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4.	MATERIAL OF FLOAT	316 SS
5.	INDICATOR	LINEAR SCALE
6.	ACCESSORIES	FLANGE, ORIFICE IN CASE OF BYPASS ROTA METER (FOR LINE SIZE ABOVE 100 MM)
7.	HOUSING PROTECTION CLASS	IP-55
8.	ACCURACY	± 2% OF MEASURED VALUE.

9.00.00 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 capillary (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. Radio-frequency/ Ultrasonic type for ash hopper, ash slurry 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 pr.	-	150% of max. design pressure

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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 DDCMIS)		
Elect. Connection	Plug in socket.		
Set point/ dead band adjustment	Provided over full range.		
Enclosure	Weather and dust proof as per IP-55		
Accessories	Siphon, snubber, chemical seal, pulsation dampeners 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	-
Power Supply (wherever required)	24 V DC, to be arranged by Contractor except for Ash Level Switches, where the same shall be as per Contractor's Standard practice.		

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.

10.00.00 DEW POINT METER

Sensor

Type : Capacitance type with change in output proportional to moisture present.

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Service	:	Dry Air
Range	:	-50 to 0 Degree Centigrade Dew-Point
Sensor Accuracy	:	Better than +/-0.5^
Operating Temperature	:	0 to 50 degree C.
Operating Pressure	:	0-10 Kg./Cm2, suitable for process application.
Analyser		
Input	:	Change in capacitance from dew point sensor.
Display	:	Combined enclosure with two three-digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of atleast 10 meters.
Range	:	-50 to 0 Degree Centigrade Dew-Point
Display Accuracy	:	Better than =/-2 Degree C.
Mounting	:	Table top/Flush mounting, to be finalised during detailed engineering.
Power supply	:	240V AC, 50 Hz to be arranged by the contractor.
Output	:	5-20 mA DC capable of driving a load impedance of 500 ohms minimum.

4-20 mA DC Output signal is to be connected to control system in Contractor's Scope (Interconnection cables are to be provided by the Contractor).

In case the system is not suitable for Direct online mounting, then all the required sampling system is to be provided by the contractor.

All required accessories including cables, sensor holder, desiccant chambers, mounting fixtures etc. are to be supplied by the Contractor within his quoted lumpsum price.

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4.00.00	**PIPING/TUBING SUPPORT**
4.01.00	Impulse piping and sample piping shall be supported at an interval not exceeding 1.5 meters. Each pipe shall be supported individually using slotted angle mounted clamps with necessary fixtures. Tubing shall run in proper perforated trays with proper cover. Tubing shall be supported inside the trays by aluminium supports. Hangers and other fixtures required for support of piping and trays shall be provided, either by welding or by bolting on walls, ceilings and structures. Hanger clamps and other fastening hardware shall be of corrosion resistant metals and hot-dip galvanized.
5.00.00	**SHOP AND SITE TESTS**
5.01.00	**General Requirements**
5.01.01	The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-Q (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.
5.01.02	Hydrostatic and pneumatic tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.
5.02.00	**Hydrostatic Testing**
5.02.01	All instrument piping/ tubing shall be hydrostatically tested upon completion of erection. The test pressure shall be 1.5 times the maximum process pressure. The test shall be performed either with the testing of associated process piping or without the associated process piping (by closing the root valve). In both the cases the instrument shall be isolated by closing the shut-off valve.
5.03.00	**Air Testing**
5.03.01	All air headers & branch pipes shall be air tested by pressure decay method as per ANSI B31.1. Flexible hoses and short signal tubing shall be tested at normal pressure for leakage. Long signal tubing shall be tested by charging each tube with air at 2 kg/ sq. cm. through a bubbler sight glass. The boiler draft and vacuum piping shall be air tested by the same method as long signal tubing.
6.00.00	**LOCAL INSTRUMENT ENCLOSURE AND RACKS**
	Transmitters and switches, devices, etc. (except for all fuel oil applications which shall be mounted close to be tapping points) mounted in the field shall be suitably grouped together and mounted (i) local instruments enclosure in case of open areas of the plant like boiler area, etc. and (ii) In local instrument racks in case of covered areas. Gauges are to be mounted on a channel or a frame or a rack (Gauges shall not be mounted directly in process pipe). These local instrument enclosures and racks shall be furnished as per the actual requirements finalised during detailed engineering stage. The exact grouping of instruments in a particular

CLAUSE NO.	TECHNICAL REQUIREMENTS
	instrument enclosure/instrument rack shall be as finalised during detailed engineering stage subject to Employer's approval. LIEs / LIRs shall be of three types depending on the number of transmitters located in it as elaborated in the typical GA of the LIE/LIR, drawing no. 0000-999-POI-A-064. These dimensions and number of instruments indicated therein are only indicative and the exact dimensions along with the number of instruments shall be as finalised during detailed engineering stage without any price repercussions. The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The enclosures shall be constructed of 3 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key. Gaskets shall be used between all mating sections to achieve protection class of IP-55. The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Exact fabrication details shall be as finalised during detailed engineering stage. The junction box for racks also shall conform to IP 55 protection class. Enclosures/racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided. Each transmitter enclosure housing instruments requiring **purge air** for continuous air purging, shall be provided with common purge air header, redundant air filter regulators of sufficient capacity, required pressure gauges, valves, fittings, SS tubings and individual purge meters for each purge line etc. as required and indicated in Instrument Installation drawings enclosed herewith. A 15 mm NB **service air** header shall be furnished in each instrument enclosure housing air & flue gas and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge, and quick disconnect connections. A hose for connecting each header to the draft instrument line four-way valves shall be furnished. The hose shall be self-storing nylon tubing having a burst pressure of 15 kg/sq.cm. The size of the hose shall be 1/2" minimum. The

CLAUSE NO.	TECHNICAL REQUIREMENTS
	service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates. The contractor shall prepare the piping drawings and the general arrangement layout drawings for each of the enclosures and racks. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry. Drawings shall indicate the arrangement of all equipment, piping, valves and fittings within, the enclosure/racks and shall be subject to Employer's approval. All liquid filled blow down lines, except those measuring vacuum shall be connected to a two inch header which is extended through one end of the enclosure and turned downward for directing the blow down into a drain. The material of the blow down header shall be carbon steel as per ASTM A 106 Gr C. The Contractor shall submit to the Employer with his proposal a copy of his welding procedure specification together with proof of his compliance with the latest applicable welding ANSI code. Prior to any welding being performed, the Contractor shall submit the qualifications of the craftsmen who will perform the work.

CLAUSE NO.	TECHNICAL REQUIREMENTS

INSTRUMENTATION AND POWER SUPPLY CABLE

1.00.00 **INSTRUMENTATION CABLE, POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL**

1.01.00 **General Requirements**

1.01.01 All cables including special 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.

1.01.01 The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope as illustrated in the enclosed Drg. No. 0270-110-POI-A-021 and ensuring completeness of the control system.

1.01.02 Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.

1.01.03 Other type of cables like fiber optic/co-axial cables for system bus, cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.

1.01.04 Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.

1.01.05 Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sump price without any further cost implication to the Owner.

2.00.00 Specification of Instrumentation cable

2.01.00 Common Requirements

S. No.	Property	Requirement
1	Voltage grade	225 V (peak value)
2.	Codes and standard	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) and their amendments read along with this specification.

CLAUSE NO.	TECHNICAL REQUIREMENTS

S. No.	Property	Requirement
3.	Continuous operation suitability	At 70 deg. C for all types of cables, while 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
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	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
A. Conductors				
Cross section area	0.5 sq. mm			
Conductor	ANSI type	ANSI type	High conductivity	ANSI type KX

CLAUSE NO.	TECHNICAL REQUIREMENTS

material	KX	SX	Annealed bare copper	
Colour code	Yellow-Red	Black-Red	As per VDE-815	Yellow-Red
Conductor Grade	As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1
No & dia of strands	7x0.3 mm (nom)			
No. of Pairs	2	2	4,8,12,16,24,48	2
Max. conductor resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4 (loop)	As per ANSI MC 96.1
Reference Standard	As per ANSI MC 96.1		VDE 0815	As per ANSI MC 96.1
B. Insulation				
Material	PVC type YI 3			Teflon (i.e. extruded FEP)
Thickness in mm (Min/Nom/Max)	0.25/0.3/0.35			0.4/0.50
Volume Resistivity (Min) in ohm-cm	1×10^{14} at 20 deg. C & 1×10^{11} at 70 deg. C.			---
Voltage Rating	225 V peak operating voltage			
Reference Standard	VDE 0207 Part 4			VDE 0207 Part 6 & ASTMD 2116.
Core diameter above insulation	Suitable for cage clamp connector			
C. Pairing & Twisting				
Max. lay of pairs (mm)	50			
Single layer of Numbered binder	Yes			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	tape on each pair provided			
	Unit formation of four pairs with printing of no. of Unit provided	N.A.	Yes	N.A.
	Conductor /pair identification as per VDE0815	N.A.	To be provided (color coding attached).	N.A.
	D. Shielding			
	Type of shielding	Al-Mylar tape		
	Individual pair shielding	No	To be provided for F-type cable	No
	Minimum thickness of Individual pair shielding	No	28 micron	No
	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	N.A.
	Drain wire provided for overall shield	Yes. 7-strand 20 AWG (0.51 mm^2) annealed Tin coated copper		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	E. FILLERS			
	Non-hygroscopic, flame retardant	To be provided		
	F. Outer Sheath			
	Material	Extruded PVC compound YM1 with FRLS properties		Teflon (i.e. extruded FRP)
	Minimum Thickness at any point	1.8 mm		0.4 mm
	Nominal Thickness at any point	>1.8 mm		0.5 mm
	Color	Blue		
	Resistant to water, fungus, termite & rodent attack	Required		
	Oxygen index as per ASTMD-2863	not less than 29%		N.A.
	Temperature index as per ASTMD-2863	not less than 250 deg.C		N.A.
	acid gas generation by weight as per IEC-60754-1	Maximum 20%		N.A.
	Smoke Density Rating as per ASTMD-2843	Maximum 60% (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)		N.A.
	Reference standard	VDE207 Part 5		VDE207 Part 6 & ASTM D2116

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	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	200 nF/km
	INSULATION RESISTANCE(MIN.)	100 M Ohm/Km		
	CROSS TALK FIGURE (MIN.) AT 0.8 KHZ	60 dB	60 dB	N.A.
	CHARACTERISTIC IMPEDANCE (MAX) AT 1 KHZ	N.A.	320 ohm for F-type 340 ohm for G-type	N.A.
	ATTENUATION FIGURE AT 1 KHZ (MAX)	N.A.	1.2 db/km	N.A.
	H. Complete Cable			
	Complete Cable assembly	Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.		N.A.
	Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification		N.A.
	I. Accessories			
	Cable accessories of flame retardant quality.	Yes. (Accessories such as harnessing components, markers, bedding, cable jointer, binding tape etc.)		
	J. Tests			
	Routine & Acceptance tests	Refer sub-section IIIE		

CLAUSE NO.	TECHNICAL REQUIREMENTS

Type tests	Refer sub-section-CNI TYPE TEST			
K 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.			
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.

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3.07.00 Penetration of water resistance and impact resistance shall be as per IEC standard.

4.00.00 **SPCIFICATION OF POWER SUPPLY CABLES**

Refer relevant subsections of this specification.

5.00.00 **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	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 heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F
Thermocouple	CJC Box (if applicable)	Plug in connector	Cage clamp (Rail mount) type.	A,B,C*
Other Field Mounted Instrument	Local JB/Group JB	Plug in connector	Screwed, Cage clamp (Rail mount) type	F,G

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RTD	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	F
Thermocouple	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	A,B,C*
Local Junction box, Temperature 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, Temperature Transmitter, 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/PLC cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standard

Notes

1. Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs.
2. For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided.

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	3. Also refer Drg. 4610-110-POI-A-021. 4. *For high temperature applications only. 5. Instrument Cabling for instruments/equipments covered under subsection MAIN EQP INST SYS shall be as per manufacturer's standard .
6.00.00	**TERMINAL BLOCKS**
6.01.00	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, temperature transmitters, 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 DDCMIS 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.
6.02.00	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.
6.03.00	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.
6.04.00	For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065.
6.05.00	The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.
6.06.00	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.
6.07.00	Internal wiring in factory pre-wired 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

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	prewired electronic equipment cabinets shall meet all the requirements as specified above.
7.00.00	**INTERNAL PANELS/ SYSTEM CABINETS WIRING**
7.01.00	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.
7.02.00	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.
7.03.00	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.
7.04.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.
7.05.00	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.
7.06.00	All the special tools as may be required for solder less connections shall be provided by Bidder.
7.07.00	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. — 2.5Sq.mm. minimum (shall be as per load requirement.)
8.00.00	**INSTRUMENTATION CABLE INSTALLATION AND ROUTING**
8.01.00	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.
8.02.00	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:

CLAUSE NO.	TECHNICAL REQUIREMENTS
	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
8.03.00	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 armoured and single for other cables) shall be provided.
8.04.00	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.
8.05.00	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.
8.06.00	The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.
9.00.00	**CABLE LAYING AND ACCESSORIES**
9.01.00	**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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	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 CABLES - LT CONTROL & INSTRUMENTATION CABLES, SPACING BETWEEN CABLES OF SAME VOLTAGE GRADE SHALL BE IN ACCORDANCE WITH THE DERATING CRITERIA ADOPTED FOR CABLE SIZING. 7 SEGREGATION (PHYSICAL ISOLATION TO PREVENT FIRE JUMPING) A ALL CABLE ASSOCIATED WITH THE UNIT SHALL BE SEGREGATED FROM CABLES OF OTHER UNITS. 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 inside conduit shall be laid on cable trays wherever available and feasible. In areas where the same are required to be buried, 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 roads - to be laid in GI/rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete; While crossing canals/river- to be laid in GI/rodent proof HDPE conduits within hume pipe.
9.02.00	Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.

CLAUSE NO.	TECHNICAL REQUIREMENTS
9.03.00	Bidder shall furnish two completely new sets of cable termination kits like Crimping tools, etc., which are required for maintenance of the system as per the type of termination used.
9.04.00	Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out 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.
9.05.00	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.
9.06.00	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.
9.07.00	The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.
10.00.00	**FIELD MOUNTED LOCAL JUNCTION BOXES**
	(i) No. of ways: 12/24/36/48/64/72/96/128 with 20% spares terminals.
	(ii) Material and Thickness: 4mm thick Fiberglass Reinforced Polyester (FRP).
	(iii) Type: 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. Raceways shall be provided inside JBs for proper termination of cables.
	(v) Type of terminal blocks: Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm^2. A M6 earthing stud shall be provided.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	(vi) Protection Class: IP: 55 minimum for indoor & IP-65 minimum for outdoor applications. (vii) Grounding: To be provided. (viii) Color: To be decided during detailed engineering & subject to Employer's approval.
11.00.00	**CONDUITS**
11.01.00	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: 9537 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.
11.02.00	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.
11.04.00	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.
11.05.00	All individually mounted equipment and devices shall be connected to the supply conduit, using not more than one meter 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. This shall include locations where conduit supported by building steel enters or becomes supported by the turbine generator foundation and where conduit supported by building steel or foundation becomes supported by steam generator framing.
11.06.00	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.
11.07.00	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 clamp backs

CLAUSE NO.	TECHNICAL REQUIREMENTS
	unless other types are acceptable to the Employer. Multiple conduit bank supports shall be constructed of special galvanized support channels with associated conduit clips.
11.08.00	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 to NEC requirements for the area classification.
11.09.00	Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.
11.10.00	Conduits shall be securely fastened to all boxes and cabinets.
12.00.00	**CABLE SUB-TRAY & SUPPORT**
12.01.00	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 Contractor. 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).
12.02.00	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.
12.03.00	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.
12.04.00	The Bidder shall furnish and install the estimated quantities and sizes of sub trays/troughs including all required fittings and adaptors on as required basis.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	TYPE TEST REQUIREMENTS
1.00.00	**TYPE TEST REQUIREMENTS**
1.01.00	**General Requirements**
1.01.01	The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard. (a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests. (b) For the rest, submission of type test results and certificate shall be acceptable provided. i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment. ii. There has been no change in the components from the offered equipment & tested equipment. iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening. (c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.
1.01.02	As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer.
1.01.03	The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.
1.01.04	For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.01.05	The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective type test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable.
2.00.00	**SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS**
2.01.00	The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems shall be as indicated below: i) Surge Withstand Capability (SWC) for Solid State Equipments/ Systems All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/ IEEE-472 may also be adopted for SWC test. ii) Dry Heat test as per IEC-68-2-2 or equivalent. iii) Damp Heat test as per IEC-68-2-3 or equivalent. iv) Vibration test as per IEC-68-2-6 or equivalent. v) Electrostatic discharge tests as per EN 61000-4-2 or equivalent. vi) Radio frequency immunity test as per EN 61000-4-6 or equivalent. vii) Electromagnetic Field immunity as per EN 61000-4-3 or equivalent. Test listed at item no. v, vi, vii, above are applicable for electronic cards only as defined under item (i) above.

CLAUSE NO.	TECHNICAL REQUIREMENTS

3.00.00 TYPE TEST REQUIREMENT FOR C&I SYSTEMS

Sl. No	Item	Test Requirement	Standard	Test To Be Specifically Conducted	NTPC's Approval Req. On Test Certificate
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
1	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes
2	Thermocouple	Degree of protection test	IS-2147	No	No
3	CJC Box	Degree of protection test	IS-2147	No	No
4	RTD	As per standard (col 4)	IEC-60751	No	No
5	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes
6	E/P converter	As per standard (col 4)	Mfr. standard	No	Yes
7	Instrumentation Cables Twisted & Shielded				
	-Conductor	Resistance test	VDE-0815	Yes	Yes
		Diameter test	IS-10810	Yes	Yes
		Tin Coating test (Persul-phate test)	IS-8130	Yes	Yes
	-Insulation	Loss of mass	VDE 0472	Yes	Yes
		Ageing in air ovens**	VDE 0472	Yes	Yes

CLAUSE NO.	TECHNICAL REQUIREMENTS				
		Tensile strength and elongation test before and after ageing**	VDE 0472	Yes	Yes
		Heat shock	VDE 0472	Yes	Yes
		Hot deformation	VDE 0472	Yes	Yes
		Shrinkage	VDE 0472	Yes	Yes
		Bleeding & blooming	IS-10810	Yes	Yes
	-Inner sheath***	Loss of mass	VDE 0472	Yes	Yes
		Heat shock	VDE 0472	Yes	Yes
		Cold bend/ cold impact test	VDE 0472	Yes	Yes
		Hot deformation	VDE 0472	Yes	Yes
		Shrinkage	VDE 0472	Yes	Yes
	-Outer sheath	Loss of mass	VDE 0472	Yes	Yes
		Ageing in air ovens**	VDE 0472	Yes	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	Yes	Yes
		Heat shock	VDE 0472	Yes	Yes
		Hot deformation	VDE 0472	Yes	Yes

CLAUSE NO.	TECHNICAL REQUIREMENTS				
		Shrinkage	VDE 0472	Yes	Yes
		Bleeding & blooming	IS-10810	Yes	Yes
		Colour fastness to water	IS-5831	Yes	Yes
		Cold bend/ cold impact test	VDE-0472	Yes	Yes
		Oxygen index test	ASTMD-2863	Yes	Yes
		Smoke Density Test	ASTMD-2843	Yes	Yes
		Acid gas generation test	IEC-60754-1	Yes	Yes
	-fillers	Oxygen index test	ASTMD-2863	Yes	Yes
		Acid gas generation test	IEC-60754-1	Yes	Yes
	-AL-MYLAR shield	Continuity test		Yes	Yes
		Shield thickness		Yes	Yes
		Overlap test		Yes	Yes
	-Over all cable	Flammability Test	IEEE 383	Yes	Yes
		Swedish Chimney Test	SEN 4241475	Yes	Yes
		Noise interference	IEEE Trans-actions	Yes	Yes

	Dimensional checks	IS 10810	Yes	Yes
	Cross talk	VDE-0472	Yes	Yes
	Mutual capacitance	VDE-0472	Yes	Yes
	HV test	VDE-0815	Yes	Yes
	Drain wire continuity		Yes	Yes

* For Drain wire only

**These tests shall be carried out as per VDE0207 Part 6 & ASTMD-2116 for TEFLON insulated & outer sheathed cables

***Applicable for armoured cables only

8 DC Power Supply System (Applicable for each model and rating)

	Degree of protection test	IS-13947	Yes	Yes
	Short circuit current capability	Approved procedure	Yes	Yes
	Voltage Proof Test	UL 950,IEC950	Yes	Yes
	Burn In test	Approved procedure	Yes	Yes
	Efficiency	Approved procedure	Yes	Yes
	Audible Noise Test	Approved procedure	Yes	Yes
	Fuse Clearing Capability	Approved procedure	Yes	Yes
	Total harmonic content	Approved procedure /CIGRE's	Yes	Yes

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Radio Frequency interference	IEC-CISPR22, IEC-61000-4-12(9b), IEC-61000-4-3, IEC-61000-4-5, IEC-61000-4-6	Yes	Yes
	Over Load Test	Approved procedure	Yes	Yes
	Restart Test	Approved procedure	Yes	Yes
	Output voltage tolerance	Approved procedure	Yes	Yes
	Parallel operation	Approved procedure	Yes	Yes
	ESD immunity Test	IEC-61000-4-2-9(1)	Yes	Yes
	Electrical Fast transient/Burst Immunity Test	IEC-61000-4-4	Yes	Yes
	Surge Protection	IEC61312, IEC61024, VDE 100-534	Yes	Yes
	Insulation Test	Approved procedure	Yes	Yes
	Load Tests.	Approved procedure	Yes	Yes
	Preliminary light load test (without	Approved procedure	Yes	Yes

CLAUSE NO.	TECHNICAL REQUIREMENTS					
			Battery supply)			
			Load sharing	Approved procedure	Yes	Yes
	9	Battery	As per standard (col 4)	IS-10918	No	Yes Note-2
	10	Voltage Stabiliser	Over Load Test	Approved procedure	No	Yes
			Temp rise test without redundant fans	Approved procedure	No	Yes
			Input voltage variation test	Approved procedure	No	Yes
	11	DDCMIS				
		CLCS Systems	Model test	Approved procedure	Yes	Yes
		BMS	Safety requirements	VDE0116 Sec 8.7	No	Yes
	12	Conductivity Type Level Switch	Degree of protection test	IS-2147	No	No
	13	Local Gauges	Degree of protection test	IS-2147	No	No
	14	Process actuated Switches	Degree of protection test	IS-2147	No	No
	15	Control Valves	CV test	ISA 75.02	Yes	Yes
	16	PLCs	As per standard (Col 4)	IEC 1131	No	No

CLAUSE NO.	TECHNICAL REQUIREMENTS

17	LIE / LIR	Degree of protection test	IS-2147	Yes	Yes
18	Flue gas O2 analyser, other Flue Gas analysers	Degree of protection test	IS-2147	No	Yes
19	Flow Nozzles & Orifice plates	Calibration	ASME PTC BS 1042	Yes	Yes

Note:

1. Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.
2. **a)** For batteries supplied with electric power supply system of DDCMIS Systems the contractor shall submit for Owner's approval the reports of all the type test as per IS 10918 carried out within last five (5) years from the date of bid opening and the tests should have been either conducted at an independent laboratory or should have been witnessed by a client. The complete type test reports shall be for any rating of battery in a ;particular group, based on plate dimensions being manufactured by supplier.

   b) For electric power supply system of auxiliary plants, not controlled from DDCMIS systems type test report for batteries shall be as per supplier's standard practice.

1.00.00 ELECTRIC ACTUATORS WITH INTEGRAL STARTERS

1.01.00 TYPE:

1.01.01 The actuators shall have integral starters along with over load relays with built in SPP (Single Phasing Preventer). A 415, 3 phase 3 wire power supply shall be given to the actuator from vendor's/employer's switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply.

1.01.02 In case supplier's standard control voltage for Open/Close contactors is 110V AC, the same is acceptable if suitable Opto Isolation circuit Is provided with coupling relays for 24 V DC command inputs.

1.02.00 INTERFACES:

1.02.01 Open/Close command termination logic with position & torque Limit Switches, positioners circuit shall be suitably built in the PCB inside *the* actuator.

(a) FOR BINARY DRIVE: Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided.

Interface with the control system shall be through hardware signal only. Inter posing relays provided (with coil burden 2.5 VA) in the actuator snail be energized to initiate opening and closing, by 24V DC signal from the external control system.

(b) Clause DELETED.

(c) Open/close command termination logic shall be suitably built inside actuator.

1.03.00 RATING :

(a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%.

(b) Sizing: Open/Close at rated speed against designed differential pressure at 90% of rated voltage. For isolating service three successive open-close operations or 15 mins, whichever is higher. For regulating service 150 starts per hour or required cycles, whichever is higher.

1.04.00 CONSTRUCTION:

(a) ENCLOSURE :

Totally enclosed weatherproof minimum IP-55 degree of protection.

(b) GEAR TRAIN :

Metal (Fiber gears are not acceptable)) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energised.

(c) MANUAL WHEEL :

Shall disengage automatically during motor operation.

1.05.00 MOTOR :

(a) TYPE :

Squirrel cage induction motor. Direct on line starting with starting current limited to six times the rated current.

(b) ENCLOSURE :

Totally enclosed, self ventilated IP-55 degree of protection.

(c) INSULATION :

Class B or better. Temperature rise 70 deg C. over 50 deg C ambient

(d) BEARINGS :

Double shielded, grease lubricated antifriction.

(e) EARTH TERMINALS :

Two

(f) PROTECTION :

Single Phasing Protection, Over heating protection through Thermostat and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design Suitable means shall be provided to diagnose the type of fault locally.

1.06.00 POSITION/TORQUE SWITCHES:

1.06.01 Four nos. (2 each in open and close position) position limit switches and two nos. (one in open and other in close direction) torque switches each having two nos. NO and two nos. NC contacts shall be provided. A single shaft shall actuate all contacts of limit switches at each position.

Limit switch and disturbance signals shall be available to DCS even when the power supply to the actuators is not available.

Torque switches shall be bypassed in both the end positions with the other end limit switches.

Limit Switches

Limit switches shall be silver plated with high conductivity and non – corrosive type. Contact rating shall be sufficient to meet the requirement of Control System subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP-55.

1.07.00 LOCAL OPERATION

1.07.01 It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.

1.08.00 POSITION INDICATOR :

1.08.01 To be provided for 0 to 100% travel.

1.09.00 POSITION TRANSMITTER (FOR MODULATING/INCHING TYPE) :

1.09.01 As required. Suitable for stabilized 4-20 mA signal, 2 wire inductive type, 24 volts DC operated.

1.10.00 WIRING :

1.10.01 Suitable voltage grade copper wire.

1.11.00 TERMINAL BOX :

(i) 9 pin plug and socket (1 no. per actuator to suit 4 pair 0.5 sq.mm. copper overall shielded (16 mm OD), instrumentation cable) suitably mounted in the starter box itself to terminate open/close command and status feedback signals with external control systems.

(ii) Additional one number 9 pin plug and socket (to suit 4 pair 0.5 sq.mm copper (16 mm OD) individual and overall shielded instrumentation cable) suitably mounted in the starter box itself for actuators with 4-20 mA position transmitters.

(iii) Necessary glands for power cab les shall be provided.

1.12.00 TERMINAL BLOCK :

1.12.01 650V grade. For power cables.

1.13.00 SPACE HEATER :

1.13.01 Space heater of suitable rating. The supply shall be derived from the main power supply available in the actuator.

1.14.00 TYPICAL WIRING DIAGRAM :

1.14.01 Refer sketch "Interfacing of actuators with DDCMIS" (enclosed sheet no.6)

1.15.00 Clause DELETED

1.16.00 PAINTING :

1.16.1 Paint shade shall be as per RAL 5012 (Blue)

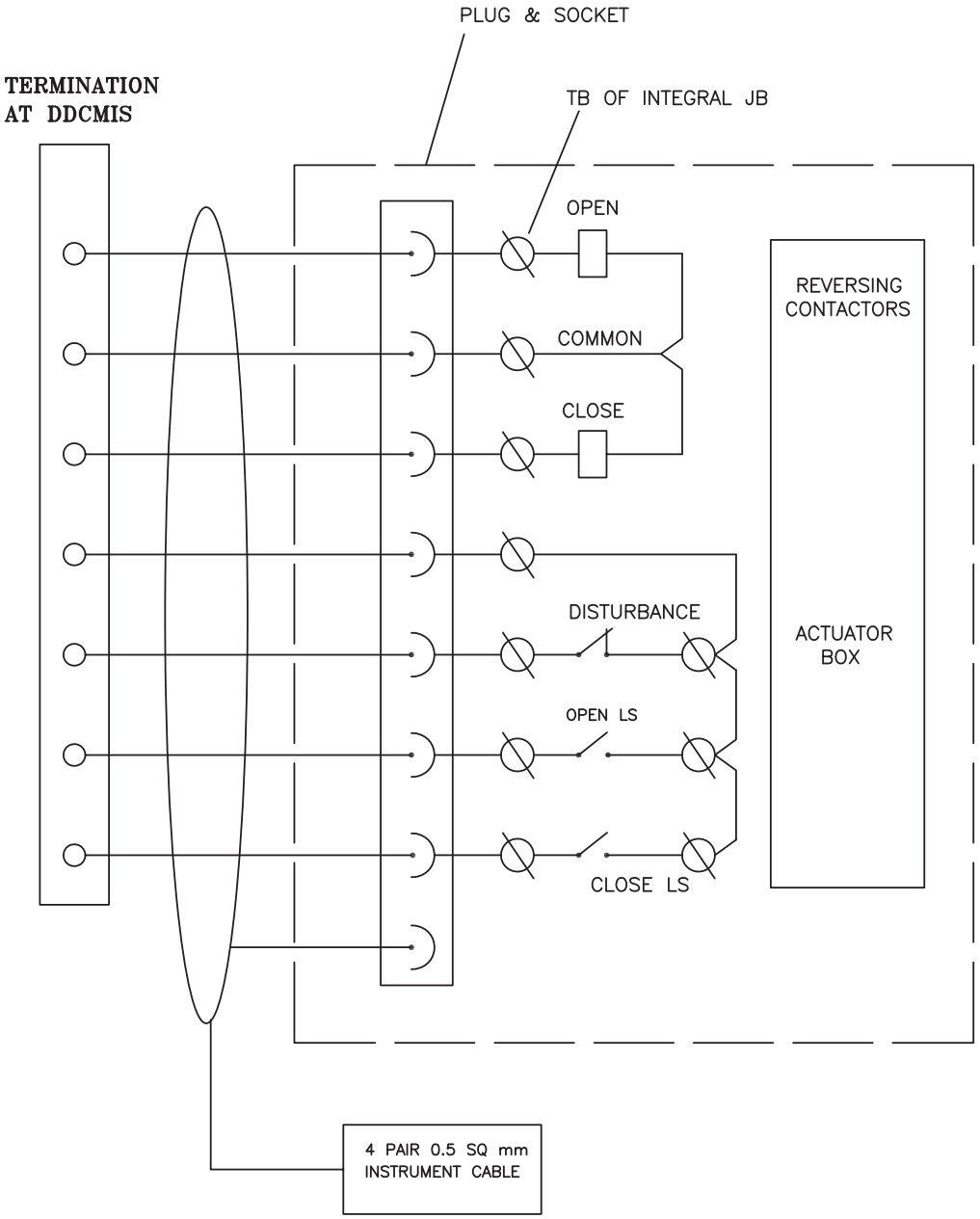
DATA SHEET FOR MOTORISED VALVE ACTUATOR

S.No	DESCRIPTION	DATA
	ACTUATOR DETAILS	
1	ACTUATOR MANUFACTURER	
2	MODEL NO	
3	TORQUE RANGE & RPM	
4	MAX. STALL TORQUE	
5	REQUIRED VALVE TORQUE	
6	TRAVEL OF VALVE STEM	
7	STEM DIA LEAD OF SCREW	
8	DUTY CYCLE	
9	OPENING / CLOSING TIME	
10	ENCLOSURE CLASS (TENV)	
11	ADMISSIBLE AMBIENT TEMPERATURE	
12	CABLE GLAND SIZE (POWER) (DOUBLE COMPRESSION TYPE)	
13	CABLE GLAND SIZE (CONTROL) (DOUBLE COMPRESSION TYPE)	
14	GEAR BOX LUBRICATION	
15	POSITION LIMIT SWITCHES (Nos)	
16	TORQUE SWITCHES (Nos)	
17	RATING OF SWITCHES (AC & DC)	
18	POSITION TRANSMITTER (ON-OFF DUTY)	
19	POSITION TRANSMITTER (INCHING DUTY)	
20	SPACE HEATER (INTERNALLY FED SUPPLY)	
21	THERMOSTAT (Nos)	
22	INTERNAL WIRING (CABLE SIZE)	
23	WIRING DIAGRAM	
24	INTERPOSING RELAY CURRENT CONSUMPTION	
25	FAULT INDICATION CONTACTS	

Contd…

DATA SHEET FOR MOTORISED VALVE ACTUATOR

	MOTOR DETAILS	
26	NOMIMAL OUTPUT (KW)	
27	RATED VOLTAGE (V)	
28	RATED FREQUENCY (Hz)	
29	NO. OF PHASES (φ)	
30	FRAME SIZE	
31	ADMISSIBLE VOLTAGE FLUCTUATIONS (%)	
32	ADMISSIBLE VOLT & FREQ. VARIATIONS (%)	
33	NOMINAL CURRENT (A)	
34	STARTING CURRENT (A)	
35	FULL LOAD SPEED (RPM)	
36	INSULATION CLASS	
37	POWER FACTOR	
38	FULL LOAD EFFICIENCY (%)	
39	TEMP. RAISE OVER AMB. TEMP. 50 DEG. C AT RATED TORQUE (DEG. C)	
40	TYPE OF STARTER PROVIDED	
42	MOTOR TYPE	
43	REFERENCE STANDARD	
44	OLR RANGE & SET VALUE (OLR PROVIDED WITH SINGLE PHASING PROTECTION)	
45	MOTOR SUITABLE FOR INCHING DUTY	
46	NO. OF STARTS / HOUR	
	GENERAL	
47	PLUG & SOCKET (MOUNTED ON TERMINAL HOUSING COVER)	
48	PAINT SHADE	
49	WEIGHT – APPROX (KG)	



INTERFACING OF ACTUATOR WITH DDCMIS