ANNEXURE-C

1.00.00	**GENERAL DESIGN AND OPERATING CONSIDERATIONS**
1.01.00	Project area being located in an earth-quake prone region, the equipment shall be designed for seismic coefficient values of 0.36g in the horizontal direction & 0.24g in vertical direction.
1.02.00	
1.03.00	The scope of work shall cover ~~33kV, 11kV~~ and 415V switchgear panels including preparation of various electrical schemes comprising of protection/ interlocking /annunciation/ inter tripping/ automatic/ manual operation schemes required for the system for the purpose of satisfactory and efficient operation of the equipment covered under the scope the equipment shall be supplied as per single line diagram and actual requirements.
1.04.00	The bidder shall also provide other necessary electrical equipments as shown in single line diagram for various requirements of the employer. The feeders shall be provided in the LT panels at various locations in power house and barrage area in addition to the normal scope of the contractor as indicated in Annexure I to this subsection.
2.00.00	**APPLICABLE STANDARDS**
2.01.00	Unless otherwise specified elsewhere in this specification, the rating, performance and testing of ~~33KV ,11KV switchboards,~~ 415V switchboards and associated control panels shall conform to the latest revision of standards listed below:

Standard		Title
IEC62271-200	:	AC metal enclosed switchgear & control gear for rated voltages above 1KV and up to and including 52KV.
IEC 60376	:	Specification for technical grade SF6 for use in electrical equipments
IS 13118	:	High voltage alternating current Circuit breakers
IS 8623	:	Specification for low-voltage Switchgear & Control gear.
IS 3156	:	Voltage transformers
IS 2705	:	Current transformers
IS 9921	:	AC disconnectors (Isolators) and earthing switches for voltages above 1000V
IS 3427	:	AC metal enclosed Switchgear & Control gear for rated voltages

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	IEC 60298	:	Above 1 kV and up to and including 52 kV
	IS 5	:	Colour for ready mixed paints & enamels.
	IS 1248	:	Direct acting Indicating analogue electrical Measuring Instruments and their accessories
	IS 722	:	AC Energy meters
	IS 13010	:	AC Watt-hour meters
	IS 3231	:	Electrical Relays for power system protection
	IS 8686	:	Static protective relays
	IS 4794	:	Push button/ switches
	IS 2099	:	Bushings for AC voltages above 1000V
	IS 6005	:	Code of practice of phosphate of iron and steel.
	IS 5082	:	Wrought Aluminum and Aluminum alloy bars, rods, tubes and sections for electrical purposes.
	IS 2633	:	Methods for testing uniformity of coating of zinc coated articles.
	IS 13703	:	Low voltage fuses for voltages not exceeding 1000V or 1500V DC
	IS 8828	:	Electrical accessories: Circuit Breakers for over current protection for household and similar installations.
	IS 13947	:	Low voltage Switchgear & Control gear
	IS 1554	:	PVC insulated (Heavy Duty) Electric Cables for working voltage upto and including 1100V.
	IS 5578	:	Guide for marking of insulated conductors.
	IS 11353	:	Guide for uniform system of marking & identification of conductors and apparatus terminals.
	IEC 60694	:	Common specifications for high voltage Switchgear and Control gear standards
	IEC 62271-100	:	High voltage alternating current circuit breakers
	IEC 60044-1	:	Current transformers
	IEC 60044-2	:	Voltage transformers

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	IEC 60529 : Degree of protection provided by enclosure (IP code) IEC 61850 : Communicable Numerical relays IS 513(2008) : Cold rolled low carbon steel sheets and strips
2.02.00	If bidder is offering equipments conforming to the standards other than those stipulated above, he should establish in the bid that standards adopted by him are comparable with relevant Indian Standards or IEC Standards. Further a comparative statement in respect of only those provisions in standards adopted by him, which are different from those provisions in standards, shall be furnished with bid. Also, the bidder must supply copies in English language of the standards and codes adopted by him (If these are in different languages, copies translated in 'English' may be supplied).
3.00.00	**DATA REQUIREMENTS**
3.01.00	Ratings The ratings and electrical characteristics of ~~33KV, 11kV~~ & 415V switchgear panels and associated equipment shall be as under:
3.02.00	

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3.03.00 415 V Switchgears

Switchgear		Fully drawout type single front
MCC		Fully drawout type single/double front
ACDB/DCDB		Fixed type single front
Power Supply		
AC System		3 phase, 4 wire, solidly earthed
(i)	Voltage	415 Volts, ± 10%
(ii)	Frequency	50 Hz ±5%
(iii)	Combined variation	10% (Absolute Sum) (Voltage & frequency)
DC System		2 Wire, unearthed
System voltage		220 V, +10% -15%
Control Supply Voltage		

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	(a)	Trip and closing coils	220V DC Unearthed
	(b)	Spring charging	220V DC Unearthed
		Busbar Rating	
	(i)	Continuous	As per requirements
	(ii)	Rated short circuit [1 sec. (rms)]	As per E0 Requirements
		One Minute Power Frequency Withstand	
	(i)	Power Circuit	2500 Volts (rms)
	(ii)	Control Circuit	1500 Volts (rms)
		Cubicle Color Finish	
		Exterior	RAL 5012 (Extreme End Covers) RAL 9002 (Rest of the Panel)
		Air Circuit Breaker, Load Break Isolators, MCCBs	
	(i)	Type	Circuit breaker Shall be air break, three pole, spring charged, horizontal drawout type, suitable for manual and electrical operation for current ratings above 630A Load break Isolators(up to 250A)/MCCBs (45KA/105KA) for current ratings 250A upto 630A
	(ii)	No. of poles	3
	(iii)	Voltage & Frequency	415 ±10%, 50 HZ ± 5%
	(iv)	Rated Operating Duty	B-3 Min, M-B-3 Min.-MB
	(v)	Current Ratings	As per Requirements
	(vi)	Rated short Circuit breaking current	
		(a) AC Component	As per E0 Requirements
		(b) DC Component	As per IS:2513 Part-1

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(vii)	No. of auxiliary contacts	4 NO + 4 NC contacts for Employer's use
Meters		
(i)	Accuracy class	2.5
(ii)	One minute power frequency withstand test voltage	2.0 KV(rms)
Current Transformers		
(i)	Type	Cast Resin, Bar primary, For 33 KV - Ring Type
(ii)	Voltage class and Frequency	650V, 50 Hz
(iii)	Class of Insulation	E or better
(iv)	Ratio	
	- Primary	As per current rating of Ckt. Breaker
	- Secondary	1A
(iv)	Accuracy class	5P 20 for protection & Class 1 for metering,
	Burden	VA adequate for application (Not less than 7.5VA.)
Voltage Transformer		
(i)	Type	Cast Resin
(ii)	Rated Voltage	
	(a) Primary	$\frac{415\ V}{\sqrt{3}}$
	(b) Secondary	$\frac{110\ V}{\sqrt{3}}$
(iii)	Method of connection	
	(a) Primary	Star
	(b) Secondary	Star
(iv)	Rated voltage factor	1.1 continuous, 1.5 for 3 seconds

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	(v)	Class of insulation	E or better
	(vi)	One minute power frequency withstand voltage	2.5 KV (RMS)
	(vii)	Accuracy class	0.5
	(viii)	Relay (1 Min Power frequency withstand test)	2 kV (rms)

4.00.00 **SPECIAL REQUIREMENTS**

1. Earthquake conditions

Under the seismic conditions, stipulated in this specification, ~~the 33kV, 11KV and~~ 415V switchgear panels shall meet the following requirements:

a. The physical alignment of ~~33KV, 11KV and~~ 415V switchgear panels along with incoming and outgoing feeder connections, supporting insulators & structures of bus bars should not get disturbed and there should not be any internal flashover and/or electrical fault.

b. All relays, transducers, indicating instruments, devices in switchgears or in Remote control panels should not mal operate.

c. Current carrying parts, supporting structure, earth connection etc. should not get dislocated and /or should not break or distort.

2. Dispatch of equipments and Handling of equipment at site

Care shall be taken for safe handling of equipments at site during transport, stacking, shifting to erection site, erection at site in order to prevent damages to the equipment.

5.00.00

5.01.00

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All 415V switchgear motor control centers (MCCs), AC & DC distribution boards (DB s) etc shall have following features:

i) Shall be of metal enclosed, indoor, floor mounted and free standing type.

ii) All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of 2mm thickness .

iii) Frame shall be enclosed in cold rolled sheet steel of thickness 1.6mm .Doors and covers shall also be of cold rolled sheet steel of thickness 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.

iv) All switchboards/panels shall be of dust and vermin proof. All cutouts shall have synthetic rubber gaskets.

v) For all LT motors below 110 kW SFU, contactor with bimetallic OLR shall be provided. The other outgoing feeders would be MCCB (molded case circuit breakers).

vi) All switchboards, MCCs and DB s shall have following distinct 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 MCCB feeder.

c) Adequately sized cable alley for power and control cables. In case cable alleys are not provided for DBs, segregated cable boxes with complete shrouding for individual feeders shall be provided at the rear for direct termination of cables in each individual feeder.

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 switch boards/MCCs/DBs of 1600A and above rating shall be of DOP IP42 and IP52 for less than 1600A rating.

g) All 415V switchgears, MCC's, AC & DC distribution boards etc. shall be painted by powder coating process paint shall for complete panels excluding end covers shall be RAL 9002 and RAL 5012 for extreme end covers of all boards.

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h) All drawout modules shall have distinct service, test & isolated positions. Power contacts shall be disconnected in both test & isolated positions where as the control contacts shall get disconnected in isolated position only.

vii) Busbars shall be of high conductivity aluminum alloy or copper.

viii) 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 segregated with barriers to prevent interpole short circuits.

ix) 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.

x) All types of relays and timer shall be subject to the 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 replacement and testing facility. The auxiliary relays and timer may be provided in fixed cases.

xi) The switchgears/MCCs 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.

xii) All current and voltage transformers as required for metering and protection specified shall be completely encapsulated, cast resin insulated type. Incomers from transformers shall have CTs for transformers restricted earth fault protection. The accuracy shall be as below :

	CT'S	VT'S
Protection	5P20	3P
Metering	1.0	0.5
REF`	PS	--

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xiii) Indicative Lamps shall be cluster LED type. All overload relays shall have overload reset push button.

xiv) 20% spare feeders of each type & rating used in the MCC with a minimum one (1) number on each bus section shall be provided.

xv) Suitable busduct adaptor panels/boxes shall be provided for top entry of 415V TPN busduct for incomer and outgoing feeder panels, as required. Also, all necessary accessories, equipment, hardware etc. required for proper termination of busducts shall be provided by the Bidder.

xvi) Suitable arrangement for power cable termination shall be provided, as required, for switchgear panels and shall be suitable for cable entry from the bottom/top as per requirement. The cable entry shall be fitted with removable gland plates of adequate size for fixing the cable glands.

Switchgear panels for the Incomer and all outgoing feeder panels shall be suitable for terminating XLPE/PVC cables. Panels shall have adequate space inside, to accommodate the heat shrinkable type cable terminations. Each power cable shall be terminated independently.

xvii) Detailed interlocking scheme for 415V switchgear

Proper interlocking scheme shall be envisaged for the following operations:

Unit Auxiliary Boards

Only one of the two Incoming breakers from Unit Auxiliary Transformer and Station Service Board shall be closed at a time, through source under voltage relay contacts and breaker position contacts. However, the incoming breaker from Station Service Board shall be normally closed under unit idle condition.

Station Service Boards

a) The Station Service Boards -1 & 2 are interconnected through 415V TPN busduct and interconnecting circuit breaker in each board.

b) The interconnecting circuit breaker of Station Service Board-1 shall be normally closed.

c) The Incoming circuit breakers of Station Service Boards -1 & 2 and interconnecting circuit breaker of Station Service Board-2 shall be interlocked in such a way so that in case of tripping of any of incoming breakers of Station Service Boards-1 & 2, the interconnecting circuit breaker of Station Service Board-2 shall close automatically. Interlocking is envisaged under all conditions of operation i.e. manual local, manual remote or auto.

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6.01.00	Breakers shall have inherent fault making and breaking capacities. They shall have shunt trip coils. In case releases are offered, the same shall have contact for energisation of lockout relay. All breakers shall have built in interlocks for equipment and personnel safety.
6.02.00	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 relays.
6.03.00	Mechanical tripping shall be through red 'Trip' push button outside the panels for breakers, and through switches for other circuits.
6.04.00	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.
6.05.00	Clear status indication for each circuit shall be provided through lamps, switch positions or other mechanical means.
6.06.00	Incomers for MCCs and DBs rated upto 630A could be load break isolators. Motor starter contactors shall be of air break, electromagnetic type as per IS: 13947 Part-4, section-1 suitable for DOL starting of motor, and shall be of utilisation category AC-3 for ordinary and AC-4 for reversing starters. DC contactor shall be of DC-3 utilisation category.
6.07.00	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.
6.08.00	The 250A & above MCCB feeders (up to 630A) shall be provided with Microprocessor based inbuilt front adjustable releases(overload & short circuit) and shall have adjustable earth fault protection unit also . MCCB shall have current limiting feature. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door can not be opened unless the MCCB is in OFF position. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked.
6.09.00	Local push button stations shall have metal enclosure of die cast aluminum or rolled sheet steel of 1.6mm thickness. Push buttons shall be of latch type with mushroom knobs.
6.10.00	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.

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6.11.00	All non-current carrying metal work of boards/panels shall be effectively bonded to earth bus of galavanised steel, extending throughout the switchboard/MCC/DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.
6.12.00	Suitable trolley arrangement shall be provided for breaker modules. Two trolleys per switchgear room shall be provided so that breaker module of all types, sizes and rating can be withdrawn on trolley and lowered for maintenance purpose.
6.13.00	The incoming connection to transformer of more than 1000KVA and inter-connecting sections between switchboards shall preferably be of busducts. The bus duct enclosure shall be made of minimum 3mm thick aluminum alloy. The section of the bus duct should have adequate strength to withstand internal and external forces resulting from the various operating conditions. Aluminum sheet hood shall be provided for outdoor bus duct enclosure flanged joints to provide additional protection against water ingress. The bus duct top shall be sloped to prevent retention of water. The Busduct shall have degree of protection IP55.
6.14.00	It should be possible to carryout maintenance on a feeder with adjacent feeders alive.
6.15.00	**Control, Protection & Metering Requirements**
6.15.01	Control circuits shall operate at suitable voltage of 110V AC or 220V DC. Necessary control supply transformers having primary and secondary fuses shall be provided for each MCC, 2 x 100% per 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.
6.15.02	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.
6.15.03	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. All equipments shall have necessary protections. However, following minimum protections shall be provided. 1) Contactor controlled motor feeders (Motors up to 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/bus coupler/outgoing breaker feeders other than motor feeders.

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a) Three phase over current protection (50)

b) Three phase earth fault protection (50N3)

c) Syn Check and Bus change over

3) Incomer From DG Set.

a) Differential Protection (87) - Three Pole

b) Reverse Power Protection.

c) Overload Alarm on one phase

d) Earth Fault Detection Relay (64)

e) Voltage controlled over current relay

e) Generator under/over voltage Protection

f) Hand Reset/Lockout Relay with a blue lamp.

g) 3 Phase Energy Meter having accuracy of 1.0 class.

4) Breaker controlled motor feeders(Motors 110KW & above)

a)Thermal Overload Protection (50I)

b)Three phase Short Circuit Protection (50)

c)Earth Fault Protection (50N/50N2)

6.16.00 **General requirements of numerical relays**

6.16.01 All relays and timers shall be rated for control supply voltage as mentioned elsewhere under parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Interrogation voltage for the binary inputs shall be suitably selected to ensure avoidance of mal operation due to stray voltages.

6.16.02 All the numerical relays shall have communications on two ports, local front port communication to laptop and a second port on IEC 61850 port to communicate with the data concentrator through LAN and Ethernet switches.

6.16.03 Relays shall be suitable for electrical measurement including voltage, current, power (active/reactive) and energy parameters.

6.16.04 All numerical relay shall have key pad / keys to allow relay settings from relay front. All hand reset relays shall have reset button on the relay front. Relay to be self or

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	hand reset shall be software selectable. Manual resetting shall be possible from remote.
6.16.05	For Breaker control from Main SCADA, hardwired potential free contacts shall be provided from Main SCADA to the numerical relays. No separate coupling relays shall be provided.
6.16.06	Trip circuit supervision shall be provided for all feeders to monitor the circuit breaker/ contactor trip circuit both in pre trip and post trip conditions.
6.16.07	Schematics requiring auxiliary relays /timers for protection function shall be a part of numerical relay. The number of auxiliary relay and timer function for protection function shall be as required. Auxiliary relays for interlocking purpose shall be of self reset type.
6.16.08	The numerical processor shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery back up for real time clock in the event of power supply failure shall be provided.
6.16.09	Sequence of events shall have 1 ms resolution at device level.
6.16.10	It shall be possible to carryout open / close operation of breakers from a laptop by interfacing from the relay front port (RS232) during initial commissioning.
6.16.11	Hardwired contacts from the Numerical relays shall be wired to main SCADA system for controls. The numerical relay shall be capable of measuring and storing values of a wide range of quantities, events, faults and disturbance recordings. The alarm / status of each of protection function and trip operation shall be communicated to main SCADA through data Concentrators. The numerical relays shall have built in feature / hardware interface to provide such inputs to main SCADA for analog / digital values. All the numerical relays shall have communications on two ports; local front port communication to laptop and a second port on IEC 61850 port to communicate with the data concentrator through LAN and Ethernet switches. The Ethernet switches along with suitable cable for connecting the same to the numerical relays are also be included in bidder's scope of supply.
6.17.00	**Meters / Instruments**
6.17.01	All meters/ instruments shall be flush mounted on front panel, at least 96 sq.mm. size with 90 degree linear scales and accuracy class of 2.0.
6.17.02	All motors of 30kW and above shall have an Ammeter. 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.

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6.18.00	In case of remote controlled breaker panels, following shall be ensured:
6.18.01	Each feeder shall have local – Remote selection. Closing & tripping from local shall be possible only in test position whereas closing & tripping from remote shall be possible in either service or test position.
6.18.02	Necessary hardware shall be provided in the switchgear panel, like coupling relays (24V DC with maximum burden of 2.5 VA), auxiliary relays, current/voltage transducers (4-20 mA, dual output) etc. to effect interlocks, exchange of information/status and exercise control from remote.
7.00.00	**TESTS**
7.01.00	
7.01.02	

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7.02.00 **L.T. Switchgear**

The following type tests certificates on each type & rating of L.T. Switchgear, MCC panel and distribution boards shall be submitted. The test shall have been conducted as per latest applicable IS/IEC.

(a) Short time withstand test with circuit breaker mounted inside the switchgear panel

(b) Temperature rise test.

(c) Type II-Short circuit co-ordination test for any three rating of MCC module as selected by the Employer.

(d) Test sequence-1 & combined test sequence shall be carried out on each rating of circuit breaker mounted inside the panel.

(e.) Degree of protection tests

(f.) Type test certificates for Numerical relays.

8.00.00 **COMPLETNESS OF EQUIPMENT**

All the fittings and accessories that might not have been mentioned specifically in the specification but are necessary for equipments of the plant shall be deemed to be included in the specification and shall be supplied and furnished by the Contractor.

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Bidder's Name: .....

TECHNICAL PARTICULARS

1.00.00	**SWITCHGEAR & MCC**	
	a) General	
	i) Manufacturer's Name	.....
	ii) Country of origin	.....
	b) Rated voltage	.....
	c) Symmetrical short circuit withstands current at rated voltage of switchgear /MCC cubicle.	.....
	d) Peak short circuit withstand current	.....
	e) Degree of protection as per IS:13947	
	i) Breaker / MCC cubicles	.....
	ii) Busbar chamber	.....
	f) Earth busbar size & material	.....
2.00.00	**POWER BUSBARS & INSULATORS**	
	a) Material & applicable standards	.....
	b) Bare/painted / epoxy insulated/sleeved	.....
	c) Continuous current rating at an ambient temp.	.....
	d) Temperature rise over design ambient temperature for continuous current rating deg. C	.....
	e) Material of the support insulators	.....
	f) One second current rating (kA)	.....
3.00.00	**CONTROL SUPPLY TRANSFORMER**	
	a) Make	.....
	b) Type	.....
	c) Material & class of insulation	.....

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Bidder's Name: .....

	d) Voltage rating & taps	.....
4.00.00	**CIRCUIT BREAKER**	
	a) Manufacturer's name and country of manufacturer	.....
	b) Rated Voltage	.....
	c) Rated operating duty	.....
	d) Design ambient temperature	.....
	e) Rated current at ambient temperature	.....
	f) Continuous current at ambient temp.	.....
	h) Rated symmetrical breaking current	.....
	i) Rated peak making current	.....
	j) Rated short time rating (for 1 sec.)	.....
	k) Rated peak momentary rating	.....
	l) No. of breaker auxiliary contacts provided on fixed portion of breaker & their rating	.....
	m) Power operating mechanism	.....
	n) Spring charging motor details	
	ii) Rating Watts	.....
	iii) Rated voltage	.....
	iv) Class of insulation	.....
	o) Emergency Manual charging facility provided	YES/NO
	p) Manual operating mechanism	.....
	q) Telescopic trolley	
	i) Make	.....

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CLAUSE NO.	LT SWITCHGEAR (E-7B)	एनटीपीसी NTPC
	Bidder's Name:	
5.00.00	**AIR BREAK SWITCHES**	
	(The following details shall be furnished for each type & rating)	
	a) Make	
	b) Type	
	c) Applicable standards	
6.00.00	**CONTROL/SELECTOR SWITCH**	
	a) Make	
	b) Type Designation	
	c) Voltage grade	
7.00.00	**CONTACTOR**	
	(The following details shall be furnished for each type and rating)	
	a) Make	
	b) Type & applicable standards	
	c) Rated voltage of main and auxiliary contacts	
8.00.00	AUXILIARY CONTACTOR	
	a) Make	
	b) Type	
9.00.00	**FUSES**	
	a) Make	
	b) Type	
	c) Category	
10.00.00	**CURRENT TRANSFORMERS**	
	(The following details shall be provided for each type & rating)	
	a) Make	

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	b) Applicable standards	.....
	c) Class & type of insulation	.....
11.00.00	**VOLTAGE TRANSFORMERS**	
	a) Make	.....
	b) Ratio	.....
	c) Class & type of insulation	.....
12.00.00	**Numerical relays**	
	a) General Technical Details and Drawings Enclosed	.....
	b) Make/Model No	.....
	c) Place of Manufacture	.....
	d) Hardware version number	.....
	e) Firmware version number	.....
	f) Rated Voltage Vn (phase-to-neutral)	.....
	g) Rated Current In	.....
	h) Rated Frequency	.....
	i) Over voltage capability - continuous	.....
	j) Over voltage capability – 3s	.....
	k) Burden on voltage transformers (VA per phase)	.....
	l) Over current capability - continuous	.....
	m) Over current capability – 1s	.....
	n) Burden on current transformers (VA per phase)	.....
	o) Reference standards	.....
	p) Operating principle	.....
	q) No Of communication Ports	.....

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Bidder's Name: .....

	r) Compliance to IEC-61850	.....
	s) Built-in functions provided in the relay (list out)	.....
	t) Protection Functions	.....
	u) Measurements	.....
	v) Monitoring Functions	.....
	w) Control functions	.....
	x) Detailed Technical Catalogue for offered Relays enclosed	.....
	y) Spares and Repairs	
	a) State availability of spares in country and spares holding in country of origin	.....
	b) Maximum repair turnaround time	.....
	c) Define the proposed repair strategy	.....
	d) Recommended spares list	.....
	z) List of reference sites in operation for more than 1 year	.....
13.00.00	THERMAL OVERLOAD RELAY & SINGLE PHASING PREVENTER	
	(The following details shall be furnished for each type & rating)	
	a) Make & type designation	.....
	b) Catalogue	.....
14.00.00	VOLTMETER	
	a) Make	.....
	b) Type	.....
15.00.00	AMMETER	
	a) Make	.....
	b) Type	.....
16.00.00	LOCAL STARTERS	
	a) Make & Type	.....

2163

Bidder's Name: .....

17.00.00 415 V NON SEGREGATED BUSDUCTS

a) Manufacturer's name & address .....

b) Type of busduct .....

c) Rated voltage (volts) .....

d) Short circuit current ratings & duration (kA /Sec) .....

e) Momentary current rating kA peak .....

f) Temperature rise over the ambient temperature

i) Busbars .....

ii) Enclosures .....

g) Material of support insulator .....

h) No. and arrangement of support insulators .....

i) One minute power frequency withstand voltage (kV) .....

18.00.00 LIGHTING TRANSFORMERS

a) Make .....

b) Voltage Ratio .....

c) kVA Rating .....

19.00.00 Metering Network and Energy Meters (For Motor>& = 100 KW)

a) **Energy Meters**

i. Manufacturer's type designation .....

ii. Accuracy (Power and Energy) .....

iii. Input Voltage .....

iv. Input current .....

v. Mounting .....

vi. Communication (in Built 485 Port) .....

vii. Data recorded in Non-volatile memory .....

Power Sector - 142, Noida U.P.

Bidder's Name: .....

	viii. Burden	.....
	b) Type designation of RS 485 Converter	.....
	c) Type designation of LAN cable	.....
	d) Type Designation of Data Cable	.....
20.00.00	**Ethernet switches (For Networking of Numerical Relays)**	
	a) Compliance to IEC 61850	.....
	b) No of Ports	.....
	c) Power supply to Ethernet Switches	.....

Power Sector, Hydro Market, Sector - 142, Noida U.P.

LT SWITCHGEAR (E-7)

(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES / CHARACTERIS-TICS ↓ → ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLIY	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Sheet Steel (IS : 513)	Y	Y		Y	Y		Y							
Aluminum Bus bar Material (IS : 5082)	Y	Y	Y	Y	Y		Y							
Copper Bus bar Material (IS : 613)	Y	Y	Y	Y	Y		Y							
Support Insulator	Y	Y	Y	Y			Y							
Air Circuit Breaker (IS: 13947)	Y	Y				Y	Y			Y	Y			Y
Energy Meters (IS : 13010, 13779)	Y	Y				Y	Y			Y				Y
Power & Aux. Contactors (IS : 13947)	Y	Y				Y	Y			Y				
Protection & Aux. Relays (IS : 3231)	Y	Y				Y	Y			Y				Y
Control & Selector Switches (IS : 13947)	Y	Y				Y	Y			Y				
CT's & PT's (IS 2705 / 3156)	Y	Y					Y							Y
MCCB (IS : 13947)	Y	Y					Y			Y				
Indicating Meters (IS : 1248)	Y	Y				Y	Y			Y				Y
Indicating Lamps (IS : 13947)	Y	Y				Y	Y			Y				
Air Break Switches (IS : 13947)	Y	Y				Y	Y			Y				
Control Terminal Blocks	Y	Y				Y	Y							

Power Sector, Hydro Market, BHEL, Sector-142, Noida U.P.

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ATTRIBUTES / CHARACTERISTICS → / ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLIY	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Fuse (IS 13703)	Y	Y				Y	Y							
Control Transformer (IS : 12021)	Y	Y				Y	Y			Y				Y
Push Buttons (IS : 4794)	Y	Y				Y	Y			Y				
Transducer (IEC : 60688)	Y	Y				Y	Y			Y				Y
MCB (IS : 8828)	Y	Y				Y	Y			Y				
Breaker Handling Trolley	Y	Y				Y			Y	Y				Y
Synthetic Rubber Gasket (IS : 11149)	Y	Y		Y	Y		Y							
LT SWITCHGEAR (IS : 8623)	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2. Makes of all major Bought Out Items will be subject to NTPC approval.

Power Sector, Hydro Market... Sector - 142, Noida U.P.

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM : PCC ,MCC , ACDB AND DCDB (UP TO 4000 A)	PROJECT :

Sl. No.	Component & Operations	Characteristics	Classification	Type of Check	Quantum of check, 6		Reference Document	Acceptance Norms	Format of Records		Agency 10			Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M**	C	N	11
	1) Makes of bought out items as per Attached Annexure - I (Subject to customer approval) 2) Relay Fat procedure to be submitted as a separate document for review 3) Documents identified in the QP for NTPC verification will be maintained. However, other documents i.e. all QC records & supplier's TCs mentioned in the QP will also be maintained by the Manufacturer, which NTPC may verify on surveillance basis at the time of final inspection. 4) Outsourcing / subcontracting of panel fabrication, assembly, pretreatment, painting, wiring, final assembly and testing activity in Switchgear manufacturing process shall be done, only with prior approval of NTPC													
A	Raw material													
1.	Angles, channels & Sheet Steel for fabrication (CRCA / HR)	1) Dimensions	Major	Meas	1 sample of each type & size per lot	-	IS-513 (94), IS-1079 (94), IS 2062 (99)	As per NTPC spec.	QC record		P			
		2) Surface finish & check for waviness / flatness	Major	Visual	-do-	-	IS-513 (94), IS-1079 (94), IS 2062 (99)	As per Mnfr std./ Drg.	QC record		P			
		3) Tensile / Bending Test	Major	Mach Test	As per IS	-	IS-513 (94), IS-1079 (94), IS 2062 (99)	IS-513 (94), IS-1079 (94), IS 2062 (99)	Supplier TC		V			
2.	Bus bars – Aluminum & Copper	1) Dimensions	Major	Meas	1 sample of each type & size per lot	-	IS-5082 (98) (for Al) IS1897 (83) (for Cu), NTPC Approved Drgs. / data sheet	IS-5082 (98) (for Al) IS1897 (83) (for Cu), NTPC Approved Drgs. / data sheet	QC record		P			
		2) Surface finish	Major	Visual	-do-	-	IS-5082 (98) (for Al) IS1897 (83) (for Cu),	IS-5082 (98) (for Al) IS1897 (83) (for Cu),	QC record		P			
		3) Conductivity	Major	Elect.	As per IS	-	IS-5082 (98) (for Al) IS1897 (83) (for Cu),	IS-5082 (98) (for Al) IS1897 (83) (for Cu),	Supplier TC		V	V	V	
B	Bought out items:													
1.	Air Circuit Breaker	1) Make, type & rating	Major	Visual	100%	-	IS-13947 Part 2/ NTPC approved drg. &data sheet	IS-13947 Part 2/ NTPC approved drg. & data sheet	QC Records		V	V	V	
		2) All routine tests including calibration of releases	Critical	Tests	-do-	100%	IS-13947 Part 2/ NTPC approved drg. & data sheet	IS-13947 Part 2/ NTPC approved drg. & data sheet	Suppliers TC	√	V	V	V	
2.	CT's	1 Overall dimensions & mounting arrangement	Major	Meas	10% of each type & rating per lot	-	Mnfr drg.	Mnfr drg.	QC Record		P	-	-	

		GEND: * RECORDS, INDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN DOCUMENTATION. **** M: MANUFACTURER/SUB-CONTRACTOR, C: CONTRACTOR / NOMINATED INSPECTION AGENCY, N: NTPC INDICATED "P" PERFORM "W" WITNESS AND "V" VERIFICATION ALL "W" INDICATED IN COLUME "N" SHALL BE 'CHP'' OF NTPC.**	FOR NTPC USE	
MANUFACTURER/SUB / SUPPLIER	**MAIN SUPPLIER**			
SIGNATURE			**REVIEWED BY**	**APPROVED BY** / **APPROVAL SEAL**

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM : PCC ,MCC , ACDB AND DCDB (UP TO 4000 A)							PROJECT :					
Sl. No.	Component & Operations	Characteristics	Classification	Type of Check	Quantum of check, 6		Reference Document	Acceptance Norms	Format of Records		Agency 10			Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M**	C	N	11
		2) Make, type & rating	Major	Visual	-do-	-	NTPC App. Drg. & data sheet, IS 2705 (92)	NTPC App. Drg. & data sheet, IS 2705 (92)	QC Record		P	-	-	
		3)IR,HV,Ratio& Polarity check	Critical	elect	10%	-	NTPC App. Drg. & data sheet, IS 2705 (92)	NTPC App. Drg. & data sheet, IS 2705 (92)	QC Record		P	-	-	
		4) All routine tests as per IS 2705 (92)	Critical	elect	10%	-	-do-	-do-	Supplier's TC		V	-	-	
3.	PT's	1 Overall dimensions & mounting arrangement	Major	Meas	10% of each type & rating per lot	-	Mnfr std.	Mnfr std.	QC Record		P	-	-	
		2) Make, type & rating	Major	Visual	-do-	-	NTPC App. Drg. & data sheet, IS 3156 (92)	NTPC App. Drg. & data sheet, IS 3156 (92)	QC Record		P	-	-	
		3)IR,HV,Ratio& Polarity check	Critical	elect	10%	-	-do-	-do-	QC Record		P	-	-	
		4) All routine tests as per IS 3156 (92)	Critical	elect	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
4.	AC / DC Power & aux. Contactors	1) Make, type & rating	Major	Visual	5 sample of each type, make & rating per lot	-	IS-13947 Part 4 sec 1 (93), NTPC appd. drag & data sheet	IS-13947 Part 4 sec 1 (93), NTPC appd. drag & data sheet	QC Records		P	-	-	
		2) Operation checks	Major	elect	--do--	-	Mnfr Std.	Mnfr Std.	QC Records		P	-	-	
5.	Air Break switches / Fuse Switch units	1) Make, type & rating	Major	Visual	5 sample of each type & rating per lot	-	IS-13947 Part 3 (93), NTPC appd. drag & data sheet	IS-13947 Part 3 (93), NTPC appd. drag & data sheet	QC Records		P	-	-	
6	Protection Relays (Electromagnetic & Static)	1) Make ,Type & rating	Major	Visual	10% sample of each type, make & rating per lot	-	NTPC App. Drag. & data sheet	NTPC App. Drag. & data sheet	QC Records		P	-	-	
		2) Routine test certificate	major	Elect	100%	-	IS-3231 (83) / IS 8686 (77) Relay Mfr's Specifications	IS-3231 (83) / IS 8686 (77) Relay Mfr's Specifications	Supplier's TC	√	V	V	V	
		2) Operational Checks	Major	elect	--do--	-	Mnfr std.	Mnfr std.	QC Records		P	-	-	
6A	Protection Relays (Numerical Relays)	1) Make, type & rating	Major	Elect	10% each type, Per lot	10% rating per lot	NTPC App. Drag. & data sheet	NTPC App. Drag. & data sheet	QC Records	√	P	V	V	

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MANUFACTURER/SUB / SUPPLIER	**MAIN SUPPLIER**			
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	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM : PCC ,MCC , ACDB AND DCDB (UP TO 4000 A)	PROJECT :

Sl. No.	Component & Operations	Characteristics	Classification	Type of Check	Quantum of check, 6		Reference Document	Acceptance Norms	Format of Records		Agency 10			Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M**	C	N	11
		2) Numerical relay fat tests .	Major	Elect	10% each type, Per lot	10% rating per lot	NTPC App. Fat procedure	NTPC App. Fat procedure	Test report	√	P	W	W	
7	Timers	1) Make ,Type & rating	Major	Visual	10% of each type, & rating per lot	-	NTPC App. Drag. & data sheet	NTPC App. Drag. & data sheet	QC Records		P			
		2)Contact configuration	Major	Elect	10% of each type, & rating per lot	-	NTPC App. Drag. & data sheet	NTPC App. Drag. & data sheet	QC Records		P			
		3) Functional Check	Major	Elec.	--do--	-	Mnfr Std	Mnfr Std	QC Records		P			
8	HRC Fuses	1) Make, type & rating	Major	Visual	10% of each rating per lot	-	IS-13703 / (93) NTPC App. Drgs.	IS-13703 / (93) NTPC App. Drgs.	QC Records		P			
9	Indicating Instruments	1) Make, type & ratings	Major	Visual	10% of each type & rating per lot	-do-	NTPC Appr .drag / data sheet	NTPC Appr .drag / data sheet	QC Records		P	V		
		3) Routine tests including calibration & accuracy test reports	Major	elect	10% of each type & rating per lot	-do-	IS 1248 (93), NTPC Appr .drag / data sheet	IS 1248 (93), NTPC Appr .drag / data sheet	Supplier's test report		V	V		
10	KWH meters	1) Make, type & ratings	Major	Visual	10% of each type & rating per lot	-do-	NTPC Appr .drag / data sheet	NTPC Appr .drag / data sheet	QC Records		P	V		
		3) Routine tests including calibration & accuracy test reports	Major	elect	100%	-do-	IS 722 (86) & IS 13779 (99) & NTPC Appr .drag / data sheet	IS 722 (86) & IS 13779 (99) & NTPC Appr .drag / data sheet	Supplier's test report		V	V	V	
11	Transducers	1) Make, type & ratings	Major	Visual	10% of each type & rating per lot	-do-	NTPC Appr .drag / data sheet	NTPC Appr .drag / data sheet	QC Records		P	V		
		3) Routine tests including calibration & accuracy test reports	Major	elect	100%	-do-	IEC 60688 & NTPC Appr .drag / data sheet	IEC 60688 & NTPC Appr .drag / data sheet	Supplier's test report		V	V		
12	Push Button & Indicating Lamp	1) Make, Type, colour & rating	Major	Visual	5 samples of each type & rating per lot	-	IS 13947 Part 5 sec1 (93) NTPC App. Drag. & data sheet	IS 13947 Part 5 sec1 (93) NTPC App. Drag. & data sheet	QC record		P			
13	Control & Selector Switches	1) Make ,Type & rating	Major	Visual	5 samples of each type & rating per lot	-	IS 13947 Part 5 sec1 (93) NTPC App. Drag. & data sheet	IS 13947 Part 5 sec1 (93) NTPC App. Drag. & data sheet	QC record		P			
		2) Contact configuration check	Major	Visual	-do-	-	-do-	-do-	QC record		P			

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SIGNATURE	

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FOR NTPC USE

REVIEWED BY	APPROVED BY	APPROVAL SEAL

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Sl. No.	Component & Operations	Characteristics	Classification	Type of Check	Quantum of check, 6		Reference Document	Acceptance Norms	Format of Records		Agency 10			Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M**	C	N	11
		3) Function test	Major	Mech.	-do-	-	-do-	-do-	QC Records		P			
14	Overload relay with SPPR facility & Heavy duty starting overload relay	1) Make, type & rating	Major	Visual	10% of each type & rating per lot	-	IS-13947 (Part-4) NTPC appd. drag & data sheet	IS-13947 (Part-4) NTPC appd. drag & data sheet	QC Records		P			
		2) Function Tests	Major	elect	5% of each type & rating	-	Mnfr Std.	Mnfr Std.	Supplier's TC		V			
15	Coupling Relays	1) Make, type & rating	Major	Visual	10% of each type per lot	-	IS-3231 (87) NTPC appd. drag & data sheet	IS-3231 (87) NTPC appd. drg & data sheet	QC Records		P	-	-	
16	MCB	1) Make, type & rating	Major	Visual	10% of each type & rating per lot	-	IS-8828 (96) & NTPC appd. drag	IS-8828 (96) & NTPC appd. drag	QC Records		P	-	-	
17	Control Transformer	1) Make, Type & Rating	Major	Visual	100%	-	NTPC Appr .drag / data sheet	NTPC Appr .drag / data sheet	QC Record		P	-	-	
		2) Voltage Ratio	Major	elec	-do-	-	-do-	-do-	QC Record		P	-	-	
		3) All Routine tests as per IS 12021 (87)	Major	elec	100%	100 %	-do-	-do-	Supplier's TC		V			
18	PVC Insulating barriers & shrouds – (Fire retardant type)	1) HV test	Major	Elect	One sample of each type per lot	-	2.5 KV for 1 min.	2.5 KV for 1 min.	QC Record		P	V	-	
		2) Flame Resistance	Major	Flame Test	Sampling as per Mnfr. Std.	-	-do-	-do-	Suppliers TC		P	-	-	
19	Bus bar Support insulator	1) Dimensions	Major	Measurement	5 sample of each type per lot	5 Sample per lot	Mnfr Std. / Mnfr drag.	Mnfr Std. / Mnfr drag	QC Record		P	V	V	Nos. of Bus bar support shall be same as type tested panel & of same dimensions
		2) Finish	Major	Visual	-do-	-do-	No visual defects.	No visual defects.	QC Record		P	V	V	
		3) Comparative Tracking Index check	Major	Elect	-do-	-do-	Mnfr Std. / Mnfr drag. & IS-2824	Mnfr Std. / Mnfr drag. & IS-2824	Supplier's TC		V	V	V	
		4) HV Test	Major	Elect	-do-	-do-	IS-2824	IS-2824	QC Record		P	V	V	
		5) IR Test	Major	Elect	-do-	-do-	IS-2824	IS-2824	QC Record		P	V	V	
		6) Flexural strength test	Critical	Mach	As per supplier's std.	-do-	Mnfr Std. / Mnfr drag.	Mnfr Std. / Mnfr drag.	Supplier's TC		V	V	V	
		7) Impact strength of raw material	Major	Mech.	-do-		-do-/ IS-2824	-do-/ IS-2824	-do-		V	V	V	

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Sl. No.	Component & Operations	Characteristics	Classification	Type of Check	Quantum of check, 6		Reference Document	Acceptance Norms	Format of Records		Agency 10			Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M**	C	N	11
20	Synthetic rubber Gasket	1) Material Type	Major	Visual	1 sample of each type & size per lot	1 sample per lot	NTPC spec & IS 11149	NTPC spec & IS 11149	QC Record		P	V	V	Type, Dimensions & profile of the gaskets should be same as type tested panel gaskets
		2) Dimensions, profile & Visual Inspection	Major	Meas	-do-	-do-	Mnfr Std	Mnfr Std	QC Record		P			
		3) Shore Hardness	Critical	Test	Mnfr Std	Mnfr Std	-do-	-do-	Supplier's TC		V			
		4) Elongation at break & ageing	Major	Test	-do-	-do-	-do-	-do-	Supplier's TC		V			
		5) Compression set	Critical	Test	-do-	-do-	-do-	-do-	Supplier's TC		V			
		6) Ozone Resistance	Major	Test	-do-	-do-	-do-	-do-	Supplier's TC		V			
21	PVC wires (ISI marked)	1) Verify size, colour and BIS marking	Major	Visual	1 sample of each type & rating per lot	-	IS-694	IS-694	QC Records		P	-	-	
22	Space Heater, Thermostat, 3 pin socket, hooter	1) Dimension/ Mounting arrangement	Major	Measurement	-do-	-	Mnfr std.	Mnfr std..	QC record		P	-	-	
		2) Functional test	Major	By Test	-do-	-	Mnfr std.	Mnfr std..	QC record		P	-	-	
23	ACB Handling trolley	Overall dimensions & functional Checks	Major	test	-do-		Mnfr std	Mnfr std	QC Record		P			
24	Bus bar fish plates	Dimensions	Major	Visual	5 sample of each type & rating per lot	-	Mnfr Std.	Mnfr Std.	QC Records		P	-	-	
25	Bus bar Joint shrouds	Dimensions	Major	Visual	- do -	-	Mnfr Std.	Mnfr Std.	QC Records		P	-	-	
26.	Spring loaded power & control contacts	Silver plating thickness, adhesion check	Major	Mach	-do-	-	-do-	-do-	QC Records		P	-	-	
27	Terminal Block	1) Make, type & rating	Major	Visual	-do-t	-	NTPC Approved Drgs.	NTPC Approved Drgs.	QC Records		P	-	-	
28	Paint	1) Make, type & shelf life	Major	Visual	100 %	-	Mnfr Std	Mnfr Std.	QC Records		P	-	-	
C	In – Process:													
1.	Fabrication	1) Cutting, punching, shearing & bending	Major	Meas	Mnfr Practice	-	Mnfr std. / drag.	Mnfr std. / drag.	QC Records		P	-	-	
		2) panel front door cut-outs punching	Major	Meas	-do-	-	Mnfr std. /NTPC Approved GA Drgs.	Mnfr std. / NTPC Approved GA Drgs.	QC Records		P	-	-	

MANUFACTURER/SUB / SUPPLIER	MAIN SUPPLIER	GEND: * RECORDS, INDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN DOCUMENTATION. ** M: MANUFACTURER/SUB-CONTRACTOR, C: CONTRACTOR / NOMINATED INSPECTION AGENCY, N: NTPC INDICATED "P" PERFORM "W" WITNESS AND "V" VERIFICATION ALL "W" INDICATED IN COLUME "N" SHALL BE 'CHP'' OF NTPC.	FOR NTPC USE			
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM : PCC ,MCC , ACDB AND DCDB (UP TO 4000 A)	PROJECT :

Sl. No.	Component & Operations	Characteristics	Classification	Type of Check	Quantum of check, 6		Reference Document	Acceptance Norms	Format of Records		Agency 10			Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M**	C	N	11
2.	Pretreatment & Painting (powder coating)	1)Chemical concentration checks of all tanks for pre treatment of sheet steel	Major	Chemical	-do-	Mnfr Practice	Mnfr Std practice, NTPC spec. IS-6005	Mnfr Std practice, NTPC spec. IS-6005	QC Records		P	V	V	
		2) Paint Shade	Major	Visual	1 sample per lot	1 sample per lot	NTPC spec., Approved Drgs.	NTPC spec., Approved Drgs., RAL std shade card	QC Records		P	-	-	
		3) Paint Thickness & Adhesion	Major	Measurement & test	Mnfr Practice	Mnfr Practice	-do-	-do-	QC Records		P	-	-	
3.	Panel Assembly	1) Panel shell assembly, Top & back cover assembly, Panel door assembly, hinge fitting & door knob fitting etc.	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC Records		P	-	-	
		2) Form 4B , 7 Type design in cable alley	Major	Process	100%	Sample	Mnfr std.	Mnfr std.	QC Records		P	V	V	
		3) Size of bus bar & bus bar finish	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC Records		P	-	-	
		4) Colour coding of bus bar	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC Records		P	-	-	
		5) Insulator type & mounting	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC Records		P	-	-	
		6) Bus bar joints	Major	Process	100%	Sample	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
		7) Bus bar support distance, tightness of bolts for Main , Control & Auxiliary bus bars and bus bar joints	Major	Process	100%		Mnfr std. NTPC Spec. / QP Manual/ NTPC Approved drg.M60.300.70KGFM,M 81.252.5KGFM, M10-2.5-4KGFM, M12-4.3-7.1KGFM,	Mnfr. std. NTPC Approved drg. / Type test report M60.300.70KGFM, M8-1.25-2.5KGFM, M10-2.5-4KGFM, M12-4.3 7.1KGFM,	QC Records		P	-	-	1) Busbar support insulator type & distance between two supports should be in line with the Type test report
		8) Main , control & Auxiliary Bus bar Clearances	Major	Process	100%		Mnfr std.	Mnfr std.	QC Records		P	-	-	

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MANUFACTURER/SUB / SUPPLIER	**MAIN SUPPLIER**			**REVIEWED BY** / **APPROVED BY** / **APPROVAL SEAL**
SIGNATURE				

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM : PCC ,MCC , ACDB AND DCDB (UP TO 4000 A)							PROJECT :					
Sl. No.	Component & Operations	Characteristics	Classification	Type of Check	Quantum of check, 6		Reference Document	Acceptance Norms	Format of Records		Agency 10			Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M**	C	N	11
		9)CT / PT mounting arrangement & tightness	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC Records		P	-	-	
		10)CT secondary shorting	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
		11)Termination for power & control circuits	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
		12)Lug size & crimping quality	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
		13)Earthling bus bar size & continuity ; earthlings of panel & doors	Major	Process	100%	-	Mnfr std.	Mnfr std.	– Records		P	-	-	
		14)Breaker safety shutter operation	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
		15)Spring loaded power & control contacts alignment	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
4.	Module assembly	1) Component identification	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
		2) Component layout, mounting & dimensions	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
		3) Incoming & outgoing power & control contacts assembly & alignment	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
		4) Power circuit wire / strip termination & clearances	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
		5) Functional Checks	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
		6) Alignment of module with master gauge	Major	Process	100%	-	Mnfr std.	Mnfr std.	QC – Records		P	-	-	
5.	Control Wiring	1) Wire Size & lug size. Colour of wire	Minor	Visual	100%	-	Wiring diagram	Wiring diagram	QC – Records		P	-	-	
		2) Proper wire Clamping & Ferruling	Minor	Visual	100%	-	As per shop practice	As per shop practice	QC – Records		P	-	-	
		3) Continuity as per wiring drag.	Critical	Test	100%	-	NTPC Appr. Drag.	NTPC Appr. Drag.	QC – Records		P	-	-	
		4) Tightness of termination & crimping check	Major	Test	100%	-	Mnfr std	Mnfr std	QC – Records		P			
D	Final Inspection: Note: 1) Type test clearance from NTPC-Engg to be verified 2) Before start of inspection , manufacturer's internal inspection (QC) records of the offered panels/ equipments & main contractor's inspection report to be submitted													

MANUFACTURER/SUB / SUPPLIER	MAIN SUPPLIER	GEND: * RECORDS, INDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN DOCUMENTATION. ** M: MANUFACTURER/SUB-CONTRACTOR, C: CONTRACTOR / NOMINATED INSPECTION AGENCY, N: NTPC INDICATED "P" PERFORM "W" WITNESS AND "V" VERIFICATION ALL "W" INDICATED IN COLUME "N" SHALL BE 'CHP'' OF NTPC.	FOR NTPC USE			
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL

MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM : PCC ,MCC , ACDB AND DCDB (UP TO 4000 A)	PROJECT :

Sl. No.	Component & Operations	Characteristics	Classification	Type of Check	Quantum of check, 6		Reference Document	Acceptance Norms	Format of Records		Agency 10			Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M**	C	N	11
		1. Overall visual check for aesthetics, verticality of panels and alignment between two transport sections	Major	Visual	100%	10%	As per approved GA Drgs	As per approved GA Drgs	QC Records	√	P	W	W	
		2. Verification of- overall dimensions including sheet steel thickness	Major	Meas.	100%	1 sample / lot	As per approved GA Drgs	As per approved GA Drgs	QC Records	√	P	W	W	
		3. Bus duct interface, phase sequence, flange dimensions & clearances	Major	Visual	100%	100%	NTPC appd Drag / NTPC spec	NTPC appd Drag / NTPC spec	QC Records	√	P	W	W	
		4. Bus bar (Main, control & Aux.) – clearances, colour coding, phase sequence identification	Critical	Measurement & visual	100%	10%	NTPC Appr. Drgs / NTPC spec	NTPC Appr. Drgs / NTPC spec	QC Records	√	P	W	W	
		5. Bus bar support arrangement centre – centre distance between supports	Major	Measurement	100%	Random sample's	NTPC accepted Type test reports	NTPC accepted Type test reports	QC Records	√	P	W	W	
		6. Overlapping of bus bar joints	Major	Elect	100%	10%	NTPC appd Drg / NTPC spec	NTPCappd Drag / NTPC spec	QC Records	√	P	W	W	
		7. Measurement of tightness of bus bar joints by torque wrench	Critical	Mach	100%	10%	M60.300.70KGFM,M8-1.25-2.5KGFM, M10-2.5-4KGFM, M12-4.3-7.1KGFM, IS-13947-1993	M60.300.70KGFM, M8-1.252.5KGFM, M10-2.54KGFM, M124.37.1KGFM,IS-139471993	QC Records	√	P	W	W	
		8. CT /PT fixing & mounting arrangement	Major	Mech.	100%	10%	Mnfr std.	Mnfr std.	QC Records	√	P	W	W	
		9. Check shrouding of accessible live parts , Cable supports and tool falling shroud in cable alley	Major	Visual	100%	10%	NTPC spec	NTPC spec	QC Records	√	P	W	W	
		10. For modules more than 30KW, minimum 4 no of support guide arrangement required.	Major	Visual	100%	10% of each type/	NTPC approved GA / scheme drag	NTPC approved GA / scheme drag	QC Records	√	P	W	W	

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FOR NTPC USE

MANUFACTURER/SUB / SUPPLIER	MAIN SUPPLIER			
SIGNATURE		REVIEWED BY	APPROVED BY	APPROVAL SEAL

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM : PCC ,MCC , ACDB AND DCDB (UP TO 4000 A)	PROJECT : 2

Sl. No.	Component & Operations	Characteristics	Classification	Type of Check	Quantum of check, 6		Reference Document	Acceptance Norms	Format of Records		Agency 10			Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M**	C	N	11
		11. Mounting arrangement of components shall be verified such that there would benohindranceforaccessibility	Major	Visual	100%	10% of each type/	NTPC approved GA / scheme drag	NTPC approved GA / scheme drag	QC Records	√	P	W	W	
		12. Check control wiring / terminal arrangement & ferruling	Major	Visual	100%	10%	As per NTPC approved drag.	As per NTPC approved drag.	QC Records	√	P	W	W	
		13. Safety Shutters operation check & padlocking arrangement	Critical	Mech.	100%	10%	NTPC spec	NTPC spec	QC Records	√	P	W	W	
		14. Check door interlock & defeat interlock	Major	Mech.	100%	10%	NTPC spec	NTPC spec	QC Records	√	P	W	W	
		15. Mach operation test for ACB as per IS	Critical	*Elect*	100%	100%	IS 13947	IS 13947	QC Records	√	P	W	W	
		16. Breaker operation at service , test & isolate position	Critical	*Elect*	100%	100%	NTPC spec	NTPC spec	QC Records	√	P	W	W	10% random sample by NTPC
		17. Power & control draw out contacts alignment check	Major	*Elect*	100%	10% of each type	NTPC spec	NTPC spec	QC Records	√	P	W	W	10% random sample by NTPC
		18. Check for Breaker antidumping & trip free feature	Major	*Elect*	100%	*100%	NTPC spec	NTPC spec	QC Records	√	P	W	W	
		19. Interlocks & operation check:- elect. / Machopen, close under test & service.	Critical	*Elect*	100%	10% of each type	Approved drgs & NTPC Spec.	Approved drgs & NTPC Spec.	QC Records	√	P	W	W	10% random sample by NTPC
		20. FRP sheets material used as barriers shall be Flame retardant material	Major	Flame Test	Sampling as per Mifr. Std.	Sampling as per Mifr. Std.	As per IS 6746 , table -4 grade –I	As per IS 6746 , table -4 grade –I	Suppliers TC	√	P	W	W	
		21. Bus bar Sleeves material shall be as per NTPC Spec. and marking UL on sleeve. Material Certification for the sleeve material complying toUL 224	Major	Measurement	5 sample of each type per lot	5 sample of each type per lot	Mnfr Std. / Mnfr drg.	Mnfr Std. / Mnfr drg.	Suppliers TC	□	P	W	W	
		22 Interchangeability check for draw out modules	Major	Mech	100%	10%	NTPC spec	NTPC spec	QC Records	√	P	W	W	

MANUFACTURER/SUB / SUPPLIER	MAIN SUPPLIER	GEND: * RECORDS, INDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN DOCUMENTATION. ** M: MANUFACTURER/SUB-CONTRACTOR, C: CONTRACTOR / NOMINATED INSPECTION AGENCY, N: NTPC INDICATED "P" PERFORM "W" WITNESS AND "V" VERIFICATION ALL "W" INDICATED IN COLUME "N" SHALL BE 'CHP'' OF NTPC.	FOR NTPC USE			
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM : PCC ,MCC , ACDB AND DCDB (UP TO 4000 A)							PROJECT :					
Sl. No.	Component & Operations	Characteristics	Classification	Type of Check	Quantum of check, 6		Reference Document	Acceptance Norms	Format of Records		Agency 10			Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M**	C	N	11
		23.Earth bus dimensions , earthling of draw out modules, door etc.	Major	Elec	100%	10% of each type f	NTPC spec	NTPC spec	QC Records	√	P	W	W	
		24.Check Paint shade, thickness, Adhesion & finish	Major	Visual/Test	100% for shade & finish; 2 – 3 samples / lot	2 - 3 samples / board	As per NTPC approved drg. For shade	As per NTPC approved drg. For shade	QC Records	√	P	W	W	
		25.Degree of protection check, check fixing of gaskets	Major	Visual	2-5 samples at casketed joints per board	2 - 5 samples board	NTPC approved drags / NTPC spec	No insertion possible from openings & casketed joints	QC Records	√	P	W	W	
		26.IR Test before & after the HV Test	Major	Elect.	100%	100%	IS-8623	IS-8623	QC Records	√	P	W	W	
		27.HV test on Power & control ckt.	Critical	Elect.	100%	100%	IS-8623	IS-8623	QC Records	√	P	W	W	
		28. Fitting of sheet steel covers at one ends of transport units	Major	Visual	100%	100%	NTPC spec	NTPC spec	QC Records	√	P	V	V	1) Generally, verification of compliance report of Manufacturer
6	Packing & transportation	Panels cleared by NTPC for dispatch to be packed suitably & transported to site after proper packing & crating	Major	Visual	100%	-	Mnfr std	Mnfr std	QC Records		P			Panels cleared by NTPC for dispatch to be packed suitably & transported to site after proper packing and crating

Make of Components – Annexure-I

Sr. No.	Item	Make
1.	Air Circuit Breaker	C&S ELECTRIC LTD. AH Type
2	Switch/Switch Fuse Unit	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
3.	HRC Fuse Link & fuse base	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
4.	Contactor & Over Load Relays	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
5.	Current Transformer	AE – MUMBAI / KAPPA – BANGALORE / PRAGATI – THANE / PRAYOG – PUNE / INDCOIL - MUMBAI / PRECISE - MUMBAI/ SOUTHERN ELECTRIC – CHENNAI , NEWTEK Electrical – Aurangabad

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MANUFACTURER/SUB / SUPPLIER	**MAIN SUPPLIER**			
SIGNATURE			**REVIEWED BY**	**APPROVED BY** / **APPROVAL SEAL**

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM : PCC ,MCC , ACDB AND DCDB (UP TO 4000 A)	PROJECT : :

Sl. No.	Component & Operations	Characteristics	Classification	Type of Check	Quantum of check, 6		Reference Document	Acceptance Norms	Format of Records		Agency 10			Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M**	C	N	11

6.		SOUTHERN ELECTRIC – CHENNAI
7.	Control Transformer	AE – MUMBAI , KAPPA – BANGALORE ,SOUTHERN ELECTRIC – CHENNAI ,PRAGATI – THANE , PRAYOG – PUNE , INDCOIL - MUMBAI , PRECISE - MUMBAI,G&M - BARODA, LOGICSTATE – DELHI , NEWTEK Electrical – Aurangabad
8.	Lighting Transformer	AE – MUMBAI ,PAGATI – THANE , INDCOIL - MUMBAI , PRECISE - MUMBAI, LOGICSTATE – DELHI
9.	Protection relays (Numerical)	ABB – BARODA / ALSTOM T&D - CHENNAI / GE – CANADA / SIEMENS – GOA SEL - US A , SCHNIEDER – FINLAND (EUROPE)
10	Protection relays (Electromachenical)	ABB / AREVA (ALSTOM) / SIEMENS/ SCHNIEDER
11.	Indicating lamp	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
12.	Push Button	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
13.	Indicating/Measuring Instrument	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
14.	Plug in Terminal & Terminals Block	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
15	Space Heater	C&S ELECTRIC LTD./ MANUFACTURER ACCEPTENCE SOURCE
16.	Thermostat	ANCO/ MANUFACTURER ACCEPTENCE SOURCE
17.	BKR control switch	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
18.	Selector Switch	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
19.	Coupling relay	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
20.	Transducer	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
21.	TIMER	L&T /SIEMENS/C&S ELECTRIC
22.	Neutral link	C&S ELECTRIC LTD./ MANUFACTURER ACCEPTENCE SOURCE
23.	Cable Lugs	DOWELLS/3D/CHETNA
24	Cable Gland	MANUFACTURER APPROVED SOURCE
25.	3 PIN POWER SOCKET	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
26.	MCB	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.
27.	WIRE	BIS APPROVED.
28.	KWH METER	Any make's Model with VDE, CE, UL , CSA OR BIS Approved with CML No.)
29.	AL BUSBAR (RAW MATERIAL)	HINDALCO / BALCO / INDALCO
30.	SHEET STEEL	TATA/SAIL/BHUSHANSTEEL/JINDAL/ESSAR/TISCO/IISCO
31..	Copper Bubar (RAW MATERIAL)	HINDUSTAN COPPER LTD./ STERLITE
32.	Paint.	MANUFACTURER ACCEPTENCE SOURCE / AKZONOBEL/JOTUN/ SHARP COATING / ASIAN PAINT / NAROLAC

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MANUFACTURER/SUB / SUPPLIER	**MAIN SUPPLIER**			
SIGNATURE			**REVIEWED BY**	**APPROVED BY** / **APPROVAL SEAL**

ANNEXURE-D

1.00.00 STANDARDS AND REGULATIONS

1.01.00 All materials in cables shall comply with the latest editions of relevant Indian Standards, Indian Electricity Rules, Indian Electricity Act and other applicable statutory provisions, rules and regulations.

1.02.00 Unless otherwise specified the design, manufacture and performance of all the equipment and material provided under this specification shall generally conform to the latest issues of the following standards:

IS:1554 (Part-I)	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V
IS:3961	Recommended current ratings for cables
IS:8130	Conductors for insulated electric cables and flexible cords
IS:5831	PVC insulation and sheath of electric cables
IS:7098 (Part-I&II)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto 33kV
IS:3975	Low carbon Galvanised steel wires, formed wires and tapes for armouring of cables
IS:8130	Conductors for insulated electrical cables and flexible cords
IS:10418	Drums for electric cables
IS:10810	Methods of test for cables
IS:4905	Methods for random sampling
IEC:502	Power cables with extruded insulation & their accessories for rated voltages 1kV to 36kV
IEC:540 & 540A	Test methods for insulation and sheaths of electric cables and cord
IEC:332	Test on electric cables under fire conditions
IEC:754	Test on gases evolved during combustion of electric cables
ASTM-D-2843	Standard test method for density of smoke from the burning or decomposition of plastics
IS:10810 Part-58	Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics
Any other applicable standard	

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2.00.00 TECHNICAL REQUIREMENTS

2.01.00 The cable shall be suitable for laying on racks, in ducts, trenches, conduits and under ground (buried) installation with chances of flooding by water.

2.02.00 Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady State and transient operating conditions as specified elsewhere in this specification.

2.03.00 Aluminium conductor used in power cables shall have tensile strength of more then 100 N/ sq.mm. Conductors shall be multi stranded.

2.04.00 XLPE insulation shall be suitable for 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.

2.05.00 The cable cores shall be laid up with the filters 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.

2.06.00 For single core armoured cables, armouring shall be of aluminium 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**
i)	Upto 13mm	1.4mm dia GS formed wire / 1.6mm dia. GS wire
ii)	Above 13 upto 25mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
iii)	Above 25 upto 40mm	1.4mm thick GS formed wire / 2.5mm dia GS wire
iv)	Above 40 upto 55mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
v)	Above 70mm	1.4mm thick GS formed wire / 4.0mm dia GS wire

2.07.00 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 indicated above for galvanized steel.

2.08.00 The gap between armour wire/formed wire shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The breaking load of armour joint shall not be less then 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of GS wires/formed wires.

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2.09.00 For power and control cable outer sheath shall be of PVC black and grey in colour respectively. 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% (to IEC-754-I)

c) Smoke density rating shall not be more then 60% during Smoke Density test as per ASTMD-2843.

2.10.00 For HT Cables, cores shall be identified by colouring of insulation or by providing coloured tapes over the cores with Red, Yellow & Blue colours.

2.11.00 For LT Power / Control Cables, cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted :

1 core	-	Red or Yellow or Blue or Black
2 core	-	Red & Black
3 core	-	Red, Yellow & Blue
4 core	-	Red Yellow Blue & Black

For reduced neutral conductor, the core shall be black.

2.12.00 For Control Cables having more then 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the core shall be grey only .The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50mm.

2.13.00 In addition to manufactures identification on cable as per IS, following marking shall also be provided over Outer sheath:

a) Cables 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 / printing shall be progressive, automatic, in line and marking shall be legible and indelible.

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2.14.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 60332 Part – 3.
2.15.00	Allowable tolerance on the overall diameter of the cables shall be +/-2 mm maximum over the declared value in the technical data sheets.
2.16.00	In plant repairs to the cable shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
3.00.00	**CABLE SELECTION AND SIZING**
3.01.00	**HT Cables**
3.01.01	HT Cables shall be sized based on the following considerations: a) Rated current of the equipment b) The voltage drop in 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
3.01.02	Derating Factors Derating factors for various conditions of installation 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 c) Variation in ground temperature and soil resistivity for buried cables
3.01.03	For HT Cables, the cross-sectional area of the metallic screen strip/tape shall be considered in design calculations.
3.02.00	**LT Power Cables**
3.02.01	LT Power Cables shall be sized based on the following considerations: a) Rated current of the equipment b) The voltage drop in cable, during motor starting condition, shall be limited to 10% and during full load running condition, it shall be limited to 3% of the rated voltage c) Short circuit withstand capability This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.

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3.02.02 Derating Factors

Derating factors for various conditions of installation 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

c) Variation in ground temperature and soil resistivity for buried cables

3.02.03 All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated.

3.03.00 Control Cables

Control cables shall be sized based on the following considerations:

a) The minimum conductor cross section shall be 1.5sq.mm.

b) The minimum no.of spare cores in control cables shall be as follows :

No of cores in cable	Min.No. of spare cores
2C, 3C	Nil
5C	1
7C-12C	2
14C & above	3

3.04.00 Cable lengths shall be considered in such a way that straight through cable joints are avoided.

3.05.00 Cable shall be of armoured type if laid in switchyard (potheadyard) area or directly buried.

4.00.00 CONSTRUCTIONAL FEATURES

4.01.00

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4.02.00 **LT Power Cables**

a) 1.1kV Grade XLPE power cables shall have compacted aluminium conductors XLPE insulated, PVC inner sheathed (as applicable), armoured / unarmoured, FRLS PVC outer sheathed conforming to IS :7098. (part-1)

b) 1.1kV Grade PVC power cables shall have aluminum conductor (compacted type for sizes above 10sq.mm), PVC insulated, PVC innersheathed (as applicable) armoured / unarmoured, FRLS PVC outersheathed conforming to IS :1554 (Part-I).

4.03.00 **Control Cables**

1.1kV Grade Control cables shall have stranded copper conductor multicore PVC insulated, PVC inner sheath, armoured / unarmoured, FRLS/ PVC outer sheathed conforming to IS :1554.(Part-I).

5.00.00 **CABLE DRUMS**

5.01.00 Cable 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 layer. 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.

5.02.00 Each drum shall carry manufacturer's name, Employer's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled 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.

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6.00.00 TESTS

6.01.00 Type tests

6.01.01 **33/11kV Cables**

Type tests on one size of each type (voltage grade) of cable:

S.No.	Type test	Remarks
Conductor		
1.	Tensile test	
2.	Wrapping test	
3.	Resistance test	
For Armour Wires / Formed Wires		
4.	Measurement of Dimensions	
5.	Tensile Test	
6.	Elongation test	
7.	Torsion test	For round wires only
8.	Wrapping test	For aluminum wires/ formed wires only
9.	Resistance test	
10. a)	Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.
b)	Adhesion test	For GS wires/formed wires only
For XLPE insulation & PVC Sheath		
11.	Test for thickness	
12.	Tensile strength and elongation test before ageing and after ageing	
13.	Ageing in air oven	
14.	Loss of mass test	For PVC outer sheath only.
15.	Hot deformation test	For PVC outer sheath only.
16.	Heat shock test	For PVC outer sheath only.

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S.No.	Type test	Remarks
17.	Shrinkage test	
18.	Thermal stability test	For PVC outer sheath only.
19.	Hot set test	For XLPE insulation only.
20.	Water absorption test	For XLPE insulation only
21.	Cold Bend Test	For PVC outer sheath only
22.	Cold Impact Test	For PVC outer sheath only
23.	Oxygen index test	For PVC outer sheath only.
24.	Smoke density test	For PVC outer sheath only.
25.	Acid gas generation test	For PVC outer sheath only.
26.	Flammability test as per IEC-332 Part-3 (Category - B)	For completed cable only.

Electrical Tests on Completed Cables

Type tests on each type (voltage grade) and each size of the cable:

27. Insulation resistance test (Volume Resistivity method)
28. High voltage test
29. Partial discharge test
30. Bending test
31. Dielectric power factor test
    a) As a function of voltage
    b) As a function of temperature
32. Heating cycle test
33. Impulse withstand test

6.01.02 **LT Power Cables**

Type tests on one size each of LT XLPE and LT PVC Power cable.

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S.No.	Type test	Remarks
	Conductor	
1.	Annealing test	For copper conductor only
2.	Tensile test	For aluminum conductor only
3.	Wrapping test	For aluminum conductor only
4.	Resistance test	
	For Armour Wires / Formed Wires	
5.	Measurement of Dimensions	
6.	Tensile Test	
7.	Elongation test	
8.	Torsion test	For round wires only
9.	Wrapping test	For aluminum wires/ formed wires only
10	Resistance test	
11. (a)	Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.
(b)	Adhesion test	For GS wires/formed wires only
	For XLPE/PVC insulation & PVC Sheath	
12.	Test for thickness	
13.	Tensile strength and elongation test before ageing and after ageing	
14	Ageing in air oven	
15.	Loss of mass test	For PVC insulation and sheath only.
16.	Hot deformation test	For PVC insulation and sheath only.
17.	Heat shock test	For PVC insulation and sheath only.
18.	Shrinkage test	
19.	Thermal stability test	For PVC insulation and sheath only.

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S.No.	Type test	Remarks
20.	Hot set test	For XLPE insulation only.
21.	Water absorption test	For XLPE insulation only.
22.	Cold Bend Test	For PVC outer sheath only
23.	Cold Impact Test	For PVC outer sheath only
24.	Oxygen index test	For outer sheath only.
25.	Smoke density test	For outer sheath only.
26.	Acid gas generation test	For outer sheath only.
27.	Flammability test as per IEC-332 Part-3 (Category - B)	For completed cable only.

Electrical Tests on Completed Cables

28. Insulation resistance test (Volume Resistively method)

29. High voltage test

6.01.03 **Control Cables**

Type tests on one size of Control cable:

S.No.	Type test	Remraks
	Conductor	
1.	Annealing test	For copper conductor only
2.	Resistance test	
	For Armour Wires / Formed Wires	
3.	Measurement of Dimensions	
4.	Tensile Test	
5.	Elongation test	
6.	Torsion test	For round wires only
7.	Wrapping test	For aluminum wires/ formed wires only
8.	Resistance test	
9.. (a)	Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.
(b)	Adhesion test	For GS wires/formed wires only

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S.No.	Type test	Remarks
	For PVC insulation & PVC Sheath	
10.	Test for thickness	
11.	Tensile strength and elongation test before ageing and after ageing	
12.	Ageing in air oven	
13.	Loss of mass test	For PVC insulation and sheath only.
14.	Hot deformation test	For PVC insulation and sheath only.
15.	Heat shock test	For PVC insulation and sheath only.
16.	Shrinkage test	
17.	Thermal stability test	For PVC insulation and sheath only.
18.	Cold Bend Test	For PVC outer sheath only
19.	Cold Impact Test	For PVC outer sheath only
20.	Oxygen index test	For outer sheath only.
21.	Smoke density test	For outer sheath only.
22.	Acid gas generation test	For outer sheath only.
	Electrical Tests on Completed Cables	
23.	Insulation resistance test (Volume Resistively method)	
24.	High voltage test.	
25.	Flammability test as per IEC-332 Part-3 (Category - B)	For completed cable only.

Note: For LT Power Cables & Control Cables for Surface Pothead yard, please refer Sub section E17 of the Technical Specification, Section-VI, Part-B.

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Bidder's Name.....

TECHNICAL PARTICULARS

1.00.00 **TECHNICAL DATA**

The following technical data shall be submitted by the Contractor for each type and size of the cable, along with his proposal:

1. Make : .....
2. Country of Manufacturer : .....
3. Type Designation : .....
4. Applicable Standard : .....
5. Cable size : .....
6. Rated voltage : .....
7. Continuous current rating for max. conductor temperature:
   When laid in air at an ambient temp. of 40 °C : .....
8. Short circuit withstand capacity and duration for
   a. Conductor : .....
   b. Armour : .....
9. **Conductor**
   a. Material : .....
   b. Nominal cross section area in sq. mm. : .....
   c. Max. D. C. resistance at 20 °C: .....
10. **Insulation**
    a. Material : .....
    b. Nominal thickness (in mm) : .....
    c. Identification of cores : .....
11. Material and Type of filler material (if required): .....

Power Sector, Hydro Marketing, Sector - 142, Noida U.P.

Bidder's Name.....

12. Material and Type of inner sheath (if required): .....

13. **Armour**

    a. Material & shape : .....

14. **Outer sheath**

    a. Material : .....

    b. Colour : .....

15. Overall dia. of cable (in mm) : .....

16. Weight per 1000 metre (in Kg.) : .....

17. Standard drum length offered : .....

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Bddier's Name.....

TECHNICAL PARTICULARS

1.00.00 **TECHNICAL DATA**

The following technical data shall be submitted by the Contractor for each type and size of the cable, along with his proposal:

1. Make : .....
2. Country of Manufacturer : .....
3. Type Designation : .....
4. Applicable Standard : .....
5. Cable size : .....
6. Rated voltage : .....
7. Continuous current rating for max. conductor temperature:
   When laid in air at an ambient temp. of 40 ° C : .....
8. Short circuit withstand capacity and duration for
   a. Conductor : .....
   b. Armour : .....
9. **Conductor**
   a. Material : .....
   b. Nominal cross section area in sq. mm. : .....
   c. Maximum D. C. resistance at 40 ° C : .....
10. **Insulation**
    a. Material : .....
    b. Nominal thickness (in mm) : .....
    c. Identification of cores : .....
11. Material and Type of filler material : .....

Sector, Hydro Marketing

Bddier's Name.....

12. Material and Type of inner sheath material : .....

13. **Armour**

a. Material type : .....

14. **Outersheath**

a. Material : .....

b. Colour : .....

15. Overall dia. of cable (in mm) : .....

16. Weight per 1000 metre (in Kg.) : .....

17. Standard drum length offered : .....

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L.T POWER CABLES (E-11)
(1.1 KV PVC & XLPE CABLES)

Item / Components / Sub System Assembly / Attributes / Characteristics	Make, Rating, Type & TC	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Hot set test (XLPE)	Lay length / Sequence	Armour coverage, Cross over, looseness, Gap between two armour wire/strip	Sequential marking/surface finish /cable length	Tensile strength, elongation before & after ageing of insulation & outer sheath	Thermal Stability of insulation and outer sheath *	Anti termite treatment on wooden drums	Constructional / requirement as per NTPC Spec.	Routine and acceptance test as per Relevant Standard and NTPC specification	FRLS Test
Aluminum (IS-8130)	Y	Y	Y	Y	Y											
PVC Compound (IS-5831)	Y		Y		Y						Y					
XLPE Compound(IS-7098 Part-I)	Y		Y		Y		Y				Y					
FRLS PVC Compound(IS-5831) ASTM-D-2843/ ASTM-D-2863 IEC-754 Part-I	Y		Y								Y					
Armour wire/strip (IS-3975)	Y	Y	Y													
Insulated Core		Y				Y	Y					Y				
Laid up core		Y						Y								
PVC Inner sheath		Y														
Armouring		Y							Y							
Outer sheath		Y								Y	Y	Y				Y
Finish cable (IS-1554 & 7098 – Part-1) ASTM-D-2843/ IS 10810 (Part- - 58) IEC-754 Part-I Swedish Chimney SS 4241475 for (F3 category) Flammability test IEC-332 Part –3 Cat-B	Y	Y							Y	Y	Y	Y		Y	Y	Y
Wooden drum (IS-10418) / Steel drum		Y											Y			

Note: 1. This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the practice and procedure along with relevant supporting documents.

2. Not applicable for XLPE insulation

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	ROUTINE TESTS Routine tests shall be carried out on each drum of finished cables for all types & sizes. Following shall constitute routine tests:
1)	Conductor Resistance test
2)	High voltage test at room temperature

	ACCEPTANCE TESTS	
	Following Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 1554 Part 1 & IS 7098 Part-I	
A)	**For Conductor**	
1)	Annealing test	For copper conductor only
2)	Tensile test	For aluminium conductor only
3)	Wrapping test	For aluminium conductor only
4)	Resistance test	
B)	**For Armour Wires / Formed Wires (If applicable)**	
1)	Measurement of Dimensions	
2)	Tensile Tests	
3)	Elongation Test	
4)	Torsion Test	For Round wires only
5)	Wrapping Test	
6)	Resistance Test	
7)	Mass of Zinc coating test	For G S wires / Formed wires only
8)	Uniformity of Zinc coating	For G S wires / Formed wires only
9)	Adhesion test	For G S wires / Formed wires only
10)	Freedom from defects	
C)	**For PVC / XLPE insulation & PVC Sheath**	
1)	Test for thickness	
2)	Hot set test	For XLPE insulation only
3)	Tensile strength & Elongation before ageing	
D)	**For completed cables**	
1)	Insulation resistance test (Volume resistivity method)	
2)	High voltage test **at room temperature**	

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E)	Following tests shall be carried out and only one sample shall be taken from each offered lot of all sizes for these tests:-
1)	Tensile strength & elongation after ageing **on PVC / XLPE insulation and PVC outer sheath**
2)	Thermal stability test **on PVC insulation and outer sheath**
3)	Oxygen index test **on outer sheath**
4)	Smoke density rating test on outer sheath as per ASTM –D 2843
5)	Acid gas generation test on outer sheath as per IEC – 754 (Part 1)
6)	Flammability test as per IEC-332 - Part- 3 (Category- B) on completed cable
7)	Fire resistance test as per SS 4241475 (F3 Category) on completed cable
F)	Following tests shall be carried on one length of each size of offered lot:
1)	Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires

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एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)													
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
Instructions: 1) Cable manufacturer to maintain records to show co- relation of raw materials to finished cables i,e raw material batch/ lot no. should be traceable to the cable drum. 2) Cable manufacturer to maintain all quality control records identified as per all QP stages enumerated below whether it is identified for NTPC verification or witness or not.															
A	**Raw material/ Brought out Items**														
1.01	Aluminum	1.Make	MA	Verify	100%	--	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	QCR		V	--	--		
		2. Resistivity	MA	Elect	As per Cable Mnfr Std.	--	IS5082	IS5082	-do--		P	--	--		
1.02	PVC / XLPE/compound for insulation	1. Make	MA	Verify	--do--	100%	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	--do--		V	V	--		
		2. Type/ Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	--do--		V	V	V		
		3. All acceptance test as per manufacturer norms including thermal stability test for PVC insulation	MA	Verify	As per manufacturer norms	As per manufacturer norms	NTPC ADS	NTPC ADS	--do--		V	V	V		Refer note 1
1.03	PVC Compound for Inner sheath	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V		
		2. Type/ Grade	MA	Verify	--do--	--do--	NTPC ADS	NTPC ADS	--do--		V	V	V		
1.04	Steel wire / Formed Wire (As applicable)	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V		
		2. Dimension	MA	Meas	1 sample from each size / lot	--	NTPC APPROVED DATA SHEET & IS 3975	NTPC APPROVED DATA SHEET & IS 3975	--do--		P	--	--		
		3. All acceptance tests as per IS 3975	MA	Verify	As per IS 3975	--	IS 3975	IS 3975	Supplier TC		V	V	--		
1.05	PVC compound for Sheath	1. Make	MA	Verfy	As per manufacturer norms	100%	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	QCR		V	V	--		
		2. Type / Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	QCR		V	V	V		
		3. All acceptance test as per manufacturer norms	MA	Verify	As per manufacturer norms	As per manufacturer norms	NTPC ADS	NTPC ADS	QCR		V	V	V		Refer note 1

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

FORMAT NO:QS-01-QAI-P-10/F3-R1

NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)												
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		4. Thermal Stability	MA	Chem	One sample / Batch	--	NTPC ADS	NTPC ADS	QCR		P	--	--	
		5. Oxygen Index	MA	Chem	--do--	--	NTPC ADS/ IS 10810 Part 58	NTPC ADS/ IS 10810 Part 58	--do--		P	-- -	--	
		6. Acid Gas Emission	MA	Chem	One sample / Batch	--	NTPC ADS / IEC60754	NTPC ADS / IEC60754	QCR		P	--	--	
1.06	Wooden Drum	1. Dimension	MI	Meas	Manuf. Std.	--	IS 10418	IS10418	--do--		P	--	--	
		2. Anti termite treatment	MI	Chem	Cable manuf. std	--	CABLE MANUF. STD.	CABLE MANUF. STD.	COC		V	V	V	COC from drum manuf.
1.07	Steel Drum	1. Dimension	MI	Meas	--do--	--	--do--	--do--	QCR		P	--	--	
		2. Surface finish	MI	Meas	--do--	--	--do--	--do--	--do-		P	--	--	
B	**Process & Stage Inspection**													
2.01	Wire Drawing	1.Surface finish	MA	Visual	One sample/Setting of each size	--	SHOULD BE SMOOTH & FREE FROM SCRATCHES	SHOULD BE SMOOTH & FREE FROM SCRATCHES	QCR		P	--	--	
		2. Wire Diameter	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		3. Tensile test	CR	Mech	--do--	--do--	--do--	--do--	--do--		P	V	V	Refer Sl. No.3.03(iii)
		4. Wrapping test	CR	Mech	--do--	--do--	--do--	--do--	--do--		P	V	V	--do--
2.02	Bunching / stranding	1. No. of wires	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		2.Dia of wire	MA	Meas	-do--	--	--do--	--do--	--do--		P	--	--	
		3. Dimension of Conductor	MA	Meas	--do--		--do--	--do--	--do--		P	--	--	
		4.Direction of lay	MA	Visual	--do--	---	--do-	--do--	--do--		P	--	--	
		5.Records of strand breakage / welding during conductor stranding	MA	Verify	--do--	--	IS 8130	IS8130	--do--		P	--	--	
		6.Surface finish	MA	Visual	--do--	-	--do--	--do--	--do--		P	--	--	
		7. DC Resistance	CR	Meas	--do--	-	IS8130/NTPC ADS	IS8130/ NTPC ADS	--do--		P	--	--	
2.03	Insulation extrusion	1. Surface finish	MA	Visual	One sample/Setting of each size	-	NTPC spec	SHOULD BE SMOOTH. NO POROSITY IS PERMITTED.	QCR		P	--	--	XLPE/ PVC compound shall be preferably loaded in to extruder by suction method.

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

FORMAT NO:QS-01-QA1-P-10/F3-R1

NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)												
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		10			11
		2.Colour of cores	MA	Visual	One sample/Setting of each size	-	NTPC ADS	NTPC ADS	QCR		P	--	--	
		3.Thickness	CR	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Spark Test	CR	Elect	100%	100%	CABLE MANUF. STD.	No FAILURE	--do --		P	V	V	1.Spark test failure record is to be verified. 2.Core repairing not permitted
		5. Hot Set	CR	Mech	One sample/Setting of each size	--	IS 7098- Part I	IS 7098- Part I	--do--		P	--	--	Sample is to be taken from both top & bottom end
2.04	Laying up	1. Core sequence	MA	Visual	--do--	--	IS 1554 (Part I) & IS 7098- Part I	IS 1554 (Part I) & IS 7098- Part I	--do--		P	--	--	
		2. Direction of lay	MA	Visual	--do--	--	-do-	--do--	--do--		P	--	--	
		3. Dia over laid up core	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.05	Inner Sheath	1.Colour	MA	Visual	-do--	-	--do--	--do--	--do--		P	--	-- -	
		2. Surface Finish	MA	Visual	100%	-	NTPC SPECIFICATION	FISH EYE, BLOW HOLE NOT PERMITTED	--do--		P	--	-	
		3.Thickness	MA	Meas	One sample/Setting of each size	-	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Dia over inner sheath	MI	Meas	--do--.	-	--do--	---do--	--do--		P	--	--	
2.06	Armouring (As Applicable)	1.Dimension	MA	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		2.No. of wires / strip	MA	Meas.	--do--	-	--do--	--do--	--do--		P	--	--	
		3. Direction of lay	MA	Visual	--do--	--	IS 1554 (Part 1) & IS 7098- Part I	IS 1554 (Part 1) & IS 7098- Part I	QCR		P	--	--	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)													
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		10			11
		4.Coverage & Quality of armouring	MA	Meas.	100%	--	Min. area of coverage of armouring shall be 90%. The gap between amour wires / formed wires shall not exceed one amour wire/ formed wire space & there shall be no cross over/ over riding of amour wire / formed wire. Zn rich paint shall be applied on amour joint surface of G.S. Wire /formed wire. The breaking load of amour wire joint shall not be less than 95% of that amour wire / formed wire. (As per NTPC specification)		QCR		P	--	--	
		5 Dia over armouring	MA	Meas.	One sample/Setting of each size	--	NTPC ADS		--do--		P	--	--	--
2.07	Outer Sheath	1. Surface finish	MA	Visual	100%	--	Pimple, Fish Eye, Burnt particles, Blow Hole not permitted. Repairing on outer sheath not permitted. (As per NTPC specification)		--do--		P	--	--	PVC FRLS compound shall be preferably loaded in to extruder by suction method.
		2.Colour of sheath	MA	Visual	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		3. Dia over outer sheath	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Thickness of outer sheath	CR	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		5. Embossing quality	MA	Visual	100%	-	Drum no., IS1554-I / IS7098-1,Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (As per NTPC specification)		--do--		P	--	--	Drum no. on cable may be embossed/printed
		6. Sequencial marking	MA	Visual	Full length	--	Sequencial marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible. (A s per NTPC specification)		--do--		P	--	--	
C	**Finished Cables**														
3.01	Type test reports clearance from NTPC Engineering	All type tests as per NTPC specification	CR	Doc.	100%	100%	NTPC SPECIFICATION / NTPC ADS / IS 1554 (Partl) & IS 7098- Part I	NTPC SPECIFICATION / NTPC ADS / IS 1554 (Partl) & IS 7098- Part I	--do--	✓	P	V	V	

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-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"
FORMAT NO:QS-01-QA1-P-10/F3-R1

NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)												
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
3.02	Routine Tests	1.High Voltage test at room temperature	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	Test certificate	✓	P	W	W	Refer note 2
		2.Conductor Resistance	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	Test certificate	✓	P	W	W	Refer note 2
3.03	**Acceptance Tests**													
3.03 (i)	Construction of finished Cable	1. OD of Cable	MA	Meas.	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		2. Laying of core	CR	Visual	--do--		NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	--do--	✓	P	W	W	
		3. Core Identification	CR	Visual	--do--		--do--	--do--	--do--	✓	P	W	W	
		4. Colour of outer sheath	MA	Visual	--do--		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		5. Inner sheath thickness	CR	Meas	- do -		--do--	--do--	--do--	✓	P	W	W	
		6. Inner sheath colour	MA	Visual	- do -		- do -	- do -	--do--	✓	P	W	W	
3.03 (ii)	Armour wires/ Formed wires (if applicable)	1.Dimensions	CR	Meas	--do--		NTPC ADS /IS1554(PartI)/IS3975	NTPC ADS /IS1554(PartI) /IS3975	--do--	✓	P	W	W	
		2. No. of wires/ formed wire	CR	Mech	-- do --		--do--	--do--	--do--	✓	P	W	W	
		3. Tensile test	CR	Mech	--do--		--do-	--do--	--do--	✓	P	W	W	
		4. Elongation test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W	
		5.Torsion test (for round wires only)	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W	
		6. Wrapping test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W	
		7. Resistance test	CR	Mech	--do--		--do--	--do-	--do-	✓	P	W	W	

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NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)												
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		8.Mass of Zinc coating	CR	Meas	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098-Part I		NTPC ADS /IS1554(Partl)/IS3975	NTPC ADS /IS1554(Partl) /IS3975	Test certific ate	✓	P	W	W	
		9. Uniformity of Zinc Coating	CR	Chem.	--do-		--do--	--do-	--do-	✓	P	W	W	
		10.Adhesion test	CR	Mech	--do--		--do--	--do-	--do--	✓	P	W	W	
		11.Freedom from defects	CR	Visual	--do--		--do--	--do--	--do--	✓	P	W	W	
3.03 (iii)	Conductor													
		1.Resistance Test	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W	
		2.Tensile test (For aluminum conductor only)	CR	Mech	Each type & size of cables as per sampling plan of IS IS 1554 (Part I)/7098(Part-1)		NTPC ADS/ IS 8130	NTPC ADS/ IS 8130	--do--	✓	P	W	W	Test report of manufacturer to be reviewed as per Sl. No. 2.01 for Tensile test & wrapping test (for Aluminum) in case this test is not applicable for cable under inspection as per IS 8130 cl. 6.2
		3.Wrapping test (For aluminum conductor only)	CR	Mech	--do--		--do--	--do--	-do--	√	P	P	W	--do--

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FORMAT NO:QS-01-QA1-P-10/F3-R1

एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)												
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance / Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
3.03 (IV)	PVC/XLPE/ Insulation & PVC Sheath	1. Thickness of insulation & PVC Sheath	CR	Meas	Each type & size of cables as per sampling plan of IS IS 1554 (Part I)/IS7098(Part-1)		NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	Test Certificate	√	P	W	W	
		2.Tensile strength & elongation at break of insulation & outer sheath (before ageing)	CR	Mech	Each type & size of cables as per sampling plan of IS IS 1554 (Part I)/IS7098(Part-1)		NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	Test Certificate	✓	P	W	W	Refer Note 3 Also
		3.Tensile strength & elongation at break of insulation & outer sheath (after Ageing)	CR	Mech	Refer Note 3		--do--	--do--	--do--	✓	P	W	W	Refer Note 3 ath)
		4. Insulation resistance (Volume resistivity method)	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098-Part I		--do--	--do--	--do--	✓	P	W	W	
		5.High voltage test at room temperature	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098-Part I		--do--	--do--	--do--	✓	P	W	W	
		6..Hot Set test (for XLPE insulation only)	CR	Phy	--do--		--do--	-do--	--do-	√	P	W	W	
		7.Thermal stability on PVC Insulation and outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		-do--	--do--	--do--	✓	P	W	W	

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FORMAT NO:QS-01-QA1-P-10/F3-R1

	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check M	Quantum of check C/ N	Reference Document	Acceptance Norms	Record Format	Agency D*	Agency M	Agency C	Agency N	Remarks
1	2	3	4	5	6		7	8	9	10				11
		8.Oxygen index Test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		NTPC ADS / IS10810 Part 58	NTPC A.D.S	--do-	✓	P	W	W	
		9.Smoke density rating test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		NTPC ADS & ASTMD2843	NTPC ADS	-do--	✓	P	W	W	
		10.Acid gas generation test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		NTPC ADS & IEC 60754-1	'NTPC ADS	Test Certificate	✓	P	W	W	
		11.Flammability test on completed cable	CR	Chem	Refer Note 4	Refer Note 4	NTPC ADS & IEC 60332 Part-3 (Category-B)	NTPC ADS	--do--	✓	P	W	W	
		12.Surface finish & length measurement.	CR	Visual & Meas	One length of each size	One length of each size	(1) Drum no. (2) IS1554-I /IS7098-1,Cable size, Voltage grade & Words " FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (3) Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible	--do--	✓	P	W	W	Pimple, Fish Eye, Burnt particles, Blow Hole etc. not permitted. Repairing on outer sheath not permitted.
		13. Sequence of cores armour coverage, gap between two consecutive armour/ formed wire	CR	Visual & Meas	One length of each size	One length of each size	Min. area of coverage of armouring shall be 90%. The gap between armour wires / formed wires shall not exceed one armour wire/ formed wire space & there shall be no cross over/ over riding of armour wire / formed wire. Zn rich paint shall be applied on armour joint surface of G.S. Wire /formed wire	--do-	√	P	W	W	
4	Packing	1. Sealing	MA	Visual	100%	100%	(1)IS1554(Part-I) & IS 7098-Part I (2) The surface of the drum and the outer most cable layer shall be covered with water proof cover. (3) Both the ends of cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by "U" nails.	QCR	✓	P	--	--	
4.01	Identification	NTPC Sealing	MA	Visual	100%	100%	Sealing shall be visible	QCR	√	P	V	V	

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NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)											
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11

Notes:

1)	If the compound manufacturer is carrying out Ageing test , test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer is to carry out ageing test & test report is to be reviewed (quantum of ageing test sample shall be one sample /batch)
2)	(a) **In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre/ Regional Offices** :- Routine Test of manufacturer internal test report are to be verified by NTPC at the time of final inspection. 2(b) **In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre/ Regional Offices,**:- Routine Test are to be witnessed by Main Contractor & NTPC. This is in addition to manufacturer internal test report to be verified by NTPC at the time of final inspection.
3)	**Refer table on page 10 &11of 11 for Sampling & Acceptance criteria.**
4)	For PVC insulated LT power cable :- For cables with OD less than equal to 30 mm, any size of cable may be clubbed together. For cables where OD is more than 30 mm, clubbing to be done for cables having similar ODs. For XLPE insulated LT Power cable: Clubbing to be done for cables having similar ODs.
LEGEND:	**NTPC ADS: NTPC approved data sheet, QCR: quality control records of cable manufacturer, CABLE MANUF STD- cable manufacturer's internal plant standard, MI: minor, MA: major, CR: critical, COC- certificate of conformance**

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FORMAT NO:QS-01-QAI-P-10/F3-R1

NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11

Sampling & Acceptance Criteria

Criteria	Manufacturer experience prerequisite	Condition	Testing procedure	Remarks
Samples as per relevant IS from every size/ type of cable in the offered lot shall be tested for Tensile Strength & Elongation (before ageing). The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/ - 15% tolerance (final values should be more than the minimum values indicated in relevant standard) of the Type Test report	In case of Manufacturers/ Supplier who have supplied cables in the past through Corporate Centre / Regional offices	In case of sizes/ type which meet the criteria	1 Sample of PVC insulation & outer sheath per type of cables offered which have met the criteria, will be put on accelerated ageing test (refer IRS specification no. IRS: S-63/2007 Rev 3.0). The samples shall be aged in air oven at temperature of 130ºc+/- 2ºc for 5 hours. 1 Sample of XLPE insulation per type of cables offered which have met the criteria, will be put on ageing test as per IS 7098. After wards the samples shall be tested for Tensile Strength & Elongation. Acceptance norms shall be as per relevant IS. **This test shall be witnessed by NTPC.**	In case the samples do not meet the requirement in accelerated ageing test **then 1 sample of that size/ type will be put on ageing test as per IS.**
		In case of size /type which do not meet the criteria	Particular size/ type will be put on ageing test as per IS. **This test shall be witnessed by NTPC.**	----

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FORMAT NO:QS-01-QAI-P-10/F3-R1

	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance / Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
				In case of Manufacturers/ Supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre / Regional offices	In case of size /type which meet the criteria		1 Sample per type out of all sizes which have met the criteria, will be put on aging test and **witnessed by NTPC as per relevant IS**							----
					In case of size/ type which do not meet the criteria		Particular size / type will be put on ageing test as per IS. **This test shall be witnessed by NTPC**							----

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भा.प.मु.नि. BHEL	**STANDARD QUALITY PLAN**		CUSTOMER : NTPC			PROJECT TITLE 3X40 MW RAMMAM HEP			SPECIFICATION NUMBER : PE-RC-999-507-E002 Rev 0				
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER: PE-QP-999-507-E002, **R01**			SPECIFICATION TITLE TECHNICAL SPECIFICATION FOR LT XLPE POWER CABLE				
	SHEET 6 OF 9		SYSTEM			ITEM : LT XLPE Power Cables			SECTION II VOLUME II				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
1.0	**Final Inspection**	**Type Tests (Refer Note-A)**	CR	Physical & Electrical Tests	Sample #	IS 7098-I & Appd. Datasheet	Approved Data Sheet	Test Report	2	1	-	*# Refer Annexure-A to QAP enclsoed*	

NOTES:-
(A) ***FOR LIST OF ROUTINE, TYPE & ACCEPTANCE TESTS, REFER ANNEXURE-A TO QAP ENCLOSED.***

LEGEND : P: PERFORMER W: WITNESSER V: VERIFIER 1- BHEL/CUSTOMER 2-VENDOR 3- SUB VENDOR CHP:CUSTOMER HOLD POINT WHICH WILL BE DECIDED AT CONTRACT STAGE

		BHEL			**PARTICULARS**		**BIDDER/ VENDOR**						
					NAME								
					SIGNATURE								
					DATE							BIDDER'S/VENDORS COMPANY SEAL	

TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS

A. Type Test Conduction:

1. Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test.

2. Sampling:
   a) Type test to be conducted on one size of cable for every lot and type of cable (CU/AL conductor)
   b) Flammability Test to be conducted only on one sample/ lot.

B. **Acceptance Test Conduction:**

1. Conduction of acceptance tests and sampling of acceptance test shall be as per QP NO. 0000-999-QOE-S-040, REV-00 along with Annexure-C (i.e. quality assurance & inspection).

C. Routine Test Conduction:

1. Conduction of Routine tests shall be as per QP NO. 0000-999-QOE-S-040, REV-00 along with Annexure-C (i.e. quality assurance & inspection).

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.0	**Tests for Conductor**				
I.	Annealing test	For copper conductor only	**T, A**	IS 10810 Pt 1	***Internal in process Test Report to be furnished for acceptance test***
II.	Tensile test	For aluminium conductor only (Not applicable for compacted circular or shaped conductor)	**T, A**	IS 10810 Pt 2	
III.	Wrapping test	For aluminium conductor only (Not applicable for compacted circular or shaped conductor)	**T, A**	IS 10810 Pt 3	
IV.	Resistance test	For Al/Cu	**T, A, R**	IS 10810 Pt 5	
2.0	**Tests for Armour Wires/Strips**				
I.	Measurement of dimensions	Applicable for Aluminium wire & GS wire/Strip	**T,A**	IS 10810 Pt 36	
II.	Tensile test	Applicable for Aluminium wire & GS wire/Strip	**T, A**	IS 10810 Pt 37	
III.	Elongation at break test	Applicable for GS wire/Strip only	**T, A**	IS 10810 Pt 37	
IV.	Torsion test	For GS round wire only	**T, A**	IS 10810 Pt 38	

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
V.	Winding test	For GS strip only	**T, A**	IS 10810 Pt 39	
VI.	Resistance test	Applicable for Aluminium wire & GS wire	**T, A**	IS 10810 Pt 42	
VII.	Uniformity of Zinc coating test	For G. S. wires/Strip only	**T, A**	IS 10810 Pt 40	
VIII.	Mass of Zinc coating test	For G. S. wires/Strip only	**T, A**	IS 10810 Pt 41	
IX.	Wrapping Test	For Aluminium wires only	**T, A**	IS 10810 Pt 3	
X.	Adhesion test	For GS wires/Strip only	**T, A**		
3.0	**Physical Tests for XLPE Insulation & PVC sheath**				
I.	Test for thickness	Applicable for XLPE insulation, PVC inner sheath & PVC outer sheath	**T, A**	IS 10810 Pt 6	
II.	Tensile strength and elongation test at break	Applicable for XLPE insulation & PVC outer sheath			
(a)	Before ageing		**T, A**	IS 10810 Pt 7	
(b)	After ageing		**T, A**	IS 10810 Pt 7	
III.	Ageing in air oven	Applicable for XLPE insulation & PVC outer sheath	**T**	IS 10810 Pt 11	
IV.	Loss of mass in air oven test	For PVC outer sheath only	**T**	IS 10810 Pt 10	
V.	Hot deformation test	For PVC outer sheath only	**T**	IS 10810 Pt 15	
VI.	Heat shock test	For PVC outer sheath only	**T**	IS 10810 Pt 14	
VII.	Shrinkage test	For XLPE insulation & PVC outer sheath only	**T**	IS 10810 Pt 12	
VIII.	Thermal stability test	For PVC outer sheath only	**T**	IS 10810 Pt 60	
IX.	Hot set test	For XLPE insulation only	**T, A**	IS 10810 Pt 30	
X.	Water absorption (gravimetric) test	For XLPE insulation only	**T**	IS 10810 Pt 33	
XI.	Insulation resistance test (Volume resistivity method)	For complete cable	**T**		
4.0	**Improved Fire performance (FR-LSH) Tests**				
I.	Oxygen index test	For PVC outer sheath only	**T, A**	IS 10810 Pt 58 / ASTMD 2863	
II.	Smoke density test	For PVC outer sheath only	**T**	IS 10810 Pt 63 / ASTMD 2843	
III.	Acid gas generation test	For PVC outer sheath only	**T, A**	IS 10810 Pt 59 / IEC-754-1	

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
IV.	Temperature Index Test	For PVC outer sheath only	**T**	IS 10810 Pt 64 / ASTMD 2863	
5.0	**Flammability Tests**				
I.	Flammability test for bunched cables	For complete cable	**T**	IS 10810 Pt 62/ IEC-60332 (Part-3-23-Cat-B/Cat-A,	**Test & Category applicable as indicated in Datasheet-A**
II.	Flammability test for single cable	For complete cable	**T,A**	IS: 10810 Pt 61 / IEC:60332 Part-1	
III.	Swedish chimney test	For complete cable	**A**	SEN SS 424 1475 (Class F3)	
IV.	Flammability test	For complete cable	**A**	IEEE: 60383	
6.0	**Electrical Tests**				
I.	High Voltage Test	For complete cable	**T, A, R**	IS 10810 Pt 45	
II.	Insulation Resistance Test (Volume resistivity method)	For complete cable	**T, A**	IS 10810 Pt 43	

L.T CONTROL CABLES (E-11)
(1.1 KV PVC CABLES)

Attributes / Characteristics / Item / Components / Sub System Assembly	Make, Type, Rating, T.C	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Lay length/Sequence	Armour coverage, cross over, looseness, gap between two armour wire	Sequential marking/surface finish/cable length	Tensile strength, elongation before & after ageing of insulation &outer sheath sheath	Thermal stability of insulation and outer sheath	Anti termite treatment on wooden drums	Constructional feature as per NTPC Spec.	Routine & Acceptance test as per relevant standard & page 2 & 3 of this table	FRLS Test
Copper Conductor (IS-8130)	Y	Y	Y	Y	Y										
PVC Compound (IS-5831)	Y		Y		Y					Y					
FRLS PVC Compound IS-5831 ASTM-D-2843/ IS 10810 (Part-58) IEC-754 Part-1	Y		Y							Y					Y
Armour wire/strip (IS-3975)	Y	Y	Y												
Insulated Core		Y				Y	Y				Y				
Laid up core		Y					Y								
PVC Inner sheath		Y													
Armouring		Y						Y							
Outer sheath		Y							Y	Y	Y				Y
Finish cable (IS-1554- 1) ASTM-D-2843/ IS 10810 (Part-58) IEC-754 Part-1 Swedish Chimney: SEN SS 424-1475(F3 category) Flammability test IEC-332 Part-3 Cat-B	Y	Y						Y	Y	Y	Y		Y	Y	Y
Wooden drum(IS : 10418) / Steel drum		Y										Y			

.Note : 1. This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents.

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CONTROL CABLE

ROUTINE TESTS

Routine tests shall be carried out on each drum of finished cables for all types & sizes.
Following shall constitute routine tests:

1) Conductor Resistance test

2) High voltage test at room temperature

ACCEPTANCE TESTS

Following Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 1554 Part 1

A) For Conductor

1) Annealing test — For copper conductor only

2) Resistance test

B) For Armour Wires / Formed Wires (If applicable)

1) Measurement of Dimensions

2) Tensile Tests

3) Elongation Test

4) Torsion Test — For Round wires only

5) Wrapping Test

6) Resistance Test

7) Mass of Zinc coating test — For G S wires / Formed wires only

8) Uniformity of Zinc coating — For G S wires / Formed wires only

9) Adhesion test — For G S wires / Formed wires only

10) Freedom from defects

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	C)	**For PVC insulation & PVC Sheath**
	1)	Test for thickness
	2)	Tensile strength & Elongation before ageing
	D)	**For completed cables**
	1)	Insulation resistance test (Volume resistivity method)
	2)	High voltage test at room temperature
	E)	Following tests shall be carried out and only one sample shall be taken from each offered lot of all sizes for these tests:-
	1)	Tensile strength & elongation after ageing on PVC insulation and PVC outer sheath
	2)	Thermal stability test on PVC insulation and outer sheath
	3)	Oxygen index test on outer sheath
	4)	Smoke density rating test on outer sheath as per ASTM –D 2843
	5)	Acid gas generation test on outer sheath as per IEC – 754 (Part 1)
	6)	Flammability test as per IEC-332 - Part- 3 (Category- B) on completed cable
	7)	Fire resistance test as per SS 4241475 (F3 Category) on completed cable
	F)	Following tests shall be carried on one length of each size of offered lot:
	1)	Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires

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NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)												
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
Instructions: 1) Cable manufacturer to maintain records to show co- relation of raw materials to finished cables i,e raw material batch/ lot no. should be traceable to the cable drum 2) Cable manufacturer to maintain all quality control records identified as per all QP stages enumerated below whether it is identified for NTPC verification or witness or not.														
A	**Raw material/ Brought out Items**													
1.01	Copper	1.Make	MA	Verify	100%	--	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	QCR		V	--	--	
		2. Resistivity	MA	Elect	As per cable Mnfr Std.	--	IS 613	IS 613	-do--		P	--	--	
1.02	PVC compound for insulation	1. Make	MA	Verify	--do--	100%	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	--do--		V	V	--	
		2. Type/ Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	-do--		V	V	V	
		3. All acceptance test as per manufacturer norms including Thermal Stability test	MA	Verify	As per manufacturer norms	As per manufacturer norms	--do--	--do--	--do--		V	V	V	Refer note 1
1.03	PVC Compound for Inner sheath	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V	
		2. Type/ Grade	MA	Verify	--do--	--do--	NTPC ADS	NTPC ADS	--do--		V	V	V	
1.04	Steel wire / Formed Wire (As applicable)	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V	
		2. Dimension	MA	Meas	1 sample from each size / lot	--	NTPC APPROVED DATA SHEET & IS 3975	NTPC APPROVED DATA SHEET & IS 3975	--do--		P	--	--	
		3. All acceptance tests as per IS 3975	MA	Verify	As per IS 3975	--	IS 3975	IS 3975	Supplier TC		V	V	--	
1.05	PVC compound for Sheath	1. Make	MA	Verify	As per manufacturer norms	100%	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	QCR		V	V	--	
		2. Type / Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	--do--		V	V	V	
		3. All acceptance test as per manufacturer norms	MA	Verify	As per manufacturer norms	As per manufacturer norms	--do--	--do--	--do--		V	V	V	Refer note 1
		4. Thermal Stability	MA	Chem	One sample / Batch	--	NTPC ADS	NTPC ADS	QCR		P	--	--	
		5. Oxygen Index	MA	Chem	--do--	--	NTPC ADS/ IS 10810 Part 58	NTPC ADS	--do--		P	---	--	

ND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERIFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

एनटीपीसी NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9			10		11
		6. Acid Gas Emission	MA	Chem	One sample / Batch	--	NTPC ADS / IEC60754	NTPC ADS	QCR		P	--	--	
1.06	Wooden Drum	1. Dimension	MI	Meas	Manuf. Std.	--	IS 10418	IS10418	-do--		P	--	--	
		2. Anti termite treatment	MI	Chem	Cable manuf. std	--	CABLE MANUF. STD.	CABLE MANUF. STD.	COC		V	V	V	COC from drum manuf.
1.07	Steel Drum	1. Dimension	MI	Meas	--do--	--	--do--	--do--	QCR		P	--	--	
		2. Surface finish	MI	Meas	--do--	--	--do--	--do--	--do-		P	--	--	
B	**Process & Stage Inspection**													
2.01	Wire Drawing	1.Surface finish	MA	Visual	One sample/Setting of each size	--	SHOULD BE SMOOTH & FREE FROM SCRATCHES	SHOULD BE SMOOTH & FREE FROM SCRATCHES	QCR		P	--	--	
		2. Wire Diameter	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		3. Annealing Test	CR	Mech	--do--	Same as 6M	IS8130/NTPC ADS	IS8130/NTPC ADS	---do--		P	V	V	Refer Sl. No. 3.03(iii).
2.02	Bunching / stranding	1. No. of wires	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		2.Dia of wire	MA	Meas	-do--	--	--do--	--do--	--do--		P	--	--	
		3. Dimension of Conductor	MA	Meas	--do--		--do-	--do--	--do--		P	--	--	
		4.Direction of lay	MA	Visual	--do--	---	--do-	--do--	--do--		P	--	--	
		5.Records of strand breakage / welding during conductor stranding	MA	Verify	--do--	--	IS 8130	IS8130	--do--		P	--	--	
		6.Surface finish	MA	Visual	--do--	-	--do--	--do--	--do--		P	--	--	
		7. DC Resistance	CR	Meas	--do--	-	IS8130/NTPC ADS	IS8130/ NTPC ADS	--do---		P	--	--	
2.03	Insulation extrusion	1. Surface finish	MA	Visual	--do--	-	NTPC spec	SHOULD BE SMOOTH. NO POROSITY IS PERMITTED.	--do--		P	--	--	PVC compound shall be preferably loaded in to extruder by suction method.
		2.Colour of cores	MA	Visual	--do--	-	NTPC ADS	NTPC ADS	--do--		P	--	--	

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एनटीपीसी NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)												
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9			10		11
		3.Core identification	MA	Visual	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	QCR		P	--	---	Core printing shall be legible & indelible
		4.Thickness	CR	Meas	--do--	--	--do-	-do-	--do--		P	--	--	
		5.Spark Test	CR	Elect	100%	100%	CABLE MANUF. STD.	No FAILURE	--do--		P	V	V	1.Spark test failure record is to be verified. 2.Core repairing not permitted
2.04	Laying up	1. Core sequence	MA	Visual	One sample/Setting of each size	--	IS 1554 (Part I)	IS 1554 (Part I)	--do--		P	--	--	
		2. Direction of lay	MA	Visual	--do--	--	-do-	--do--	--do--		P	--	--	
		3. Dia over laid up core	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.05	Inner Sheath	1.Colour	MA	Visual	-do--	-	--do--	--do--	--do--		P	--	---	
		2. Surface Finish	MA	Visual	100%	-	NTPC SPECIFICATION	FISH EYE, BLOW HOLE NOT PERMITTED	--do--		P	--	-	
		3.Thickness	MA	Meas	One sample/Setting of each size	-	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Dia over inner sheath	MI	Meas	--do--	-	--do--	---do--	--do--		P	--	--	
2.06	Armouring (As Applicable)	1.Dimension	MA	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		2.No. of wires / strip	MA	Meas.	--do--	-	--do--	--do--	--do--		P	--	--	

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NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)												
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9			10		11
		3. Direction of lay	MA	Visual	One sample/Setting of each size	--	IS 1554 (Part 1)	IS 1554 (Part 1)	QCR		P	--	--	
		4.Coverage & Quality of armouring	MA	Meas.	100%	--	Min. area of coverage of armouring shall be 90%. The gap between amour wires / formed wires shall not exceed one amour wire/ formed wire space & there shall be no cross over/ over riding of amour wire / formed wire. Zn rich paint shall be applied on amour joint surface of G.S. Wire /formed wire. The breaking load of amour wire joint shall not be less than 95% of that amour wire / formed wire. (As per NTPC specification)		--do--		P	--	--	
		5.Dia over armouring	MA	Meas.	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.07	Outer Sheath	1. Surface finish	MA	Visual	100%	--	Pimple, Fish Eye, Burnt particles, Blow Hole not permitted. Repairing on outer sheath not permitted. (As per NTPC specificaton)		--do--		P	--	--	PVC FRLS compound shall be preferably loaded in to extruder by suction method
		2.Colour of sheath	MA	Visual	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		3. Dia over outer sheath	MA	Meas.	--do--	--	--do-	--do--	--do--		P	--	--	
		4.Thickness of outer sheath	CR	Meas.	--do--	-	--do--	--do--	--do--		P	--	--	
		5. Embossing quality	MA	Visual	100%	-	Drum no., IS1554 Part -1 , Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (As per NTPC specification)		--do--		P	--	--	Drum no on cable may be embossed/ printed

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NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)												
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9			10		11
		6. Sequencial marking	MA	Visual	Full length	--	Sequencial marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible. (A s per NTPC specification)		QCR		P	--	--	
C	Finished Cables													
3.01	Type test reports clearance from NTPC Engineering	All type tests as per NTPC specification	CR	Doc	100%	100%	NTPC SPECIFICATION / NTPC ADS / IS 1554 (Part1)	NTPC SPECIFICATION / NTPC ADS / IS 1554 (Part1)	-do--	✓	P	V	V	
3.02	Routine Tests	1.High Voltage test at room temperature	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part 1)	NTPC ADS / IS 1554 (Part 1)	Test certific ate	✓	P	W	W	Refer note 2
		2.Conductor Resistance	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part 1)	NTPC ADS / IS 1554 (Part 1)	--do--	✓	P	W	W	
3.03	Acceptance Tests													
3.03(i)	Construction of finished Cable	1. OD of Cable	MA	Meas	Each type & size of cables as per sampling plan of IS 1554 (Part 1)		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		2. Laying of core	CR	Visual	--do--		IS 1554 (Part 1)	NTPC ADS / IS 1554 (Part 1)	-do--	✓	P	W	W	
		3. Core Identification	CR	Visual	--do--		--do--	--do--	--do--	✓	P	W	W	Core printing shall be legible & indelible
		4. Colour of outer sheath	MA	Visual	--do--		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		5. Inner sheath thickness	CR	Meas	- do -		--do--	--do--	--do--	✓	P	W	W	
		6. Inner sheath colour	MA	Visual	- do -		- do -	- do -	--do--	✓	P	W	W	
3.03 (ii)	Armour wires/ Formed wires (if applicable)	1.Dimensions	CR	Meas	Each type & size of cables as per sampling plan of IS 1554 (Part 1)		NTPC ADS /IS1554(Part1)/IS3975	NTPC ADS /IS1554(Part1)/ IS3975	--do--	✓	P	W	W	
		2. No. of wires/ formed wire	CR	Mech	-- do --		--do--	--do--	--do--	✓	P	W	W	
		3. Tensile test	CR	Mech	--do--		--do-	--do--	--do--	✓	P	W	W	

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Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/N				D*	M	C	N	
1	2	3	4	5	6		7	8	9			10		11
		4. Elongation test	CR	Mech	Each type & size of cables as per sampling plan of IS 1554 (Part 1)		NTPC ADS /IS1554(PartI)/IS3975	NTPC ADS /IS1554(PartI)/ IS3975	Test certific ate	✓	P	W	W	
		5.Torsion test (for round wires only)	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W	
		6. Wrapping test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W	
		7. Resistance test	CR	Mech	--do--		--do--	--do-	--do-	✓	P	W	W	
		8.Mass of Zinc coating	CR	Meas	--do--		--do--	--do--	--do--	✓	P	W	W	
		9. Uniformity of Zinc Coating	CR	Chem	--do--		--do--	--do--	--do--	✓	P	W	W	
		10.Adhesion test	CR	Mech	--do--		--do--	--do-	--do--	✓	P	W	W	
		11.Freedom from defects	CR	Visual	--do--		--do--	--do--	--do--	✓	P	W	W	
3.03 (iii)	Conductor	1. Annealing Test	CR	Mech	-do--		NTPC ADS/ IS 8130	NTPC ADS/ IS 8130	--do--	✓	P	V	V	Refer Sl No. 2.01
		2.Resistance Test	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W	
3.03 (iv)	PVC Insulation & PVC Sheath	1.Thickness of insulation & sheath	CR	Meas	--do-		NTPC ADS/ IS 1554(PartI)	NTPC ADS/ IS 1554(PartI)	--do--	✓	P	W	W	
		2.Tensile strength & elongation at break of insulation & outer sheath (before ageing)	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W	Refer Note 3 also
		3.Tensile strength & elongation at break of insulation & outer sheath (after Ageing)	CR	Mech	Refer Note 3		NTPC ADS/ IS 1554(PartI)	NTPC ADS/ IS 1554(PartI)	--do-	✓	P	W	W	Refer Note 3
		4. Insulation resistance (Volume resistivity method)	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1)		--do--	--do--	--do--	✓	P	W	W	
		5.High voltage test at room temperature	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W	
		6.Thermal stability on PVC Insulation and outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		-do--	--do--	--do--	✓	P	W	W	
		7.Oxygen index Test on outer sheath	CR	Chem	--do--		NTPC ADS / IS\0810 Part 58	NTPC A.D.S	--do-	✓	P	W	W	
		8.Smoke density rating test on outer sheath	CR	Chem	--do--		NTPC ADS & ASTMD2843	NTPC ADS	-do--	✓	P	W	W	

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NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)											
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9			10		11
		9.Acid gas generation test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		NTPC ADS & IEC 60754-1	NTPC ADS	Test certificate	✓	P	W	W	
		10.Flammability test on completed cable	CR	Chem	Refer Note 4	Refer Note 4	NTPC ADS & IEC 60332 Part-3 (Category-B)	NTPC ADS	--do--	✓	P	W	W	
		11.Surface finish & length measurement.	CR	Visual & Meas	One length of each size	One length of each size	(1).Drum no. (2) IS 1554 –Part-I (3) Cable size, Voltage grade & Words " FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (4) Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible		--do--	✓	P	W	W	Pimple, Fish Eye, Burnt particles, Blow Hole etc. not permitted. Repairing on outer sheath not permitted.
		12. Sequence of cores armour coverage, gap between two consecutive armour/ formed wire	CR	Visual & Meas	One length of each size	One length of each size	Min. area of coverage of armouring shall be 90%. The gap between armour wires / formed wires shall not exceed one armour wire/ formed wire space & there shall be no cross over/ over riding of armour wire / formed wire. Zn rich paint shall be applied on armour joint surface of G.S. Wire /formed wire		--do--	✓	P	W	W	
4	Packing	1 Sealing	MA	Visual	100%	100%	(1)IS1554(Part-I) (2) The surface of the drum and the outer most cable layer shall be covered with water proof cover. (3) Both the ends of cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by "U" nails.		QCR	✓	P	--	--	
4.01	Identification	NTPC Sealing	MA	Visual	100%	100%	Sealing shall be visible	Sealing shall be visible	--do--	✓	P	V	V	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART I AND NTPC TECHNICAL SPECIFICATION)								
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Record Format	Agency	Remarks
Notes:										
1)	If the compound manufacturer is carrying out Ageing test , test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer is to carry out ageing test & test report is to be reviewed (quantum of ageing test sample shall be one sample /batch)									
2)	(a) **In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre/ Regional Offices** :- Routine Test of manufacturer internal test report are to be verified by NTPC at the time of final inspection. 2(b) **In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre/ Regional Offices**,:- Routine Test are to be witnessed by Main Contractor & NTPC. This is in addition to manufacturer internal test report to be verified by NTPC at the time of final inspection.									
3)	**Refer table on page 8 of 8 for Sampling & Acceptance criteria.**									
4)	The test shall be carried out on every size & type of control cable offered for inspection as an acceptance test. This test will be carried out using composite sampling i.e. irrespective of sizes of cables of a particular type, may be tested together as per calculations in line with the IEC (all sizes will be covered)									
LEGEND:	**NTPC ADS: NTPC approved data sheet, QCR: quality control records of cable manufacturer, CABLE MANUF STD- cable manufacturer's internal plant standard, MI: minor, MA: major, CR: critical, COC- certificate of conformance**									

NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART I AND NTPC TECHNICAL SPECIFICATION)

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Record Format	Agency	Remarks

SAMPLING & ACCEPTANCE CRITERIA

Criteria	Manufacturer experience prerequisite	Condition	Testing procedure	Remarks
Samples as per relevant IS from every size of cable in the offered lot shall be tested for Tensile Strength & Elongation (before ageing). The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/ - 15% tolerance (final values should be more than the minimum values indicated in relevant standard) of the Type Test report	In case of Manufacturers/ Supplier who have supplied cables in the past through Corporate Centre / Regional offices	In case of sizes which meet the criteria	1 Sample per type out of sizes which have met the criteria, will be put on accelerated ageing test (refer IRS specification no. IRS: S-63/2007 Rev 3.0). The samples shall be aged in air oven at temperature of 130°c+/- 2°c for 5 hours. After wards the samples shall be tested for Tensile Strength & Elongation. Acceptance norms shall be as per relevant IS. **This test shall be witnessed by NTPC.**	In case the samples do not meet the requirement in accelerated ageing test then 1 sample of that size will be put on ageing test as per IS.
		In case of size which do not meet the criteria	Particular size will be put on ageing test as per IS. **This test shall be witnessed by NTPC.**	----
	In case of Manufacturers/ Supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre / Regional offices	In case of size which meet the criteria	1 Sample per type out of all sizes which have met the criteria, will be put on aging test and **witnessed by NTPC as per relevant IS**	----
		In case of size which do not meet the criteria	Particular size will be put on ageing test as per IS. **This test shall be witnessed by NTPC**	----

LEGEND:- "RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

CLAUSE NO.	CABLING, EARTHING & LIGHTNING PROTECTION (E12)	एनटीपीसी NTPC हाइड्रो Hydro

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 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/ codes as applicable.

IS: 513	Cold rolled low carbon steel sheets and strips
IS: 802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers
IS: 1079	Hot Rolled carbon steel sheet & strips
IS: 1239	Mild steel tubes, tubular and other wrought steel fittings
IS: 1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS: 1367 Part-13	Technical supply conditions for threaded Steel fasteners (Hot dip galvanized coatings on threaded fasteners)
IS: 13947	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS: 2309	Code of Practice for the protection of building and allied structures against lightning.
IS: 2629	Recommended practice for hot dip galvanizing of iron & steel
IS: 2633	Method for testing uniformity of coating on zinc coated articles
IS: 3043	Code of practice for Earthing
IS: 3063	Fasteners single coil rectangular section spring washers
IS: 6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles
IS: 8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables
IS: 8309	Compression type tubular terminal ends for aluminium conductors of insulated cables
IS: 9537	Conduits for electrical installation
IS: 9595	Metal - arc welding of carbon and carbon manganese steels - recommendations.

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	IS: 13573	Joints and terminations for polymeric cables for working voltages from 6.6kv upto and including 33kv performance requirements and type tests.
	IS: 2062	Structural Steel (Standard Quality)
	IS : 316	Code of practice for use of metal arc welding for general construction in mild steel.
	IS : 277	Galvanized sheet steel.
	IS : 808	Rolled Steel Beam, Channels and Angle section.
	IS : 800	Specification for use of structural steel in general building construction.
	BS: 476	Fire tests on building materials and structures
	IEEE: 80	IEEE guide for safety in AC substation grounding
	IEEE: 142	Grounding of Industrial & commercial power systems
	DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
	DIN 46329	Cable lugs for compression connections, ring type, for Aluminium conductors
	VDE 0278	Tests on cable terminations and straight through joints
	BS: 6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
		Indian Electricity Act. Indian Electricity Rules.

1.02.00 Equipment complying with other internationally accepted standards such as IEC, BS, DIN, 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 bid and shall clearly bring out the salient features for comparison.

2.00.00 EQUIPMENT DESCRIPTION

2.01.00 Metallic Cable trays, Fittings, Accessories & Support System

2.01.01 Cable trays shall be ladder/perforated type as specified 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. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.

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2.01.02	Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized after fabrication as per relevant IS.
2.01.03	Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. 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. Typical details of cable trays, fittings and accessories are shown in the enclosed drawings
2.01.04	Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of minimum thickness 2 mm and shall be hot dip galvanized after fabrication as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm
2.02.00	**Support System for Cable Trays**
2.02.01	Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".
2.02.02	Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:- having provision of supporting cable trays on both sides. The support system shall be the type described hereunder

a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fitings and accessories shall be prefabricated factory galvanised.

c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied

d. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.

e. The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below:

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The main support channel and cantilever arms shall be fabricated out of minimum 2.5mm thick rolled steel sheet conforming to IS.

f. Cantilever arms as required shall be provided as shown in the enclosed drawings. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.

2.02.03 The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to the Employer. The bidder shall submit the detailed typical drawings of the system offered by him along with the bid.

2.03.00 Pipes, Fittings & Accessories

2.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

2.03.02 GI Pipes shall be of medium duty as per IS: 1239

2.03.03 Duct banks shall be provided with High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

2.04.00 Junction Boxes

2.04.01 Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of 20mm diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports for the following tests shall be furnished:-

(a) Impact resistance for impact energy of 2 Joules (IK07)as per BS EN50102

(b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb.

(c) Class of protection shall be IP 55.

(d) HV test.

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2.04.02	Terminal blocks shall be 1100 volts grade, 10 Amps rated, made up of unbreakable polyamide 6.6 grade, complete with insulating barriers. Clip on type terminals, washers, nuts and identification strips. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be non ferrous. WAGO terminal of cage clamp with lugs shall also be acceptable. All terminal blocks shall be suitable for terminating on each side two (2) nos. stranded copper conductors of size upto 2.5 sq mm each.
2.05.00	**Terminations**
2.05.01	Terminations for 11 kV & 33 KV XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits shall be pre-moulded type, taped type or heat shrinkable type. Terminations shall be type tested as per IS: 13573. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solder-less crimping type cable lugs & ferrule as per DIN standard.
2.05.02	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 system.
2.05.03	Selection of cable drums for each run shall be so planned so as to avoid using straight through joints.
2.06.00	**Cable glands**
2.06.01	Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene and of tested quality.
2.07.00	**Cable lugs/ferrules**
2.07.01	Cable lugs for power cables shall be Tinned Copper solder-less crimping type conforming to IS: 8309 suitable for aluminum compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper conforming to IS: 8309. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments.
2.08.00	**Trefoil clamps**
2.08.01	Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength when installed at 1 mt. intervals, to withstand the forces generated by the system short circuit current of 105 KA peak.

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2.09.00	**Cable Clamps & Straps**
2.09.01	The cable clamps required to clamp multi-core cables on vertical run shall be made up of Aluminium strip of 25x3 mm size. For clamping the multi-core cables, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment
2.10.00	**Galvanising**
2.10.01	Galvanizing of steel components and accessories shall conform to IS: 2633 & IS: 4759. Additionally galvanizing shall be uniform, clean smooth, continuous and free from acid spots
2.10.02	The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified. However nuts and bolts of size lesser than M12 can be electro galvanized / electro plated.
2.11.00	**Welding**
2.11.01	The welding shall be carried out in accordance with IS: 9595. All welding procedures and welders qualification shall also be followed strictly in line with IS: 9595
3.00.00	**INSTALLATION**
3.01.00	**Cable tray and Support System Installation**
3.01.01	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.
3.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms at an interval of 2000 mm. Vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the enclosed drawings.
3.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated in the relevant tray layout drawings.
3.01.04	The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners shall be subjected to QA approval.

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3.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted / stenciled with identification numbers at every floor.
3.01.06	In certain cases it may be necessary to site fabricate some of the portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. In such cases the Contractor shall fabricate at site, suitable sections of trays, supports and accessories to make the installation complete for the specific purpose after obtaining employer's prior approval, which shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.
3.02.00	**Conduits/Pipes/Ducts Installation**
3.02.01	The Contractor shall be fully responsible for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.
3.02.02	GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.
3.02.03	Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of coundits/pipes shall be sealed with Glasswool/Cement Mortar/Putty to prevent entrance of moisture and foreign material
3.02.04	Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit/pipe size (dia)	**Spacing**
Up to 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm	3.0 M

3.02.05	For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.

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3.03.00	**Junction Boxes Installation**
3.03.01	Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings or as decided by the employer and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations as indicated in drawings/as directed by Project Manager.
3.04.00	**Cable Installation (for cables upto & including 33 KV grade)**
3.04.01	Cable installation shall be carried out as per IS: 1255 and other applicable standards. Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case, the drum shall be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.
3.04.02	While laying cable, ground rollers shall be used at every 2 metre interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager without any extra cost.
3.04.03	Cables shall be laid on cable trays strictly in line with approved cable schedule. Where specific cable layouts are not shown on drawings, Contractor shall route these as directed by the Project Manager
3.04.04	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 two metre. All multi-core 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, multi-core power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multi-core 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 bound to trays/supports by aluminium strips at every five meter interval and at every bend.

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3.04.05	Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255.
3.04.06	Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ Heavy duty PVC pipes.
3.04.07	Cable drum lengths shall be selected in such a way so that cable joints are avoided.
3.04.08	In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to be made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing
3.04.09	Wherever few cables are branching out from main trunk route troughs shall be used.
3.04.10	The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.
3.04.11	Contractor shall furnish three copies of the report on work carried out in a particular week, such as cable numbers and date on which laid, actual length and route, testing carried out, termination done alongwith the marked up copy of the cable schedule and interconnecting drawing where any modifications are made
3.04.12	Separation At least 300mm clearance shall be provided between: - HT power & LT power cables, - LT power & LT control/instrumentation cables,
3.04.13	**Segregation** 1) Segregation means physical isolation to prevent fire jumping. 2) All cables associated with the unit shall be segregated from cables of other units. 3) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set. 4) In switchyard, control cables of each bay shall be laid on separate racks/trays.

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3.04.14 Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

No. of cores in cable	No. of spare cores
2C, 3C	NIL
5C	1
7C-10C	2

3.04.15 **Directly Buried Cables**

a) Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS: 1255 and the enclosed drawings showing cabling details.

b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

3.04.16 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties of 'TY-CAB' or equivalent type with cable number heat stamped on the cable tags

3.04.17 While crossing the floors, un-armoured cables shall be protected in conduits up to a height of 500 mm from floor level if not laid in tray.

3.04.18 11 KV Aerial bunched cables shall be installed on 9Mtr. Long poles (Type 540SP-32 or equiv) and 11Mtrs. long poles at road crossings (Type 540SP-55 or equiv) and made of ERW tubes, stepped tubular or swaged tubular type, as required, as per relevant IS & REC standards.

The poles shall be painted with two coats of red Oxide and Zinc chromate in Synthetic compound primer on the exposed outside surface and with Bituminous paint all along the inside of the pole and outside portion which shall be embedded in foundation, at manufacturing stage.

The spacing between poles shall not be more than 30 Mtrs. and sag of cable shall not be more than one metre. The poles shall be designed and erected to withstand the following forces:

a) Self weight of cables

b) Forces and moments resulting due to action of wind, snow and eccentric placing of transformer

c) Forces during stringing operations

d) Forces/moments due to different spans and sags of cables
Short circuit forces including snapping of cables.

3.05.00 Cable Terminations & Connections

3.05.01 The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/ termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.

3.05.02 Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.

3.05.03 The equipment will be generally provided with undrilled gland plates for cables/ conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.

3.05.04 Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.

3.05.05 The panels where a larger number of cables are to be terminated and cable identification may be difficult, each core ferrule shall include the complete cable number as per the drawings. The ferrules shall be indelible interlocking type and shall fit tightly on cores. Spare cores shall have similar ferrules with a suffix letter 'S' alongwith cable numbers and coiled up after end sealing.

3.05.06 All cable terminations shall be appropriately tightened to ensure secure and reliable connections.

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3.05.07 It is the responsibility of the Contractor to terminate the cables at motor terminals in correct phase sequence to ensure the proper direction of rotation.

3.05.08 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires modifications, the same shall be carried out by the Contractor as directed by the Project Manager at no extra cost.

4.00.00 EARTHING SYSTEM

4.01.00 Earthing system shall be in strict accordance with IS: 3043 and Indian Electricity Rules/Acts.

4.02.00 The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects

4.03.00 The material of the earthing conductors shall be as follows:

1) Conductors above ground level and in built up trenches. - Galvanized steel

2) Conductors buried in earth - Mild steel

3) Earth electrodes - Mild steel rod

4.04.00 The sizes of earthing conductors for various electrical equipments shall be as below:

Equipment		Earth conductor buried in earth	Earth conductor above ground level & in built-up trenches
a)	Main earth grid	40 mm dia. MS rod	65x8mm GS flat
b)	33KV/11KV switchgear/ 415V equipment	---	65x8mm GS flat
c)	415V MCC/Distri-bution boards/ Transformers		50x6mm GS flat
d)	LT Motors above 125 KW	---	50 x 6mm GS flat
	25 KW to 125 KW	---	25 x 6mm GS flat
	1KW to 25 KW	---	25 x 3mm GS flat
	Fractional Horse power motor	---	8 SWG GS wire (To be terminated with suitable lugs)

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	e) Control panel & control desk	---	25 x 3 mm GS flat
	f) Push button station/ Junction Box	---	8 SWG GI wire (To be terminated with suitable lugs)
	g) Columns, structures, cable trays and bus ducts enclosures	---	50x6mm GS flat
	h) Crane, rails, rail tracks & other non-current carrying metal parts	---	25x6mm GS flat

4.05.00 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 instructed by the Employer. 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 to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable.

4.06.00 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 metre. Wherever earth mat is not available Contractor shall do the necessary connections by driving an earth electrode in the ground. Where the trays are laid on the cable trestle, the same shall be earthed through strip along trestle leg at 30 mt (max) interval & structural footing of the trestle shall be earthed at an interval of 30 mt. (max.) with 3 mt. long 40 mm dia MS electrode.

4.07.00 Neutral points of HT transformer shall be earthed through NG resistors if required. The Contractor shall connect the NGR earthing point/neutral point of LT transformer by two separate GI strips to two seperate earth electrodes.

4.08.00 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.

4.09.00 Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.

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4.10.00	Suitable earth risers as approved by employer shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.
4.11.00	Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding.
4.12.00	Earthing conductors buried in ground shall be laid minimum 600 mm below ground 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.
4.13.00	Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.
4.14.00	A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductor's crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.
4.15.00	Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.
4.16.00	Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.
4.17.00	Earth pit shall be constructed as per IS: 3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with treated with Bentonite as per IS 3043.
4.18.00	On completion of installation continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured in presence of Employer's representatives. All equipment required for testing shall be furnished by contractor.
4.19.00	Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and gates shall be connected to earthing grid by one lead.
5.00.00	**LIGHTNING PROTECTION SYSTEM**
5.01.01	Lightning protection system shall be in strict accordance with IS: 2309
5.01.02	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

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5.01.03 Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings

5.02.00 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 inaccessible 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.
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.

6.00.00 QUALITY ASSURANCE PROGRAMME

Bidder shall furnish detailed Quality Assurance Program and Quality Plans for all materials and accessories to be supplied and installed under the scope of the specification as per General Technical Conditions of technical specification. The Quality Plans shall include all tests/ checks as per relevant National/International Standards and the requirements of this specification including tests listed in this section.

7.00.00 TESTS

7.01.00 Type tests on Cable Trays support system:

Test 1: On main support channel type-C2 for cantilever arms fixed on one side only.

a) Test 1A: A 3.5 metre length of main support channel shall be fixed vertically at each end to a rigid structure as per the fixing arrangement as shown in the enclosed drawing. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the

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outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the points shown in the enclosed drawings and at the following load intervals:

i) Working load
ii) Working load + point load
iii) Off load
iv) Proof load + point load
v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.

b) Test 1B: Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2.

Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides

a)Test 2A: A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per the fixing arrangement as shown in the enclosed drawing. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.

i) Working load
ii) Working load + Point load
iii) Off load
iv) Proof load + Point load
v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.

b) Test 2 B: The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side.

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Test 3: Tests on Channel Fixed on Beam/Floor

A length of main support channel section shall be fixed to steel structure/floor and have loads applied as shown in the drawing enclosed and as detailed below

a) Test 3A : A length of steel structure shall be rigidly supported. It should be fitted on a metre length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place.

b) Test 3B : With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place.

c) Test 3C : With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line.
The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded.

Test 4 : Channel Insert Test

A 2.5 m length of C1 channel fixed to the concrete wall/ steel structure as per actual site installation conditions. 6 nos. of 750 mm cantilever arms shall be attached to C1 channel as shown in enclosed drawing. Each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.

i) Working load

ii) Working load + Point load

iii) Off load

iv) Proof load + Point load

v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.

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Test 5: Channel nut slip characteristics (what ever applicable)

Tests 5A1,5A2, 5A3 : A length of channel C1 section 200mm long shall have fitted bracket with the two bolts fixing as shown in drawing enclosed.

With loads applied at the position shown in drawing enclosed nut slip shall be determined with bolt torque of 30NM, 50 NM and 65 NM No fewer than three measurements shall be made for each torque setting.

A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM.

Tests 5B1,5B2, 5B3: The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting.

A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM.

Test 6 **Weld Integrity Test**

After deflection test as per test 1A, 1B, 2, 3, 4 & 5, weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any.

7.02.00 Type Test on Cable termination kit as per IS:13573 for above 3.3 kV .

7.03.00 **Routine/ Acceptance Tests**

7.03.01 Routine Tests

a) Routine tests as per specification and applicable standards shall be carried out on all equipments/items covered in the specification.

b) Physical & dimensional check on all equipments as per approved drawings/standards.

c) HV/IR as applicable.

d) Check/measurement of thickness of paint/zinc coating/nickel-chrome plating as per specification & applicable standard.

7.03.02 **Acceptance Test**

a) Galvanising Tests as per applicable standards

b) Welding checks

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c) Deflection tests on cable trays:

One piece each of 2.5m length of cable tray of 300mm & above shall be taken as sample from each offered lot. It shall be supported at both end & loaded with uniform load of 76 kg/meter along the length of cable tray. The maximum deflection at the mid-span of each size shall not exceed 7mm.

d) Proof load tests on cable tray support system

i) Tests on Main Support Channel shall be done if only C1 Channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test.

ii) Test on Main Support Channel shall be done with C2 channel and cantilever arms fitted on both sides, if C2 channels are in scope of supply. This test shall be same as test 2A of type test. Then test (i) above shall not be done.

iii) Nut slip characteristic test (it shall support minimum load of 350kg before nut slips with a bolt torque of 65 NM). This test shall be same as test 5B3 of type test.

The procedure for carrying out tests at "d" above shall be as per details given in Type Tests in specification thereafter Die-Penetration test shall be carried out to check weld integrity.

e) The above acceptance tests shall be done only on one sample from each offered lot.

8.00.00 COMMISSIONING

8.01.00 The Contractor shall carry out the following commissioning tests and checks after installation at site. In addition the Contractor shall carry out all other checks and tests as recommended by the Manufacturers.

8.02.00 Cables

a) Check for physical damage

b) Check for insulation resistance before and after termination/jointing.

c) HT cables shall be pressure tested (test voltage as per IS:7098) before commissioning.

d) Check of continuity of all cores of the cables.

e) Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections etc., shall be carried out by the Contractor at no extra cost.

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f) Check for correct polarity and phasing of cable connections.

g) Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc.

h) Check for provision of correct cable tags, core ferrules, and tightness of connections.

8.03.00 Cable trays / supports and accessories

1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories.
2) Check for continuity of cable trays over the entire route.
3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.
4) Check for earth continuity and earth connection of cable trays.

8.04.00 **Earthing and Lightning protection system**

1) Earth continuity checks.

2) Earth resistance of the complete system as well as sub-system.

8.05.00 **GENERAL COMMISSIONING CHECKS (Application to all electrical equipments)**

(a.) Check for name plate details according to specification.

(b.) Check for physical damage, if an

(c.) Check for tightness of all bolts, clamps & connecting terminals.

(d.) Check for earth connection.

(e.) Check for cleanliness of insulators & bushings.

(f.) Check for lubrication of all moving parts.

(g.) Check for provision of heater

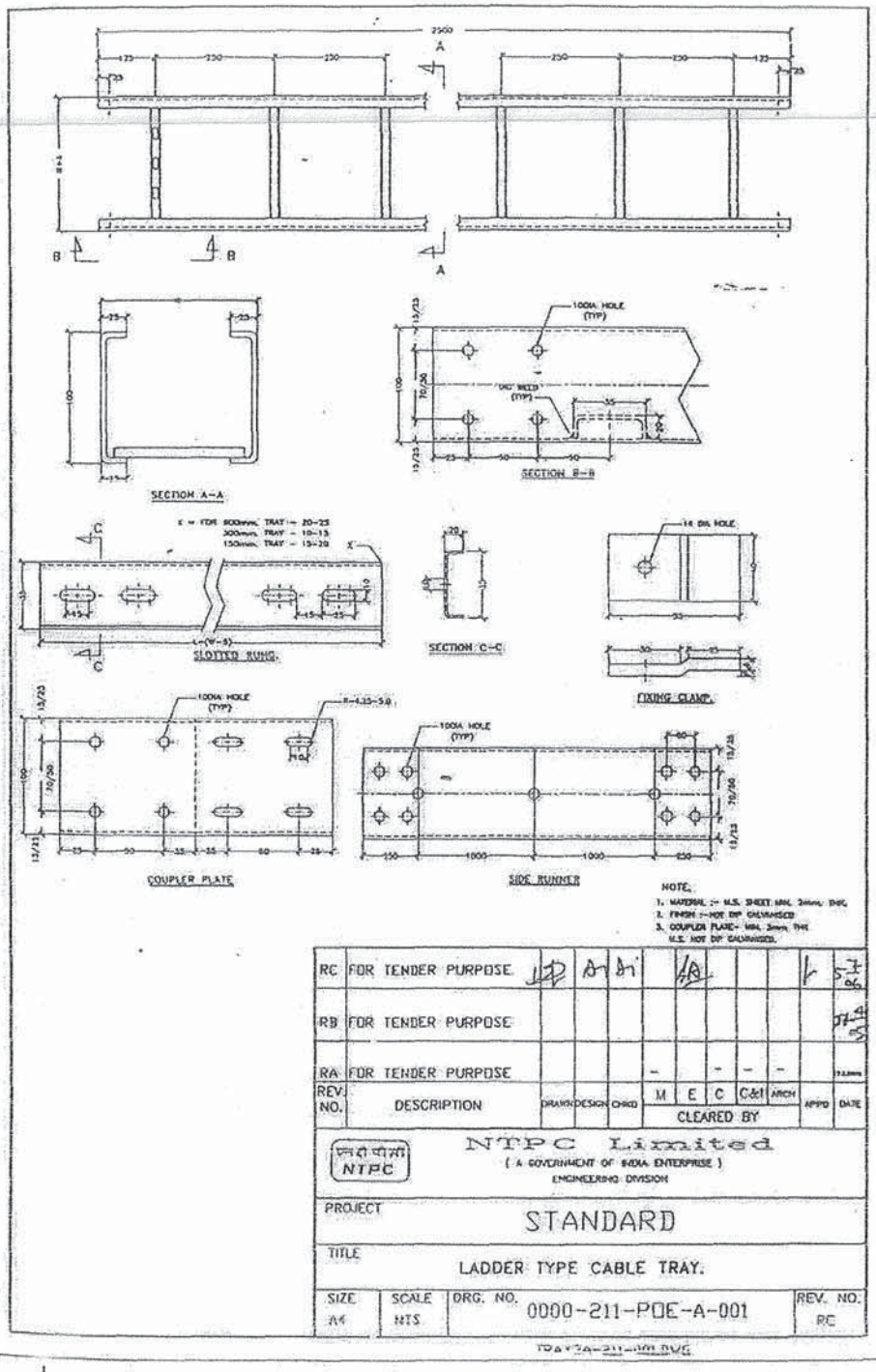
Note: For Cabling, Earthing & Lightning Protection of Surface Pothead yard, please refer Sub Section E17 of the Technical Specification, Section-VI, Part-B.

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Sl. No.	Drawing Name	Drawing No.
1	Ladder type Cable Tray	0000-211-POE-A-001
2	Perforated Type Cable Tray	0000-211-POE-A-002
3	C1 & C2 Channel, Cable Tray Support System	0000-211-POE-A-013
4	Typical Details of Cable Tray Support System	0000-211-POE-A-014
5	Typical Details of Cable Tray Support System	0000-211-POE-A-015
6	Cantilever Arms	0000-211-POE-A-016
7	Typical Details of Cable Tray Support System	0000-211-POE-A-017
8	Typical Details of Cable Tray Support System	0000-211-POE-A-018
9	Fixing of Channel in Trench Wall	0000-211-POE-A-019
10	Bracket Floor Plate Light Duty	0000-211-POE-A-020
11	Bracket Floor Plate Heavy Duty	0000-211-POE-A-021
12	Bracket C1 Channel Clamp Heavy Duty And Bracket C2 Channel	0000-211-POE-A-022
13	Bracket Right Angle & Bracket Right Angle Heavy Duty	0000-211-POE-A-023
14	Beam Clamp	0000-211-POE-A-024
15	Bracket C1 Channel Clamp	0000-211-POE-A-025
16	Bracket Beam Clamp	0000-211-POE-A-026
17	Typical Details of Structure for Testing	0000-211-POE-A-036
18	Typical Details of Structure for Testing	0000-211-POE-A-037
19	Typical Details of Structure for Testing	0000-211-POE-A-038
20	Typical Details of Structure for Testing	0000-211-POE-A-039

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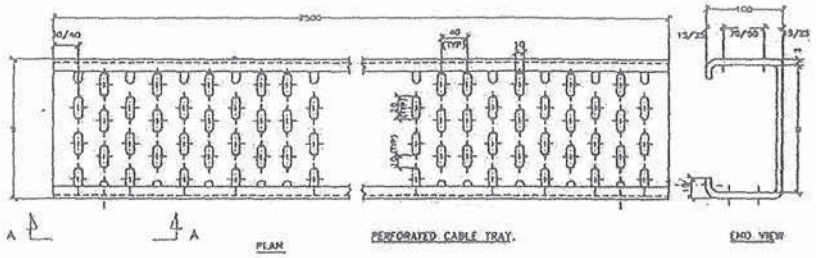
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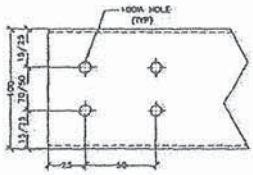
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TITLE: LADDER TYPE CABLE TRAY.

SIZE	SCALE	DRG. NO.	REV. NO.
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NOTE.
1. ALL DIMENSIONS ARE IN mm.
2. W-SIDE W (WIDTH) :- 150, 300 & 600mm
3. MATERIAL :- 2mm M.S. SHEET MIN.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
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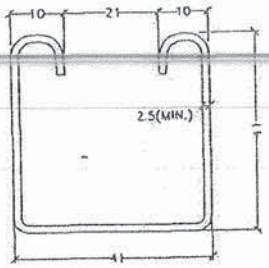
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TITLE	PERFORATED TYPE CABLE TRAY.

SIZE	SCALE	DRG. NO.	REV. NO.
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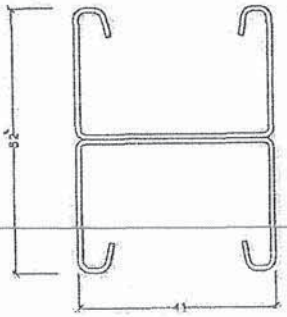
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Sector-142, Noida U.P.

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SINGLE CHANNEL-TYPE C1



TWO LENGTHS OF C1 WELDED BACK TO BACK

DOUBLE CHANNEL-TYPE C2

NOTES

1) ALL DIMENSIONS ARE IN mm.

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PROJECT	STANDARD
TITLE	C1 & C2 CHANNEL CABLE TRAY SUPPORT SYSTEM

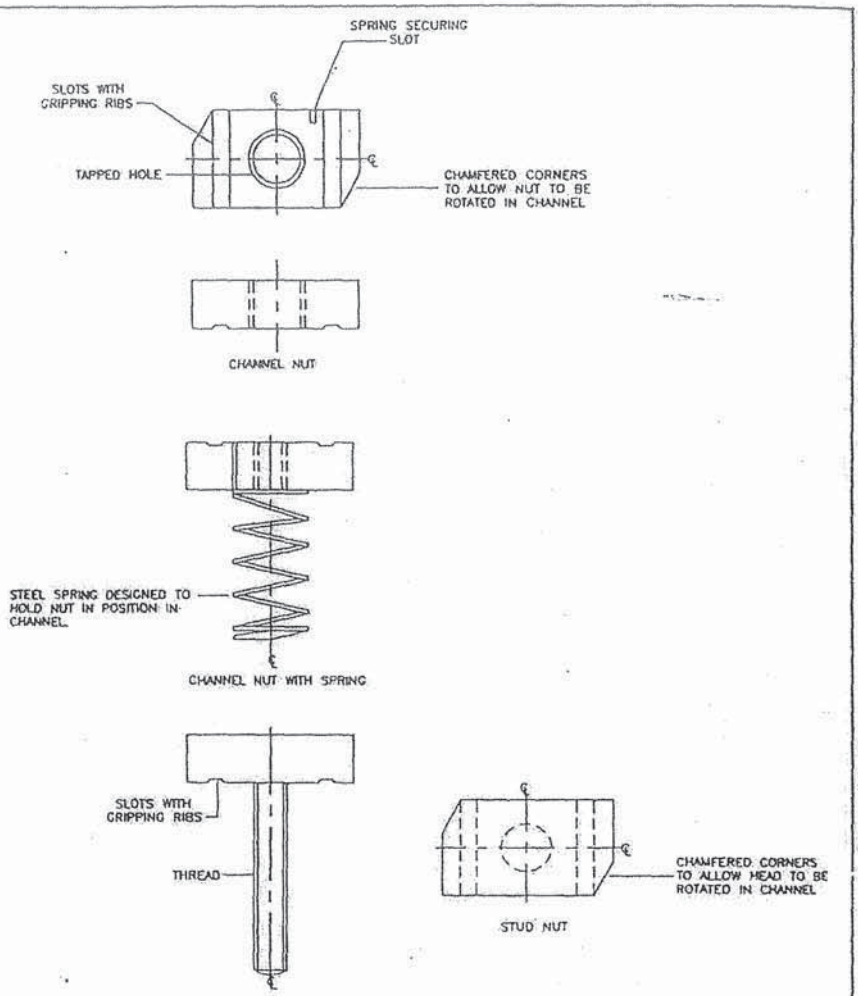
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A4	NTS	0000-211-POE-A-013	RB

TRAY1A-211-013

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TYPICAL DETAILS OF FIXING ACCESSORIES

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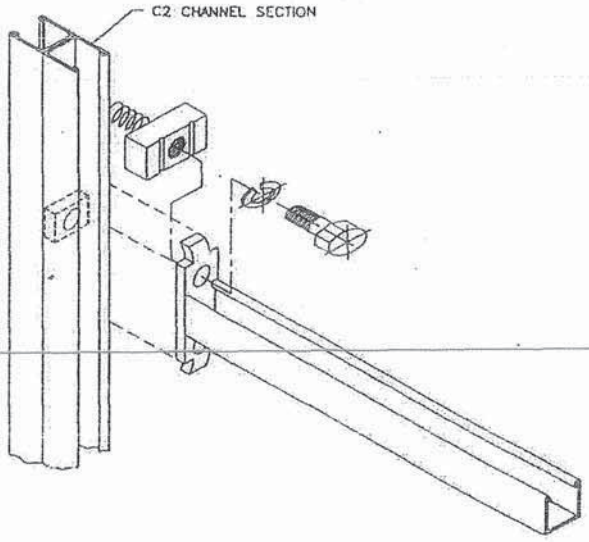
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PROJECT	STANDARD
TITLE	TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PGE-A-014	RB

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Sector, Hydro Marketing



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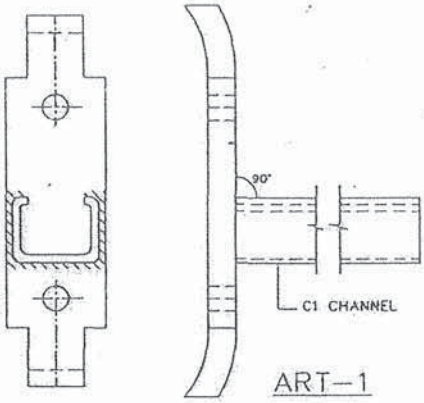
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TITLE: TYPICAL DETAIL OF CABLE TRAY SUPPORT SYSTEM

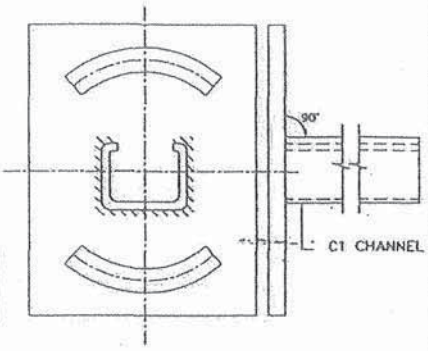
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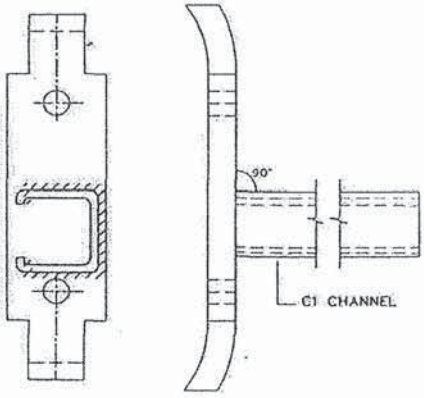
ART–1



ART–3

NOTES

1. MATERIAL MILD STEEL
2. MATERIAL HOT DIPGALVANISED



ART–2

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RB	FOR TENDER PURPOSE ONLY										
RA	FOR TENDER PURPOSE ONLY				–		–	–	–		
		CLEARED BY									

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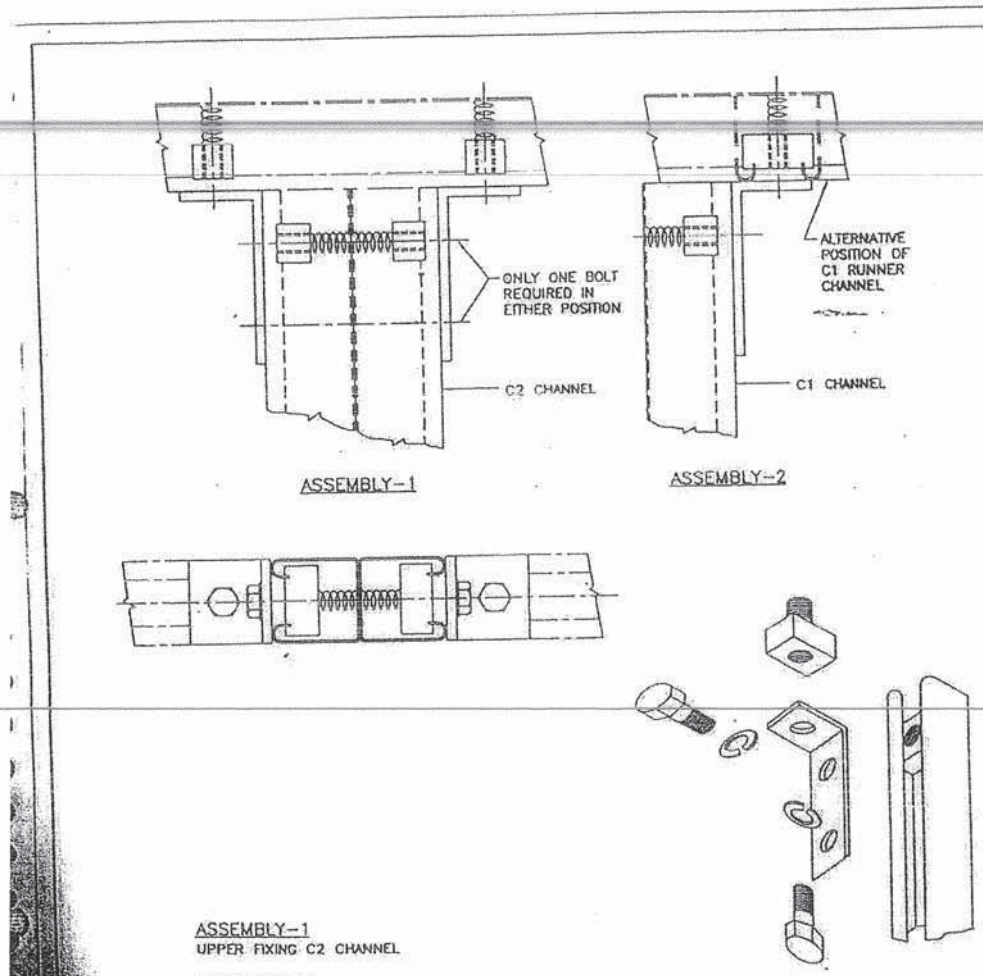
PROJECT	STANDARD
TITLE	CANTILEVER ARMS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-016	RB

CAD FILE NAME : STAND-211-016.DWG

1478

Public Sector, Hydro Marketing * Sector 1/2, Noida U.P. *



ASSEMBLY–1
UPPER FIXING C2 CHANNEL

ASSEMBLY–2
UPPER FIXING C1 CHANNEL

UPPER FIXING FOR CHANNEL VERTICAL SUPPORTS

REV NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RB	FOR TENDER PURPOSE ONLY										
RA	FOR TENDER PURPOSE ONLY				–		–	–	–		

CLEARED BY

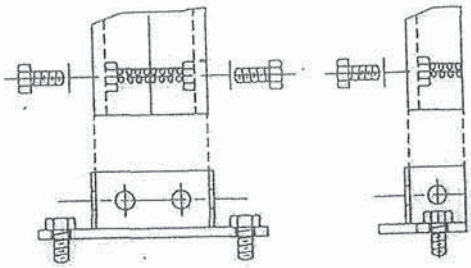
NTPC Limited
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ENGINEERING DIVISION

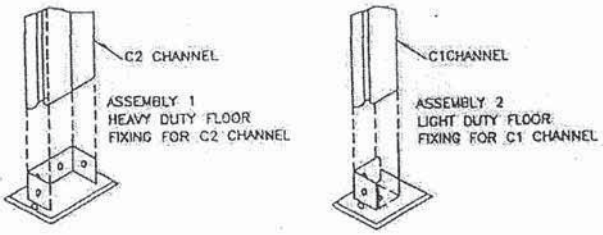
PROJECT	STANDARD
TITLE	TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-017	RB

CAD FILE NAME : STAND-211-017.DWG

1479





FLOOR FIXING FOR CHANNEL VERTICAL SUPPORTS

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RB	FOR TENDER PURPOSE ONLY				-		-	-	-		
RA	FOR TENDER PURPOSE ONLY										

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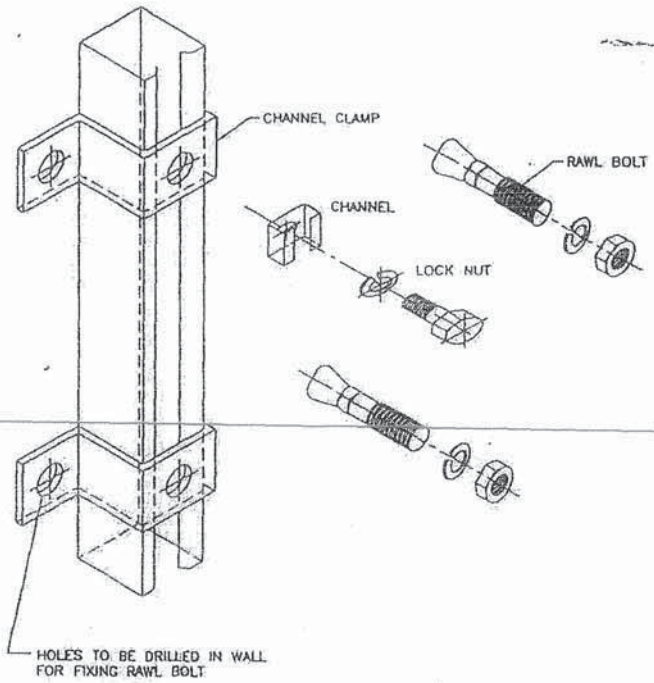
एनटीपीसी NTPC

NTPC Limited
(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-POE-A-016
REV. NO	RB

1480

Power Sector, Hydro Marketing
Sector-142, Noida U.P.



REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RB	FOR TENDER PURPOSE ONLY									A	
RA	FOR TENDER PURPOSE ONLY				–		–	–	–		

CLEARED BY

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ENGINEERING DIVISION

PROJECT: STANDARD

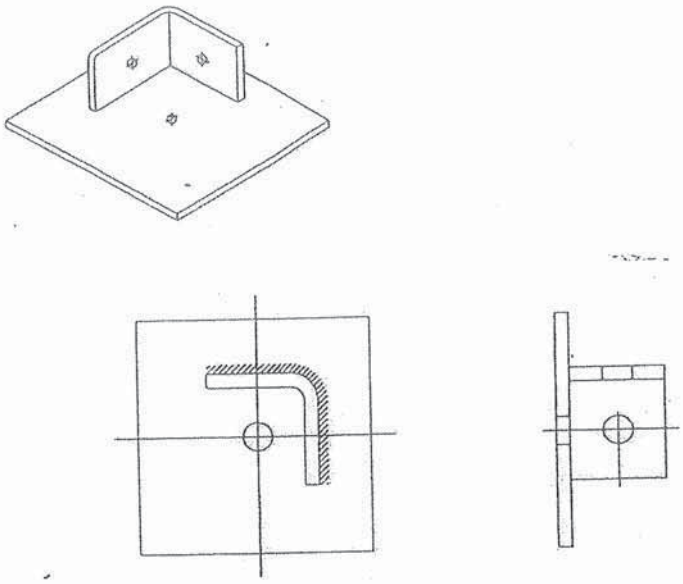
TITLE: FIXING OF CHANNEL IN TRENCH WALL

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-019	RB

CAD FILE NAME : STAND-211-019.DWG

1481

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NOTES

1) MATERIAL : MILD STEEL.

2) FINISH : HOT DIP GALVANISED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RB	FOR TENDER PURPOSE										
RA	FOR TENDER PURPOSE				-		-	-	-		

CLEARED BY

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PROJECT	STANDARD
TITLE	BRACKET FLOOR PLATE LIGHT DUTY.

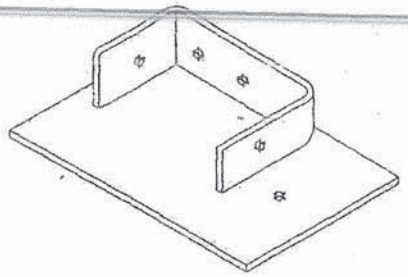
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PQE-A-020	RB

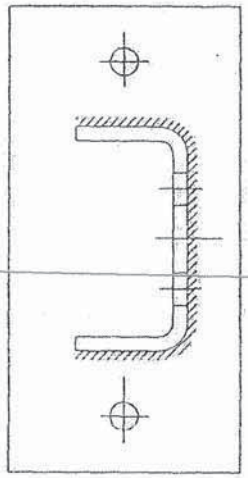
TRAY1A-211-020

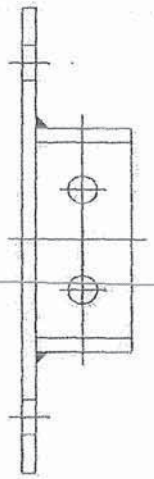
1482

Power Sector, Hydro Marketing, Sector-142, Noida U.P.

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NOTES

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

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RB	FOR TENDER PURPOSE										1-5-01
RA	FOR TENDER PURPOSE				-		-	-	-		

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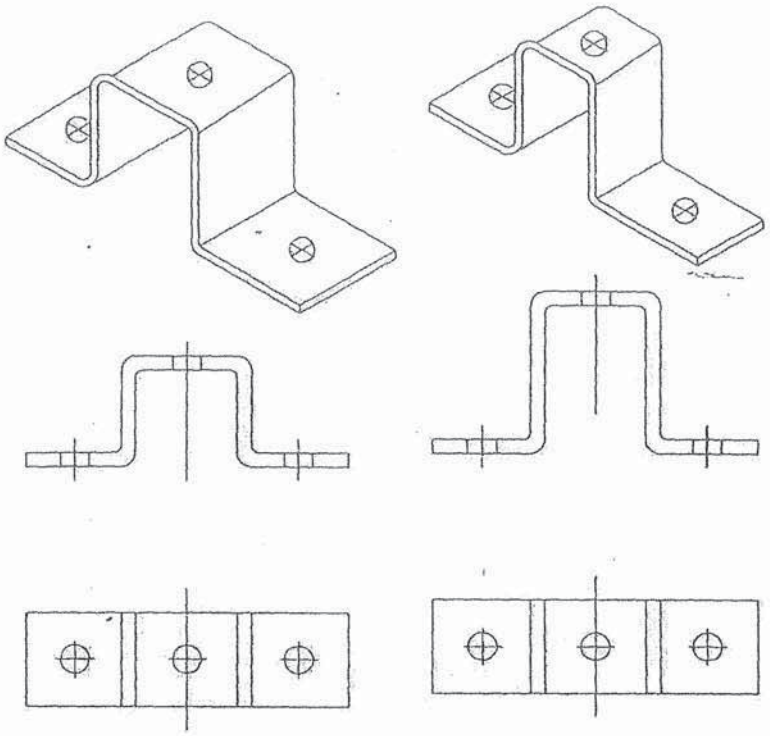
PROJECT: STANDARD

TITLE: BRACKET FLOOR PLATE HEAVY DUTY.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-021	RB

TRAY1A-211-021

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BRACKET-C1 CHANNEL CLAMP HEAVY DUTY.

BRACKET-C2 CHANNEL CLAMP.

NOTES

1) MATERIAL : MILD STEEL.

2) FINISH : HOT DIP GALVANISED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RB	FOR TENDER PURPOSE										
RA	FOR TENDER PURPOSE				-		-	-	-		

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ENGINEERING DIVISION

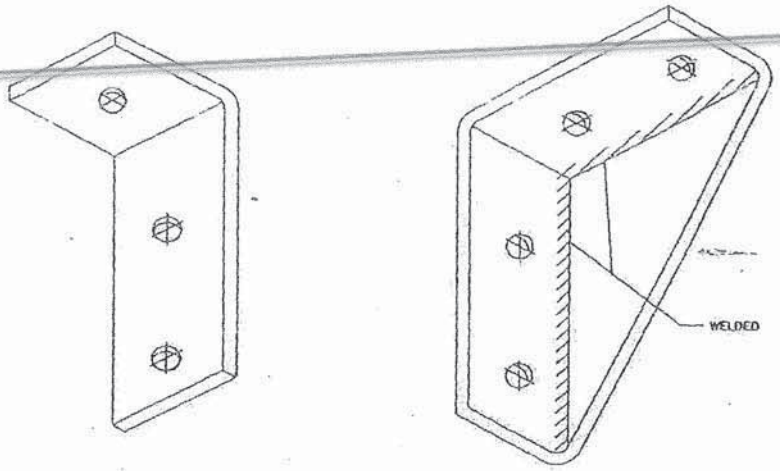
PROJECT	STANDARD
TITLE	BRACKET C1 CHANNEL CLAMP HEAVY DUTY. AND BRACKET C2 CHANNEL.
SIZE	A4
SCALE	NTS
ORG. NO.	0000-211-POE-A-022
REV. NO.	RB

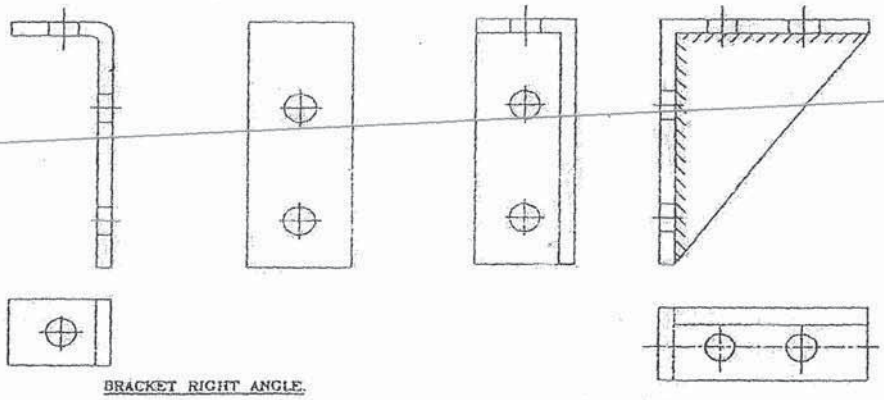
TRAY1A-211-022

1484

Hydro Marketing Sector, Noida (U.P.)

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BRACKET RIGHT ANGLE.

BRACKET RIGHT ANGLE HEAVY DUTY.

NOTES
1) MATERIAL : MILD STEEL.
2) FINISH : HOT DIP GALVANISED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RB	FOR TENDER PURPOSE										
RA	FOR TENDER PURPOSE										

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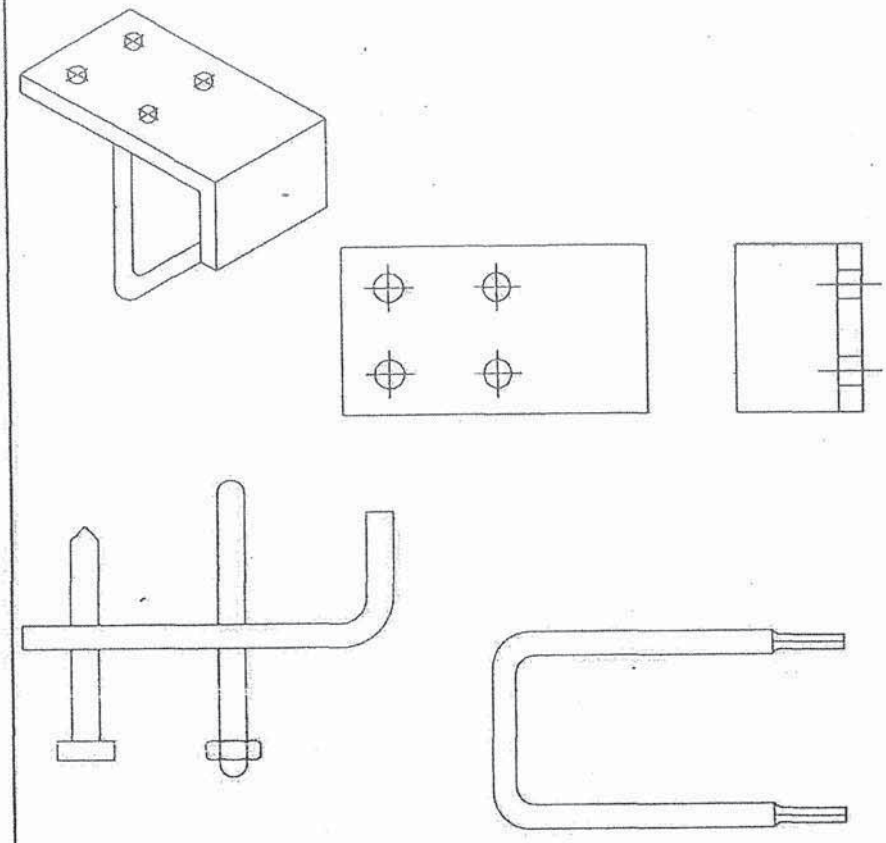
PROJECT	STANDARD
TITLE	BRACKET RIGHT ANGLE & BRACKET RIGHT ANGLE HEAVY DUTY.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-023	RB

TRAYIA-211-023

1485

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NOTES

1) MATERIAL : MILD STEEL.

2) FINISH : HOT DIP GALVANISED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RB	FOR TENDER PURPOSE										15.5.06
RA	FOR TENDER PURPOSE				-		-	-	-		

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ENGINEERING DIVISION

PROJECT	STANDARD
TITLE	BEAM CLAMP.

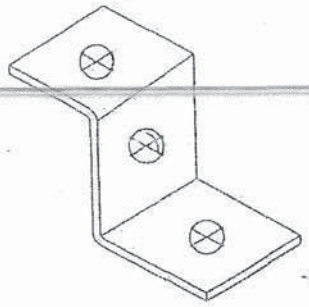
SIZE	SCALE	ORG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-024	RB

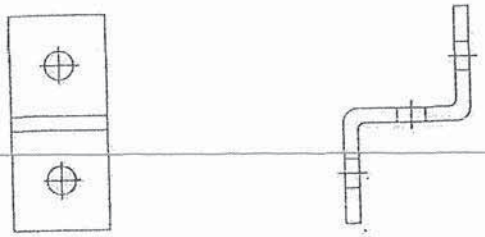
TRAY1A-211-024

1486

Power Sector, Hydro Mailing, Sector-142, Noida U.P.

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BRACKET-C1 CHANNEL CLAMP

NOTES

1) MATERIAL : MILD STEEL

2) FINISH : HOT DIP GALVANISED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RB	FOR TENDER PURPOSE										
RA	FOR TENDER PURPOSE				-		-	-	-		

CLEARED BY

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ENGINEERING DIVISION

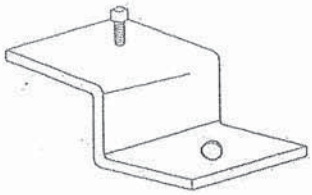
PROJECT	STANDARD		
TITLE	BRACKET C1 CHANNEL CLAMP.		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-025	REV. NO. RB

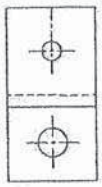
TRAY1A-211-025

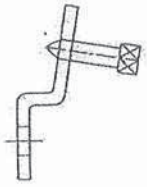
Jaypee Sector-Hydro Mall Seating Section-132, Noida

1487

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NOTES:
1) MATERIALS -MILD STEEL
2) FINISH-HOT DIP GALV.

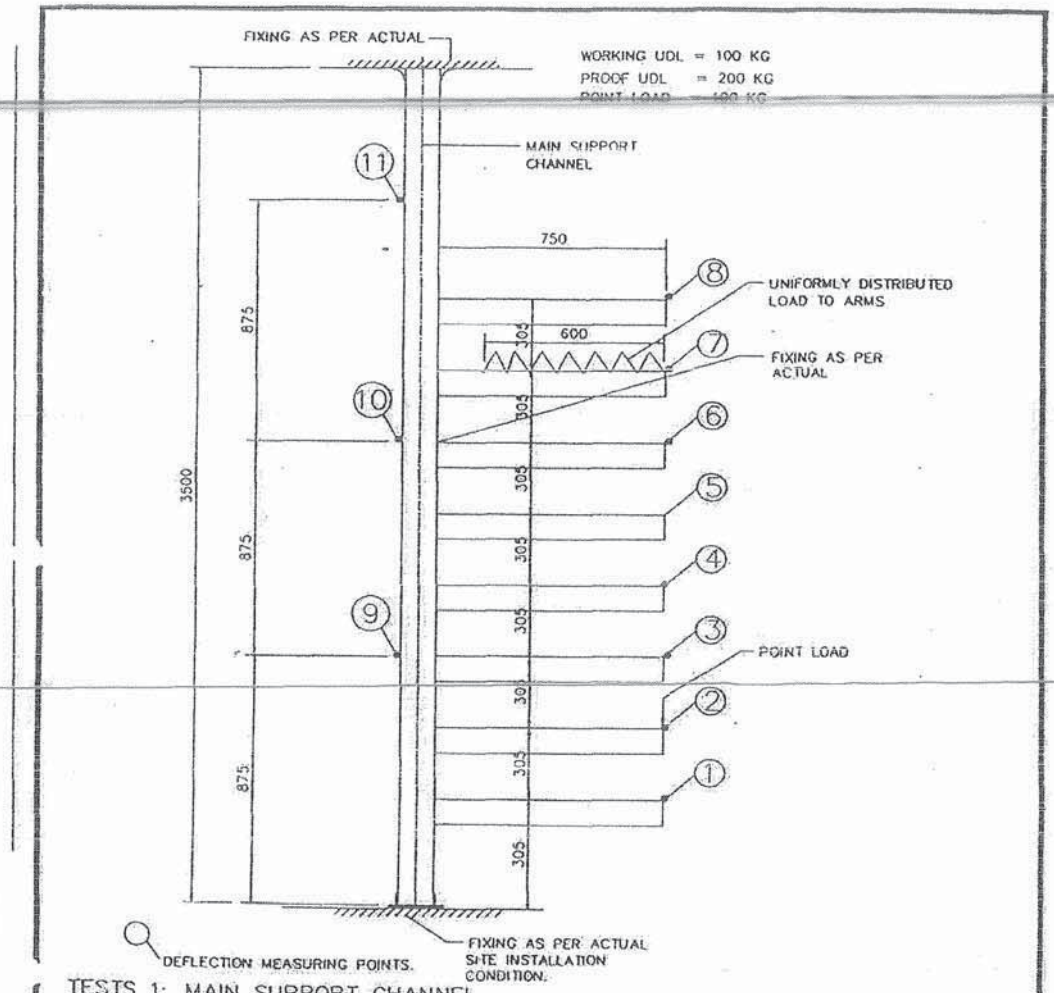
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RB	FOR TENDER PURPOSE										
RA	FOR TENDER PURPOSE				-		-	-	-		

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PROJECT	STANDARD		
TITLE	BRACKET BEAM CLAMP		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-026	REV. NO RB

TRAYSUP2-211-026

1488



TESTS 1: MAIN SUPPORT CHANNEL
(CANTILEVER ARMS ON ONE SIDE)

NOTES
ALL DIMENSIONS ARE IN MM
(SCALE–NTS)

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RA	FOR TENDER PURPOSE ONLY										

CLEARED BY

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ENGINEERING DIVISION

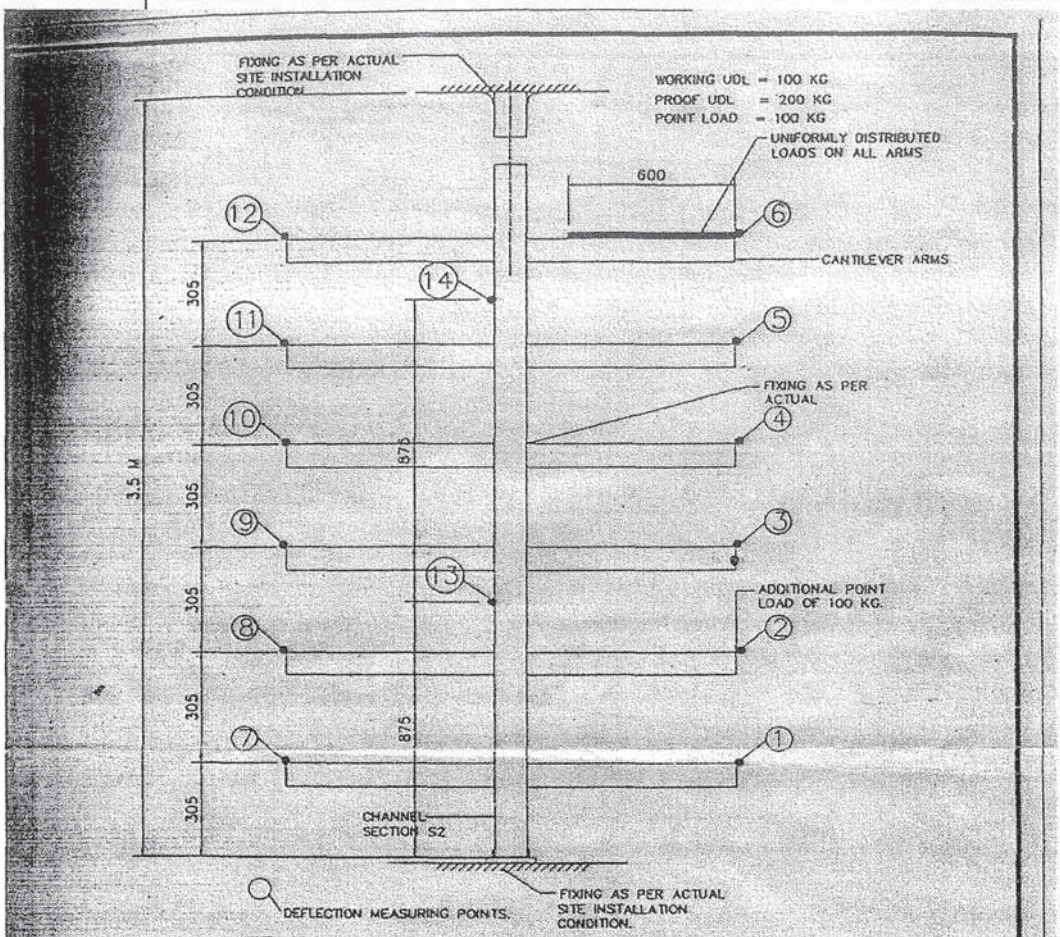
PROJECT: STANDARD

TITLE: TYPICAL DETAILS OF STRUCTURE FOR TESTING

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-036	RA

CAD FILE NAME : STAND-211-036.DWG

1489



TEST 2A : MAIN SUPPORT CHANNEL
(CANTILEVER ARMS ON BOTH SIDES)

NOTES
ALL DIMENSIONS ARE IN MM
(SCALE–NTS)

REV. NO.	DESCRIPTION	DRAWN/DESIGN	CHKD	CLEARED BY M	E	C	C&I	ARCH	APPD	DATE
RA	FOR TENDER PURPOSE ONLY			-	-	-	-	-		

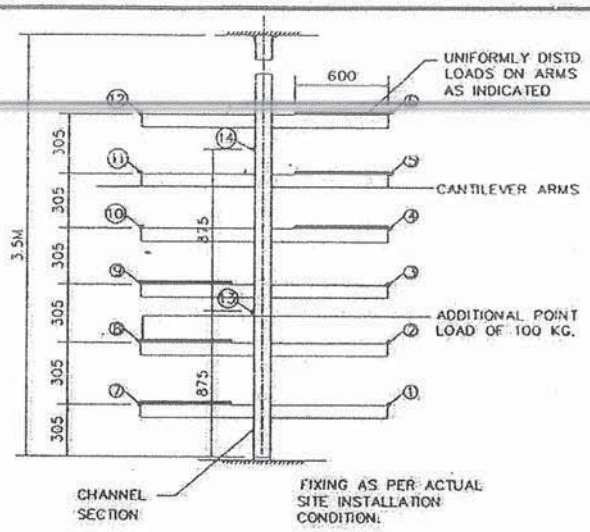
नेशनल थरमल पावर कार्पोरेशन लिमिटेड
National Thermal Power Corporation Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD
TITLE	TYPICAL DETAILS OF STRUCTURE FOR TESTING

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-037	RA

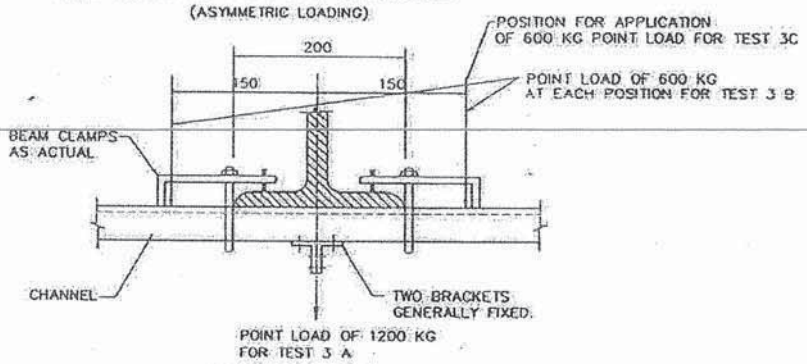
CAD FILE NAME : STAND-211-037.DWG

1490



TEST 2B MAIN SUPPORT CHANNEL

(ASYMMETRIC LOADING)



TEST 3A, 3B & 3C

NOTES

1. FIXING SHALL BE AS PER ACTUAL SITE INSTALLATION CONDITION.
2. ALL DIMENSIONS ARE IN MM (SCALE–NTS)

REV NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RA	FOR TENDER PURPOSE ONLY	K	[illegible]	[illegible]	-	[illegible]	-	-	-	[illegible]	[illegible]

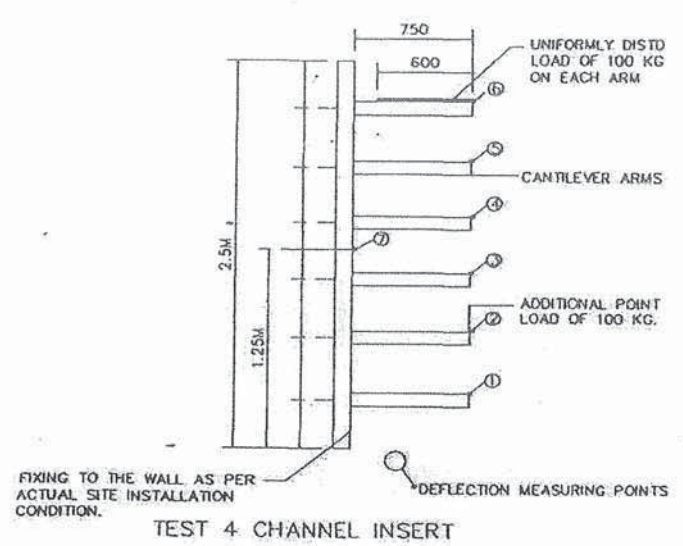
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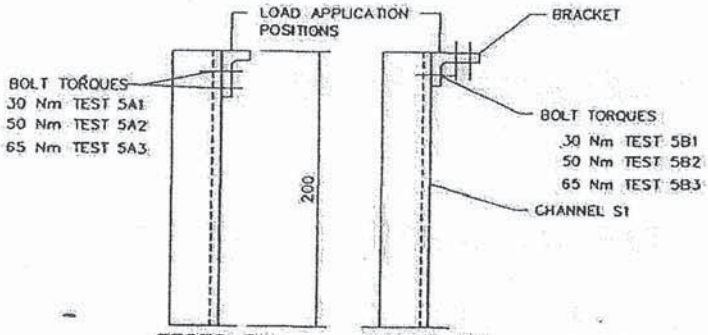
PROJECT	STANDARD		
TITLE	TYPICAL DETAILS STRUCTURE FOR TESTING		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-038	REV. NO. RA

CAD FILE NAME : STAND-211-038.DWG

1491



TEST 4 CHANNEL INSERT



TESTS 5A 1,2,3 & 5B 1,2,3 CHANNEL NUT SLIP CHARACTERISTIC.

NOTES

ALL DIMENSIONS ARE IN MM (SCALE–NTS)

RA	FOR TENDER PURPOSE ONLY										
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						

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National Thermal Power Corporation Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	TYPICAL DETAILS OF STRUCTURE FOR TESTING		
SIZE: A4	SCALE: NTS	DRG. NO.: 0000-211-POE-A-039	REV. NO.: RA

CAD FILE NAME : STAND-211-039.DWG

CLAUSE NO.	CABLING, EARTHING & LIGHTNING PROTECTION (E12)	एनटीपीसी NTPC Shakti Hydro
	Bidder's Name.....	
	TECHNICAL PARTICULARS	
	Technical Information and data to be submitted with proposal.	
1.0	**CABLE TRAYS, FITTINGS & ACCESSORIES**	
	a) Maker's Name, Country of manufacture	
	b) Type & material of cable tray	
	c) Type of cable support system	
	d) Applicable standard	
2.0	**JUNCTION BOXES**	
	a) Maker's Name & Country of Manufacture	
	b) Applicable Standard	
	c) Material	
	d) No of terminals	
	e) Degree of protection	
3.0	**CABLE GLANDS**	
	a) Maker's name & Country of manufacture	
	b) Type of cable gland	
	c) Material	
	d) Applicable Standard	
4.0	**CABLE TERMINATION KITS**	
	a) Maker's Name & Country of manufacture	
	b) Type of system Termination H.T./L.T.	
	c) Outdoor/Indoor	

Power Sector, Hydro Mech... Sector - 142, Noida U.P.-201...

2197

CABLING, EARTHING, LIGHTNING PROTECTION (E-12)

ATTRIBUTES / CHARACTERISTICS / ITEMS/COMPONENTS / SUB SYSTEMS	Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV & IR	Galvanise Test (If Applicable)	Functional	Bought out items/Bill of material	Routine tests as per relevant standard & specification	Acceptance tests as per relevant standard & specification	Constructional feature as per NTPC Specification
Wall Mounted-Lighting Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y
Switch box/junction box/ Receptacles Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y
Cable glands(BS-6121)	Y											Y		
Cable lug(IS-8309)	Y											Y		
Lighting wire(IS-694)	Y											Y		
Flexible conduits	Y											Y		Y
Conduits(Galvanise & Epoxy) IS-9537 & IS-2629,2633 ,6745	Y		Y								Y	Y		Y
RCC Hume Pipe (IS-458)												Y		
Cable termination & straight through joint (VDE-0278)	Y											Y		Y
Cable Trays, Flexible supports system & accessories IS-513, 2629,2633,6745	Y		Y		Y	Y	Y	Y	Y	Y		Y	Y	Y
Trefoil clamp	Y													Y
GI flats for earthing & lighting protection (IS 2062, 2629, 6745,2633)	Y		Y						Y			Y		Y
GI wire (IS-280)	Y											Y		
Fire Sealing System (BS –476)												Y	Y	Y

Note:1. This is an indicative list of tests /checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2. Deflection Test on cable trays and Proof Load test on cable trays support system will be as per details given in the NTPC technical specification & approved MQP. The above acceptance tests shall be done only on one sample from each size of offered lot.

3. Make of all items will be subject to NTPC approval.

Power Sector, Hydro Market, Sector - 142, Noida U.P.

एनटीपीसी NTPC

ITEM:(MATERIAL,CLASS,GRADE,RATING, SIZE ETC.) **GALVANIZED CABLE TRAYS (Perforated & Ladder type) & ACCESSORIES**

STANDARD QUALITY PLAN

CONFORMING TO CODE :

SL. NO.	COMPONENT & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1	2	3	4	5	6		7	8	9	D*	**	10		11
	FINISHED CABLE TRAYS & ACCESSORIES	1 **In Black Condition**											-	**A)The cable trays shall be galvanised at NTPC approved sources only.**
		a) Weld Quality	Major	Visual	100%	Random	Manufacturer's Plant Std	Manufacturer's Plant Std	Inspection report		P		-	
		b) Burs	Major	Visual	Random		-	No Burs	-do-		P		-	**B) The supplier to ensure procurement of steel from main producers like**
		2 **After Galvanising**												
		2.1 General Physical inspection including Galvanising Quality/ Defects, Dicromating, White rusting etc.	Major	Visual	IS-4759 -1996	5 sample/lot	IS-2629-1985 IS-4759-1996	IS-2629-1985 IS-4759-1996	-do-		P	W	W	SAIL/TISCO,Rastriya Ispat/Ispat Ind. Jindal/Esser/Lloyds/IIS Co. and Zinc from Hindustan Zinc Ltd. **C)Welding shall be done by qualified welders as per supplier system**
		2.2 Dimensional check & Sheet Thickness	Major	Measur ement	-do-	-do-	NTPC/Main Supplier Approved Drawing	NTPC/Main Supplier Approved Drawing	-do-		P	W	W	**D)Pre-tretment of fabricated cable trays shall be carried out in seven tank process as per IS 2629.All the process parameters e.g. Concentration, temperature, density etc. to be maintained and recorded by the Galvaniser**
		2.3 Galvanising tests												
		a) Coating thickness measurement survey by Elcometer	Critical	Measure ment	-do-	-do-	IS-4759-1996 IS-3203-1982	IS-4759-1996 Table-I	-do-		P	W	W	
		b) Mass of zinc coating	Critical	Measur ment	-do-	1 coupon sample of each thickness	IS-6745-1972 IS-2633-1986	IS-4759-1996 Table - I	-do-		P	W	W	**E)The process of pretreatment shall be varified by NTPC on surveillance basis during Inspection of cable trays**
		c) Uniformity of zinc coating/dip test	Critical	Measur ment	-do-	-do- -do-	IS-2629-1985 IS-2633-1986 IS-4759-1996	IS-4759-1996 cl. 9.3	-do-		P	W	W	***F* One piece each of 2.5 meter length size of cable tray of 300 mm & above**
		d) Adhesion test	Critical	Visual	-do-	-do-	IS-2629-1985	IS-2629-1985	-do-		P	W	W	**shall be taken as sample from each offered lot for inspection. It shall be**
		2.4 Deflection Test	Critical	Measu rement	1 sample from each size type/ lot	1 sample from each size type/ lot	*F*	*F*	-do-		P	W	W	**supported at both ends & loaded with uniformly distributed load of 76kg/ meter along the length of cable tray. The maximum deflection at mid span of each sample shall not exceed 7mm.**

LEGEND: RECORDS IDENTIFIED IDENTIFIED WITH **"TICK"** SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION

** M: MANUFACTURER/SUB-SUPPLIER, C:CONTRACTOR/NOMINATED INSPECTION AGENCY. N: NTPC. INDICATE **"P"** PERFORM **"W"** WITNESS AND **"V"** VERIFICATION AS APPROPRIATE

"CHP" BY NTPC SHALL BE IDENTIFIED IN COLUMN **"N"** AS **"W"**.

एनटीपीसी NTPC	ITEM: (MATERIAL, CLASS, GRADE, RATING, SIZE ETC.) GALVANISED FLEXIBLE CABLE TRAYS SUPPORT SYSTEM	STANDARD QUALITY PLAN CONFORMING TO CODE: Design as per NTPC Specification

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7	8	9	D*	**	10		11
	Flexible cable trays Support Structure	1. In Black Condition a) Weld Quality	Major	Visual	100%	Random	Manufacturer's Plant Std	Manufacturer's Plant Std	Inspection Report		P	V	V	o
		b) Burs	Major	Visual	Rando m	-	No Burs	No Burs	-do-		P		-	
2.	Finished Galvanized	2. After Galvanising												
		2.1 General physical inspection including Galvanizing Quality/Defects, Dicromating, White Rusting etc.	Major	Visual	100%	5 Sample/L ot	IS-2629-1985 IS-4759-1996	IS-2629-1985 IS-4759-1996	-do-		P	W	W	
		2.2 Dimensional Check & Thickness Check	Major	Measurem ent	-do-	-do-	NTPC/Main Supplier Approved Drg.	NTPC/Main Supplier Approved Drg.	-do-		P	W	W	
		2.3 Galvanizing Tests												
		a) Coating thickness measurement survey by Elcometer	Critical	Measurem ent	IS-4759-1996	-do-	IS-4759-1996 IS-3203-1982	IS-4759-1996 IS-3203-1982	-do-		P	W	W	
		b) Mass of zinc coating	Critical	Measurem ent	-do-	1 coupon sample of each thickness	IS-6745-1972 IS-4759-1996	IS-6745-1972 IS-4759-1996	-do-		P	W	W	
		c) Uniformity of zinc coating/dip test	Critical	Measurem ent	-do-	-do-	IS-2633-1986 IS-4759-1996	IS-2633-1986 IS-4759-1996	-do-		P	W	W	
		d) Adhesion Test	Critical	Visual	-do-	-do-	IS-2629-1985	IS-2629-1985	-do-		P	W	W	

LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION

M: MANUFACTURER/SUB-SUPPLIER, C: **Main Supplier: NTPC, N: NTPC. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE

"CHP" BY NTPC SHALL BE IDENTIFIED IN COLUMN "N" AS "W"

एनटीपीसी NTPC	ITEM: (MATERIAL, CLASS, GRADE, RATING, SIZE ETC.)	STANDARD QUALITY PLAN CONFORMING TO CODE: Design as per NTPC Specification

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		
					M	C/N					M	C	N
1.	2.	3.	4.	5.	6.		7	8	9	D*	**	10	
		Proof Load Test as per note 6 Followed by Die Penetration Test (For 600 mm and above cable tray support system)	A	Meas/Visual	One Sample from each offered lot	One Sample from each offered lot	NTPC Technical Specification/ No visible cracks should develop on the weld part	NTPC Technical Specification/ No visible cracks should develop on the weld part	Inspection Report		P	W	W

Note :

1. The supplier to ensure procurement of steel from main producers like SAIL/TISCO, Rastriya Ispat/Ispat Ind. Jindal/Esser/Lloyds/IIS Co. and Zinc from Hindustan Zinc Ltd.
2. Welding shall be done by qualified welders as per supplier system.
3. Material shall be galvanized at NTPC approved sources only.
4. Pre-treatment of cable trays support system shall be carried out in seven tank process as per IS-2629. All the process parameters e.g. Concentration, temperature, density etc. to be maintained and recorded by the galvaniser.
5. The process of pre-treatment shall be verified by NTPC on surveillance basis during inspection of Galvanised Flexible Cable Trays support system.
6. (i) Test on Main support Channel shall be done if only CI channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test as per tech. Spec.

   (ii) Test on Main Support Channel shall be done with C2 Channel and cantilever arms fitted on both sides, if C2 channels are in scope of supply. This test shall be same as test 2 A of type tests. Then test at (i) above shall not be repeated.

   (iii) Nut slip characteristic test (It shall support minimum load of 350 Kg. Before Nut Slips with bolt torque of 65 NM). This test shall be same as test 5 B of type tests.

   (iv) The procedure for carrying out above test shall be as per details given in Type Tests Specification.

LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION
M: MANUFACTURER/SUB-SUPPLIER, C: **Main Supplier, N: NTPC. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE
"CHP" BY NTPC SHALL BE IDENTIFIED IN COLUMN "N" AS "W"

	e) OIL FILTER/AIR FILTER	III			A	BALL & KIRCH	GERMANY				
					DR	PALL INDIA	INDIA				
		III			DR	EPE FILTER	INDIA				
		III			DR	HYDAC	INDIA				
20	e) OIL FILTER/AIR FILTER	III			DR	BHAGWATI FILTER	AHMEDABAD				
		III			DR	INTERNORMAN					
	f) SOLENOID VALVE	III			DR	HYDAC(INDIA)	NAVI MUMBAI				
		III			N	YUKEN	BANGALORE				
		III			N	REXROTH	INDIA				
	g) OIL SAFETY RELIEF VALVE	II			A	YUKEN	BANGALORE				
		II			DR	BRIL	INDIA				
		II			A/DR	HYDAC	Navi Mumbai / Coimbatore				
	h)ISOLATING VALVE	II			A	HYDAIR	MUMBAI				
		II			A	AUDCO	CHENNAI				
		II			A	FOURESS	BANGALORE				
		II			A	LEADER	JALANDHAR				
		II			A	HYDAC	MUMBAI				
	i) MAIN DISTRIBUTING VALVE	II			A	KAREYN	DEHRADOON				
		II			A	PRECISSION MACHINES	DEHRADOON				
		II			DR	BHOPAL ORTHOGRAPHIC	BHOPAL				
	j) CONTROL & INDICATION PANEL	I			A	CONTROL & SWITCHGEAR	NOIDA				
		I			DR	SKYTECH SYSTEM					
21	j) CONTROL & INDICATION PANEL	I			DR	ASHOK ELECTRONICS	BHOPAL				
		I			DR	TENCO	INDORE				

PROJECT: RAMMAM HEPP (3 X 40 MW)
Package: ELECTROMECHANICAL (EPC)
CONTRACTOR: BHEL
CONT NO: 5602-003

LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL

Doc No: CS-5602-003-9
Revision No: 00
Date: 20-Jan-15

SUB SYSTEM: GENERATOR AND AUX

SR NO	ITEM	QP /INS--PN CAT *	QP NO. 5601--QVE-Q-	QP_SUBMN_SCH	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SC_APPL_STATUS	SS DETAIL SUB-SCHEDULE	SS APPL SCHEDULE	REMARKS
36	PD MONITORING SYSTEM	III				MC MONITORING	SWIZERLAND	DR			
37	THERMOSTAT	III				BHEL APPD SOURCES		N			
38	SPACE HEATER	III				BHEL APPD SOURCES		N			
39	DIAL THERMOMETER	III				ASHCROFT	GERMANY / INDIA	N			
		III				CHEMTROLS	GOA	N			
		III				GOA INST INDUST.	GOA	N			
		III				BUDDENBERG	UK	N			
		III				KOBOLD	GERMANY	N			
40	STEEL PLATES	III					VENDORS APPROVED FOR TURBINE ARE ALSO ACCEPTABLE				
		III				DILINGER	GERMANY	N			TO BE COVERED IN RESPECTIVE QP
		III				JINDAL STEEL	INDIA	N			TO BE COVERED IN RESPECTIVE QP
		III				SAIL	INDIA	N			TO BE COVERED IN RESPECTIVE QP
		III				AZORSTALHL	UKRAIN	N			TO BE COVERED IN RESPECTIVE QP

ENGINEERING DIV / QAI

Main Contractor's Signature

Sl. No.	ITEM	QP / INSCAT.	QP No:- 5602-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
						Statcon	Hapur	DR		
						Hoppekke	Germany	DR		
9.	Fire Sealing System i) Type – A material supplier	III				M/s 3M India	Bangalore	A		
						M/s GE Silicon	USA	A		
						M/s Dow Corning	USA	A		
	ii) Type – B Material supplier	III				M/s Lloyds	Delhi	A		
						M/s Signum	Nagpur	A		
						M/s Vijay System Engineers Pvt. Ltd.	Mumbai	A		
	iii) Execution Agency for above					Same as 9 (ii) & 3 M India	Same as 9 (ii) & 3 M India	A		
10.	GI cable trays. fitting & accessories including bends	I	8			Inar Profiles Ltd	Enkapalli	A		
						Vatco	Mumbai	A		Galvanization at Sigma Mumbai
						Indiana cable trays	Mumbai	A		Galvanization at Karamtara galvaniser
						Industrial Perforation	Kolkata	A		
						Ratan Engineering	Kolkata	A		Galvanization at B.P. Projects
						India Electric Syndicate	Kolkata	A		Galvanization at BMW Industries/B.P Projects
						Steelite engg.	Mumbai	A		
						Premier Power Products	Kolkata	A		Galvanising at Neha Galvaniser
						Indiana Gratings	Pune	A		Galvanization at Poona Galvanizer/ Anand Yeknow

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-001-QOE-R-01 REVISION NO. 00 DATE 21st Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
										Aids Engg
						M.J. Engineering	Okhla/ Bhiwadi	A		
						Jamna Metal	Delhi/ Kundli	A		
						T.R.G	Chennai	A		Galvanization at TM Radhakrishna Chetty & Co
						Amtech	Pune	A		Galvanization at B.G. Shirke - Pune
						Kannade Anand Udyog	Mumbai	A		Fabrication at their units: Plot No. 42, Moriv District Thane & Plot No.: D-35 Anand Nagar MIDC, Addl. Ambernath , Dist.Thane Galvanization and offer the galvanized cable trays for inspection at D-34 Anand Nagar MIDC, Addl. Ambernath, Dist.Thane.
						Rukmani	Raipur	A		Ladder type cable trays only
						Passive Infra	Hasangarh (Rohtak)	A		
						Unitech Fabricators & Engineers	Howrah/ Hoogly (Kolkata)	A		
						Patny System	Hyderabad	A		Galvanisation at Gurpreet galvaniser - Hyderabad
						Rabi Engg	Kolkata	A		Galvanizing from NTPC approved sources
						Maheswari Electricals	Noida	DR		
11.	Cable tray flexible support system (GI)	I	9			Vatco	Mumbai	A		Galvanising at Sigma Mumbai
						Inar profiles	Enkapalli	A		

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-001-QOE-R-01 REVISION NO. 00 DATE 21st Jan 2015

APPENDIX-C
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Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
						Industrial perforations	Kolkata	A		
						Premier power products	Kolkata	A		Galvanising at Neha Galvaniser
						Steelite engg.	Mumbai	A		
						Indiana gratings	Pune	A		Galvanising at Poona Galvaniser
						Amtech	Pune	A		Galvanising at B.G. Shirke
						Ratan Projects	Kolkata	A		Galvanization at NTPC approved sources
12.	Lead coated steel flexible conduits	III				M/s PLICA	Ghaziabad	A		
						M/s Lapp	Germany	DR		
						M/s Bansal Labs	Bhopal	DR		
13.	Junction boxes / Link Boxes/ Test Link Box/ Adopter box, Switch Boxes, Pull Boxes (Hot Dip Galvanized)	III				Main contractor approved sources with galvanization from NTPC approved sources (Note-2)		Noted		
14.	FRP Junction boxes	II	10			Main Contractor approved sources		Noted		
15.	Cable termination kits & straight through jointing kit	I	11			M/s 3M Electro & Communication	Pune	A		up to 33 KV
						Raychem	Mumbai	A		Heat shrinkable type up to 33 KV

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL
	REF NO : 5602-001-QOE-R-01 REVISION NO. 00 DATE 21st Jan 2015	

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
						Yamunapower	Yamunanagar	DR		
						Hari Consolidated Pvt Ltd	Delhi	A		Heat shrinkable type Upto 11 KV with conditions
16.	Cable glands	III				Main contractor approved sources		Noted		
17.	Cable lugs	III				M/s Dowell	Mumbai	A		
						M/s Billets Elektro Werke Ltd. (3 D)	Umbergaon	A		
						M/s Chetna	Nasik	A		
						Additionally Any make's model with VDE or CE or UL or CSA marking or BIS approved with CML no. Refer Note-3		Noted		
18.	Lighting fixtures with accessories	I	12			M/s Crompton	Mumbai	A#		#- "A"- for filament type and " DR" for LED Type
						M/s Bajaj Electricals	Mumbai	A#		
						M/s Philips	Noida	A#		
						M/s Wipro	Mumbai	A#		
						M/s Surya Rosini	Kashipur	DR		
						M/s HAVELLS	NOIDA	DR.		
19.	Lamps	III				M/s Crompton	Mumbai	A#		#- "A"- for filament type and " DR" for LED Type
						M/s Bajaj Electricals	Mumbai	A#		

PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-001-QOE-R-01 REVISION NO. 00 DATE 21st Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SCAPPL SCHEDULE	REMARKS
						M/s Philips	Noida	A#		
						M/ s Wipro	Mumbai	A#		
						M/s Surya Rosini	Kashipur	DR		
						M/s HAVELLS	NOIDA	DR		
20.	Lighting Panels	I				Please refer seriel no- 3 as identified in LT Switchgear & LT Busduct sub package list				
21.	DG set Control panel / Synchronising panel	I	14			L&T	Mumbai / Coimbatore	A		
						GE	Bangalore	A		
						Siemens	Mumbai	A		
						C&S Electric	Noida / Hardwar	A		
						Schneider	Nasik	A		
						Unilec	Gurgaon	A		
						Switching Circuits	Kolkata	A		
						Tricolite	Sahibabad / Manesar	A		
						Hindustan Control & equipment Ltd	Kolkata	A		With fabrication & painting at unit II & MP Electrical Narendrapur
						Maktel	Vadodara	A		
						Jakson	Greater Noida	A		
						Vidyut Control	Gaziabad	A		
						Adlec Power	Rohad (Jhajjar)	A		
						Pyrotech	Udaipur	A		
						Anand Power Ltd.	Noida	A		

27.01.15

PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-001-QOE-R-01 REVISION NO. 00 DATE 21st Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
						Positronics	Vadodara	A		
						M/s Sterling Generators Pvt Ltd	Silvasa	A		For DG Set Control Panel only
						Contro & Schematics	Hyderabad	A		
						Supernova	Rajpur	A		
22.	Industrial /welding receptacles & boxes	III				Schneider	Nasik	A		
						M/s BCH	Faridabad	A		
						M/s Ajmera	Mumbai	A		
						M/s. Sakthi & Crown	Chennai	A		
						Additionally Any make's model with VDE or CE or UL or CSA marking or BIS approved with CML no		Refer Note-3		
23.	Lighting mast with raise & lower type lantern carriage	I	15			M/s Bajaj	Pune	A		
						M/s Philips	Kolkata	A		Fabrication, galvanization and testing at M/s. B.P. Project, Hoogly
						M/s CGL	Mumbai	A		Fabrication, galvanization and testing at M/s. B.P. Project, Hoogly
						M/s Wipro	Pune	DR		
						M/S TLL	SILVASA	DR.		
24.	Lighting pole /(steel tubular ~~pole type~~)	I	16			BIS licensee as per IS 2713 with valid CMLnumber		A		
25.	EHV cables (132 kV)	I				Universal cable ltd.	Satna	A@		

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-001-QOE-R-01 REVISION NO. 00 DATE 21st Jan 2015

Sl. No.	ITEM	QP / INSCAT.	QP No:- 5602-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
	@ subject to sub-QR clearance									
						Kei industries	Bhiwadi	A@		
						Phelps dodge	Bangkok	A@		
						Iljin electric	South korea	A@		
						CCI	Nasik	DR@		
26.	132 kV cable termination & straight through jointing kits* @ subject to sub-QR clearance	I				Iljin	Korea	A		*TC as per applicable IEC 60840 to be submitted for NTPC review
						Shanghai G&W	China	A		
						ABB Kabeldon	Sweden	A		
						Pfisterer AG	Switzerland	A		
						Tyco Electronics Raychem GmbH	Germany	A		
27.	Lighting poles (polygonal type)	I				M/s Bajaj	Pune	A		
						M/s KL Industries	Mumbai	DR		
						M/s B.P. Projects	Hoogly	A		
						M/s TLL	SILVASA	DR		
28.	PVC conduit/hume pipe/lighting wire/GI pipes/HDPE pipe/Structural Steel	III				BIS licensee / ISI marked with valid CML number		A		

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-001-QOE-R-01 REVISION NO. 00 DATE 21st Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SCAPPL SCHEDULE	REMARKS
29.	GI steel rigid conduit/ epoxy conduit	III				BIS licensee with valid CML number		A		
30.	Trefoil clamps/Earthing & Lighting Protection Material/Sheet Steel/ FRP cable trench cover/drum lifting jack/Earth wire/ FRP/Aluminum Ladder/Dimmer & Passive Infrared Sensors	III				Main Contractor Approved Sources		Noted		
31.	FAN with regulators & Exhaust Fan	III				M/s Crompton		Noted		
						M/s Orient				
						M/s Khaitan				
						M/s Polar				
						M/s GEC				
						M/s Havells				
						M/s Bajaj				
32.	FQP of DG Set Installation.	I	G-01							

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-001-QOE-R-01 REVISION NO. 00 DATE 21st Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
33.	FQP of Cables & Accessories	I	G-02							
34.	FQP of Earthing	I	G-03							
35.	FQP of Station Lighting	I	G-04							

NB:
Under Sub Supplier approval status as per NTPC column:
A: mean that vendor for this item is acceptable to NTPC.
Under QP / INSPN CATEGORY column:

CAT-I : For these items the Quality Plans approved by NTPC & final acceptance will be on physical inspection & witness by NTPC

CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on basis of verification of documents as per approved QP

CAT-III : For these items Main supplier approves the Quality Plans. The final acceptance by NTPC shall be on basis of certificate of conformance by the main supplier.

@ : Vendors acceptance is subject to sub-QR clearance.

Note-1- Approval conditions attached to above identified vendors, as applicable shall be adhered to.

Note-2 – List of NTPC acceptable galvanizers

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-001-QOE-R-01 REVISION NO. 00 DATE 21st Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS

1. M/s M J Engg,Delhi 2. M/s Jamna Metal.Delhi 3. M/s A.V. Engg, Kolkata 4. M/s Inar Profiles, Vishakapatnam 5. M/s Anand Udyog, Mumbai 6. M/s Techno Engg,Chandigarh 7. M/S Steelite Engg. Mumbai	8. M/s National Galvanizer, Kolkata 9. M/s Unistar Galvanizer, Kolkata 10. M/s B.P. Project. Kolkata 11. M/s Bajaj Pune 12. M/s Electrocare Industries, Mumbai 13. M/s B.G. Shirke, Pune 14. M/s Gurpreet Galvanizer, Hyderabad 15. M/s Sigma, Mumbai	16. M/s Radhakrishnan Shetty, Chennai 17. Karamtara Mumbai 18.Poona Galvanizers Pune 19. Neha Galvanizer- Kolkata 20. Unitech galvanizers- Hoogly 21. Gurpreet galvanizers- Hyderabad 22- DMP Projects- Kolkata	*Additional galvanizer's , if any , proposed by manufacturer through main contractor during detailed engineering shall be reviewed & assessed by NTPC as per the merits of the case.*

Note-3 : VDE / CE / UL / CSA MARKING FOR PRODUCT QUALITY: SELF CERTIFICATION/VALID CERTIFICATION FROM THIRD PARTY AGENCY OR BIS APPROVAL LETTER WITH CML NO. FOR PRODUCT QUALITY SHALL BE SUBMITTED FOR NTPC's INFORMATION

21/1/15
PRERNA SRIVASTAVA
for BHEL

	Project : RAMMAM-III ELECTRIC PROJECT (3X40MW) Package : 132 KV Switchyard Package Supplier : BHEL-TBG Package No.: CS-5602-003-9			Annexure-1 List for Items Requiring Quality Plan Approval and Acceptable Sub-Vendors as proposed by M/s. BHEL			DOC.NO. : 5602-003-QOE-R-01 REV.NO. : 0 DATE : 22.01.2015 PAGE :
S.N.	Item Description	QP/ Insp. Cat.	QP # 5602-003 QOE- Q-	Proposed sub-supplier	Place	Sub-Supplier approval status/ category	REMARK
13	INSTRUMENTATION CABLE	I	130	CORDS	BHIWADI	A	
				DELTON	FARIDABAD	A	
				ELKEY TELELINKS	FARIDABAD	A	
				KEI	BHIWADI	A	
				NICCO	KOLKATA	A	
				PARAMOUNT	KHUSKHERA	A	
				POLYCAB	DAMAN	A	
				THERMO CABLE	HYDERABAD	A	
				UNIVERSAL CABLES	SATNA	A	
14	SUB STATION AUTOMATION SYSTEM (BCU, GRP, ENERGY METER, NUMERICAL RELAYS, SWITCHYARD PROTECTION) (Item subject to Sub QR approval)	I	140	ALSTOM T&D	CHENNAI	A	
				ABB	PEENYA	A	
				SCHNEIDER	NOIDA	A	
				SIEMENS	KALWA	A	
				BHEL	BHOPAL	A*	* : Approved only for C&R Panel
15	COMPONENTS FOR CONTROL & RELAY PANELS, PROTECTION PANELS, ISLANDING SCHEME & BAY CONTROL UNIT :	I	150				* : Control Measure of Items shall be same as in the Quality Plan of SAS.
a	ENERGY METER	*		CONZERV	BANGALORE	A	
				ELSTER	MUMBAI	A	
				LANDIS & GYR	SWITZERLAND	A	
				GEC	UK	A	
				SEMS	UDAIPUR	A	
				L&T	MYSORE	DR	
				WALLABY	BANGALORE	DR	
b	FIBRE OPTIC CABLE	*		AKSH OPTIFIBRE	BHIWARI	A	
				BIRLA ERICSSON	REWA	A	
				FINOLEX	PUNE	A	
c	EVENT LOGGER	*		ALSTOM T&D	UK / FRANCE/CHENNAI	A	
				HATHWAY	UK	A	
d	GPS TIME SYNCHRONISATION EQUIPMENT	*		ARBITER	USA	A	
				HATHWAY	UK / USA	A	
				HOPF	GERMANY	A	
				SERTEL	CHENNAI	A	

	Project : RAMMAM-III ELECTRIC PROJECT (3X40MW) Package : 132 KV Switchyard Package Supplier : BHEL-TBG Package No.: CS-5602-003-9			Annexure-1 List for Items Requiring Quality Plan Approval and Acceptable Sub-Vendors as proposed by M/s. BHEL			DOC.NO. : 5602-003-QOE-R-01 REV.NO. : 0 DATE : 22.01.2015 PAGE :
S.N.	Item Description	QP/ Insp. Cat.	QP # 5602-003 QOE- Q-	Proposed sub-supplier	Place	Sub-Supplier approval status/ category	REMARK
e	RELAY TEST KIT	*		DOBLE ENGG	USA	A	
				MEGGER	UK	A	
				OMICRON	USA/AUSTRALIA	A	
				SCOPE T & M	PUNE	A	
f	DISTURBANCE RECORDER	*		ABB	FINLAND	A	
				ALSTOM T&D	USA	A	
				HATHWAY	UK	A	
				SIEMENS	GERMANY	A	
g	LARGE VIDEO SCREEN (LVS)	*		BARCO	NOIDA	A	
				DELTA	GURGAON	A	
				PLANAR	USA	A	
h	RELAYS (Item subject to Sub QR approval) (NUMERICAL AND AUXILLARY)	*		ABB	SWEDEN/ BANGALORE	A	
				ALSTOM T&D	UK/CHENNAI	A	
				SCHNEIDER	UK	A	
				SIEMENS	GERMANY	A	
				GE	BANGALORE	DR	
i	ETHERNET SWITCH	*		HIRSCHMANN	GERMANY	NOTED	
				GARETTCOM	USA	NOTED	
				RUGGEDCOM	CANADA	NOTED	
16	AC KIOSK	I	160	I COMM TEL	HYDERABAD	A	
				JINDAL MECTEC	GURGAON	A	
				U-FOAM	HYDERABAD	A	
				ISOLLYOD	BADDI	DR	
17	1.1KV GRADE POWER, CONTROL CABLES	I	170				Refer the Cabling List
18	BATTERY (Ni-Cd/Lead acid)	I	180				Refer the Switchgear List
19	BATTERY CHARGER	I	190				Refer the Switchgear List
20	LT SWITCHGEAR	I	200				Refer the Switchgear List
21	BMK'S/ JB'S (ALL TYPES) / LIGHTING PANELS/	II	210				Refer the Switchgear List
22	MCC (FIXED TYPE)	II	220				Refer the Switchgear List

	Project : RAMMAM-III ELECTRIC PROJECT (3X40MW) Package : 132 KV Switchyard Package Supplier : BHEL-TBG Package No.: CS-5602-003-9			Annexure-1 List for Items Requiring Quality Plan Approval and Acceptable Sub-Vendors as proposed by M/s. BHEL			DOC.NO. : 5602-003-QOE-R-01 REV.NO. : 0 DATE : 22.01.2015 PAGE :
S.N.	Item Description	QP/ Insp. Cat.	QP # 5602-003 QOE- Q-	Proposed sub-supplier	Place	Sub-Supplier approval status/ category	REMARK
23	SF6 Gas Filling and Evacuating Plant, Gas Recycling & Purifying Plant, Gas Leakage Detecter	III		AI QUALITEK	USA	NOTED	
				DILO	GERMANY	NOTED	
				ENERVAC	CANADA	NOTED	
				VACCUUM PLANT INDUSTRIES	PUNE	NOTED	
				MANIK MOTORS	HYDERABAD	DR	
24	OPERATIONAL ANALYSER WITH DCRM KIT	III		DOBBLE	USA	NOTED	
				GE	SWEDEN	NOTED	
				MEGGER	UK	NOTED	
				OMICRON	USA	NOTED	
				SCOPE T & M	PUNE	NOTED	
				VIC	USA	NOTED	
				HATHWAY	USA	DR	
				TECH IMP SYSTEMS	ITALY	DR	
25	LEAKAGE CURRENT ANALYSER FOR SURGE ARRESTOR	III		DOBLE ENGG	USA	NOTED	
				ISA	ITALY	NOTED	
				SCOPE T & M	PUNE	NOTED	
				TRANSINOR	NORWAY	NOTED	
26	AC FOR AC KIOSK	III		BLUESTAR	THANE	NOTED	
				CARRIER	GURGAON	NOTED	
				HITACHI	GANDHINAGAR	NOTED	
				VOLTAS	THANE	NOTED	
27	GS FLAT/ 40MM DIA M.S.ROD/ M.S EARTH RODS /U CLAMP/ GI EARTH PIPE / GI PIPE / GI CONDUIT (INCLUDING BENDS) / PVC PIPES	III		BHEL APPROVED SOURCES			
28	CABLE TRAY, BENDS, COUPLER PLATES, CABLE RACK ASSEMBLY	III					Refer the Cabling List
29	GS EARTHWIRE / LIGHTING WIRE	III		BHEL APPROVED SOURCES			
30	CABLE GLANDS	III					Refer the Cabling List
31	CABLE LUGS	III					Refer the Cabling List
32	LIGHTING FIXTURES & LUMINARIES	III					Refer the Station Lighting list
33	LIGHTING POLE	III		BIS approved Vendors as per IS-2713			

	Project : RAMMAM-III ELECTRIC PROJECT (3X40MW) Package : 132 KV Switchyard Package Supplier : BHEL-TBG Package No.: CS-5602-003-9			Annexure-1 List for Items Requiring Quality Plan Approval and Acceptable Sub-Vendors as proposed by M/s. BHEL			DOC.NO. : 5602-003-QOE-R-01 REV.NO. : 0 DATE : 22.01.2015 PAGE :
S.N.	Item Description	QP/ Insp. Cat.	QP # 5602-003 QOE- Q-	Proposed sub-supplier	Place	Sub-Supplier approval status/ category	REMARK
34	INDUSTRIAL RECEPTACLES	III					Refer the Cabling List
35	BAY IDENTIFICATION TAGS, PHASE MARKERS & DANGER PLATES	III	*	BHEL/TBG APPROVED SOURCES			
36	PIANO SWITCHES	III	*	BIS APPROVED SOURCES			
37	WPS (Aluminium Tube)	I	W-010	BHEL APPROVED SOURCES			
38	WPS (Earthing Grid)	I	W-020	BHEL APPROVED SOURCES			
39	FQP Switchyard Equipments	I	5602-003 - QOE - R-01	Switchyard Contrcator			

Note

1 SYSTEM SUPPLIERS/SUB-SUPPLIERS APPROVAL STATUS CATEGORY(SHALL BE FILLED BY NTPC)
A-For this items proposed vendor is acceptable to NTPC.To be indicated with letter "A" in the list along with condition of approval,if any
DR-For these items "Detailed required for NTPC review.To be identified with letter "DR" in the list.
NOTED- Items for which vendors are approved by Main Supplier & accepted by NTPC without specific vendor approval from NTPC are to be identified with "NOTED".

2 QP / INSPN CATEGORY
CAT-I :For these items the Quality Plans approved by NTPC & final acceptance will be on physical inspection witness by NTPC
CAT-II :For these items the Quality Plans approved by NTPC.However no physical inspection shall be done by NTPC.The final acceptance by NTPC shall be on basis of documents as approved QP
CAT-III:For these items Main supplier approves the Quality Plans.The final acceptance by NTPC shall be on basis of certificate of conformance by the main supplier.

3 UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

4 Clearance to be taken from NTPC before placing the order

(Manish Kashyap) NTPC
22/1/15
(D. GHOSH) BHEL
22/1/15
(D. SENGUPTA) BHEL
(SOUMIK BANERJEE) BHEL

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOE-R-01 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
1	Floor mounted Draw out type indoor LT Switchgear Panel (MCC panels etc.)	I	1			L&T	Mumbai / Coimbatore/ Ahmednagar	A		BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						GE	Bangalore	A		BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Siemens	Mumbai	A		BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						C&S Electric	Noida / Hardwar	A		BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.

21/1/15
PRERNA SRIVASTAVA

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOE-R-01 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
						Schneider	Nasik	A		ACB from Schneider, France. BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Unilec	Gurgaon	A		BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						ABB	Bangalore	DR		
2.	Floor mounted Fixed type indoor LT Switchgear Panel (ACDB / DCDB / Lighting DB	I	2			L&T	Mumbai / Coimbatore/ Ahmednagar	A*		**Note- Out of the identified vendors in "DR" for Fixed type outdoor LT Switchgear Panel, maximum two vendors to be proposed to NTPC for review.** *- DR for Fixed type outdoor LT Switchgear Panel

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOE-R-01 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
	/Starter panels / Solenoid valve distribution boards)									BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						GE	Bangalore	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Siemens	Mumbai	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						C&S Electric	Noida / Hardwar	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL
	REF NO : 5602-003-QOE-R-01 REVISION NO. 00 DATE 20th Jan 2015	

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003- QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
						Schneider	Nasik	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Unilec	Gurgaon	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Switching Circuits	Kolkata	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Tricolite	Sahibabad / Manesar	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOE-R-01 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
						Hindustan Control & equipment Ltd	Kolkata	A*		With fabrication & painting at unit II & MP Electrical Narendrapur *- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Maktel	Vadodara	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Jakson	Greater Noida	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Vidyut Control	Gaziabad	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid

Power Sector, Hydro Automation, Sector-142, Noida U.P.

Pinaka 21/1/15

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOE-R001 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
										CML no.
						Adlec Power	Rohad (Jhajjar)	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Pyrotech	Udaipur	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Anand Power Ltd.	Noida	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						Control & Schematics	Hyderabad	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOE-R-01 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
										CML no.
						Positronics	Vadodara	A*		*- DR for Fixed type outdoor LT Switchgear Panel BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
						BCH	Faridabad	DR		
						Bhopal Swgr	Bhopal	DR		
3	Wall mounted fixed type indoor / outdoor LT Switchgear non compartmentalized Panel (Lighting panels / AC / DC Fuse boards / MCB boxes)	I	3			L&T	Mumbai / Coimbatore/ Ahmednagar	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						GE	Bangalore	A		BOIs preferably with CE/VDE/UL/CSA

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9					LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL				REF NO : 5602-003-QOE-R-0 REVISION NO. 00 DATE 20th Jan 2015
Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
										marked or BIS approved with valid CML no.
						Siemens	Mumbai	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						C&S Electric	Noida / Hardwar	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Schneider	Nasik	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Unilec	Gurgaon	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Switching Circuits	Kolkata	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Tricolite	Sahibabad / Manesar	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Hindustan Control & equipment Ltd	Kolkata	A		With fabrication & painting at unit II & MP Electrical Narendrapur BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOE-R-01 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
										CML no.
						Maktel	Vadodara	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Jakson	Greater Noida	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Vidyut Control	Gaziabad	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Adlec Power	Rohad (Jhajjar)	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Pyrotech	Udaipur	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Anand Power Ltd.	Noida	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Control & Schematics	Hyderabad	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Positronics	Vadodara	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOE-R-01 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
										CML no.
						Control Devices	Kolkata	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Jasper	Noida	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Havells	Faridabad	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Novateur Electrical & distribution systems	Murthal	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
						Avaid Technovator	Manesar	A		BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
4	ACB	(part of LT Swgr MQP)	4			C&S Electric	Noida	A		
						L&T	Mumbai	A		
						GE	Bangalore	A		
						Siemens	Germany	A		
						Schneider	France	A		
5	LT Busduct (	I	5			C&S Electric	G.Noida	A		

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOE-R-01 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
	air insulated non phase segregated type)					C&S Electric	Hardwar	A		
						Unilec	Gurgaon	A		Upto 3200 A
						KGS Engg Ltd	Chennai	A		
						Spaceage Swgr Ltd	Bawal	A		
						REEP	Chennai	A		
						Enpro	Chennai	A		
						Jasper Engg Ltd	Noida	A		With Copper flexible
6	LT Buct (insulated sandwitched type)	I	6			C&S Electric	G.Noida	DR		
						Jasper Engg Ltd	Noida	DR		
						Schneider	Baroda	DR		
7	IEC 61850 Compliant Numerical Relays	(part of Swgr MQP)				SEL	Pullman. USA	A		A@- Subject to Sub-QR clearance form NTPC Engg
						ALSTOM T&D	Stafford, UK	A		P14X, P34X, P44X, P64X, P74X models only. A@- Subject to Sub-QR clearance form NTPC Engg

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOE-R-01 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
						ALSTOM T&D	Chennai	A		P14X, P34X, P44X, P64X, P74X models only. A@- Subject to Sub-QR clearance form NTPC Engg
						GE Multilin	Zamudio, Vizcaya, Spain/ Markham, Ontario, Canada	A		F 650 only A@- Subject to Sub-QR clearance form NTPC Engg
						Schneider	Stone, UK	A		PX30 & PX40 models only. A@- Subject to Sub-QR clearance form NTPC Engg
						ABB	Finland	A		A@- Subject to Sub-QR clearance form NTPC Engg
						ABB	Baroda	A		For 6XX Series A@- Subject to Sub-QR clearance form NTPC Engg
						Siemens	Goa	A		7SR2X series only A@- Subject to Sub-QR clearance form NTPC Engg
						Siemens	Germany	A		7SX Series only A@- Subject to Sub-QR clearance form NTPC Engg

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOPR-01 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003- QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
8	Local Push Button Station	III				Main contractor approved sources for the box (with push button with CE/VDE/UL/CSA marked or BIS approved with valid CML no.)		Noted		
9	FQP for LT Switchgear	I	G-01							
10	FQP for LT Busduct	I	G-02							

NB:
Under Sub Supplier approval status as per NTPC column:
A: mean that vendor for this item is acceptable to NTPC.
Under QP / INSPN CATEGORY column:
CAT-I : For these items the Quality Plans approved by NTPC & final acceptance will be on physical inspection & witness by NTPC
CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on basis of verification of documents as per approved QP
CAT-III : For these items Main supplier approves the Quality Plans. The final acceptance by NTPC shall be on basis of certificate of conformance by the main supplier.
General Notes:

एनटीपीसी NTPC	PROJECT : RAMMAN STAGE-III ELECTRIC PROJECT (3X40 MW) PACAKGE :EPC Sub Package: LT Switchgear & LT Busduct CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QOE-R-01 REVISION NO. 00 DATE 20th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS

Vendor list & category of the mandatory spares shall be as mentioned above.
For item not appearing in the above list, main contractor to approach NTPC for acceptable vendors & inspection categorization of the same.
NTPC Approval conditions to above identified vendors shall be adhered to. Vendor's approval conditions will be informed on specific request of Main Contractor.

Note-1- VDE / CE / UL / CSA MARKING CERTIFICATION PREFERABLY FROM THIRD PARTY AGENCY OR BIS APPROVAL LETTER SHALL BE SUBMITTED FOR NTPC's VERIFICATION /INFORMATION

Note 2- Out of the identified vendors in "DR" for Fixed type outdoor LT Switchgear Panel, maximum two vendors to be proposed to NTPC for review.

for BHEL
PRERNA SRIVASTAVA

PROJECT :RAMMAN ST ... ELECTRIC PROJECT (3X40 MW) PACAKGE : EPC Sub Package: HT Power cables, LT power cables, Control cables, CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS RE... G QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QAI-P01 REVISION NO. 00 DATE 19th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
1	HT Cable upto 11KV	I	Q-01			Universal Cable Ltd.	Satna	A		
						Torrent Cable Ltd	Nadiad	A		
						Polycab Wires Pvt. Ltd	Daman	A		
						KEI Industries	Bhiwadi	A		
						Havells India Ltd.	Alwar	A		
						Finolex	Pune	A		
						Uniflex	Valsad	A		
						NICCO	Shamnagar , Kolkata	A		
						Incab	Pune	A		
						Sri ram Cables	Bhiwadi	A		
						Krishna Electrical Indsutries Ltd	Gwalior	A		
						KEC International	Vadodara	A		
2	1.1 KV Power cable (PVC & XLPE)	I	Q-02			Universal Cable Ltd.	Satna	A		
						NICCO	Shamnagar , Kolkata	A		
						Torrent Cable Ltd	Nadiad	A		
						Incab	Pune	A		
						Hindustan Vidyut Products Ltd	Faridabad	A		
						KEI Industries	Bhiwadi	A		
						Delton Cable Ltd	Faridabad	A		A)Unarmoured cable all sizes. B) Armoured cable up to 3.5 x 240 sq. Mm with GI strip armour and

PROJECT :RAMMAN ST E-III ELECTRIC PROJECT (3X40 MW) PACAKGE : EPC Sub Package: HT Power cables, LT power cables, Control cables, CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS RE IRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL	REF NO : 5602-003-QQE-R-01 REVISION NO. 00 DATE 19th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003- QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
										1CX70 sq mm with al strip armour
						Paramount Cable	Khushkhera	A		
						Polycab Wires Pvt. Ltd	Daman	A		
						Gemscabs Industries	Bhiwadi	A		
						Cords Cables	Bhiwadi	A		
						Havells India Ltd.	Alwar	A		
						Sri ram Cables	Bhiwadi	A		
						Ravin Cables	Pune	A		
						Thermocables	Hyderabad	A		
						Sbee Cables	Bangalore	A		
						Suyog Cables	Vadodara	A		
						Gupta Power Cables	Bhubaneswar	A		
						Finolex	Pune	A		
						Scot Innovation wires & cables	Baddi	A		
						Anhui Hualing	China	A		
						LS Cable	Korea	A		
						Radiant Cables	Hyderabad	A		
3	1.1 KV Control cable	1	Q-03			NICCO	Shamnagar , Kolkata	A		
						Torrent Cable Ltd	Nadiad	A		
						Incab	Pune	A		
						Polycab WiresPvt. Ltd	Daman	A		
						Hindustan Vidyut Products Ltd	Faridabad	A		
						KEI Industries	Bhiwadi	A		

एनटीपीसी NTPC	PROJECT :RAMMAN ST[illegible] I ELECTRIC PROJECT (3X40 MW) PACAKGE : EPC Sub Package: HT Power cables, LT power cables, Control cables, CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS RI[illegible]NG QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL

APPENDIX - C

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
						Delton Cable Ltd	Faridabad	A		
						Paramount Cable	Khushkhera	A		
						Gemscabs Industries	Bhiwadi	A		
						Cords Cables	Bhiwadi	A		
						SPM Cables	Hyderabad	A		
						Elkay Telelink	Faridabad	A		
						Havells India Ltd.	Alwar	A		
						R.R. Kabel	Silvasa	A		
						Ravin Cables	Pune	A		
						Gupta Power cable	Bhubaneswar	A		
						Thermocables	Hyderabad	A		
						Finolex	Pune	A		
						Sbee Cables	Bangalore	A		
						Suyog Cables	Vadodara	A		
						Universal Cables	Satna	A		
						Scot Innovation wires & cables	Baddi	A		
						Anhui Hualing	China	A		
						LS Cable	Korea	A		
						Radiant Cables	Hyderabad	A		
4	FQP of Cables & Accessories	1	G-01							SFQP no. -000-999-QOE-I-004 will be applicable

Note 1 : Approval conditions attached to sub- vendors shall be adhered to.

Note 2 : Abbreviations

A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list alongwith the condition of approval, if any.

DR – For these items "Detailed required" for NTPC review. To be identified with letter "DR" in the list.

NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with "NOTED.'

1. QP/INSPN CATEGORY:

एनटीपीसी NTPC	PROJECT :RAMMAN ST. -III ELECTRIC PROJECT (3X40 MW) PACAKGE : EPC Sub Package: HT Power cables, LT power cables, Control cables, CONTRACTOR : M/S BHEL CONT. NO. CS-5602-003-9	LIST OF ITEMS RE IRING QP APPROVAL & ACCEPTABLE VENDOR AS PROPOSED BY M/S BHEL DATE 19th Jan 2015

Sl. No.	ITEM	QP / INS CAT.	QP No:- 5602-003- QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS PROPOSED BY M/S BHEL	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS

CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC..
CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.
CAT-III : For these items Main Supplier approves the Quality Plans.The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.

21/1/15
PRERNA SRIVASTAVA
for BHEL

Project : Rammam Stage - III Package: EPC (Electro-Mechnaical) Pkg-Transformers Supplier : BHEL, Jhansi / Bhopal Contract No.: CS-5602-003-9	Annexure - II LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL	DOC.NO. : 5602-003-QOE-R-00 REV.NO. : 0 DATE: 21.01.2015 PAGE : 9 OF 14

S.N.	Item Description	QP / Insp. Cat	QP # 5602-003-QVE-	QP Sub. Schedule	QP Approval Schedule	Proposed sub-supplier	Place	Sub-Supplier approval status / Cat.	Sub-supplier details' submission sch.	Remark
g	Control & Auxiliary Transformer	*				Automatic Electric	Mumbai	A		
						Indcoil	Mumbai	A		
						Kappa	Chennai	A		
						Logicstat	Delhi	A		
						Pragati Electricals	Mumbai	A		
						Prayog Electricals	Mumbai	A		
h	DC Contactor	*				Alstom	Chennai	A		
						Andrew Yule	Kolkata	A		
						BCH	Faridabad	A		
						Telemechanique	France	A		
i	HRC Fuse Link & Base	*				Alstom	Chennai	A		
						GEPC	Hosur	A		
						L & T	Mumbai	A		
						Siemens	Mumbai	A		
j	Indicating Lamps & Assembly	*				Alstom	Chennai	A		
						BCH	Faridabad	A		
						Concord	Faridabad	A		
						L&T	Mumbai	A		
						Siemens	Mumbai	A		
						Vaishno Raas Control	NOIDA	A		
k	Indicating Meters	*				Alstom	Chennai	A		
						Automatic Electric	Mumbai	A		
						IMP	Mumbai	A		
						Meco	Mumbai	A		
l	Induction Motor (for OLTC	*				ABB	Faridabad	A		
						Alstom	Kolkata	A		
						Crompton Greaves	Mumbai	A		
						KEC	Bangalore	A		

21/1/15

Project : Rammam Stage - III Package: EPC (Elctro-Mechnaical) Pkg-Transformers Supplier : BHEL, Jhansi / Bhopal Contract No.: CS-5602-003-9	Annexure - II LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL	DOC.NO. : 5602-003-QOE-R-00 REV.NO. : 0 DATE: 21.01.2015 PAGE 10 OF 14

S.N.	Item Description	QP / Insp. Cat	QP # 5602-003-QVE-	QP Sub. Schedule	QP Approval Schedule	Proposed sub-supplier	Place	Sub-Supplier approval status / Cat.	Sub-supplier details' submission sch.	Remark
m	Limit Switch / Micro Switch	*				BCH	Faridabad	A		
						Essen	Chandigarh	A		
						Marquardt	Germany	A		
						Telemechanique	France	A		
n	LT AC Auxillary Contactor Switches	*				Alstom	Chennai	A		
						BCH	Faridabad	A		
						GEPC	Bangalore	A		
						L & T	Mumbai	A		
						Siemens	Mumbai	A		
						Kaycee	Mumbai	A		
						L & T	Mumbai	A		
						Siemens	Thane	A		
o	LT PVC Coper Wires	*				BIS Approved Makes	*	A		
p	MCB / MCCB	*				Alstom	Chennai	A		
						L & T	Mumbai	A		
						Legrand	Mumbai	A		
						Schneider	Nasik	A		
						Siemens	Mumbai	A		
q	Push Button	*				Alstom	Chennai	A		
						BCH	Faridabad	A		
						Concord	Faridabad	A		
						L & T	Mumbai	A		
						Siemens	Mumbai	A		
r	Rotary Switch Control & Selector Switch	*				Alstom	Chennai	A		
						Kaycee	Mumbai	A		
						L&T	Mumbai	A		
						Siemens	Mumbai	A		
s	Single Phase Preventer (SSP)	*				Indoasian	Jalandhar	A		
						L&T	Mumbai	A		
						Minilec	Pune	A		
						Siemens	Mumbai	A		

Project : Rammam Stage - III Package: EPC (Electro-Mechnaical) Pkg-Transformers Supplier : BHEL, Jhansi / Bhopal Contract No.: CS-5602-003-9	Annexure - II LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL	DOC.NO. : 5602-003-QOE-R-00 REV.NO. : 0 DATE: 21.01.2015 PAGE 11 OF 14

S.N.	Item Description	QP / Insp. Cat	QP # 5602-003-QVE-	QP Sub. Schedule	QP Approval Schedule	Proposed sub-supplier	Place	Sub-Supplier approval status / Cat.	Sub-supplier details' submission sch.	Remark
t	Switch Fuse Unit	*				Alstom	Chennai	A		
						BCH	Faridabad	A		
						Control & Switchgear	Delhi	A		
						GEPC	Hosur	A		
						L&T	Mumbai	A		
						Siemens	Mumbai	A		
u	Tap Position Indicators	*				Lektro Lab Equipment	Mumbai	A		
						Neutronics	Mumbai	A		
						Perfect Controls	Chennai	A		
						Pradeep Sales & Services	Mumbai	A		
						Radix	Mumbai	A		
						Siemens	Mumbai	A		
v	Terminal Block & Studs	*				Connect Well	Mumbai	A		
						Elemex	Vadodara	A		
						Essen	Chandigarh	A		
						Technoplast	Ahmedabad	A		
						Tosha	Vadodara	A		
w	Thermal Overload Relays	*				ABB	Bangalore	A		
						Alstom	Chennai	A		
						BCH	Faridabad	A		
						L & T	Mumbai	A		
						Siemens	Mumbai	A		
						Telemechanique & Control	NOIDA	A		
x	Time Delay Relay (Pneumatic / Static)	*				ABB	Bangalore	A		
						Alstom	Chennai	A		
						BCH	Mumbai	A		
						L&T	Mumbai	A		
						Siemens	Mumbai	A		

21/1/15

Project : Rammam Stage - III Package: EPC (Electro-Mechnaical) Pkg-Transformers Supplier : BHEL, Jhansi / Bhopal Contract No.: CS-5602-003-9	Annexure - II LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL	DOC.NO. : 5602-003-QOE-R-00 REV.NO. : 0 DATE: 21.01.2015 PAGE 12 OF 14

S.N	Item Description	QP / Insp. Cat	QP # 5602-003-QVE-	QP Sub. Schedule	QP Approval Schedule	Proposed sub-supplier	Place	Sub-Supplier approval status / Cat.	Sub-supplier details' submission sch.	Remark
35	Bare Conductor	*				Shree Cables	Bhopal	A		For Dry Type Transformers Only
						Chandra Metals	Allahabad	A		
						Copper Strips Pvt. Ltd.	Bhopal	A		
						Cosmos Conductor Pvt Ltd	Tumkur	A		
36	Copper Conductor Bus bar	*				MP Electricals	Bhopal	A		
						Ken Electricals	Rewa	A		
						Copper Strips Pvt Ltd	Bhopal	A		
						Chandra Metals	Allahabad	A		
37	Epoxy Insulator / Bushing	*				Baroda Bushings	Baroda	A		
						Baroda Mould & Dyes	Baroda	A		
						India Insulator	Miraj	A		
38	Epoxy Casting Material	*				Huntsman Advance Material (I) Pvt Ltd.	Mumbai	A		
						Atul Ltd	Valsad	A		
39	Fibre Glass Covered Copper	*				Pearl	Bangalore	A		
						Vindhya Enterprises	Rewa	A		
						ABC Electricals	Rewa	A		
						Cosmos Conductor Pvt Ltd	Tumkur	A		
40	Fibre Glass Sheet	*				Glass Fibre Ltd	Mumbai	A		
						Text Plast (I) Pvt Ltd	Hardwar	A		
						Techin Vest (IP) Ltd	Hardwar	A		
						Permali Wallace Ltd	Bhopal	A		
41	Sheet Metal Enclosure	*				Bharat Fabricators	Bhoapl	A		
						BFI	Jhansi	A		
42	Temperature Survellance Unit	*				Unified Electro Tex	Bangalore	A		
						Pecon	Vadodara	A		
43	Thermistor/RTD	*				Pecon	Vadodara	A		
						Integrated Control	Pune	A		

21/1/15 21U

एनटीपीसी NTPC	PROJECT : RAMMAM (3X40 MW)	ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL PACKAGE	REF. NO.: CS-5602-003
	PACKAGE : EPC		REV. NO.: 00 Page 101 of 153
	CONTRACTOR : BHEL	SUB-SYSTEM: BHEL EMRP	
	CONTRACT NO. : CS-5602-003		DATE:

SL. NO.	ITEM	QP/ INSP. CAT.	QP. NO.	QP. SUBMISSION SCHEDULE	QP APPL. SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL/ STATUS/ CAT	SS DETAIL SUB SCHEDULE	SC APPL. SCHEDULE	REMARKS
1	LT MOTORS (REFER NOTE 1)	I				KEC	BANGALORE/ HUBLI	A			HUBLI UPTO 90 KW, RQP
		I				SIEMENS	MUMBAI	A			RQP
		I				CGL	AHMEDNAGAR	A			RQP
		I				MARATHON	KOLKATA	A			RQP
		I				BBL	MUMBAI	A			RQP
		I				ABB	FARIDABAD/ BANGALORE	A			FARIDABAD UPTO 55 KW, BANGALORE ABOVE 55 KW, RQP
		I				JYOTI	VADODARA	A			
		I				LHP	SOLAPUR	A			
		I				NGEF	HUBLI	A			UPTO 15 KW
2	ELEVATORS	I				ECE	GHAZIABAD	A			
		I				TECHNO INDUSTRIES	AHMEDABAD	A			
		I				OTIS	MUMBAI	A			
		I				OMEGA	AHMEDABAD	A			
		I				SAMIL ELTEC	KOREA	A			

Investors

Page 1 of 2

ENGINEERING DIV/ QAI

20/1/15 (AGM-EMRP) for SR.NO: 2-ELEVATORS

Abhishek Jain ABHISHEK JAIN (BHEL-Bhopal)

एनटीपीसी NTPC	PROJECT : RAMMAM (3X40 MW)			LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL					REF. NO.: CS-5602-003		APPENDIX - C
	PACKAGE : EPC			PACKAGE					REV. NO.: 00 Page 102 of 153		
	CONTRACTOR : BHEL			SUB-SYSTEM: BHEL EMRP							
	CONTRACT NO. : CS-5602-003								DATE:		
SL. NO.	ITEM	QP/ INSP. CAT.	QP. NO.	QP. SUBMISSION SCHEDULE	QP APPL. SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL/ STATUS/ CAT	SS DETAIL SUB SCHEDULE	SC APPL. SCHEDULE	REMARKS
		I				KONE	CHENNAI	A			
		I				JOHNSON	CHENNAI	DR			
		I				SCHINDLER	MUMBAI	DR			
		I				EAST INDIA ELEVATORS	AHMEDABAD	DR			

NOTE 1 :

) Acceptance of Motor less than 30 KW is based on COC of the manufacturer and the contractor confirming as follows: It is hereby confirmed that the above mentioned motor /motors vas/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage and frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, istance between centre of stud and gland plate and tested in accordance with approved drawing /data sheets

) 30 KW and above Acceptance of Motor rating between 30 KW and 50 KW is based on NTPC review of Routine Test inspection report as per IS 325 witnessed by main contractor along vith COC of the manufacturer and the contractor confirming as follows: It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC pecific requirements regarding ambient temp., voltage and frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud and gland late, space heater and tested in accordance with approved drawing /data sheets. Above 50 KW up to 200 KW NTPC INSPECTION AS PER NTPC APPROVED QP

(NTPC)

20/1/15
CAGM - EMRP)
for Sl.No. 2 - ELEVATORS

ENGINEERING DIV/ QAI

	Project: Rammam Stage-III	Annexure-II	DOC.NO.	: 5602-003-QOE-R0
NTPC	Package : IP BUSDUCT	LIST OF ITEMS REQUIRING QUALITY PLAN	REV.NO.	: 00
	Supplier : BHEL Rudrapur	AND SUB-SUPPLIER APPROVAL	DATE	: 21.01.2015
	Contract No.: CS-5602-003-9		PAGE	: 1 of 4

S. No.	Item Description	QP/ Insp. Cat.	QP No. 5602-003-QVE-	QP Sub. Schedule	QP Approval Schedule	Proposed sub-supplier	Place	Sub-Supplier approval status / category	Sub-supplier Details Submission Schedule	Remark
1	Isolated Phase Busduct	I	Q-410			BHEL	Rudrapur	A		
2	Al Sheet, Al Plate	*				Bharat Al Company Ltd.	Korba	A		
						Hindalco Industries Ltd.	Renukoot	A		
3	Al Extrusion	*				Hindalco Industries Ltd.	Renukoot	A		
						Indian Al. Company Ltd.	Alupuram, Kerla	A		
						Jindal Aluminium Ltd.	Bangalore	A		
						Century Extrusions	Kolkata	A		
4	Cu Flats	*				Mehta Tubes Pvt Ltd	Mumbai	NOTED		Copper to be procured from BHEL approved sources
						Rachna Metals Industries	Delhi	NOTED		
						Chowdhary Metal Ind	Secunderabad	NOTED		
						Morakhia Metals	Ahmedabad	NOTED		
						Kanak Pipe Industries	Mumbai	NOTED		
						Gujrat Cipromet Ltd	Mumbai	NOTED		
						Jyoti Copper Craft	Dewas	NOTED		
5	Cu Strips / Flexibles	*				Forward Engineering	Bhopal	NOTED		
						Rasshm Enterprises	Bhopal	NOTED		
						B B Electro Technic	Mumbai	NOTED		
						Shree Cables and Cond.	Bhopal	NOTED		
						BHEL (EMRP)	Mumbai	NOTED		
						SRG Metalcraft	New Delhi	NOTED		
						Cuprum Industries	Bhopal	NOTED		
6	ISMC, ISA, ISMB	*				SAIL	New Delhi	A		
						TISCO	New Delhi	A		
						ISCO	New Delhi	A		
						Rashtriya ispat Nigam	New Delhi	A		
7	Epoxy Seal of bushing / Insulators	*				Baroda Moulds & Dies	Vodadora	A		
						A Bonds strands	Chennai	A		
						Baroda Bushing & Insulators	Vadodara	A		
						India Insulators	Miraj	A		
						Epothane	Ghaziabad	DR		
						Ganpati Fibretech	Noida	A		

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Power Sector, Hydro & Marketing

(Sreelim... 21/10/15 (S. M. Sreelimale 21)

Arvind
BHEL, Rudrapur

NTPC	Project: Rammam Stage-III		Annexure-II					DOC.NO.	: 5602-003-QOE-R0	
	Package : IP BUSDUCT		LIST OF ITEMS REQUIRING QUALITY PLAN					REV.NO.	: 00	
	Supplier : BHEL Rudrapur		AND SUB-SUPPLIER APPROVAL					DATE	: 21.01.2015	
	Contract No.: CS-5602-003-9							PAGE	: 2 of 4	
								Sub-Supplier approval status / category	Sub-supplier Details Submission Schedule	
S. No.	Item Description	QP/ Insp. Cat.	QP No. 5602-003-QVE-	QP Sub. Schedule	QP Approval Schedule	Proposed sub-supplier	Place			Remark
8	Porcelain Insulator	*				CJI	Khurja	A		
						BHEL	Bangalore / Jagdishpur	A		
9	Voltage Transformer	*				Pragati Electrical Pvt. Ltd.	Mumbai	A		
						Paras power	Bangalore	A		
						Electrical Control & Systems	Vadodara	DR		
						Kalpa	Bangalore	DR		
						Instrans Engg & Mfg	Bangalore	DR		
10	Current Transformer	*				Pragati Electrical Pvt. Ltd.	Mumbai	A		
						Paras power	Bangalore	A		
						Kalpa	Bangalore	DR		
						Prayog Electrical Ltd.	Pune	A		
						Electrical Control & Systems	Vadodara	DR		
						Instrans Engg & Mfg	Bangalore	DR		
11	Lightning Arrester	*				Oblum	Hydrabad	A		
						CGL	Nasik	A		
						Alstom	Pondicherry	DR		
						Elpro	Pune	DR		
						Lamco	Hyderabad	A		
12	Neutral Grounding Tranformer	I	Q-411			Pragati Electrical Pvt. Ltd.	Mumbai	A		
						Prayog Electrical Ltd.	Pune	A		
						Andrew Yule	Chennai	A		
						PS Electricals	Chennai	DR		
13	Neutral Grounding Resitors	I	Q-412			R.S.I.	Bhiwadi	A		
						S.R.Narkhede	Pune	A		
						Lachhman Electronics	New Delhi	A		
						Resitech Electricals	Kolkata	A		
						Amp Control	Pune	A		
						Essan	Bangalore	DR		

Power Sector, Hydro Marketing, Sector-142, Noida U.P.

Approved
BHEL, Rudrapur

	Project: Rammam Stage-III	Annexure-II	DOC.NO.	: 5602-003-QOE-R0
NTPC	Package : IP BUSDUCT	LIST OF ITEMS REQUIRING QUALITY PLAN	REV.NO.	: 00
	Supplier : BHEL Rudrapur	AND SUB-SUPPLIER APPROVAL	DATE	: 21.01.2015
	Contract No.: CS-5602-003-9		PAGE	: 3 of 4

S. No.	Item Description	QP/ Insp. Cat.	QP No. 5602-003-QVE-	QP Sub. Schedule	QP Approval Schedule	Proposed sub-supplier	Place	Sub-Supplier approval status / category	Sub-supplier Details Submission Schedule	Remark
14	Silver Plating	*				R R Enterprises	Rudrapur	A		
						Metal Handicrafts Service Center	Moradabad	DR		
						Adarsh electroplating	Bhopal	DR		
15	Rubber Bellow	*				United Rubber	Mumbai	A		
						Cori Engineering	Chennai	A		
						D.Wren & Com	Kolkata	A		
						Kanwal Industrial Corp	Noida	A		
						Resistoflex	Noida	DR		
						Rubber Products ltd	Mumbai	DR		
16	Air Pressurisation Equipment	II	Q-413			Melcon Indistries Ltd.	New Delhi	A		
						MVS Engineering	New Delhi	A		
						Elecmach Pneumatic	New Delhi	A		
						Powergear	Bangalore	DR		
						S K System Pvt Ltd	New Delhi	DR		
17	Galvanised Steel Structure	III				Sangam Structural Ltd	Allahabad	A		
						RS Infraprojects	Ghaziabad	A		
						Pioneer Fabricators	Meerut	A		
						Jamuna Metals	Delhi	A		
						Passive Infraprojects	Rohtak	A		
						Nexo Structures	Ludhiana	DR		
						Saral Industries	Rae Bareli	DR		
18	H.V. Fuse	*				Sadtem	France	A		
						Brush Fuse Gear	U.K.	A		
						Cooper Bussman	Pondicherry	A		
19	Space Heater & Thermostat	*				BHEL Approved sources		NOTED		
20	Stainless Steel Hardwares	*				BHEL Approved sources		NOTED		
21	HTS Zinc/Cd Electroplated Hardwares	*				BHEL Approved sources		NOTED		
22	Terminal Blocks (Control)	*				Wago Controls (I) Ltd.	Noida	A		
						Element & Electronics	Vadodra	A		

Asstt. Manager (Engg.) 21/10/15

Asstt. Manager (Engg.) BHEL, Rudrapur

	Project: Rammam Stage-III		Annexure-II					DOC.NO.	: 5602-003-QOE-R0		
	Package : IP BUSDUCT		LIST OF ITEMS REQUIRING QUALITY PLAN					REV.NO.	: 00		
	Supplier : BHEL Rudrapur		AND SUB-SUPPLIER APPROVAL					DATE	: 21.01.2015		
	Contract No.: CS-5602-003-9							PAGE	: 4 of 4		
								Sub-	Sub-supplier		
S. No.	Item Description	QP/ Insp. Cat.	QP No. 5602-003-QVE-	QP Sub. Schedule	QP Approval Schedule	Proposed sub-supplier	Place	Supplier approval status / category	Details Submission Schedule	Remark	
23	MCBs	*				Indo Kopp	New Delhi	A			
						MDS	Sonipat	A			
						Havells		A			
24	Surge Capacitors	*				Madhav Capacitors	Pune	A			
						ABB	Bangalore	DR			
						Shakti Capacitors Pvt Ltd	Sangli	DR			
25	LAVT Cubicle / NG Cubicle/ Marshalling Box	II	Q-414			Pyrotech	Udaipur	A		1. Cubicle shall have dummy items like PT, LA etc for dimensional check.	
						Bus Bar Systems	Bangalore	DR			
						RSI	Bhiwadi	DR			
						Powergear	Bangalore/ Hindupur	A			
26	FQP	I	G-001			BHEL		A			
27	WPS	I	W-001			BHEL		A*		*In case a fresh WPS is proposed, BHEL would get a fresh approval accordingly	

LEGENDS :

1. SYSTEM SUPPLIERS/SUB-SUPPLIERS APPROVAL STATUS CATEGORY(SHALL BE FILLED BY NTPC)
   - A-For this items proposed vendor is acceptable to NTPC.To be indicated with letter "A" in the list along with condition of approval,if any
   - DR-For these items "Detailed required for NTPC review.To be identified with letter "DR" in the list.
   - NOTED- For these items vendors are approved by Main Supplier & accepted by NTPC without specific vendor approval from NTPC.To be identified with "NOTED".
2. QP/INSPN CATEGORY
   - CAT-I :For these items the Quality Plans approved by NTPC & final acceptance will be on physical inspection witness by NTPC
   - CAT-II :For these items the Quality Plans approved by NTPC.However no physical inspection shall be done by NTPC.The final acceptance by NTPC shall be on basis of docoments as per approved QP
   - CAT-III :For these items Main supplier approves the Quality Plans.The final acceptance by NTPC shall be on basis of certificate of conformance by the main supplier.
   - * :Control measure of item covered in quality plan of main item.
3. UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

21/10/15

BHEL, Rudrapur

NTPC	PROJECT :RAMMAM (3 X 40 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
	PACKAGE : ELECTROMECHANICAL	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : M/S BHEL	VENDOR AS APPROVED BY	DATE : 21/01/2015
	CONTRACT NO :CS-5602-001	M/S BHEL	

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remarks
		III				ABB	Germany	Noted			
41	Volt meter/Frequency meter (Analog)	III				Rishabh	NASIK	A			
		III				AE	Mumbai	A			
		III				YOKOGAWA	Japan	A			
		III				MECO	Mumbai	A			
42	Thermocouples & RTD	II				Detriv Instrumentation & Electronics Ltd.	Mumbai	A			
		II				Thermal Instruments India Pvt.Ltd(GIC)	Sawantvadi	A			
		II				Pyro Electric	Goa	A			
		II				Tempson	Udaipur	A			
		I				Techno Instrument	Ahmedabad	A			
		II				Thermosensor	Germany	A			Thermocouple only
		II				Ephymess	Germany	A			RTD only
		*				Wika	Germany	DR			
		*				Kobold	Germany	DR			
		*				Toshniwal Industries	Ajmer	DR			
43	Transducer	II				Southern Transducer	Chennai	A			
		II				Elester (ABB)	Mumbai	A			
		III				Camlille Bauer	Switzerland	A			
		II				AE	Mumbai	A			
		II				Rishabh	Nasik	A			
		III				Metrawatt	Germany	A			
		*				ADEPT	Pune	DR			
		*				MASIBUS	Gandhi Nagar	DR			* Inspection category shall be decided during detail engg.
		*				Pyrotech	Udaipur	DR			* Inspection category shall be decided during detail engg.
44	Synchronising relay	III				ABB	Bangalore	A			
		III				Areva	Chennai	A			
		III				Siemens	Mumbai	A			
45	UPS / ACDB	I				Fuji Electric	Japan	A			

NTPC	PROJECT :RAMMAM (3 X 40 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
	PACKAGE : ELECTROMECHANICAL	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : M/S BHEL	VENDOR AS APPROVED BY	DATE : 21/01/2015
	CONTRACT NO :CS-5602-001	M/S BHEL	

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remarks
64	Normal type Push Buttons/switches/indicators	III				Siemens		N			
		III				Teknic controls		N			
		III				Schneider		N			
		III				Control and Switchgear		N			
65	Contactors	III				Siemens /Schneider/ABB		N			
66	Rotoray switch	III				Kaycee/Salzer		N			
67	Arrow Lamp	III				Signal construct GMBH		N			
68	Electronic Trivector meter	III				Secure meters India (P) ltd	Udaipur	A			
		III				Elster		A			
		III				Landis + Gyr		A			
69	MCB	III				MDS/Indo Copp/ABB/Hevells/Ido Asia		N			
70	Time delay relay	III				Electronic Automation Pvt Ltd		N			
		III				Multicomat	Switzerland	N			
71	Switch mode power supply	III				Powertech/ABB/Phoenix/Wide mullar/Cosel/Lamda		N			
72	Alarm Annunciator Panel/window	III				INDUSTRIAL INSTRUMENTS AND CONTROLS	Hyderabad	A			
		III				Procon	Chennai	A			
		III				Pyrotech	Udaipur	A			
		III				Masibus	Gandhinagar	N			
73	Speed Transducers and Speed signal generator					Braun	Germany	N			
						Jaquet	USA	N			
						Ashoka Electronics	Bhopal	DR			
74	Telecommunication and EPBX System										Refer Note - 5
75	CCTV Components (IP Based)	*				Pelco	USA	DR			Refer Note : 6
		II				Bosch	Brand name	A			Refer Note : 6
		*				Dv Tel	USA	DR			Refer Note : 6
		II				Axis		A			Refer Note : 6
		*				Honeywell	USA	DR			Refer Note : 6

TENTATIVE BOQ OF HVAC SWBD. & COMPONENTS							
SL No.	Swbd. Name	Quantity	Rating (A)	UOM	No of Incomer	No of Bus coupler	Remarks
1	415 V Power House AC MCC	1	400	No	3	2	3 bus section (Drawout)
2	415 V Power House AC & Ventilation MCC	1	400	No	2	1	2 bus section (Drawout)
3	416 V BFV House HVAC MCC	1	100	No	2	1	2 bus section (Drawout)
4	415 V Barrage Area HVAC ACDB	1	200	No	2	1	2 bus section (Fixed)
5	415 V Swyd. EM Building HVAC ACDB	1	200	No	2	1	2 bus section (Fixed)
6	ACDB (WALLMOUNTED) 12 OUTGOING	2	32	No	---	---	Each outgoing shall be 16A, 3 phase (Component selection shall be as per specification)
7	ACDB (WALLMOUNTED) 12 OUTGOING	2	32	No	---	---	
9	LPBS (STRT+STOP)	15	---	No	---	---	
10	LOCAL MOTOR STARTER (0.37 kw to 2.2 kw)	120	---	No	---	---	
11	SWITCHGEAR TOOLS & TACKLES	1	---	Set	---	---	

Note.
The above BOQ is tentative only, the same may change during detailed engineering.

1

Tentative BOQ for 415 V Power House AC MCC						
SL No	MODULE NAME	TYPE	Rating	Unit	NO	Remarks
1	400A INCOMER (TYPE-EM3 I/C, CONTACTOR CONTROLLED)	Component selection shall be as per specification	400	A	3	3 bus section (Drawout)
2	400A Busoupler (TYPE-EM3 B/C, CONTACTOR CONTROLLED)		400	A	2	3 bus section (Drawout)
3	DOL feeder Type-1 (TYPE-DK2)		22	KW	6	Starter Feeder (High inertia Fan with starting time more than 5 sec.)
4	DOL feeder Type-2 (TYPE-DK2)		1.1	KW	5	Starter Feeder
5	Supply feeder Type-1 (E3)		16	A	20	3 phase supply feeder
6	Supply feeder Type-2 (E3)		32	A	4	3 phase supply feeder
7	Supply feeder Type-3 (E3)		63	A	6	3 phase supply feeder
11	Line PT (PART OF INCOMER)		Rating shall be as per requirement	KVA	2	
12	Bus PT (TYPE-G1)			KVA	3	
13	Control Supply Module (TYPE-CS)			KVA	3	
14	Panel Space Heater Module (PS)			KVA	3	

Note:

1 Any other equipment required to complete the system shall be as per specification and deemed to be included along with above BOQ, which shall be evaluated for successful bidder during detailed engineering.

2 Above BOQ is tentative only, which may change during contract stage.
.

3 Bidder to consider vertical panel (including horizontal & Vertical bus bar), all swg. components (Dropper), spare modules and any other essential components while considering complete BOQ of each swbd.

Tentative BOQ for 415 V Power House AC & Vent MCC						
SL NO	MODULE NAME	TYPE	Rating	Unit	NO	Remarks
1	400A INCOMER (TYPE-EM3 I/C)	Component selection shall be as per specification	400	A	2	2 bus section (Drawout)
2	400A Busoupler (TYPE-EM3 B/C)		400	A	1	2 bus section (Drawout)
3	Heater Feeder Type-1 (DK21*)		55	KW	2	Contactor controlled without overload relay
4	Heater Feeder Type-2 (DK21*)		36	KW	2	Contactor controlled without overload relay
5	Heater Feeder Type-3 (DK2*)		12	KW	1	Contactor controlled without overload relay
6	Heater Feeder Type-4 (DK2*)		Up to 6	KW	8	Contactor controlled without overload relay
7	Single Phase Supply feeder Type-1 (E1)		16	A	2	
7	Single Phase Supply feeder Type-2 (E1)		32	A	2	
8	Line PT (PART OF INCOMER)		Rating shall be as per requirement	KVA	2	
9	Bus PT (TYPE-VM)			KVA	2	
10	Control Supply Module (TYPE-CS)			KVA	2	
11	Panel Space Heater Module (TYPE-PS)			KVA	2	

Note:

1 Any other equipment required to complete the system shall be as per specification and deemed to be included along with above BOQ, which shall be evaluated for successful bidder during detailed engineering.

2 Above BOQ is tentative only, which may change during contract stage.
.

3 Bidder to consider vertical panel (including horizontal & Vertical bus bar), all swg. components (Dropper), spare modules and any other essential components while considering complete BOQ of each swbd.

Tentative BOQ for 415 V Power House AC MCC						
SL No	MODULE NAME	TYPE	Rating	Unit	NO	Remarks
1	100A INCOMER (TYPE-EM3 I/C)	Component selection shall be as per specification	100	A	3	3 bus section (Drawout)
2	100A Busoupler (TYPE-EM3 B/C)		100	A	2	3 bus section (Drawout)
4	DOL feeder Type-1 (TYPE-DK2)		7.5	KW	1	Starter Feeder
5	DOL feeder Type-2 (TYPE-DK2)		5.5	A	1	3 phase supply feeder
6	Supply feeder Type (E3)		16	A	12	3 phase supply feeder
7	Supply feeder Type (E1)		16	A	5	3 phase supply feeder
11	Line PT (PART OF INCOMER)		Rating shall be as per requirement	KVA	2	
12	Bus PT (TYPE-G1)			KVA	2	
13	Control Supply Module (TYPE-CS)			KVA	2	
14	Panel Space Heater Module (PS)			KVA	2	

Note:

1 Any other equipment required to complete the system shall be as per specification and deemed to be included along with above BOQ, which shall be evaluated for successful bidder during detailed engineering.

2 Above BOQ is tentative only, which may change during contract stage.
.

3 Bidder to consider vertical panel (including horizontal & Vertical bus bar), all swg. components (Dropper), spare modules and any other essential components while considering complete BOQ of each swbd.

Tentative BOQ for 415 V Barrage Area HVAC ACDB						
SL No	MODULE NAME	TYPE	Rating	Unit	NO	Remarks
1	200A INCOMER	Component selection shall be as per specification	200	A	2	Fixed Type
2	200A Busoupler		200	A	1	Fixed Type
3	Supply feeder Type-1 (E3)		16	A	42	3 phase supply feeder Fixed type
4	Bus PT (G1)		Rating shall be as per requirement	KVA	2	Fixed Type
5	Panel Space Heater Module (PS)			KVA	2	Fixed Type

Note:

1 Any other equipment required to complete the system shall be as per specification and deemed to be included along with above BOQ, which shall be evaluated for successful bidder during detailed engineering.

2 Above BOQ is tentative only, which may change during contract stage.
.

3 Bidder to consider vertical panel (including horizontal & Vertical bus bar), all swg. components (Dropper), spare modules and any other essential components while considering complete BOQ of each swbd.

Tentative BOQ for 415 V Swyd. Area HVAC ACDB						
SL No	MODULE NAME	TYPE	Rating	Unit	NO	Remarks
1	200A INCOMER	Component selection shall be as per specification	200	A	2	Fixed Type
2	200A Busoupler		200	A	1	Fixed Type
3	Supply feeder Type-1 (E3)		16	A	45	3 phase supply feeder Fixed type
4	Bus PT (G1)		Rating shall be as per requirement	KVA	2	Fixed Type
5	Panel Space Heater Module (PS)			KVA	2	Fixed Type

Note:

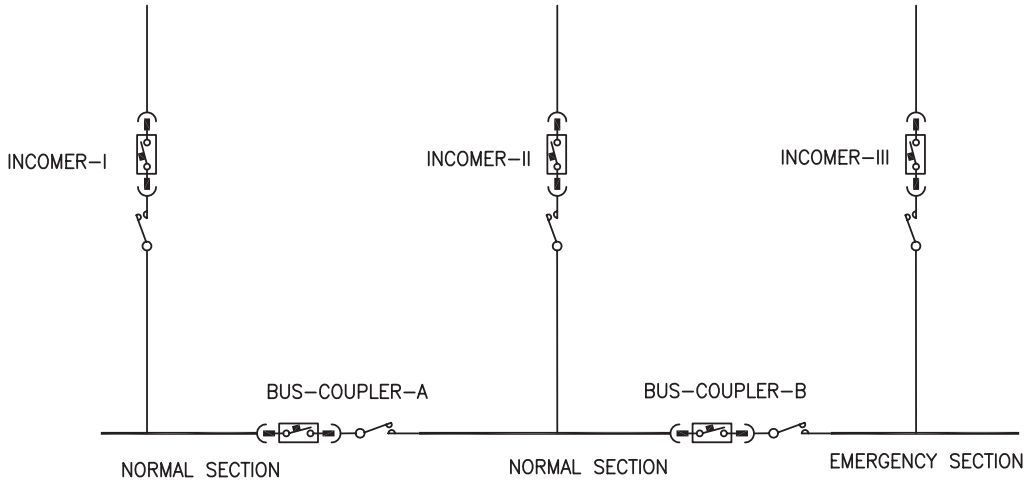
1 Any other equipment required to complete the system shall be as per specification and deemed to be included along with above BOQ, which shall be evaluated for successful bidder during detailed engineering.

2 Above BOQ is tentative only, which may change during contract stage.
.

3 Bidder to consider vertical panel (including horizontal & Vertical bus bar), all swg. components (Dropper), spare modules and any other essential components while considering complete BOQ of each swbd.

REPRESENTATIVE SINGLE LINE DIAGRAM FOR HVAC LT BOARDS

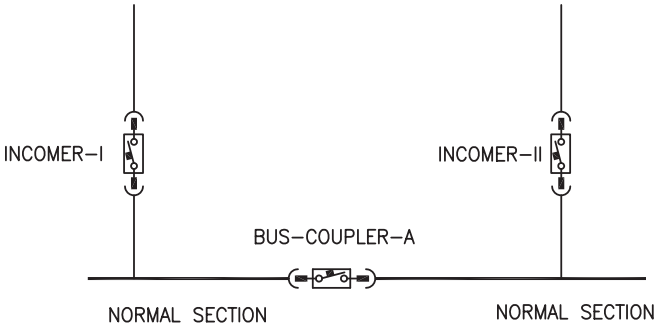
(FOR TENDER PURPOSE ONLY)



TYPICAL SINGLE LINE DIAGRAM FOR LT SWBD. WITH EMG. SECTION (DRAWOUT TYPE)

NOTE:

1. EACH INCOMER SHALL BE CAPABLE OF CATERING LOAD OF 2 ADJACENT BUS SECTIONS, i.e. INCOMER-I SHALL BE CAPABLE OF CATERING THE LOAD OF BUS SECTION - A & B; INCOMER-II SHALL BE CAPABLE OF CATERING LOADS OF BUS SECTION-A & B OR B & C; INCOMER -III SHALL BE CAPABLE OF CATERING LOADS OF BUS SECTION-B & C.
2. IN NORMAL OPERATING CONDITION ALL THREE INCOMERS SHALL CATER THE LOAD OF THEIR RESPECTIVE BUS SECTION, HOWEVER UPON FAILURE OF INCOMER-I, INCOMER-II SHALL CATER THE LOAD OF SECTION-A & SECTION-B THROUGH BUS COUPLER-A & VICE VERSA.
3. BUS SECTION-C SHALL BE CONSIDERED AS EMERGENCY BUS, AS ALL EMERGENCY LOADS SHALL BE CONNECTED TO THIS SECTION. UPON FAILURE OF NORMAL SUPPLY INCOMER-I & INCOMER-II SHALL AUTOMATICALLY TRIP ALONG WITH BUS COUPLER-B.



TYPICAL SINGLE LINE DIAGRAM FOR LT SWBD. (DRAWOUT & FIXED TYPE)

LEGEND



MCCB



CONTACTOR

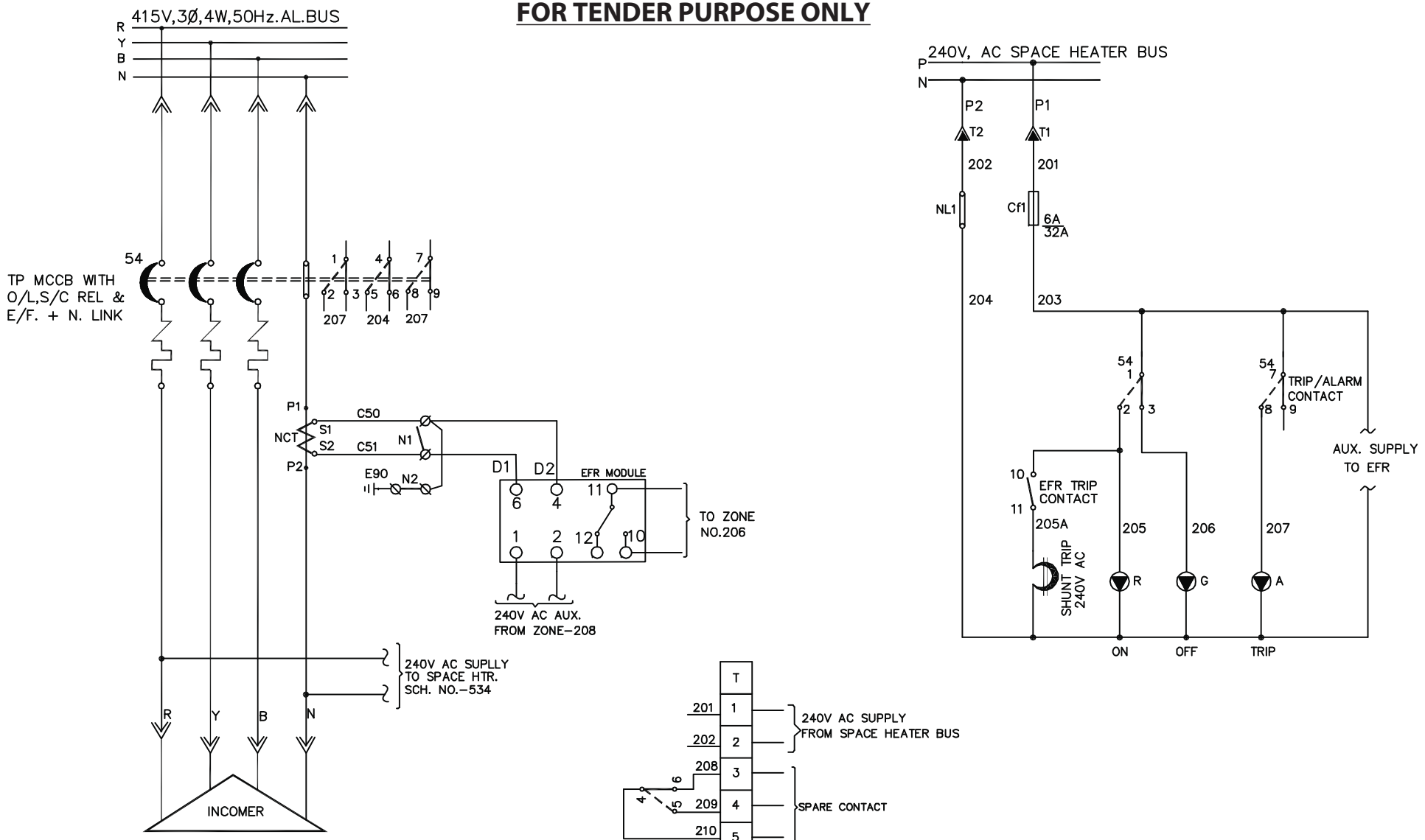
REPRESENTATIVE SCHEMES

FOR

LT SWGR INCOMER, BUS COUPLER & OUTGOING FEEDERS

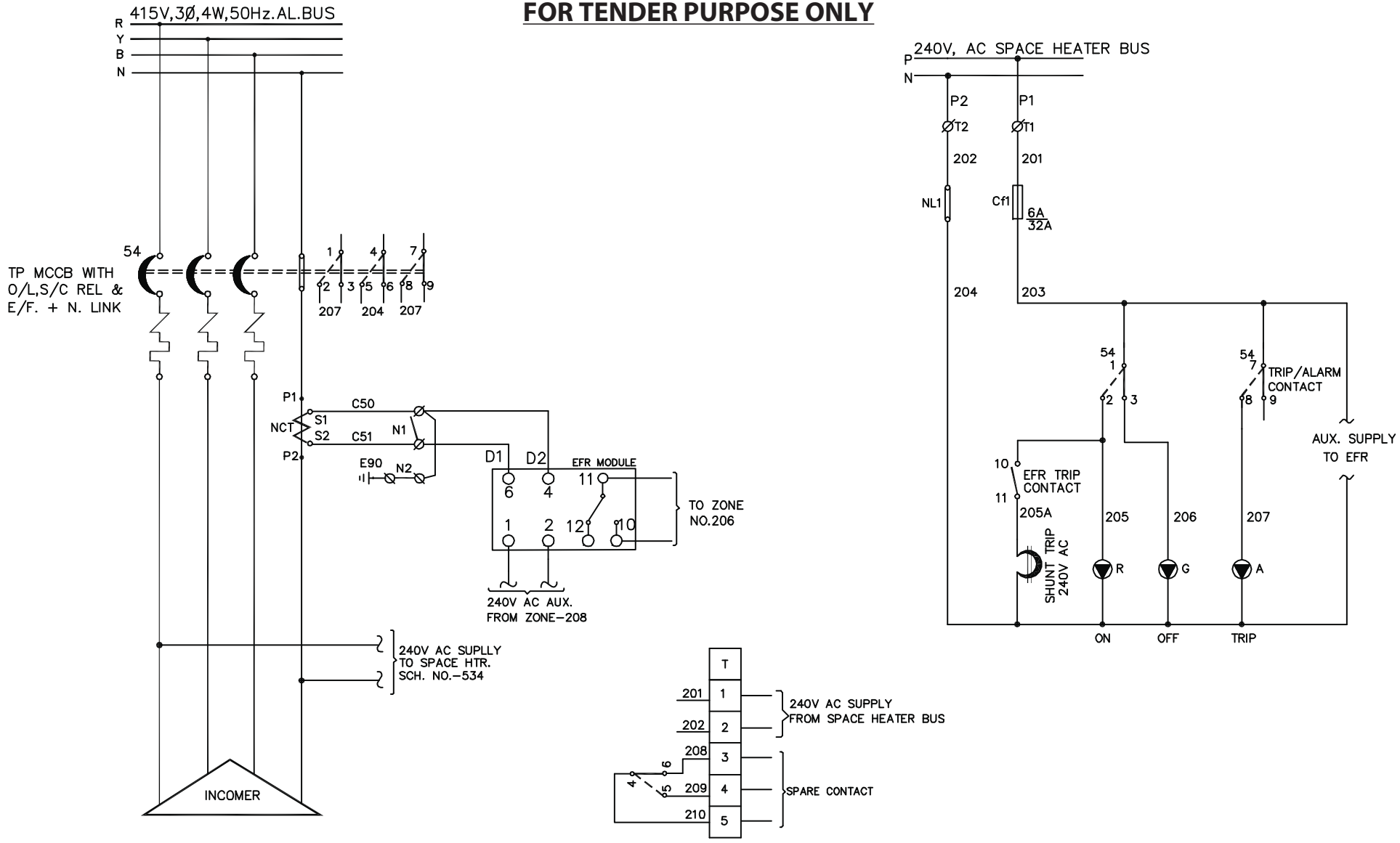
(FOR TENDER PURPOSE ONLY)

FOR TENDER PURPOSE ONLY

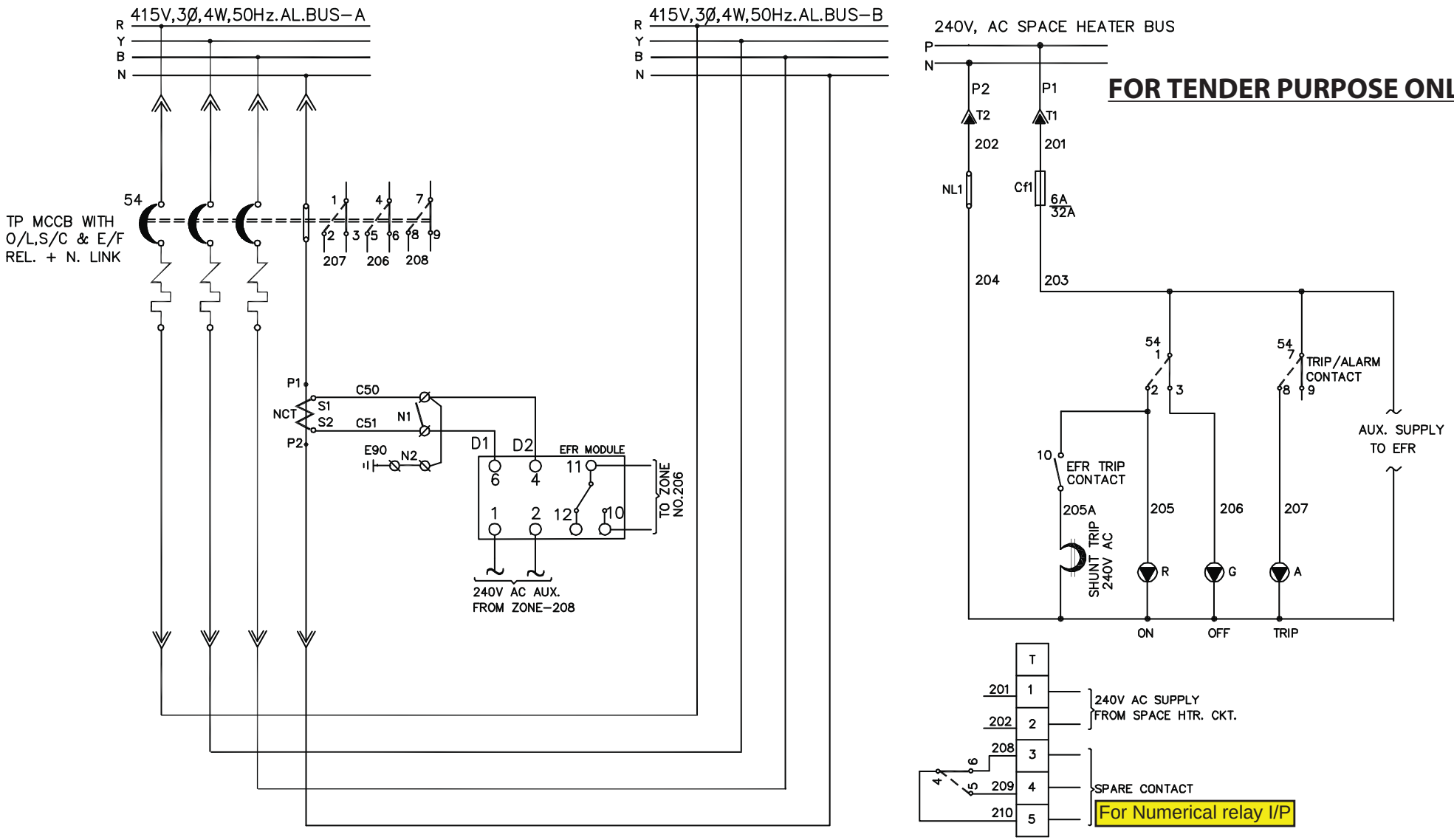


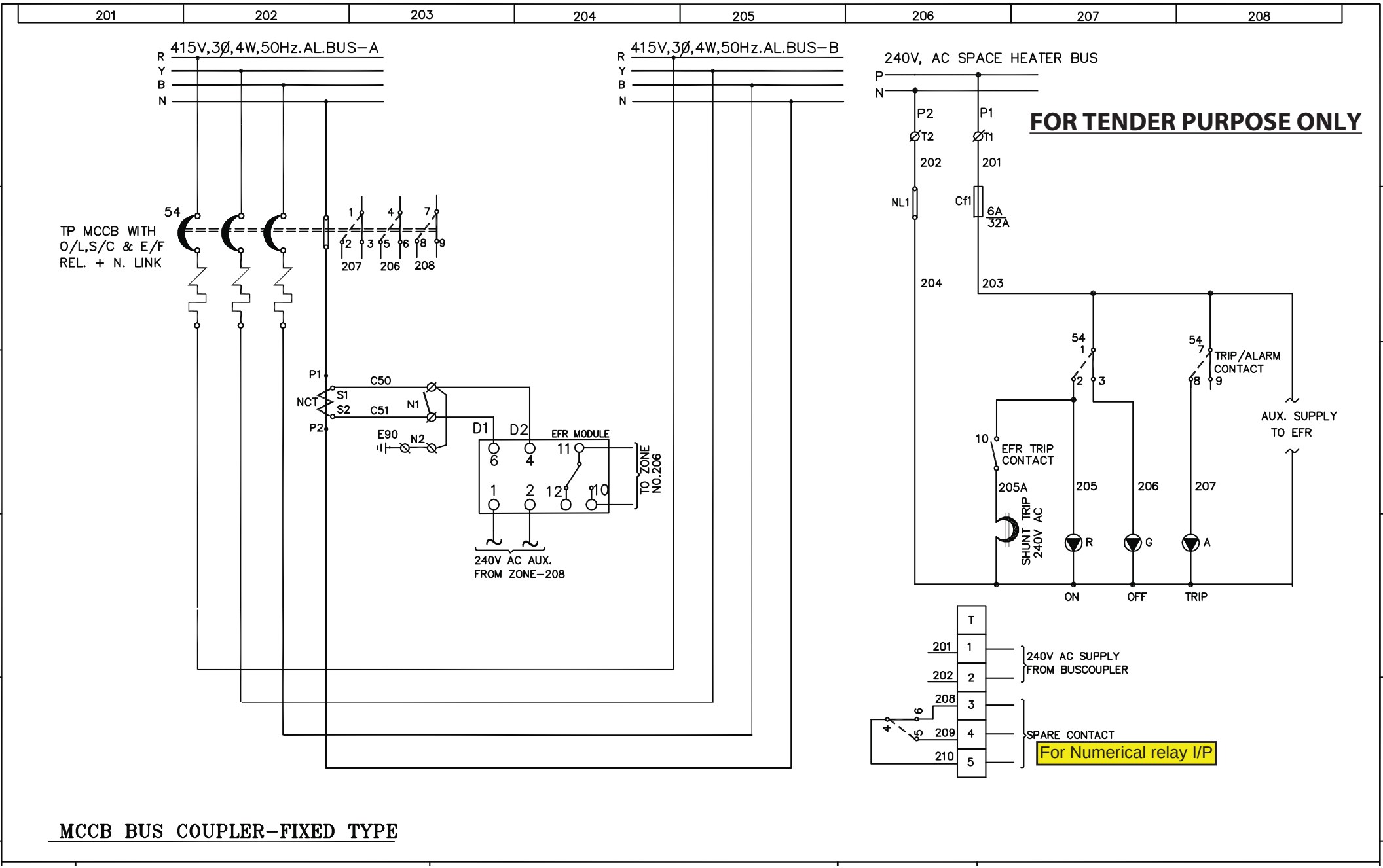
MCCB INCOMER-D/O TYPE

FOR TENDER PURPOSE ONLY



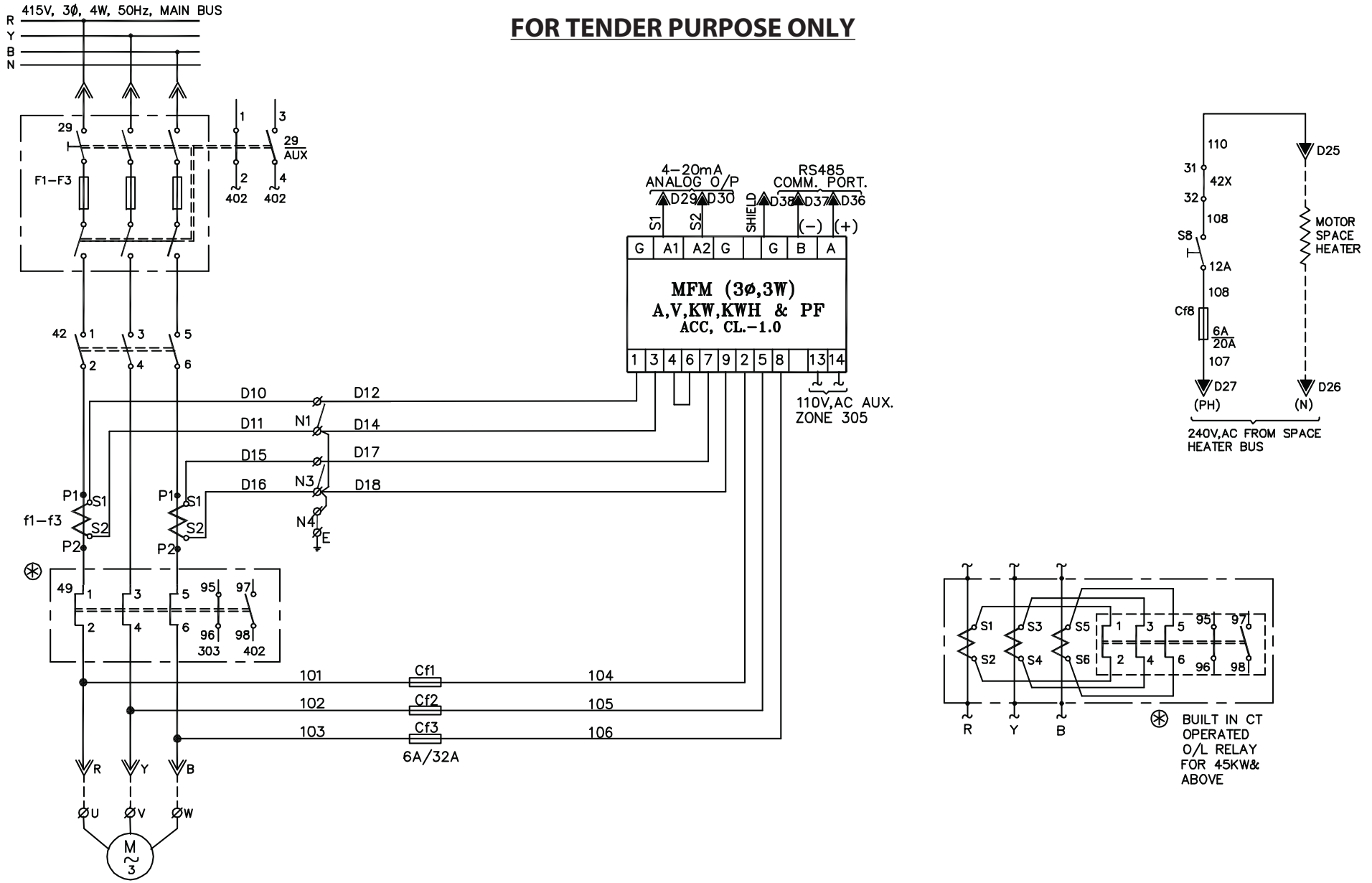
MCCB INCOMER-FIXED TYPE


201
202
203
204
205
206
207
208
415V,3Ø,4W,50Hz.AL.BUS–A
R
Y
B
N
54
TP MCCB WITH
O/L,S/C & E/F
REL. + N. LINK
1
4
7
2
3
5
6
8
9
207
206
208
P1
NCT
S1
S2
P2
C50
C51
N1
E90
N2
D1
D2
EFR MODULE
11
6
4
1
2
12
10
TO ZONE
NO.206
240V AC AUX.
FROM ZONE–208
415V,3Ø,4W,50Hz.AL.BUS–B
240V, AC SPACE HEATER BUS
P
N
P2
P1
T2
T1
202
201
NL1
Cf1
6A
32A
204
203
54
1
2
3
TRIP/ALARM
CONTACT
7
8
9
AUX. SUPPLY
TO EFR
10
EFR TRIP
CONTACT
205A
205
206
207
SHUNT TRIP
240V AC
R
G
A
ON
OFF
TRIP
T
201
1
240V AC SUPPLY
FROM SPACE HTR. CKT.
202
2
208
3
4
6
5
209
4
SPARE CONTACT
210
5
For Numerical relay I/P
FOR TENDER PURPOSE ONLY
MCCB BUS COUPLER–D/O TYPE



MCCB BUS COUPLER–FIXED TYPE

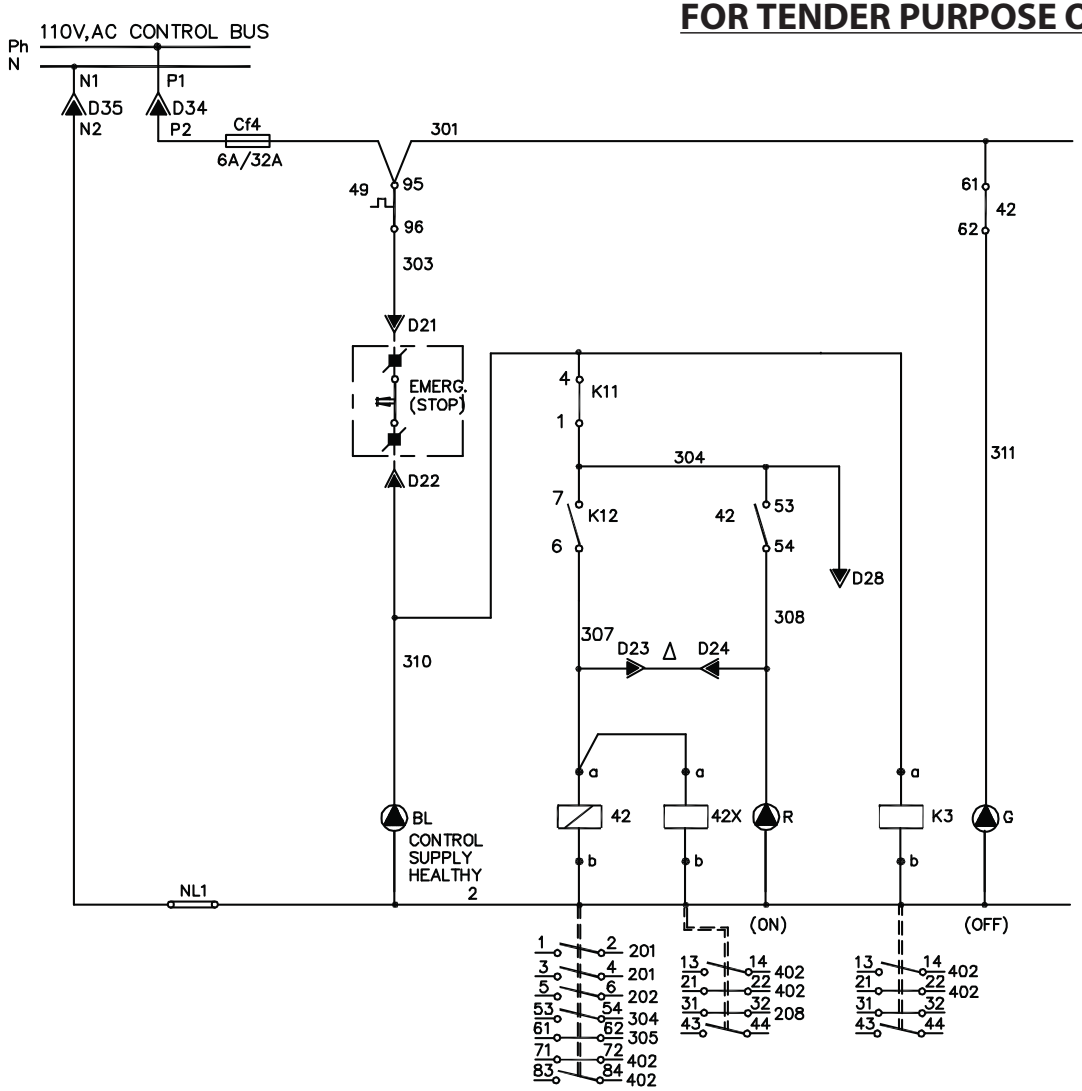
FOR TENDER PURPOSE ONLY



SCHEMATIC/WIRING DIAGRAM APPLICABLE FOR MODULE TYPE DK21 DDCMIS CONTROLLED UNIDIRECTIONAL DRIVES 30KW & BELOW 110KW

301	302	303	304	305	306	307	308

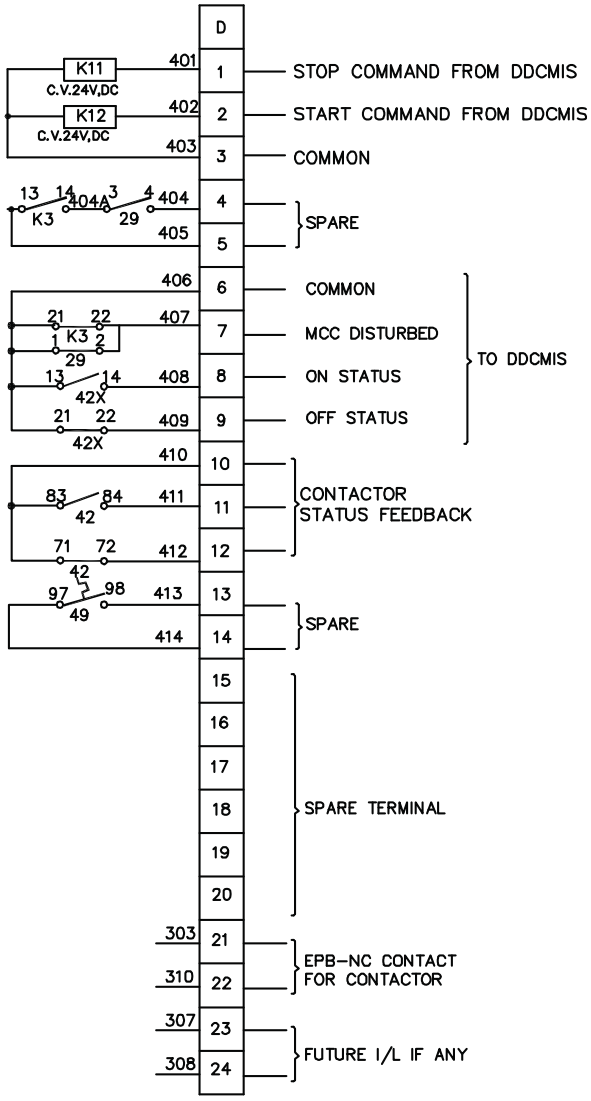
FOR TENDER PURPOSE ONLY

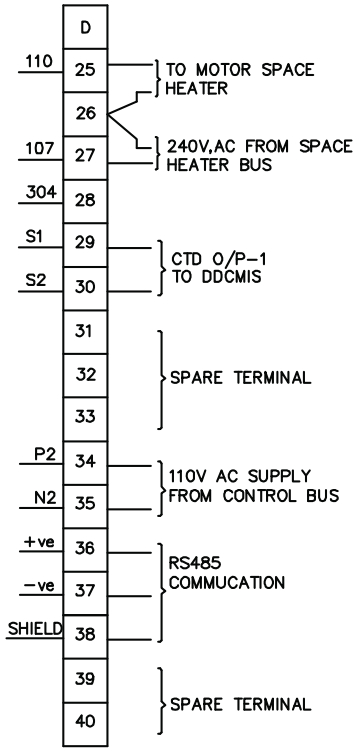


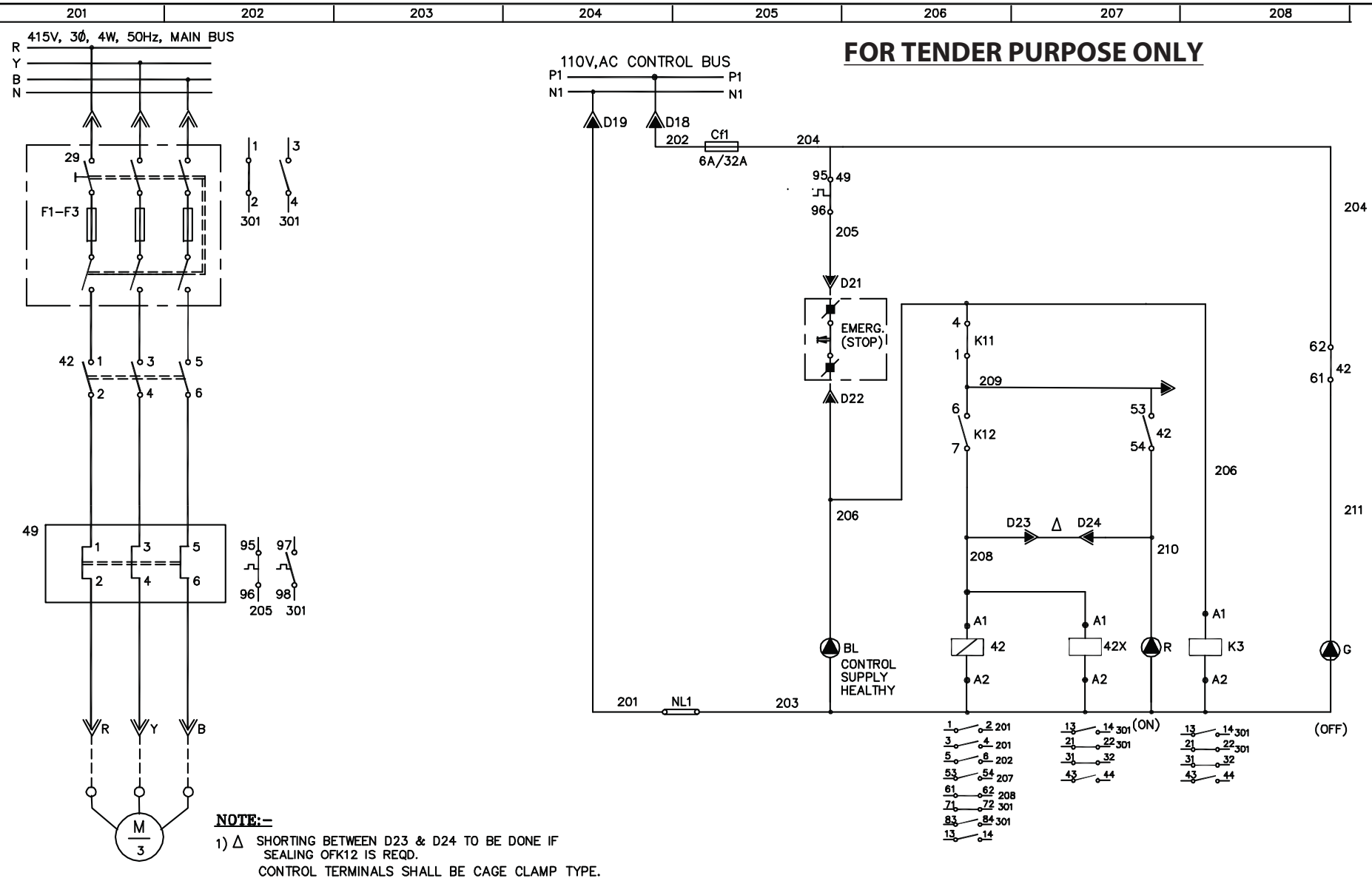
NOTE:-

1) Δ SHORTING BETWEEN D23 & D24 TO BE DONE IF SEALING OF K12 IS REQD.
2) CONTROL TERMINALS SHALL BE CAGE CLAMP TYPE.

FOR TENDER PURPOSE ONLY

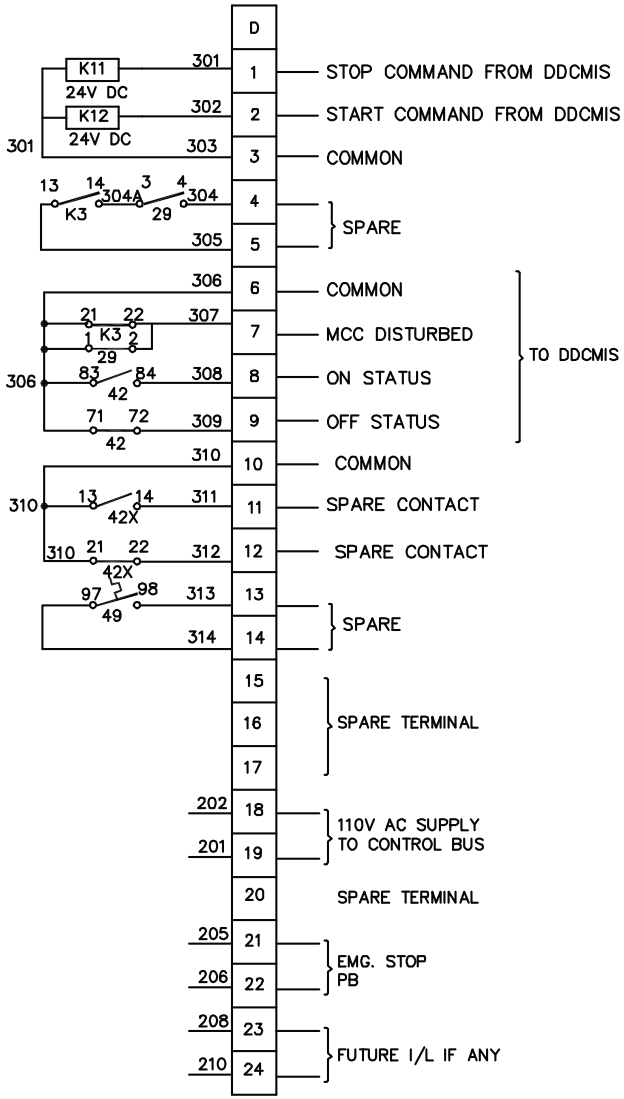


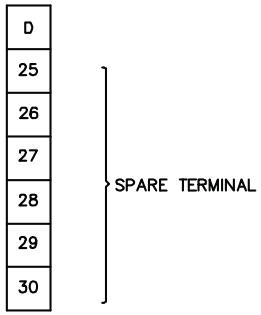




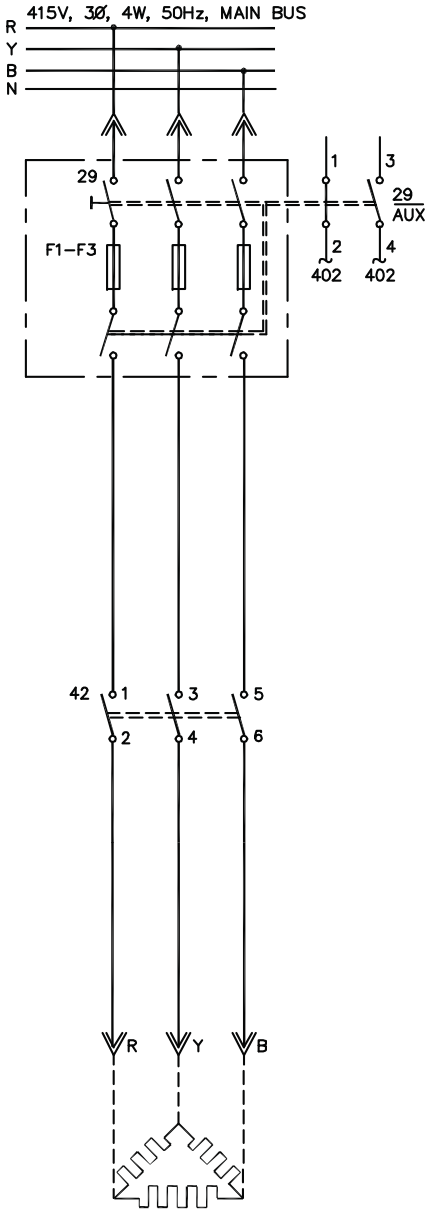
SCHEMATIC/WIRING DIAGRAM APPLICABLE FOR MODULE TYPE DK2 DDC/PLC CONTROLLED UNIDIRECTIONAL DRIVES UPTO 30 KW

FOR TENDER PURPOSE ONLY





201	202	203	204	205	206	207	208

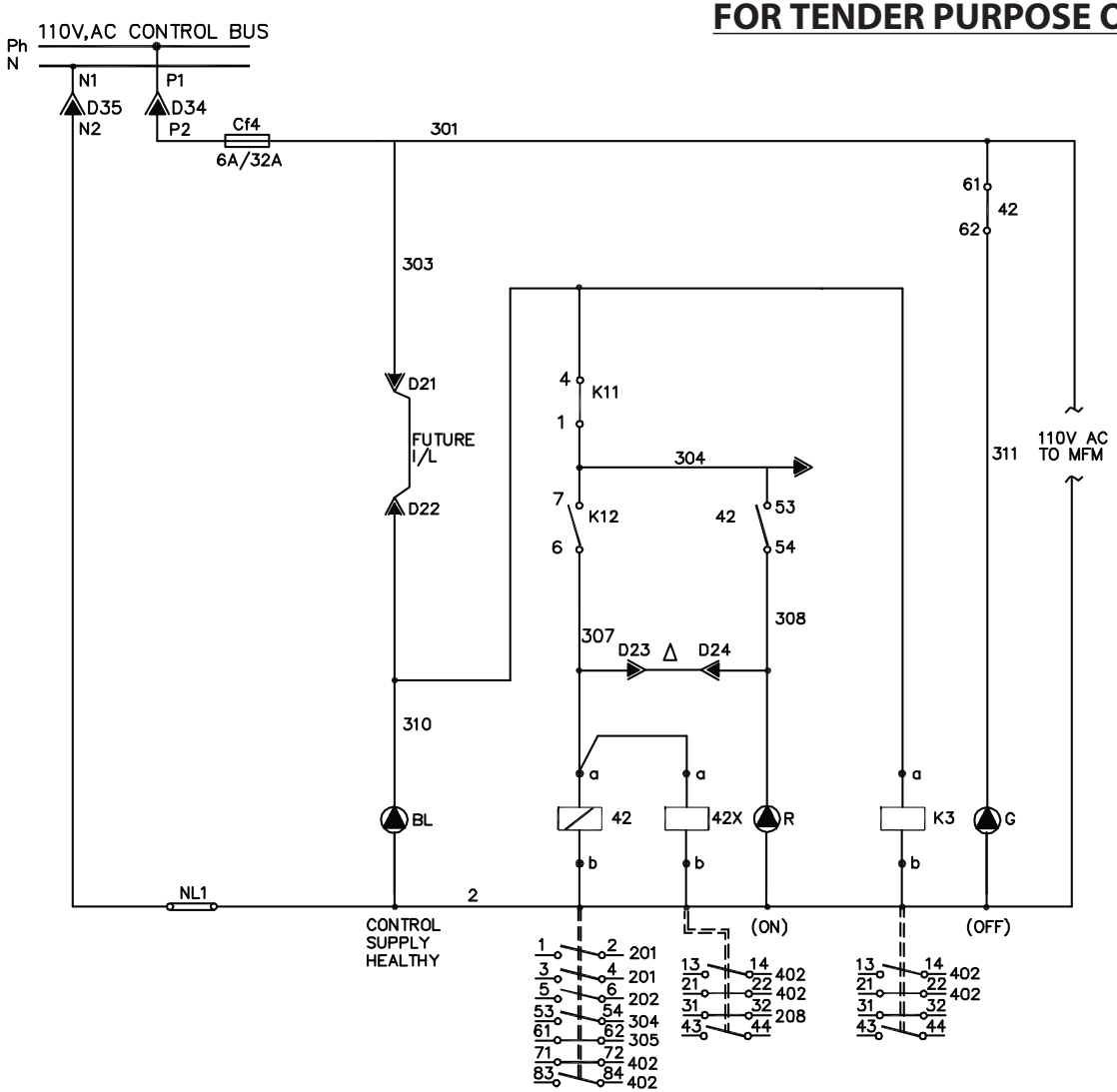


FOR TENDER PURPOSE ONLY

SCHEMATIC/WIRING DIAGRAM APPLICABLE FOR MODULE TYPE DK21* 3 PHASE HEATER FEEDER

301	302	303	304	305	306	307	308

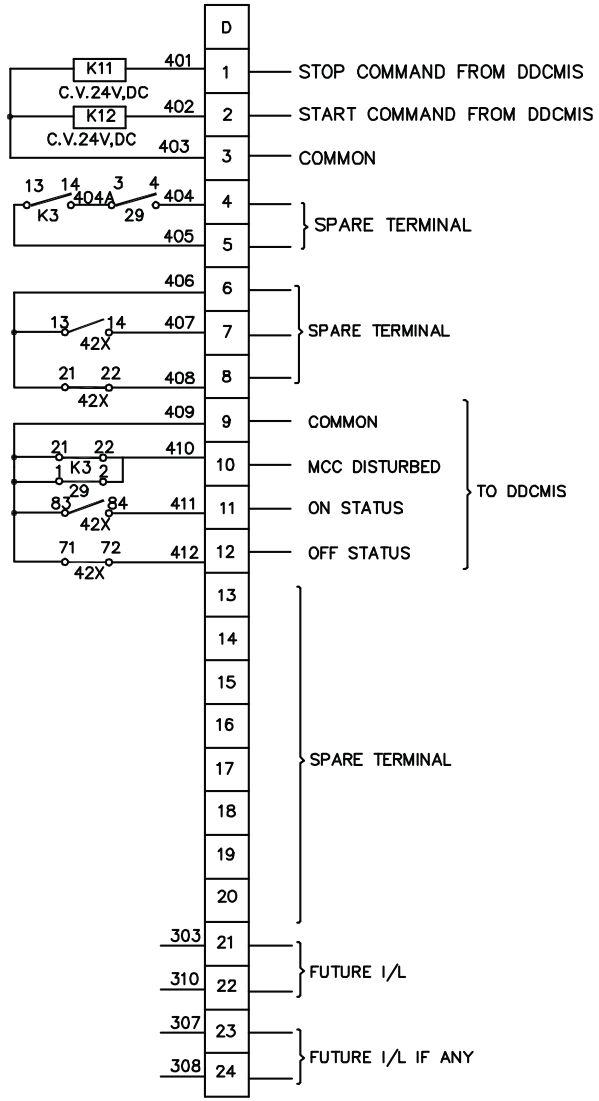
FOR TENDER PURPOSE ONLY

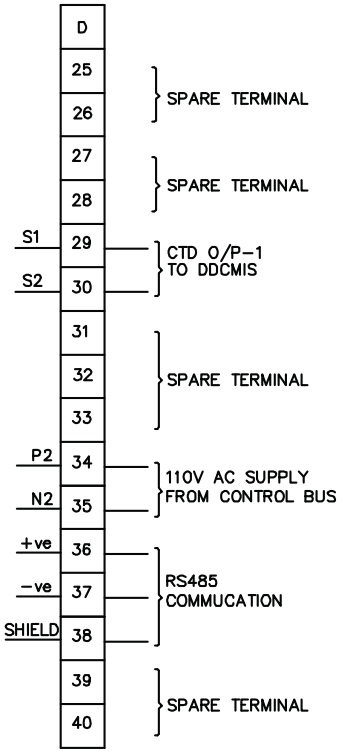


NOTE:-

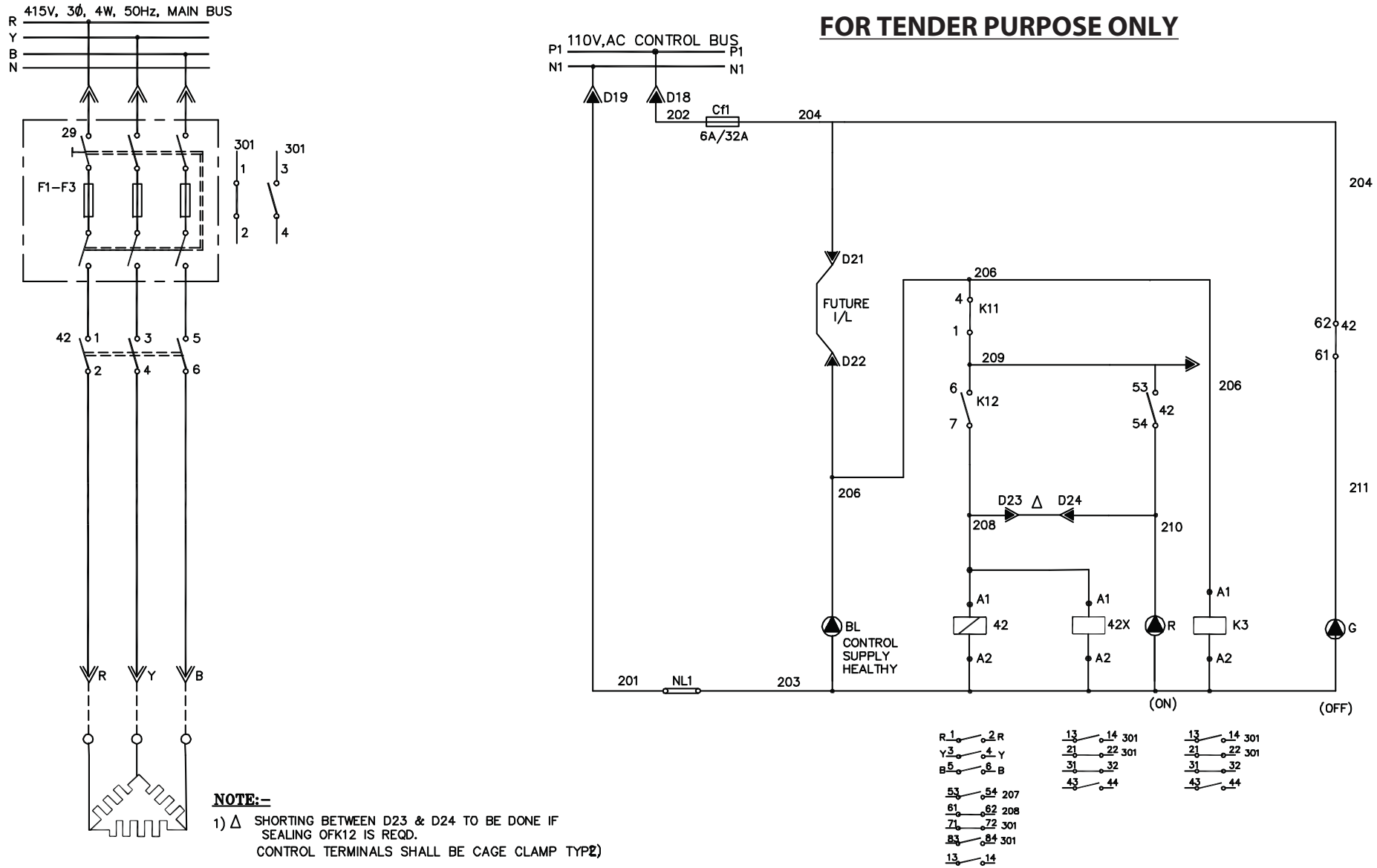
1) Δ SHORTING BETWEEN D23 & D24 TO BE DONE IF SEALING OF K12 IS REQD.
2) CONTROL TERMINALS SHALL BE CAGE CLAMP TYPE.

FOR TENDER PURPOSE ONLY





FOR TENDER PURPOSE ONLY



NOTE:–

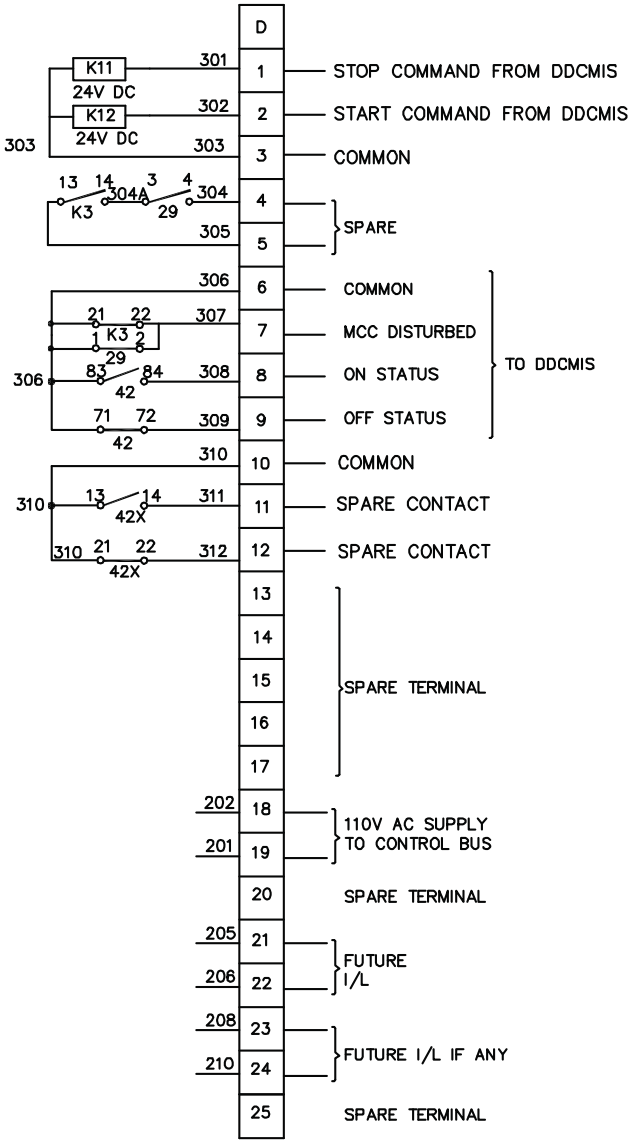
1) Δ SHORTING BETWEEN D23 & D24 TO BE DONE IF SEALING OFK12 IS REQD.
CONTROL TERMINALS SHALL BE CAGE CLAMP TYPE)

Heaters

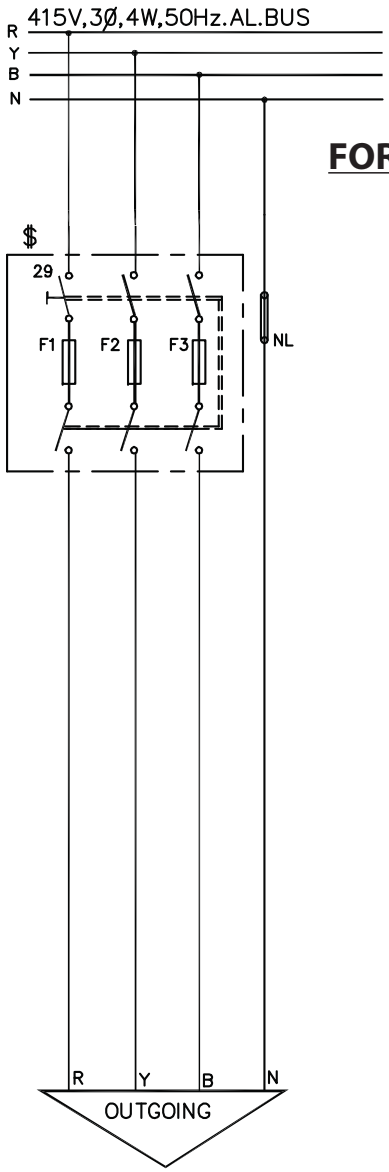
SCHEMATIC/WIRING DIAGRAM APPLICABLE FOR MODULE TYPE DK2 DDC/PLC CONTROLLED UNIDIRECTIONAL DRIVES UPTO 30 KW**

301	302	303	304	305	306	307	308

FOR TENDER PURPOSE ONLY

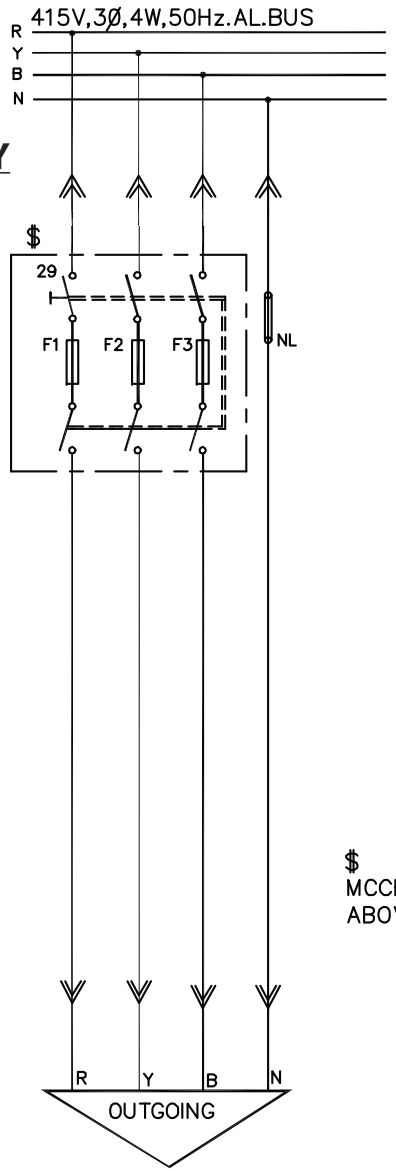


201	202	203	204	205	206	207	208



SCHEME APPLICABLE FOR MODULE TYPE–E (FIXED TYPE)
3PH+NEUTRAL OUTGOING SFU FEEDER

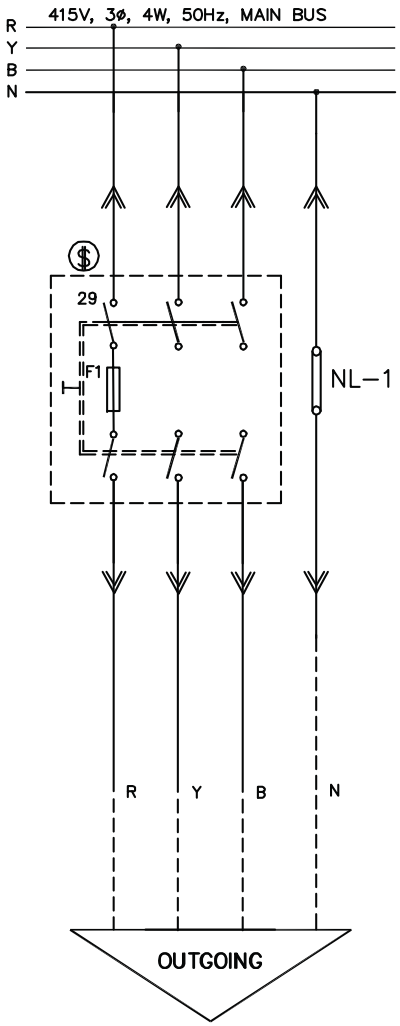
FOR TENDER PURPOSE ONLY



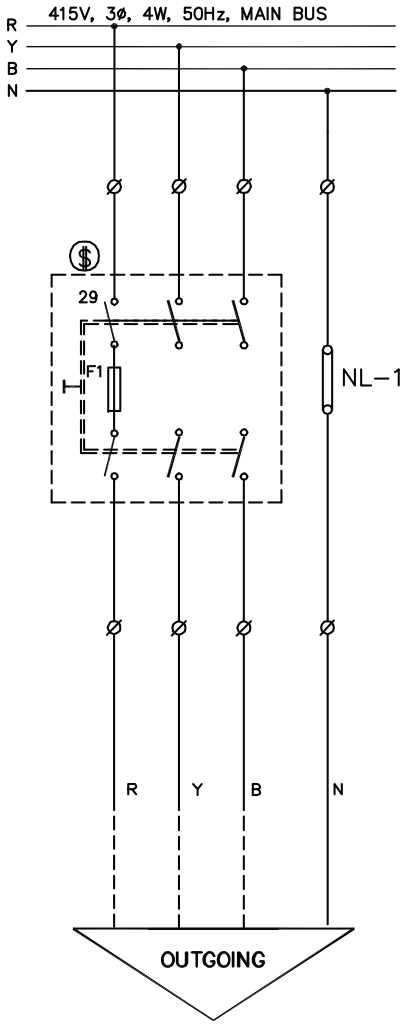
SCHEME APPLICABLE FOR MODULE TYPE–E (DRAWOUT TYPE)
3PH+NEUTRAL OUTGOING SFU FEEDER

$
MCCB SHALL BE PROVIDED FOR 100A &
ABOVE RATING FEEDER.

FOR TENDER PURPOSE ONLY



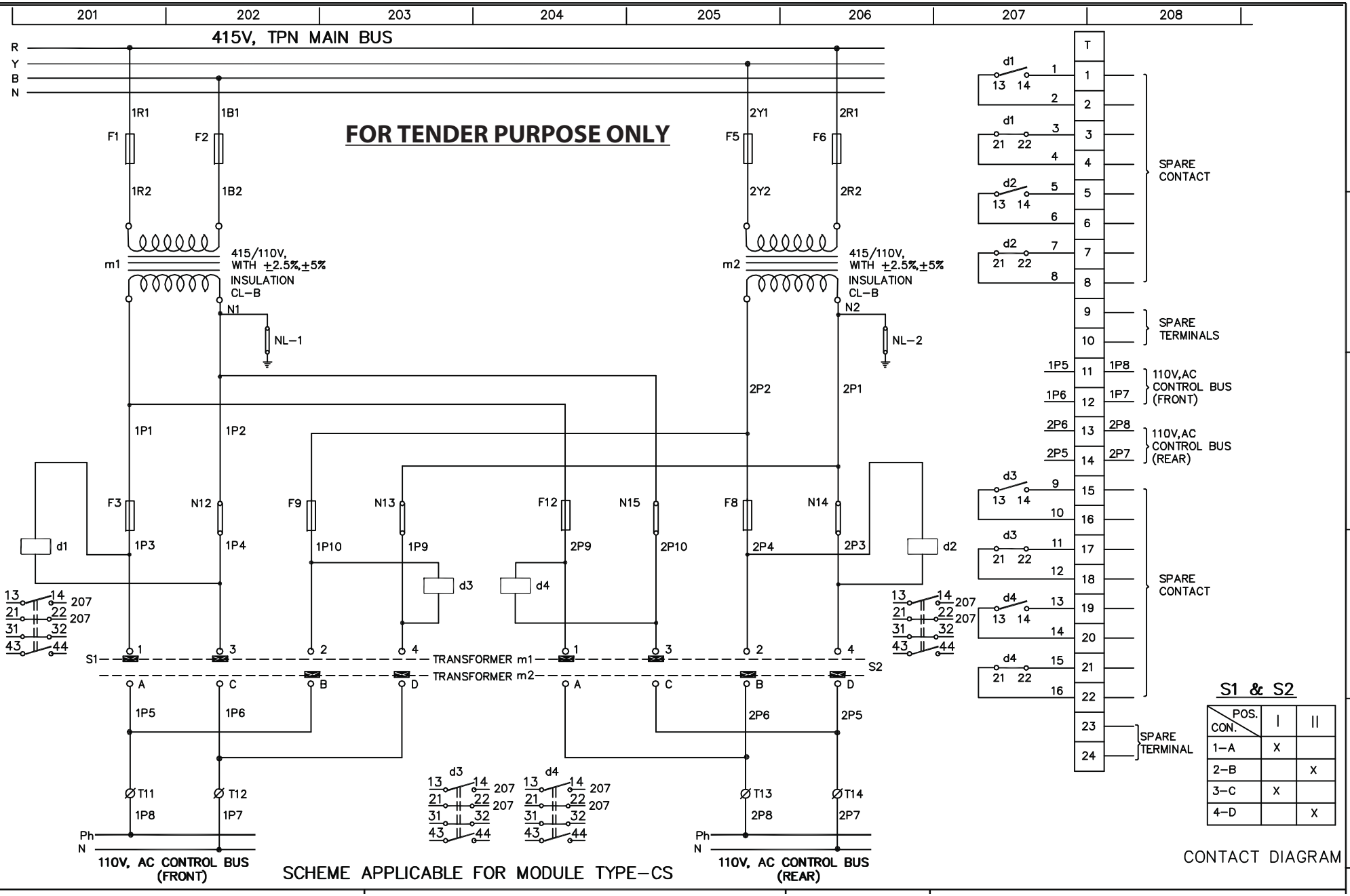
DRAW OUT TYPE SFU FEEDER



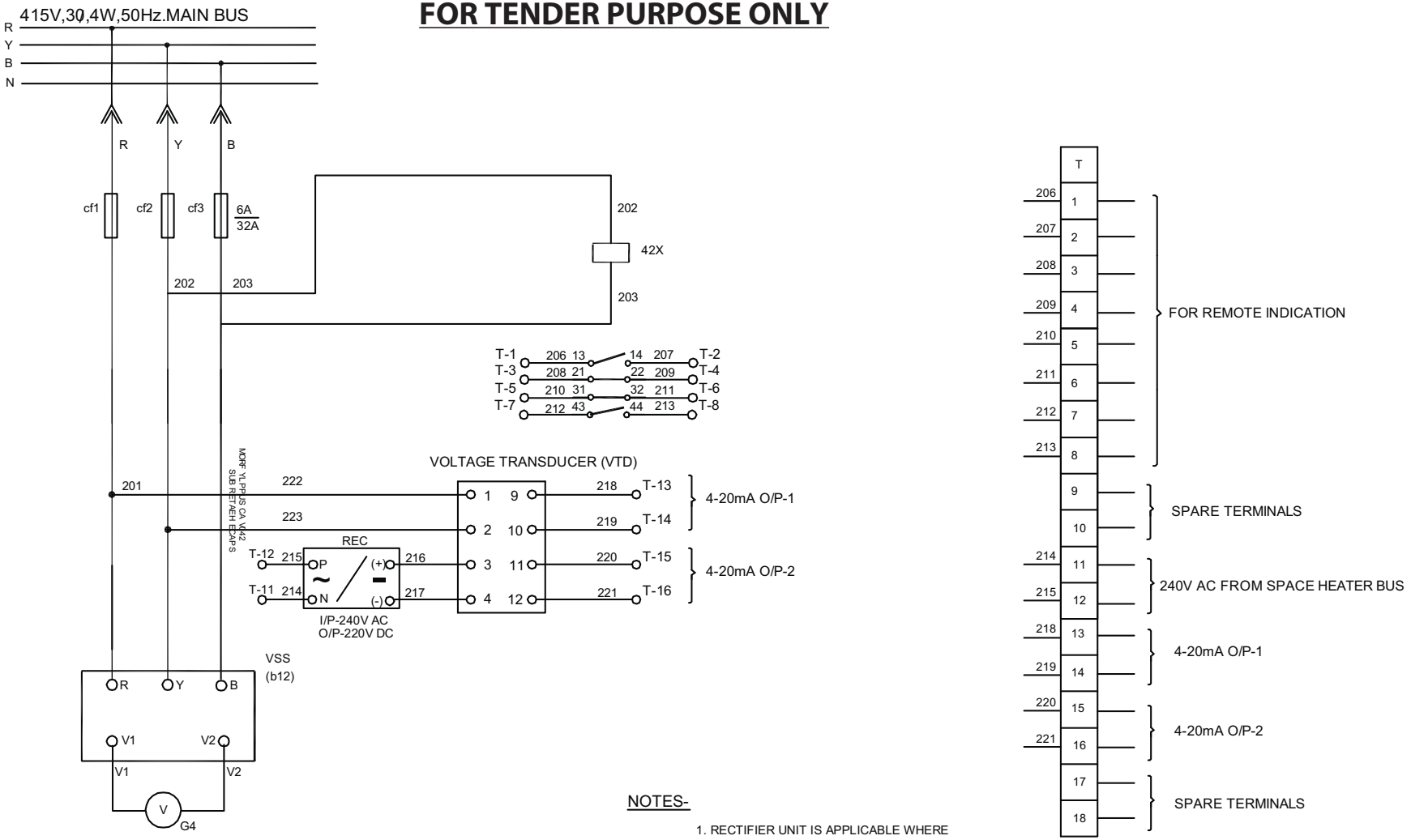
FIXED OUT TYPE SFU FEEDER

NOTE: –

1. EXACT PHASES FOR OUTGOING SHALL BE AS PER THE SLD.
2. E1 TYPE FEEDER IS EXACTLY THE SAME AS E TYPE EXCEPT FOR THE NUMBER OF FUSES
3. ($) MCCB SHALL BE PROVIDED FOR 100A & ABOVE RATING FEEDER.


201
202
203
204
205
206
207
208
415V, TPN MAIN BUS
R
Y
B
N
FOR TENDER PURPOSE ONLY
1R1
1B1
2Y1
2R1
F1
F2
F5
F6
1R2
1B2
2Y2
2R2
m1
415/110V,
WITH ±2.5%,±5%
INSULATION
CL–B
m2
415/110V,
WITH ±2.5%,±5%
INSULATION
CL–B
N1
NL–1
N2
NL–2
2P2
2P1
1P1
1P2
F3
N12
F9
N13
F12
N15
F8
N14
d1
1P3
1P4
1P10
1P9
2P9
2P10
2P4
2P3
d2
d3
d4
13 14 207
21 22 207
31 32
43 44
S1
S2
TRANSFORMER m1
TRANSFORMER m2
A
C
B
D
1P5
1P6
2P6
2P5
T11
T12
T13
T14
1P8
1P7
2P8
2P7
Ph
N
110V, AC CONTROL BUS
(FRONT)
SCHEME APPLICABLE FOR MODULE TYPE–CS
110V, AC CONTROL BUS
(REAR)
T
SPARE
CONTACT
SPARE
TERMINALS
110V,AC
CONTROL BUS
(FRONT)
110V,AC
CONTROL BUS
(REAR)
SPARE
CONTACT
SPARE
TERMINAL
S1 & S2
POS.
CON.
I
II
1–A
2–B
3–C
4–D
CONTACT DIAGRAM

FOR TENDER PURPOSE ONLY

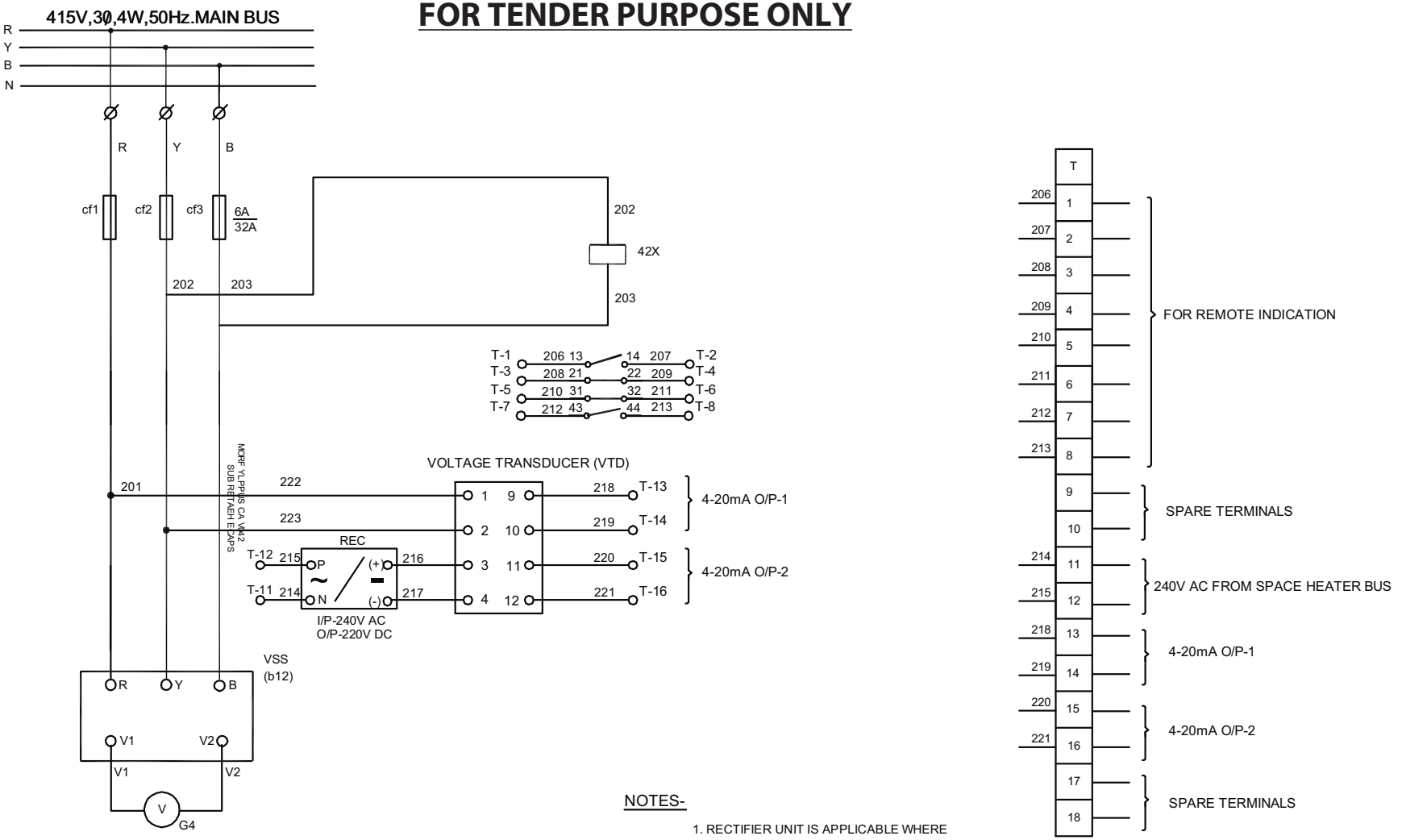


SCHEMATIC DIAGRAM FOR MODULE TYPE-VM
(DRAWOUT TYPE)

NOTES-

1. RECTIFIER UNIT IS APPLICABLE WHERE DC SUPPLY IS NOT AVAILABLE.

FOR TENDER PURPOSE ONLY



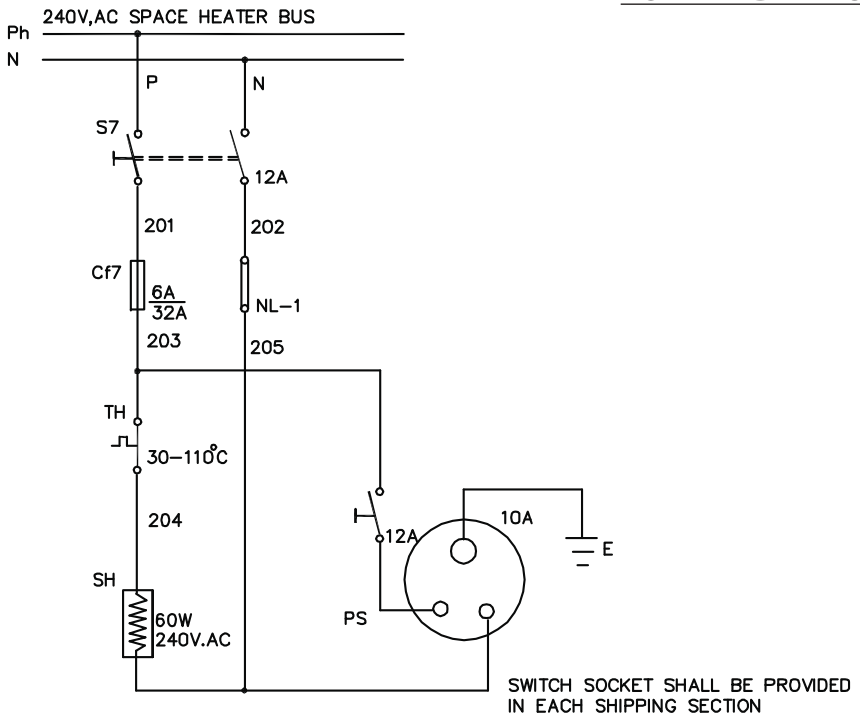
SCHEMATIC DIAGRAM FOR MODULE TYPE-VM
(FIXED TYPE)

NOTES-

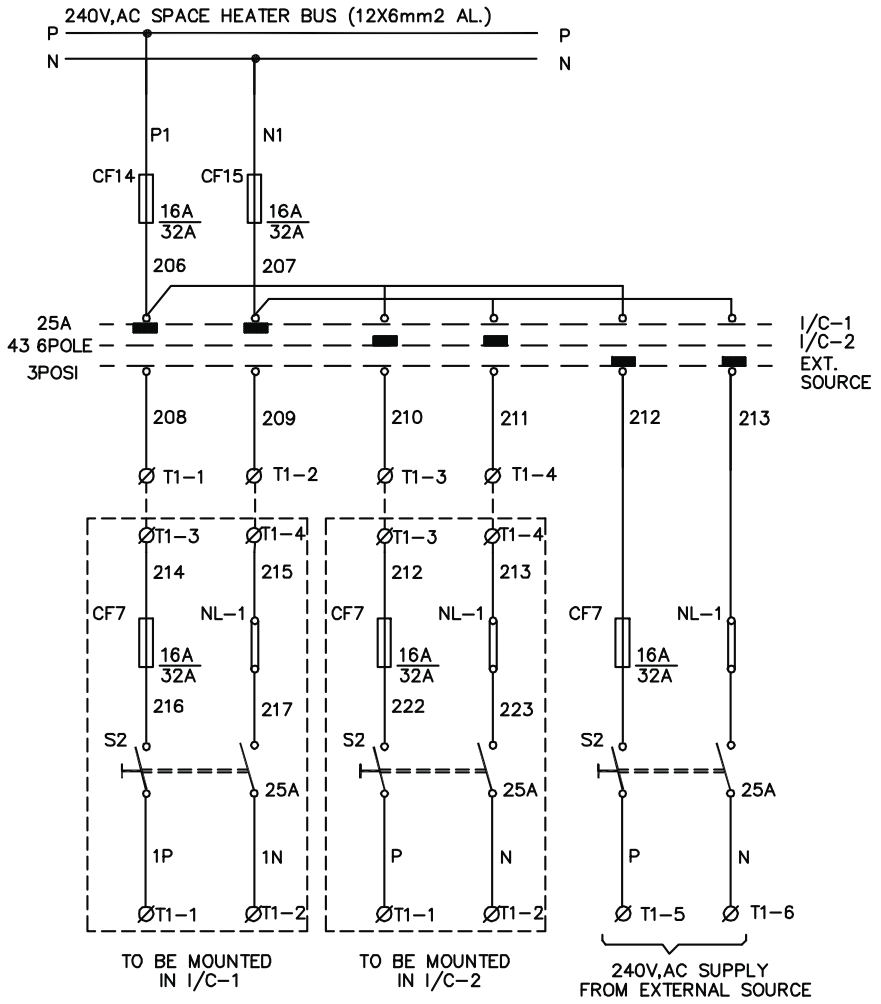
1. RECTIFIER UNIT IS APPLICABLE WHERE DC SUPPLY IS NOT AVAILABLE.

T (FIXED)

FOR TENDER PURPOSE ONLY



PANEL SPACE HEATER CIRCUIT SHALL BE PROVIDED IN CABLE ALLEY OF EACH VERTICAL PANEL



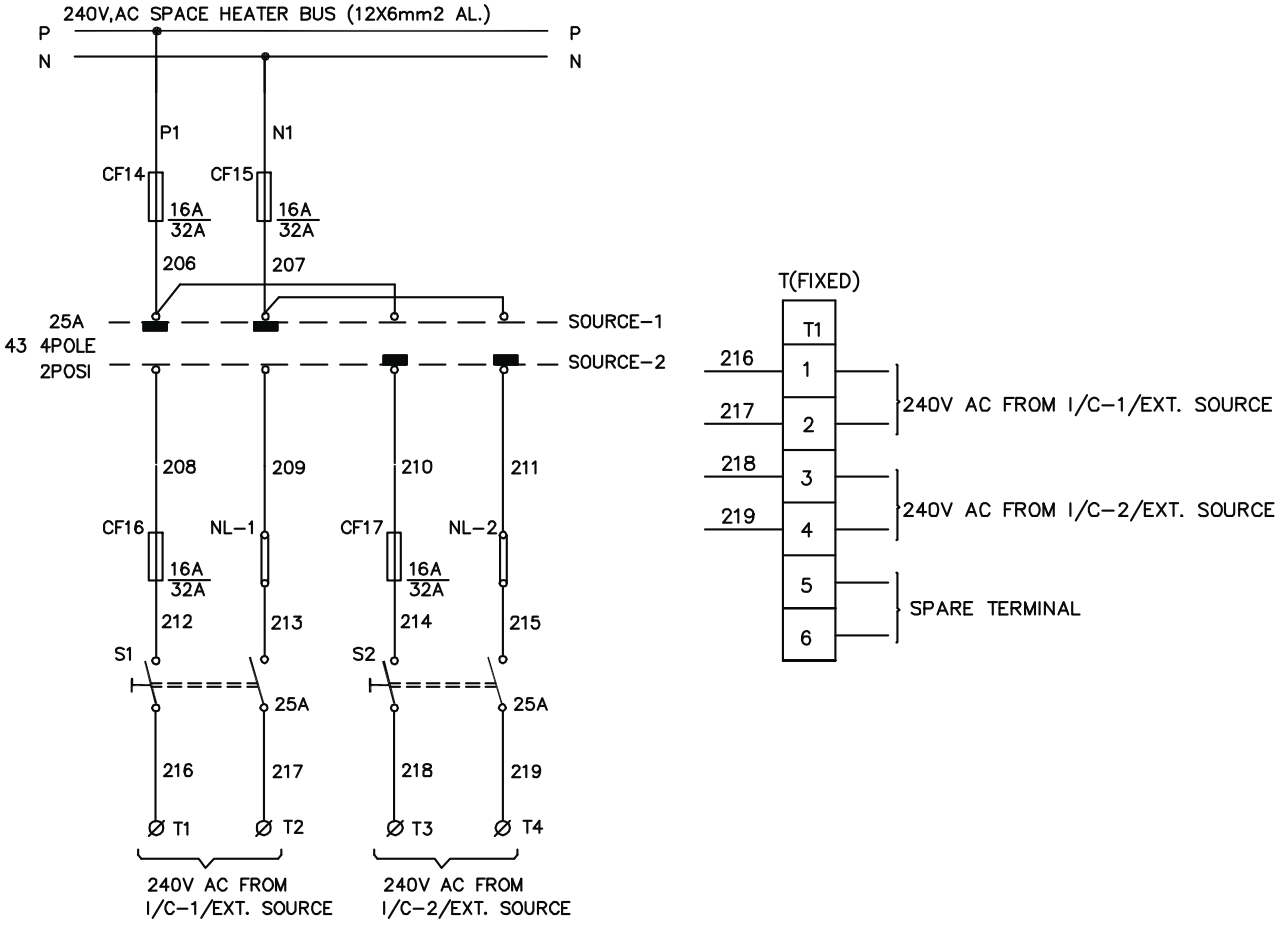
NOTE:-

1. 240V, AC SUPPLY SOURCE FOR SPACE HEATER BUS TO BE PROVIDED IN BUSCOUPLER FEEDER WHERE TWO I/C AND ONE B/C ARE THERE.
2. 240V, AC SUPPLY SOURCE FOR SPACE HEATER BUS TO BE PROVIDED IN I/C-1 FEEDER WHERE TWO INCOMERS ARE THERE.

SCHEME APPLICABLE FOR 3PHASE &

4WIRE SYSTEM FOR AC BOARDS

FOR TENDER PURPOSE ONLY



NOTE:-

1. 240V, AC SUPPLY SOURCE FOR SPACE HEATER BUS TO BE PROVIDED IN INCOMER-1 WHERE TWO INCOMER ARE THERE OR INCOMER FEEDER WHERE ONLY ONE INCOMER IS THERE.
2. FOR EMERGENCY SWGR/MCC,THIS PROVSION SHALL BE APPLICABLE.

SCHEME APPLICABLE FOR DC/AC BOARD

CLAUSE NO.	LIST OF MANDATORY SPARES (ELECTRICAL)	
Clause No.	**Item**	**Quantity**
7.00.00	**LT/HT SWITCHGEAR (33 KV,11 kV & 415 V SWITCHGEAR)**	
7.01.00	Circuit breaker (triple pole)/ MCCB/Isolator/Switch	1 No. for each type and rating
7.02.00	Current transformer	1 No. of each type and rating
7.03.00	Potential Transformer	1 No. of each type and rating
7.04.00.	TNC control switch for circuit breaker control	2 Nos. of each type and rating
7.05.00	HRC fuses links	6 Nos. of each type and rating
7.06.00	Ammeter selector switches	2 Nos. of each type and rating
7.07.00	Local/Remote selector switches	2 Nos. of each type and rating
7.08.00	Voltmeter selector switches	3 Nos. of each type and rating
7.09.00	Shunt trip coil	2 Nos. of each type and rating
7.10.00	Closing coil	2 Nos. of each type and rating
7.11.00	Push button for trip circuit healthy test	2 Nos. of each type and rating
7.12.00	KWh meter, 3 phase, 3 wire(Microprocessor based Trivector)	1 No. of each type and rating
7.13.00	Alarm bell	1 No. of each type and rating
7.14.00	Relays (including Anti pumping relay, Aux. relay, Lockout relays/times	2 Nos. of each type and rating

Power Sector, Hydro Market, Sector - 142, Noida U.P.

CLAUSE NO.	LIST OF MANDATORY SPARES (ELECTRICAL)	
Clause No.	**Item**	**Quantity**
7.15.00	Discrepancy control switch for C.B. control	2 Nos. of each type and rating
7.16.00	ACB driving motor	2 Nos. of each type and rating
7.17.00	ACB driving mechanism	2 Nos. of each type & rating

Power Sector, Hydro Marketing * Sector - 142, Noida U.P.

LIST OF MANDATORY SPARES (ELECTRICAL)

Clause No.	item	Quantity
11.00.00	**HT CABLE, LT POWER CABLE , CONTROL CABLE & AERIAL BUNCH CABLE**	
11.01.00	Each and every type of cable	10% of installed quantity
12.00.00	**CABLING EARTHING & LIGHTNING PROTECTION**	
12.01.00	Termination of each type and rating	5% of installed qty. (min. one No)
12.02.00	Jointing kit of each type and rating	5% of installed qty. (minimum one No)
13.00.00		
13.01.00		
13.02.00		
13.03.00		
13.04.00		
13.05.00		
14.00.00		
14.01.00		
14.02.00		
14.03.00		
14.04.00		
14.05.00		

Power Sector, Hydro Mart, Sector - 142, Noida U.P.

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SECTION: I

SUB-SECTION: C4

TECHNCIAL SPECIFICATION

(C&I PORTION)

Index

Section-C

1.1 Specific technical requirement

Section-D

1.1 Instrument Specification

1.2 Specification for Local Control Panel (LCP)

1.3 MOV Data Sheet & Wiring Diagram

1.4 Quality Plan for Instruments & LCP

1.5 Instrument hook-up diagram

1.6 Instrument Stub Detail

1.7 List of Deliverables

1.8 Cable Termination details

1.9 Sub-vendor list

1.10 List of Mandatory Spares

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SPECIFIC TECHNICAL REQUIREMENTS (C&I)

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Specific Technical Requirements (C&I):

1. Bidder shall provide complete Instrumentation (temperature sensors, humidity sensors, local indicators for pressure and temperature etc.) & remote position indication along with other accessories required for control, monitoring and operation of entire HVAC System. Supplied system shall have provision to be operated from main plant DCS/SCADA (BHEL scope) also. Necessary provision to exchange signals (Hard and soft connectivity both) with DCS/SCADA shall be provided.

2. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same / different Section noted by the bidder in the specification, will be brought to the notice of BHEL in the form of pre bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer/BHEL shall prevail without any commercial implication.

3. The HVAC system shall be complete with local panels for supply and exhaust fans, annunciation cum control panel, push button stations. Local control posts/local control panel for operation & status indication of drives for Air Washer Units shall be provided. Bidder to confirm supply of the required no. of control post/panel to control the operation of all Air Washer Units.

4. The field I/Os to be grouped together in Junction Boxes suitably and a common trunk cable shall be taken to the panel. All fields cabling for instruments/ motor/ pump/ blower to JB is in bidder's scope of supply. All instruments shall be terminated on JB/LCP in field. Both the instrument and JB/LCP are in bidder scope.

5. 415/230 V AC Power supply shall be provided by BHEL at a single point, further distribution to various instruments/equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument / equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Suitable Automatic changeover arrangement of the input feeders also to be provided by the bidder in the LCP. Bidder to submit the power requirement along with the bid.

6. Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook-up diagram of drives is included for reference

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7. The power supply for fire dampers shall be fed from the Local Control Panel of the Ventilation system. Provision for input fire signal from fire alarm system to be ensured in the Control panel for opening/ closing of the motor operated fire dampers. Open/Close indication shall be available on Panel placed in Control room.

8. The quantity of instruments indicated in tender P&ID and Design Memorandum/Philosophy are minimum, for bidding purpose. However, bidder shall also include in his proposal all the instruments and devices, which are needed for the completeness of system/equipment, supplied by the bidder, even if the same is not specifically appearing in the P&ID and Design philosophy. If any additional instruments are required for safe & reliable operation of plant during detail engineering, bidder shall supply the same without any price implication.

9. Provision for earthing of the panel to be provided by vendor.

10. Vendor to submit GA drawing of control panel indicating layout of instruments, construction details, wiring diagram, class of protection for enclosure, paint type, paint colour, thickness and material of enclosure sheet, control scheme during detailed engineering.

11. All the instrumentation, equipments and accessories under this specification shall be furnished as per technical specification and ranges, makes/numbers as approved by the owner during detail engineering.

12. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/erection of the local instruments shall be furnished, even if not specifically asked for, on as required basis. The instrument fittings shall be of forged SS. Instrument piping shall be designed for maximum design pressure & temperature of the process. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out to the LCP.

13. The make/model of various instruments/items/systems shall be as per Customer approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

14. For cable scope refer Electrical scope sheet between BHEL and vendor defined in electrical specification.

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15. The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering.

16. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of no deviation, it will be considered as compliance to the specification in totality.

17. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication.

18. Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However any instrument/ analyzer installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.

19. Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection, JB grouping, Annunciation list, SOE list, List of Instruments/devices. Also editable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.

20. Local control panel required for operation shall be in bidder scope.

21. Bidder to include IO from fire protection system also for closing the dampers in the event of fire. Number of I/Os & other specifications in this regard shall be finalized during detail engineering.

22. The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Solenoid Valve shall be rated for 24V Dc only.

23. All the drives of the Ac system shall have the provision of Local/manual starting. In local mode, it will operate through push button station with ON/OF indication and Local/Remote selection switch. Local control panel or Local push button station required for operation shall be in bidder scope.

24. All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications.

25. Redundancy of sensors shall be provided

- Triple redundancy for all analog and binary inputs required for protection of systems/drives.
- For all control functions dual redundancy of the sensors shall be provided by the bidder.

26. Bidder to provide mandatory spares as per mandatory spares list. Attached elsewhere in the specification.

27. The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards.

NOTES:

1. All equipment items shall be of latest design with proven on track record from reputed experienced manufacturers of specified type and range of equipment. The make/model of various instruments/items/systems and instrument sub-vendor shall be subject to approval of BHEL/Customer during detailed engineering stage.

2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by Vendor without any technical, commercial and delivery implication to BHEL.

3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the Vendor without any price/time implication.

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SPECIFICATION FOR MEASURING INSTRUMENTS (PRIMARY & SECONDARY), TRANSMITTERS, SWITCHES, GAUGES ETC.

1.00.00 MEASURING INSTRUMENTS

1.01.00 Measuring instruments/ equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven for similar application. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, makes/numbers as approved by the Employer during detailed engineering. All instruments required for functional compliance to this specification and required as per international standards/good engineering practice shall be provide on as required basis.

1.02.00 Every panel-mounted instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

1.03.00 All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided. The Contractor shall furnish all Instrumentation/ Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering.

1.04.00 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis.The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.

2.00.00 TEMPERATURE ELEMENTS AND ACCESSORIES

2.01.00 **Resistance Temperature Detector (RTD)**

Sr.No.	Features		Essential/Minimum Requirements
1	Type of RTD.	:	Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
2	No. of element	:	Duplex
3	Housing/Head	:	IP-65/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection.

	4	Sheathing of RTD	:	Metal sheathed, ceramic packed
	5	Calibration and accuracy	:	As per DIN-43760 Class-A for RTD
	6	Characteristic	:	Linear with respect to temp. within ±1/2 percent of top range value.
	7	Accessories	:	Thermowell (as specified below) and shall be spring loaded for positive contacts with the well.
	8	Standard	:	DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.

2.02.00 **Thermowell (for all process temp. elements)**

Shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3 1974)

2.03.00 **Temperature Transmitter**

Following types of 2-wire temperature transmitter (directly powered from 4-20mA input cards of SCADA) shall be provided for all the RTDs. The temperature transmitter shall be fully compatible with the RTDs being provided by the contractor.

(a) Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermowell along with its plug-in connector shall be min. IP65.

(b) Single Input DIN-rail mounted Temperature Transmitter

These shall be suitable for mounting on DIN-rails in JBs. The specifications of the JBs shall be same as indicated in Subsection INST. CABLE with additional DIN-rails and IP65 Protection Class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

(c) Dual-input Temperature Transmitter with Indicator

These shall be suitable for mounting on pipes/support. These shall be provided for temperature measurement which are used for tripping / protection of auxiliaries e.g. for bearing temperature on which trip is envisaged. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails. This change-over is to be alarmed. Protection class shall be IP65 minimum.

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Common requirements for each of the above type of temperature transmitters

(i)	Output	:	2-wire (power supply from input card of Control System) with 4-20 mA output with superimposed HART protocol signal.
(ii)	Input	:	Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples - K&R types (input type to be selectable at site through HART terminal)
(iii)	Isolation	:	min. 500 V AC
(iv)	EMC compatibility	:	as per EN 61326
(v)	Operating ambient temperature	:	0 to 85 deg.C (without indicator)
(vi)	Power supply	:	Compatible with input module of Control System
(vii)	Accessories	:	Mounting arrangements including clamps etc.
(viii)	Composite Accuracy	:	(a) For head mounted and DIN-rail mounted (Refer note 2) types : RTD =<0.4% of 0-250 deg.C span (b) For dual-input type : RTD =<0.25% of 0-250 deg.C span

Notes :

1. In case of failure (open or burn-out) of RTD temp. transmitter shall provide low temperature output.

2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp. transmitter, for converting sensor input to output in 4-20 mA (e.g. basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg.C, based on the figure/formula given in the standard product catalogue for span as specified above for various types of TEs specified. All such accuracy/temp. effect figures in catalogue shall be first converted to deg.C, and then percentage of these converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.

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3.00.00 PROCESS ACTUATED SWITCHES

FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
	Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and cali-llary (10 m minimum)	Capacitance types for oil and dirty medium, water, condensate application. Float type switches for applications as decided by Employer during detailed engineering. Capacitance/Conductivity/ Ultrasonic type for acid and alkali application.
Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
Over range proof pressure	150% of max. design pressure	-- -	150% of max. design pressure
Repeatability	± 0.5% of full range		
No. of contacts	2 No.+2NC, SPDT snap action dry contact		
Rating of contacts	60 V DC, 6 VA (or more if required by SCADA)		
Elect. Connection	Plug in socket		
Set point/ dead band adjustment	Provided over full range		
Enclosure	Weather and dust proof as per IP-55		

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Accessories	Syphon, snubber, chemical seal, pulsation dampe-ners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
Mounting	Suitable for enclosure/rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-

Where the process fluids are corrosive, viscous,solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.



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vii) Indicating lamps

a) Switch-board type, filament lamps of low watt consumption for 220V DC operation shall be furnished. Each lamp shall be furnished with a suitable rated series resistor to avoid short circuiting of control supply in the event of fusing of lamp filament. Lamps shall be provided with screwed translucent covers to diffuse light, coloured red, green, amber or white as required and shall be preferably un-breakable moulded from heat resisting, translucent and fast coloured material. Any other type of assembly shall be subject to Purchaser's approval.

b) Selection of lamp cap colours shall be as follows:

Red, Yellow, Blue	:	Potential indication
White	:	Energized equipment or circuit supervision
Red, Green	:	'Closed' and 'Open' position.
Amber	:	Alarm or auto trip conditions.

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c) Bulbs and their caps shall be interchangeable and easily replaceable from the front of the panel and shall normally not require any special tools for replacement. However, in case any special tools are required for this purpose, these shall be supplied by the tenderer with the panels.

vii) Miniature Circuit Breakers (MCBs)

a) Potential circuits for relaying and metering shall be protected by suitable MCBs located in such a position that they are easily and safely accessible. Individual MCBs as well as set of MCBs shall be fully and properly identified.

b) Miniature circuit breakers shall be supplied for DC & AC auxiliary supplies. Separate MCBs for control, protection, indication and alarm circuits shall be supplied with proper identification. MCBs shall be provided on both positive as well as negative side of DC supply.

c) MCBs shall be provided with phase circuit labels. MCBs shall have imprints of the current as well as voltage ratings.

d) The MCBs shall have contacts to operate the alarm when the MCBs are in OFF position.

e) Operating characteristics of MCBs shall be properly co-ordinated to achieve proper discrimination to isolate faulty circuits.

f) Switch rating shall not be less than 10 amperes continuous for working at 220 volts DC/240 volts AC control circuits. The DC breaker rating shall be adequate and subject to approval. The contacts shall be silver faced.

viii) Automatic Semaphore Indicators

Automatic semaphore indicators of reputed make shall be provided for automatic indication in mimic diagrams of the position (open or closed) of circuit breakers, isolators and other remote switches. The switches shall be of the supply failure indication type in which the disc comes to neutral position when both the units of the indicator are de-energized.

ix) Push Buttons

Unless otherwise stated, all push buttons shall be self reset type and provided with coloured knobs in approved colour and back connected terminals. They shall be suitable for semi-flush mounting on panels. They shall be provided with integral engraved inscription plates, the inscription being placed below the push buttons. All push buttons shall be fitted with two pairs of normally open and two pairs of normally closed contacts. The contacts shall be rated to make, break and carry not less than 1A at 220Volts DC or 6A at 415 volts AC.

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Push buttons can be arranged as push button station, i.e. start/stop, raise/stop/lower as per control scheme logic.

x) Switches

a) Control and selector switches shall be of rotary type and provided with properly designed plates, clearly marked to show operating positions. Circuit labels, with inscriptions as approved by Purchaser, shall form integral part of the switches.

b) Every switch shall have a few spare ways which shall have to be wired to the terminal blocks.

Illuminated type push button switches as per logic requirement shall be used preferably in groups.

Push button for emergency control shall be provided with covers to protect against inadvertent operation.

c) Switch ratings shall not be less than 10 Amperes continuous and the DC breaking rating shall be adequate and subject to Purchaser's approval.

d) As far as possible all the switches, push buttons, lamps, relays, instruments etc. should be interchangeable to reduce the cost of inventory.

e) The control and indication devices on various panels shall be of same make to limit inventory requirement, as far as practicable.

xi) Annunciator

a) An alarm annunciator of 150 points shall be provided & operate on 220 volts DC for audible and visual alarm.

b) Annunciator shall have following features;

Type	:	Static, plug in card/module type
Facia	:	Elegant, sleek, facia windows requiring minimum space.
Power	:	Minimum low wattage/ filament /consumption neon lamps (as approved).
Lamp replacement	:	From front
Standard	:	IS: 8686 or equivalent.
Flasher Relay	:	To be provided common.

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Alarm Buzzer	:	To be provided common.
Accept/ Reset/Cancel	:	To be provided common for each group.
DC Fail Alarm	:	To be provided on AC system.
Test Facility	:	To be provided
Alarm Pick up time	:	Not more than 15 milli seconds for fleeting contacts
Test Voltages	:	2 kV rms for 1 min. as per IS:3231
Repeat Alarm	:	Repeat Alarm for selected annunciations individually or group alarm through potential free contact

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8.00.00	**FLOW SENSORS**
8.01.00	**DIGITAL FLOW CONTROLLERS AND DETECTORS**
	• General range of use in the installations

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The equipment shall be used :

- inside rooms with normal temperature
- for fluids with temperatures ranging from 5°C to 55°C, of the following type: Oil, water slightly silty with solid particles
- in locations and for equipment seldom subjected to vibration.

They shall be used for the following functions:

- start-up/shutdown sequences
- alarm
- protection
- Electrical connection

Since flow detectors are not easily replaceable, they shall be delivered with a 5 meter cable length, a stuffing box for leak tightness, and no terminal block in the box.

8.02.00 **FLOW MEASUREMENT DEVICES**

8.02.01 GENERAL

- Types of measurement devices chosen :
  - The only equipment used shall be electromagnetic flowmeters, i.e. equipment creating a magnetic field perpendicular to the flow, and evaluating the flow based on the induced electromotive force produced by the displacement of the conductive fluid.
- General range of use in the installations

Its use shall be reserved to the following cases:

- equipment subjected to vibration
- measurement of water heavily silty with solid particles
- measurement in fluid with sufficient conductivity
- Measurement in cases where flow restriction is not acceptable.

The equipment's temperature shall remain between - 10°C and + 55°C, and the fluid temperature shall remain between - 5°C and + 55°C.

It shall be used for the following functions:

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- regulation
- start-up/shutdown sequences
- alarm
- protection

- Applicable technical specifications

The output relays performing threshold detection shall comply with the section of the present document (§ 13.1.3.2) defining instantaneous relays.

The precision of the flowmeter shall be better than class 2.

8.02.02 INSTALLATION PRINCIPLES

A straight length of 15D upstream and 5D downstream, free of obstacles, shall be required both for vertical and horizontal installation.

When Electromagnetic flowmeters are installed on vertical pipes, the direction of fluid flow shall be from bottom to top.

9.00.00 VIBRATION MEASUREMENT

9.01.00 GENERAL FUNCTIONAL SPECIFICATIONS

9.01.01 EQUIPMENT FUNCTION

The equipment shall perform continuous monitoring of the characteristic operating vibrations produced by a hydroelectric unit, and shall allow analysis of these vibrations.

When these levels exceed the range assigned to them by the adjustments, the equipment shall output orders and information.

9.01.02 INPUT VARIABLE

The input variables shall be of the electrical type (current or voltage, DC or AC) from accelerometric sensors.

9.01.03 OUTPUT INFORMATION

Output information shall be transmitted to the control system for processing (i.e. for protection and monitoring functions)

The protection system shall deliver at the output:

- either instantaneous information from the measuring relay,

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	♦ or information from the instantaneous measuring relay and the adjustable specified time relay.
9.01.03.01	**Design principles**
	The number of components shall be reduced to the minimum, in particular the number of instantaneous on-off relays of the emergency command path.
9.01.03.02	**On-off output relays with contacts**
	These relays shall comply with CECC standard 16000 category 2.
	♦ Dielectric strength : 2000 V coil/mass – 1000 V between contacts
	♦ Impulse wave : 3000 V common mode - 2000 V differential mode
	♦ Mechanical shock : 50 g
	♦ Mechanical vibration : 2 g
	They shall usually have 2 two-way contacts with a breaking capacity of 0.5 A at 127 V DC, with a time constant (L/R) of 40 ms.
	Exceptionally, the Contractor may propose:
	♦ two "working" contacts with the same characteristics,
	♦ two "rest" contacts with the same characteristics,
	♦ or one "working" contact and one "rest" contact with the same characteristics.
9.01.03.03	**Operating time and disengaging time for measuring relays**
	Any variation of the characteristic quantity with a duration less than 60 ms shall not cause any logic information output at the measuring relays, and any variation with a duration greater than 60 ms shall lead to information output in less than 100 ms.
	The disengaging times shall be less than 50 ms, unless otherwise specified. The tolerance on the times indicated shall be -15 %.
9.01.03.04	**Time relays**
	The specified time relay shall be adjustable between 0.6 and 6 s, by means of a slider with permanent variation, or by graduated steps; unless otherwise specified, the range shall be graduated as follows: **0.6 - 1 - 2 - 3 - 4 - 5 - 6 S.**
	The time precision shall be 10% of the value displayed in the rated range of the influence quantities, and whatever the application duration of the quantity measured before it exceeded the operating threshold. The disengaging time for the specified time relay shall be less than 50 ms. If the relay is in operating condition, the return time to initial condition shall be at most 50 ms.

9.01.04	OTHER REQUIREMENTS The protection system shall remain at rest for any supply interruption lasting less than 30 ms.

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1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, supervision, erection, and commissioning at site of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

a) IS-6005 : 1998 : Code of practice for phosphating of iron and steel.
b) IS-5 : 2007 : Colors for ready mixed paints and enamels.
c) IS-1248:2003 : Direct Acting Indicating Analog Elec Measuring Instruments.
d) IS/IEC 60947:Part 1:2004 : Low Voltage switchgear & control gear: Part-I (General Rules)
e) IS-8828:1996 : Circuit breaker for household and similar installations.
f) IS-13947 (Part-I):1993 : Low Voltage switchgear & control gear : Part-I (General Rules)
g) ISA-18.1:1979 : Annunciator Sequences and Specification
h) NFPA-496:2003 : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/LED cluster, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)
1.6 mm for doors and Not less than 2.0 mm for others

Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm.The doors shall be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents. Double door shall be provided with suitable glass windows, as per the requirement.

3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation system along with louvers shall be provided at bottom and top of the doors covered with removable wire mesh.

3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm2 size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.

3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm2 to 2.5mm2 external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.

3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.

3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm2 size.

3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte

Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

3.1.18 Vendor shall furnish electric load and heat load list (in case panel is to be placed in ac environment) of each panel.

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.

3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge	Left Hand Side
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test	Right Hand Side

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped	Left Hand Side
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy	Right Hand Side

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2.	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.

4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrossion, incidental damage due to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145A-DS2-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 DATE: 16.09.2013
		SHEET 1 OF 3

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

			DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER			
	CONSTRUCTION		■ FOLDED ☐ WELDED	
	ENCLOSURE SHEET THICKNESS **(As per Section 8.13,Volume V of contract specification)**	FRONT	☐2.0 mm	
		OTHER	☐ 2.0 mm	
		DOOR	☐ 1.6 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. ☐ Other ……	
		OTHER	☐ Load bearing sheet front shall have 3mm thickness	
TECHNICAL	INPUT POWER SUPPLY * **(As per Electrical specification)** (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		☐ 240V 50 Hz AC ☐ 220V DC ■ 415V 3 PHASE 3W ☐ 400V 3 PHASE 4W	
	NO. OF FEEDERS **(As per Electrical specification)**		☐ ONE ☐ TWO	
	STARTER WITH MCC		☐ REQUIRED ■ NOT REQUIRED	
	IPR POSITION		■ MCC ☐ RELAY PANEL	
	CONTACT RATING OF RELAY		■ 5 Amp, 230 V AC ■ 0.25 Amp, 220V DC	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____NOS. (AS REQUIRED)	
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)		☐ REQUIRED ■ NOT REQUIRED	
	PAINT TYPE **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ EPOXY ENAMEL ☐ EPOXY POWDER COATED	
	MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		■ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ LIGHT GREY ☐ OPALINE GREEN	
	FINISH (EXTERNAL) **(As per Annex-1, Section 7.6,Voulme IV of contract specification)**		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH (INTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		■ IP-55 (FOR INDOOR SERVICE) ■ IP-67 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE		■ RELAY BASED	
	FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)		……..(Vendor to specify)	

BHEL	**DATA SHEET FOR LOCAL PANELS**	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 / DATE: 16.09.2013
		SHEET 2 OF 3

TAG No. …… Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

	DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	PANEL TYPE	☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
	CABLE GLAND	■ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT) *	☐ 1 Amp CT ☐ 4-20 mA	
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING	☐ APPLICABLE ■ NA	
	* TO BE CO-ORDINATED WITH PEM ELECTRICAL		

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI	NAME:
DESIGNATION	SR.ENGR	DY.MNGR	D. GM	
SIGNATURE				SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR LOCAL PANELS**	SPECIFICATION NO.: PE-SS-999-145-054A VOLUME SECTION REV. NO. 02 DATE: 16.09.2013 SHEET 3 OF 3

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT		
		OTHER		
		DOOR		
		HEIGHT		
		OTHER		
TECHNICAL	INPUT POWER SUPPLY			
	NO. OF FEEDERS			
	CONTACT RATING OF RELAY			
	TEMP SCANNER			
	CONTROL SUPPLY			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)			
	PAINT TYPE			
	PANEL COLOUR (EXTERNAL)			
	FINISH (EXTERNAL)			
	TYPE OF MIMIC MATERIAL OF MIMC THICKNESS OF MIMIC			
	PANEL COLOUR (INTERNAL)			
	FINISH (INTERNAL)			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 / DATE: 16.09.2013
		SHEET 3 OF 3

TAG No. …… Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

	PANEL TYPE		
	CABLE GLAND		
	AMMETER (TYPE OF INPUT)		
	SCOPE OF SUPERVISION		

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTYAVA	MA MANSOORI	NAME:
SIGNATURE				SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

1.00.00	**CONTROL DESK & PANELS**
1.01.00	GENERAL
1.01.01	All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads, internal piping & accessories as required for completeness of the system.
1.01.02	All panels, desks, cabinets shall be free standing type & have bottom I top entry for cables to be finalised application wise during detailed engineering. The bottom of desk & cabinets shall be sealed with bottom plate, compression cable glands (double for field and single for inside rooms) and fire proof sealing material to prevent ingress of dust and propagation of fire.
1.01.03	All wiring shall be arranged to enable the removal of instruments/devices without unduly disturbing them.
1.01.04	Sufficient number of power receptacles with disconnect switches shall be installed within all panels/desk
1.01.05	Contractor shall provide the Control Desk (CD), PC racks independent and dedicated for each of the units and other subsystems to be mounted in the respective control room.
1.01.06	All Control Desk (CD), PC racks shall be property grounded. The grounding scheme shall be as approved by Employer
1.01.07	Exterior steel surface shall be sand blasted, ground smooth, filled, primed, sanded and smooth enamel painted to give a good finish subject to minimum paint thickness of 65-75 microns for sheet thickness of 3 mm and 50 microns for sheet thickness of 2mm. The exact color shall be finalised during detailed engineering.
1.01.08	Due consideration shall be given to the ergonomics of control desk and the control room design. The design shall conform to the EN ISO 11064 (Agronomical design of control room), Part-1,2 and 3.
2.00.00	**CONTROL DESK & PANEL**
2.01.00	GENERAL
2.01.01	The exact dimensions, material, construction details etc. of Control Desk etc. shall be as per the actual requirement and shall be finalised during detailed engineering. The general arrangement of the desk/panel shall also be finalized during detailed engineering, subjected to Employer's approval.
2.01.02	The Contractor must pay particular attention in the positioning of desk mounted Monitors in relation to control room lighting in order to minimise reflections. CPU's for OVVS and operator station shall be kept separately at the back of LVS Panels.

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2.01.03	For control desk mounted instruments devices etc.. which are to be powered from UPS, all required conversion and interface equipments/ accessories to make such devices compatible with LIPS supply shall be provided. All necessary hardware like Inputmodules, fuse unit for each feeder as well as switch fuse unit for each instrument/ device an the power supply line shall be provided. From UPS, redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover d UPS leaders. Power supply distribution scheme shall be as approved by Employer during detailed Engineer stage.
2.01.04	All work related to manufacture and assembly of control desk including their fabrication, painting, wiring, tubing installation with specified mounting accessories shall be completed and shall be fully tested prior to st7pmen2 to the project site. The manufacturing and testing of panel/desk as stated above shall be done in the manufacturing works of a qualified manufacturer acceptable to the Employer.
2.01.05	The Contractor shall complete all the internal wiring d the desk/panel at the shop as per the final drawings as approved by the Employer, during detailed engineering. However, ff any further wiring modification is required at site as per system requirement, the Contractor shall do necessary modification at site within the quoted lumpsum price.
2.02.00	**Control Desk (CD)**
2.02.01	The CD shall also be arranged in continuous arc shape. CD shall be state of the art free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. A 19mm thick wooden top shall be provided on the desk with proper finish of acrylic PVC/ Polyeutherene paint. All operator TFT monitors & mouse under the scope of the Contractor shah be mounted on this CD. The Control desk shall be provided with a motorized mechanism to keep the TFT monitors and the synchroscope concealed under the wooden top when not in use. The up-down movement of the TFT monitor shall initiated by push button mounted on the control desk. Exact details shall be finalised during detailed engineering stage. Control desk shall consist of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, Mouse pads, Monitor shelf and concealed cable and wire way management, perforated trays with covers in both horizontal & vertical directions. PA system hand sets, telephone sets, very few PB stations and lamps shall be mounted on the control desk on mosaic grid structure and the same shall be decided during detailed engineering. The ASCII Keyboard shall be capable of being pulled out through a tray. The CPU's of QWS etc. shall be located separately at the back of LVS panels. The desk shall be arranged in
2.02.01	The ASCII Keyboard and the same shall be capable of being pulled out through a tray. He CPU's of OWS etc. shall be located separately at the back of LVS panels. The desk shall be arranged in continuous arc shape. The exact profile of the desk. Dimension and the radius of curb
2.02.02	To achieve durable & water resistant finish, a coat of "Polyeutherene crystal clear" on the surface of control desks shall be provided. Final paint finish with proper smoothening is to be ensured. Final finish of CD should be in line with relevant International standards.

2.02.03	The cabling / wiring between OWS & CPU's, power supply cables etc. shall be aesthetically routed and concealed from view.
2.03.00	**Hardwired devices on Control Desk (draw out section)**
2.03.01	CD shall be provided with a mosaic based draw out section wherein mosaic compatible conventional back-up hardwired devices shall be mounted. The mosaic grid construction should be flexible enough to allow easy shifting at site of any to any other free location without any cutting or special equipments/ tool.
2.04.00	**Control Desk Devices** • Miniaturised push buttons shall be provided as actuating elements to meet the functional requirements for start/stop of Motor/pump, open/close of damper/valve/ electrical breakers, safe shut down of the unit. "Release" push buttons shall be provided for a set of push buttons/Auto/Manual stations. Depending on the type of control/function and required number of push buttons and indicating LEDs & their color, push buttons stations shall be selected. The number and rating of contacts of push button stations shall be as per the requirement of SCADA. The size of the push button stations & A/M stations shall be 24 x 48 mm or 25x 50 mm and shall have service inscription details at the front. • Push buttons shall have normally front display section with illuminated screen- The screen shall have sufficient space for service inscription at front. Service inscription shall be slit type. The LEDs shall be located in the individual compartment by use of insertable partitions. The illuminated screen compartment may be of any of the colours, i.e. white, red, green, blue and amber. The rating of lamps shall be as suitable for SCADA. These stations shall be suitable for plug in type Connection at the back and shall be suitable for mosaic grid mounting.
2.06.00	**Internal Panel / Desk Items**
2.06.01	Equipment and devices mounted within the panels/desk (whether supplied by the Contractor or by others) shall be mounted on suitable racks/brackets and shall be arranged for convenient access for adjustment and maintenance work. Locations for internal panel/desk devices shall be as per Employer approved drawings showing their exact location.

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DATA SHEETS FOR MOTORISED VALVE ACTUATOR

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-SS-999-145-I007	
		VOLUME II B	
		SECTION D	
		REV. NO. 04	DATE:15/05/2019
		SHEET 1 OF 4	

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT	3x40 MW NTPC RAMMAM HEP	
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	☐ ON / OFF ** ☐ INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:68	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.**	
HANDWHEEL as per standard EN 12570:2000	* REQUIRED	■ YES ☐ NO	
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW) (REFER NOTE NO. 6 & 7)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF I.S. TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐	
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☐ EPOXY CONFIRMING TO CORROSION CATEGORY C5-I	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V	
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ☐ IP 68 ☐ FLAME PROOF	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ☐ _____	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED (THERMISTOR PTC)	
INTEGRAL STARTER	INTEGRAL STARTER	☐ REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	☐ CONTACTORS ☐ THYRISTORS	
	TYPE	☐ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	IF SMART (REFER BELOW POINT a – h)		
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐.....	
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC	
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....	
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP	
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	☐ REQUIRED	
	OPEN / CLOSE PB	☐ REQUIRED ☐ NOT REQUIRED	
	STOP PB	☐ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	☐ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	☐REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	☐ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL(Refer Note 14)	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY,)	
	ACTION ON LOSS OF EXTERNAL ELECTRIC POWER	☐STAYPUT ☐ FAIL SAFE	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter) **DATASHEET & WIRING DIAGRAM OF ISOLATION DEVICE TO BE PROVIDED**	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER TO BE DECIDED DURING DETAILED ENGINEERING	
	QUANTITY	☐ 2 NOs. ☐ 3 NOs.	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms	
TORQUE SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-SS-999-145-I007	
		VOLUME II B	
		SECTION D	
		REV. NO. 04	DATE:15/05/2019
		SHEET 3 OF 4	

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

LIMIT SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY				
	OPEN : INT : CLOSE	☐1 No ■2 Nos.	2 Nos. (ADJ.)	☐1 No. ■2Nos.		
	CONTACT TYPE	2 NO + 2 NC				
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC				
	ACCURACY	2% OF SET VALUE				

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☐ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	■ 24V DC ☐	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@☐ IP 68 @☐.....	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET	☐ REQUIRED ☐ NOT REQUIRED	
	NO. OF PINS REQUIRED(TO BE CHECKED AS PER SIGNALS IN DRIVE CONTROL PHILOSOPHY)		
	NOS. OF PLUG & SOCKET	☐ 1 Nos. for ON/OFF ☐ 2 NOS.(for inching duty) ☐ OTHER (TO BE SPECIFIED INLINE WITH DRIVE CONTROL PHILOSOPHY)	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:————	
	@ SPACE HEATER CABLE GLAND	SIZE:————	
	CONTROL CABLE GLANDS-1	QUANTITY & SIZE :————	
	CONTROL CABLE GLANDS-2	QUANTITY & SIZE :————	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	———— Kg.

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-SS-999-145-I007	
		VOLUME II B	
		SECTION D	
		REV. NO. 04	DATE:15/05/2019
		SHEET 4 OF 4	

Data Sheet A & B

DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
   IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691, IS-4722, IEC 60947-5-1 AND EN 15714-3 :2010 OR LATEST VERSION.
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
7. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. **(FOR NTPC PROJECTS)**

   THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE RUNNING AT 80 PERCENT OF RATED VOLTAGE AT RATED TORQUE AND 85 PERCENT RATED VOLTAGE AT 33 PERCENT EXCESS RATED TORQUE FOR A PERIOD OF 5 MINUTES EACH. **(FOR NON NTPC PROJECTS)**
8. IN ADDITION TO ABOVE REQUIREMENTS FOR LIMIT/TORQUE SWITCH, **MECHANICAL END STOP** WITH ACCURACY OF 2% SHALL BE SUPPLIED.
9. IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.
10. LOCAL POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL.
11. CONTROL WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM.
12. ENDURANCE: RATED TORQUE RANGE SHOULD BE BASED ON ISO 5211, ISO5210.
13. TAG PLATE SHALL BE CONFIRMING TO STANDARD BS-15714.
14. INTEGRAL STARTER/ACTUATOR DISTURBED SIGNAL SHALL BE CHECKED AND INCLUDE AS PER DRIVE CONTROL PHILOSOPHY.
15. **** VALVES WITH 10 DEGREE/20DEGREE FEEDBACK REQUIREMENT FOR APPLICATIONS SUCH AS CW/ACW/PLANT WATER SYSTEM ETC SHALL BE CONSIDERED AS INCHING DUTY VALVES. ACCORDINGLY, POSITION FEED BACK TRANSMITTER, PLUG & SOCKET REQUIREMENT SHALL BE CONSIDERED.**

$$ **TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.**

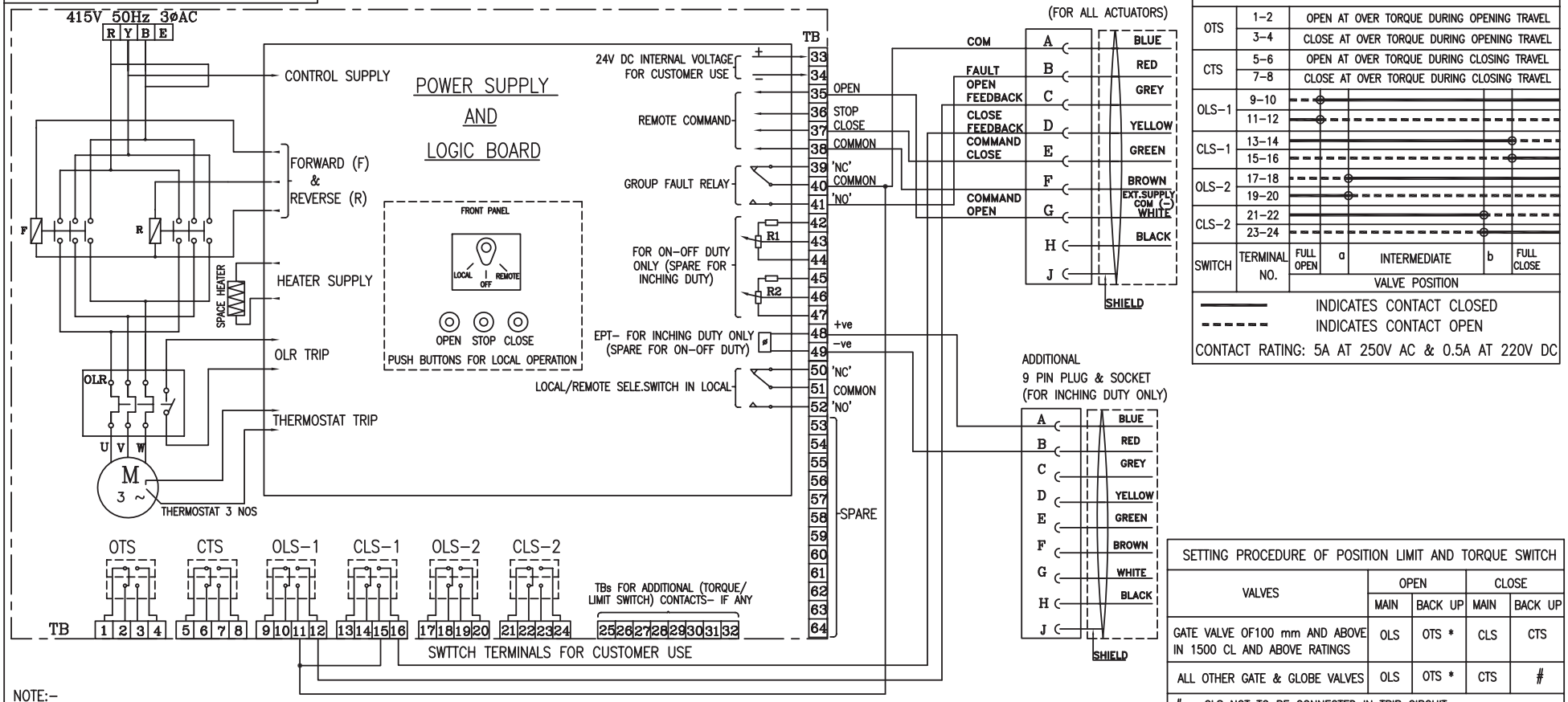
**EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.**

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME	MADHAV GUPTA	VIPUL KUMAR VERMA	SHIVRAJ SINGH BANSALA	NAME
SIGNATURE				SIGNATURE
DATE	15.05.2019	15.05.2019	15.05.2019	DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ BE FILLED BY ES

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.

DRAWING NO. 3-V-MISC-24283



CONTACT DEVELOPMENT DIAGRAM

OTS	1–2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3–4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5–6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7–8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS–1	9–10	
	11–12	
CLS–1	13–14	
	15–16	
OLS–2	17–18	
	19–20	
CLS–2	21–22	
	23–24	

SWITCH TERMINAL NO. | FULL OPEN | a | INTERMEDIATE | b | FULL CLOSE | VALVE POSITION

INDICATES CONTACT CLOSED
INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#

– CLS NOT TO BE CONNECTED IN TRIP CIRCUIT
* – BYPASS OTS FOR INITIAL 5% OF TRAVEL(FOR GATE VALVES ONLY)

NOTE:–

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1–24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25–32
2. CTS – TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS – TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS–1, OLS–2 – LIMITSWITCHES FOR POSITION OPEN
5. CLS–1, CLS–2 – LIMITSWITCHES FOR POSITION CLOSE
6. EPT – ELECTRONIC POSITION TRAMSMITTER (CONTACTLESS TYPE, FOR INCHING DUTY)
7. R1–R2–POTENTIOMETER 2 x 100 OHMS (FOR ON–OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M – MOTOR 3ø 415V 50 Hz AC SUPPLY
10. TORQUE SWITCH BYPASS WITH LIMITSWITCH BOTH ON OPEN & CLOSE DIRECTION TO BE DONE INTERNALLY.

REV	DATE	ALTERED
		CHD & APPD

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS FOR NTPC PROJECTS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI–620014.
365–121

	NAME	SIGN	DATE	NO.OF VAR.
DRN	N.P.ESWAR	N.P	17.03.05	–
CHD	D.DINAKARAN	D.D	17.03.05	
APPD	K.ARUNACHALAM	K.A	17.03.05	

DEPT	SCALE	WEIGHT (KG).	REFERENCE INFORMATIONS	NO. OF ITEMS
VL	NTS	–		–
CODE –				

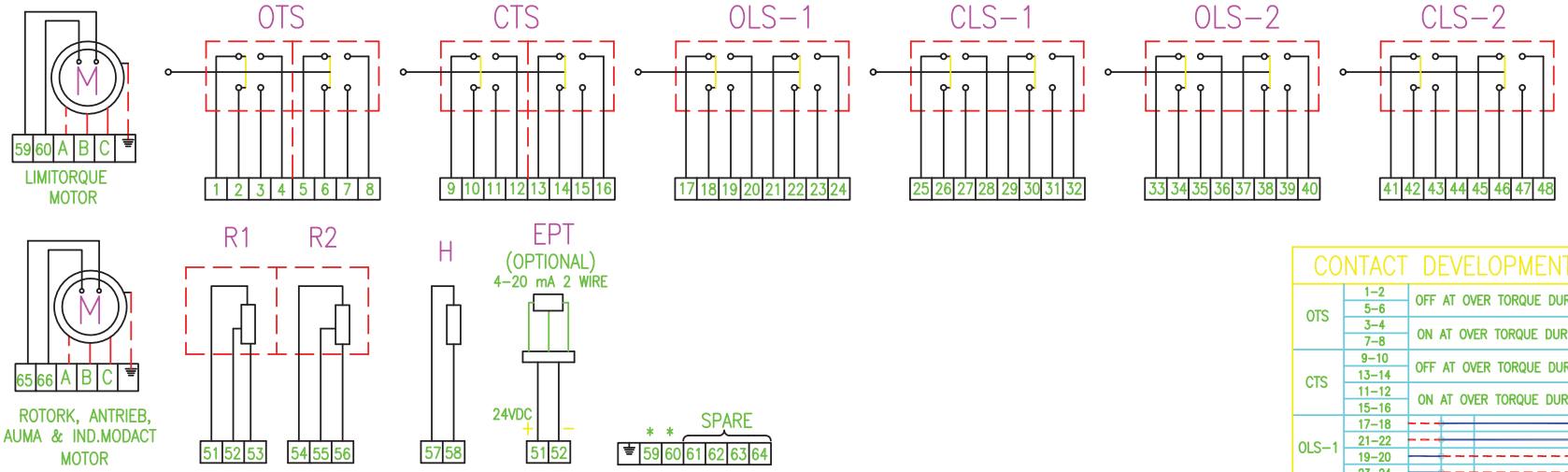
TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET FOR NTPC PROJECTS

CARD CODE: U 01

DRAWING NO.: 3–V–MISC–24283

REV: 0

Size A3



* – SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT

SWITCHES – ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY

THERMOSTAT – 65–66 (ROTORK, AUMA, ANTRIEB & IND.MODACT), 59–60 (LIMITORQUE).

EPT – ELECTRONIC POSITION TRAMSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)

THERMOSTAT TERMINALS – TERMINATED IN MOTOR TB IN ANTRIEB & IND.MODACT AND IN MAIN TB IN OTHER MAKES

CTS – TORQUE SWITCHES FOR CW ROTATION (CLOSE) – 2 NO+2 NC

OTS – TORQUE SWITCHES FOR CCW ROTATION (OPEN) – 2 NO+2 NC

OLS–1, OLS–2 – LIMITSWITCHES FOR POSITION OPEN – 2 NO+2 NC

CLS–1, CLS–2 – LIMITSWITCHES FOR POSITION CLOSE – 2 NO+2 NC

OTS, CTS – TWO INDEPENDENT SWITCHS IN ANTRIEB & LIMITORQUE

OLS–2 & CLS–2 – CAM DISC IN ROTORK & ANTRIEB

R1–R2– POTENTIOMETER 2 x 100 OHMS

H – SPACE HEATER 1ø 240V AC SUPPLY

M – MOTOR 3ø 415V 50 Hz AC SUPPLY

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS	CTS	@

@ – CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

NOTE:

1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

CONTACT DEVELOPMENT DIAGRAM

OTS	1–2	OFF AT OVER TORQUE DURING OPENING TRAVEL
	5–6	
	3–4	ON AT OVER TORQUE DURING OPENING TRAVEL
	7–8	
CTS	9–10	OFF AT OVER TORQUE DURING CLOSING TRAVEL
	13–14	
	11–12	ON AT OVER TORQUE DURING CLOSING TRAVEL
	15–16	
OLS–1	17–18	
	21–22	
	19–20	
	23–24	
CLS–1	25–26	
	29–30	
	27–28	
	31–32	
OLS–2	33–34	
	37–38	
	35–36	
	39–40	
CLS–2	41–42	
	45–46	
	43–44	
	47–48	



INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

REV	DATE	CHED	APPD	DESCRIPTION
11	09.09 2000			CONTACT DEV. FIG.ADDED.

365–139

BHARAT HEAVY ELECTRICALS LTD.
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI 620014.

DRAWN N.P.ESWAR
CHECKED K.ARUNACHALAM
APPROVED P.LOGANATHAN
DATE 09.09.2000

TITLE
INTERNAL WIRING DIAGRAM
FOR
ELECTRICAL VALVE ACTUATORS (AC)
(DRAWN FOR INTERMEDIATE POSITION OF VALVES)

DRAWING No. 4–V–MISC–90271 REV 11

RETRACED WITH REVISION 11

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QUALITY ASSURANCE FOR INSTRUMENTS

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR FLOW SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	100%	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	RANGE						
	MODEL / TAG No.						
	END CONNECTION						
	DIMENSIONS						
	SIZE						
2	ACCURACY & REPEATABILITY (WET CALIBRATION)	100%		P	W	V	
3	HV / IR	100%		P	W	V	
4	CONTACT RATING / No. OF CONTACTS	RANDOM		P	W	V	
5	MATERIAL TC FOR BODY, WET PARTS, SENSING ELEMENT	ONE / LOT		P	W	V	
6	ACCESSORIES AS APPLICABLE	100%		P	W	V	
7	DEGREE OF PROTECTION	ONE / LOT		P	W	V	
8	OVER PRESSURE TEST	100%		P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out routine test for 100%
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TEMPERATURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	100%	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MODEL/TAG NO.						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS CHECK	100%		P	W	V	
3	ACCURACY	100%		P	W	V	
4	SWITCHING DIFFERENTIAL	100%		P	W	V	
5	CONTACT RATING / No. OF CONTACTS	RANDOM		P	W	V	
6	MATERIAL TC FOR BULB, CAPILLARY, ARMOUR	ONE / LOT		P	V	V	
7	HV / IR	RANDOM		P	W	V	
8	DEGREE OF PROTECTION	TYPE TEST		P	V	V	
9	THERMOWELLS						
	DIMENSIONS,PROCESS CONN	100%		P	W	V	
	MATERIAL TC	ONE / LOT		P	V	V	
	HYD TEST	100%		P	W	V	
	IBR CERTIFICATE, IF APPLICABLE			P	V	V	
10	REPEATABILITY	100%		P	V	V	
11	HYSTERISIS	100%		P	V	V	
12	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.
4. Manufacturer to carry out routine test for 100%

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to carry out ROUTINE TEST on 100 %.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR FLOAT OPERATED LEVEL SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	MODEL NO/TAG NO						
	TYPE						
	END CONNECTION						
2	ON/OFF DIFFL			P	W	V	
3	REPEATABILITY			P	W	V	
4	IR TEST			P	W	V	
5	HV TEST			P	V	V	
6	PR. TEST ON CHAMBER	SEE NOTE-5		P	V	V	
7	MATL. TC FOR CHAMBER & FLOAT	FOR LOT	---	V	V	V	
8	CONTACT CONFIG. & RATING FOR MICROSWITCH	FOR LOT	---	V	V	V	
9	TC FOR DEGREE OF PROTECTION	TYPE TEST	---	V	V	V	
10	MANUFACTURER TO ENSURE WELDING PROCEDURE,WELDERS & NDT AS PER ASME FOR PR >40 KG/CM2		---	P	V	V	
11	CHECK FOR TEMP. SUITABILITY FOR MICROSWITCH AND LEAD WIRE	SEE NOTE-1 BELOW	---	V	V	V	
12	ACCESSORIES AS APPLICABLE		APPROVED SPEC./ DATA SHEETS	V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. IBR certificates shall be provided wherever required.
6. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANALYTICAL INSTRUMENTS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	VISUAL						
	MAKE, MODEL No.						
	POWER SUPPLY						
	TYPE						
2	DIMENSIONS CHECK			P	V	V	
3	FUNCTIONAL CHECK			P	V	V	
4	LEAKAGE TEST			P	V	V	
5	HV / IR TEST			P	V	V	
6	LINEARITY			P	V	V	
7	RESPONSE TIME			P	V	V	
8	ENCLOSURE CLASS			P	V	V	
9	ACCESSORIES, AS APPLICABLE			P	V	V	
10	ACCURACY / CALIBRATION			P	V	V	
11	ALARM CONTACT TEST			P	V	V	
12	ANALOG OUTPUT CHECK			P	V	V	
13	BURN-IN TEST OF ELECTRONIC PARTS	1/LOT		P	V	V	
14	IN-BUILT INDICATOR, ZERO, SPAN, RANGE SCALE SELECTION ETC	SEE NOTE-1 BELOW		P	V	V	

Legend :

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Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

CHECK LIST FOR TEMPERATURE ELEMENT

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MODEL No./TAG No.						
	PROCESS CONNECTION						
2	STABILITY			P	W	V	
3	INSULATION RESISTANCE			P	W	V	
4	ENCLOSURE CLASS			P	W	V	
5	RESPONSE TIME			P	W	V	
7	ACCURACY			P	W	V	
8	HYDROSTATIC TEST			P	W	V	
9	ELECTRICAL CHARACTERISTIC OF SENSOR (CONTINUTY OF T/C WIRES & INSULATION RESISTANCE OF RTD LEADS w.r.t. BODY			P	W	V	
10	TEMP CURVES / CHARTS			P	V	V	
11	AMBIENT TEMP. EFFECT CHECK			P	W	V	
12	HV TEST			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.
4. IBR certificate to be provided, if applicable

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR SOLENOID VALVES

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MAKE						
	MODEL No.						
2	MATERIAL (BODY. PLUNGER/TRIM)			P	W	V	
3	PORT SIZE			P	W	V	
4	CABLE CONNECTION SIZE			P	W	V	
5	ENCLOSURE CLASS			P	W	V	TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR
6	No. OF COILS & INSULATION CLASS			P	W	V	TEST CERTIFICATE TO BE FURNISHED FOR INSULATION CLASS BY VENDOR
7	POWER SUPPLY CHECK			P	W	V	
8	IR / HV TEST			P	W	V	
9	FUCTIONAL TEST			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TEMPERATURE GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	DIAL SIZE						
	MODEL NO./TAG NO./TYPE						
	RANGE/SCALE						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	HYSTERESIS						
3	OVER TEMP. TEST			P	W	V	
4	AMBIENT TEMP. COMPENSATION CHECK	1 OF TYPE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	THERMOWELL						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	THERMOWELL	SEE NOTE-1 BELOW	AS PER APPD DWG		V	V	
	MATERIAL TC & DIMN. CHECK						
	HYD.TEST						
	OVER RANGE TEST						

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. IBR certificate to be provided if called for in specn.
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR	ONE / LOT		P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR SIGHT FLOW INDICATOR

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	MODEL						
	TAG No.						
	VISUAL						
2	DIMENSIONS,			P	W	V	
3	PROCESS CONNECTION			P	W	V	
4	RANGE / SCALE			P	W	V	
5	ACCURACY			P	W	V	
6	MATERIAL TC FOR METERING TUBE, ORIFICE PLATE, FLANGES AND FASTNER			P	V	V	
7	CALIBRATION REPORT	ONE / SIZE		P	V	V	
8	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	
9	TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

PEM :: C&I

QUALITY PLAN
FOR
ELECTRO-MAGNETIC FLOWMETER

QUALITY PLAN NO.: **PE-QP-999-145-I 011**
VOLUME IIB
SECTION D
REV. NO. 00 DATE: 31.03.2014
SHEET 1 OF 1

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1	Standard Certificates	Certificate of Compliance, Warranty Certificate,	Major	Visual	As applicable	Technical documents/Approved documents	Technical catalogue/Approved documents	Technical catalogue/ Approved documents	2/3	---	2, 1	
2	Visual Check	Mechanical	Major	Visual	100%	Technical catalogue/Approved documents	Technical catalogue/Approved documents	Technical catalogue/ Approved documents	2/3	1	1	
3	Functional test & power ON	Electrical	Major	Visual	100%	Functional test report for meter & transducer	Approved documents	Technical catalogue/ Approved documents	2/3	-	1	
4	HART Communication	Electrical	Major	---	100%	Technical catalogue/Approved documents	Technical catalogue/Approved documents	Technical catalogue/ Approved documents	-	-	1	

LEGEND:

$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - Custmer
2 - Vendor
3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
	INCOMING											
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Relevant standard	Relevant standard	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	Relevant standard	Relevant standard	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Relevant standard	Relevant standard	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	Relevant standard	Relevant standard	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.

1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: **PE-QP-999-145-I056**
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 22-02-2008
SHEET 2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type	CR	Visual	Sample	BHEL Spec. and BOM	BHEL Spec. and BOM	Log Book	2	---	---	
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	Relevant standard	Relevant standard	Log Book	2	---	---	
		3. Operation / Functional check	CR	Electrical	Sample+ 100%@	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	+ for relay & contactors only
		4. I.R.	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	
		6. Calibration	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	1	
		7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	

LEGEND: * CR - Critical characteristics
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MI - Minor characteristics

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V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	3 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
	IN PROCESS											
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
	ASSEMBLY											
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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MI - Minor characteristics

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
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SHEET	4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	

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PEM :: C&I

STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: **PE-QP-999-145-I056**
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 22-02-2008
SHEET 5 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
	FINAL											
12.	Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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1 - BHEL; 2 - Vendor; 3 - Sub-vendor

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1	
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
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SHEET	7 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant standard	BHEL approved spec/drg & relevant standard	Inspection Report	2	1	1	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

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CONTROL DESK, PLC PANEL, SMOKE DETECTOR, FIRE ALARM CONTROL PANEL

ITEMS \ TESTS	Visual ®	GA, BOM ,Lay Out of components ®	Dimensions ®	Paint Shade/Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ osaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element, Annunciation	Mimic ®	Test as per IEC 1131 ® *	Test as per Std ® & (A)
1. Annunciation, Control, PLC Panel, Fire alarm panel	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y
2. Smoke Detectors (UL-268,EN-54 PT-7), Heat Detectors (UL-521/EN 54 PT-5) Annunciation/ Control Panel (UL -864, EN-54, PT-2)															Y

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents.

- *Applicable for PLC
- Y - Test Applicable , ® - Routine Test (A) - Acceptance Test

INSTRUMENTATION CABLE

TESTS / ITEMS	Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheathe/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity, at room & Elevated Temp. (A) ++	Spark test report review ®
1. Instrument cable twisted and shielded															
Conductor(IS-8130)	Y			Y			Y								
Insulation(VDE-207)				Y	Y	Y	Y						Y		Y
Pairing/Twisting				Y	Y		Y								
Shielding				Y			Y			Y					
Drain wire	Y			Y			Y		Y	Y					
Inner Sheath				Y	Y	Y	Y					Y	Y		
Outer Sheath				Y	Y	Y	Y					Y	Y		
Over all cable	Y	Y	Y	Y	Y		Y	Y			Y			Y	
Cable Drums(IS-10418)				Y			Y								

Note : High Temp. cables shall be subjected to tests as per VDE-207 (Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.

Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all item.

Note : ® - Routine Test A - Acceptance Test Y - Test Applicable

Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)

- * FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1)
- ** Characteristic Impedence, Attenuation, Mutual Capacitance, Cross Talk (As applicable)

\+ Sample size will be One No. of each size/type per lot.

++ Sample size will be One No. sample for complete lot offered irrespective of size/type.

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MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y	
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y	
3. Pr./D.P.Switch (BS-6134)	Y	Y	Y	Y	Y	Y
4.Electronic Transmitter (IEC-770)	Y	Y	Y	Y	Y	Y
5. Temp. Switch	Y	Y	Y	Y	Y	Y
6. Recorder (IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y
7. Vertical indicators	Y	Y	Y	Y		Y
8. Digital Indicators	Y	Y	Y	Y		Y
9. Integrators	Y	Y	Y	Y		
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y
12. Thermocouples (ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y
13. RTD (IEC-751)	Y	Y	Y	Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

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TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
14. Thermowell									Y	Y	Y
15. Cold junction compensation box	Y	Y	Y	Y				Y			
16. Orifice plate (BS-1042)	Y	Y	Y	Y *	Y	Y **	Y **		Y	Y **	Y
17. Flow nozzle (BS-1042)	Y	Y	Y	Y *	Y	Y	Y		Y	Y	Y
18. Level transmitter/ switch	Y	Y	Y	Y				Y	Y	Y	Y
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.											
** If applicable											

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

ITEM/ COMPONENT/ SUB SYSTEM ASSEMBLY/ TESTING \ Test/Attributes Characteristics	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator ®	EPT output ®	Grease leakage ®	Local/ Remote (Open-Stop-Close) Operation®	Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER (IS_9334)														
Motor	Y	Y	Y	Y	Y									
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	

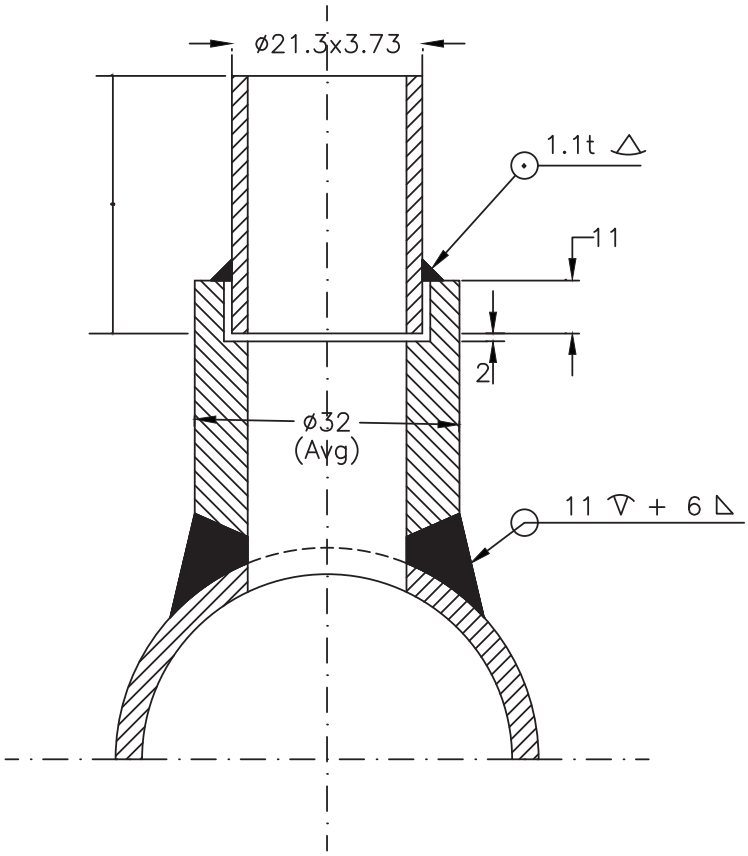
Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.

® - Routine Test (A) - Acceptance Test Y - Test applicable

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INSTRUMENT STUB & INSTALLATION DRAWING



NOTE :

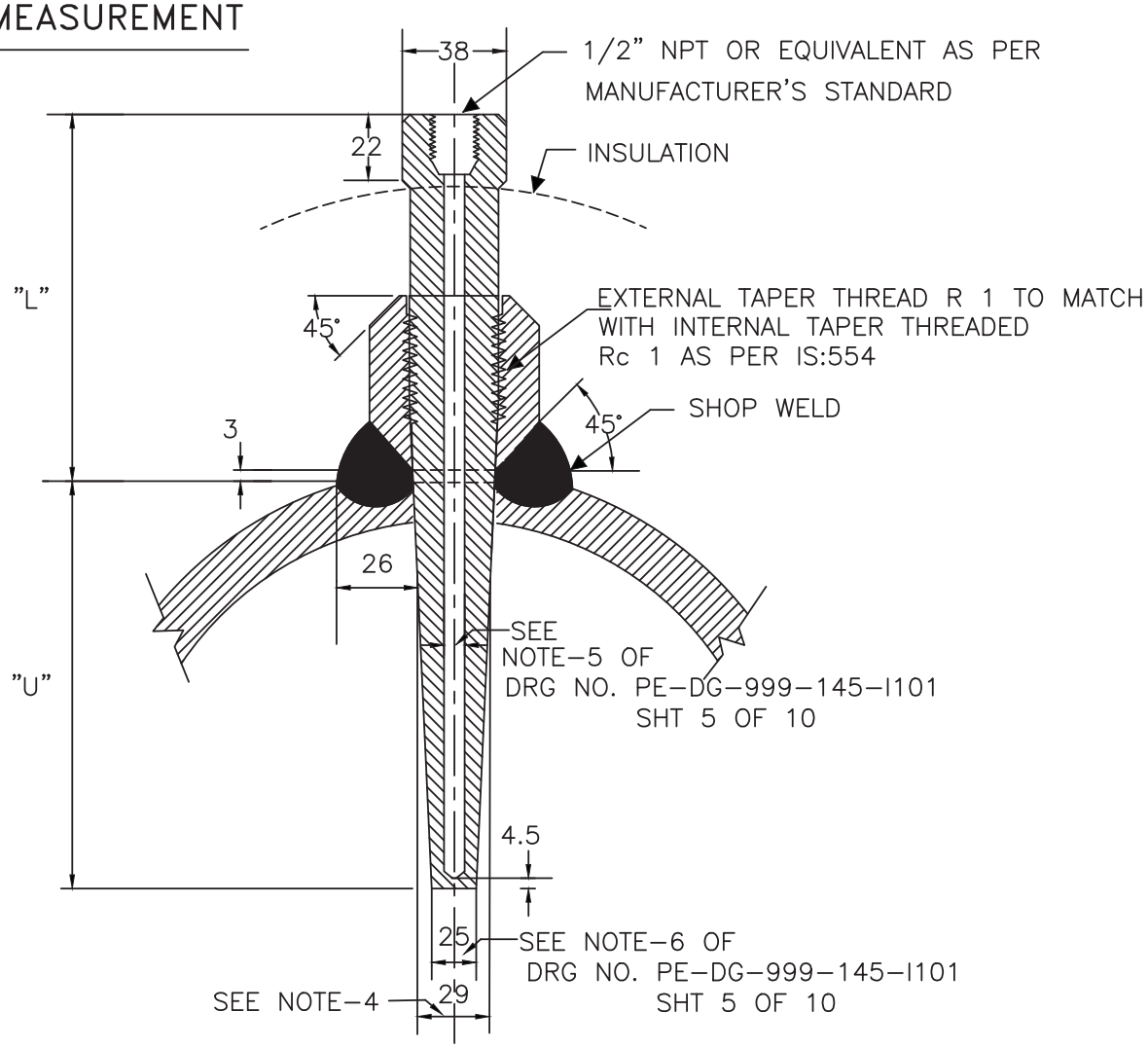
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES

BHEL

TITLE :
INSTRUMENT STUB DETAILS
FOR PRESSURE MEASUREMENT
(PRESS < 60Kg/Cm2, TEMP < 425DegC & Nb15, CLASS 3000#)

DRG. NO.
PE-DG-999-145-I101
REV. 00
SH. 4 OF 10 SHS.

TEMP. MEASUREMENT



NOTES :-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE DESIGN PRESS/ TEMP BELOW 40 KG/CM2(g)/400°C.
2. FOR PRESS. TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. SEE NOTES-2 TO 8 IN SHT. 5 OF 10 OF THIS DRG.
4. THERMOWELL SHALL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER Rc 1.
5. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED

BHEL	TITLE : INSTRUMENT STUB DETAILS FOR TEMPERATURE MEASUREMENT (APPLICABLE FOR PIPE SIZE ABOVE 4") [DESIGN PRESS < 40 Kg/Cm2 (g) & DESIGN TEMP < 400 C]	DRG. NO. PE-DG-999-145-I101 REV. 00 SH. 6 OF 10 SHS.

NOTES :–

1. IMPULSE PIPES SHALL BE OF SEAMLESS AND ANNEALED CONFORMING TO ANSI B36.10 IN LINE WITH THE MAIN PIPE MATERIAL.
2. PIPE FITTINGS SHALL BE OF FORGED MATERIAL CONFORMING TO ANSI B16.11–1991.
3. SNUBBER SHALL BE PROVIDED FOR PUMP DISCHARGE PRESS MEASUREMENTS.
4. IN CASE OF STEAM SERVICE SYPHON SHALL BE MADE BY BENDING THE TUBE OR PIPE.
5. VALVE MANIFOLDS & SNUBBER SHALL BE OF FORGED SS–316.
6. FOR SEA WATER APPLICATION SS316L FITTINGS TO BE PROVIDED.
7. 25NB x 15NB WELDED REDUCER SHALL BE USED FOR ROOT VALVE OF 25NB SIZE.
8. ROOT VALVES SHALL BE AS FOLLOWS:

   i) FOR PRESS <40 ATA & TEMP <425 DEG C, ONE(1) NO. 15Nb, ROOT VALVE OF SUITABLE CLASS SHALL BE USED.
   ii) FOR PRESS >40 ATA & TEMP <425 DEG C, TWO(2) NO. 15Nb, ROOT VALVE OF SUITABLE CLASS SHALL BE USED.
   iii) FOR PRESS >40 ATA & TEMP >425 DEG C, TWO(2) NO. 25Nb, ROOT VALVES OF SUITABLE CLASS SHALL BE USED.

9. HORIZONTAL PIPE RUNS SHOULD HAVE A SLOPE IN THE DIRECTION  SHOWN OF 1:20 AS MINIMUM.
10. FOR PRESSURISED STEAM & WATER SERVICE THE ASSOCIATED INSTRUMENT SHOULD BE MOUNTED BELOW THE TAPPING POINT. FOR VACUUM/AIR/GAS SERVICE, THE ASSOCIATED INSTRUMENT SHOULD BE MOUNTED ABOVE THE TAPPING POINT.
11. SEAMLESS PIPE/SEAMLESS TUBE/CAPILLARY LENGTH SHALL BE SUCH THAT THE GAUGES/TRANSMITTERS/SWITCHES ARE MOUNTED IN ACCESSIBLE AREA.

LEGEND :–

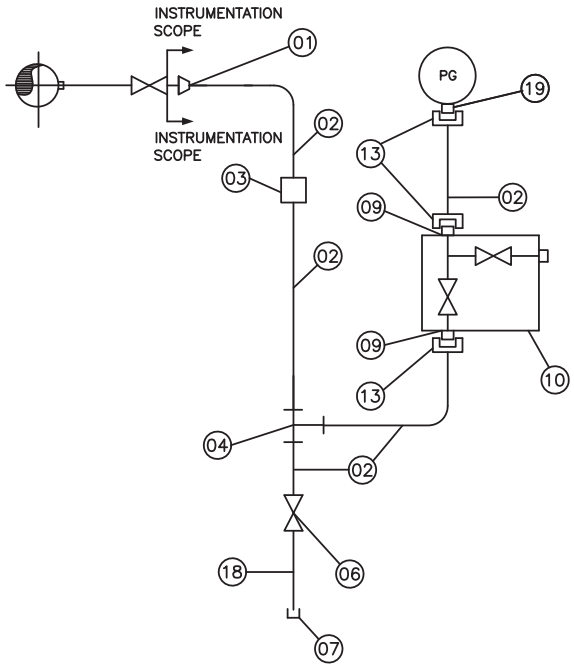
A/R – AS REQUIRED

NPTF – NATIONAL PIPE THREAD FEMALE

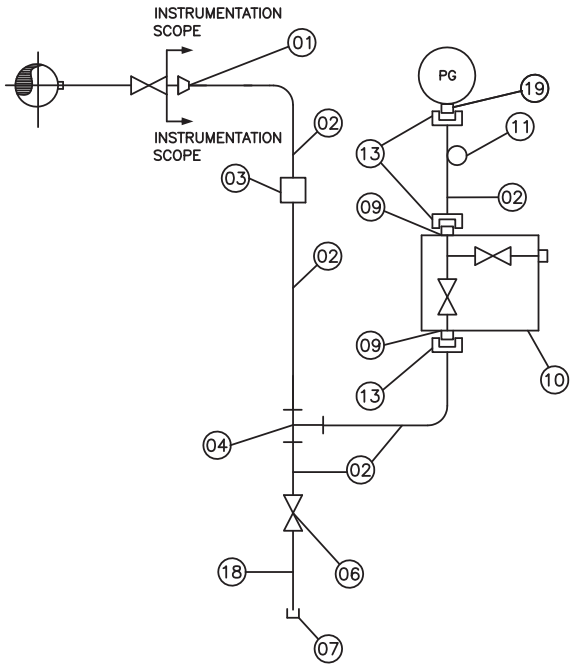
NPTM – NATIONAL PIPE THREAD MALE

SW – SOCKET WELD

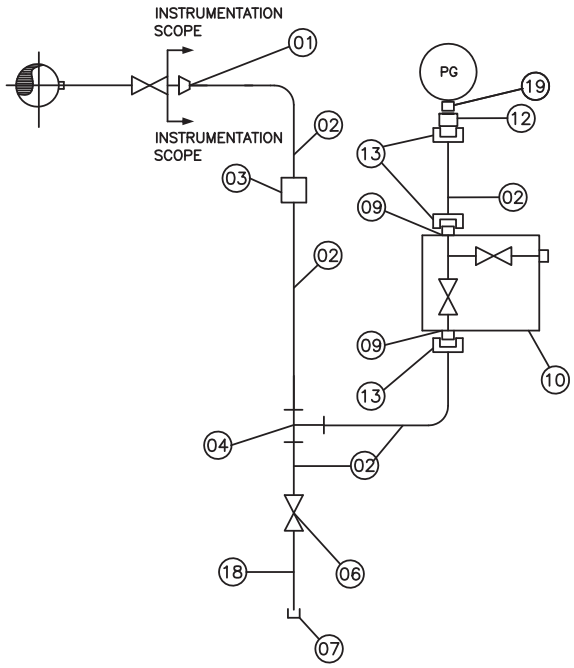
BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM NOTES	DRG. NO.	PE–DG–999–145–IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	2 OF 9	



WATER SERVICE

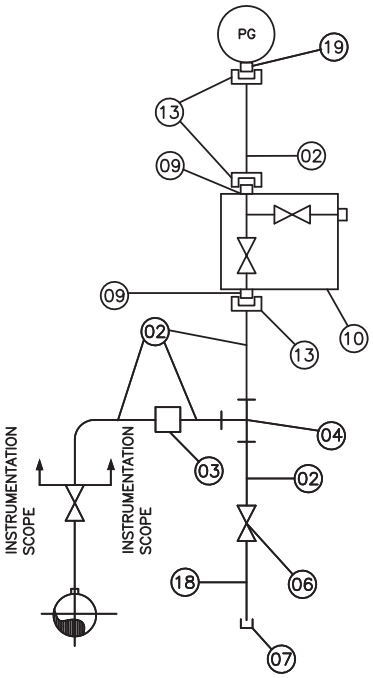


STEAM SERVICE

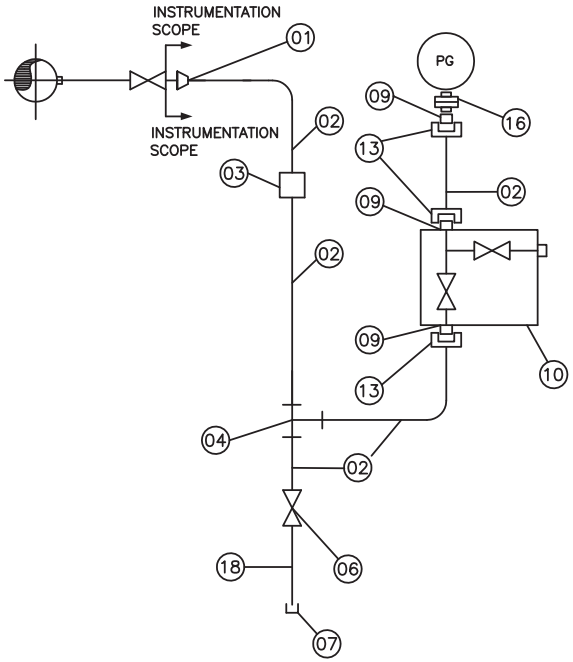


PULSATING SERVICE

BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM PRESSURE GAUGES	DRG. NO.	PE-DG-999-145-IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	3 OF 9	



AIR SERVICE

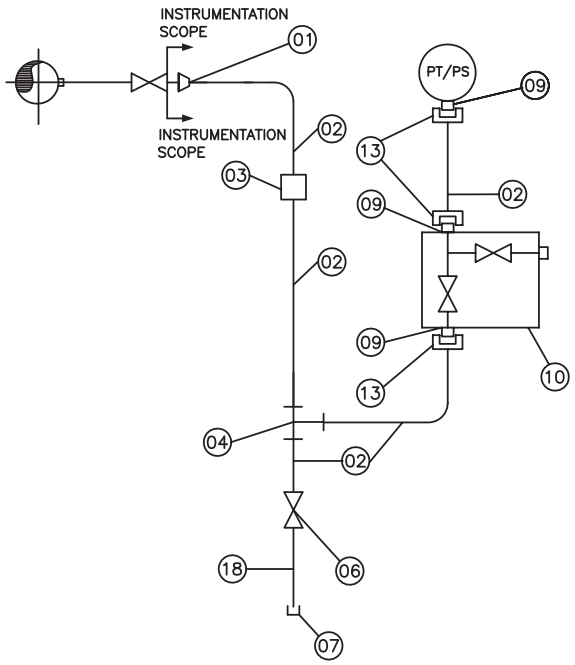


WITH CHEMICAL SEAL

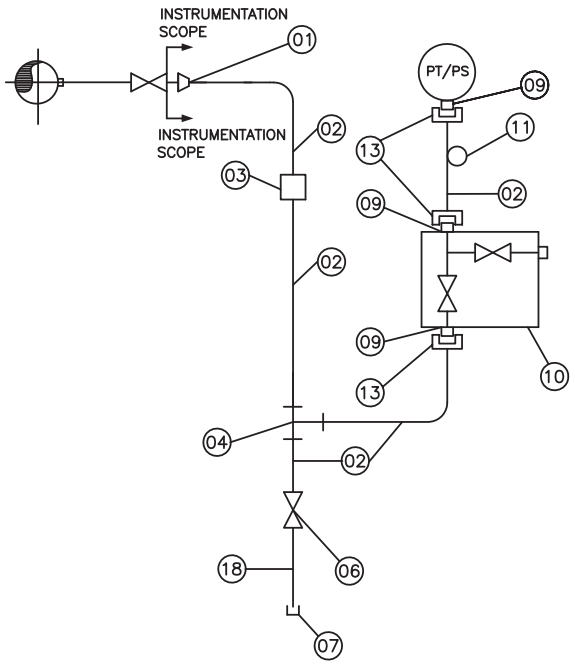
(FOR VISCOUS NON–CORROSIVE FLUID ONLY)

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY				
				WATER	STEAM	PULSATING	AIR	CHEMICAL
01	REDUCER (IF APPLICABLE)	SAME AS MAIN PIPE	1" X 1/2"SW	01	01	01	00	01
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R	A/R	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R	A/R	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	01	01	01	01	01
09	ADAPTER – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02	02	02	03
10	TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG	SS316	1/2" NPTF	01	01	01	01	01
11	SYPHON	SS316	1/2" SW	00	01	00	00	00
12	SNUBBER	SS316	M20X1.5M X M20X1.5F	00	00	01	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	03	03	03	03	03
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00	00	00	01
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	01	01	01	01	01
19	ADAPTER – M TO F	SS316	M20X1.5M X 1/2" NPTF	01	01	01	01	00

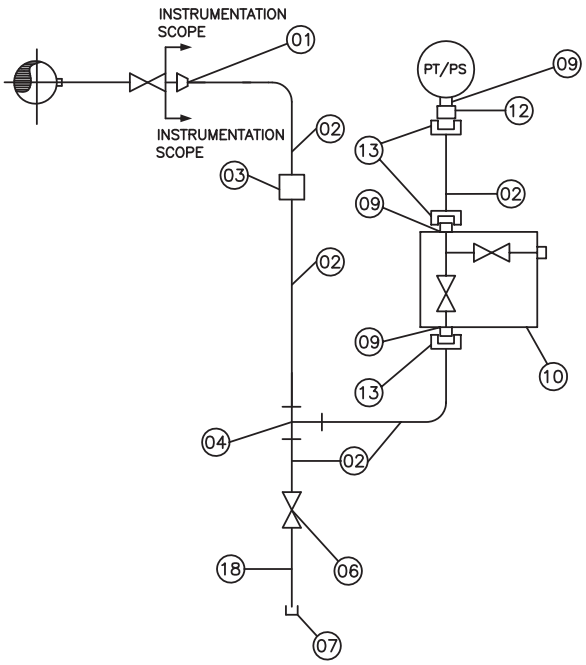
BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM PRESSURE GAUGES	DRG. NO.	PE–DG–999–145–IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	4 OF 9	



WATER SERVICE

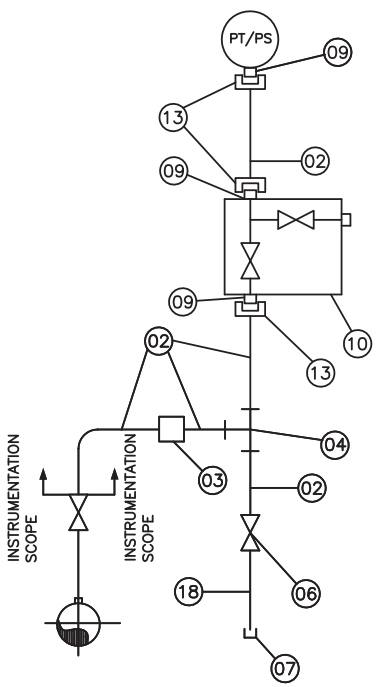


STEAM SERVICE

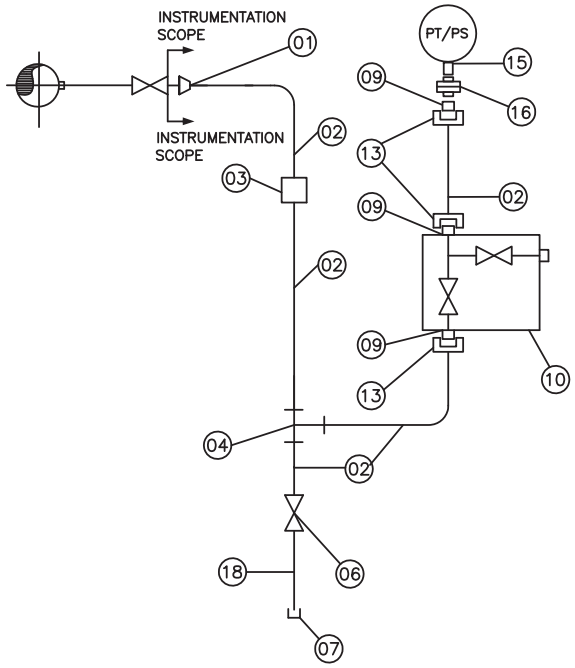


PULSATING SERVICE

BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM PRESSURE SWITCHES/TRANSMITTERS	DRG. NO.	PE-DG-999-145-IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	5 OF 9	



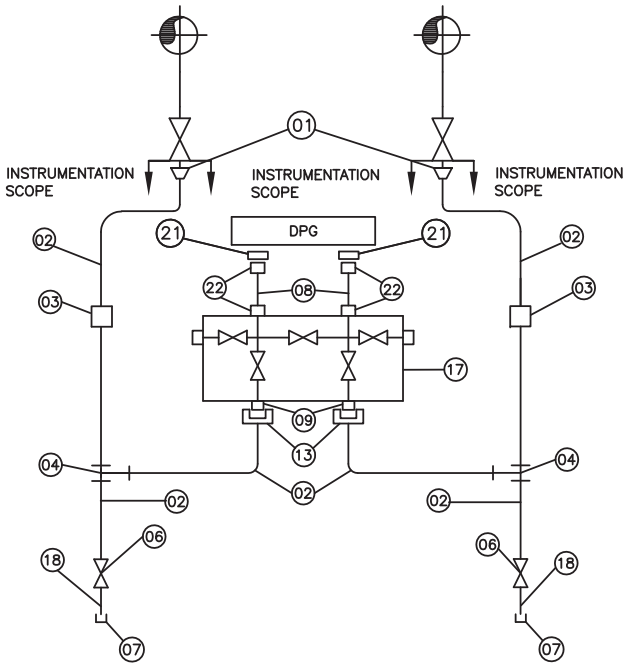
AIR SERVICE



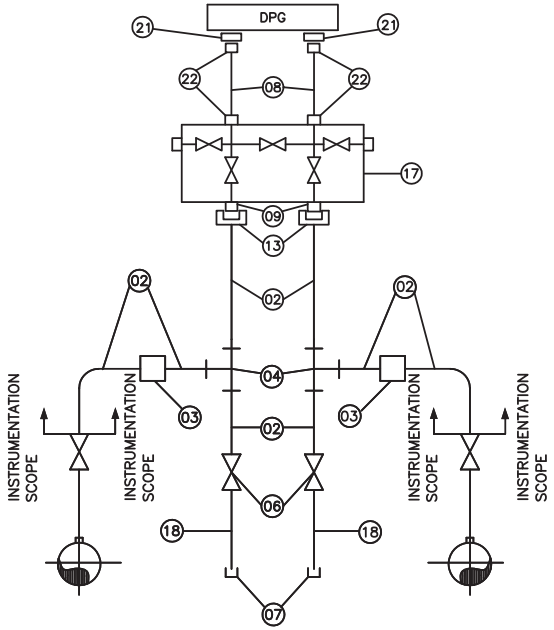
WITH CHEMICAL SEAL
(FOR VISCOUS NON–CORROSIVE FLUID ONLY)

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY				
				WATER	STEAM	PULSATING	AIR	CHEMICAL
01	REDUCER (IF APPLICABLE)	SAME AS MAIN PIPE	1" X 1/2"SW	01	01	01	00	01
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R	A/R	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R	A/R	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	01	01	01	01	01
09	ADAPTOR – M TO M	SS316	M20X1.5M X 1/2" NPTM	03	03	03	03	03
10	TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG	SS316	1/2" NPTF	01	01	01	01	01
11	SYPHON	CS	1/2" SW	00	01	00	00	00
12	SNUBBER	SS316	M20X1.5M X M20X1.5F	00	00	01	00	00
15	CONNECTOR – M TO M	SS316	1/2" NPTM X 1/2" NPTM	00	00	00	00	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00	00	00	01
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	03	03	03	03	03
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	01	01	01	01	01

BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM PRESSURE SWITCHES/TRANSMITTERS	DRG. NO.	PE–DG–999–145–IXXX
		REV. NO.	00 DATE 05.11.13
		SHT	6 OF 9



WATER SERVICE



AIR SERVICE

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				WATER	AIR
01	REDUCER (IF APPLICABLE)	SS316	1" X 1/2"SW	02	00
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	02	02
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	02	02
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	02	02
08	SEAMLESS TUBE	SS316	1/2" OD	A/R	A/R
09	ADAPTOR – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02
17	FIVE VALVE MANIFOLD WITH DRAIN PLUG	SS316	1/2" NPTF	01	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	02	02
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	02	02
22	TUBE FITTING DFDC	SS316	1/2" NPTM X 1/2"OD TUBE	04	04
21	CONNECTOR – F TO F	SS316	1/2" NPTF X 1/2" NPTF	02	02

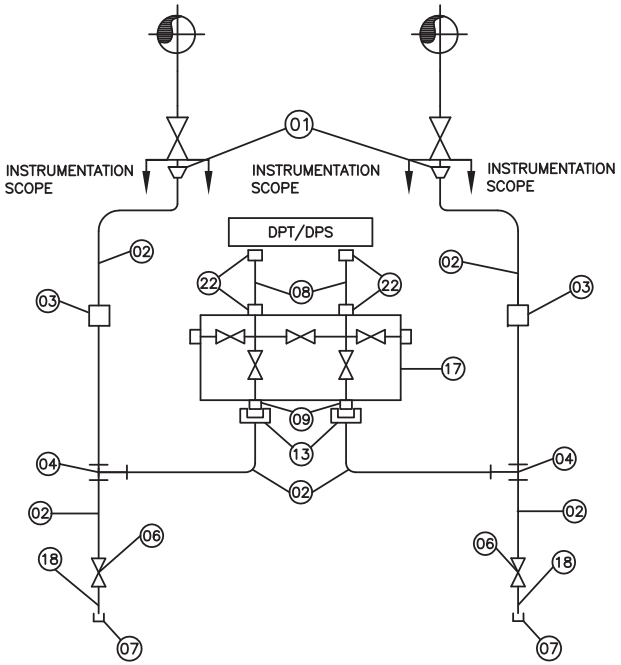
BHEL

TITLE :–

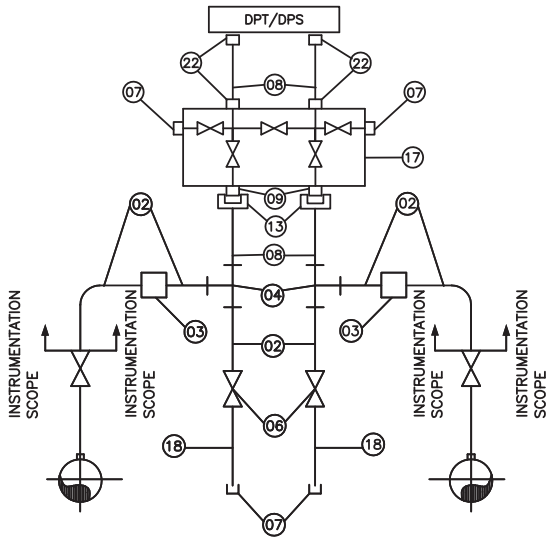
INSTRUMENT INSTALLATION DIAGRAM

DIFFERENTIAL PRESSURE GAUGES

DRG. NO.	PE–DG–999–145–IXXX		
REV. NO.	00	DATE	05.11.13
SHT	7 OF 9		



WATER SERVICE



AIR SERVICE

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				WATER	AIR
01	REDUCER (IF APPLICABLE)	SS316	1" X 1/2"SW	02	00
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R
04	FORGED TEE	SS316	1/2" SW	02	02
06	FORGED GLOBE VALVE	SS316	1/2" SW	02	02
07	CAP	CS	1/2" NPTF	02	02
08	SEAMLESS TUBE	SS316	1/2" OD	A/R	A/R
09	ADAPTER – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02
17	FIVE VALVE MANIFOLD WITH DRAIN PLUG	SS316	1/2" NPTF	01	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00
15	CONNECTOR – M TO M	SS316	1/2" NPTM X 1/2" NPTM	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	02	02
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	02	02
21	CONNECTOR – F TO F	SS316	1/2" NPTF X 1/2" NPTF	00	00
22	TUBE FITTING DFDC	SS316	1/2" NPTM X 1/2"OD TUBE	04	04

BHEL

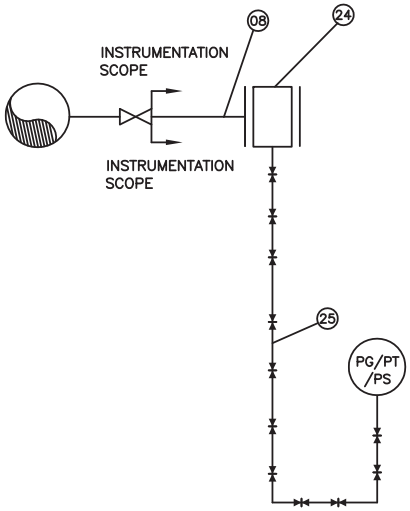
TITLE :–

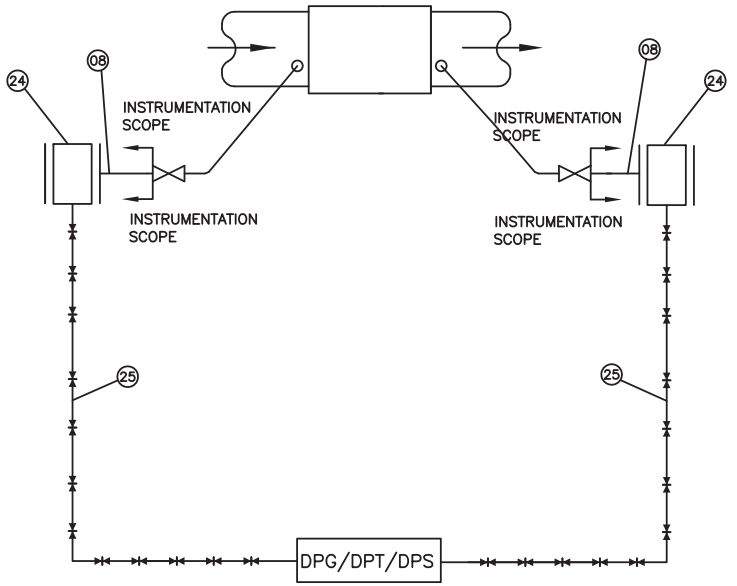
INSTRUMENT INSTALLATION DIAGRAM

DIFFERENTIAL PRESSURE SWITCHES/TRANSMITTERS

DRG. NO.	PE–DG–999–145–IXXX		
REV. NO.	00	DATE	05.11.13
SHT	8 OF 9		

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				PG/PS/PT	DPG/DPS/DPT
24	FLANGE SUPPLIED WITH PG/PS PT/DPG/DPS/DPT TO SUIT 1/2" OR 1" NB PIPE	SAME AS MAIN PIPE	1/2" SW	01	02
08	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
25	SS ARMORED CAPILLARY TUBE (MINIMUM 5M IN LENGTH)	SS316	–	A/R	A/R





BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM WITH CAPILLARY TUBES	DRG. NO.	PE–DG–999–145–IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	9 OF 9	

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LIST OF DOCUMENTS/DELIVERABLES

3x40 MW NTPC RAMMAM HEP HVAC SYSTEM LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT							
		DOCUMENT NUMBER PE-GL-999-145-I100			SHEET 1 of 1		
Sl.No.	**DRAWING NO.**	**DRAWING/DOCUMENT TITLE**	**CATEGORY**	**CUSTOMER**	**FROM**	**USER**	**REMARKS**
		INSTRUMENTATION					
1	PE-V0-414-571-I901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I	
2	PE-V0-414-571-I902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I	
3	PE-V0-414-571-I903	INSTRUMENT HOOK UP	A	-	VENDOR	C&I	
4	PE-V0-414-571-I904	FIELD JB TERMINATIONS	I	-	VENDOR	C&I	
5	PE-V0-414-571-I905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I	
6	PE-V0-414-571-I906	TRANSMITTER RACK GROUPINGS	I	-	VENDOR	C&I	
7	PE-V0-414-571-I907	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A	-	VENDOR	C&I	
8	PE-V0-414-571-I908	CONTROL VALVE DATASHEET WITH VALVE AND ACTUATOR SIZING CALCULATION	A	-	VENDOR	C&I	
9	PE-V0-414-571-I909	CONTROL VALVE NOISE CALCULATION(BOTH HYDRO-STATIC & HYDRO-DYNAMIC)	I	-	VENDOR	C&I	
10	PE-V0-414-571-I910	FLOW ELEMENT DATA SHEET WITH SIZING CALCULATION	A	-	VENDOR	C&I	
11	PE-V0-414-571-I911	THERMOWELL SIZING CALCULATION	I	-	VENDOR	C&I	
		OTHER DOCUMENTS					
1	PE-V0-414-571-I951	LIST OF I&C SPARE PARTS	A	-	VENDOR	C&I	
2	PE-V0-414-571-I952	LIST OF I&C DRAWINGS/DOCUMENTS	A	-	VENDOR	C&I	
3	PE-V0-414-571-I953	ESSENTIAL & START-UP SPARES LIST	A	-	VENDOR	C&I	
4	PE-V0-414-571-I954	DETAILED IMPLEMENTATION SCHEDULE FOR I&C SYSTEM	A	-	VENDOR	C&I	
5	PE-V0-414-571-I955	I&C SYSTEM DESIGN BASIS REPORT INCORPORATING CONTROL PHILOSOPHY/ OPERATION PHILOSOPHY/ DESIGN PHILOSOPHY/ REDUNDANCY PHILOSOPHY	A	-	VENDOR	C&I	
	Notes:						
		$$ - Approval by BHEL if Vendor BBU Item Approval by Customer if Customer BBU Item					

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INSTRUMENTATION CABLE, CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

1.00.00 **INSTRUMENTATION CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL**

1.01.00 **General Requirements**

1.01.01 All Instrumentation cables, internal wiring and electrical field construction material shall conform to this specification; Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification. All required instrumentation cables and associated accessories (trays, conduits, junction boxes, terminal blocks etc.) shall be provided on as required basis within the quoted lumpsum price.

2.00.00 **INSTRUMENTATION CABLE SPECIFICATIONS**

2.01.00 **Common Requirements**

S. No.	Property	Requirement
1	Voltage grade	225 V (peak value)
2.	Codes and standards	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions), ASTM D 2116, ASTM D 2843, 2863, IEC 60754-1 and their amendments read along with this specification.
3.	Continuous operation suitability	70 deg. C for all types of cables, 205 Deg C for Type-C cables.
4.	Progressive automatic on-line sequential marking of length in meters	To be provided at every one meter on outer sheath.
5.	Marking to read 'FRLS'	To be provided at every 5 meters on outer sheath except for Type-C cable.
6.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet

S. No.	Property	Requirement
7.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.
8	Ovality at any cross-section	Not more than 1.0 mm
9	Others	a) Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided. b) Cables shall be suitable for laying in conduits, ducts, trenches, racks and underground-buried installation c) Repaired cables shall not be acceptable.

2.02.00 **Specific Requirements**

Specification Requirements	T/C extension cable (Type A & B)	High temp T/C extension cable (Type – C)	Type F & G cable
A. Conductors			
Cross section area	0.5 sq. mm		
Conductor material	a. ANSI type KX (For K-type Thermocouple) b. ANSI type SX (For R-type thermocouple)	ANSI type KX	High conductivity Annealed bare copper
Colour code	As per ANSI MC 96.1		As per VDE-815

Conductor Grade	As per ANSI MC 96.1		Electrolytic
No & dia of strands	7x0.3 mm (nom)		
No. of Pairs	2	2	2,4,8,12,16,24
Max. conductor resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4 (loop)
Reference Standard	As per ANSI MC 96.1		VDE 0815
B. Insulation			
Material	PVC type YI 3	Teflon (i.e. extruded FEP)	PVC Type YI 3
Thickness in mm (Min/Nom/Max)	0.25/0.3/0.35	0.4/0.50	0.25/0.3/0.35
Volume Resistivity (Min) in ohm-cm	1×10^{14} at 20 deg. C/ 1×10^{11} at 70 deg. C.	2.8×10^{14} at 20 deg. C, 2×10^{11} at 205 deg. C	1×10^{14} at 20 deg. C/ 1×10^{11} at 70 deg. C.
C. Pairing & Twisting			
Max. lay of pairs (mm)	50		
Single layer of Numbered binder tape on each pair provided	Yes	Yes	Yes
Unit formation of four pairs with printing of no. of Unit provided	N.A.	N.A.	Yes

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Conductor/ pair identification as per VDE0815	N.A.	N.A.	To be provided
D. Shielding			
Type of shielding	Al-Mylar tape		
Individual pair shielding	No		To be provided for F-type cable
Minimum thickness of Individual pair shielding	No		28 micron
Overall cable assembly shielding	To be provided		
Minimum thickness of Overall cable assembly shielding	55 micron		
Shielding coverage	100% with at least 20% overlap		
Drain wire provided for individual shield	N.A.		Yes (for F-type) 7-strand 20 AWG (0.51 mm^2) annealed Tin coated copper
Drain wire provided for overall shield	Yes. 7-strand 20 AWG (0.51 mm^2) annealed Tin coated copper		
E. FILLERS			
Non-hygroscopic, flame retardant	To be provided		

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F. Outer Sheath			
Material	Extruded PVC compound YM1 with FRLS properties	Teflon (i.e. extruded FRP)	Extruded PVC compound YM1 with FRLS properties
Minimum Thickness at any point	1.8 mm	0.4 mm	1.8 mm
Nominal Thickness at any point	>1.8 mm	0.5 mm	>1.8 mm
Color	Blue		
Resistant to water, fungus, termite & rodent attack	Required		
Oxygen index as per ASTMD-2863	not less than 29%	N.A.	not less than 29%
Temperature index as per ASTMD-2863	not less than 250 deg.C	N.A.	not less than 250 deg.C
acid gas generation by weight as per IEC-60754-1	Maximum 20%	N.A.	Maximum 20%
Smoke Density Rating as per ASTMD-2843	Maximum 60% **	N.A.	Maximum 60% **
Reference standard	VDE207 Part 5	VDE 0207 Part-6 & ASTMD 2116	VDE 0207 Part-5
** (defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)			

G. Electrical Parameters			
MUTUAL CAPACITANCE BETWEEN CONDUCTORS AT 0.8 KHZ (MAX.)	200 nF/km		120 nF/km for F type 100 nF/km for G-type
INSULATION RESISTANCE (MIN.)	100 M Ohm/Km		
CROSS TALK FIGURE (MIN.) AT 0.8 KHZ	60 dB	N.A.	60 dB
CHARACTERISTIC IMPEDANCE (MAX) AT 1 KHZ	N.A.		320 ohm for F-type 340 ohm for G-type
ATTENUATION FIGURE AT 1 KHZ (MAX)	N.A.		1.2 db/km
H. Complete Cable			
Complete Cable assembly	Swedish Chimney test as per SEN-SS 4241475 class F3.	N.A.	Swedish Chimney test as per SEN-SS 4241475 class F3.
Flammability	Flammability as per IEEE-383 read in conjunction to this specification	As per manufacturer's standard subject to Employer's approval	Flammability as per IEEE-383 read in conjunction to this specification
I. Tests			
Routine & Acceptance tests	Refer sub-section IIIE		
Type tests	Refer sub-section-CNI TYPE TEST		

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J. Cable Drum	
Type	Non-returnable wooden drum (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to the entire drum) or steel drum. For high temperature (Teflon insulated/ sheathed cables), drums of other material as per manufacturer's practice can be provided subject to Employer's approval.
Outermost layer covered with waterproof paper	Yes
Painting	Entire surface to be painted
Length	1000 m ± 5% for up to & including 12 pairs 500 m ± 5% for above12 pairs

3.00.00 SPECIFICATION OF OPTICAL FIBER CABLES (OFC)

3.01.00 Optic Fiber cable shall be 4/8/12 core, galvanised corrugated steel taped armoured, fully water blocked with dielectric central member for outdoor/ indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multi mode fibers on as required basis so as to avoid the usage of any repeaters. The core and cladding diameter shall be 9 +/- 1 micrometer and 125 +/- 1 micrometer respectively. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturer, progressive automatic sequential on-line marking of length in meters at every meter on outer sheath.

3.02.00 The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Steel central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum& crush resistance 4000 N minimum. The operating temperature shall be –20 deg. C to 70 deg.C

3.03.00 All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards.

3.04.00 Bidder to ensure that minimum 100% cores are kept as spares in all types of optical fibre cables.

3.05.00 Cables shall be suitable for laying in conduits, ducts, trenches, racks and under ground buried installation.

3.06.00 Spliced / Repaired cables are not acceptable.

3.07.00 Penetration of water resistance and impact resistance shall be as per IEC standard.

4.00.00 INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit & torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A.

TABLE A: CABLE TERMINATION TO BE FOLLOWED

Application		Type Of Termination		Type Of Cable
FROM (A)	TO (B)	END A	END B	
Valves/ dampers drives (Integral Junction box)	Marshalling cubicle/ Marshalling cum termination Cubicle/ local group JB	Screwed / Plug in connector	Posts mount cage clamp type.	G
Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G
RTD	Temperature Transmitter	Plug in connector	Screwed, Cage clamp	F
Thermocouple	Temp. Transmitter	Plug in connector	Screwed, Cage clamp	A,B,C*
Other Field Mounted Instrument	Local JB/Group JB	Plug in connector	Screwed, Cage clamp (Rail mount) type	F,G
Application		Type Of Termination		Type Of Cable
FROM (A)	TO (B)	END A	END B	

Local Junction box, Temp. Transmitter, Int. Junction box of LIE/ LIR/ Group JB/ MCC/ SWGR	Group JB	Cage clamp (Rail mount) type.	Cage clamp (Rail mount) type.	F,G
Local Junction box, Int. Junction box of LIE/ LIR/ Group JB/ MCC/ SWGR	Marshalling Cubicle/ Marshalling cum Termination Cabinet	Cage clamp (Rail mount) type.	Posts mount cage clamp type.	F,G
Marshalling cubicle/ Termination Cabinet	Electronic system cabinet	Cage clamp Post mounted type.	Plug in connector/ Other System as per manufacturer's Standard	Internal wiring
Marshalling/ Termination System Cabinets	UCD mounted equipments	Post mount cage clamp type.	Plug in connector/ Cage clamp type (rail mounted).	F,G (with plug-in connector at one end)
DDCMIS cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standard

Notes

1. This is a standard table. Applicability shall be as per scope.
2. Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs.
3. Wherever, existing terminal blocks like in the case of conventional motorized drives, MCC/ SWGR etc. are being used, existing type of termination shall be used.
4. For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided.
5. *For high temperature applications only.

	6. All the termination in field JBs, system/ termination cabinets shall be provided with suitable lugs. 7. All the spare cores of field cables entering the system/ termination cabinets shall be terminated.
5.00.00	**TERMINAL BLOCKS**
5.01.00	All terminal blocks shall be rail mounted/ post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, CJC boxes, instrument enclosures/ racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/ termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The terminal blocks for SCADA input/output connections from/to SWGR/ MCC, Actuators with Integral Starter (for coupling relays and check back signals of 11 kV and 3.3 kV auxiliaries, LT drives/valves & dampers/solenoids, CT & VT, etc.) shall be provided with built in test and disconnect facilities complete with plug, slide clamp, test socket etc. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval.
5.02.00	All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, test plug bolts and test plug (as specified above for SWGR connections) transparent covers, support brackets, distance sleeves, warning label, marking, etc.
5.03.00	The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.
5.04.00	**Not used**
5.05.00	The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.
5.06.00	For ensuring proper connections, Bidder shall provide suitable accessories, along with insulation sleeves. The exact connecting accessory shall be finalised as per application during detail engineering stage subject to Employer's approval without any cost repercussions.
5.07.00	Internal wiring in factory prewired electronic equipment cabinets may be installed according to the Bidder's standard as to wire size and method of termination or internal equipment. Terminal blocks for connection of external circuits into factory prewired electronic equipment cabinets shall meet all the requirements as specified above.

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6.00.00	**INTERNAL PANELS/ SYSTEM CABINETS WIRING**
6.01.00	Internal panel/ cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.
6.02.00	Wiring to door mounted devices shall be done by 19 strand copper wire provided with adequate loop lengths of hinge wire so that multiple door opening shall not cause fatigue breaking of the conductor.
6.03.00	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends in Employer's approved format. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.
6.04.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.
6.05.00	All floor slots of desk/ panels/ cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.
6.06.00	All the special tools as may be required for solderless connections shall be provided by Bidder.
6.07.00	Wire sizes to be utilised for internal wiring. (i) Current (4-20 mA), low voltage signals (48V); Ammeter/ Voltmeter circuit, control switches etc. for electrical system. — 0.5 Sq.mm. (ii) Power supply and internal illumination. — 2.5 Sq.mm. minimum (shall be as per load requirement.)
7.00.00	**INSTRUMENTATION CABLE INSTALLATION AND ROUTING**
7.01.00	All cables assigned to a particular duct/ conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.
7.02.00	Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows : From 11 kV/6.6 kV/3.3 kV tray system - 914 mm From 415V tray system - 610 mm From control cable tray system - 305 mm

7.03.00	Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Fire proof sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for field and single for inside rooms) shall be provided.
7.04.00	All cables shall be identified by tag. Nos. provided in Employer's approved format at both the ends as well as at an interval of 5 meters.
7.05.00	Line voltage drop due to high resistance splices, terminal contacts, insulation resistance at terminal block, very long transmission line etc. shall be reduced as far as practicable.
7.06.00	The cables emanating from redundant equipment/ devices shall be routed through different routes. The above segregation of cables & wiring for redundant equipments/ devices shall be in accordance with IEEE-Std-422.
8.00.00	**CABLE LAYING AND ACCESSORIES**
8.01.00	**Cable Laying** 1 Cables shall be laid strictly in line with cable schedule. 2 Identification tags for cables. Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray. 3 Cable tray numbering and marking: To be provided at every 10m and at each end of cable way & branch connection 4 Joints for less than 250 Meters run of cable shall not be permitted. 5 Buried cable protection: With concrete slabs; Route markers at every 20 Meters along the route & at every bend. 6 Road Crossings: Cables to pass through buried high density PE pipes encased in PCC. At least 300 mm clearance shall be provided between - HT power & LT power cables, - LT power & LT control/instrumentation cables, Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing.

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	7 Segregation (physical isolation to prevent fire jumping): a All cable associated with one module shall be segregated from cables of other modules. b Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. 8 Cable clamping All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided. 9 Optical fiber cables shall be laid on cable trays wherever available and feasible. When the cables are laid outside buildings, conduits shall be used. In areas where cable trays are not available, the same shall be buried in separate trench approx.1.6 meter depth, to be laid in 2" GI/ rodent proof HDPE conduits covered with sand, brick and soil along the pipe line route; While crossing canals/river- to be laid in GI/rodent proof HDPE conduits within hume pipe.
8.02.00	**NOT USED.**
8.03.00	Bidder shall furnish two completely new sets of cable termination kits like Crimping tools, maxi-termi/ wire-wrap tools etc., which are required for maintenance of the system as per the type of termination used.
804.00	Cables, which terminate in cabinets of drawout sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of drawout sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.
8.05.00	No splices shall be made in conductors for instrument and control circuits except where required at connections to devices equipped with factory installed pigtails. Such splices shall be made only in approved splicing boxes of fitting with removable cover. The splices shall be made with sufficient slack left in the wires to permit withdrawal of the splice from the splicing box for ease of future disconnection of the splices. All exposed conductor or connector surfaces shall be covered with a minimum of three half-lapped layers of all weather vinyl plastic electrical tape. Taping shall extend a minimum of two cable diameters over the cable jacket and a similar distance over the other insulation or connections requiring insulation.
8.06.00	The Bidder shall be responsible for proper grounding of all equipment under C&I package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests. All the cables etc. required for grounding of all equipments supplied under this package are to be supplied by the Bidder.

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8.07.00 The Contractor shall take full care while laying/ installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends.

9.00.00 FIELD MOUNTED LOCAL JUNCTION BOXES

(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spare terminals.
(ii)	Material and Thickness	minimum 4mm thick Fibreglass Reinforced Polyester (FRP).
(iii)	Type	Screwed at all four corners for door. Door handle shall be self locking with common key. Door gasket shall be of synthetic rubber.
(iv)	Mounting clamps and accessories	Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass, included in Bidders scope of supply.
(v)	Type of terminal blocks	Rail mounted maxitermi or cage-clamp type suitable for conductor size upto 2.5 mm2. A M6 earthing stud shall be provided.
(vi)	Protection Class	IP:55 minimum for indoor & IP-66 minimum for outdoor
(vii)	Colour	To be decided during detailed engineering & subject to Employer's approval.

10.00.00 CONDUITS

10.01.00 Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9357 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant lead coated steel, water leak, fire and rust proof. The temperature rating of flexible conduit shall be suitable for actual application.

10.02.00 The Bidder shall install conduits according to the general routing as approved by Employer and shall coordinate conduit locations with other works.

11.03.00 All grounding bushings within all enclosures shall be wired together and connected internally to the enclosure grounding lug or grounding bus with 8 AWG bare copper conductor. Conduit runs to individually mounted equipment shall be grounded to the Employer's cable tray grounding conductor with 12 AEG bare copper conductor. All grounding bushings, clamps and connectors shall be subject to approval of the Employer.

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10.04.00	All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.
10.05.00	All individually mounted equipment and devices shall be connected to the supply conduit, using not more than one metre of flexible conduit adjacent to the equipment or device. Flexible conduit shall be installed in all conduit runs, which are supported by both building steel and structures subject to vibration or thermal expansion.
10.06.00	Special areas, such as control rooms in which external noise is to be minimized, shall have flexible conduit in conduit runs where the runs cross from the main building framing to the control room framing.
10.07.00	Conduit supports shall be furnished and installed in accordance with these specifications. Support material shall comply with the following requirements. i) Hanger rods shall be 12 mm diameter galvanized threaded steel rods. ii) Single conduit supports shall be one-hole cast metal straps and clampbacks unless other types are acceptable to the Employer. Multiple conduit bank supports shall be constructed of special galvanized support channels with associated conduit clips.
10.08.00	Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform with NEC requirements for the area classification.
10.09.00	Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Watertight conduit unions and rain tight conduit hubs shall be utilized for all the applications which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.
10.10.00	Conduits shall be securely fastened to all boxes and cabinets.
11.00.00	**CABLE SUB-TRAY & SUPPORT**
11.01.00	The cable sub-trays and the supporting system, to be generally used between Local/ Group JBs and the main cable trays and the same shall be furnished and installed by the Bidder. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route).
11.02.00	The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded. The cable trays shall not have sharp edges, burrs or projections injurious to the insulation or outer sheath of the cables.

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11.03.00	The supporting arrangement of cable tray system shall be able to withstand the weight of the cable and cable tray system. The supporting interval shall not be more than the recommended span for the above loading for the type of cable tray selected. The tray shall not overhang by more than one meter from the support at the dead end. As far as practicable the cable sub-tray system shall be supported from one side only, in order to facilitate installation and maintenance of cables.

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SUB VENDOR LIST

SUB-VENDOR LIST (As on 06.02.2020)

SLNO	Package Name	Vendor Name	Vendor Address
1	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,
2	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone-9999464663 Pincode : 382729 Email : sales@precisionmass.com
3	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in
4	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
5	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de
6	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com
7	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
8	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mktg@indfos.com
9	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
10	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone-24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
11	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net
12	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
13	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
14	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone-9999464663 Pincode : 382729 Email : sales@precisionmass.com
15	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
16	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
17	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
18	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone-9920576002 Pincode : 396105 Email : sales@nesstech.co.in
19	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
20	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
21	TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
22	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
23	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in
24	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone-24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
25	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
26	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
27	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
28	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone-9999464663 Pincode : 382729 Email : sales@precisionmass.com
29	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
30	LEVEL GAUGE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com

31	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
32	FLOW ELEMENT	TM TECNOMATIC SPA	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzocc VIA DELLE INDUSTRIE, 36 CREMONA Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com
33	FLOW ELEMENT	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net
34	FLOW ELEMENT	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com
35	FLOW ELEMENT	MICRO PRECISION PRODUCTS PVT. LTD.	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola,Tehsil & Distt. Palwal FARIDABAD Phone- 9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com
36	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV INDUSTIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com
37	TEMP. ELEMENT	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in
38	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema,Mahim Mumbai Phone- 09322664709 Pincode : 400016 Email : ramk@giconindia.com
39	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com
40	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	M. D. BICHU/R. M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in
41	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
42	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
43	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
44	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
45	TEMP. ELEMENT	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
46	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
47	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,
48	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com
49	TRANSMITTERS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
50	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
51	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
52	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
53	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,
54	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com
55	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
56	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com
57	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in
58	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com
59	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com
60	TEMPERATURE SWITCH	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
61	TEMPERATURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com
62	TEMPERATURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com

63	TEMPERATURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in
64	TEMPERATURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
65	SIGHT FLOW INDICATORS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
66	SIGHT FLOW INDICATORS	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
67	SIGHT FLOW INDICATORS	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
68	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	T. BALAKRISHNAN/S.VENKATESH 217 , ARCOT ROAD PORUR , CHENNAI Phone- 9444057761 Pincode : 600116 Email : bkequip@gmail.com
69	SIGHT FLOW INDICATORS	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
70	SIGHT FLOW INDICATORS	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com
71	DIFFERENTIAL PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
72	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net
73	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com
74	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com
75	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
76	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com
77	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
78	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
79	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
80	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
81	ROTAMETER	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com
82	ROTAMETER	TANSA EQUIPMENTS PVT. LTD.	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com
83	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune Phone- 9370469466 Pincode : 411038 Email : sales@eurekaflow.com
84	ROTAMETER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
85	LEVEL SWITCH-CAPACITANCE TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
86	LEVEL SWITCH-CAPACITANCE TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
87	LEVEL SWITCH-CAPACITANCE TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
88	LEVEL SWITCH-CAPACITANCE TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
89	LEVEL SWITCH-CAPACITANCE TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
90	LEVEL SWITCH-CAPACITANCE TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
91	LEVEL SWITCH-CONDUTIVITY TYPE	Sapcon Instrument Pvt Ltd.	131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.com
92	LEVEL SWITCH-CONDUTIVITY TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
93	LEVEL SWITCH-CONDUTIVITY TYPE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com

94	LEVEL SWITCH-CONDUTIVITY TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
95	LEVEL SWITCH-CONDUTIVITY TYPE	HI-TECH SYSTEMS & SERVICES LTD.	Mr. Vikash Agrawal/Mr. Tarun Debnath 119, PARK STREET , KOLKATA Phone- 033-22290045 Pincode : 700016 Email : sandeep@hitech.in
96	LEVEL SWITCH-CONDUTIVITY TYPE	RAMAN INSTRUMENTS PVT.LTD.	Mr. N R Shenoy/Mr G B Vijh 8, First Floor.Plot : 160A Bait-Ush-Sharaf, 29th Road,Bandra(W) MUMBAI Phone- 09892331381 Pincode : 400050 Email : ramanbpl@vsnl.com
97	LEVEL SWITCH-CONDUTIVITY TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
98	LEVEL SWITCH-CONDUTIVITY TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
99	LEVEL SWITCH-FLOAT TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
100	LEVEL SWITCH-FLOAT TYPE	D.K. INSTRUMENTS PVT.LTD.	N.SIKDAR/ SUMIT SIKDAR 76/2,SELIMPUR RD DHAKURIA Kolkata Phone- 033-2415-1310. Pincode : 700031 Email : dkinst@vsnl.net
101	LEVEL SWITCH-FLOAT TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
102	LEVEL SWITCH-FLOAT TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
103	LEVEL SWITCH-FLOAT TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
104	LEVEL SWITCH-FLOAT TYPE	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
105	LEVEL SWITCH-FLOAT TYPE	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
106	LEVEL SWITCH-FLOAT TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
107	LEVEL SWITCH-FLOAT TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
108	LEVEL SWITCH-FLOAT TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
109	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
110	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
111	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
112	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
113	ULTRASONIC FLOW METERS	Electronet Equipments Pvt Ltd.	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com
114	ULTRASONIC FLOW METERS	Adept Fluidyne Pvt. Ltd.	Vinayak Gadre Plot No 4,S.No.17/1-B Kothrud Industrial Estate Pune Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com
115	ULTRASONIC FLOW METERS	FLEXIM Flexible Industriemesstechnik GmbH	Boxberger Str., 4, Berlin Berlin Phone- 0049 30 93 66 76 60 Pincode : 12681 Email : info@flexim.de
116	ULTRASONIC FLOW METERS	Rockwin Flowmeter India Pvt. Ltd.	B-24, Site-IV, Sahibabad Industrial Area Ghaziabad, Phone- 9810129687 Pincode : 201010, Email : amiya@rockwin.com
117	ULTRASONIC FLOW METERS	FLASH FORGE PVT LTD	Mr. Gautam Makker, 503, 'A'-wing, Delphi, Orchard Avenue Road, Powai Mumbai Phone- 022-42784300 Pincode : 400076 Email : hemendrapatil@f-f.co.in
118	ULTRASONIC FLOW METERS	NIVUS GMBH	Mr. Marcus Fischer Im Taele 2, D - 75031 Eppingen Phone- 00491712233770 Pincode : Email : carolin.schuster@nivus.com
119	FLOW ELEMENT - ORIFICE	TANSA EQUIPMENTS PVT. LTD.	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com
120	FLOW ELEMENT - ORIFICE	MINCO (INDIA) PRIVATE LIMITED	Mr. Rajeev Vasudeva, D/35, TIVIM INDUSTRIAL ESTATE, KARASWADA, MAPUSA, Goa, Phone- 9313637073 Pincode : 403526, Email : gicdelhi@general-gauges.com
121	FLOW ELEMENT - ORIFICE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
122	FLOW ELEMENT - ORIFICE	Electronet Equipments Pvt Ltd.	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com
123	FLOW ELEMENT - ORIFICE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com
124	FLOW ELEMENT - ORIFICE	HYDROPNEUMATICS PVT. LTD.	Mr. DM Bichu G/B, Hill Crown Apts., College Road Mapusa Phone- 0832-2360364 Pincode : 403507 Email : ajayrc@hydropneumatics.co.in

125	FLOW ELEMENT - ORIFICE	MICRO PRECISION PRODUCTS PVT. LTD.	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola,Tehsil & Distt. Palwal FARIDABAD Phone- 9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com
126	FLOW ELEMENT - ORIFICE	MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	Mr. Raghavendra M. Kulkarni D2-49/50, Tivim Industrial Estate, Karaswada Mapusa Phone- 0832-2257059 Pincode : 403526 Email : gicflowelement@giconindia.com
127	FLOW ELEMENT - ORIFICE	CHEMTROLS INDUSTRIES PVT. LTD.	Mr. K. NANDAKUMAR AMAR HILL, SAKI VIHAR ROAD, POWAI, MUMBAI Phone- 022-67151261 Pincode : 400072 Email : manikandan@chemtrols.com
128	FLOW ELEMENT - ORIFICE	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net
129	FLOW ELEMENT - ORIFICE	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com
130	FLOW ELEMENT - ORIFICE	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum Phone- 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com
131	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
132	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com
133	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com
134	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com
135	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
136	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
137	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
138	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
139	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
140	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
141	ELECTROMAGNETIC FLOW METER	V.A Valves	Mr.Vishal Jain, Udyog Nagar, Gadaipur, Jalandhar Phone- 9872626376 Pincode : 144004 Email : support@fedrelflowmeters.com
142	ELECTROMAGNETIC FLOW METER	Adept Fluidyne Pvt. Ltd.	Vinayak Gadre Plot No 4,S.No.17/1-B Kothrud Industrial Estate Pune Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com
143	ELECTROMAGNETIC FLOW METER	Electronet Equipments Pvt Ltd.	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com
144	ELECTROMAGNETIC FLOW METER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
145	ELECTROMAGNETIC FLOW METER	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com

Note:
1) Sub-Vendor List is subject to end user approval.
2) New Sub-Vendor if proposed by Vendor during contract stage shall subject to end user approval.

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MANDATORY SPARES LIST

Clause No.	Item	Quantity
2.00.00	**MEASURING INSTRUMENTS**	
1	Electronic Transmitters	
(i)	Transmitters of all type, range and model no. (for the measurement of Pressure, differential pressure flow,	10 % of each type and model or 2Nos.

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Clause No.	Item	Quantity
	level, etc.)	whichever is more
(ii)	Electronic cards / PCB's for each type and model of transmitters.	10 % of each type and model or 2Nos. whichever is more
2	Temperature elements	
(i)	a) RTD's b) Any other temperature sensor	10 % of each type and model or 2Nos. whichever is more
(ii)	Temperature Transmitters	10% of each type and model or 2Nos. whichever is more
3	Electrical Metering Instruments: Electrical meters including voltmeter (analog), motor current ammeter, semaphore indicator, frequency meter (analog), synchroscope	1 no. of each type and model.
4	Vibration Monitoring System	
(i)	Sensors	10% or 2 Nos. whichever is more
(ii)	Power Supply Module Cards	10% or 2 Nos. whichever is more
(iii)	Driver / Interface Cards & all other electronic cards.	10% or 2 Nos. whichever is more

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Clause No.	Item	Quantity
4.00.00	**PROCESS CONNECTION PIPING**	
(i)	Valves of all types	10%
(ii)	2 way, 3way, 5way valve manifolds	10% of each type, class, size and model or 2 whichever is more
(iii)	Fittings	10% of each type or model.
5.00.00	**INSTRUMENTATION CABLE, INTERNAL WIRING**	
(i)	Pre fabricated cable of each type (other than SCADA application)	10% of installed quantity
(ii)	Other cables (including core cables)	5 % of each type, pair and size of actual installed quantity

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Clause No.	Item	Quantity
6.00.00	CONTROL DESK & CONTROL PANEL	
(i)	Replacement lamps/ LED's for each type of lamps/ LED	100%
(ii)	MCBs	10% of each type and rating.
(iii)	Fuses	100% of each type and rating.
(iv)	Blank tiles	10% of total no. of tiles

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Clause No.	Item	Quantity
12.00.00	**WATER LEVEL MEASUREMENTS**	
(i)	Sensor for level overshoot detection	10% of each type, model and rating or 2 nos. whichever is more.
(ii)	Electronic cards/ Relays/ fuses/ connectors/ Power supply modules / power packs / special cable (as applicable)	10% of each type, model and rating or 2 nos. whichever is more.

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SECTION: I

SUB-SECTION: C5

TECHNCIAL SPECIFICATION

(MH PORTION)

MATERIAL HANDLING EQUIPMENT

MANUAL HOIST (CHAIN PULLEY BLOCK)

1.0 MANUAL HOIST (CHAIN PULLEY BLOCK)

Required number of manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

Manual hoists (hand operated) shall be as per IS 3832. Duty shall be class II.

The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.

Maintenance tools and tackles shall be as per data sheet attached.

DESIGN CRITERIA

1.0.0 Capacity of manual (Chain pulley block) hoists shall be decided keeping 25% margin over equipment to be handled.

Chain pulley block (Manual hoist) - 300kg to <2T, wherever feasible, considering layout constraints.

For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the electrical/ manual hoist with the help of floor operated pendant

MINIMUM LIFTING REQUIREMENT

S.N.	AREA DESCRIPTION	QTY (nos.)	CAPACITY (T)	TYPE
1	LIST TO BE MENTIONED AS APPLICABLE			
2				
3				

Note:
1. Area, type, capacity mentioned are minimum requirement and shall be finalised during detail engineering without any commercial implication
2. Travel and Lift are layout dependent and shall be finalised during detail engineering without any commercial implication
3. Additional manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

2.0 SCOPE OF SUPPLIES

Equipment and services to be furnished by the bidder for the MANUAL HOIST with accessories as per the details given elsewhere in the specification.

Any equipment / accessories not specified in the specification but required to make the MANUAL HOIST complete and efficient operation shall also be under the bidder's scope of work.

Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

2.1.0 Services to be provided by the bidder: Packing suitable to avoid transit/storage damage, forwarding and transportation to site, storage and handling at site.

2.2.0 Erection and Commissioning

2.3.0 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.

3.0 Inspection and Testing

As per enclosed reference quality plan and as per IS 3832 (latest revision). Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement/ CHP (Customer Hold Point) at any stage of inspection deemed necessary by Consultant/ end Customer during detailed engineering shall be carried out without any commercial or technical implication.

4.0 Works Excluded

Supply of ISMB monorail, as applicable.

5.0 PAINTING SPECIFICATION

As per painting details specified elsewhere in specification.

6.0 PACKING

In general packing shall be wooden box packing.

7.0 TESTING AT VENDOR'S WORKS

Hoist along with accessories shall be demonstrated for the rated capacity for the service conditions specified as specified in QAP and IS 3832 for manual hoist.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

8.0 MAKE OF SUB - VENDOR ITEMS

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client. (Refer Annexure-I)

9.0 TESTING AT SITE

B) MANUAL HOIST:

As required for statutory clearance for operating at site with following minimum test i.e., overload and load test.

10.0 TECHNICAL DATA SHEET:

A) MANUAL HOIST (CHAIN PULLEY BLOCK):

1.0	**Type**	Chain pulley block with/without trolley
2.0	**General Design**	IS: 3832
3.0	**Duty Class as per IS:3832**	Class –II
4.0	**Hoisting Mechanism**	
a)	Type	Hand operated gear transmission
b)	Type of gear	Spur / Helical
c) i) ii) iii)	Load Chain Type Material Conforms to (Std./Code)	 Link type As per relevant standard IS: 6216 / ISO 3077/
d) i) ii) iii)	Hand Chain Type Material Conform to Std.	 Link type Mild steel Grade 30 IS:2429 Part 1 / 2
e)	Load Hook & Hook Block	
i)	Type of load hook	Plain shank- Trapezoidal section/ 'C' type
ii)	Load hooks conforms to	IS: 15560
iii)	Type of hook suspension	Swivelling type with safety latch
iv)	Type of make of bearing	Thrust ball bearing of hook suspension
v)	Type & Material of hook	As per IS 15560
f)	Gears/ Pinions	
 i) ii)	Type Material Type of Bearing	Spur Alloy steel / carbon steel/ High graded cast iron Antifriction ball bearing / Roller
g)	Sprockets: Type of bearings used	 Antifriction ball bearing / Roller
i)	Method of lubrication Bearings Gearing & Pinions Sprocket	 Grease Grease Grease
h)	Brakes Type	Screw and friction disc type
5.0	**Trolley and Bridge drive**	
a) i) ii)	Trolley Type Material of frame	 Geared (Manually operated) Mild steel (IS:2062 Grade A or B)
b) i) ii) iii)	Drive Chain Type Material Design of drive chain	 Link type Steel Gr.30 IS : 2429 Part 1/2
c) i) ii) iii) iv)	Wheel Number of pairs of wheel Flange Type of bearings need Wheel material	 Two in each trolley/bridge Single flanged Antifriction As per IS 3832
d) i) ii) iii)	Gears Type Material Type of bearings used	 Spur / helical Cast iron/EN8 Antifriction
e) i) ii)	Method of lubrication for Bearings General	 Grease Grease

iii)	Sprockets	Grease
6.0	**Painting**	As per manufacturer's standard

11.0 Maintenance Tools and Tackles

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality, specially protected against rusting. The following shall be provided as minimum requirement:

S. No.	Description	Qty.
1	Complete set of ring spanners	1 Set
2	Complete set of screwdrivers (Min. 6 nos. of suitable sizes)	1 Set
3	Adjustable Spanner	1 No.
4	Insulated pliers	1 No.
5	Wrench spanner	1 No.
6	Grease Gun	1 No.
7	Oil Gun	1 No.
8	Hand Lamp	1 No.
9	Line tester	1 No.

Note: The tools shall be supplied in one tool box. Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

12.0 DRAWING/DOCUMENT SUBMISSION

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

A) MANUAL HOIST (CHAIN PULLEY BLOCK):

Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-414-553-A200	Manufacturing Quality Plan
2	PE-V0-414-553-A201	GA Drawing for Chain Pulley Block with detail BOM with painting details
3	PE-V0-414-553-A202	O & M Manual

A typical MQP is enclosed for the reference. Bidder to submit project specific MQP for BHEL/Customer approval.

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order.

2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.

3. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:

a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labelled and included in BOQ / BOM in tabular form.

c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Drawings/ documents to be submitted for purchaser's review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 …etc.

13.0 MANDATORY SPARES:

MANDATORY SPARES FOR MANUAL HOIST (AS APPLICABLE)

A. Mechanical spares for Manual hoist:

S. No.	Description	Qty.	Remarks
1	**Manual Hoists (Chain Pulley Block) (FOR EACH TYPE & CAPACITY)**		
a	All Bearings	1 set of each type / rating	
b	Brake assembly and its liners (as applicable)	1 set of each type / rating	

Note: "One (1) Set" is defined as 100% requirement for one hoist for the entire hoists of similar size & capacity.

ANNEXURE I: MAKES AND SUB VENDOR LIST

CHAIN PULLEY BLOCK	UNIVERSAL HOIST-O-FABRIK
	CENTURY CRANE ENGINEERS PVT. LTD.
	BAKELITE ELECTRICAL MFG. CO. PVT. LTD.
	TRACTEL TIRFOR INDIA PVT. LTD.
	BRADY & MORRIS ENGINEERING CO. LTD.
	TUOBRO FURGUSON (INDIA) PVT LTD
	TECHNO INDUSTRIES

Note: No other make will be acceptable, until and unless specifically got approved by BHEL/Customer/ Customer's consultant during detail engineering only. Acceptance/non acceptance of same shall not have any impact on manufacturing, delivery schedule and on cost of the CPB.

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO MANUAL HOIST:

Sl no.	ITEM	MAKES
1.0	STEEL	SAIL/IISCO/TATA STEEL / JINDAL
2.0	HOOKS	STEEL FORGINGS/ KARACHIWALA/SMRITI/NASIK FORGE.
3.0	STEEL FORGINGS	CHOWDHARY/WESTERN INDIA FORGINGS/ HINDUSTAN STEEL FORGINGS/ RUBY FORGINGS OR AS APPROVED BY BHEL.
4.0	BRAKES	OEM

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

PAINTING SPECIFICATION

1. Painting specification for steel structures:

Surface preparation: De greasing and Mechanical cleaning with wire brush or blasting according to SIS 055900, Grade 2 ½.

Primer : HB Zn Phosphate - 2 coat, Minimum DFT 80 µ per coat.

Finish Coat : HB MIO epoxy - 1 coat, Minimum DFT 120 µ per coat

Total DFT : 260 µm

2. Painting specification for Indoor components.

Surface preparation: blasting according to SIS 055900, Grade 2 ½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Primer : Zinc phosphate epoxy - 2 coat, Total DFT 80 µm.

Finish Coat : Chlorinated rubber paint- 2 coats, Total DFT 80 µm for indoor and 100 µm for outdoor.

Total DFT : 160 µm for indoor and 180 µm for outdoor.

3. Colour Shade (as applicable):

SL. No.	Item Description	Colour Shade
1	Crane Structure	Golden Yellow Shade 356 as per IS-5
2	Trolley and hook	Crimson Shade 540 as per IS-5

The painting schedule shall be submitted to BHEL/Customer for approval.

MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **(Manual Hoist)** **QP No.:** **REV**.:0, **Date.:** , **PAGE**: 1 OF 4	**PROJECT: 3x40 MW NTPC RAMMAM HEP** **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	10.			11.
1	**RAW MATERIAL & B/OUT ITEMS:**												
1.1	HOOKS	CHEMICAL & MECH	MA	LAB ANALYSIS	ONE SAMPLE PER HEAT		MATERIAL SPECIFICATION AS PER APPROVED DRAWINGS.		MTC. ✓	P	V	V	
		MARK & IDENTIFICATION	MA	VISUAL	100%		HOOK TC FROM COMPETENT AUTHORITY		TC ✓	P	V	V	
		INTERNAL DEFECTS	MA	UT	100%		ASTM A-388	(REFER NOTE I)	IR ✓	P	V	V	ON SHANK PORTION
		PROOF LOAD TEST	MA	REVIEW	100%		IS 15560		TC ✓	P	V	V	
		NDT AFTER PROOF LOAD TEST	MA	DPT	100%		ASTM E-165	NO RELEVANT INDICATTION	TC ✓	P	V	V	
1.2	LOAD CHAIN	- DIMENSIONS	MA	MEASUREMENT	100%		APPD. DRGS	APPD. DRGS.	IR ✓	P	V	V	
		- BREAKING STR & % ELONGATION	MA	-TENSILE TEST	1/LOT		-DO-	-DO-	MTC ✓	P	V	V	
		- PROOF LOAD -HEAT TREATMENT	MA	-TENSILE TEST	100%		-DO-	-DO-	MTC ✓	P	V	V	
			MA	REVIEW	100%		-DO-	-DO-	HT CHRT ✓	P	V	V	
		-GRADE	MA	REVIEW	1/BATCH		-DO-	-DO-	MTC ✓	P	V	V	

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-SUPPLIER C: BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **(Manual Hoist)** **QP No.:** **REV**.:0, **Date.:** , **PAGE**: 2 OF 4	**PROJECT: 3x40 MW NTPC RAMMAM HEP** **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.		10.			11.
1.3	RAW MATL. (BAR /FORGING) FOR GEAR BLANKS/SHAFTS/ PINIONS/AXLE/ RATCHET PAWL / RATCHET WHEEL & PLATES FOR FABRICATION ETC	CHEMICAL COMPOSITION	MA	Review	ONE SAMPLE PER HEAT		Material specification as per approved drawings.		MFR'S TC	✓	P	V	V	TC or inspection report for components shall be given. For rounds ≥50mm and plates ≥25 mm.
		MECHANICAL	MA	Review						✓	P	V	V	
		INTERNAL DEFECTS	MA	UT	100%		ASTM A-388 REFER NOTE 1		IR	✓	P	V	V	
		NDT AFTER MACHINING	MA	DPT	100%		ASTM E-165 NO RELEVANT INDICATION		TC	✓	P	V	V	
1.4.	LOAD CHAIN WHEELS	- CHEMICAL & MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT		APPD. DRG.	APPD. DRG.	MTC	✓	P	V	V	
1.5	BEARINGS	MAKE, TYPE, CATALOUGE NO.	MA	VISUAL	RANDOM		APP DRG / MFR"S CATALOGUE	APP DRG / MFR"S CATALOGUE	IR	✓	P	V	V	
1.6	HAND CHAIN WHEEL	CHEMICAL MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT		AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	100%		AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	

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MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **(Manual Hoist)** **QP No.:** **REV**.:0, **Date.:** , **PAGE**: 3 OF 4	**PROJECT: 3x40 MW NTPC RAMMAM HEP** **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.		10.			11.
1.8	TROLLEY GEARS, PINION,WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%		APPVD DRGS	APPVD DRGS	IR/TC	✓	P	V	V	
2	**IN PROCESS**													
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS	MA	HARDNESS	100%		IS:3832/ APPD DRG.	IS:3832/ APPD. DRG.	IR	✓	P	V	V	
		-SURFACE CRACK	MA	DPT	100 %		ASTM E165	NO DEFECT	IR	✓	P	V	V	
2.2	COMPONENTS AFTER HARDFACING & MACHINING	HEAT TREATMENT	MA	HT CHART	100%		IS 1875/IS 4367/IS 3832		IR	✓	P	V	V	
		SURFACE HARDNESS	MA	HARDNESS	10%		--DO--		IR	✓	P	V	V	
		SURFACE CRACK	MA	DPT FOR SURFACE CRACK	100%		ASTM E 165	NO DEFECT	IR	✓	P	V	V	
		DIMENSION	MA	MEASURE	10%		IS 3832		IR	✓	P	V	V	
3.0	**FINAL INSPECTION**													
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION	CR	MEASUREMENT	100 %		IS:3832 /APPD DRG	IS:3832 /APPD DRG	IR	✓	P	W	V	
		ENDURANCE TYPE TEST	MA	TYPE TEST	1 PER SIZE		IS 3832	IS 3832	TC	✓	P	V	V	
		OPERATIONAL PROOF LOAD & LIGHT LOAD TEST, EFFORT.	CR	LOAD TEST	100%		-DO-	-DO-	IR	✓	P	W	V	
		HEIGHT OF LIFT	MA	VISUAL	100 %		-DO-	-DO-	IR	✓	P	W	V	
		SWIVELING OF HOOK	MA	VISUAL	100%		APPROVED	APPROVED	IR	✓				

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR SIGNATURE	** M : MANUFACTURER / SUB-SUPPLIER C: BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **(Manual Hoist)** **QP No.:** **REV**.:0, **Date.:** , **PAGE**: 4 OF 4	**PROJECT: 3x40 MW NTPC RAMMAM HEP** **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.		10.			11.
		EFFORT	MA	PULL ON CHAIN	100%		DRG -DO-	DRG -DO-	IR	✓	P	W	V	
3.2	PAINTING	-CLEANING - SHADE & DFT OF PAINT	MA MI	VISUAL VISUAL	AT RANDOM AT RANDOM		APPROVED DRAWING/ **SPECIFICATION**	APPROVED DRAWING/ **SPECIFICATION**	IR IR		P - p	--- W	-- ---	
3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%				IR		P	V	---	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%		SPECS.	SPECS.	IR		P	---	---	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%		APPD. QP	APPD. QP		✓	V	V	V	

CR – CRITICAL, MA – MAJOR , MI – MINOR

NOTE 1: WHEN BACK WALL ECHO (BWE) IS SET AT 100% OF FULL SCREEN HEIGHT (FSH) IN DEFECT FREE AREA THEN
(A) DEFECT ECHO SHALL NOT EXCEED 20% OF FSH &
(B) BWE SHOULD BE MINIMUM 80% OF FSH IN ANY AREA.
NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INLCUDED IN QA DOCUMENTATION.

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-SUPPLIER C: BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

SECTION: I

SUB-SECTION: C6

TECHNCIAL SPECIFICATION

(OPERATION AND MAINTENANCE SERVICES FOR HVAC SYSTEM)

1.0 OPERATION AND MAINTENANCE SERVICES

The bidder scope also covers the Operation and Maintenance (O&M) services for Preventive and Breakdown maintenance from the date of successful commissioning of HVAC System before handing over to end customer. However, actual date of start of O&M services shall be communicated to successful bidder by BHEL site personnel.

Bidder to note that the spares and consumables required for maintenance of the equipment during this O&M period shall be in bidder's scope of supply. Bidder shall use only genuine parts as mentioned in O&M Manual. Any damage or malfunction caused by the use of unauthentic parts or unqualified personnel shall be responsibility of bidder and as a consequence of above bidder is required to replenish the unauthorised part and abridge the qualified person without any commercial implication to BHEL.

O&M Services scope also covers all regular maintenance by certified and trained service engineers and supply of genuine parts and lubricants as per the original equipment manufacturer's recommendations in a pro-active manner.

For the purpose of Operation of HVAC System, One-day shall be considered as 24 hours i.e. 3 shifts of 8 hours each. The HVAC System (along with related accessories) shall be operated on Round-the-clock basis on all the days of the year including Sundays and Public Holidays

O & M Personnel should be acquainted with local language. Governmental / Statutory approval w.r.t. O&M service as applicable shall be in bidder's scope.

Total duration of the Operation and Maintenance services by Bidder can be increased or decreased as per requirement and payment in such case shall be made on pro-rata basis.

Depending on start of O&M services, there is a possibility that some period of O&M services and Warranty period may overlap. However, it is clarified that any maintenance required or any spare of HVAC System required to be replaced during Warranty period (as part of warranty clause requirement) shall not be made part of O&M Services. Bidder may take care of this fact while working out the prices of O&M services.

Wherever AC system has been written in O&M Service Specification, the same shall be deemed as complete HVAC System.

The Bidder shall deploy following minimum manpower for Operation of HVAC System.

i. One qualified and experienced AC operator per shift on "Round the Clock" basis throughout the year for all days of the year including Sundays & Public Holidays. There must be minimum 30 minutes overlapping between two shift operators to get familiarize with the status of HVAC System. Under normal circumstances one shift shall not be more than 8 hours.

ii. One Helper per shift on " Round the Clock" basis throughout the year for all the days of the year including Sundays and Public Holidays. The helper shall assist the HVAC System Operator in day to day operation of HVAC System and accessories and shall assist him for keeping HVAC System equipment's in neat and tidy condition. Under normal circumstances one shift shall not be more than 8 hours

1.1 Responsibility of HVAC System Operator

i. HVAC System operator shall be responsible for proper sequential operation of HVAC System (AC and Ventilation System) including operation of standby equipment in a predefined sequence and stopping the same (when necessary) as per the procedural practice. In case of any abnormality (like non availability of power supply at incomer of HVAC System), he shall immediately report the matter to BHEL site Engineer for further action. Similarly, any malfunctioning in the system shall be immediately reported by him to BHEL site Engineer for suitable corrective action irrespective of time of occurrence of malfunctioning / abnormality in the system. A log book of all such outrages shall be maintained by HVAC system operator, which shall be shared with BHEL site engineer on periodic basis.

ii. HVAC System operator shall take hourly readings of all the parameters of HVAC System / Equipment's including reading on main electrical panel of HVAC System. Temperature & RH readings inside all AC areas shall be taken at least once in a day. All the readings shall be recorded in a logbook register.

1.2 Responsibility of Helper.

i. The HVAC System helper shall assist HVAC System operator for day to day smooth operation of HVAC System, like Checking of water levels of overhead Tank, cleaning of strainers, cleaning of AHU filters, other filters and outdoor units etc. as and when required. He shall be responsible for keeping all the equipment's of HVAC System including PAC Unit & AHU rooms in clean and tidy condition. He shall also carry out general cleaning of all AC equipment's including Electrical Panels (Part of AC System), AHU's etc. on regular basis.

ii. The helper shall work under the control of HVAC System operator and shall always ensure that unusable junk materials are not allowed to be kept in HVAC System room or AHU rooms. Under such eventuality, he will report the matter to Plant Operator, who in turn will take suitable action including reporting the matter to BHEL site Engineer.

1.3 All the log book registers shall be arranged by Bidder. Log book register duly paged and bounded will be maintained in good condition by Bidder.

1.4 All the necessary tools and other materials, required for operation of HVAC System shall be kept by Bidder under the control of HVAC System operator. Required testing instruments like refrigerant leak detector, Multi Meter (for Electrical portion of HVAC System), Sling pshycrometer, Line Tester, Tool Kit, Torch etc. should also be always available with Plant Operator.

1.5 In case of any operator / helper being on leave, Bidder shall immediately take advance action and provide substitution so that minimum manpower as indicated above is not reduced on any day. In case a particular shift duty A/C Operator or helper does not turn up due to any reasons, the earlier duty person shall continue to make sure that HVAC System never remains unattended.

2.0 Maintenance of HVAC System

i. Maintenance work under scope of the Bidder shall broadly include but in no way limited to the following:

a) Preventive maintenance of the plant.

b) Servicing of the plant at regular interval including cleaning of AHU filters etc., Strainer, PAC filters, Outdoor unit cleaning etc.

c) Attending to complaints.

d) Replacement of worn out or defective components

e) Replacing of refrigerant gas and oil as and when required.

No consumable or any other items of HVAC system shall be arranged by Customer and no extra payment shall be made by customer in this regard.

ii. Bidder shall be responsible at all time, during the entire period of contract for satisfactory performance of HVAC system (including accessories) with zero down time. During emergency or breakdown, Bidder's Engineer along with related technicians shall be available immediately even though it may be beyond normal working hours or on public holidays till the HVAC System is restored back into normal satisfactory condition. Response time for attending breakdown complaints shall not exceed 2 hours.

iii. Defective / worn out components shall be replaced only by genuine and original parts. OEM or its authorized dealer's invoice shall be submitted as proof of using genuine parts. All common spares required for HVAC system shall normally be kept available in the plant by the Bidder. However, for critical spares, the same shall be made available in not more than 72 hours from the time of break-down requiring such spare.

iv. Preventive Maintenance, servicing of HVAC System equipment's and accessories etc. shall be done by Bidder in a planned manner in consultation with concerned customer's engineer. Preventive maintenance and service should be done as per the recommendations / guidelines of various OEMs

v. Major servicing & over handling of equipment's like compressors, evaporators, condensers, pumps, AHU's, piping / ducting works, valves etc. shall be done by Bidder once in a year or as per OEM requirement whichever is earlier.

vi. Painting of all equipment's including base frames & accessories like piping, electrical panel boards etc. shall be done once in two years.

vii. In case any repair/services of particular equipment of system like chiller unit is to be carried out by Bidder through OEM (or their authorized dealer), all the arrangements including tools, O&M spares etc. shall be the total responsibility of Bidder.

viii. Bidder shall arrange and maintain separate logbook register for services / maintenance of HVAC System. Record of work done for services/maintenance repairs etc. shall be recorded by Bidder's engineer in this register. This register

shall always be with updated records & shall be produced to customer's engineer on weekly basis or as & when required by him.

ix. Bidder shall arrange and maintain sufficient stock of spares and consumable at site (HVAC room). Similarly, all necessary tools & instruments required for the purpose of servicing / maintenance / routine testing etc. shall also be arranged by Bidder and should be available at site at all times.

x. Repairs / servicing works shall normally be done by Bidder at site up to maximum possible extent. However, in case any equipment or accessories is essentially required to be taken by Bidder out of the plant premises for repairing / servicing, all necessary arrangements including to and fro transportation shall be the responsibility of Bidder. Bidder shall also inform concerned customer's engineer for doing procedural formalities (like issue of gate pass etc.), prior to taking out the materials out of Plant premises.

xi. In case bidder fails to supply the spares required for maintenance of the equipment, same shall be provided by BHEL at Bidders risk and cost.

xii. Bidder shall be fully responsible for safety of his personal at all times. Bidder shall also be responsible for taking all safety precautions at all the times, especially during servicing / preventive maintenance and repairs of HVAC System equipment's etc.

xiii. All the safety controls of AC Plant such as HP, LP, OP, Water pressure switch, inter locking etc. shall be positively checked at least once a month or as per OEM recommendation whichever is earlier and same shall be recorded by AC Operator.

xiv. Technicians & helpers engaged by the Bidder shall wear uniform with nameplate for easy identification, while being within plant premises

xv. AC Operator shall be focal point for customer. He shall report to customer engineer on daily basis, for taking necessary instructions and to update the status of AC system

xvi. If any damage to the equipment and its accessories has happened due to improper maintenance by bidder shall be recovered from the bidder.

xvii. Bidder to ensure healthiness of all the equipment being operated by them as part of O&M services, before handing over the same to end Customer.

xviii. Bidder is to arrange all the safety gears like helmets, air plugs, safety shoes etc. during the maintenance for the O&M Staff.

SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATIONS

SECTION-D

AIR HANDLING UNITS

1. GENERAL

1.1 This specification covers the design, manufacture, Construction features, installation, commissioning, inspection and performance testing at site of AHUs.

2. CODES AND STANDARDS

2.1 The design manufacture and performance of AHU shall comply with all currently applicable statutes, regulations and safety codes in the locality where the AHU is to be installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this spec. shall be construed to relieve vendor of this responsibility. In particular the equipment shall conform to the latest editions of the following standards:

2.1.1 IS-659 : Safety code for air conditioning

2.1.2 IS-660 : Safety code for mechanical refrigeration

2.1.3 ASHRAE : Method of testing forced circulation air-cooling and air heating coils. standard 33

2.1.4 ARI 41 : Standard for forced circulation air cooling and air heating coils.

2.1.5 ARI 430/435 : Air-cooling and air heating coils Central Station AHU / Application of Central Station AHU.

2.1.6 AMCA : 211 and 311

In case of any conflict in the standards and this specification the decision of PEM,BHEL shall be final and binding.

3. CONSTRUCTION FEATURES

3.1 The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m^3 density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof.

Necessary arrangement shall be provided on the casing for measuring temperature and pressure in cooling/heating coil. Class of instruments shall be min. 2.

3.2 Fan impeller shall be forwardly/backwardly inclined curved blade centrifugal type. Impeller shall be double width double inlet type. Fans shall be preferably low rpm (<=1500) to minimize vibration and noise. Noise shall be within 85 dB(A) at 1 metre distance from AHU casing. Max. Vibration level shall be acceptance and norms to be specified. Two to three wheels (impellers) shall be provided for each AHU. Impeller blades shall be fabricated from (min. 1.0 mm) galvanized/ epoxy powder coated sheet steel. Fan shall be of epoxy powder coated / galvanized sheet steel (min. 1.6 mm) scroll with die formed inlets for uniform air flow. Fan shafts shall be solid cold rolled carbon steel (EN8 normalised), ground and polished. Fan shaft bearings shall be of heavy duty type selected for average operating life of 100,00 hours. Bearings shall be self-aligning, permanently lubricated type. Make of Brgs(SKF/FAG/NORMA/TATA) to be specified. Bearing Housing shall be of casting of min. IS Gr. 210, split type and

suitably supported. The V-belt drive with belt guard shall be provided. Motors shall have minimum 15% margin over maximum BHP in working range.

3.3 Cooling water cooling coils and steam/hot water coils shall be internally corrugated copper/ cupronickel tubes (as per manufacturer's standard) with smooth non corrugated external fins of aluminium (thickness 0.14 mm and grade 1100 as per spec) unless specified otherwise in specification. At least 5 fins /per cm. shall be provided. The cooling water coils shall have suitable (standardize class, size, threading) drain and vent connections.

3.4 The filters in the filter section shall be provided as detailed in data sheet A.

3.5 Humidifier shall be Pan type/as specified in the specification.

Pan type Humidifier consisting of SS304/316 tank, heater, geyserstat with piping connection to supply air duct shall be provided unless specified otherwise in data sheet A.

Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.

3.6 Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room.Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized

3.7 Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU.

The AHU shall be provided with 18 G SS drain pan.

4. TESTING AND INSPECTION AT MANUFACTURERS WORKS:

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection.

4.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.

4.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating. For pipes and fittings compliance report shall be furnished by Manufacturer for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

4.3 Shaft: Mechanical and chemical.

4.4 Motors (of approved make): Routine TC.

4.5 Workmanship and dimensional check as per manufacturing drg. and approved Drgs.

4.6 Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked to avoid loosening. Balancing weights and fasteners used shall be galvanized.

4.7 Performance test of one Centrifugal fan/per type/per size as per AMCA standard (for indigenous make).

4.8 Centrifugal fans for AHUs will be 100% run tested by main contractor of BHEL. One centrifugal fan/per type/per size will be run tested. Vibration shall be within good zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

4.9 Complete assembly of one AHU/per type/ per size (excluding cooling coil and filter) shall be witnessed.

4.10 Run test of one complete assembly/per type/per size (excluding cooling coil and filter). Vibration shall be within satisfactory zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

5. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

5.1 GA drawing of AHU & data- sheet to be submitted along with technical schedules enclosed in Volume III.

5.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.

5.3 Installation and erection manual.

5.4 Inspection, operation & Maintenance Manuals.

5.5 Equipment description giving complete design calculations, basis of design, selection criteria etc.

5.6 Test Certificates.

5.7 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

5.8 Performance Test Certificates.

5.9 Vendor shall also provide soft copy of each drawing in AutoCAD format.

5.10 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

	TITLE	SPECIFICATION NO. PES- 571-11000-A-002
BHEL	**AIR HANDLING UNIT** **DATA SHEET - A**	VOLUME - II-**B** SECTION - D REV 00 DATE JAN 2020 SHEET 1 OF 2

DESCRIPTION		**DATA**
1.	Nos. required/working	: Refer to Section-C of Specific technical requirement.
2.	Location	: Refer to Section-C of Specific technical requirement.
3.	Service/type	: Ventilation /Double skin.
4.	Fan type	: Centrifugal (forward/backward curve Blade) limit load.
	a) Capacity	: To Suit as per calculation.
	b) Static pressure	: To suit but not less than 100 mm wc for AHU's with pre filters.
	c) Discharge direction	: To suit layout.
	d) Motor	: By Bidder,
	e) Local push button station (Start/Stop)	: By Others
	f) Motor location	: Inside AHU Casing.
	g) Drive	: Belt, pulley, belt guard.
5.	Face and Bypass Damper	: Not Required
6.	Cooling coil	
	a) Duty sensible heat	: To suit as per calculations
	b) Duty latent heat	: -do-
	c) Type of coil	: Cooling Water.
	d) No. of rows	: To suit but not less than four (4)
	e) Material of tube /Thickness	: Seamless Copper to ASTME-75/Equivalent.
	f) Material of fins	: Aluminium to SAE-1100-/1145-0
	g) Number of fins	: Not greater than 5 per cm (13 per inch).
	h) Max. face velocity	: 2.5 m/sec.
	i) Air flow quantity	: To suit as per tender drawings/documents.
7.	3 - way motorised mixing valve with thermostat.	: Required with thermostat & actuator for cooling water system for each AHU.

8.	Damper at discharge	: Manually operated at discharge of each AHU outlet.
	a) Material of construction	: Mild Steel, galvanised.
9.	Filters	
	a) Type & thickness	: Dry panel type/ 50 mm
	b) Filter area. as specied in section-c.	: To suit as per velocity requirements. "V" – Bank-
	c) Filter efficiency 20micron	: Average arrestance efficiency of 80 % down to
	d) Press drop (Clean)	: Not to exceed 2.5 mmwc when clean & 6.5 mmwc while dirty.
10.	Humidification section	: As per the System requirement.
	a) Type	: Pan type, unless otherwise specified.
	b) Operation	: Automatic with Humidification.
11.	Fresh air arrangement	: Required.
	a) Fresh air fan	: Tube axial flow fans with motor.
	b) Accessories	: i) Inlet cone with Bird screen. : ii) Dry panel pre-filters, : iii) High efficiency filters for control room areas. : iv) Volume Control Dampers, : v) Supports etc.
12.	Vibration isolator required.	: Yes
13.	Type of vibration isolator.	: Neoprene ribbed Rubber for AHU's.
14.	Any other requirement	: i) In addition to dry panel filters on AHU, High efficiency filters (average arrestance efficiency of 80-90 %) shall be provided in supply air duct side of AHU for all power house and transformer cavern and allied areas. : ii) Bidder to also provide suitable electrical strip heaters for winter heating & monsoon reheating with Contactor box etc. Heaters to be interlocked with airstat.
15.	Instrument & controls	: Lot.(including Control box for strip heaters, pan humidifiers etc. in each AHU room.)
16.	Insulation of drain piping	: Lot.

SECTION-D

VENTILATION FANS

1. GENERAL

This specification covers the design, manufacture, testing of performance at manufacturer's/sub-contractors works, delivery at site, handling at site, erection and commissioning of ventilation fans.

2. CODE AND STANDARDS

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where it is to be installed. The equipment shall conform to latest edition of applicable Indian Standards or their equivalent standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall conform to the latest editions of the Following standards.

2.1.1 IS:4894 -Centrifugal fans

2.1.2 IS:3588 -Electric Axial Flow fans

2.1.3 IS:2312 -Propeller type A.C. ventilation fans

2.1.4 IS-3963 -Roof extractor units

2.1.5 BS:848 -Method of performance test for fans.

2.1.6 AMCA publication 99 standards handbook

2.1.7 AMCA standard 210, Test code for air moving devices.

3. DESIGN AND CONSTRUCTION

3.1 THE ENCLOSED DATA SHEET A GIVES THE NECESSARY DETAILS FOR CENTRIFUGAL/AXIAL/ROOF EXTRACTOR UNITS ETC.

3.2 WELDING PROCESS AND WELDERS EMPLOYED FOR FABRICATION SHALL BE QUALIFIED AS PER ASME SEC. IX

3.3 CASING

3.3.1 The centrifugal fans casing shall be of welded construction fabricated with heavy gauge material (min 3 mm) with flanges (min. 5 mm) on inlet and out let side for direct connection and shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed airtight. Horizontal Split casings shall be provided on large size fans. Casing drain (at bottom) with threaded plug/ with valve shall be provided, as required. All mounting/ connecting holes shall be drilled off centre.

3.3.2 The axial flow casing for supply fans/roof extractors shall be of heavy gauge construction (min 3 mm) properly reinforced for rigidity and shall be complete with suitable supports. Access doors with suitable locking arrangement shall be provided in the casing for easy access to the motor and impeller. External junction box/ Terminal box on casing with IP-55 protection shall be provided, if required. Wiring for motor from external junction box/ Terminal box shall be through flexible conduit.

3.3.3 Suitable motor brackets designed for rigid mounting of motors, shall be provided for roof extractors and wall mounted exhaust/ supply fans.

3.4 IMPELLER

3.4.1 Centrifugal fan impeller shall have die formed, aerofoil or laminar blades welded to the rim and back plate and shall have non-overloading, self cleaning characteristics. Rim shall be spun to have smooth contour. If required, intermediate stiffening rings

shall be provided. Shaft sleeves shall be furnished, if specified. The impeller, pulley and shaft sleeve shall be secured to the shaft by key and/or nuts (threaded opposite to direction of rotation of impeller). The impeller shall be statically and dynamically balanced.

~~3.4.2~~ The axial fan impeller shall be of high efficiency aerofoil design. The blades shall be mounted on a streamlined hub and the impeller shall be mounted directly on the motor shaft. Impeller shall be in one piece however; fabricated blades will be acceptable up to 450 mm impeller diameter.

3.4.3 Roof ventilator impeller may either be centrifugal or axial type. Backward inclined blades shall be provided for centrifugal impellers. Blades may be die-formed or cast. Axial flow impeller shall be directly mounted to motor shaft whereas centrifugal impeller may either be direct-driven or belt-driven. The shaft of belt-driven centrifugal fan shall be solid cold rolled carbon steel, ground and polished. However, direct mounted impellers are preferred.

3.5 BEARINGS:

3.5.1 The centrifugal fan bearing may be ball, roller or sleeve bearings of self-aligning heavy duty type with adequate capacity and life. Make of Bearings to be specified. Bearings shall be oil/grease lubricated and provided with fittings for lubrication from outside and shall be located in easily accessible position to facilitate maintenance.

3.6 INLET CONES AND GUARDS

3.6.1 Centrifugal fans inlet shall be spun to have a smooth contour. Inlet screen, if provided, shall be galvanised wire mesh of 25 mm square with wire thickness of min. 1.5 mm.

3.6.2 Inlet cone, outlet bell and suitably designed guards shall be provided.

3.7 GUIDE VANES:

3.7.1 In case of vane axial fans guide vanes shall be provided on discharge side.

3.8 BASE PLATE AND VIBRATION ISOLATORS

3.8.1 Base plate and vibration isolators, which may be double deflection rubber in shear or rubber in compression type or spring type shall be provided. With each fan rubber bushes, washers wherever needed for vibration isolator in sufficient nos. shall be included, as required, to ensure isolation of foundation from vibration of equipment. For roof ventilators suitable mounting arrangement shall be provided such that there is no ingress of rain water into the building.

3.9 HOOD AND COWL

3.9.1 Roof exhaustors shall be provided with hinge type hood providing easy access to motor and impeller. Weather proof lockable type disconnect switch shall be provided such that hood can open only when the disconnect switch is in'off' position. On larger size of roof ventilators hoods may be of split construction. 15 mm mesh galvanised bird screen shall be provided.

3.9.2 Rain protection cowls shall be designed to suit wall exhausters/supply fans for protecting fans from rain. The cowls shall be provided with bird screen of heavy gauge expanded metal netting.

3.10 SPEED

3.10.1 The speed of axial flow fans/roof ventilators shall not exceed 960 RPM for impeller dia exceeding 450 mm and shall not be greater than 1440 with impeller dia less than 450 mm.

4. MOTORS

Drive motors shall be of totally enclosed type, suitable for horizontal/vertical mounting as applicable and shall comply with the requirments of the specifications furnished elsewhere for motors.

5. ACCESSORIES

Accessories as specified in Data sheet-A and as required for satisfactory trouble free & safe operation of fans shall be provided.

6. TESTING AND INSPECTION

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection by BHEL

- Visual inspection of sheets/plates, angles, channels etc. – Pitting, lamination in sheets/ plates, angles and channels shall be avoided.- visual inspection by main contractor of BHEL.
- Sheets/ Plates - Test certificate shall be furnished for physical and chemical properties for sheets / plates- for review by BHEL
- Shaft: Mechanical and chemical— review by BHEL
- Motors (of approved make): Routine TC ,FLP TC if applicable
- Workmanship and dimensional check as per manufacturing drg. and approved Drgs.- by main contractor of BHEL.- Shall be checked by BHEL/ Customer during final inspection.
- Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked/ welded to avoid loosening. - witness by manufacturer - TC to be furnished for review by BHEL(consisting of weight of impeller, radius of correction and balancing rpm). For spare impellers Dynamic Balancing shall be witnessed by BHEL.
- Performance test of one Centrifugal fan or Axial Fan /per type/per size as per applicable standard – by BHEL.
- Centrifugal/ Axial fans 100% run tested by main contractor of BHEL. Run test by BHEL/Customer may be at random or 100%- Vibration shall be within satisfactory zone of VDI 2056 (group- G) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient

7. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

7.1 GA drawing & data- sheet to be submitted along with technical schedules enclosed in Volume III.

7.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.

7.3 Equipment description giving complete design calculations, basis of design, selection criteria etc.

7.4 Test Certificates.

7.5 Performance Test Certificates.

7.6 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

7.7 Installation and erection manual.

7.8 Inspection, operation & Maintenance Manuals.

7.9 Vendor shall also provide soft copy of each drawing in AutoCAD format.

7.10 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE	SPECIFICATION NO. PES-571-11000-A-03
CENTRIFUGAL FAN	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 00 / DATE: JAN 2020
	SHEET 1 OF 2

No.	Particulars	Data
1	**General Information**	
1.1	Fan Designation/application.	Refer schedule of Ventilation system.
1.2	Nos. required/capacity	Refer Section-C of Specific Technical Requirement
1.3	Location	Refer layout drg. Attached.
2.0	**Design Data**	
2.1	Type	DIDW for Ventilation
2.2	Type of blades	backward curved
2.3	Arrangement	To suit application as per layout.
2.4	Discharge direction	To suit application as per layout.
2.5	Duty	Continuous
2.6	Capacity at site (Cubic Meter/hr) & static pressure.	Refer Section-C of Specific Technical Requirement
2.7	Suction pressure (mm Wg)	As per system requirement.
2.8	Fluid	Atmospheric Air.
2.9	Suction Temperature	Refer weather data attached.
2.10	Suction humidity	Refer weather data attached.
3.0	**Materials**	
3.1	Fan Scroll	Heavy Gauge Mild Steet to IS: 2062 with galvanised
3.2	Fan Casing (side plates & stiffeners)	Heavy Gauge Mild Steet to IS: 2062 / IS: 1079 / Eq. Minimum 3 mm thick casing.
3.3	Impeller	Mild Steel/plate to IS: 2062
3.4	Impeller hub	Mild Steet/plate to IS: 2062
3.5	Impeller back plate blade & shroud	Mild Steet to IS: 2062 / IS: 1079 / Eq.
3.6	a) Shaft b) Shaft sleeve	EN-8 or eqv. -do-
3.7	Support frame and structure.	Mild Steet to IS: 2062
3.8	Flexible connection at outlet canvas with MS Flanges and cleats (3mm thick).	Fire resistant type plastic impregnated

3.9	V Belt	ISI marked (Reinforced rubber section to IS: 4776)
3.10	V Pulley	Cast Iron multi groove to grade FG 20 as per IS: 210. Having taper lock type
3.11	Slide rails	M.S./C.I.
3.12	Connection pieces	G.I. according to supplier's design
3.13	Bolts & nuts	M.S. Galvanized / Epoxy painted.
3.14	Vibration isolating pads, washers and spring if any.	Hard synthetic rubber

4.0 **ACCESSORIES**

4.1	Common base plate	Required.
4.2	Anchor bolts	-do-
4.3	Vibration Isolators	Hard synthetic rubber
4.4	V-belt pulleys	-do-
4.5	V-belts	Reinforced rubber of appropriate section
4.6	Belt guard	Required.
4.7	Outlet damper	Required(M.S. Heavy Gauge)
4.8	Inlet guard	Required.
4.9	Inlet Vane (variable)	Not required.
4.10	Drain valve	Required.
4.11	Acoustic silencers	Not required.

5.0 **Motor**

5.1	Motor by	Bidder
5.2	Starter by	Bidder
6.0	Painting of fans including base frame	Galvanized / epoxy painting (as per Section-C & painting specifications)

NOTE:

1) Motors shall have 15 % margin on duty power point.

2) Fan shall be designed to operate with in 9% and 25% of system throttling line.

3) Opposed Multiple louvers damper shall be provided at fan outlet.Louvres shall be of 2 mm thick MS (galvanized). Casing shall be of 3.15 mm thick MS (galvanized).

	TITLE	SPECIFICATION NO. PES-571-11000-A-03
BHEL	**Ventilation Fan (Axial Flow Type)**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 / DATE: JAN 2020
		SHEET 1 OF 2

No.	Particulars	Data
	General Information	
1)	Designation	Supply/Exhaust Fans.
2)	Nos. required	Refer schedule of Ventilation system in section-C under specific technical requirement.
3)	Service	To exhaust warm air/to supply fresh air.
4)	Location	Wall mounted.
5)	Area	Same as above in 2.
	Design Data	
6)	Type supply	Axial fans suitable for 415V/3 phase for Motor.
7)	Air delivery capacity	As per schedule of ventilation system.
8)	Fluid	Atmospheric Air.
9)	Temperature	Refer Section of specific technical requirement
10)	Static Pressure required	As per Section'C' schedule of ventilation system.
11)	Outlet Air Velocity	Not more than 12 m/sec.
	Materials	
12)	Casing	M.S. (IS-2062)
13)	Impeller	Cast A1uminium. (Alloy A-6M, IS-617)
14)	Hub	Al Alloy.
15)	Support frame and structure. (Galvanized/	M.S. of adequate thickness Painted) IS-2062.
16)	Neoprene rubber pads	As required.
17)	Coned inlet for wall exhausters/supply fans	MS (IS-2062)
18)	Supporting frame for mounting.	Required.
19)	Protective screen at inlet.	Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh.
20)	Rain Protection Cowl	Aluminum or hot dip Galvanized after fabrication from M.S.

Motor

21)	Motor by	Bidder
22)	Starter by	Bidder

NOTE:

1) For Battery Room, motor for fan shall be of flame proof type & fan of spark proof construction with Epoxy painting.

2) Gravity type damper shall be provided at the outlet of axial fan for exhaust application.

3) Motor shall have 15% margin over Duty Point.

SECTION-D

CENTRIFUGAL PUMPS

1. GENERAL

1.1 This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer's or his subcontractor's works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter.

2. CODES AND STANDARDS

2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable):

2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water.

2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump.

2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water.

2.1.4 BS - 599 : Method of testing Pumps.

2.1.5 PTC - '6' : Centrifugal Pumps Power test code

2.1.6 API - 610

2.1.7 Hydraulic Institute Standards of USA

Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards.

2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser's engineering shall be final and binding.

3. DESIGN REQUIREMENTS

3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability.

3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards..

3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.

3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A.

4. CONSTRUCTION FEATURES:

4.1 **PUMP CASING**

4.1.1 Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand 1.5 times the maximum pressure developed by the pump at the pumping temperature.

4.1.2 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves or plugged with threaded plugs as required.

4.1.3 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.

4.1.4 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610

4.2 **IMPELLER**

4.2.1 Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be checked for eccentricity and statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity. Supplier shall ensure during balancing that wall thickness of impeller vane, shroud etc is maintained above the minimum thickness requirement as per design.

4.3 **WEARING RING**

4.3.1 Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

4.4 **SHAFT**

4.4.1 Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runway speed.

4.5 **BEARING**

4.5.1 Bearings and hydraulic devices**,** of approved make, (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.

4.6 **STUFFING BOX**

4.6.1 Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer. Tubings used for connections shall be flexible metallic type preferably SS-304/316. PVC/ rubber tubings are not acceptable.

4.7 **SHAFT COUPLING**

4.7.1 The pumps shall be directly coupled to their drives through heavy-duty flexible coupling. Suitable sturdy coupling guards of min. 1.5 mm MS sheet/ Aluminium sheet shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

4.8 **BASE PLATE AND SOLE PLATE**

4.8.1 Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided. The external corners of the base plate shall be rounded to avoid sharp corners. Drilled holes shall have sufficient space around for proper seating of washer with nut. If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 **PRIME MOVER**

4.9.1 The drive motor selected shall conform to the requirements of the enclosed motor specifications.

4.10 **LIFTING ARRANGEMENT**

4.10.1 Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance..

5. PERFORMANCE REQUIREMENTS

5.1 The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.

5.2 Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.

5.3 Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.

5.4 The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.

6. DRIVE RATING

6.1 The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.

6.2 In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.

6.3 The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

7. SCOPE OF INSPECTION AND TESTING

7.1 CASTING

7.1.1 The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.

7.1.2 Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.

7.1.3 Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.

7.1.4 Verification of Heat treatment charts (as applicable)

7.1.5 Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.1.6 Surface finish of Steel castings shall meet MSS SP-55.

7.2 **FORGING**

7.2.1 Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.

7.2.2 Verification of heat treatment charts (time temperature) (as applicable).

7.2.3 Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.3 **FABRICATED ITEMS**

7.3.1 Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.

7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel as per ASME Sec IX.

7.3.3 Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8

7.3.4 Verification of heat treatment charts (time temperature), (as applicable)

7.3.5 **Note:** For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.

7.4 **IN PROCESS INSPECTION AND TESTING**

7.4.1 Identification Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. Permissible defects and acceptance norms need to be specified. On static parts acceptance norms are as per ASME Sec.III NB 2546.

7.4.2 Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness) as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency.

7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable

a) Cracks, flakes, seams and laps

b) Defects giving indications longer than that from a 4mm equivalent flaw.

c) Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%.

d) Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.

7.4.4 For static duty components - as per NB 2542.2 of ASME Sec. III

7.4.5 Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage.

Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures

7.4.6 Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.

7.5 **PERFORMANCE TEST**

7.5.1 Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked.

a) Capacity V/s Head

b) Capacity V/s Power absorbed by pump

c) Capacity V/s pump efficiency

Note : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity.

7.5.2 NPSH test in case specifically mentioned elsewhere.

7.5.3 Vibration, noise level and temperature rise measurement. Noise level shall be within 85dB(A) at 1 metre distance. Vibration within satisfactory zone of VDI 2056 Group G machines. Temperature shall not exceed ambient + 40 deg. C.

7.5.4 Overall dimensions as per GA drawings. One pump/type/size assembly with job motor shall be mounted on base plate, provided the components are ordered on the same manufacturer.

7.5.5 Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.

7.5.6 Painting and packing as per technical specification.

7.6 **TEST AT SITE**

7.6.1 The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.

7.7 **PERFORMANCE GUARANTEE**

7.7.1 The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification. The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head

8. CLEANING, PROTECTION , PAINTING & PACKING

8.1 Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere. Flanges, inlet and outlet pipe, etc shall be protected. Packing shall be done as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere.

9. DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

9.1 Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include:

a) Foundation base plate and sole plate details as applicable

b) Civil foundation and anchor bolts details and loading data

c) Minimum submergence required for the pump (if applicable)

9.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction and/ make with standard applicable codes.

9.3 Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.

9.4 Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.

9.5 Experience list about the supply and successful operation of similar pumps for similar application.

9.6 A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.

9.7 Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.

9.8 Data sheet-B with all the particulars filled in.

10. MANUFACTURERS NAME AND TAG. PLATES

10.1 Each pump shall have a permanently attached brass/ Stainless steel tag on the body indicating the following information both in Hindi and English:

a) Manufacturer's name and trade mark.

b) Design Capacity and Head.

c) Design.

d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

11. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

11.1 Certified GA drawings of pump motor assembly weights, crane.

11.2 Detailed cross sectional drawings of the pump and motor assembly and all equipment & accessories supplied under the this specification along with details of material of construction with applicable standard codes.

11.3 Foundation drawings with details of foundation pocket indicating static as well as dynamic load and other data with dimensions.

11.4 Certified characteristics curves (discharge capacity vs. head, BHP and efficiency) of each type of pump and motor.

11.5 Material and other test certificates as required by the application clauses of this specification.

11.6 Motor speed torque curves super imposed on pump speed torque curves.

11.7 Quality plan along with complete details of testing and inspection requirements of centrifugal pumps in BHEL format. Vendor shall also furnish Field Quality Plan.

11.8 Installation , operation and maintenance manual.

11.9 Other drawings and data, if necessary.

11.10 Vendor shall also provide soft copy of each drawing in AutoCAD format.

11.11 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE	SPECIFICATION NO. PE-TS-413-571-11000-A004.
CENTRIFUGAL PUMPS	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 00 / DATE: JAN 2020
	SHEET 1 OF 2

DESCRIPTION		**DATA**
1.	Designation	: Cooling Water pumps for Ventilation plant.
2.	Type	: Horizontal, Centrifugal pump or vertical split type casing pump .
3.	Quantity	: Refer to section-C of Specific Technical Requirements
4.	Installation	: On floating type foundation.
5.	Fluid to be handled	: Water
6.	Temperature of fluid	: To suit.
7.	Capacity M3/hr and TDH at rated	: To suit system requirements but head shall not be less than 25 MWC.
8.	Duty	: Continuous (24 hours / day)
9.	Suction condition	: Flooded
10.	Type of drive	: Direct
11.	Prime Mover	: LV AC motor
12.	Maximum speed	: 1500 RPM
13.	Type of lubrication	: Grease Lubrication
14.	Material	
	a) Impeller	: Refer to section-C of Specific Technical Requirements
	b) Pump shaft	: Refer to section-C of Specific Technical Requirements
	c) Casing	: Refer to section-C of Specific Technical Requirements
	d) Wearing ring	: Refer to section-C of Specific Technical Requirements
	e) Shaft Sleeve	: Refer to section-C of Specific Technical Requirements
	f) Base plate	: Refer to section-C of Specific Technical Requirements
	g) Bolt and nuts.	: Refer to section-C of Specific Technical Requirements
	h) Stuffing Box gland/bush	: Refer to section-C of Specific Technical Requirements

i) Stuffing box Packing. : Refer to section-C of Specific Technical Requirements

j) Pump motor coupling. : Refer to section-C of Specific Technical Requirements

15. **ACCESSORIES REQUIRED:-**

The following accessories shall be provided by the bidder for each pump:

a) Suction & Discharge pressure gauges. : Yes.

b) Vent connection : Yes.

c) Drain piping up to common drain point in plant room. : Yes

d) Companion flanges. : Yes

e) Common base plate. : Yes.

f) Suction strainer. : Yes

g) Isolating valve : Yes

h) NRV at pump outlet at inlet/outlet : Yes

i) Any special requirements : The Cooling Water pumps shall be suitably insulated as per spec.

j) Inspection & Testing : As per specification enclosed elsewhere.

SECTION-D

PACKAGE AIR CONDITIONING UNIT

1 GENERAL

1.1 This specification covers the design, manufacture, inspection and testing at the manufacturer's works and suitable packing delivery and testing of the packaged air conditioning unit.

2 CODES AND STANDARDS

2.1 The design, manufacture, inspection, testing and performance of the packaged type air conditioning unit shall comply with all statutes, regulations and safety codes currently applicable in the locality where the equipment will be installed. The equipment shall also conform to the latest editions of the codes and standards specified herein under. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

In particular, the packaged air conditioning Unit (max 7.5 TR capacity, ductable or non ductable type) or cassette type (up to 5 TR) shall conform to the latest editions of the following standards:

2.1.1	I.S.660	: Safety code for Mechanical Refrigeration.
2.1.2	I.S.5111	: Code of practice for measurement, and testing of refrigerant compressor.
2.1.3	I.S.659	: Safety code for air conditioning.
2.1.4	I.S.2494	: V Belt for industrial purpose.
2.1.5	I.S.3142	: V grooved pullies for V Belts.
2.1.6	I.S.4503	: Shell and tube type heat exchanger.
2.1.7	ARI 210	: Standard for/unitary air conditioning equipment
2.1.8	ARI 270	: Standard for application installation and servicing of unitary equipment.
2.1.9	ASHRAE-37	: Standard methods of testing for rating unitary air conditioning and heat pump / equipment.
2.1.10	ANSI-B9-1	: Safety code for mechanical refrigeration.

3 DESIGN AND CONSTRUCTIONAL REQUIREMENTS

3.1 Compressor

The compressor shall be hermatic or semi-hermatic or screw rotary type or scroll type. The same shall be suitable for CFC free environment friendly latest refrigerrant e.g. R407C etc. The compressor shall be mounted on anti-vibration spring/rubber pads and shall be positioned in such a way that it is freely accessable with sufficient space all around for easy maintenance. Safety controls like High and Low pressure cut-out overload and single phasing protection for the motors shall be provided. A crankcase heater shall also be provided, if considered necessary by the vendor.

3.2 Condensing unit

Shell and tube type water-cooled condenser or air-cooled condenser with adequate area shall be provided as specified in Data Sheet-A. The condensing unit shall be complete with multipass heads and shall be fitted with the following:

3.2.1 Hot gas inlet and liquid outlet connection with shut off valve for liquid.

3.2.2 Drain plug, air vent and test valve.

3.2.3 Water inlet and outlet connection with thermowell and suitable cocks respectively.

3.2.4 Relief valve and air purge valve (Fusible plug in place of relief valve not acceptable)

3.2.5 Any other accessory as recommended by the manufacturer for proper functioning of the equipment.

3.3 AIR HANDLING FAN

The air handling fan shall be of the centrifugal type and with forward curved blades. This shall be driven by means of a three phase induction motor through V belt drive. The fan static pressure shall be selected for passing air through high efficiency absolute filters, if specified in Data Sheet-A.

3.4 Filters

Filters shall be of dry panel type and shall be cleanable. The velocity of air across the filters shall not exceed 1.75m/sec (350FPM).

3.5 Cooling Coil

The cooling coil shall be of direct expansion type and shall be made of heavy gauge copper with aluminium fins. The fins shall be bonded to the copper tubes under hydraulic pressure. A distributor shall be provided for feeding the refrigerant to different sections of the coil. Rows shall be staggered in the directions of airflow. The velocity of air across coil shall not exceed 2.5M/Sec. (500 FPM).

3.6 Controls

All necessary controls and accessories like thermostatic expansion valve, refrigerant solenoid valve, distributor, filter drier in the liquid lines, shut off valves, HP/LP cut out for compressor, thermostat with adjustable settings, overload and single phasing preventer for motor etc. are to be provided. The microprocessor based control panel shall be provided outside the packaged unit on one side. The control panel shall generally be in line with the specification for control panels given elsewhere.

The control shall be so interlocked that the fan shall be started independently first, and then only the compressor. Tripping of the compressor by the thermostat or compressor cut outs shall not trip the fan. The thermostat setting shall be adjustable

3.7 Refrigerant Piping

The refrigerant piping shall be either heavy gauge copper as furnished in Data Sheet-A. The piping shall be completely factory assembled, pressure tested, dehydrated and initially charged with REFRIGERENT and compressor oil. The line accessories shall include liquid line shutoff valve dehydrator, strainer, flow indicator and distributor etc.

3.8 Cabinet

All the equipments, except control panel, mentioned above shall be provided within a heavy gauge sheet metal cabinet, of floor/ wall mounted type. This shall be given two coats of anti-corrosive and rust proof paint, finished with two coats of final paint . Painting shall be as per manufacturers std unless specified otherwise in data sheet ‘A’. The interior of the cabinet shall be provided with thermal and acoustic insulation of minimum 25mm thick. The insulating material shall be fire proof.

The front and back side of the cabinets shall be easily removable providing maintenance to all the interior parts.

All the electric wires within the cabinet shall run in flexible conduits and carry identification tags. The bottom side of the panel shall be specially ribbed to take care of the transportation.

3.9 Other Accessories

Each packaged air conditioner shall be provided with required number of neoprene rubber isolating pads.

4 CONTROL AND INTERLOCK REQUIREMENTS

The compressor shall have all protective devices like HP/LP cutouts, overload protection for the motor, single phasing preventor for motor etc.

The interlocking requirement shall be as indicated below:

4.1 The compressor shall not start, unless condenser water flow is achieved for water cooled condenser. The condenser flow shall be sensed by means of a flow switch.

4.2 The compressor shall not start unless the evaporator fan is started.

4.3 The tripping of compressor on HP/LP, overload or on thermostat shall not trip the fan.

4.4 Strip heater (if provided in the ducting system) shall not be switched on, unless the evaporator fan is started and airflow is established. For this purpose, an air stat on flow switch shall be used. The heater shall be separately controlled by humidistat/thermostat

4.5 A humidifying package, if specified in data sheet A, shall be controlled by humidistat.

5 TEST AND INPSECTION

5.1 Inspection and Testing at Manufacturer's Works

5.1.1 static and dynamic test for fans

5.1.2 Hydrostatic static test on condenser and cooling coil.

5.1.3 vacuum/pressure test for the complete refrigeration circuit.

5.1.4 Visual and Free running test of the packaged unit on test bed.

5.1.5 Free running test on compressor.

5.1.6 AIR CAPACITY WITH ANEMOMETER.

5.1.7 NOISE LEVEL- <=85 dB(A).

5.1.8 Other tests as per approved qualities plan/scope of inspection.

5.2 Inspection and Testing at Site

5.2.1 Performance testing of the packaged unit for 72 hours in summer / monsoon & 24 hours in winter. Up-to 3 TR (individual M/c capacity) inside room temperature (Dry & wet bulb) will be checked with all machines in the room operating.

The actual days of testing shall be mutually agreed. During the above testing, the following readings shall be taken to compare the same with guaranteed performance data.

5.2.1.1 Condenser inlet and outlet pressure and temperature

5.2.1.2 Entering and leaving air temperature of the cooling coil air filters.

5.2.1.3 Motor current for the compressor and blower.

5.2.1.4 Air quantity delivered by the fan. This shall be computed by adding air quantity leaving all the grilles entering the air filters.

Room temperature (Dry & wet bulb)

5.2.1.5 Test to ensure all controls and safety instruments are working properly.

During the above testing, noise level also will be checked to ensure that the same are within acceptable limits. Any undue vibration detected physically will be corrected.

All tools and instruments required for the above testing will be provided by the vendor.

6 PAINTING:

The packaged unit shall be given two coats of primer paint finished with two coats of finish paint as per Manufacturers std. unless specified otherwise elsewhere/ Data sheet 'A'. The colour of finish paint will be as specified in Data Sheet-A.

7 GUARANTEES

The package unit shall be guaranteed for performance measured in terms of the inside temperature maintained.

The packaged unit shall also be free from any manufacturing defects and shall be guaranteed as per contract after the first test as per 5.0 is successfully carried out, and the plant taken over by the purchaser.

8 NAME PLATES

Suitable Name plate as per Data Sheet 'A', depicting the equipment number as designated in Data Sheet A shall be provided for each packaged unit and screwed to a prominent position on the packaged unit.

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1 Final technical data as per Data Sheet-A

9.2 G.A. and interior view of packaged unit

9.3 Electrical wiring diagram

9.4 Catalogues for all controls

9.5 O & M Manual

9.6 Erection Manual

9.7 Vendor shall also provide soft copy of each drawing in AutoCAD format.

9.8 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE	SPECIFICATION NO. PES-571-11000-A-05
PACKAGE AIR -CONDITIONING UNIT	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 01 / DATE: JAN 2020
	SHEET 1 OF 1

DESCRIPTION		**DATA**
1)	Capacity of the unit at operating conditions.	: As specified
2)	Numbers required	: Refer to Section-C of Specific Technical Requirements
3)	Designation of the unit	: Package AC Unit
4)	Whether air cooled/water cooled	: Refer to Section-C of Specific Technical Requirements
5)	The plant shall be suitable for maximum- - ambient temp.	: Refer outdoor design condition as specified.
6)	Whether a plenum Chamber required	: Units shall be connected to fresh air ducts.
	OR	
	Whether to be connected duct system.	: Yes.
7)	Whether Humidifier required for humidity- -control.	: Refer to Section-C of Specific Technical Requirements
8)	Whether strip heaters required for winter heating.	: Refer to Section-C of Specific Technical Requirements
9)	Whether strip heater required for Humidity control.	: Refer to Section-C of Specific Technical Requirements
10)	Final painting colour shade stage.	: Subject to approval / during detail engineering
11)	Whether fan static pressure is to be designed for filters arrangement shown.	: Yes.
12)	Installation supporting structure/ drain piping, insulation.	: Required. Drain piping with insulation up to the nearest drain point.
13)	Controls & Instruments	: Yes (Lot)
14)	Isolation Switch	: Yes
15)	Electrical feeder requirement	: To be provided by Vendor

SECTION-D

AIR FILTER

1. GENERAL

This specification covers the design, manufacture, inspection and testing at manufacturer's work or his sub-contractor's works of Air filters to be used for air-conditioning and ventilation system.

2. CODES AND STANDARDS

This design, manufacture and performance of AIR FILTERS shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to latest applicable Indian/British/USA standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. The following standards, in particular, shall be applicable for certified ratings of filters and for conducting performance test, if required.

a) BS EN - 779 -Methods of test for air filters used in air conditioning and general ventilation.

3. GENERAL

The enclosed Data sheet A gives the type and other particulars of filters required.

3.1 POLY FIBRE AIR FILTERS

Filtering media shall consist of a suitable fibrous material (e.g. polyethylene extruded sections coir etc.) packed into a 20 gauges GSS framework, complete with handles etc. The filter element shall be supported by galvanised steel wire mesh of 10mm. sq. on either side, Velocity across the filters shall not exceed 2.5 M/sec. Average efficiency Em (%) shall be >/= 80 as per BS EN - 779.

3.2 DRY FABRIC AIR FILTERS

Filter element shall be pressed felt filter fabric or suitable material recommended by the manufacturer, stitched on to galvanised wire gauge support and crimped to form deep folds. Suitable aluminium spacers shall be provided to ensure uniform distribution of air flow through filters. Filter casing shall be provided with neoprene sponge rubber sealing, The filter shall have Average efficiency Em (%) of >/= 95 as per BS EN - 779.

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

Filter shall consist of V-fold galvanised wire mesh interspaced with flat layers of galvanised wire mesh. The density of media shall increase in the direction of air flow. Edges of wire mesh shall be suitably hemmed to prevent abrasion during handling. The media shall be supported on either side by galvanised expanded metal casing. The framework shall be at least 18 gauge GSS. Filter shall be either dry or wetted type as per data sheet=A. The oil shall be mineral oil of approved quality and make. As a the filter frame made of Aluminium alloy conforming to IS:737 can be considered unless use of aluminium is prohibited otherwise due to site conditions being saline/corrosive.

All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance Am (%) shall be >/= 90. However oil wetted air filters shall have Average Efficiency Em (%) >/= 90 as per BS EN - 779..

3.4 AUTOMATIC CLEANING FILTERS

This shall consist of a filter mat and drop eliminator, driven by a suitably rated geared

motor unit being supported on a steel framework. The filter mat shall consist of an endless steel wire mat insets of steel mesh held between an upper & a lower shall drop eliminator shall consist of an endles steel wire without insets of steel mesh. The unit shall include a suitable oil pump, gladge raking mechanism and sludge container and tensioning device. Pressure drop shall be limited to 0.5 / mm WG when clean & 10 mm when dirty. Air velocity across filter shall not exceed 3 M/sec.

3.5 ABSOLUTE FILTERS

Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctyphalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame.

3.6 WATER REPELLANT NYLON FILTERS

This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only.

4. INSPECTION & TESTING

The scope of inspection for air filters shall be as below:

4.1 Dimensional inspection of frame & filter media.

4.2 Witnessing of type tests on one per type per size air filters for the following properties.

a) Gravimetric efficiency.

b) Pressure drop in clean & dirty (choked - %age to be specified) condition.

c) Efficiency as per BS EN - 779.

4.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet).

5. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

5.1 GA Drawing.

5.2 Drawing showing material/construction detail

5.3 Installation and\service manual

5.4 Rating curves/charts

5.5 Test certificates

5.6 Elect. diagrams (when automatic cleaning type)

5.7 Vendor shall also provide soft copy of each drawing in AutoCAD format.

5.8 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

	TITLE	SPECIFICATION NO. PES-571-11000-A-06
BHEL	**AIR FILTER** **DATA SHEET - A**	VOLUME II-B SECTION D REV 00 DATE: JAN 2020 SHEET 1 OF 1

DESCRIPTION		**DATA**
1)	**General**	
1.1	Service	: Air Conditioning & Ventilation.
1.2	Location	: Ventilation plant, & Ductable Split AC plant, fresh air fan system. Also for split AC.
1.3	Nos.	: Refer Section 'C' of Specification.
1.4	Total air flow/type	: Refer Section 'C' of Specification.
1.5	Temperature	: As per project information.
1.6	Relative Humidity	: 100%
1.7	Gas Composition	: Atmospheric Air (Dusty) as prevalent in power Station.
1.8	Filter Media	: Synthetic non-woven
1.9	Efficiency filters.	: Average arrestance efficiency of 65-80 % for Dry Panel filter (pre-filters) and average arrestance Efficiency of 80 % down to 20 micron for
1.10	Allowable pressue drop	: 2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters(prefilters). 12 mm in clean condition for fine filters.
1.11	Frame Work	: 18 G, GSS.
1.12	Mounting	: Ladder Type M.S Angles (galvanised)
1.13	Size	: 600 x 600 mm

Note:-

1) Face velocity of air across the filters shall not exceed 2.5 m/sec and for absolute filters velocity shall not exceed 1.5 m/sec.

SECTION-D

LOW PRESSURE AIR DISTRIBUTION SYSTEM

1. GENERAL

1.1 This specification covers the design, manufacture, construction features, installation, inspection testing and air balancing of air distribution system upto a total pressure of 95mm w.g. The specification is intended to cover the air distribution for air conditioning system and ventilation system not involving localised exhaust.

2. CODES AND STANDARDS

2.1 The design, construction and performance of complete system shall conform to all currently applicable stuatues, regulations, safety codes in the locality where the equipment are to installed

2.2 Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the following standards:-

a) IS: 655 - Specifications for metal air ducts.

b) IS:277 - Specifications for galvanised steel sheets.

c) IS:737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

3. MATERIAL

3.1 Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.

3.2 The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per technical requirement refer to Section-C of Specific Technical Requirements.

3.3 The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest

4. CONSTRUCTION/FABRICATION

4.1 The thickness of sheets, the type of bracing and other fabrication details shall generally conform to requirements given hereunder unless specified otherwise in data sheet A and/or indicated on drawings.

4.2 **RECTANGULAR DUCTS**

4.2.1

S.No.	Max Side	Sheet Thickness		Type of transverse Joint connections	Bracings
		(mm) GI	(mm) Al		
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None

b)	601 to 750	0.63 (24G)	0.80	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles,connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

4.2.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.

4.2.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.

4.2.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:

a) Upto 1000mm - 6 mm dia GI bolts
b) 1001 to 1500 - 8 mm dia GI bolts
c) 1501 and above - 10mm dia GI bolts

4.2.5 The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.

4.2.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.

4.3 **ROUND DUCTS**

4.3.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) Al	
a)	Up to 150	0.63 (24G)	0.80	None
b)	151 to 600	0.80 (22G)	1.00	None
c)	601 to 1000	1.00 (20G)	1.50	40x40x3mm girth MS
d)	1001 to1250	1.00 (20G)	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

4.3.2 The seams on round ducts may be continuously welded or grooved longitudinal seam. In case of welding of GI sheet, zinc rich paint shall be applied on the welded zone.

4.3.3 Round ducts shall either be joined by welding or the ducts shall be swedged 40mm from the ends such that larger end will butt against the swedge and is held in place with sheet metal screws.

4.4 **DUCT SUPPORTS**

Unless specified otherwise on drawings, rectangular ducts with larger side of 2250mm or above shall be supported by 15mm MS rods and 50x50x3mm and MS angles while those below 2250 mm shall be supported by 10mm MS rods and all angles shall be given a coat of primer paint. The duct supports shall be at a distance not exceeding 1800mm. The MS rods shall be fixed to MS angle cleats, which in turn are fixed to ceiling slab by suitable anchor fasteners. All anchor fasteners, MS angle cleats, coach screws, hooks and other supporting material required shall be provided by vendor.

However, If ducts are thermally insulated, the MS angles and supports shall not be in direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.

4.5 **FLEXIBLE CONNECTIONS**

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band 9r (or) collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

4.6 **TRANSFORMATIONS AND BREACHES**

All curves, bends, offsets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.

4.7 **CAULKING**

Wherever duct passes through wall, the opening between masonary and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.

4.8 **EASEMENT**

Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.

4.9 **ACCESS DOORS**

Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc.

All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.

4.10 **DAMPERS AND SPLITTERS**

4.10.1 Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.

4.10.2 FIRE DAMPERS

Fire dampers shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal sensor or fusible link type.

4.10.3 VANES

Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.

4.10.4 FLASHING

For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.

4.11 **DIFFUSERS AND GRILLS**

The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser.

Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be

single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.

4.12 **PLENUMS AND RA BOXING**

All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at appox. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonary construction to which angles are fastened.

Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box ~~shall be~~ fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.

4.13 **ACCOUSTIC LINING**

The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.

4.14 **PAINTING**

Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.

4.15 **THERMAL INSULATION**

Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.

5. INSPECTION AND TESTING

5.1 **INSPECTION & TESTING DURING FABRICATION**

5.1.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.

5.1.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

5.1.3 Check for dimensions & mass as per latest IS-277.

5.1.4 Check for defect, twists, ungalvanised spots as per IS-2629.

5.1.5 Bend test & wrapping test as per IS-277.

5.1.6 Zinc coating test on samples as per IS-6745.

5.2 **INSPECTION & TESTING AT SITE.**

5.2.1 The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.

5.2.2 After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.

6. BALANCING

6.1.1 The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit

6.1.2 All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.

7. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT

7.1 Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.

7.2 Test certificates in line with scope of inspection.

7.3 Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual**.**

7.4 Installation instruction manual and air balancing manual.

7.5 Duct air leaking test procedure/smoke test procedure.

7.6 Vendor shall also provide soft copy of each drawing in AutoCAD format.

7.7 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

	TITLE	SPECIFICATION NO. PES-571-11000-A-07
BHEL	**LOW PRESSURE AIR DISTRIBUTION SYSTEM**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 / DATE: JAN 2020
		SHEET 1 OF 1

Description	**Data**
1. General (List of areas)	: As per Specification/Tender drawing.
2. GSS Duct Work a) Type	: GSS as per IS: 277 (Zinc coating as per Section-C of Specific Technical Requirements.)
b) Size	: As per Section-C of Specific Technical Requirements and bill of quantity.
3. Acoustic lining AC Outlet.	: Up to 5m length from Ductable split
4. Special painting	: Galvanised.
5. Thermal Insulation	: Required in supply air duct in AC entire length.
6. Diffusers (Circular/Square) 300 mm size 350 mm size 450 mm size 550 mm size 600 mm size Any other size	: Bidder to estimate as per drawings./specification. All grille frame and louvers shall be manufactured of at least 16 SWG Aluminium
7. SA grilles (for each size)	: To suit air flow as per System requirements / Tender Drawings.
8. RA grilles (for each size)	: -do-

NOTE:

1. Duct sheet thickness shall be as per IS-655
2. Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
3. Bidder to provide suitable gasketing at each duct flange.
4. Fire damper shall be motor operated type, when otherwise specified under Section-C.
5. Access door in ducting system shall be provided as required.
6. MS Angle (painted) shall be used for duct supports etc.
7. Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system and 12 M/sec for Ventilation duct. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.
8. All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.

SECTION-D

THERMAL INSULATION FOR COLD SURFACES

1. SCOPE

This specification covers design, manufacture, testing at manufacturers works, supply, application & finishing of insulation for cold piping, air conditioning ducting & equipment for low temperature service.

2. CODES & STANDARDS

The design, manufacture and performance of materials covered under this specification shall comply with all currently applicable statues, regulations & safety codes in the locality where the equipment/material are to be installed. The material shall also conform to the latest applicable Indian/British/American codes & standards. Nothing in this specification shall be construed to relieve the vendor of his responsibility. In particular, the material shall conform to the latest editions of the following standards :-

2.1 IS:3069 : Glossary of terms & symbols & units relating to thermal insulation materials.

2.2 IS:4671 : Expanded polystyrene for thermal insulation purposes.

2.3 IS:3677 : Mineral wool for thermal insulation.

2.4 IS:8183 : Resin bonded mineral wool.

3. DESIGN REQUIREMENTS

3.1 The insulating material as well as protective covering shall be new & unused, non-corrosive, vermin/rodent proof and shall be guaranteed to withstand continuously & without deterioration the maximum/minimum temperatures to which they may be subjected to, under specified site conditions.

3.2 The insulation material must be light weight, strong, free from shots & coarse fibre & shall provide high insulation efficiency at low weight & coat. It should be non-hygroscopic & should not rot. It shall not settle or shake down even when subjected to prolonged vibrations.

3.3 The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

4. APPLICATION DETAILS

4.1 The surface to be insulated shall be thoroughly cleaned and allowed to dry. Pressure / hydrostatic tests, if any, shall be carried out before application of insulation.

4.2 A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.

4.3 Hot industrial bitumen of grade 85/40 or 85/25 conforming to latest IS: 702 shall be uniformly applied @ 1.5 kg/sq.m on the surface to be insulated. A similar layer shall also be applied on the inside surface & edges of the insulation. A suitable cold adhesive compound may also be used in place of bitumen.

4.4 Insulation in the form of pipe sections/rolls slabs of specified density & thickness should be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed

with bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.

4.5 In case of double layer application both circumferential & longitudinal joints shall be suitably staggered.

5. VAPOR SEALING & INSULATION FINISH

The insulation shall be treated for vapor sealing & weather proofing & finished as specified in DATA SHEET A The acceptable types of finishes are outlined below:-

5.1 FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH

5.1.1 A thick vapor seal of hot bitumen @ 2.5 kg/Sqm shall be applied on the outer surface of insulation & allowed to dry.

5.1.2 The surface shall then be wrapped with 20mm (3/4"_ hexagonal mesh of 24 SWG GI wire, butting all the joints & laced down with 22 SWG GI lacing wire.

5.1.3 12.5mm (1/2 inch) thick sand cement plaster in the ratio of (1:1) shall be applied in two layers, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.

5.2 FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.

5.2.1 The insulation shall be covered with 500 g polythene/polythene bonded Hessians (PBH) with 50mm overlap on longitudinal & circumferential joints. Overlaps shall be sealed with synthetic adhesive in case o-f polythene & liberal coat of bitumen in case of PBH:

5.2.2 The surface shall then be wrapped with 20mm (3/4") mesh of 24 SWG GI wire butting all the joints & laced down with 22 SWG GI lacing wire.

5.2.3 12.5mm thick (1/2 inch) sand cement plaster in ratio of(4:1) shall be applied in two layers, the second layer being brought to a smooth & even finish similarly as described above.

5.3 FINISH III: EXTERNAL INSULATION WITH SHEET METAL FINISH

5.3.1 The insulation shall be covered with 500g polythene with 50mm overlaps at joints, which shall be sealed with synthetic adhesive or equivalent compound.

5.3.2 The polythene shall be covered with 24 gauge GI/aluminum sheet

5.3.3 25mm wide x 22 SWG GI/aluminum peripheral straps shall be fixed over the GI/aluminum sheet at 300mm centres to secure.

5.4 FINISH IV: EXTERNAL INSULATION WITH PLASTER & WATER PROOFING COMPOUND

For ducts & piping exposed to atmosphere, the finish shall be as follows:

5.4.1 A thick vapor seal of hot bitumen at 2.05 kg/sq.m shall be applied on the outer surface of insulation & allowed to dry.

5.4.2 The surface shall then be wrapped with 20mm (32/4") hexagonal mesh of 24 SWG GI Wire butting all the joints & laced down with 223 SWG GI lacing wire.

5.4.3 12.5mm thick (1/*2 inch) sand cement plaster in ratio of (4:1) shall be applied in two layers, the second layer being brought to a smooth finish with water proofing compound added to the cement.

5.4.4 3 mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fiberglass RP tissue & allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire & finally bitumen paint shall be applied over wire netting.

6. INSULATION OF PUMPS & VALVES

6.1 For all inspection covers & hatches on equipment, pump casing & valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge aluminum sheet metal boxes, which shall be bolted together around the equipment to permit easy removal & replacement. Proper care shall be taken to maintain continuity of vapor seal between the static & removable partitions of the insulation.

6.2 The tenderer may offer thickness of insulation & finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser's approval.

7. INSPECTION & TESTING (REFER SPEC. NO - PES-553.00)

7.1 All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes & standards, shall be carried out at manufacturer's works & test certificates including these for material/accessories shall be furnished for purchasers approval.

8. PAINTING

8.1 Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1 Final version of data sheet 'B' incorporating changes if any along with design data.

9.2 Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following:-

a) Thermal conductivity test.

b) Sound absorption coefficient test.

c) Corrosion test.

d) Sulphur content, moisture content, shot content, moisture absorption etc.

e) Compressive strength & cross breaking strength test.

9.3 Sketches / technical literature / sectional drgs. indicating insulation materials finish and method of application etc.

9.4 Manual dealing with safety aspects & instructions for combating fire arising out of insulation work.

9.5 Instructions on erection and maintenance of insulation work.

9.6 Vendor shall also provide soft copy of each drawing in AutoCAD format.

9.7 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

	TITLE	SPECIFICATION NO. PES-571-11000-A-08	
BHEL	**INSULATION** **DATA SHEET - A**	VOLUME II-B	
		SECTION D	
		REV 00	DATE JAN 2020
		SHEET 1 OF 1	

Insulation Material

Insulation	Code	Thermal Conductivity MW/cm ^{0}C	Density Kg/m^3
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 ^{0}C	At least 24 for duct insulation and 48 for acoustic lining.
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 ^{0}C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 10 ^{0}C	At least 15
Al foiled face Nitrile rubber / XLPE	EN12667	0.037 at 20 ^{0}C	At least 140

Type of Insulation

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded roll Mineral Wool (IS:8183)	Roll/slab	25
		Or AI foiled face Nitrile rubber/XLPE	Roll/slab	25
ii)	Refrigerant Piping	a) Expanded Polystyrene	Pipe Section	75
		or b) Mineral Wool	Pipe Section	75
iii)	AHU drain pipe	a) Expanded Polystyrene	Pipe Section	25
		or b) Mineral Wool	Pipe Section	25
iv)	AHU drain pan coil section and fan section	a) Expanded Polystyrene	Slabs	25
		or b) Mineral Wool	Slabs	25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene	Pipe Section	75
		or b) Mineral Wool	Pipe Section	75
vi)	Chiller	a) Expanded Polystyrene	Slabs	100
		or b) Mineral Wool	Slabs	100
vii)	Chilled Water Pumps	a) Expanded Polystyrene	Slabs	50
		or b) Mineral Wool	Slabs	50
viii)	Expansion tank with pipe	a) Expanded Polystyrene	Slabs/Pipe Section	50
		or b) Mineral Wool	Slabs/Pipe Section	50

Insulation shall be fire retardant class.

SECTION: I

SUB-SECTION: E

LIST OF ANNEXURES

SECTION-I

SUB SECTION E

ANNEXURE-I

LIST OF MAKES-HVAC SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(3x40 MW NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	VAPOUR ABSORBTION MACHINE	VOLTAS / THERMAX
3	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMADENTA
4	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
5	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
6	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRYAIRE(FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
7	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
8	CHILLED & CONDENSER WATER PUMP	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
9	COOLING TOWER	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
10	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP
11	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
13	INSULTATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
14	BALANCING VALVE	ADVANCE
15	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE / ADVANCE
16	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
17	GATE/GLOBE VALVES	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
18	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY /JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
19	MOTORIZED BUTTERFLY VALVE	ANERGY / / BELIMO / JOHNSON / HONEYWELL / SIEMENS
20	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(3x40 MW NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
		PVT LTD / SUNGOV ENGINEERING
21	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
22	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
23	GI SHEETS FOR DUCTING	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL
24	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
25	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
26	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
27	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
28	RELIEF / PURGE VALVE	BRASSOMATIC
29	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
30	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
31	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
32	PRESSURE GAUGE	GENERAL INST CONSORTIUM / BELL / H.GURU INST P. LTD. / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES/ PRECISION MASS PRODUCTS PVT. LTD. / BOSE PANDA INSTT. PVT. LTD.
33	TEMPERATURE GAUGE	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)/ BAUMER TECHNOLOGIES/ GOA THERMOSTATIC/ GAUGE BOURDON/ BUDENBERG GAUGE/ PRECISION MASS PRODUCTS
34	LEVEL GAUGE	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND
35	PRESSURE SWITCH / DP SWITCHES	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT/ KASTURBA UDYOG/ BARKSDALE/ PRECISION MASS PRODUCTS/ MITTAL REFRIGERATION
36	TEMPERATURE SWITCH	INDFOSS/ SEIMENS / DANFOSS/ DK INSTRUMENTS/ SOR INC / VASU / DRESSER / TOSHNIWAL / SWITZER
37	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
38	LEVEL SWITCH	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V ATUOMATE /CHEMTROLS / SIMENS / FLOW STAR / TRAC/ FLOW TECH/ NIVO CONTROLS/ PUNE TECHTROL/ SAPCON/ BAUMER TECHNOLOGIES/ GIC/ SBEM
39	TRANSMITTERS	TAYLOR / ABB/BRISTOL BABCOCK / BIRLA KENT TAYLOR / BLISS ANAND /SBEM/ SMART INST / V AUTOMATION & INST / FISHER-ROSEMOUNT/ SIEMENS/ TATA HONEYWELL/ PUNE TECHTROL/ NIVO CONTROLS/ PANAM ENGINEERS/ EMERSON/ MOORE INDUSTRIES/ TOSHINIWAL INDUSTRIES/ YOKOGAWA/ E&H/ ABB
40	SIGHT FLOW INDICATORS	SIGMA / LEVCON /V AUTOMAT / TELLACE /EUREKA / TATA HONEYWELL/BLISS ANAND/ SCIENTIFIC DEVICES/ BK EQUIPMENTS/ INSTRUMENTATION ENGINEERS
41	FLOW ELEMENT	BRISTOL BABCOCK / BALIGA /LIGHTING EQUIP /ENGINEERING SPECIALITIES /IL / MINCO/ MICRO PRECISION / STAR MECH
42	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM/ PYRO ELECTRIC /WAAREE INSTRUMENTS/ DETRIVE INST & ELECTRONICS / TOSHNIWAL/ GOA INSTRUMENTS/ GAUGE BOURDON/ TECHNO INSTRUMENTS/ TEMPSENS INSTRUMENTS/ THERMAL INSTRUMENTS/ TM TECHNOMATIC/ BAUMER TECHNOLOGIES
43	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA /TRAC / FLOW STAR/ SCIENTIFIC DEVICE
44	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
45	PLC BASED PANEL	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB/ MITSUBISHI ELECTRIC
46	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO
47	PRINTER	HP / CANON / EPSON / XEROX / IBM / LEXMARK
48	UPS	HITACHI-HIREL / APC / DELTA / EMERSON / DB POWER / APLAB
49	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
50	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
51	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
52	METERING PUMP	SHAPO TOOLS / VK PUMPS
53	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
54	PRESSURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
55	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL
56	ROTAMETER	CHEMTROLS SAMIL / EUREKA IND / IL / TRANSDUCERS AND CONTROL

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(3x40 MW NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
57	BATTERY CHARGER	AMARARAJA/ CHHABI ELECTRICAL / DUBAS ENGG. / HBL POWER SYSTEM / STATCON / CALDYNE
58	BATTERY (NI -Cd)	HBL POWER / AMCO SAFT / SAFT
NOTE		
	1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. LIST OF SUB-VENDOR SHALL BE FINALIZED WITH THE FINALLY SELECTED L-1 VENDOR BUT PRIOR TO ORDER FINALIZATION ON L-1 VENDOR BY THE BHEL. 2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER. 3. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3 & C-4 FOR ELECTRICAL AND C&I RELATED EQUIPMENT LIST OF MAKE.	

LIST OF MAKES OF SUB-VENDOR ITEMS

VENTILATION SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLIACBLE
(3x40 MW NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT)

S.No.	Description	Makes
1.	**AIR WASHER & UAF***	HYDERABAD POLUTION CONTROL / SK SYSTEM / ADVANCE VENTILATION / DRAFT AIR / BLUE STAR / VOLTAS / STERLING WILSON & ROOTS COOLING SYSTEM / C.DOCTOR
2.	**AIR HANDLING UNITS**	
3.	**CENTRIFUGAL FAN**	FLAKT / KRUGGER / DRAFT AIR / HYDERABAD POLUTION CONTROL / ADVANCE VENTILATION / PATEL AIR / NICOTRA/ SK SYSTEM / MARATHON / CB DOCTOR / SARLA
4.	**AXIAL FLOW FANS/RE UNITS**	HYDERABAD POLLUTION/ SK SYSTEM / ADVANCE VENTILATION / KRUGER / NICOTRA / MARATHON / FLAKT / CB DOCTOR/ PATEL AIR /SITAL
5.	**FAN**	FLAKT WOODS/ KRUGER/ ANDREW YULE/ AEROTHERM/ DUVENT/ SIWENT (SARLA)/ S.R PRAYAVARAN/ GEC(Alstom)
6.	**CENTRIFUGAL WATER PUMP**	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
7.	**INDUCTION MOTORS (LT)**	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP/ KIRLOSKAR/ G.E.C.
8.	**AIR FILTER**	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER /SPECTRUM / AIR TECH / PUROMATIC/ CHEMFARM/ KIRLOAKAR/ CLEAR AIR PUROFIL/ DYNA
9.	**INSULTATION MATERIAL**	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
10.	**RESIN BOUNDED FIBRE GLASS**	UP TWIGA/ CLYOL/ COOLINE
11.	**FIRE DAMPER**	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
12.	**BUTTERFLY VALVE**	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
13.	**NON RETURN VALVE**	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
14.	**GATE/GLOBE VALVES**	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
15.	**PIPING - ERW**	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
16.	**GI SHEETS FOR DUCTING**	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL/ NIPPON
17.	**HUMID STAT**	JHONSON CONTROL / HONEYWELL / PENN
18.	**GRILLES/ DIFFUSERS**	MOOSA HAJI/ NUTECH/ COSMOS/ OPELLA/ CARYAIRE
19.	**PRESSURE GAUGE**	GENERAL INST CONSORTIUM / BELL / H.GURU INST / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES/PRECISION MASS PRODUCTS/ BOSE PANDA/ FIEBIG/ JAPSIN/ MICA
20.	**THERMOSTATS**	H.GURU/ FIEBIG/ JAPSIN/ MICA/ PENN/ HONEYWELL

21.	**TEMPERATURE GAUGE**	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)/ BAUMER TECHNOLOGIES/ GAUGE BOURDON/ GOA THERMOSTAT/ BUDENBERG GAUGE/ PRECISION MASS PRODUCTS
22.	**LEVEL GAUGE**	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND
23.	**PRESSURE SWITCH / DP SWITCHES**	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT/ KASTURBA UDYOG/ BARKSDALE/ PRECISION MASS/ MITTAL REFRIGERATION
24.	**LEVEL SWITCH**	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V AUTOMAT /CHEMTROLS / SIMENS / FLOW STAR / TRAC/ NIVO CONTROLS/ PUNE TECHTROLS/ SAPCON INSTRUMENTS/ BAUMER TECHNOLOGIES/ GIC
25.	**Y / POT STRAINER**	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING
26.	**CONTROL PANEL**	INDUSTRIAL CONTROL & APPLIANCE/ PYROTECH /POSITRONICS / CONTROL & SWITCHGEAR /SIEMENS / L&T /GE POWER /RITTAL / HOFFMAN
27.	**SWITCHGEAR**	(MCCB, CROMPTON/ SIEMENS/ ABB/ L&T CONTRACTORS ETC.)
28.	**CABLES**	FINOLEX/ NICCO/ UNIVERSAL CABLES/ GRANDLEY/ CCI/ POLYCAB/ FORT GLOSTER
NOTE		
	* Designed by C. Doctor / Blue Star / Voltas / Hyderabad Pollution Controls / SK System /Advance Ventilation / Draft Air / Sterling & Wilson / Roots cooling and fabricated by their approved fabricators.	
	1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. LIST OF SUB-VENDOR SHALL BE FINALIZED WITH THE FINALLY SELECTED L-1 VENDOR BUT PRIOR TO ORDER FINALIZATION ON L-1 VENDOR BY THE BHEL. 2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER. 3. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3 & C-4 FOR ELECTRICAL AND C&I RELATED EQUIPMENT LIST OF MAKE.	

SECTION-I

SUB SECTION -E

ANNEXURE-II

MANDATORY SPARE LIST

ANNEXURE - II LIST OF MANDATORY SPARES 3x40 MW NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT		
S. No.	**Description**	**UNIT**
A	**HVAC Spares**	
5.00.00	**Ventilation system**	
5.01.00	Supply air fan assembly (for each model and capacity)	
5.01.01	Supply air fan	1 No.
5.01.02	V-belts for blower	4 Sets
5.01.03	Blower bearings	1 Set
5.01.04	Motor	1 No.
5.02.00	Exhaust Air Fan Assembly (for each model and capacity)	10%
5.03.00	Local indicators like temperature gauges, pressure, gauges, differential pressure gauges etc.	10% or 2 Nos. of each make, model and type whichever is more
B	**Electrical spares**	
7.00.00	**LT / HT SWITCHGEAR (33 KV, 11 kV & 415 V SWITCHGEAR)**	
7.01.00	Circuit breaker (triple pole) / MCCB / Isolator / Switch	1 No. for each type and rating
7.02.00	Current transformer	1 No. of each type and rating
7.03.00	Potential Transformer	1 No. of each type and rating
7.04.00.	TNC control switch for circuit breaker control	2 Nos. of each type and rating
7.05.00	HRC fuses links	6 Nos. of each type and rating
7.06.00	Ammeter selector switches	2 Nos. of each type and rating
7.07.00	Local / Remote selector switches	2 Nos. of each type and rating
7.08.00	Voltmeter selector switches	3 Nos. of each type and rating
7.09.00	Shunt trip coil	2 Nos. of each type and rating
7.10.00	Closing coil	2 Nos. of each type and rating
7.11.00	Push button for trip circuit healthy test	2 Nos. of each type and rating
7.12.00	KWh meter, 3 phase, 3 wire (Microprocessor based Trivector)	1 No. of each type and rating
7.13.00	Alarm bell	1 No. of each type and rating
7.14.00	Relays (including Anti pumping relay, Aux. relay, Lockout relays / times	2 Nos. of each type and rating
7.15.00	Discrepancy control switch for C.B. control	2 Nos. of each type and rating
7.16.00	ACB driving motor	2 Nos. of each type and rating
7.17.00	ACB driving mechanism	2 Nos. of each type & rating
11.00.00	**HT CABLE, LT POWER CABLE , CONTROL CABLE & AERIAL BUNCH CABLE**	
11.01.00	Each and every type of cable	10% of installed quantity
12.00.00	**CABLING EARTHING & LIGHTNING PROTECTION**	
12.01.00	Termination of each type and rating	5% of installed quantity (minimum one no.)

S. No.	Description	UNIT
12.02.00	Jointing kit of each type and rating	5% of installed quantity (minimum one no.)
C	**C&I Spares**	
2.00.00	**MEASURING INSTRUMENTS**	
2.01.00	Electronic Transmitters	
(i)	Transmitters of all type, range and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)	10 % of each type and model or 2 Nos. whichever is more
(ii)	Electronic cards / PCB's for each type and model of transmitters.	10 % of each type and model or 2 Nos. whichever is more
2.02.00	Temperature elements	
(i)	a) RTD's b) Any other temperature sensor	10 % of each type and model or 2 Nos. whichever is more
(ii)	Temperature Transmitters	10% of each type and model or 2 Nos. whichever is more
2.03.00	Electrical Metering Instruments: Electrical meters including voltmeter (analog), motor current ammeter, semaphore indicator, frequency meter (analog), synchroscope	1 No. of each type and model.
2.04.00	**Vibration Monitoring System (if applicable)**	
(i)	Sensors	10% or 2 Nos. whichever is more
(ii)	Power Supply Module Cards	10% or 2 Nos. whichever is more
(iii)	Driver / Interface Cards & all other electronic cards.	10% or 2 Nos. whichever is more
4.00.00	**PROCESS CONNECTION PIPING**	
(i)	Valves of all types	10%
(ii)	2 way, 3way, 5way valve manifolds	10% of each type, class, size and model or 2 whichever is more
(iii)	Fittings	10% of each type or model.
5.00.00	**INSTRUMENTATION CABLE, INTERNAL WIRING**	
(i)	Pre fabricated cable of each type (other than SCADA application)	10% of installed quantity
(ii)	Other cables (including core cables)	5 % of each type, pair and size of actual installed quantity
6.00.00	**CONTROL DESK & CONTROL PANEL**	
(i)	Replacement lamps / LED's for each type of lamps / LED	100%
(ii)	MCBs	10% of each type and rating.
(iii)	Fuses	100% of each type and rating.
(iv)	Blank tiles	10% of total No. of tiles
12.00.00	**WATER LEVEL MEASUREMENTS**	
(i)	Sensor for level overshoot detection	10% of each type, model and rating or 2 Nos. whichever is more.
(ii)	Electronic cards/ Relays/ fuses/ connectors/ Power supply modules / power packs / special cable (as applicable)	10% of each type, model and rating or 2 Nos. whichever is more.
D	**MANDATORY SPARES FOR MANUAL HOIST (AS APPLICABLE)**	
1	Manual Hoists (Chain Pulley Block) (FOR EACH TYPE & CAPACITY)	
(i)	All Bearings	1 set of each type / rating
(ii)	Brake assembly and its liners (as applicable)	1 set of each type / rating

S. No.	Description	UNIT
Notes:		
a)	Spares listed in Price Schedule is bare minimum requirement. In case any additional mandatory spares required for 5 years of successful operation of the system or those covered elsewhere in the tender specification apart from specified above, same shall be deemed to have been covered in bidder's scope of supply.	
b)	One set corresponds to actual quantity of components and devices as installed for one equipment / item / assembly.	
c)	All Spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is "not applicable" for particular equipment, then suitable applicable alternate spare has been offered / shall be supplied by the bidder without any financial implication."	
d)	Any item which is quoted as "not applicable" by the bidder in the above list and is found to be "applicable" at a later date shall be supplied by the bidder without any commercial and delivery implication.	
e)	Any cell left blank in the unpriced schedule shall be treated as "Quoted" and is included in total price.	

SECTION-I

SUB-SECTION-E

ANNEXURE-III

LIST OF TOOLS & TACKLES
AND
LIST OF COMMISSIONING SPARES

LIST OF TOOLS & TACKLES

SL NO	ITEM DESCRIPTION	UNIT	QTY
1	FLAT D WRENCH - 6 MM TO 32 MM (12 Pcs)	SET	1
2	BOX WRENCHES - 6 MM TO 22 MM (14 Pcs)	SET	1
3	RING SPANNER - 6 MM TO 32 MM (12 Pcs)	SET	1
4	ALLEN KEYS - 2 MM TO 10 MM	SET	1
5	CRESCENT SCREW SPANNER	NO.	1
6	SCREW DRIVER	NO.	1
7	OFFSET SCREW DRIVER	NO.	1
8	INSULATED PLIER	NO.	1
9	TORCH LIGHT FOR 2 CELL	NO.	1
10	HAMMER 1 LB	NO.	1
11	OIL CAN	NO.	1
12	POCKET THERMOMETER - 0 TO 50 DEG. C)	NO.	1
13	INSULATION TAPE ROLL	NO.	1
14	STEEL FOOT RULE - 12"	NO.	1
15	FEELER GAUGE 9 BLADES	NO.	1
16	PIPE WRENCH	NO.	1
17	FLARE NUT (1/4")	NOS.	6
18	FLARING TOOL	NO.	1
19	TUBE CUTTER	NO.	1
20	GAS CHARGING PIPE	NO.	1
21	NITOGEN CHARGING ADAPTER	NO.	1
22	FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 0 - 300 MM PSI	NO.	1
23	FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 30 - 150 MM PSI	NO.	1
24	PSYCHRO METER	NO.	1
25	LOCK WITH KEY FOR TOOL BOX	NO.	1
26	RATCHET 1/4"	NO.	1
27	MS TOOL BOX	NO.	1
28	LOCK WITH KEY FOR TOOL BOX	NO.	1
29	HAND LAMP	NO.	1
30	Grease Gun	NO.	1

NOTE:-
Above is the minimum list. Any other Tools and tackles required for HVAC system w.r.t. Mechanical, Electrical and C&I part shall also be provided by the vendor as per system / customer requirement without any commercial & Delivery implication to BHEL.

LIST OF COMMISSIONING SPARES

SL NO	ITEM DESCRIPTION	UNIT	QTY
1	FAN BELTS (each type & size)	SET	1
2	PRESSURE GAUGE (for each type and range)	NO.	1
3	TEMPERATURE GAUGE (for each type and range)	NO.	1
4	FILTER (each size)	SET	1
5	COMPRESSOR OIL	Ltr.	1 Lot
6	REFRIGERANT GAS OF EACH TYPE IN A NON-RETURNABLE CYLINDERS	Kg	1 Lot

NOTE:-
Above is the minimum list. Any other commissioning spare required for HVAC system w.r.t. Mechanical, Electrical and C&I part shall also be provided by the vendor as per system / customer requirement without any commercial & Delivery implication to BHEL.

SECTION-I

SUB-SECTION-E

ANNEXURE-IV

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE

Appendix – E

DISTRIBUTION OF DRGS / DOCUMENTS
(refer Annexure-II, Part-C, GTR, Technical Specification, Section-VI)

Sr. No	Description	TO NTPC-EC	TO NTPC-SITE
1.	Plant Definition Manual	3 Sets Manuals+ 1 CD	7 Sets Manuals+ 2 CDs
2.	Drawings / documents (layout/ GA/data sheet/ P&I/ calculation/ type test reports/ SLD/ Schematics etc.) "FOR APPROVAL"	6 prints + Soft copy	--
3.	Drawings / documents "FOR INFORMATION"	4 prints + Soft copy	--
4.	Drawings "FINAL DRAWING" (Approved by NTPC, in Cat. I or IV) for distribution	2 prints + 1 CD	8 prints +2 CD2
5.	Drawings "AS BUILT"	2 prints + 1 CD	8 prints +2 CD2
6.	Erection / Installation Manual "DRAFT" for NTPC review	1 Set Manuals+ soft copy by Email	3 Sets Manuals+ soft copy by Email
7.	Erection / Installation Manual "FINAL"	2 Sets Manuals+ 1 CD	8 Sets Manuals+ 2 CDs
8.	Operation & Maintenance Manual "Draft" (for approval)	2 Sets Manuals+ soft copy by Email	2 Sets Manuals+ soft copy by Email
9.	Approved Operation & Maintenance Manual "FINAL" (For distribution)	2 Sets Manuals+ 1 CD	8 Sets Manuals+ 2 CDs
10.	Commissioning & performance test procedure manual for approval (DRAFT)	2 Sets Manuals+ soft copy by Email	2 Sets Manuals+ soft copy by Email
11.	Commissioning & Performance procedure manual for distribution (FINAL)	3 Sets Manuals+ 1 CD	7 Sets Manuals+ 2 CDs
12.	Performance & functional Guarantee test reports	3 Prints+ 1 CD	5 Prints+ 2 CDs
13.	Progress Reports	3 Prints+ soft copy by Email	5 Prints+ soft copy by Email
14.	Project Completion Report	3 Prints + 1 CD	12 Prints +2 CD

NOTES:

1. Date of submission of soft copy is to be taken as the date of submission.
2. All drawings/ documents shall be in English and in Metric Units.

SECTION-I

SUB-SECTION-E

ANNEXURE-V

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

S. NO.	BHEL DRAWING NO	NTPC DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
1	PE-V0-414-571-11000-A001**	********	INSPECTION CATEGORIZATION AND SUBVENDOR LIST FOR HVAC SYSTEM	04
2	PE-V0-414-571-11000-A002	5602-003-QVM-Q-130	QUALITY PLAN FOR VENTILATION SYSTEM (HVAC)	16
3	PE-V0-414-571-11000-A003	5602-003-QVM-Q-124	QUALITY PLAN FOR HORIZONTAL CENTRIFUGAL PUMP	17
4	PE-V0-414-571-11000-A004	5602-003-QVM-Q-140	QUALITY PLAN FOR HVAC	16
5	PE-V0-414-571-11000-A005	5602-003-QVM-Q-141	QUALITY PLAN OF AHU	16
6	PE-V0-414-571-11000-A006	5602-003-QVM-Q-142	QUALITY PLAN OF CENTRIFUGAL FANS	14
7	PE-V0-414-571-11000-A007	5602-003-QVM-Q-143	QUALITY PLAN OF AXIAL FANS	16
8	PE-V0-414-571-11000-A008	5602-003-QVE-Q-133	QUALITY PLAN FOR LT MOTOR	18
9	PE-V0-414-571-11000-A009	5602-003-QVE-Q-168	QUALITY PLAN FOR LT SWITCHGEAR	18
10	PE-V0-414-571-11000-A010	5602-003-QVE-Q-209	MANUFACTURING QUALITY PLAN FOR LT CONTROL CABLE	18
11	PE-V0-414-571-11000-A011	5602-003-QVM-Q-163	QAP for Pipes	20
12	PE-V0-414-571-11000-A012	5602-003-QVM-Q-138	QUALITY PLAN FOR BUTTERFLY VALVE CI/CCS/CSS CONSTRUCTION(UPTO PN10 & SUBJECT TO LIFE CYCLE TEST)	18
13	PE-V0-414-571-11000-A013	5602-003-QVM-Q-126	QUALITY PLAN FOR STRAINER / FILTER	16
14	PE-V0-414-571-11000-A101**	5602-003-H145-PVM-W-002	HEAT LOAD CALCULATION FOR AC AREAS	04
15	PE-V0-414-571-11000-A102**	5602-003-H145-PVM-W-010	OPERATION AND CONTROL PHILOSOPHY FOR HVAC SYSTEM	06
16	PE-V0-414-571-11000-A103**	5602-003-H145-PVM-W-003	PRESSURE DROP CALCULATION FOR CIRCULATING WATER PIPING	14
17	PE-V0-414-571-11000-A104	5602-003-H145-PVM-W-004	VENTILATION FAN SCHEDULE.	24
18	PE-V0-414-571-11000-A105	5602-003-H145-PVM-W-005	SPLIT AC SCHEDULE	19
19	PE-V0-414-571-11000-A203	5602-003-H145-PVM-Y-006	DATA SHEET & GA FOR PUMPS WITH FOUNDATION DETAILS.	19

20	PE-V0-414-571-11000-A204	5602-003-H145-PVM-Y-007	DATA SHEET & GA FOR AHU WITH FOUNDATION DETAILS.	19
21	PE-V0-414-571-11000-A205	5602-003-H145-PVM-Y-008	DATA SHEET & GA FOR PACKAGE AC	18
22	PE-V0-414-571-11000-A206	5602-003-H145-PVM-Y-009	DATA SHEET & GA FOR WINDOW / SPLIT AC	16
23	PE-V0-414-571-11000-A207	5602-003-H145-PVM-Y-010	DATA SHEET & GA FOR CENTRIFUGAL FANS	16
24	PE-V0-414-571-11000-A208	5602-003-H145-PVM-Y-011	DATA SHEET & GA FOR AXIAL AND PROPELLAR FANS	16
25	PE-V0-414-571-11000-A210	5602-003-H145-PVM-Y-012	DATA SHEET & GA FOR VALVES AND STRAINER.	13
26	PE-V0-414-571-11000-A212	5602-003-H145-PVM-Y-013	DATA SHEET FOR INSULATION (THERMAL AND ACCOUSTIC).	16
27	PE-V0-414-571-11000-A213	5602-003-H145-PVM-Y-014	DATA SHEET & GA FIRE DAMPER WITH ACTUATOR.	14
28	PE-V0-414-571-11000-A214	5602-003-H145-PVM-Y-015	DATA SHEET FOR INSTRUMENTS (PRESSURE GAUGE, TEMP GAUGE, LEVEL GAUGE, PRESSURE SWITCH, LEVEL SWITCH).	16
29	PE-V0-414-571-11000-A215	5602-003-H145-PVM-Y-016	DATA SHEET OF PIPE.	9
30	PE-V0-414-571-11000-A216	5602-003-H145-PVM-Y-017	DATA SHEET OF GI AND MS SHEET.	9
31	PE-V0-414-571-11000-A217	5602-003-H145-PVM-Y-018	DATA SHEET & GA FOR PRE AND FINE FILTERS.	14
32	PE-V0-414-571-11000-A218	5602-003-H145-PVM-Y-019	DATA SHEET & GA FOR MOTORS (Fan, pumps, Supply and Exhaust axial fans)	19
33	PE-V0-414-571-11000-A219	5602-003-H145-PVM-Y-020	DATA SHEET & GA FOR HEATERS	10
34	PE-V0-414-571-11000-A220	********	TECHNICAL DATA SHEET & G.A. DRAWING OF FRESH AIR AXIAL FAN FOR AIR CONDITIONING SYSTEM	16
35	PE-V0-414-571-11000-A221	********	TECHNICAL DATA SHEET & G.A. DRAWING OF PAN HUMIDIFIER	12
36	PE-V0-414-571-11000-A222	********	GA OF AIR TERMINALS LIKE SUPPLY/RETURN AIR DIFFUSER / GRILL / BACK DRAFT DAMPER / INTAKE LOUVER ETC FOR HVAC SYSTEM	18
37	PE-V0-414-571-11000-A223	********	DATA SHEET & GA FOR AUTOMATIC BACKWASH SELF CLEANING FILTER (ABSF)	10

38	PE-V0-414-571-11000-A224	********	DATA SHEET & GA FOR CYCLONE SEPERATOR	10
39	PE-V0-414-571-11000-A501**	5602-003-H145-PVM-Y-021	PID FOR AC SYSTEM	04
40	PE-V0-414-571-11000-A502**	5602-003-H145-PVM-W-035	SCHEME FOR AIR DISTRIBUTION IN TG BUILDING.	10
41	PE-V0-414-571-11000-A503**	5602-003-H145-PVM-F-003	PID FOR VENTILATION SYSTEM	04
42	PE-V0-414-571-11000-A504	5602-003-H145-PVM-F-023	TYPICAL Details- DUCT FABRICATION DRAWING / SUPPORT / ERECTION. INSULATION OF DUCTING / PIPING & EQUIPMENTS, PIPE ERECTION	10
43	PE-V0-414-571-11000-A505**	5602-003-H145-PVM-F-024	AC DUCT LAYOUT FOR CONTROL ROOM ALONGWITH FOUNDATION DETAIL OF AC EQUIPMENT	21
44	PE-V0-414-571-11000-A506**	5602-003-H145-PVM-F-025	AC LAYOUT FOR OTHER AC AREAS ALONGWITH FOUNDATION DETAIL OF AC EQUIPMENT	21
45	PE-V0-414-571-11000-A507**	5602-003-H145-PVM-F-026	VENTILATION ROOM & VENTILATION DUCT LAYOUT FOR ALL THE FLOOR FOR POWER HOUSE ALONGWITH FOUNDATION DETAIL OF VENTILATION EQUIPMENT	21
46	PE-V0-414-571-11000-A508	5602-003-H145-PVM-F-027	VENT. ARRANGEMENT FOR BATTERY ROOM ALONGWITH FAN FIXING DETAIL.	16
47	PE-V0-414-571-11000-A509	5602-003-H145-PVM-F-035	VENT. ARRANGEMENT FOR VARIOUS AUXILIARY BUILDING ALONGWITH FAN FIXING DETAIL.	25
48	PE-V0-414-571-11000-A701	5602-003-H145-PVM-F-036	ELECTRICAL PANEL DRAWING INCULDING SLD	25
49	PE-V0-414-571-11000-A702	5602-003-H145-PVM-Y-031	TDS OF CONTROL PANEL / PLC WITH CONFIGURATION DIAGRAM, BILL OF MATERIAL, GA &INTERNAL WIRING DIAGRAM, LOGIC FLOW DIAGRAM, IO WIRING DIAGRAM , PLC ROOM LAYOUT	22
50	PE-V0-414-571-11000-A703	5602-003-H145-PVM-H-033	ELECTRICAL FEEDER LIST.	22
51	PE-V0-414-571-11000-A704	5602-003-H145-PVM-H-032	CABLE SCHEDULE	22

52	PE-V0-414-571-11000-A705	5602-003-H145-PVM-Y-028	TDS FOR POWER AND CONTROL CABLES-TYPE TEST CERTIFICATE FOR CALES, TYPE TEST PROCEDUE, CROSS SECTION	22
53	PE-V0-414-571-11000-A706	5602-003-H145-PVM-Y-029	TDS AND GA FOR ELECTRICAL PANEL- SCHEME, SLD, BILL OF MATERIAL	22
54	PE-V0-414-571-11000-A707	5602-003-H145-PVM-Y-030	TDS FOR CABLING-CABLE TRAY, CABLE SUPPORT, TYPE TEST CERTIFICATE, JOINTING KITS, TRIFOIL CLAMPS, ABOVE GROUND EARTHING	25
55	PE-V0-414-571-11000-A708	********	DRIVE LIST FOR HVAC SYSTEM	20
56	PE-V0-414-571-11000-A709	********	I/O LIST FOR HVAC SYSTEM	20
57	PE-V0-414-571-11000-A710	********	LOGIC DRAWING FOR HVAC SYSTEM	20
58	PE-V0-414-571-11000-A711	********	TECHNICAL DATASHEET & GA , TYPE TEST OF JUNCTION BOX FOR HVAC SYSTEM	20
59	PE-V0-414-571-11000-A712	********	INSTRUMENT SCHEDULE WITH TAG NUMBER FOR HVAC SYSTEM	24
60	PE-V0-414-571-11000-A713	********	INTERCONNECTION OF FIELD INSTRUMENTS UPTO JUNCTION BOX FOR HVAC SYSTEM	24
61	PE-V0-414-571-11000-A901	5602-003-H145-PVM-W-034	PERFORMANCE / DEMONSTRATION TEST PROCEDURE.	20
62	PE-V0-414-571-11000-A902	5602-003-H145-PVM-X-037	O & M MANUAL.	30

BHEL Drawing / Document indicated with ** are basis engineering documents.

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in auto-cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. inspection, construction, erection and maintenance etc.:-

a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labelled and included in BOQ / BOM in tabular form.

c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Drawings/ documents to be submitted for purchasers review/ approval shall be under revision a, b, c… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under r-0, 1, 2, 3 ….etc.

f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS no., technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL'S title block and shall bear BHEL'S drawing no.

i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL'S/ customer's/ consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

j) Bidder to follow the following the drawing submission schedule:

k) 1st submission of drawings from date of LOI as per the submission schedule (week).

l) Every revised submission incorporating comments – within 7 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

SECTION-I

SUB-SECTION-E

ANNEXURE-VI

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	**COVER PAGE**				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	**INDEX**				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	**DESCRIPTION OF PLANT/SYSTEM**				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
3.8	Control philosophy /control write-ups				
4.0	**COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)**				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	**OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR**				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	**MAINTENANCE GUIDELINES FOR PLANT**				

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
	PERSONAL				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

SECTION-I

SUB-SECTION-E

ANNEXURE-VII

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1 SCOPE OF THE DOCUMENT

2 PURPOSE OF STORAGE & PRESERVATION

3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION

- a) GENERAL STORAGE REQUIREMENTS
- b) GENERAL PRESERVATION REQUIREMENTS
- c) GENERAL INSPECTION REQUIREMENTS

4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT

5. CONCLUSION

6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. ‘No smoking’ signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
    a. Rust preventive fluid (RPF)
    b. Rust protective paints
    c. Tarpaulin covers, in case of outdoor storage
    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
    - Ingress of moisture and corrosion damages.
    - Damage to protective coating.
    - Open ends in pipes, vessels and equipment -
        - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.
    - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
    - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere**. (C)

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage**. (S)

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	**Description of the equipment**	**Type of Storage**	**Check for**	**Remarks**
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

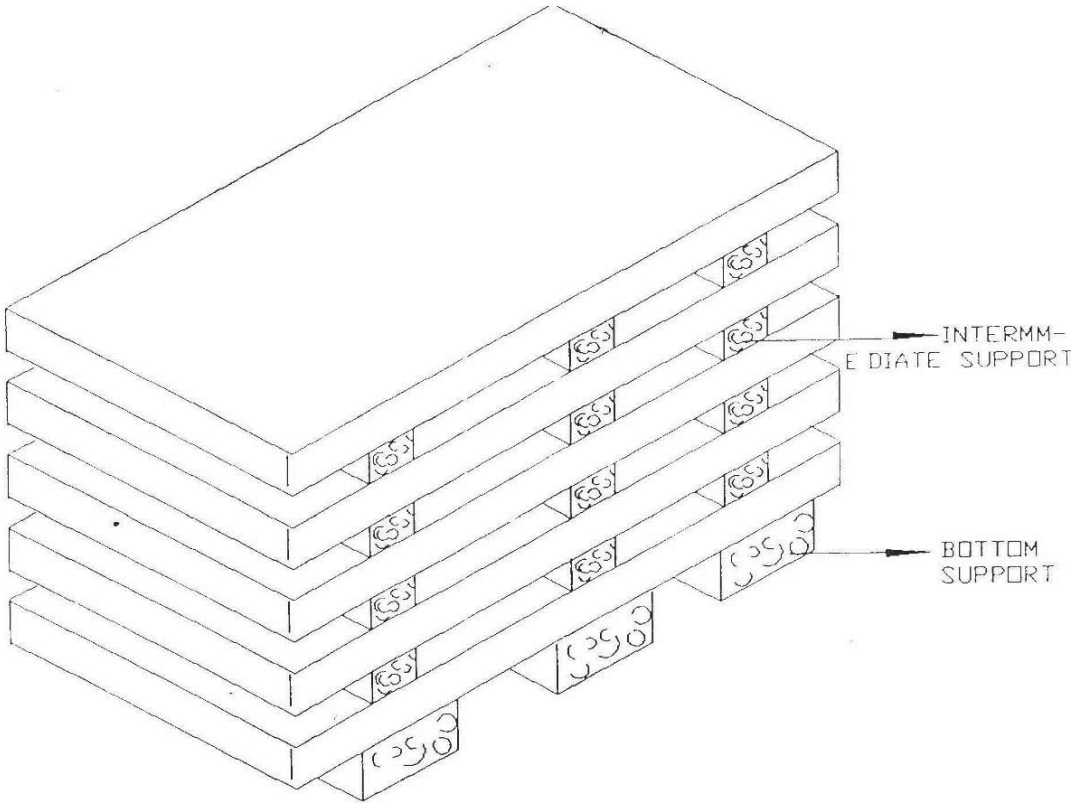


Figure – 1 – PLATE STACKING ARRANGEMENT

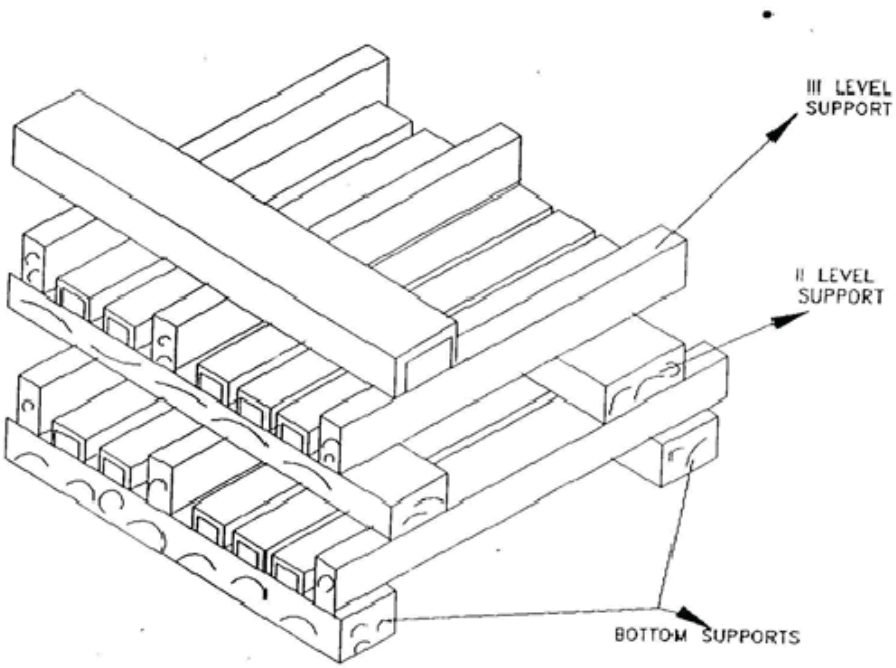


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

SECTION-I

SUB SECTION E

ANNEXURE-VIII

PAINTING SPECIFICATION & COLOUR SCHEME (COVERED UNDER SECTION C2-B)

SECTION-I

SUB SECTION E

ANNEXURE-IX

PACKING PROCEDURE
(COVERED UNDER SECTION C2-B)

SECTION-II

SECTION-II

SUB-SECTION-1

INSPECTION AND TESTING

1.01.00 Inspection and Tests during Manufacture.

1.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.

1.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

1.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

1.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.

The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.

For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.

1.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

1.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.
Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.

1.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory

Regulations shall be certified by a Competent Authority under the regulations in the specified format.

1.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

1.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

1.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major but welding joints shall be radiographed unless otherwise stipulated.

Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.

1.02.00 Performance Tests at Site

1.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

1.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

1.02.03 The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

1.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required

QAP FORMAT

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT: SYSTEM :

VENDOR : ITEM :

SL NO	COMPONENT /OPERATION OPERATIONS	CHARACTERISTICS CHECKED	CATEGORY	TYPE /METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

Legend: 1. BHEL 2. Vendor 3. Sub-Vendor

QP No	CQS/SQP/31	Signature	Date			
	Rev		Name			
Page No	1 of 1		Party	Customer/Consultant	Bhel	Vendor

SECTION: II

SUB SECTION: 2

LIST OF DOCUMENTS TO BE SUBMITTED WITH BID

BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:

1. Compliance cum confirmation certificate
2. Un priced format for HVAC package
    a. Unpriced format for Main package, mandatory spares, tools and tackles and commissioning spares on BHEL e-procurement portal.
3. Deviation schedule /No deviation certificate in attached format 'Deviation sheet (Cost of withdrawal)'.
4. Pre-bid clarification schedule and signed copy of technical corrigenda, if any.

SECTION: II

SUB SECTION: 3

COMPLIANCE CUM CONFIRMATION CERTIFICATE

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site

commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

SECTION: II

SUB SECTION: 4

PRE-BID CLARIFICATION SCHEDULE

PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

SECTION: II

SUB SECTION: 5

NO DEVIATION CERTIFICATE
(REFER ANNEXURE-II OF GCC REV 07)

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. Cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. All the bidders have to list out all of their Technical & Commercial Deviations (if any) in detail in the above format.
3. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
4. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable. In absence of same, such deviation (s) shall not be considered and offer shall be considered in total compliance to NIT.
5. Bidder shall furnish price copy of above format along with price bid.
6. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
7. Bidders to note that any deviation (technical / commercial) not listed in above and asked after Part I opening shall not be considered.
8. For deviations w.r.t. Credit period, Liquidated damages, Firm prices if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VII, will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
9. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not

be considered.
10. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
11. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
12. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
13. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.