with temperature rise test (type test). - Degree of protection test for IPX3 on enclosure (type test).		
1.09.00	Commissioning Checks Apart from general & prescribed commissioning checks following additional checks shall also be performed on GT:- - FRA Test - Core isolation test - DGA test		
1.10.00	Initial Operation for Transformers - Continuously observe the transformer operation at no load for 24 hrs. w.r.t. Voltage, no load current, temperature rise and noise. - Gradually put the transformer on load, check and measure increase in temperature in relation to the load and check the operation with respect to temperature rise and noise level etc. - For GT Infra red thermography shall be done after 12 hours of full load operation and results will be recorded for future reference.		
1.11.00	TRANSPORTATION		
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01
			PAGE 120 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS																																						
2.00.00	The contractor shall be responsible to select and verify the route, mode of transportation and make all necessary arrangement with the appropriate authorities for the transportation of the equipment. All metal blanking plates and covers which are specifically required to transport the transformer shall be considered part of the transformer and handed over to NTPC after completion of the erection. The scope of any necessary modification/ extension/ improvement to existing road, bridges, culverts etc. shall be included in the scope of the bidder. NOTE: Despite all condition monitoring done by the Owner, the Contractor shall be responsible to obtain all required inputs such as DGA to evaluate the Transformer. The guarantee and costs of any repair done under the guarantee shall not be affected by any condition monitoring done or not done by the Owner during the guarantee period. A full DGA test shall be completed at the end but before expiry of the guarantee period.																																						
	MAINTENANCE, TESTING & MONITORING EQUIPMENTS																																						
	<table><tr><td>1)</td><td>Oil BDV Measurement kit.</td><td>Automatic oil testing unit for checking BDV of transformer oil upto 80kV.</td><td>1 No.</td></tr><tr><td>2)</td><td>Oil Purifying Equipment</td><td>1,000 Litres / hr.</td><td>1 No.</td></tr></table>			1)	Oil BDV Measurement kit.	Automatic oil testing unit for checking BDV of transformer oil upto 80kV.	1 No.	2)	Oil Purifying Equipment	1,000 Litres / hr.	1 No.																												
	1)	Oil BDV Measurement kit.	Automatic oil testing unit for checking BDV of transformer oil upto 80kV.	1 No.																																			
2)	Oil Purifying Equipment	1,000 Litres / hr.	1 No.																																				
2.01.00 HIGH VACUUM TYPE OIL PURIFYING EQUIPMENT																																							
2.01.01	TECHNICAL PARAMETERS <table><tr><td>a) Capacity</td><td colspan="3">1,000 litres/hr</td></tr><tr><td>b) Type</td><td colspan="3">Weather proof mobile and outdoor type high vacuum oil filtration plant.</td></tr><tr><td>c) Processing temperature (direct heating of oil prohibited)</td><td colspan="3">60 °C (max.)</td></tr><tr><td>d) Capability of plant on a single pass basis</td><td colspan="3"></td></tr><tr><td> i) Removal of moisture</td><td colspan="3">From 100 ppm to 3 ppm</td></tr><tr><td> ii) Removal of dissolved gas content</td><td colspan="3">From 10% by vol. to 0.1% by Vol.</td></tr><tr><td> iii) Improvement of dielectric strength</td><td colspan="3">From 20 kV to 70 kV</td></tr><tr><td>e) Filtration pore diameter</td><td colspan="3">0.5 microns or less</td></tr><tr><td>f) Vacuum pumping system</td><td colspan="3">Two independent vacuum pumping combination, one for degassing chamber and other for transformer oil evacuation and creating high vacuum in tank. The blank off vacuum of each pumping system shall be 10⁻²</td></tr></table>			a) Capacity	1,000 litres/hr			b) Type	Weather proof mobile and outdoor type high vacuum oil filtration plant.			c) Processing temperature (direct heating of oil prohibited)	60 °C (max.)			d) Capability of plant on a single pass basis				i) Removal of moisture	From 100 ppm to 3 ppm			ii) Removal of dissolved gas content	From 10% by vol. to 0.1% by Vol.			iii) Improvement of dielectric strength	From 20 kV to 70 kV			e) Filtration pore diameter	0.5 microns or less			f) Vacuum pumping system	Two independent vacuum pumping combination, one for degassing chamber and other for transformer oil evacuation and creating high vacuum in tank. The blank off vacuum of each pumping system shall be 10 ⁻²		
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Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 121 OF 126																																			

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC		
2.02.00			3 torr or less.		
	g) Operating voltage	440/400 Volt, 50 Hz, 3 phase, 4 wire supply.			
	OIL BDV MEASUREMENT KIT 1) Automatic oil testing unit for checking BDV of Transformer oil up to 80kV. 2) The kit should be suitable for laboratory use. 3) The kit should be fully automatic with sequence control. 4) Separate voltmeter for calibration of kit should be supplied. 5) The results should be stored in memory for subsequent retrieval. 6) Separate printer should be available for printing test results. 7) The kit should be able to test oil as per BS5730, IEC156, ASTM test standard. 8) Basic accuracy desirable is 3%.				
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01	PAGE 122 OF 126

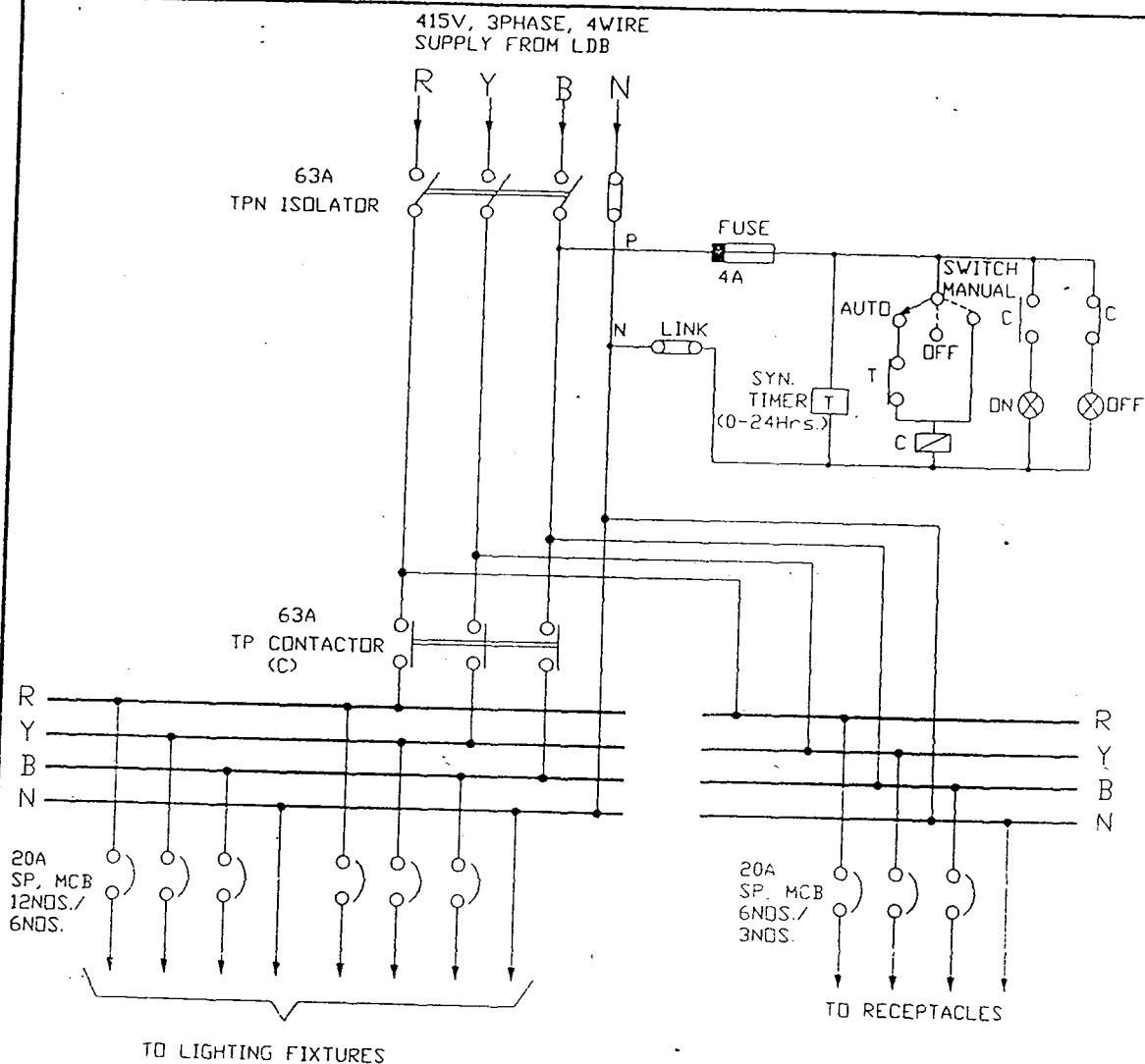
CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
1.00.00	O. DRY TYPE TRANSFORMER (LT INDOOR)			
	Sr. No.	PARAMETERS	INDOOR TRANSFORMER	
	i)	Type	Epoxy cast resin/resin encapsulated	
	ii)	Service	INDOOR	
	iii)	MVA & Voltage ratio	As per system requirement	
	iv)	Vector group		
	v)	Impedance		
	vi)	Tap changer type & range		
	vii)	SC withstand time & Fault Level		
	viii)	Termination		
	ix)	Number of phases	Three (3)	
	x)	Type of cooling	AN Additionally Transformer shall be provided with fans/blowers (with 100 % standby) for forced air cooling however all tests and performance guarantee shall correspond to air natural (AN) cooling.	
	xi)	Duty	Continuous	
	xii)	Insulation level	As per chapter B-0, Part-B	
	xiii)	Maximum Temperature rise of winding over 50 deg. C ambient. (by resistance method)	70 deg.C	
	xiv)	Earthing	Solidly earthed via cu flat.	
	xv)	Noise Level	Not to exceed values specified in NEMA TR-1.	
	xvi)	PD Level for HV coil (max.)	20 pc	
	xvii)	Loading Capability	Continuous operation at rated KVA on any tap with voltage variation of +/-10% corresponding to the voltage of the tap as well as in accordance with IEC60076-7/IS: 6600.	
	xviii)	Flux Density	Not to exceed 1.9 Wb/sq.m. at any tap position with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following over fluxing conditions due combined voltage and frequency fluctuations: a) 110% for continuous rating. b) 125% for at least one minute. c) 140% for at least five seconds.	
Note:- LT Indoor transformers shall be 3 phase, 4 wire system with additional LVN Bushing for equipment earthing.				
1.01.0	CODES AND STANDARDS			
	Dry type transformers	IS: 11171, IEC 60076-11		
	Indian Electricity Act 2003 and Indian Electricity Rules, BEE			
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01	PAGE 123 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	notification & CEA guidelines		
1.02.00	DESIGN AND CONSTRUCTIONAL FEATURES		
1.02.01	The core shall be constructed from high grade non-ageing cold rolled grain oriented silicon steel laminations of M4 grade or better quality. The insulation of core to clamp-plates shall be able to withstand a power frequency voltage of 2 kV (rms) for one (1) minute.		
1.02.02	The transformers shall be housed in a metal protective housing, having a degree of protection of IP-23. Enclosure shall be of a tested quality sheet steel of minimum thickness 2mm & shall also accommodate cable terminations. The housing door shall be interlocked such that it should be possible to open the door only when transformer is off. The enclosure shall be provided with lifting lugs and other hardware for floor mounting. Suitable bi-directional skids with pre-drilled holes shall be provided integral with the enclosure or bi-directional rollers shall be provided with suitable locking arrangement.		
1.02.03	Winding conductor shall be electrolytic grade Copper. Windings shall be of class F insulation. All windings are to be uniformly insulated.		
1.02.04	Transformer HV bushings and LV bushings can be either solid porcelain or epoxy type. Bushing shall be suitable for satisfactory operation in the high ambient temperature inside Bus Duct enclosure (if applicable). LV flange area shall be of non-magnetic material.		
1.02.05	Bushing CTs shall be provided in the LV neutral side of adequate rating for REF protection, WTI, etc.		
1.02.06	For Marshalling Box the sheet steel used shall be at least 1.6 mm thick cold rolled. The box shall be tank mounted type. The degree of protection shall be IP-54 in accordance with IS-13947. Wiring Scheme shall be engraved in a stainless steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door.		
1.02.07	Transformer shall be provided with fans/blowers (with 100 % standby) for forced air cooling however all tests and performance shall correspond to air natural cooling.		
1.03.00	PAINTING		
	The inside of enclosure and accessories (except M. Box) shall be painted with two coats of fully glossy white colour with total DFT of 25 to 60 microns. The external paint colour of transformer & accessories shall be blue corresponding to RAL 5012. The external surface of transformer & accessories shall have two coats of chemical resistant epoxy zinc phosphate primer and two coats of polyurethane finish paint with total DFT of 80 to 150 microns. The internal surface of M.Box shall have two coats of chemical resistant epoxy zinc phosphate primer and two coats of chemical & thermal resistant epoxy enamel white paint with total DFT of 80 to 150 microns.		
1.04.00	FITTING		
	Winding temperature indicator (WTI)	Shall be Platinum resistance type temperature detector in each limb. Single Indicating meter may be provided for display of temperature of all limbs. Accuracy class of Indicating meter shall be +/- 1% or better and it shall have least count of 0.1 °C or better. 1 no. 4-20 mA signal shall be provided for remote monitoring of winding Temperature.	
Kawas WTE Project (2× 350 TPD) EPC Package		TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9	Electrical specification IIIB-01 PAGE 124 OF 126

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
1.05.00 1.05.01 1.05.02 1.05.03 <			

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
Kawas WTE Project (2× 350 TPD) EPC Package	TECHNICAL SPECIFICATION SECTION VI, PART B BID DOC. NO. CS-2600-001-9		Electrical specification IIIB-01	PAGE 126 OF 126

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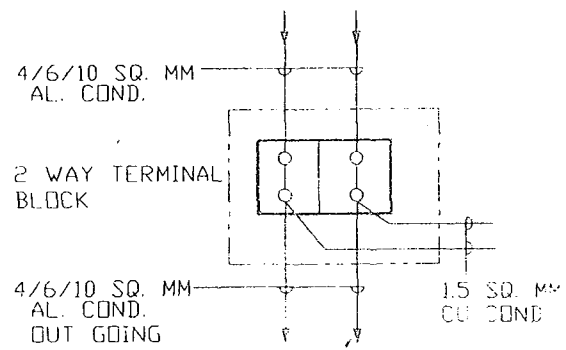


S.NO.	LP TYPE	INCOMER ISOLATOR	OUTGOING 20A MCB'S
1.	LP-1	63A TPN + 63A CONT + SYNC. TIMER + INDICATING LAMPS	12 NDS. SP+ 6 NDS. SP
2.	LP-2	63A TPN + 63A CONT + SYNC. TIMER + INDICATING LAMPS	6 NDS. SP+ 3 NDS. SP

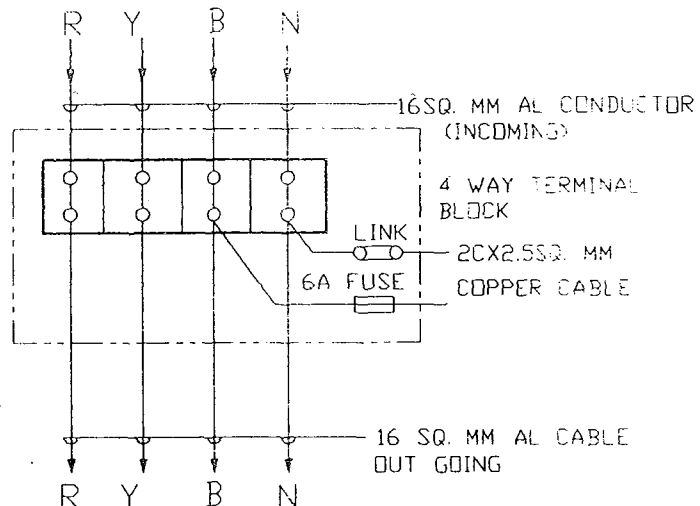
RB	FOR TENDER PURPOSE	NS	DESIGN	CHKD	M	E	C	C&I	ARCH	APPO	DATE
RA	FOR TENDER PURPOSE	NS	DESIGN	CHKD	M	E	C	C&I	ARCH	APPO	DATE
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	Cleared By						
		NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		SCHEMATIC DIAGRAM FOR LIGHTING PANELS									
SIZE A4	SCALE NTS	ORG. NO. 0000-217-PDE-A-001								REV. NO. RB	
		SH. 1 OF 20									

L19.DWG

This drawing was prepared by the undersigned and covers all the work shown on the drawing. Any contradiction or discrepancy between this drawing and the specification shall be referred to the undersigned for clarification. Any contradiction or discrepancy between this drawing and the specification shall be referred to the undersigned for clarification.



JUNCTION BOX TYPE - E

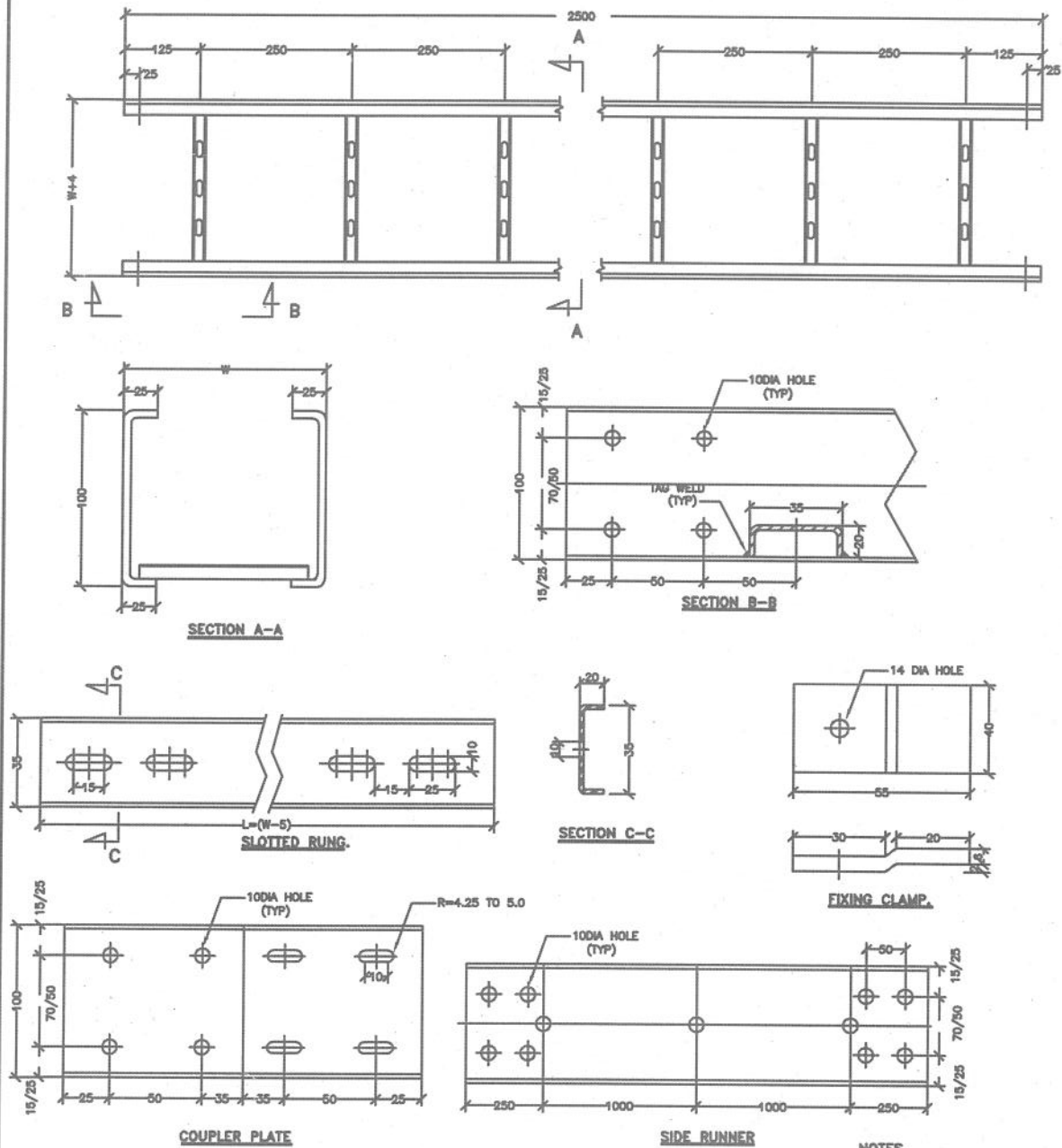


JUNCTION BOX TYPE - S

RB	FOR TENDER PURPOSE	REV	REV	AN	-	AN	-	-	-	20/11/06	
RA	FOR TENDER PURPOSE	REV	REV	AN	-	AN	-	-	-	24/2/2000	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPRO. DATE	
					CLEARED BY						
		NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		SCHEMATIC DIAGRAM OF JUNCTION BOX WIRING									
SIZE A4	SCALE NTS	DRG. NO. 0000-217-PDE-A-001 SH. 3 OF 20							REV. NO. RB		

L2.DWG

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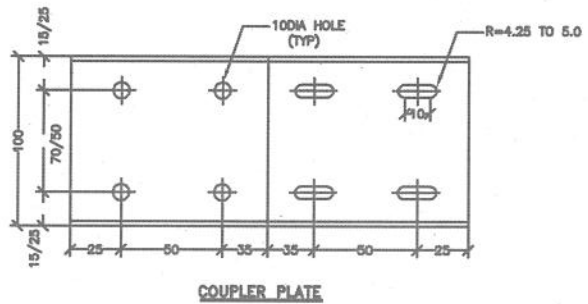
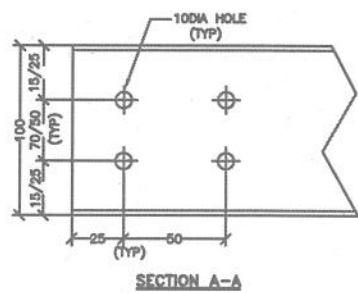
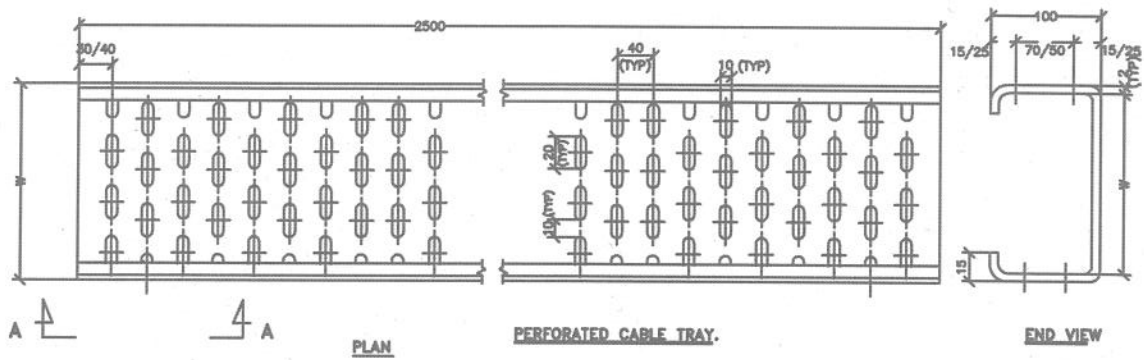


NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL:-2mm THICK MS SHEET.
3. FINISH :-HOT DIP GALVANISED
4. THICKNESS:-3mm COUPLER PLATE
2mm TRAY.
5. TOLERANCE:-AS PER RELEVANT IS.

RD	FOR TENDER PURPOSE	13	13	REL	-	W	-	-	-	05.07.12	
RC	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	
RB	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-		
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-		
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी पी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE LADDER TYPE CABLE TRAY.											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-001								REV. NO. RD	

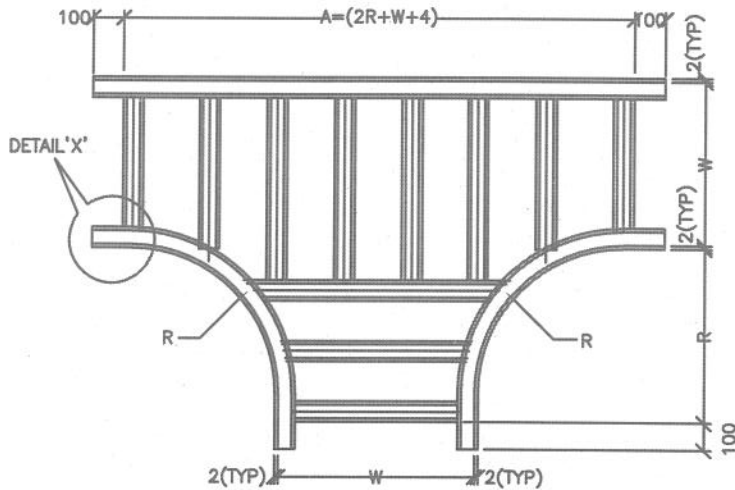
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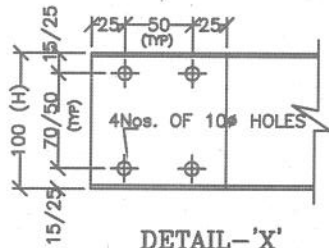
- NOTES.
1. ALL DIMENSIONS ARE IN mm.
 2. MATERIAL:-2mm THICK MS SHEET.
 3. FINISH :-HOT DIP GALVANISED
 4. THICKNESS:-3mm COUPLER PLATE
2mm TRAY.
 5. TOLERANCE:-AS PER RELEVANT I.S.
 6. INNER WIDTH (W) :- 150, 300 & 600mm.

RD	FOR TENDER PURPOSE	13	13	RVP	-	W	-	-	-	AS	05/07/20
RC	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05/07/2000
RB	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07/04/2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17/01/2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी पी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT											
STANDARD											
TITLE											
PERFORATED TYPE CABLE TRAY.											
SIZE	SCALE	DRG. NO.								REV. NO.	
A4	NTS	0000-211-PDE-A-002								RD	

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HORIZONTAL TEE



DETAIL - 'X'

INNER WIDTH OF TRAY (W)	DEPTH OF TRAY (H)	BENDING RADIUS (R)	A		
			150	300	600
150, 300 & 600	100	600	1354	1504	1804
		900	1954	2104	2404
		1200	2554	2704	3004

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :- 150, 300 & 600mm.
3. MATERIAL :- 2mm. THICK MS SHEET.
4. TOLERANCE :- AS PER RELEVANT LS.
5. FINISH :- HOT DIP GALVANISED

RD	FOR TENDER PURPOSE	h3	h3	REV	-	WV	-	-	-	DT	05-07-10
RC	FOR TENDER PURPOSE	RT	AG	VKM	-	SS	-	-	-	DT	05-07-2007
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05-07-2006
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17-06-2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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NTPC

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

CABLE TRAY DETAILS
HORIZONTAL TEE

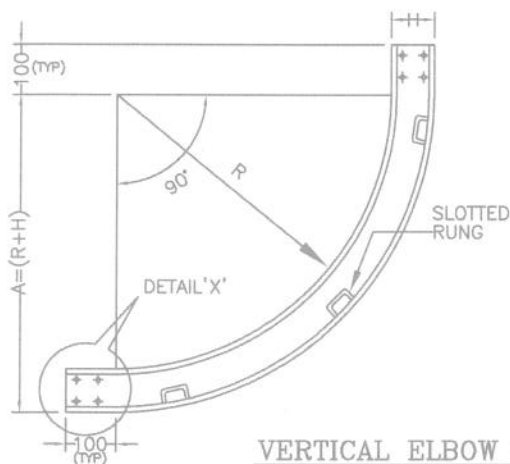
SIZE
A4

SCALE
NTS

DRG. NO.

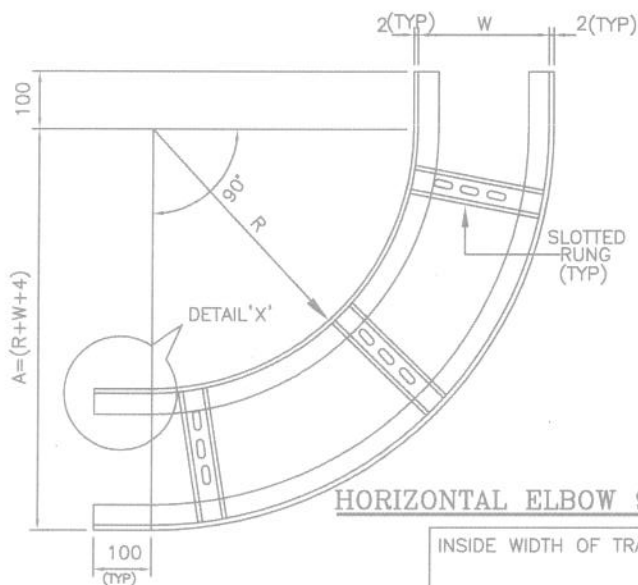
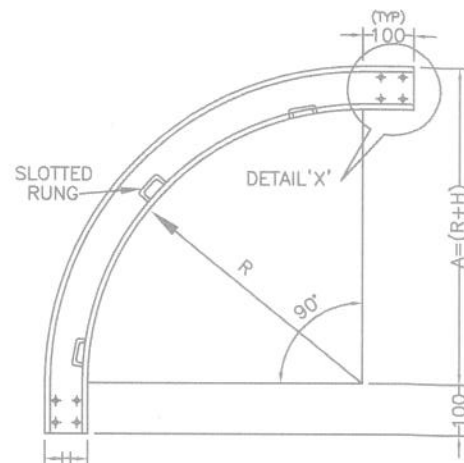
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REV. NO.
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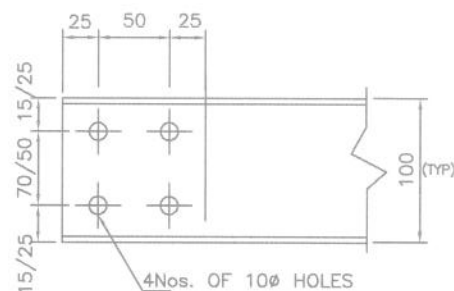


VERTICAL ELBOW 90° UP/DOWN

IN SIDE WIDTH OF TRAY (W)	DEPTH OF TRAY (H)	BENDING RADIUS (R)	A
150, 300, & 600	100	600	700
		900	1000
		1200	1300



HORIZONTAL ELBOW 90°



DETAIL-X

INSIDE WIDTH OF TRAY (W)	DEPTH OF TRAY (H)	BENDING RADIUS (R)	A		
			150	300	600
150, 300 & 600	100	600	754	904	1204
		900	1054	1204	1504
		1200	1354	1504	1804

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :- 150, 300 & 600mm.
3. MATERIAL :- 2mm. THICK MS SHEET.
4. TOLERANCE :- AS PER RELEVANT I.S.
5. FINISH :- HOT DIP GALVANISED

RC	FOR TENDER PURPOSE	M3	M3	R4P	-	VV	-	-	-	AS	05/07
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05/07
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

CABLE TRAY 90° BENDS (CTB 90°)

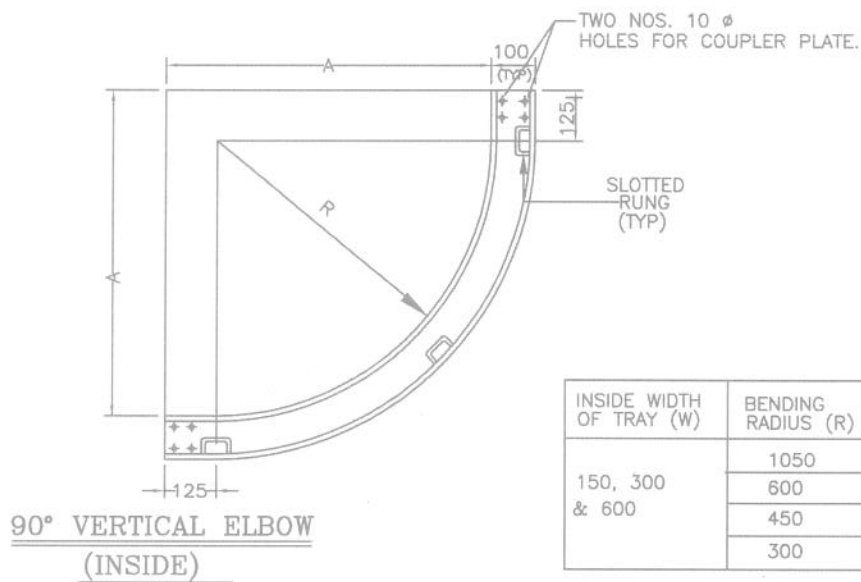
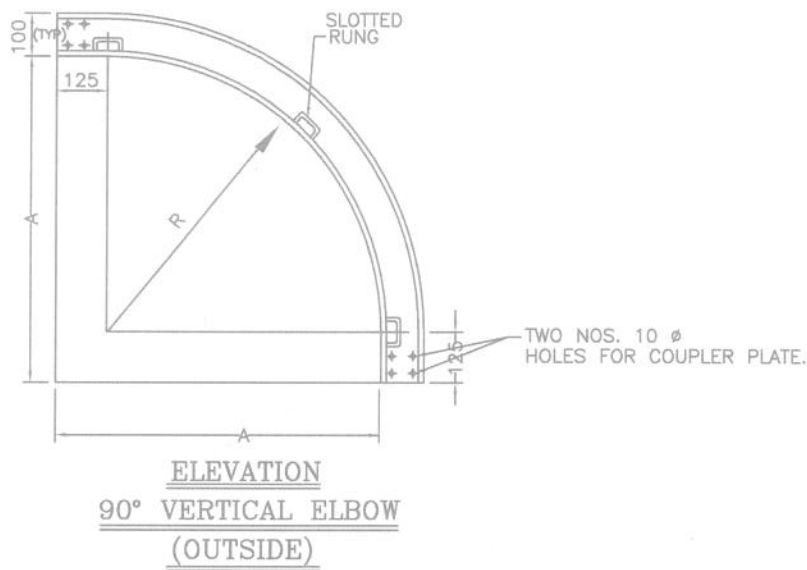
SIZE
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SCALE
NTS

DRG. NO.

0000-211-PDE-A-005

REV. NO.
RC



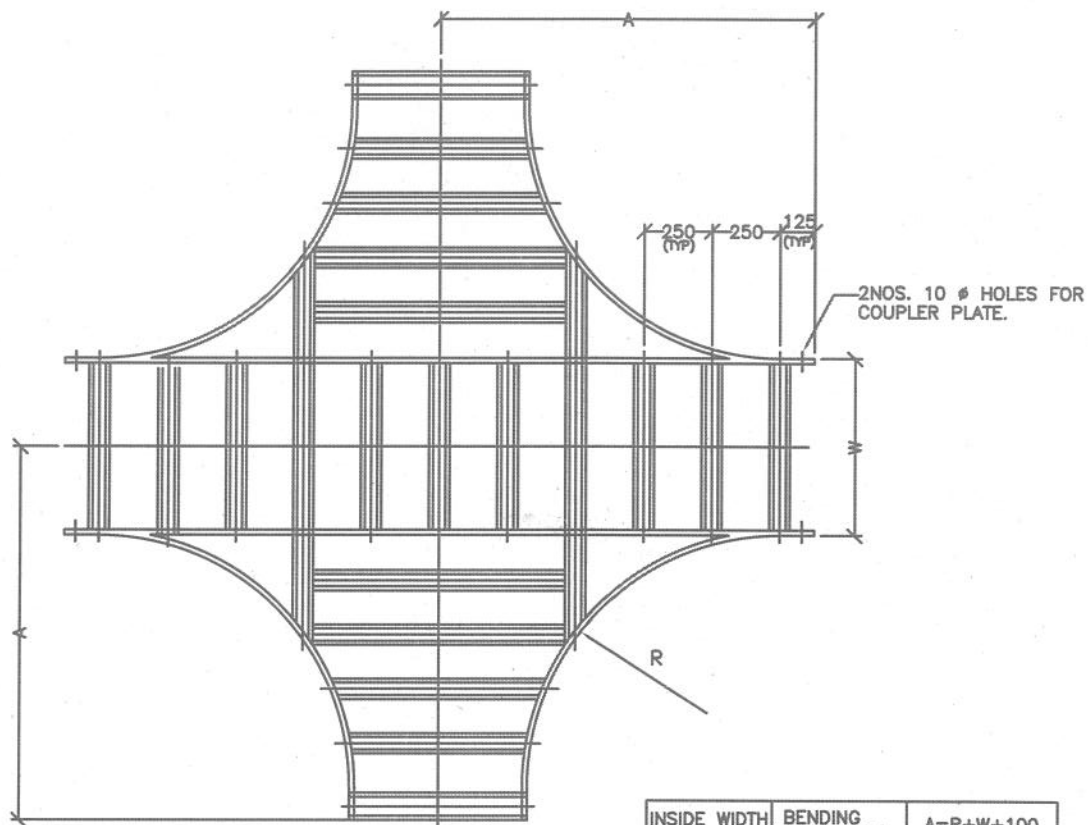
INSIDE WIDTH OF TRAY (W)	BENDING RADIUS (R)	A
150, 300 & 600	1050	1175
	600	725
	450	575
	300	425

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :- 150, 300 & 600mm.
3. MATERIAL :- 2mm. THICK MS SHEET.
4. TOLERANCE :- AS PER RELEVANT I.S.
5. FINISH :- HOT DIP GALVANISED

RC	FOR TENDER PURPOSE	M	M	RV	-	VV	-	-	-	-	AS	05.07.2006
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	-	AS	05.07.2006
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	-	17.01.2006
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE	
CLEARED BY												
 NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION												
PROJECT STANDARD												
TITLE CABLE TRAY 90° VERTICAL ELBOW (OUTSIDE) 90° VERTICAL ELBOW (INSIDE)												
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-006								REV. NO. RC		

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PLAN

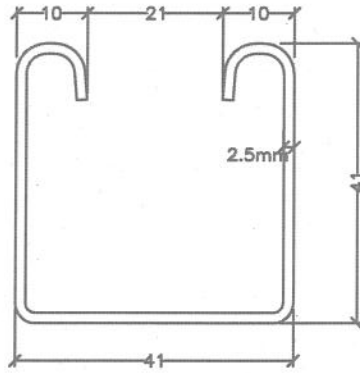
INSIDE WIDTH OF TRAY (W)	BENDING RADIUS (R)	$A = R + \frac{W}{2} + 100$
600	1050	1450
	600	1000
	450	850
	300	700
300	1050	1300
	600	850
	450	700
	300	550

NOTES.

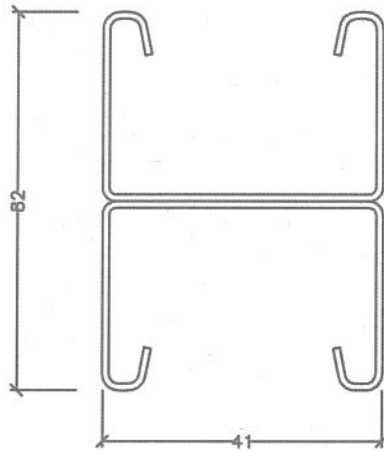
1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :- 150, 300 & 600mm.
3. MATERIAL :- 2mm. THICK MS SHEET.
4. TOLERANCE :- AS PER RELEVANT I.S.
5. FINISH :- HOT DIP GALVANISED

RC	FOR TENDER PURPOSE	As per	-	VV	-	-	-	-	05.07.2000		
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	AS		
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	07.08.2000		
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		CABLE TRAY DETAILS CROSS									
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-008							REV. NO. RC		

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SINGLE CHANNEL-TYPE C1



DOUBLE CHANNEL-TYPE C2

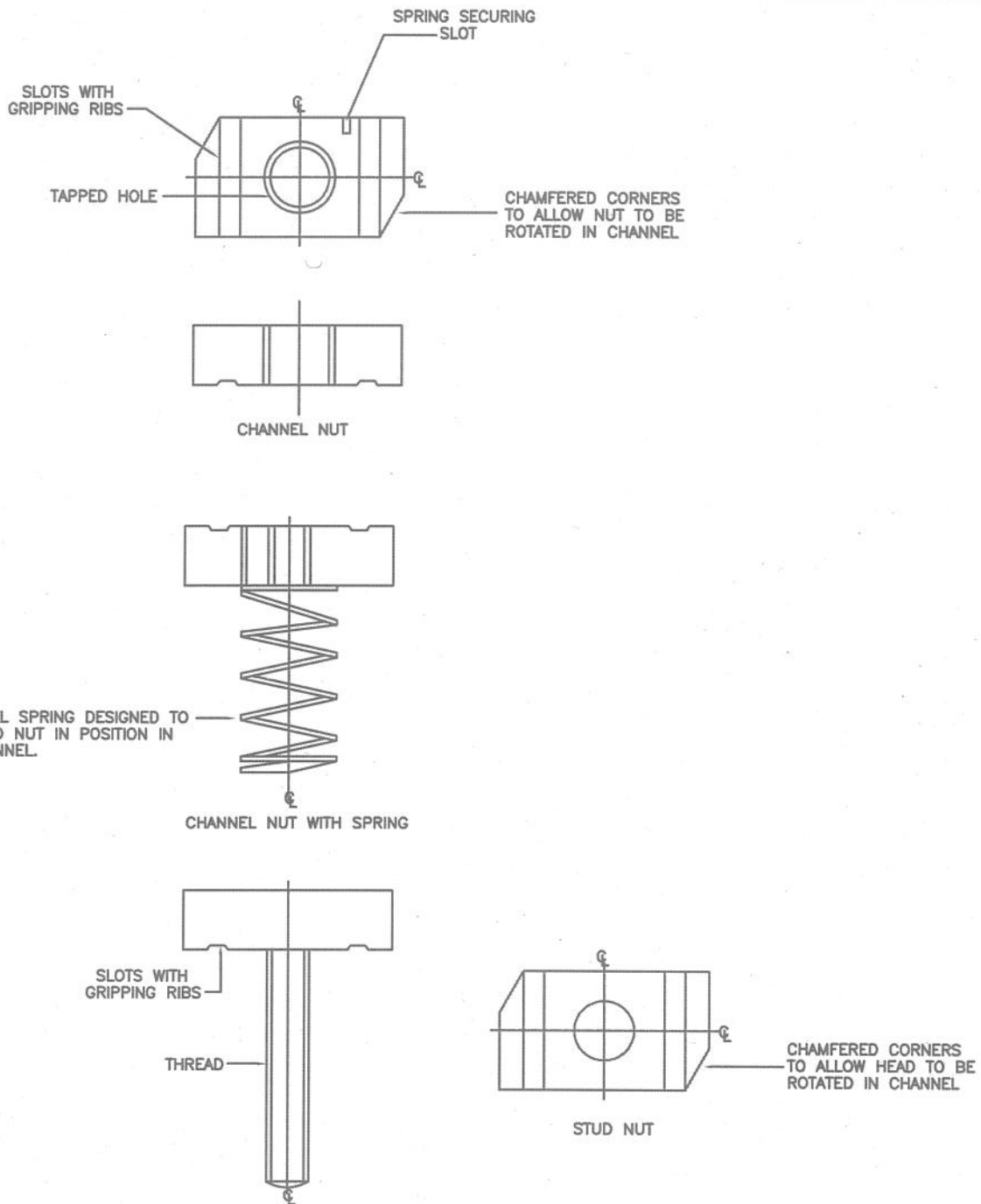
TWO LENGTHS OF C1 WELDED BACK TO BACK

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :- 2.5mm. THICK MS SHEET.
3. TOLERANCE :-AS PER RELEVANT I.S.
4. FINISH :-HOT DIP GALVANISED

RC	FOR TENDER PURPOSE	1/3	1/3	248	-	✓	-	-	-	AS	05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.07.10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.08.09
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		C1 & C2 CHANNEL, CABLE TRAY SUPPORT SYSTEM									
SIZE A4	SCALE NTS	DRG. NO. 0000-211-P0E-A-013								REV. NO. RC	

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TYPICAL DETAILS OF FIXING ACCESSORIES

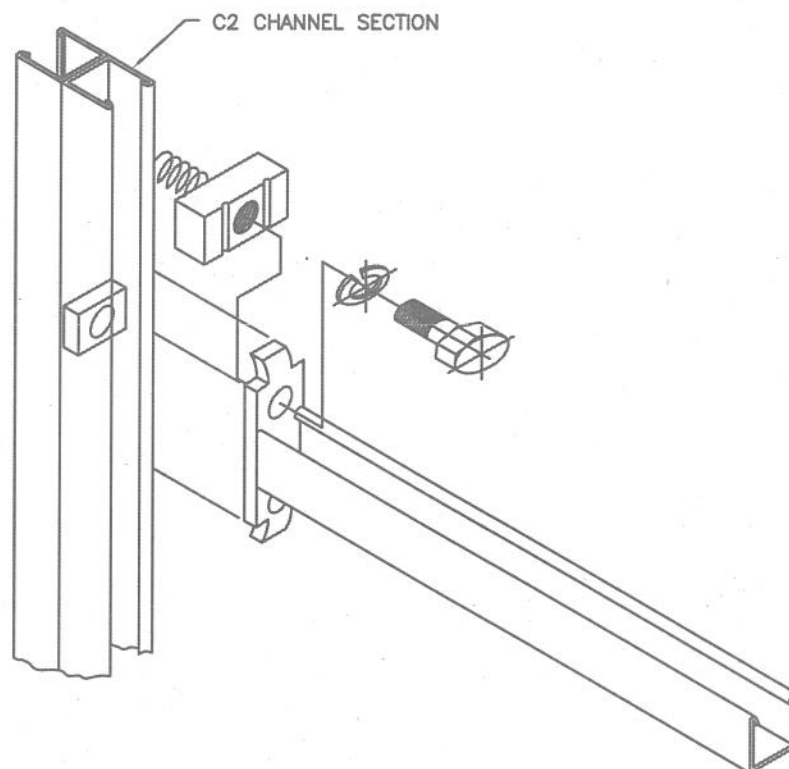
NOTES.

1. MATERIAL :- MILD STEEL
2. FINISH :- HOT DIP GALVANISED

RC	FOR TENDER PURPOSE	M	M	R	-	V	-	-	-	AS	05-07-10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05-07-10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07-08-09
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
 एन टी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-014								REV. NO. RC	

TRAY1A-211-014

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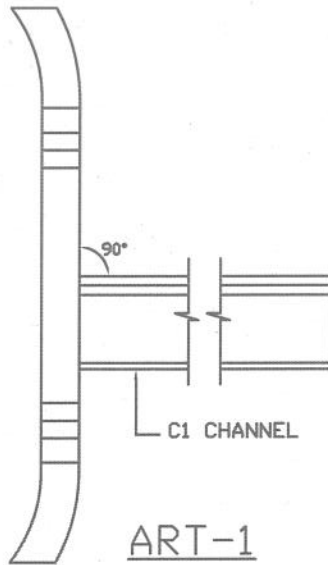
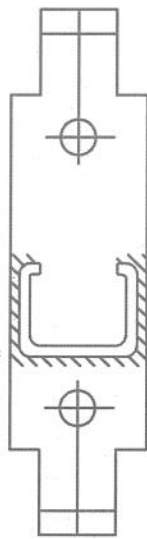


NOTE.

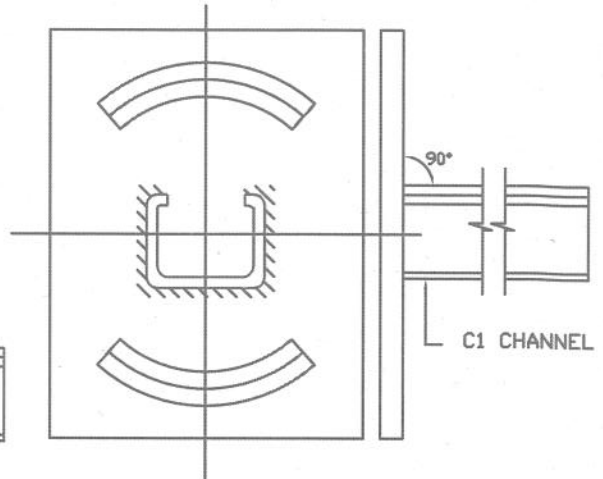
1. FINISH :-HOT DIP GALVANISED

RC	FOR TENDER PURPOSE	M3	M3	R4P	-	VV	-	-	-	AS	05/17/2000
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05/17/2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07/01/2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी पी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT											
STANDARD											
TITLE											
TYPICAL DETAIL OF CABLE TRAY SUPPORT SYSTEM											
SIZE	SCALE	DRG. NO.								REV. NO.	
A4	NTS	0000-211-POE-A-015								RC	

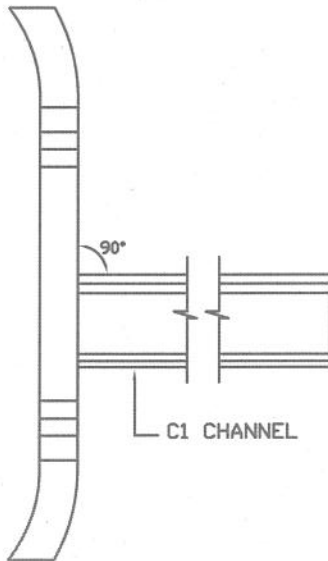
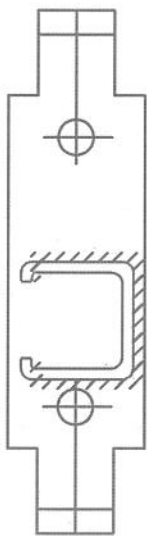
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ART-1



ART-3



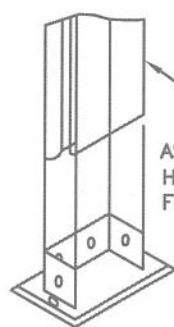
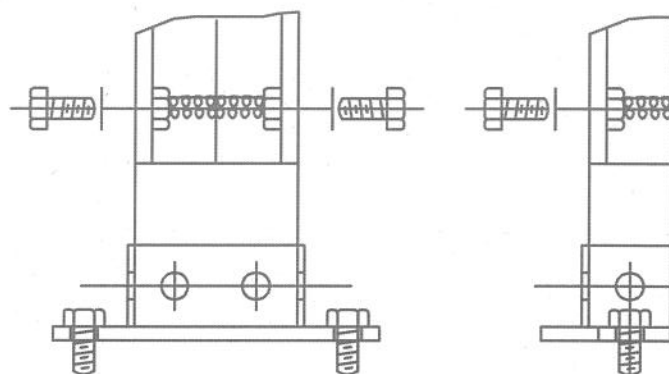
ART-2

NOTES.

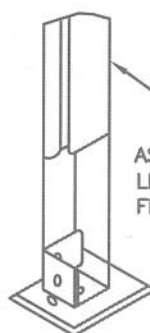
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	M3	M3	REV	-	✓	-	-	-	✓	05-02-70
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.07.8000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.08.8000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT											
STANDARD											
TITLE											
CANTILEVER ARMS											
SIZE	SCALE	DRG. NO.								REV. NO.	
A4	NTS	0000-211-POE-A-016								RC	

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ASSEMBLY 1
HEAVY DUTY FLOOR
FIXING FOR C2 CHANNEL



ASSEMBLY 2
LIGHT DUTY FLOOR
FIXING FOR C1 CHANNEL

FLOOR FIXING FOR CHANNEL VERTICAL SUPPORTS

NOTES.

1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	M3	M3	EXR	-	✓	-	-	-	AS	05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.02.10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.06.2009
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी पी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT											
STANDARD											
TITLE											
TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM											
SIZE	SCALE	DRG. NO.				REV. NO.					
A4	NTS	0000-211-POE-A-018				RC					

Diagram illustrating the installation of a channel clamp on a wall using rawl bolts and lock nuts.

The diagram shows a vertical channel clamp being attached to a wall. The clamp has four pre-drilled holes, two on each side. The wall has corresponding holes to be drilled for the rawl bolts.

The components shown are:

- CHANNEL CLAMP
- CHANNEL
- LOCK NUT
- RAWL BOLT

The assembly process involves drilling holes in the wall, inserting the rawl bolts, and then securing the channel clamp with the lock nuts.

1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

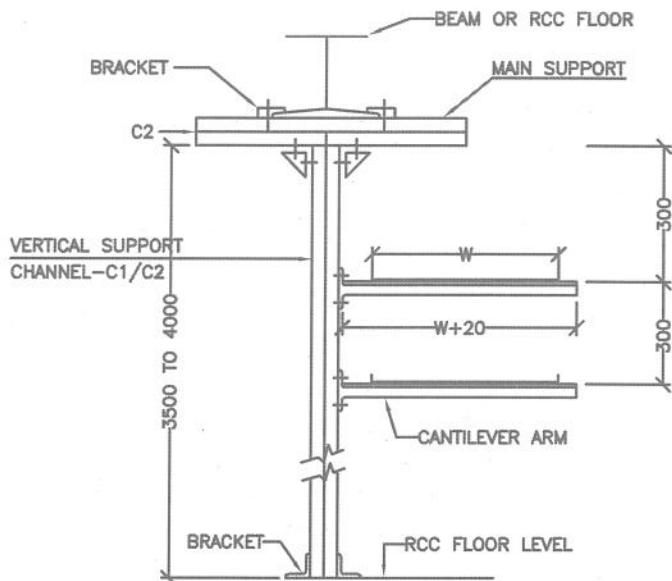
[illegible]

Diagram illustrating the components and dimensions of a cantilever arm assembly:

- BRACKET**: Labels pointing to the top and bottom horizontal supports.
- MAIN SUPPORT**: Label pointing to the top horizontal support.
- C2**: Label pointing to the top horizontal support.
- BRACKET**: Label pointing to the bottom horizontal support.
- VERTICAL SUPPORT C1/C2**: Label pointing to the vertical support structure.
- W**: Dimension indicating the width of the top horizontal support.
- W+20**: Dimension indicating the width of the bottom horizontal support.
- CANTILEVER ARM**: Label pointing to the vertical support structure.
- Dimensions**: Three vertical dimensions of 300 units each, indicating the height of the sections.

[illegible]

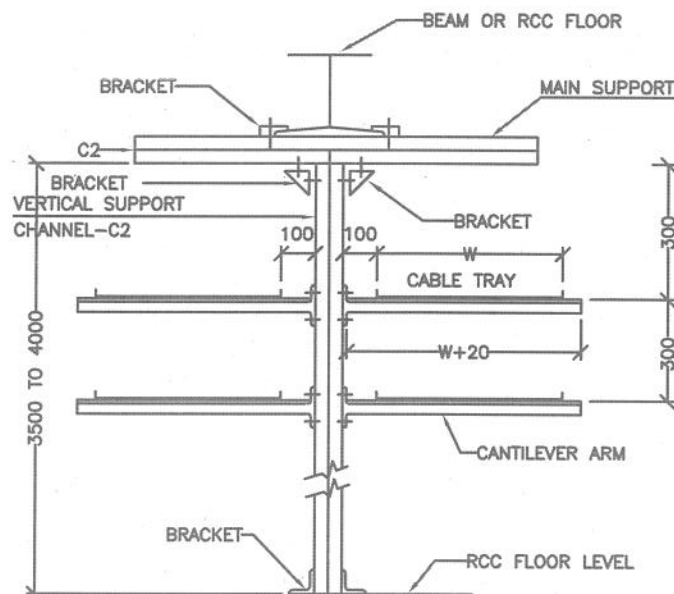
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VERTICAL SUPPORT

- 1) UPTO 3 TIER - C1 CHANNEL
- 2) ABOVE 3 TIER - C2 CHANNEL

ARRANGEMENT TYPE-D1



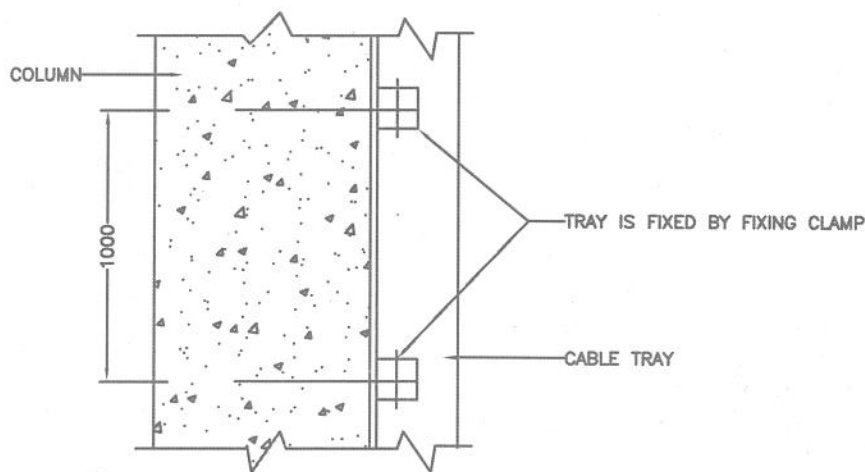
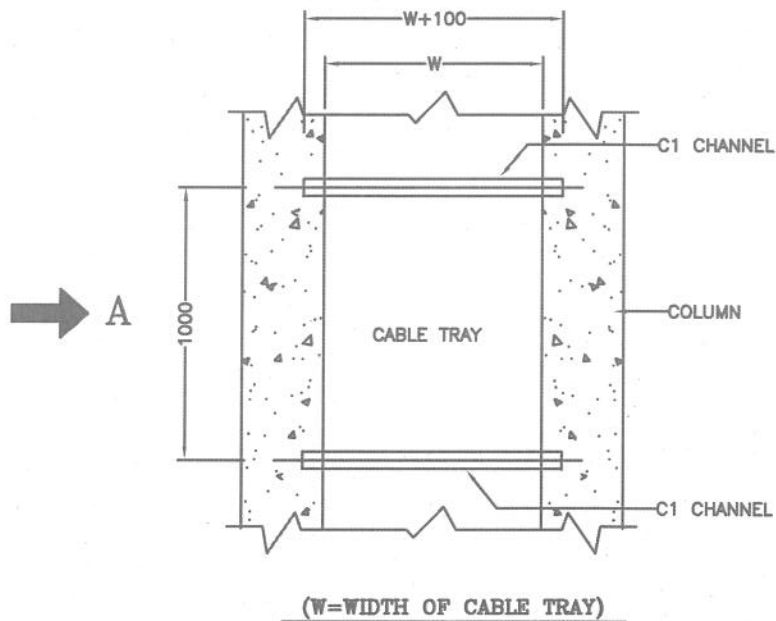
ARRANGEMENT TYPE-D2

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

RC	FOR TENDER PURPOSE	M	M	EXP	-	W	-	-	-	AS	05/07/10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05/07/10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	05/07/10
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी पी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE STANDARD CABLE SUPPORT ASSEMBLY											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-032								REV. NO. RC	

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VIEW-A
ARRANGEMENT TYPE-S1

NOTES.

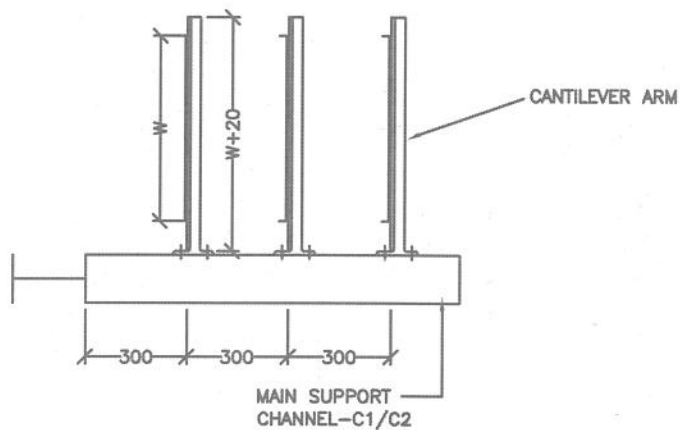
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

RC	FOR TENDER PURPOSE	12	12	EXP	-	VV	-	-	-	AS	05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.07.10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.06.00
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT		STANDARD									
TITLE		STANDARD CABLE SUPPORT ASSEMBLY									
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-033								REV. NO. RC	

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MAIN SUPPORT

- 1) FOR 1 TO 6 TIER OF 600mm TRAY - C2 CHANNEL
- 2) FOR 1 TO 3 TIER OF 300mm TRAY - C1 CHANNEL
- 3) FOR 4 TO 6 TIER OF 300mm TRAY - C2 CHANNEL
- 4) FOR 1 TO 6 TIER OF 150mm TRAY - C1 CHANNEL



ARRANGEMENT TYPE-S2

NOTES.

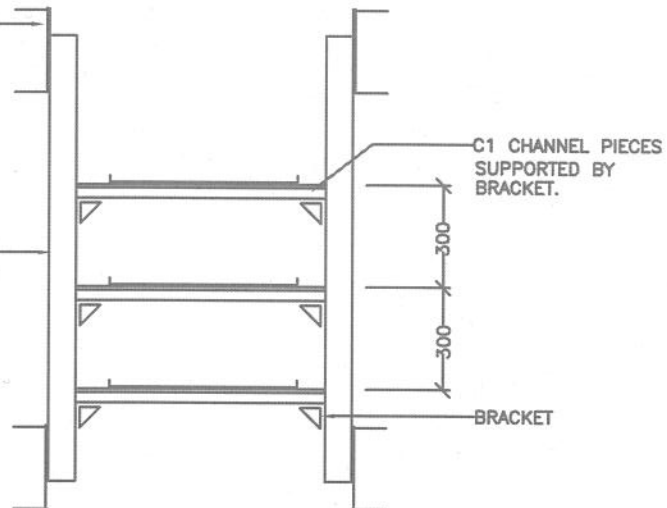
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

RC	FOR TENDER PURPOSE	A3	A3	OKP	-	VV	-	-	-	-	05/02/16
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05/02/16
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17/01/2016
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		STANDARD CABLE SUPPORT ASSEMBLY									
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-034								REV. NO. RC	

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CHANNELS SUPPORTED BY
FLOOR BEAM

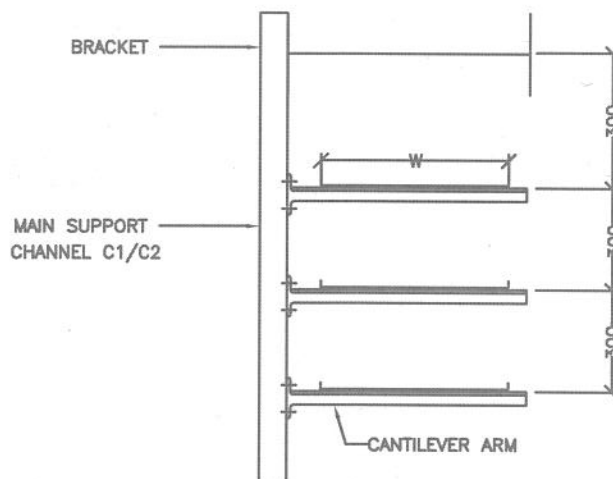
MAIN SUPPORT
CHANNEL IS
SUPPORTED BY
BRACKET



MAIN SUPPORT

- 1) UPTO 3 TIER - C1 CHANNEL
- 2) ABOVE 3 TIER - C2 CHANNEL

ARRANGEMENT TYPE-S3



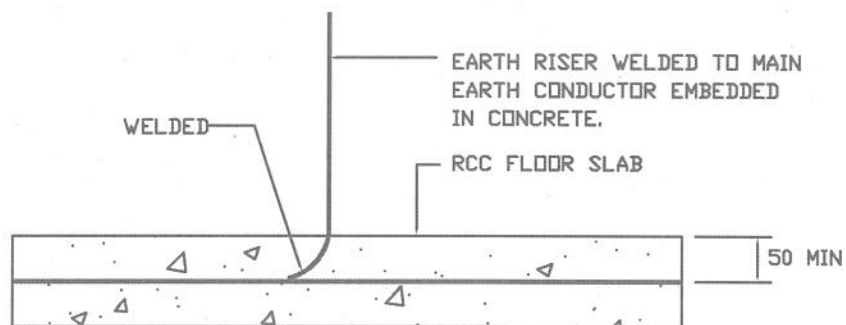
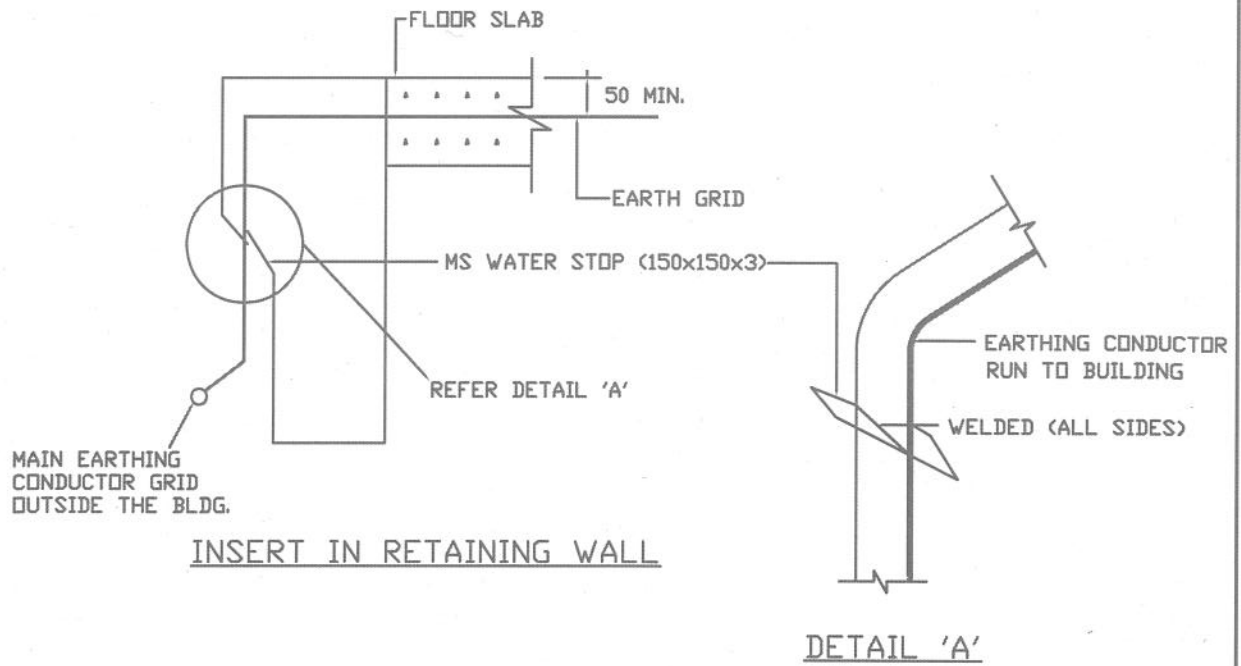
ARRANGEMENT TYPE-S4

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

RC	FOR TENDER PURPOSE	M3	M3	R/R	-	W	-	-	-	-	05/07/10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	15.07/2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी पी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE STANDARD CABLE SUPPORT ASSEMBLY											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-035								REV. NO. RC	

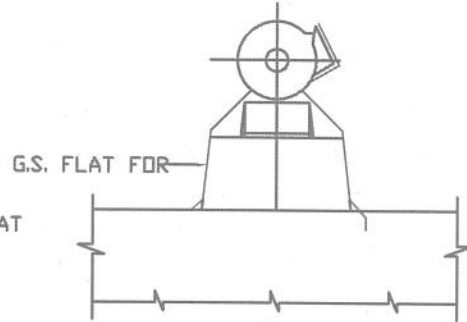
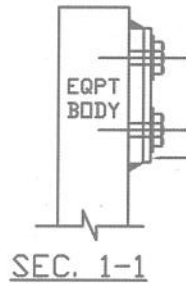
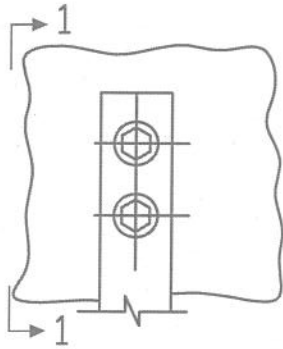
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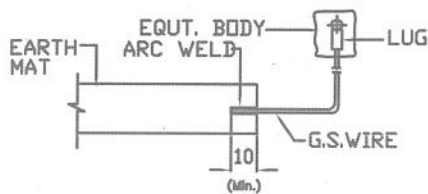
EARTH RISER

NOTE.
1. ALL DIMENSIONS ARE IN mm.

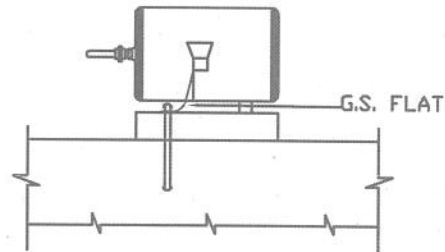
RC	FOR TENDER PURPOSE	M3	M3	R4	-	W	-	-	-	AS	05.07.18
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	05.07.18
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.08.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE EARTHING DETAILS											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-041								REV. NO. RC	



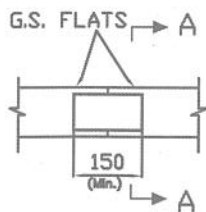
EQUIPMENT GROUNDING WITH G.S. FLAT



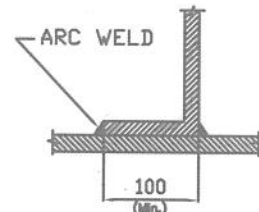
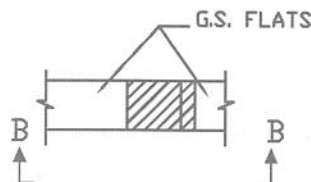
EQUIPMENT GROUNDING WITH G.S. WIRE



MOTOR TERMINAL BOX GROUNDING DETAIL



LAP JOINTS BETWEEN G.S. FLATS

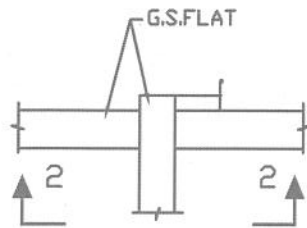


ANGULAR JOINTS BETWEEN G.S. FLATS

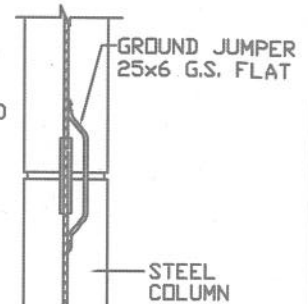
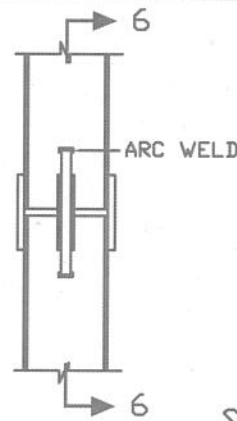
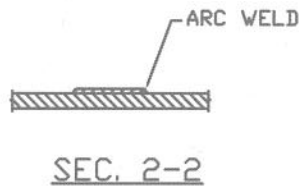
NOTE.
1. ALL DIMENSIONS ARE IN mm.

RC	FOR TENDER PURPOSE	13	13	REL	-	NV	-	-	-	-	05-02-76
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	01.11.88
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.88
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE EARTHING DETAILS											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-042								REV. NO. RC	

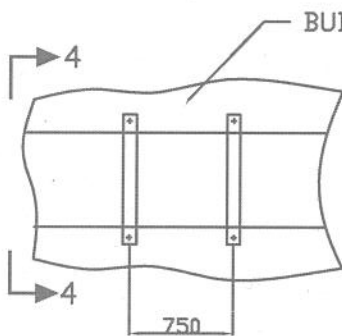
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CROSS JOINTS BETWEEN FLATS

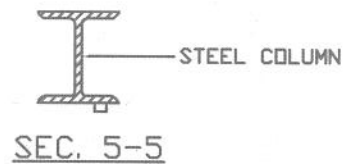
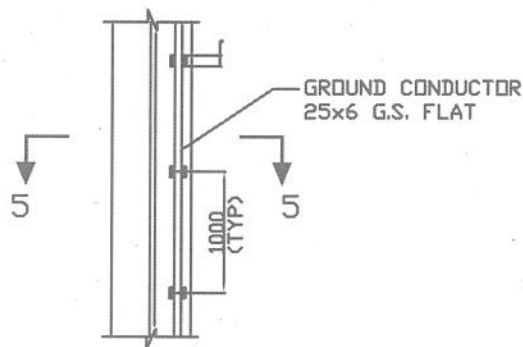


BONDING OF STEEL COLUMN



SEC. 4-4

GROUND CONDUCTOR ALONG BUILDING WALL

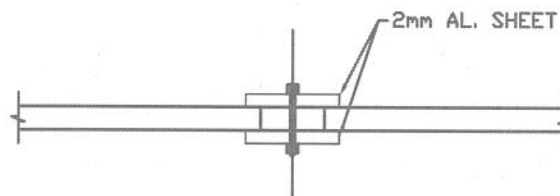


GROUND CONDUCTOR ALONG STEEL COLUMN STRUCTURE

NOTE.
1. ALL DIMENSIONS ARE IN mm.

RC	FOR TENDER PURPOSE	M3	M3	PXL	-	WV	-	-	-	AS	05/07/10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	05/07/10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07/01/2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE EARTHING DETAILS											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-043								REV. NO. RC	

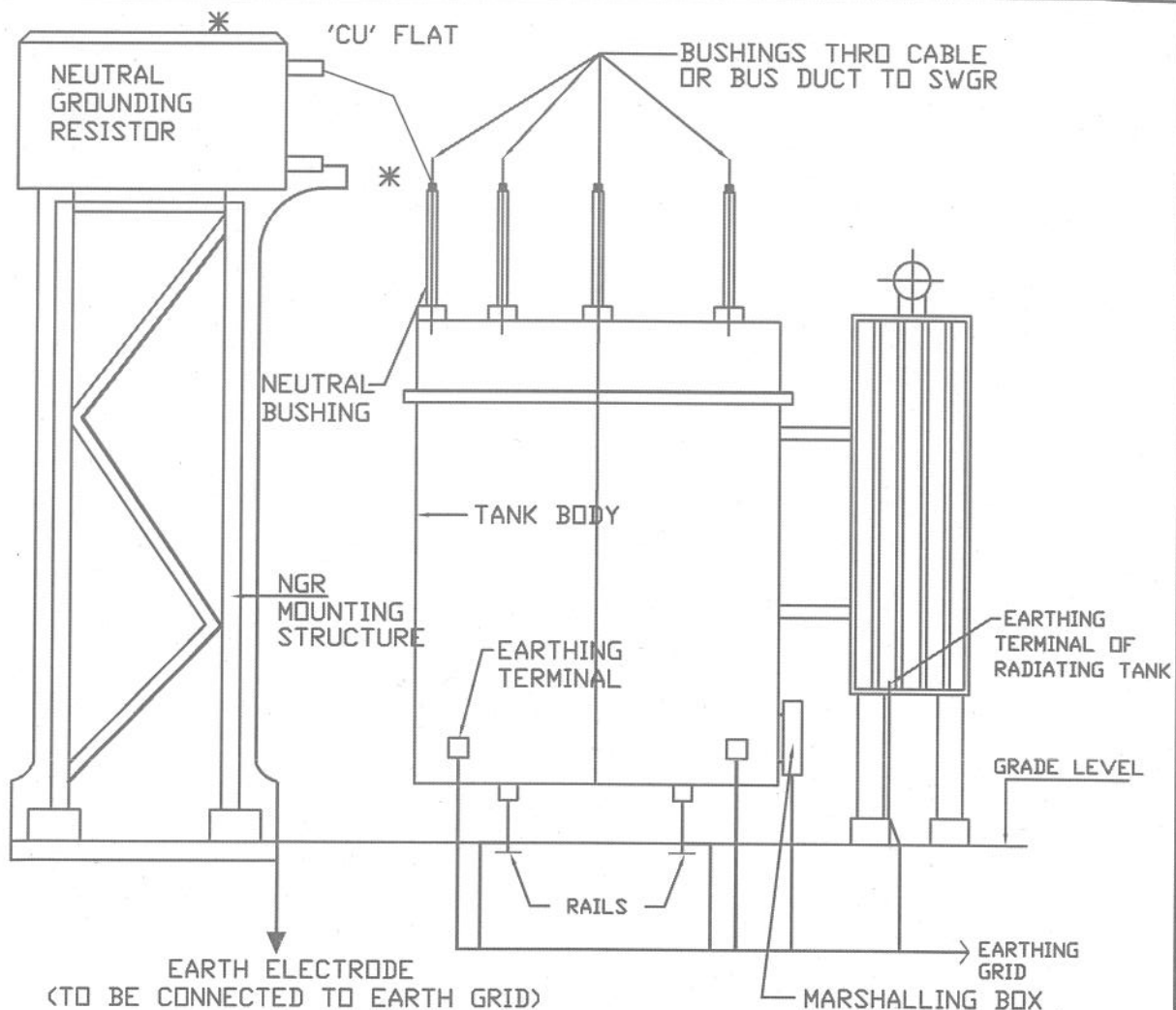
A schematic diagram of a square flange. It consists of a square frame with a central circular hole. A line labeled "GLAND PLATE" points to the top-left corner of the square frame. The frame has break lines (zig-zag lines) at the top-right and bottom-left corners, indicating it is a partial view of a larger assembly.



NOTE.
1. ALL DIMENSIONS ARE IN mm.

[illegible]

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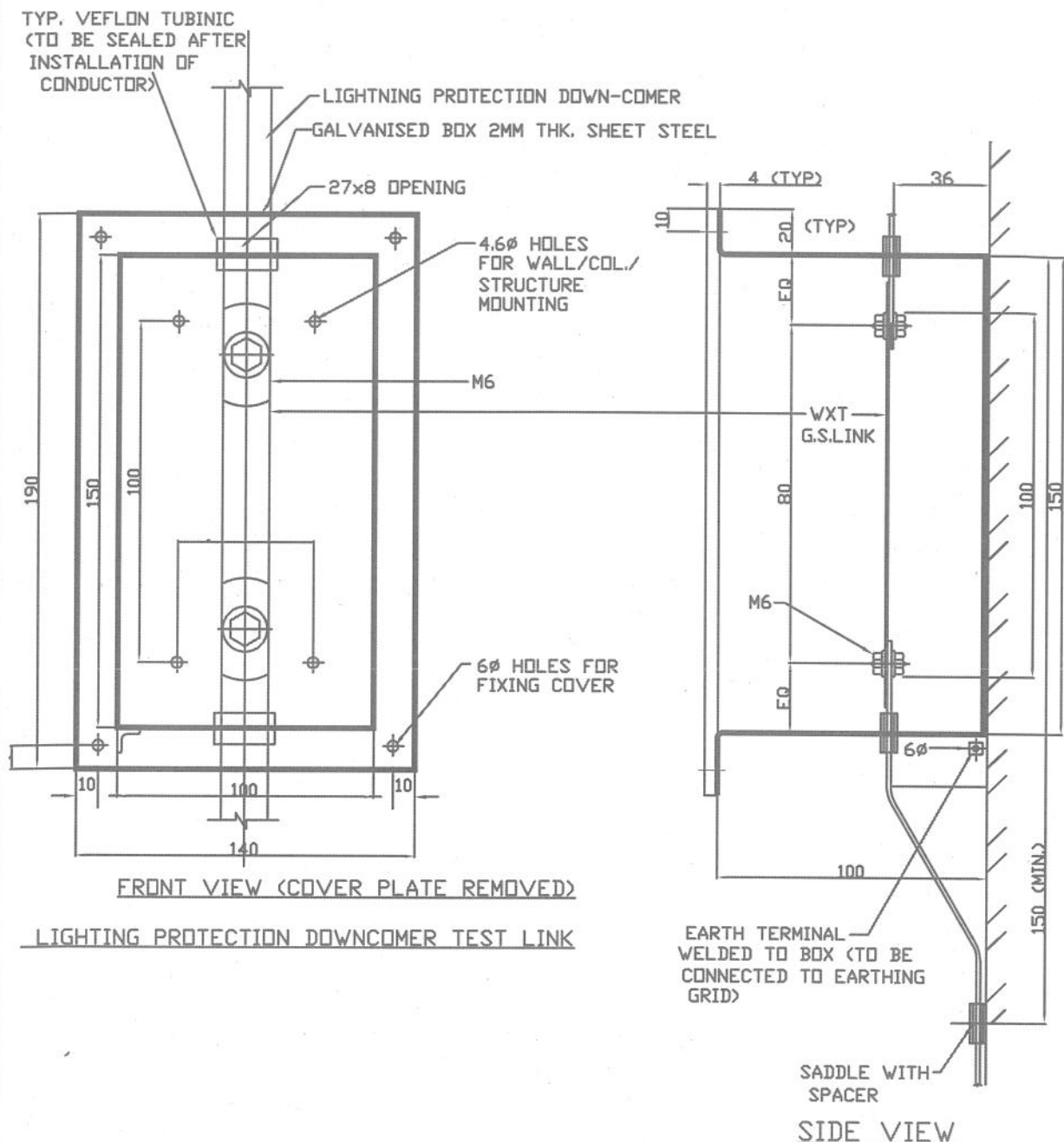
EARTHING DETAILS TRANSFORMER

NOTE.

1. ALL DIMENSIONS ARE IN mm.
2. THE TRANSFORMER NEUTRAL FOR HT TRANSFORMER SHALL BE EARTHED THROUGH FLATS AS SHOWN (SUPPLIED BY TRANSFORMER SUPPLIER)

RC	FOR TENDER PURPOSE	13	13	REV	- W	-	-	-	-	AS	05.02/10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	05.11.0000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.06.0000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
एन टी पी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE EARTHING DETAILS											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-045							REV. NO. RC		

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NOTE.

1. ALL DIMENSIONS ARE IN mm.
2. THE TEST LINK SHALL BE OF SAME WIDTH AND THICKNESS AS THE DOWNCOMER. THE NUTS BOLTS AND WASHER TO BE OF GS.
3. THE DOWN COMER ENTRY AND EXIT POINTS IN TO BOX BE MADE WATER-TIGHT AFTER LAYING OF CONDUCTOR.

RC	FOR TENDER PURPOSE	13	13	rel	-	W	-	-	-	AS	05/07/10	
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	05/07/10	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07/01/2000	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE	
					CLEARED BY							

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NTPC

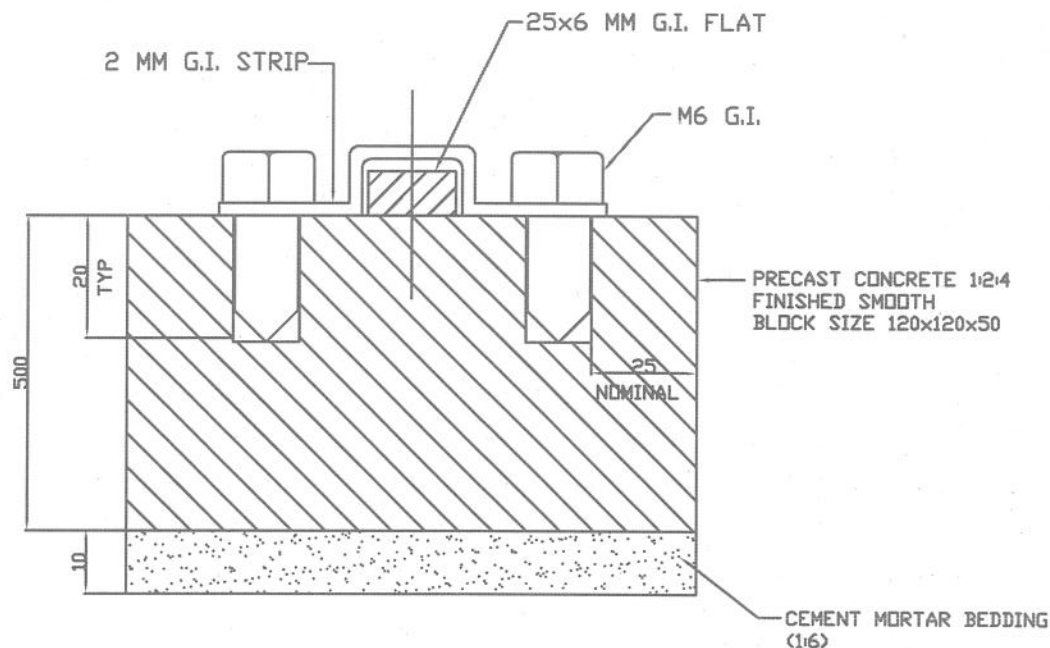
NTPC LTD.

(A GOVERNMENT OF INDIA ENTERPRISE)

ENGINEERING DIVISION

PROJECT		STANDARD									
TITLE		LIGHTNING PROTECTION DETAILS.									
SIZE	SCALE	DRG. NO.								REV. NO.	
A4	NTS	0000-211-POE-A-047								RC	

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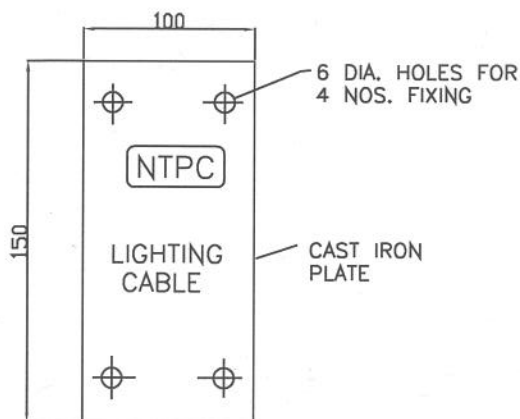
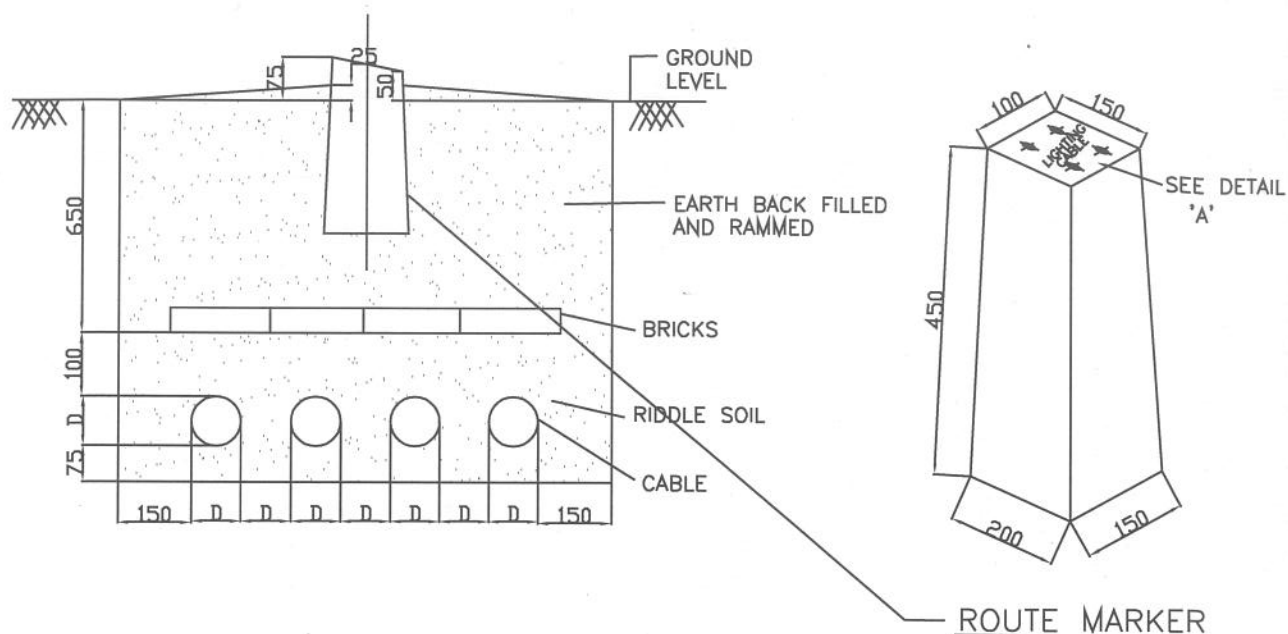


BLOCK SPACING 1000MM CENTRE TO CENTRE

TYPICAL DETAILS OF CLEATING HORIZONTAL CONDUCTOR OVER WATER PROOFING

NOTE.
1. ALL DIMENSIONS ARE IN mm.

RC	FOR TENDER PURPOSE	1/2	1/3	2/4	-	VV	-	-	-	AS	05/02/00
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	05/02/00
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07/01/0000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी पी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE LIGHTNING PROTECTION DETAILS											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-048								REV. NO. RC	

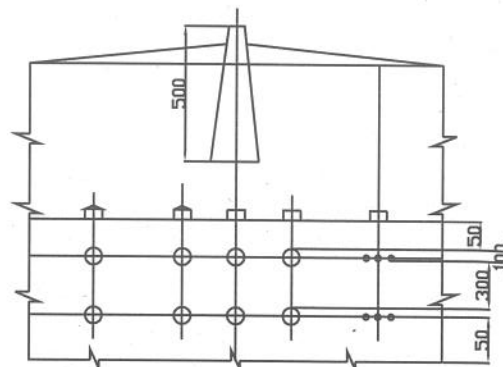
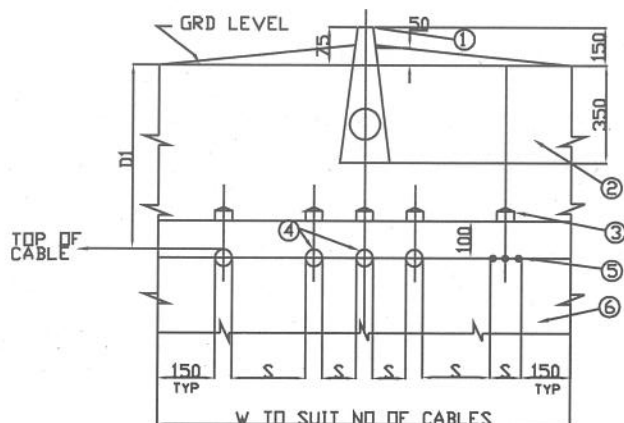


DETAIL - 'A'

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ROUTE MARKERS SHALL BE CONSTRUCTED OF CONCRETE WITH CAST IRON PLATE, WITH THE ROUTE INFORMATION ENGRAVED ON IT, BOLTED ON TOP OF THE CONCRETE BLOCK AS SHOWN.
3. CAST IRON PLATE SHALL BE OF Min. 6.0mm THICKNESS.

RC	FOR TENDER PURPOSE	13	13	RKG	-	NV	-	-	-	AS	05-07-10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	20.11.2006
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
एन टी पी सी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE BURIED CABLE TRENCH DETAILS FOR LIGHTING											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-049								REV. NO. RC	



DIRECTLY BURIED CABLES IN SINGLE LAYER

DIRECTLY BURIED CABLES IN TWO LAYER

LEGEND

- ① — CABLE ROUTE MARKER
- ② — EARTH BACK FILLED & RAMMED
- ③ — PROTECTIVE COVERS
 - a) BRICKS FOR LOW VOLTAGE CABLES
 - b) RCC FOR HIGH VOLTAGE CABLES WITH HOLE AT EACH END TO TIE EACH OTHER WITH G.S. WIRE
- ④ — ARMoured POWER CABLE
- ⑤ — ARMoured CONTROL CABLE
- ⑥ — FINE SAND/RIDDED SOIL COMPACTED

DIMENSION MIN.	1100V GRADE CABLES	FOR 3.3 KV TO 11KV	ABOVE 11KV & UPTO 33KV
D1	750	900	1050
S	= d BETWEEN CABLES OF SAME CLASS = 300MM BETWEEN CABLES OF DEFT CLASS = 400MM BETWEEN 1/C POWER CABLE AND COMMUNICATION CABLE. = 300MM BETWEEN MULTICORE POWER CABLE & COMMUNICATION CABLE.		

d - OVERALL DIAMETER OF THE BIGGER OF THE TWO CABLES.
D1 - MINIMUM DEPTH OF LAYING FROM GROUND SURFACE TO TOP OF CABLES.

NOTE

1. SINGLE CORE CABLES SHALL BE RUN IN TREFOIL FORMATION AND SHALL BE BOUND BY SELFLOCKING CABLE TIES AT EVERY 750 MM.
2. CABLE IDENTIFICATION TAG SHALL BE TIED AT BOTH ENDS OF THE CABLE.
3. IF THE MINIMUM CLEARANCE AS INDICATED THE ABOVE TABLE FOR CABLES OF DIFFERENT CLASSES ARE NOT FEASIBLE BRICK BARRIERS SHALL BE USED BETWEEN ADJACENT CABLES.
4. G.I/HUME/HDPE. PIPES SHALL BE PROVIDED FOR ROAD CROSSING AT A MINIMUM DEPTH OF 600 FROM THE GRADE LEVEL AS DECIDED BY NTPC.
5. ALL DIMENSIONS ARE IN mm

RC	FOR TENDER PURPOSE	13	13	RKP	-	W	-	-	-	05.07.10	
RB	FOR TENDER PURPOSE	RKG	RKG	SG	-	SS	-	-	-	10.11.2006	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	17.01.2000	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						

CLEARED BY

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NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

BURIED CABLES TRENCH FOR HT & LT CABLES

SIZE
A4

SCALE
NTS

DRG. NO.

0000-211-POE-A-050

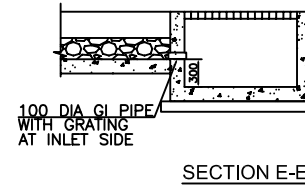
REV. NO.
RC

CLAUSE NO.	 TECHNICAL REQUIREMENTS																																																																		
	ANNEXURE-A <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;">SI No.</th><th style="width: 40%;">Location**</th><th style="width: 15%;">Average Illumination Level (Lux)</th><th style="width: 40%;">Type of Fixture</th></tr> </thead> <tbody> <tr> <td>(a)</td><td>Turbine Hall operating floor</td><td>200</td><td>High/medium bay LED luminaire</td></tr> <tr> <td>(b)</td><td>Turbine Hall Other Platforms</td><td>200</td><td>LED high/medium bay, LED well glass fixtures</td></tr> <tr> <td>(c)</td><td>Switchgear rooms, Charger, Rectifier room</td><td>200</td><td>Industrial type LED Luminaire</td></tr> <tr> <td>(d)</td><td>Control room, computer room, control equipment room</td><td>350</td><td>LED luminaire equivalent to Mirror optics with anti-glare features or down-lighter.</td></tr> <tr> <td>(e)</td><td>Offices, conference rooms, etc.</td><td>300</td><td>Decorative mirror optics Type LED luminaire or LED down-lighter</td></tr> <tr> <td>(f)</td><td>Battery rooms</td><td>100</td><td>Totally enclosed corrosion Proof LED Luminaire</td></tr> <tr> <td>(g)</td><td>Transformer yard</td><td>20 (general) 50 (on equipment)</td><td>LED Luminaire</td></tr> <tr> <td>(h)</td><td>Boiler platforms</td><td>100</td><td>LED well glass fixtures,</td></tr> <tr> <td>(i)</td><td>Diesel generating room /enclosure, Compressor room, pump house etc.</td><td>150</td><td>LED medium bay/ Industrial type LED Luminaire</td></tr> <tr> <td>(j)</td><td>Fuel oil pump house</td><td>150</td><td>Flame proof fluorescent fixtures suitable for division-2 hazardous area</td></tr> <tr> <td>(k)</td><td>Cable galleries/vault</td><td>50</td><td>Industrial type LED Luminaire</td></tr> <tr> <td>(l)</td><td>Street lighting- primary roads secondary roads</td><td>20 10</td><td>LED street lights</td></tr> <tr> <td>(m)</td><td>Outdoor storage handling and unloading area</td><td>20</td><td>LED Luminaire</td></tr> <tr> <td>(n)</td><td>Cement stores</td><td>150</td><td>Industrial dust proof type LED Luminaire</td></tr> <tr> <td>(o)</td><td>Chemical stores/House</td><td>150</td><td>Corrosion proof LED Luminaire</td></tr> </tbody> </table>			SI No.	Location**	Average Illumination Level (Lux)	Type of Fixture	(a)	Turbine Hall operating floor	200	High/medium bay LED luminaire	(b)	Turbine Hall Other Platforms	200	LED high/medium bay, LED well glass fixtures	(c)	Switchgear rooms, Charger, Rectifier room	200	Industrial type LED Luminaire	(d)	Control room, computer room, control equipment room	350	LED luminaire equivalent to Mirror optics with anti-glare features or down-lighter.	(e)	Offices, conference rooms, etc.	300	Decorative mirror optics Type LED luminaire or LED down-lighter	(f)	Battery rooms	100	Totally enclosed corrosion Proof LED Luminaire	(g)	Transformer yard	20 (general) 50 (on equipment)	LED Luminaire	(h)	Boiler platforms	100	LED well glass fixtures,	(i)	Diesel generating room /enclosure, Compressor room, pump house etc.	150	LED medium bay/ Industrial type LED Luminaire	(j)	Fuel oil pump house	150	Flame proof fluorescent fixtures suitable for division-2 hazardous area	(k)	Cable galleries/vault	50	Industrial type LED Luminaire	(l)	Street lighting- primary roads secondary roads	20 10	LED street lights	(m)	Outdoor storage handling and unloading area	20	LED Luminaire	(n)	Cement stores	150	Industrial dust proof type LED Luminaire	(o)	Chemical stores/House	150	Corrosion proof LED Luminaire
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WASTE TO ENERGY PLANT BADARPUR			STATION LIGHTING																																																																

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(p)	Permanent stores	150	LED high/medium bay / Industrial trough LED Luminaire
	(q)	Workshop. Building	150	LED high/medium bay / Industrial trough LED Luminaire
	(r)	Laboratory General Analysis area	150 300	Corrosion proof LED Luminaire
	(s)	Garage/Car Parking	50	Industrial type LED Luminaire
	(u)	AIS Switchyard and Substation	20(general 50(on strategic equipment)	LED Luminaire
	(v)	Transfer points, Sheds, tunnels, bunker house, Crusher house, Conveyor Gallery etc. in bidders scope	100	LED Dust tight/Well glass type Luminaire
	(w)	Facility building, canteen etc	150	Industrial type LED Luminaire
	(x)	Hydrogen Plant Building	150	Explosion proof HPMV/ Fluorescent fittings suitable for class-I and Division –IIC
	(y)	DC Lighting- Control room	-	In candescent down light fixtures, Decorative recessed type with cylindrical reflector
	(z)	DC Lighting- Other Area	-	Incandescent Industrial Bulkhead
	(aa)	Corridors, Walkways	50	LED Luminaire
	(ab)	Building Periphery Lighting	10	LED Street Light fixture/ LED Luminaire
	(ac)	Security Lighting along Boundary	10	LED Street Light fixture/ LED Luminaire
	(ad)	ESP platform	150	LED well glass fixtures
	(ae)	Gate complex/Time Office	150	LED Luminaire
	(af)	GIS Hall	150	LED medium bay/ Luminaire
	(ag)	DM plant, water treatment plant CW Pump house, Raw water PH, Fire Water PH	150	LED high/medium bay / Industrial trough LED Luminaire
WASTE TO ENERGY PLANT BADARPUR			STATION LIGHTING	

CLAUSE NO.	TECHNICAL REQUIREMENTS							
	ANNEXURE-B							
	Sl.	Plant Areas	Normal AC Lighting System	Emergency AC Lighting System	220 V DC Lighting System	Portable DC Fixtures		
	1	TG Building(turbine hall, switchgear room etc)	80%	20%	√		—	
	2.	Boiler Platform	80%	20%	√			
	3	DG Area/ Room	80%	20%				
	4	Compressor Room					√	
	5	ESP Control Room	80%	20%			√	
	6	Unit Control Room	70%	30%				
	7	Switchyard Control Room	80%	20%				
	8	Battery Room	80%	20%				
	9	Cable Spreader Room/ Vault	80%	20%	√			
	10	Make Up Water Pump House Hydrogen Plant	100%				√	
	11	Chemical House	100%				√	
	12	Fuel Oil Pump House	100%				√	
	13	Ash Handling Plant	100%				√	
	14	Water Treatment Plant	100%				√	
	15	CT Switchgear Room	100%				√	
	16	Cooling Towers	100%					
	17	Workshop	100%				√	
	18	Service Building	100%					
	19	Area Lighting	100%					
	20	Street Lighting	100%					
	21	Transformer Yard and Storage Yard	100%					
	22	Coal Handling Plant	100%			√		
	23	GIS Hall	80%	20%				
24	AIS Switchyard	80%	20%					
WASTE TO ENERGY PLANT BADARPUR				STATION LIGHTING				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	DC Emergency Lighting:			
		Area	Average Lux Level	
	1	Unit Control Room	100	
	2	Control Equipment Room	100	
	3	Switchyard Control Room	20	
	4	Strategic Control Points (In TG Building & Boiler Area, Switchgear room, SWAS, Battery Room, UPS Area, TG Hall, Lube oil Room etc	20	
	5	Cable Vault & Galleries	1 fixture at every 20 metres spacing along walkways	
	6	Boiler Stair Case	1 fixture at every 20 metres spacing along walkways	
	7	Exit/ Entry of Main Plant Building	1 fixture	
	8	Fire Exit Sign	1 fixture	
WASTE TO ENERGY PLANT BADARPUR			STATION LIGHTING	



- | TRANSFORMER
RATING | HV SIDE XLPE CABLE SIZE
(sq. mm) | | |
|-----------------------|-------------------------------------|----------|----------|
| | 11KV | 6.6KV | 3.3KV |
| 1000 KVA | 3Cx150 | 3Cx150 | 3-1Cx150 |
| 1600 KVA | 3Cx150 | 3Cx150 | — |
| 2000 KVA | 3Cx150 | 3-1Cx300 | — |

Diagram illustrating the cross-section of a cable trench. The trench is 300 units wide and 300 units deep. The top layer is labeled "LEAN CONCRETE" with a thickness of 50 units. The bottom layer is labeled "75 DIA PVC PIPE". The middle section is labeled "SAND FILL AFTER CABLING". The top surface is at elevation "EL.(-)0.20M".

		LV FLANGE DIMENSION (in mm)			TOP OF LV FLANGE (in mm)	
RATING	DIMENSIONS mm	L	M	N	X	Y
1000 KVA		60	860	315	1500	730
1600 KVA		40	1000	380	1600	760
2000 KVA		40	1160	380	1750	810

500 DEEP GRATING

REMOVABLE GATE

3000W

EL: 3.4M

EL: FFL (SAME AS SWGR ROOM LVL)

40mm GRAVELS

300x300 CABLE SLIT

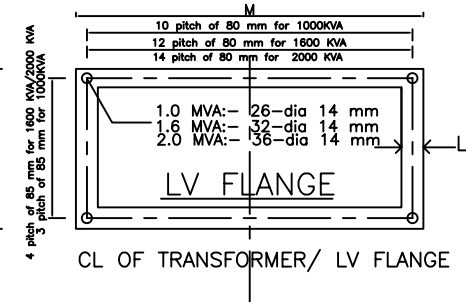
200

GROUND LVL

300 (MIN)

3000 3050 3050 3000

SECTION A-A



NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

STANDARD DRAWING

1.0/1.6/2.0 MVA TRANSF (OUTDOOR)
(LV - BUSDUCT, HV CABLE TERMINATION)

SIZE	SCALE	DRG. NO.	REV. NO.
		0000-000-POE-FB-002	0

Terminal No.	Description	Remarks
T-01	230V, Single Phase, 50Hz, AC Supply	
T-02		
T-03	MOG (Oil Level) Alarm	
T-04		
T-05	Buchholz Relay Alarm	
T-06		
T-07	Buchholz Relay Trip	
Dummy		
T-08	PRV-1 Alarm	
T-09		
T-10	PRV-1 Trip	If applicable
T-11		
Dummy	PRV-2 Alarm	
T-12		
T-13	PRV-2 Trip	
T-14		
Dummy	OTI Alarm	
T-15		
T-16	OTI Trip	
T-17		
T-18	WTI-1 Alarm	
T-19		
Dummy	WTI -1 Trip	
T-20		
T-21	WTI-2 Alarm	If applicable
T-22		
T-23	WTI -2 Trip	
Dummy		
T-24	Neutral CT (for 64-REF Protection)	If applicable
T-25		
T-26	Neutral CT (for 51N-Earth Fault Protection)	
T-27		
Dummy	CT Shorting Terminal	
T-28		
T-29	WTI 1-CT	
T-30		
T-31	WTI 2-CT	If applicable
T-32		
T-33	CT Shorting Terminal	
T-34		
T-35	Spare Terminals for NTPC use	
T-36		
T-37		
T-38		
T-39		
T-40		
T-41		
T-42		
T-43		
T-44		
T-45		
T-46		
T-47		
T-48		

Notes:

- 1 The Terminals from T-01 to T-48 shall be designated as indicated in the chart for all outdoor transformers (upto 16MVA)
- 2 The Terminals which are not used for a particular Transformer shall be left as spare. e.g. in case there is only one WTI alarm & trip, then terminals T-25 to T-28 & T-38 to T-40 shall be left as spare terminals.

Title:	Standard Terminal Numbers for Marshalling Box of all Transformers
Drawing No:-	0000-203-PVE-B-001