	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 5 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
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
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	

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

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 6 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

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
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

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

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 7 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
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
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	
BHEL			**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 8 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

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	10	10	11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1$	1	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1$	1	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

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

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
	SHEET 9 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION	VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

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

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
		SHEET 1 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	**W**	**V**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
	BHEL		**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
		SHEET 2 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

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

CABLE SCHEDULE FORMAT

ANNEXURE III

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.

2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.

3. The field properties shall be as under:
    a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
    b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
    f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
    g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.

4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).

5. The cables shall be described as per the scheme listed below:

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

A	NN	A	NNN
|	|	|	|
Cable Voltage Code (see B below)	No. of cores (e.g. 01,03,3H, 07)	Cable code (See C below)	Cable size (e.g. 035,185,2.5, 0.5)

please refer below examples:

i) 3C x 120 sq. mm. (1.1kV) PVC FRLS, Unarmoured Aluminium cable, the voltage code shall be D03G120
ii) 3C x 2.5 sq. mm. (1.1kV) PVC FRLS, Unarmoured Copper cable, the voltage code shall be D03C2.5
iii) 3.5C x 120 sq. mm. (1.1kV) PVC non-FRLS, Armoured Aluminium cable, the voltage code shall be D3HF120

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)
B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS
B = Armoured Non-FRLS
C = unarmoured FRLS
D = Unarmoured Non-FRLS

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

6. Once a cable list has been given to PEM for routing, any subsequent changes required in the cable list (which may be in the form of addition of cables, deletion of cables, change of type or size of cable, etc.) must be informed as specific changes (as a separate file MS Excel of the same format as the original file) to the cable list given earlier if the cable list has been routed and cable schedule generated. The routing status of the cable list shall be got confirmed from PEM by the agency that has prepared the cable list before the changes are intimated. In case PEM confirms that the cable list in question has not been taken up for routing, and the revised cable list is acceptable,

the same may be sent. Since cable routing through the program involves adding each cable list to the project cable schedule database, the original cable schedule shall not be furnished to PEM with revisions incorporated within.

7. For any assistance or clarifications, please contact mailto:praveendutta@bhelpem.co.in

SECTION-C3
(SPECIFIC TECHNICAL REQUIRMENT- C&I)

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TECHNICAL SPECIFICATION (CONTROL AND INSTRUMENTATION) FOR SEWAGE TREATMENT PLANT

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INDEX

SPECIFIC TECHNICAL REQUIREMENT OF SEWAGE TREATMENT PLANT (CONTROL & INSTRUMENTATION)

3X800 MW PVUNL PATRATU TPP

SPECIFIC TECHNICAL REQUIREMENT FOR SEWAGE TREATMENT PLANT

1. SEWAGE TREATMENT PLANT shall be operated from DCS (BHEL's scope). However the control of sewage pumps in various plant areas (as applicable) shall be through self-standing local control panel in Bidder's scope .

2. The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire STP. 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 section noted by the bidder in the specification, the same 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 shall prevail without any commercial implication.

3. The make/model of various instruments/items/systems shall be as per NTPC 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.

4. All instruments shall be terminated on JB/LCP in field and both instrument and JB/LCP are in bidder scope.

5. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.

6. Bidder to provide mandatory spares as per mandatory spares list

7. 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.

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

9. Bidder shall specifically mention the deviation wrt C&I specification, in absence of any deviation a No deviation certificate to be submitted.

10. All transmitters & electronics items will be explosion proof / intrinsically safe as per hazardous area classification.

11. Diaphragm seal shall be provided with Instruments having contact with corrosive media.

12. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of deviation, a No deviation certificate is to be furnished.

13. The quantity of instruments for the system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant

auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

14. Bidder to terminate all instrumentation and control elements in junction boxes. bidder to provide input/output list, drives list, junction box schedule and termination details, recommended control logics / write-up etc. the list of documents to be submitted after award of contract is to be referred by bidder.

15. All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply. All transmitters shall be HART compatible.

16. 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.

17. 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.

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

19. Bidder to furnish electrical load UPS load data during detailed engineering

20. Bidder to provide temperature transmitter along with compensating cable, JB/Rack & other erection hardware

21. 415 V AC/230 V AC supply shall be provided by BHEL at a single point, further distribution to various instruments/Equipments 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. Bidder to submit the power requirement along with the bid.

22. Bidder’s presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic. Intimation to attained FAT shall be informed in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder’s scope.

23. Contractor's C&I representative shall be present at BHEL-PEM for 3 man-days, for preparation of Control scheme of STP. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder’s scope.

24. Bidder’s presence is required for 15 Man days (in three visit) at site during commissioning of DDCMIS for assistance related to process correctness. Three visit with total 15 Man days (Excluding travel time) in which one visit shall be of 5 Man days each. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder’s scope.

25. Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection, JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable 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.

26. The solenoid operated valves/dampers/gate shall have limit switch for open close feedback, solenoid valve shall be 24 V DC rating.

27. Interface of MCC, HT SWGR, field instruments, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.

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

29Number of pairs to be selected for Screen /Control cable
a) F-Type: 2P/4P/8P/12P (Size: 0.5sqmm2)
b) G-Type: 2P/4P/8P/12P (Size: 0.5sqmm2)
c) Core Cable: 3CX2.5sqmm2/ 5CX2.5sqmm2/ 12CX1.5sqmm2

30. Use of process actuated shall be avoided unless unavoidable.

31.Redundancy of sensors shall be provided by bidder.
(i) Triple redundancy for all analog and binary inputs required for protection of system/drives.
(ii) For all other control functions dual redundancy of the sensors shall be provided by the bidder.

32. All field instruments enclosure shall be IP65 local panel/cabinet enclosure shall be IP 55, unless otherwise specified.

33. In addition to requirements specified here, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.

34. In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail.

35. Measuring instruments (primary & secondary), SWAS equipment/analysers offered for this package shall have at least one year's satisfactory operation in one power station having unit rating of 200 MW or above. Provenness certificate shall be provided as per the attached format (Annexure - 1).

36. All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipment are protected against rain/ sunlight etc.

37. Comprehensive Annual Maintenance Contract (AMC) for three (03) years after warranty period shall be provided by the contractor for analysers.

GENERAL REQUIREMENT
OF SEWAGE TREATMENT PLANT
(CONTROL & INSTRUMENTATION)

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0 The quantity of instruments for auxiliary system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & I D. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

3.0 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. Further all the instruments shall be of proven reliability, accuracy, and 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 specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold 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 contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.

LIST OF DELIVERABLES

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR NTPC (3X800 MW)PVUNL PATRATU TPP FOR SEWAGE TREATMENT PLANT

DOCUMENT NUMBER PE-GL-434-145-I100 SHEET 1 of 1

Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-434-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-434-145-I902	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V0-434-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V0-434-145-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5	PE-V0-434-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V0-434-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V0-434-145-I907	FIELD JB/LIE/LIR, DRIVES TERMINATIONS	A
8	PE-V0-434-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V0-434-145-I909	QUALITY PLANS (INSTRUMENTS,LCP etc.)	A
10	PE-V0-434-145-I910	INSTRUMENT HOOK UP DRAWING	A
11	PE-V0-434-145-I911	THERMOWELL SIZING CALCULATION	A
12	PE-V0-434-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
13	PE-V0-434-145-I914	ANNUNCIATION & SOE LIST	A

NOTES: 1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.
2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.

SUB–SECTION – IIIC – 04

MEASURING INSTRUMENTS

(PRIMARY & SECONDARY)

1.00.00	**MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)**
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. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval.
1.02.00	Every panel-mounted instrument requiring power supply shall be provided with 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 transmitters, sensors, switches and gauges 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 on as required basis with in quoted lump sum price. 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 contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. 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.
1.05.00	All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor). For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications. For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum.
1.06.00	For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.

2.00.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTERS**

2.01.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS**

Sl.No.	Features	Essential/Minimum Requirements
1.	Type of Transmitter	Microprocessor based 2 wire type (loop powered), Hart protocol compatible.
2.	Accuracy	± 0.1% of calibrated span (minimum)
3.	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)
4.	Turn down ratio (minimum)	10:1 for vacuum/very low pressure applications (i.e. pressure <= 200 mmWC) 5:1 for very high pressure application (i.e. pressure >= 200 Kg/cm2) 30:1 for other applications
5.	Stability	± 0.1% of calibrated span for six months for Ranges up to and including70 Kg/cm² ± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm²
6.	Zero and span drift	+/- 0.015% per deg.C at max span +/-0.11% per deg.C at min. Span
7.	Load impedance	500 ohm (minimum)
8.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistant coating
9.	Over Pressure	150% of max. Operating pressure
10.	Connection (Electrical)	Plug and socket type
11.	Process connection	1/2 inch NPT (F)
12.	Span and Zero	Continuous, tamper proof, Remote as well as manual adjustability from instrument with zero suppression and elevation facility.
13.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & Gauge pressure transmitters, 3-valve and 5 valve manifold for DP/Level/Flow applications. The valve manifold shall be non integral type (except Fuel Oil area).

		-For hazardous area, explosions proof enclosure as described in NEC article 500 Mounting: 2 inch pipe mounting.
14.	Diagnostics & display	Self-Indicating feature and digital display on transmitter
15.	Power supply	24V DC ± 10%.
16.	Adjustment/calibration/maintenance	From hand held HART calibrator/ centralized PC based system (as applicable).

Notes

- For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement.
- LVDT type is not acceptable.
- 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.

2.02.00 GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER

Type	Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter.
Principle	TDR (Time domain reflectometry)
Probe Type & Material	(i) Coaxial probe of SS316/316L. If required, probe shall be suitable for overfill prevention. (ii) Rod probe, cable probe of SS316/SS316L can be used for applications wherever coaxial probe is not suitable.
Output signal	4-20 mA DC along with superimposed digital signal (based on HART protocol), suitable for over fill prevention.
Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
Power supply	24 VDC +/- 10%.
Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.

Adjustment/ calibration	Using hand held HART calibrator/ centralized PC based system (as applicable).
Zero & span adjustment	Continuous, temper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.
Display	Integral digital display.
Load Impedance	500 ohms (minimum).
Electromagnetic compatibility	Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 5008 1-2 & EN 50082-2
Mounting	(i) External cage shall be provided where ever side mounting is required. External cage and other mounting accessories to be provided by the contractor. (ii) Where ever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor. (iii) All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.

Note: Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

2.03.00 Ultrasonic Type level Transmitter

S.No.	Features	Essential/Minimum requirement
1.	Type of Transmitter	Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter.
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).

3.	Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
4.	Power supply	24 V DC +/- 10%.
5.	Temperature compensation	To be provided within transducer.
6.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.
7.	Adjustment/calibration/ maintenance	Using hand held HART calibrator/ centralized PC based system (as applicable). .
8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.
9.	Sensor Material	Corrosion resistant material to suit individual application requirement.
10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.
11.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.
12.	Display	Integral digital display
13.	Diagnostics	Loss of echo alarm etc.
14.	Load Impedance	500 ohms (minimum).
15.	Electrical Connection	Plug and socket

16.	Accessories	• All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations. • All mounting accessories required for erection and commissioning shall be provided. • For hazardous area, explosion proof enclosure as described in NEC article 500

Note:

1) Contractor can also provide Radar type transmitter as per above specification in place of ultrasonic transmitter subject to approval by Employer during detailed Engineering. Sonic frequency based transmitters can also be provided under "ultrasonic transmitters" category for fly ash silo level.

2) Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

3) For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.

3.00.00 **Temperature Elements and accessories**

3.01.00 **Thermocouple**

Sr. No.	Features		Essential/Minimum Requirements
1	Type of Thermocouple.	:	16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded separate junction type).
2	No. of element	:	Duplex
3	Housing/Head	:	IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well.
4	Insulation and Sheathing of Thermocouple	:	Swaged type mineral (magnesium oxide) insulation and SS316 sheath.
5	Calibration and accuracy	:	As per IEC-584/ ANSI-MC-96.1 (special limits of errors/ class1) for T/C.
6	Accessories	:	Thermo well and associated fittings
7	Standard	:	IEC-584/ ANSI MC 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well

3.02.00 **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. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be

				provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well
	4	Insulation and sheathing of RTD	:	Mineral (magnesium oxide) insulation and SS316 sheath,
	5	Calibration and accuracy	:	As per As per IEC-751/ DIN-43760 Class-A for RTD
	6	Accessories	:	Thermo well and associated fittings
	7	Standard	:	IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.

NOTES :

1) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.

2) The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

3.03.00 Metal Temperature Thermocouples

Measuring Medium	Metal Temperature
Material of Thermocouple.	Chromel Alumel Type K
Type of Thermocouple	Duplex with ungrounded separate hot junctions
Insulation	Mineral Insulation (Magnesium Oxide).
Thermocouple wire gauge	16 AWG
Protective sheath	SS 321
Protective sheath dia	8 mm OD
Calibration & accuracy	As per IEC-584/ ANSI-MC-96.1 (special limits of error) for T/C
Mounting accessories	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310. Adjustable gland fitting for connection at the junction box end as per manufacturer's standard.
Cold end sealing	SS pot seal with colour coded PTFE Insulated flexible tails. Sealing compound- Epoxy resin. Length of PTFE insulated flying leads shall be minimum 750 mm.

	Minimum bending radius	30 mm
	Length of T/C	On as required basis considering location of measurement point and the JB/TTJB location.

Notes :

1) The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.

2) For boiler metal temperature applications, considering the location of installations and response time, manufacturer's standard and proven specification for metal temperature measurement can also be accepted subject to employer's approval. The manufacturer shall submit adequate supporting documents for establishing their standard and proven practice.

3.04.00 **Thermo well** (for all process temp. elements)

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

(b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.

(c) For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if required based on the specified boiler design parameters).

(d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.

3.05.00 **Not Used**

3.06.0 **TEMPERATURE TRANSMITTER (TT)**

Following types of 2-wire (loop powered) temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

a. Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. Temperature transmitter and associated temperature element shall be factory fitted.

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 IP 65 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 **integral** Indicator:

These shall be suitable for mounting on pipes/ support. Both elements of the duplex thermocouple/ RTD shall be wired to a single transmitter. Integral 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.

d. Common requirements for each of the above type of temperature transmitters.

Output	:		2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal.
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).
Isolation	:		Min. 500 V AC.
EMC compatibility	:		As per EN 61326.
Operating ambient temperature	:		0 to 85 deg C (without indicator). 0 to 70 deg C (with indicator).
Power supply			24V DC +/- 10%.
Accessories			Mounting arrangements including clamps etc.
Composite Accuracy	(i)		For head mounted and DIN-rail mounted types:
(Refer note 2)		RTD	=<0.4% of 0-250 deg C span
		T/C-K type	=<0.4% of 0-600 deg C span
		T/C-R type	=<0.4% of 0-1000 deg C span
		CJC accuracy (for thermocouples) shall be =< 1 deg C	
	(ii)		For dual-input type:
		RTD	=<0.25% of 0-250 deg C span
		T/C-K type	=<0.2% of 0-600 deg C span
		CJC accuracy (for thermocouples) shall be =< 1 deg C	

e. Field bus compatible temperature transmitters

Temperature transmitters of this category shall be field mounting type & shall be capable of withstanding operating ambient temperature upto 85 deg C. These modules shall be connected to DDCMIS through field bus such as Profibus, Foundation Field bus etc directly from the transmitter. Maximum Number of inputs per such temperature transmitter shall be eight. These shall be mounted in cabinets/enclosures/JBs in non-AC areas.

As an alternate, these signals from temperature transmitters can be connected to DDCMIS through standard remote I/O modules of the DCS, in which case, the temperature transmitter signals will be acquired through 4-20mA input modules in the remote I/O cabinet for connecting to DDCMIS through remote I/O bus.

Air conditioned panel shall be provided for remote I/O.

Notes ***(Common for a) to d) above):-***

1. In case of failure (open or burn-out) of RTD/thermocouple, 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 Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters are to be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input specified in (i) & (ii).

8.00.00 **E-P Converter**

E-P converters and associated accessories shall be furnished in accordance with the specifications given below :

A. Fail Freeze Type E/P convertes

1	Air supply Pressure	:	2 kg/sq. cm.
2	Input signal	:	4-20mA DC
3	Output signal	:	0.2 to 1.0 kg/sq. cm
4	Linearity	:	0.5% of span or better.
5	Span/Zero Adjustment	:	To be provided
6	Hysteresis	:	0.5% of span or better.
7	Fail Freeze Feature	:	Stay put at last position on failure of 4 –20mA signal.
8	Allowable drift rate	:	Maximum 2% set point/ hour.
9	Ambient Temperature Effect	:	less than 0.02% of span per deg C between -
10	Mounting	:	Surface/Pipe/Bracket Mounting.
11	Protection class	:	IP 65.
12	Connection Port Sizes	:	¼ inch NPT (F)
13	Electrical Cable Entry	:	½ inch NPT
14	Output Pressure Gauge	:	1/4 inch NPT connection, 2 inch dial.
15	Accessories	:	All accessories like mounting brackets, fittings etc. required for installation is to be supplied.

B. FaiL Safe type E/P converters

1	Air supply Pressure	:	2 kg/sq. cm.
2	Input signal	:	4-20mA DC
3	Output signal	:	0.2 to 1.0 kg/sq. cm
4	Linearity	:	0.5% of span or better.
5	Span/Zero Adjustment	:	To be provided.
6	Hysteresis	:	0.5% of span or better.
7	Fail Safe Feature	:	Output shall drive to minimum on failure of either 4-20mA signal or air supply.
8	Mounting	:	Surface/Pipe/Bracket Mounting.
9	Ambient Temperature Effect	:	less than 0.02% of span per deg C between -20 to +60 deg C.
10	Protection class	:	IP 65.
11	Connection Port Sizes	:	¼ inch NPT (F)
12	Electrical Cable Entry	:	½ inch NPT
13	Output Pressure Gauge	:	1/4 inch NPT connection, 2 inch dial.
14	Accessories	:	All accessories like mounting brackets, fittings etc. required for installation is to be supplied.

15.00.00 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 (5 m minimum, to suit application)	Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the 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 maximum operating pr.	-	150% of maximum operating pr.
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 adjustment	Provided over full range.		
Dead band adjustment	Adjustable/ fixed as per requirement of application.		

Enclosure	Weather and dust proof as per IP-55, metallic housing.		
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)	As per Contractor's Standard practice.		

Notes :-

1) 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.

2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications.

3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

16.00.00 **NOT USED**

17.00.00 **SOLENOID VALVES**

Solenoid valves shall fulfil the following requirements:

a. Type 2/3/4 way SS 316/Forged Brass (depending on the application subject to Employer's approval during detailed Engg.)

b. Power supply : 24 V DC $\pm$ 10%.

c. Plug and socket electrical connection.

d. Insulation : Class 'H'

normal, reverse indication and required channel alarm contact shall be provided. The contact rating shall be 60VDC, 6VA (or more if required by Control system). The exact details of the RRI shall be strictly as approved by Employer during detailed engineering. The power supply of RRI is to be arranged by the Bidder

19.00.00 **WATER SY STEM RELATED SPECI AL INSTRU MENTS (DM PLANT, CPU PLANT, P T PLANT, ETC)**

19.01.00 **ANALYSER INSTRUMENTS:**

For T echnical sp ecification of Cation/Specific Con ductivity, pH, Sodium, Sili ca, Tu rbidity, Total Di ssolved Solid s (T DS) an d Co ncentration analysers, pl ease refer S pecification of Analysers, Part-B, Sub-section IIIC-13, SWAS chapter of this specification.

19.02.00 **Residual Chlorine Analyser**

a An automati c chlori ne re sidual analy ser of amp erometric type shall b e provided alongwith the chlorinating plant for mon itoring the residual chlorine content of cooli ng water. The analyser sh all be suitable fo r a ccurate re sidual me asurement in open/closed systems. The measure ment accura cy shall not be affected by p resence of treatment chemicals a s chromate s, phosphates, de-former hig hly polluted water, change in temperature etc.

b The analyser shall com ply with th e follo wing specification requireme nts, as a minimum

	(i)	Indicator	:	Provision of LC display in the panel of analyser.
	(ii)	Range	:	0 to 20.0 mg/L (ppm)
	(iii)	Accuracy	:	2% or better
(iv)		Sensitivity	:	0.01 mg/1
	(v)	Output signal	:	4-20mA DC isolated output,
(v	i)	Alarm annunciation	:	High an d lo w alarms to be provid ed on pan el an d shall be field adjustable.
(vii)		Calibration	:	Zero and span adjustment facility to be provided. Final calibration adj ustments of the a nalyser to b e done at si te and duly verified by titration. Temperature compensation range 0 to 50degC.
	(x)	Mounting	:	The a nalyser sh all b e suitable for fiel d mou nting conform to protection class IP-55.
	(xii)	Electrodes	:	Platinum/Gold and cop per ele ctrodes shall b e provided with cell cleaning system.

(c) Circulating water a s sam ple to resi dual chlo rine a nalyser sh all be taken from hot circulating water pipe work before entry to cooling towers. Exact location and layout of sampling a rrangement sh all be finali sed du ring detailed eng g. stage. Bidd er shall provide necessary pumpi ng system (with 100% standby) for m eeting th e analyser requirements, if needed. All the drain s sha ll b e terminated u p to the ne arest plant drainage system.

19.03.00 All the outdoor field instru ments such as analysers/transmitters/meters etc. shall be provided with suita ble Free standing ca binet(s)/panel/rack so that the equipme nts a re prote cted against rain/ sunlight etc.

19.04.00 Parshall Flume

The Bidder shall provide all the control and Instrument devices including primary sensors, transmitters, flow indicator cum integrator / totaliser and shall include all required accessories for the flow measurement of raw water through the clarifier. The system shall be of reputed make and acceptable to the owner.

Level measurement shall be based on ultrasonic/radon technology. The flow compensation is to be implemented in the transmitter itself. The transmitter shall provide 4-20 mA DC in direct proportion to flow and shall be able to drive a load impedance of 500 ohms minimum

Accuracy shall be +/- 1 % or better.

All the mounting hardware and accessories required for erection and commissioning of the same are to be provided by the contractor. Mounting fittings material shall be SS316. All weather canopy is to be provided for electronics/sensor to protect the same from rain/ sunlight etc.

The Type makes and models no. shall be subject to Owner's approval.

19.05.00 Electronic Flow-Meter

The electronic flow meter shall include flow sensor and flow indicator cum integrator / totaliser and shall include all required accessories for satisfactory operation. The flow meter shall be based on full bore electromagnetic principle and shall be electronic type of proven design, make and model acceptable to the owner.

The Bidder shall submit all necessary technical literature and details of selection criteria of the instrument offered to substantiate the model selected. The Bidder shall also furnish list of similar installation along with feed back on satisfactory performance of the instruments.

The flow meter shall meet or exceed the following requirement :

(a)	Output	:	4-20 mA DC Isolated output
(b)	Accuracy	:	± 0.5% of calibrated span or better *
(c)	Repeatability	:	± 0.2% of calibrated span or better
(d)	Power Supply	:	240V AC ± 10%, 50 HZ ± 5%/ 24 V DC, to be arranged by the contractor.
(f)	Protection class	:	IP-55
(e)	Flow tube		SS304
(f)	liner		Hard Rubber

The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totaliser/ integrator to get the daily and monthly discharge as stated above.

20.00.00 AC PLANT RELATED SPECIAL INSTRUNMENTS

20.01.00 HUMIDITY SENSOR

Sensor :	Capacitance type
Accuracy :	+/-3% R.H
Range :	0-100% R.H
Output :	4-20 ma

Time constant : 2 mins.

Output from the sensor is to be connected to respective control system. Contractor can also provide com bined in strument for me asurement of humidity and temp erature subje ct to Employer's approval during detailed engineering. In all such cases, 4-20 ma outputs, each for temperature and humidity measurements are to be provided.

20.02.00 TEMPERATURE/ HUMIDITY INDICATOR

Sensor : RTD for(Pt 100) for temperature

: Capacitance Type for Hu midity (specs for h umidity and temperature shall be as mentioned above)

Display : Combined e nclosure with two three di git seven se gments LE D display with de cimal point after two digits. LE D height shall be 4 in ches, clearly legible from a distance of at least 10 meters.

Range : 0-60 Deg C for temperature.

: 0-95.0 % for Relative Humidity.

Accuracy : Better than +/_0.5 % for Temperature

: Better than +/_2.5 % for Relative Humidity

Mounting : Table Top/ wall mounting.

Power supply : 240 V AC, 50 Hz.

Output : 4-20 mA signal each for temperature.

Qty. : 15 nos. ea ch of temperature & Humidity indicato rs (combine d indicato rs for Humidity and temperature is also applicable).

One Set of output sign al is to be conne cted to resp ective co ntrol syste m. Apart from displaying the temperature/humidity values on indicator.

21.00.00 Limit switches

For offsite plant application Limit switches shall be gold plated with high conductivity and non corrosive type. Contact rating shall be sufficient to meet the requi rement of DDCMIS subj ect to a minimum of 60 V, 6 VA rating. Protection class shall be IP 55.

For m ain plant appli cation limit switche s are to be provided as p er contractor standard and proven practice.

22.00.00 SPECIFICATIONS OF EFFLUENT QUALITY MONITORING SYSTEM (EQMS)

22.01.00 COMMON REQUIREMENTS FOR ALL ANALYSERS

Sno	Features	Minimum Requirement
1.	Output signals	Analog 4-20 mA DC galvanically isolated.
2.	Zero & span Adjustment	To be provided with range selection facility
3.	Ambient temp	50 degC
4.	Sample Temperature	40 degC
5.	Indication	Digital Alph anumeric Di splay of re ading in engineering units shall be provided.

6.	Type of Electronics	Microprocessor based with self-diagnostic
7.	Calib ration	Manual
8.	Others	All interconn ection tu bing and cabling betwe en sensor a nd analyzer / analyzer p anel etc to be provided. All ch emical re agents re quired for E QMS analyzers for entire AMC period is to be supplied in phased manner depending on shelf life.
9.	Location of the Temp & flow measurement	Effluent Trea tment plant o utlet (Exact locatio n to be decided by contractor in consultation with site)
10.	Location of the Anal yser cabinet/enclosure	
11.	Accessories	All the acce ssories re quired for mo unting the sensor/analyser are to be provided
12.	Digital Signal Transmission	Each an alyser shall have a p rovision fo r bidirectional soft conn ectivity over Modbus/RS232/RS485 with employer's ce ntral cloud server in addition to 4-20 ma connectivity to DDCMIS.
13.	Compliance to standards	CPCB's (Ce ntral Pollutio n cont rol Bo ard) latest regulatory requirement p revailing at th e time of execution of the contract.

22.02.00 CONDUCTIVITY ANALYSER

Type	Continuous flow through type
Measuring Range	0 – 60000 µS/cm for sea water application 0-5000 µS/cm for other application
Response Time	<= 5 sec (90% of full scale)
Temperature Compensation	Automatic
Power	To be arranged by the contractor
Accuracy	<= +/- 1 %

22.03.00 pH ANALYSER

Type	Cell flow through sample
Measuring Range	0-14 units of pH
Temperature Compensation	Automatic
Power	To be arranged by the contractor.
Accuracy	<= +/- 1 %

22.04.00 BOD BIOLOGICAL OXYGEN D EMAND / COD CHEMICAL OXYGEN DEMAN D ANALYSER

Principle	COD/BOD measurement by: Option A. Total Org anic Carbon (TOC) mea surement complying to US EPA 415.1 / 415.2 or equivalent standard for effluent/sewage/waste water. Option B. UV-VIS spe ctrometer me asuring ab sorption i n UV-VIS spectrum.
Measuring Range	0-50 mg/L for BOD, 0-500 mg/L for COD
Response Time	<= 15 min
Power	To be arranged by contractor
Cleaning Self-cle	aning (Automatic)
Accuracy	+/- 3%

22.05.00 OIL IN WATER ANALYSER

Principle UV	Fluorescence
Measuring Range	0 to 30 mg/l
Response Time	<= 60 sec
Power	To be arranged by the contractor.
Cleaning	Self-cleaning (Automatic)
Accuracy	+/- 5 % of full scale

22.06.00 TOTAL SUSPENDED SOLIDS – TSS ANALYSER

Principle	Light reflection principle
Measuring Range	0-500 mg/l
Response Time	<= 5 min
Power	To be arranged by bidder (Refer terminal point)
Cleaning	Self-cleaning (Automatic)
Accuracy	+/- 5%

22.07.00 **ENCLOSURE/CABINETS / PANELS**

The enclosure shall accommodate all EQMS Analyser. The enclosure shall provide protection from dust, humidity, precipitations, sunlight and environmental pollution. The material for the enclosure shall be of steel plate with minimum 2 mm thick frame and 1.6 mm thick CRCA steel sheet of protection IP 55 or better with safety lock of good quality. The lighting provision in the cabinet and the canopy for the cabinet is to be provided. The cabinets shall be designed such that the wet section and dry section are separate, the exact details shall be finalized during detailed engineering.

In order to ensure the healthy operation of the installed electronic modules, cards, analyzers, etc inside the enclosure during continuous operation, the EQMS enclosure shall be provided with Air conditioner unit .

23.00.00 **Monitoring System for Coal Bunker, Fly Ash Silo and ESP Hopper (First Field)**

Complete Level Monitoring System comprising of Acoustic Frequency Based 3D Level Scanners, PC, electronic modules, splitters, modems, junction boxes, mounting kit, enclosures, interconnecting cables, software and all other accessories required to make the system complete and fully functional, shall be provided on as required basis for continuous level measurement and monitoring of level of each coal bunker, each Fly Ash Silo and each ESP Hopper (First Field of ESP Only) complying with following requirements:

S. No.	Feature	Requirements
1	Type	One Set of Non-Contact Acoustic Frequency Waves Based 3D Level Scanner for each Coal Bunker, each Fly Ash Silo and each ESP Hopper (First Field)
2	Protection Class	IP-65 or Better
3	Housing and Antenna	Die-Cast Aluminium
4	Accuracy	1% or Better
5	Measurement Range	Empty to Full (Coal Bunker, Fly Ash Silo and ESP Hopper as applicable)
6	Power Supply	24V DC For 3D Level Scanner, 230V AC for LMS PC
7	Local Indicator (Applicable for Coal Bunker and Fly Ash Silo)	For Each Bunker Bay, One Set of Local Indicators mounted at Tripper Floor for respective coal bunkers in that Bay. One Set of Local Indicators for Fly Ash Silos. Above Local Indicators shall display Average Level of each Coal Bunker/Fly Ash Silo. Local Indicator shall be mounted inside an Enclosure with Transparent Window for Viewing. Degree of Protection of Enclosure – IP55 or Better
8	LMS PC	1 No. PC Per Unit (in Programmer Room in Main Plant CCR/CR) for Coal Bunkers. 1 No. PC Per Unit (in ESP Control Room) for ESP Hoppers. 1 No. PC (in AHP Control Room) for Fly Ash Silos. Above PCs shall display Average Level, Maximum Level, Minimum Level, Volume, Mass and Real Time Complete 3D Profile of each Coal Bunker/Fly Ash Silo/ESP Hopper (First Field). The minimum specifications of LMS PC shall be as specified in Sub-Section-DDCMIS, Section-VI, Part-B.
9	4-20 mA signal shall be hardwired to corresponding DDCMIS for displaying Average Level of each Coal Bunker, each Fly Ash Silo and each ESP Hopper in the First Field of ESP. In addition to the information available in LMS PC, the Contractor shall provide all required hardware and software to display the respective information on OWS located at Main Plant CCR/CR, AHP CR and ESP CR. Further, information available in LMS PC for Coal Bunkers shall also be made available in CHP DDCMIS OWS.	

3.00.00 **SPECIFICATION OF ANALYSERS**

3.01.00 Field proven reputed international make microprocessor based monitors/analyzers with LCD display and with necessary fault diagnostic features shall be employed. All analysers shall provide 4-20mA output signal capable of driving a load impedance of 500Ohms minimum. The type, size, capacity, material, make, model and other specification details of the rest of the SWAS system like coolers, gauges/switches, sample pipes, filter, pressure reducing elements, grab sampling arrangement, valves & fittings, panels etc. shall be as decided during detailed engineering stage and shall be subject to Employer's approval. The power supply to all the analysers/ monitors shall be supplied by Contractor from his UPS system with all necessary switches, fuses, wiring/cabling and other required accessories etc. for distribution to individual requirements.

Minimum specifications of analysers					
Requirements	**Conductivity**	**PH**	**Phosphate**	**Chloride**	**Turbidity**
Type	For Hotwell, Two removable Type of Cells, For Others, Continuous Flow Through Type	Cell Flow Through sample	Colorimetric	Continuous Flow Through Type with Chloride & Sulphate Responsive Electrodes	Light reflection principle
Accuracy	≤ ± 1%	≤ ± 1%	≤ ± 5% of reading	≤ ± 5%	≤ 2% for range 0-50 NTU, ≤ 5% for range 50 – 200 NTU

Response Time (90 % of Full Scale)	≤ 5 sec.		≤ 16 min.		≤ 5 min.
Range	0-1, 0-10, 0-100 micro-mho/cm (freely programmable) for Specific Conductivity. 0-1 micro-mho/cm log scale for Cation conductivity	6-11 pH freely programmable	0-10 ppm freely programmable	0-1000 ppb freely programmable	0 – 100, 0-200 MTU, programmable
Temperature Compensation	Automatic/	Automatic	Automatic	Automatic	
Sample Flow			50-150 ml/min		
No. of Streams	Single	Single	Single	Single	

Minimum specifications of analysers …….continued

Requirements	**Hydrazine**	**Silica**	**Sodium**	**Dissolved O2**	**Total Iron (Fe)**
Type	Automatic Continuous Electrochemical Type	Continuous Colorimetric Type	Continuous Flow Through sample	Continuous Flow Through sample	Continuous Flow Through sample
Accuracy	≤ ± 5%	≤ ± 5% of reading	≤ ± 10% of reading	≤ ± 5% of reading	<±5 % of reading or ±0.005 ppm
Response Time (90 % of Full Scale)	≤ 3 min.	≤ 15 min. (including sample switching)	≤ 4 min.	≤ 30 sec.	≤ 15 min. (including sample switching)
Stability	Calibration Once in a Month		Calibration Once in a Month		

Range	0-50, 0-100 ppb freely programmable	0-50, 0-100 ,0-500 ppb freely programmable	0-1,0-10, 0-200 ppb freely programm-able	0-20,0-200 ppb freely programmable	0-50ppb, 0-150ppb, 0-300ppb, 0-1ppm, 0-5ppm freely programm-able or as per the process requirement.
No. of Streams	Single	Multi stream with sequencer/ stream selector (min. 4 streams)	Multi stream with sequencer/ stream selector (min. 4 streams)	Single	Multi stream with sequencer/ stream selector (min. 4streams)
Temperature Compensation	Automatic	Automatic	Automatic	Automatic	Automatic
Sample Flow	170 ml/min (max)	50-150 ml/min	125 ml/min (max)	170 ml/min (max)	200ml/min (max)
REMARKS	All the analysers/cells shall have open Corrosion resistant drain to waste header.				
	Analysers/ monitors/ cells shall be suitable for operating under the conditions specified.				
	Dual cation exchange column shall be provided for cation conductivity.				
	For Hot well conductivity measurement, the Contractor shall provide direct insertion / withdrawal type conductivity cell whereas for all other samples it shall be flow-through type. Monitors for hot well conductivity shall be suitable for field mounting.				

4.00.00 **SAMPLE PIPING SYSTEM**

4.01.00 This shall include piping, fittings, valves and accessories from tapping point upto SWAS conditioning panel located in SWAS room on as required basis. All sample piping shall be 3/4" NB seamless type of material ASTM A213 TP 316 H, conforming to ANSI B36.19. The schedule number shall be suitable for the particular application.

4.02.00 All fittings shall be socket welding type and of material ASTMA182 F316H conforming to ANSI B 16.11.

4.03.00 Single and multi tubes shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy check up and for proper connections.

4.04.00 The valves to be used in sample piping shall be of stainless steel conforming to ASTM A182. The pressure temperature ratings shall be as per ANSI B16.34. The valve design shall be such that the seats can be reconditioned and stem and disc can be replaced without

removing valve body from the line. The specification of End size, Pressure class, Type, End preparation, Body, etc. for different type of valves are specified in SWAS table in Clause No. 4.06.00 of Subsection IIIC-09, Section-VI, Part-B.

4.05.00 **Material Specifications for Sample Pipe Lines**

The piping to be furnished and installed for water and steam analysis system shall be as indicated below:

	Piping System	Material
1.	Piping from the sample inlet bulk head fittings to the shut off valves	Stainless steel, ASTM A 213, Type 316H, 16 BWG tubing
2.	Piping for the high pressure samples and sample blow down piping	Stainless steel, ASTM A 213, Type 316 H. 14 BWG tubing
3.	Blow down header	Stainless steel, ASTM A 312, Type 304 Schedule 160
4.	Miscellaneous drains receiver holder	Stainless steel, ASTM A 312, Type 304 Schedule 40
5.	Piping from the shut-off valves to the terminal points including branch piping and the closed cooling water grab sample piping	Stainless steel, ASTM A 213, Type 316 H, 16 BWG tubing
6.	Closed cooling water piping except grab sample and water purge line	Carbon steel, ASTM A 53 Gr. A, Schedule 40.
7.	Sample through drain piping and waste header piping	Carbon steel, ASTM A 53 Gr. A, Schedule 40.
8.	Purge air piping/tubing and filling valves	Brass/Copper

4.06.00 **SWAS Valve Table:**

S. No.	Service / Location	End Size	Pr. Class	Type	End Preparation	Body	Make (as specified or equivalent)
1	Sample Shut off valve	0.38	6000	Globe	SW	316SS	Thiedig
2	Sample blow down valve	0.38	6000	Ball valve	SW	316SS	Thiedig
3	Solenoid valve	--	--	2 way	--	316SS	ASCO
4	Pr. reducing Valve	0.38	--	Needle	Tube	316SS	Thiedig
5	Safety relief Valve	0.25	3000	Relief	Tube	316SS	Nupro
6	PI and FI isolation valve	0.25	3000	Needle	Tube	316SS	Whiety
7	Back pr. regulating valve	0.25	300	C.W.	SCR	316SS	Cono. flow H30XT-

							HAXXXG
8	Grab	0.25	300	3-way	Tube	316SS	Whiety
9	Quick	--	--	ball	--	316SS	Hancock Walther
10	Individual P.C. and S.C. inlet & outlet valve					316SS	Hancock/ ACKER MANN
11	P.C. I\L & O\L header & chilled water I\L & O\L isolation valve	--	--	Gate	--	316SS	Hancock
12	Safety relief valve at each PC & SC and cooling water header	--	--	Relief	--	316SS	Baldota
13	High Pressure reducing valve	--	--	--	--	316SS	--
14	Isolation valve before primary cooler	--	--	Needle	Tube	316SS	Whiety

5.00.00 **Contract quantities**

Refer Appendix- I to part A, Section VI of technical specifications.

SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.

Sl. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
		Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
1	Sensing Element and material	Bourdon for high pressure, Diaphragm/Bellow for low pr. Of 316 SS	Mercury in steel for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary.	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel/304 SS
3	Dial size	150mm	150 mm	Tubular covering entire range
4	End connection	1/2 inch NPT (M)	3/4" NPT (M)	Process connection as per ASME PTC and drain/vent 15 NB
5	Accuracy	±1% of span	± 1% of span	± 2%
6	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
8	Over range test	Test pr. for the assembly shall be1.5 to the max. Design pr. at 38°C.		
9	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
10	Zero/span adjustment	Provided	Provided	--
11	Identification	Engraved with service legend or laminated phenolic name plate		

12	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.
13	Material of Bourdon/ movement	316 SS / 304 SS	316 SS / 304 SS	

Notes:-

*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

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.

SUB–SECTION – IIIC-08

CONTROL VALVES AND ACTUATORS

CONTROL VALVES, ACTUATORS & ACCESSORIES

1.00.00	**CONTROL VALVES, ACTUATORS & ACCESSORIES**
1.01.00	**General Requirements**
1.01.01	The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification.
1.01.02	All the control valves and accessories offered by the Bidder shall be from reputed, experienced manufacturers of specified type and range of valves.
1.01.03	For special type of control valves such as combined pressure and temperature control valves for Aux PRDS application, separator drain control valves, refer to the corresponding mechanical sections.
1.01.04	Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.
1.02.00	**CONTROL VALVE SIZING & CONSTRUCTION**
1.02.01	The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.
1.02.02	The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer's approval during detailed engineering.
1.02.03	Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation/flashing service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished.
1.02.04	Control valves for application such as SH Spray Control, RH spray Control, Heavy Oil Heating, pressurizing and Control system, HP/LP heater Emergency level control, Emergency Make-up to condenser hotwell, GSC minimum flow, Deaerator Drain to Condenser Hotwell, Condensate spill to condensate reserve tank, condenser normal make-up and valve gland sealing supplying pressure control, CEPS minimum flow control, **BFP circulation control valve** shall have permissible leakage rate as per leakage Class V. All other control valves shall have leakage rate as per leakage Class-IV **as per ANSI / FCI /70.2,2006 or equivalent**.

1.02.05 The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers except for few cases as per contractor's standard and proven practice subject to employer's approval.

1.02.06 Control valves for steam and water application shall be provided with rangability of 30:1 for all services except for applications wherein control valves are envisaged to be operated in lower range like Reheater spray and superheater spray system wherein control valve with rangability of 50:1 shall be provided

2.00.00 VALVE CONSTRUCTION

2.01.00 All valves shall be of globe body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.

2.02.00 Valves with high lift cage guided plugs & quick-change trims shall be supplied.

2.03.00 Cast Iron valves are not acceptable.

2.04.00 Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable.

2.05.00 Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.

2.06.00 All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing)

2.07.00 Valve characteristic shall match with the process characteristics.

2.08.00 Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.

2.09.00 Flanged valves shall be rated at no less then ANSI press class of 300 lbs.

3.00.00 VALVE MATERIALS

Sr. No.	Service	Body material	Trim Material
1	Non-corrosive, non-flashing and non-cavitation service except DM water	Carbon steel ASTM-A216 Gr. WCB for design fluid temperature below 275 Deg. C Alloy steel ASTM-A217Gr. WC6 for design fluid temperature above 275 Deg. C and upto 400 Deg. C Alloy steel ASTM-A217Gr. WC9 for design fluid temperature above 400 Deg. C	316SS stellited with stellited faced guide posts and bushings.
2.	Severe flashing/cavitation services	Alloy steel ASTM-A217 Gr. WC9	440 C

3.	Low flashing/cavitation service	Alloy steel ASTM-A217 Gr. WC6	17-4 PH SS
4.	DM water service	316 SS	316 SS

NOTE: (a) Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34.

(b) Severe flashing / cavitation services includes as a minimum all control valves whose downstream piping is connected to condenser or flash tank.

However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.

Contractor shall ensure that all required measures like proper selection of anti-corrosive/erosive material along with durable epoxy coating with polyurethane finish shall be provided for all the C&I equipment/ devices being supplied in this contract, which are mounted in non-AC areas (prone to sea water environment corrosion / erosion) like measuring instruments, control valves & actuators, JBs, LIEs / LIRs, impulse pipes, sample pipes, fittings, conduits, cable trays and accessories, local control panels, erection hardware items etc. Contractor shall furnish their comprehensive proposal regarding the anti-corrosion/ erosion measures for protection against sea water environment which shall be finalized during detailed engineering subject to Employer's approval.

4.00.00 END PREPARATION

Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalized during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.

5.00.00 VALVE ACTUATORS

All control valves shall be furnished with pneumatic actuators except for pressure and temperature control valve for auxiliary PRDS application (electro-hydraulic / pneumatically operated) and separator drain control valve (electro-hydraulic type).The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.

Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.

The travel time of the pneumatic actuators shall not exceed 10 seconds.

6.00.00 **CONTROL VALVE ACCESSORY DEVICES**

6.01.00 All pneumatic actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

7.00.00 **SPECIFICATIONS FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER**

1	Electrical	a) Input Demand Signal	4-20 mA
		b) Power Supply	Loop Powered from the output card of Control System.
		c) HART Protocol	Compatibility for Remote Calibration & Diagnostics (Super-imposed HART signal on input Signal (4-20 mA)
		d. Valve position sensing	Position sensing, 4-20 mA output signal to be provided for control system.
2	Environment	a) Operating temp.	(-)30 To 80 Deg. C
		b) Humidity	0-95 %
		c) Protection class	IP-65 Minimum
3	Software for Configuration and Diagnostics	Software	Software shall meet the requirements for Configuration, Diagnostics, Calibration and Testing of the actuator.
		Diagnostic/Test features	Advanced diagnostic features like Stroke counter or Travel counter, Leakage in actuators, Valve Signature analysis, Step Response test, Valve friction /Jamming detection etc to be provided.
4	Test reports/ Certificates	Factory Valve Signature Tests Reports (Pr Vs Valve travel and Travel Vs I/P signal) are to be provided.	
		Test certificates as per Manufacture Standard/Relevant Standard are to be submitted.	
5	Configuration/ Calibration.	Remote & Local Calibration, Auto & Manual Calibration shall be possible.	
6	Operating Range	Full range/ Split range.	
7	Modes	Valve Action	Direct / Reverse Valve Action

		Flow Characterization	Possible to fit Valve Characteristic Curves- Linear , Equal percentage etc.
8	Fail Safe/Fail Freeze	Fail Safe/Fail Freeze feature is to be provided. (In case the fail freeze feature is not intrinsic to the positioner, Bidder shall achieve the same externally through solenoid valve connected in the pneumatic circuit).	
9	Pneumatic	Air capacity	Sufficient to handle the valves & actuators selected/ Boosters to be supplied, if required.
		Air pressure	To suit the air supply pressure/quality available.
		Process connection	¼" NPT
10	Performance	Characteristic deviation	<=0.5 % of span.
		Ambient temp effect	<=0.01 %/ deg C or better.
10	EMC & CE Compliance	Required to International Standard like EN/IEC.	EN50081-2 & EN50082 or equivalent.
11	Accessories	In-built Operator Panel	Display with push buttons for configuration and display on the positioner itself (Password protected/Hardware lock).
		Hand Held Hart Calibrator	Universal Hart Calibrator to be provided (for quantity, refer Part-A: Contract quantities of the specification).
		Press Gauge Block	For supply & output pressures, Air Filter Regulator and other accessories shall be provided on as required basis for making system complete.
		Electrical Cable Entry	1/2"'NPT, side or bottom entry to avoid water

			ingress.
		Valves Mounting Assembly	For Sliding Stem/Rotary/Single acting/Double acting actuators on as required basis

*** Note**:

The HART signals shall be picked up from marshalling terminals of DDCMIS (SG/TG DDCMIS as well as BOP DDCMIS), as applicable. The details of the above mentioned HART management system specification are mentioned in HART system (Annexure IIIC-02C to DDCMIS).

The positioners shall be monitored from this HART management system .To achieve this, Bidder shall provide the necessary software to achieve the functionalities described above under " Software for Configuration and Diagnostics", and this software shall be loaded in the HART management system.

8.00.00 TEST AND EXAMINATION

All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:

8.01.00 Non Destructive Test as per ANSI B-16.34.

8.02.00 Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.

8.03.00 Valve closure test and seat leakage test in accordance with ANSI-B 16.34/ FCI 70.2 standard and as per the leakage class indicated above

8.04.00 Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.

8.05.00 CV Test: Please refer Cl No. 1.00.00 & 3.00.00 OF Sub-section- IIIC-10 (Type test requirements), Control Valves.

Bidder shall furnish all the control valves under this main plant package as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.

SUB–SECTION – IIIC-12

CONTROL DESK & PANELS

1.00.00	**CONTROL DESK & PANELS**
1.01.00	**GENERAL**
1.01.01	All control desk, panels, LVS panel 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 / top entry for cables to be finalised application wise during detailed engineering stage. 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. Sufficient number of power receptacles with disconnect switches shall be installed within all panels/desk.
1.01.03	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.
1.01.04	The design shall conform to the EN ISO 11064 (Ergonomical 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, grounding, general arrangement etc. of Control Desk etc. shall be as per the actual requirement and shall be finalised during detailed engineering and subjected to Employer's Approval. For bidding purpose, the length of the desk/ panel and CD mounted devices are given in Appendix-I to Part-A, Section-VI.
2.01.02	For control desk mounted instruments/ devices etc., which are to be powered from UPS, all required conversion of interface equipments / accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like Input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS, redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.
2.02.00	**Control Desk (CD)**
	Control desk **shall be Modular, non-welded construction** free standing table top type with **front &** back **cover** constructed of **1.6** mm thick CRCA steel plates**.** The tabletop of the control desk shall be arc-shaped for mounting **TFT** monitors **& mice for SG, TG, BOP (irrespective of scope of supply) and synchroscope**. **TFT monitors and synchroscope shall be provided with adjustable mounting arrangement.** The work surface of control desk shall be 30mm thick with the top 12mm of Acrylic Solid Surface **(ASS)** and the remaining 18mm of laminated medium density fiber board**. Work surface shall be made of two different colors at same level and seamlessly joined in each section**. **The structure frame shall consist of extruded aluminum top and bottom horizontal beams and vertical support tensioned together to form an integrated, finished curvilinear shaped frame. Vertical & Horizontal supports, minimum 2.5mm and 2mm thick respectively, have to be provided for the structure frame. Extreme side legs shall be illuminated type and should complete the overall form and aesthetics of the desk. It shall have concealed cable & wire way**

	management system. PA system hand sets, telephone sets, very few PB stations and lamps shall be mounted on the control desk on mosaic grid structure as per attached list. Sliding keyboard trays shall be provided on the CD. The exact profile of the desk, dimension and the radius of curvature shall be finalised during detailed engineering stage.
2.02.01	All operator monitors & mice for SG, TG, BOP shall be mounted on this CD.
2.02.02	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 (CD) (draw out section)**
2.03.01	CD shall be provided with a draw out section where hardwired devices shall be mounted on a mosaic grid mosaic portion for mounting backup.. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat and flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.
2.04.00	**Control Desk Devices**
	"Release" & Lamp Test 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 button stations shall be selected. 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. Emergency push buttons(with cover) shall be mounted on top of CD, as per quantity indicated in Part-A of specification.
2.05.00	**Unit-Incharge Desk**
	Profile and construction of the Unit Incharge Desk shall be same as that of CD. Provision for Operator Work Station and PA system/ telephone handset etc. shall be provided similar to the Control Desk..
2.05.01	**Internal Panel/Desk Items**
2.06.00	Equipment and devices mounted within the panels/desk shall be mounted on suitable racks/brackets and shall be arranged for convenient access for adjustment and maintenance work.
2.07.00	**Furniture**
2.08.00	**Bidder sh**all provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe. Each module shall have transparent cover and adjustable partition. It shall have locking provision for security. The components shall be suitable for integration/fabrication without any welding technology.
	1. Work Station furniture

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (inkjet or A4 laser) etc. is to be provided..

2. Server Rack

Server rack shall be provided to mount programmer stations, PC based systems (of rack type and tower type), Matrix KVM switcher, Mini UPS etc. in Programmer room. Suitable arrangement for Ventillation and cooling shall be built in.

3. PC rack

PC rack shall be provided to mount CPUs of work stations/PCs of OWS/LVS etc in Control Room.

4. Chairs

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

5. Tables

a Industry standard computer tables shall be provided & shall be as approved by Employer during detailed Engineering.

b Conference Room standard tables shall be provided with acrylic coat for good finish. Details shall be finalised & approved by Employer during detailed engg.

6. Almirahs

Steel Almirahs shall be provided for keeping documents in the documentation room.

7. Keypad

Keypads shall be provided for the storing of keys of relevant areas in the respective control rooms

8. Lockers

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel & also for documents.

3.00.00 LVS PANEL

3.01.00 An arc shaped Large Video Screen (LVS) panel shall be supplied for mounting large video screens in number of tiers in various Control rooms as specified at Part-A of specification. An indicative typical sketch of Control Room Concept showing LVS & OWS is given in drawing no. 0000-999-POI-A-061Rev.B.

3.02.00	The profile, dimensions and the general arrangement shall be finalised & approved by Employer during detailed engineering. Recommendations, if any, for the control room lighting in order to ensure continuous proper viewing of the LVS screen by the operator & shift incharge (without any fatigue) shall be clearly brought out by the Contractor in his offer, along with all relevant details/basis.
3.03.00	Any other requirement for proper LVS mounting & functioning & viewing shall also be specifically brought out by the Contractor in his offer, along with all relevant details.
4.00.00	**CONTRACT QUANTITIES** Refer Appendix-I to Part-A, Section-VI of Technical Specifications.

INSTRUMENT CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

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 / Marshalling – cum Termination Cubicle / local group JB	Plug in connector	Post 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	Local junction box / 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	Cage clamp (Rail mount) type.	F,G
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/ MCC/SWGR	Group JB	Cage clamp (Rail mount) type.	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, Temperature Transmitter, Int. Junction box of LIE/ LIR/ Group JB / MCC/SWGR	Marshalling / Marshalling – cum Termination Cubicle	Cage clamp (Rail mount) type.	Cage clamp (Post mounted) type.	F,G
Marshalling cubicle/ Termination Cabinet	Electronic system cabinet	Cage clamp (Post mounted) type.	Plug-in connector / other system as per Mfr.'s Standard	Internal wiring
Marshalling/ Termination System Cabinets	UCD mounted equipments	Cage clamp (Post mounted) type.	Plug in connector / Cage clamp type (rail mounted).	F,G (with plug-in connect or at one end)
DDCMIS/PLC cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standar d

Notes

1 Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs, except for pre-fabricated cables which shall be as per manufacturer's standard.

2 For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided.

3 * For high temperature applications only.

4 . For connection between field/JB and DDCMIS marshalling cabinet

minimum 4 pair instrumentation cable shall be used.

5 All the spare cores of instrumentation cable have to be terminated in Marshalling cabinets/ DCS panel end.

6 For Cable type and cable termination scheme for the instruments/ equipment that are connected to Steam Turbine and Generator (STG) control system defined at Part A, sub section IIC, clause no. 2.03.01 (a) (ii) above and hydrogen generation plant auxiliaries system, Contractor's standard and proven practice is also acceptable. However, for termination of instrumentation cable at marshalling cabinets/DCS panel end, cage-clamp termination shall be offered. For power and control cable termination, Contractor's standard and proven practice would be acceptable

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 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, 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.
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	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.
7.03.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.
7.04.00	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.
7.05.00	All the special tools as may be required for solder less connections shall be provided by Bidder.
7.06.00	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:

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. 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 Not in use

8.05.00 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 No jointing is permissible for Instrumentation cables. For other cables Jointing for more than 250 Meters run of cable shall 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.

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 (OFCs) :

Outside Building Area - to be laid necessarily inside GI conduit with support from cable tray/Trestle structure

Inside Building Area – to be laid on separate cable sub-trays

While buried- in separate burried trench approx.1.0 meter depth, to be laid in 2" rodent proof HDPE conduits covered with sand, brick, laid breadth-wise and soil along the pipe line route by contractor;

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 rodent proof HDPE conduits within hume pipe.

10 **Laying of Network Cable (UTP/STP) :**

Out side Building Area- to be laid necessarily inside GI conduits with support from cable tray / Trestle structure.

Inside Building Area- to be laid necessarily inside GI conduits on separate cable sub-trays.

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.

9.03.00 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.

9.04.00 The Bidder shall be responsible for proper grounding of all equipment under this 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.

9.05.00 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	Screwed at all four corners for door. 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 required for erection shall be of SS, included in Bidders scope of supply.
(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.
(vi)	Protection Class	IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.
(vii)	Grounding	To be provided.
(viii)	Color	RAL 7035

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 galvanized steel with , water leak, fire and rust proof protected *for the areas of* Mills,Drum, Main Steam, RH steam Air Heaters and Furnace, BFPDT's .

And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided. The temperature rating of flexible conduit shall be suitable for actual application.

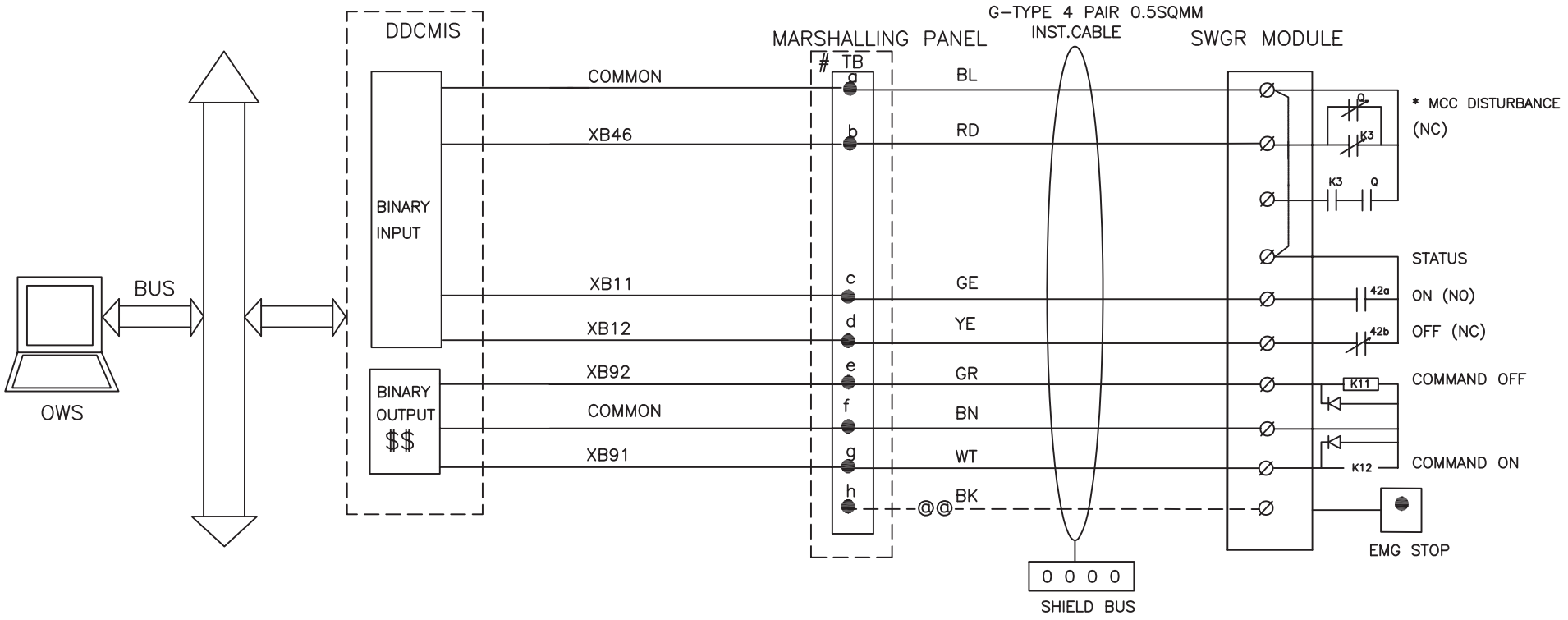
11.02.00 All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.

11.03.00 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.
11.04.00	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.
11.05.00	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.

SIGNAL EXCHANGE BETWEEN DRIVES AND DCS

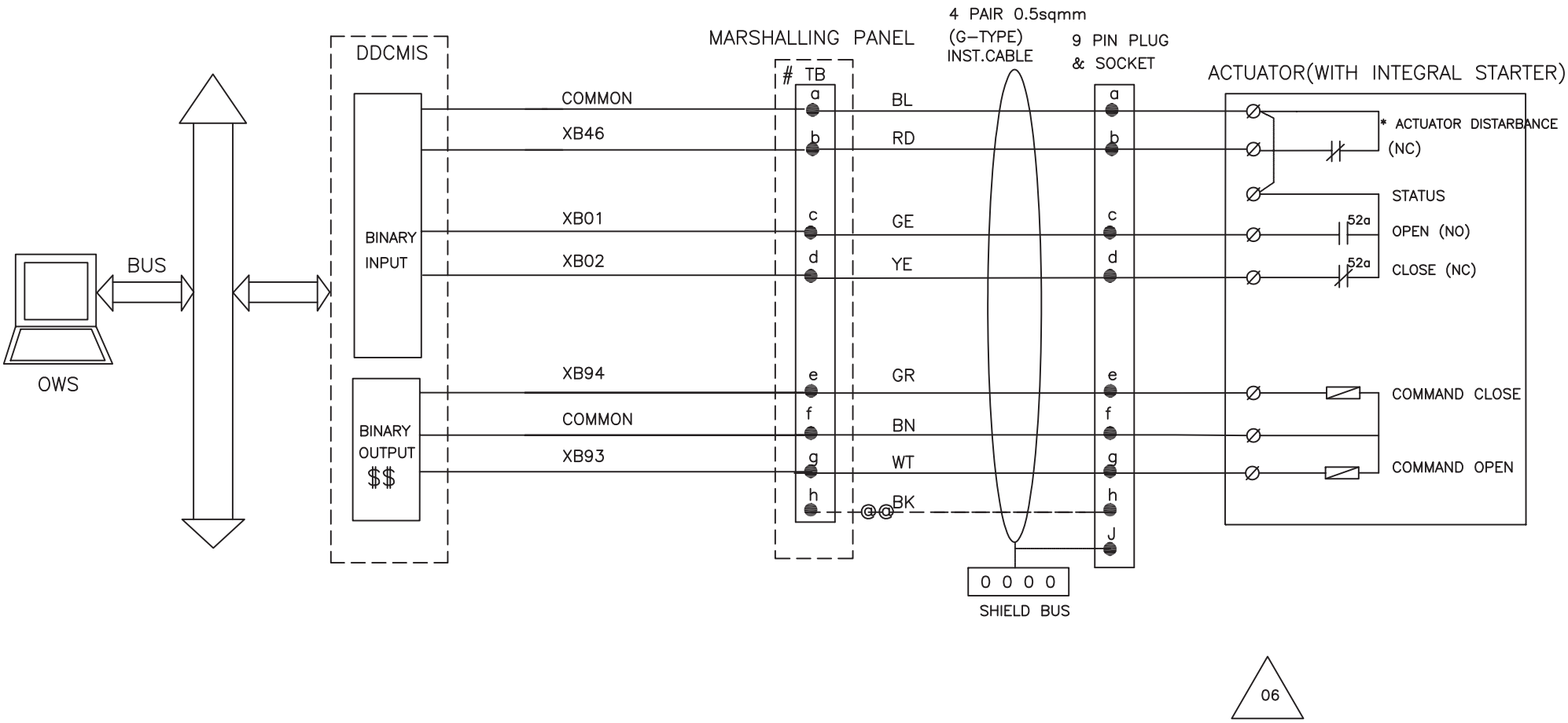
DDCMIS INTERFACE WITH LT MCC (LT)



NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION SEQUENTIALLY.
NOTE:-4 * MCC DISTURBED= THERMAL O/L OPT/CONT SUPP FAIL/EPB OPTD /DRIVE POWER SUPPLY OFF

BHEL	3X800 MW NTPC PATRATU STPP PHASE-I	DRG.NO.	9585-001-405-PVI-B-152B
	DDCMIS INTERFACE WITH LT MCC (LT)	SHT	05 OF 34

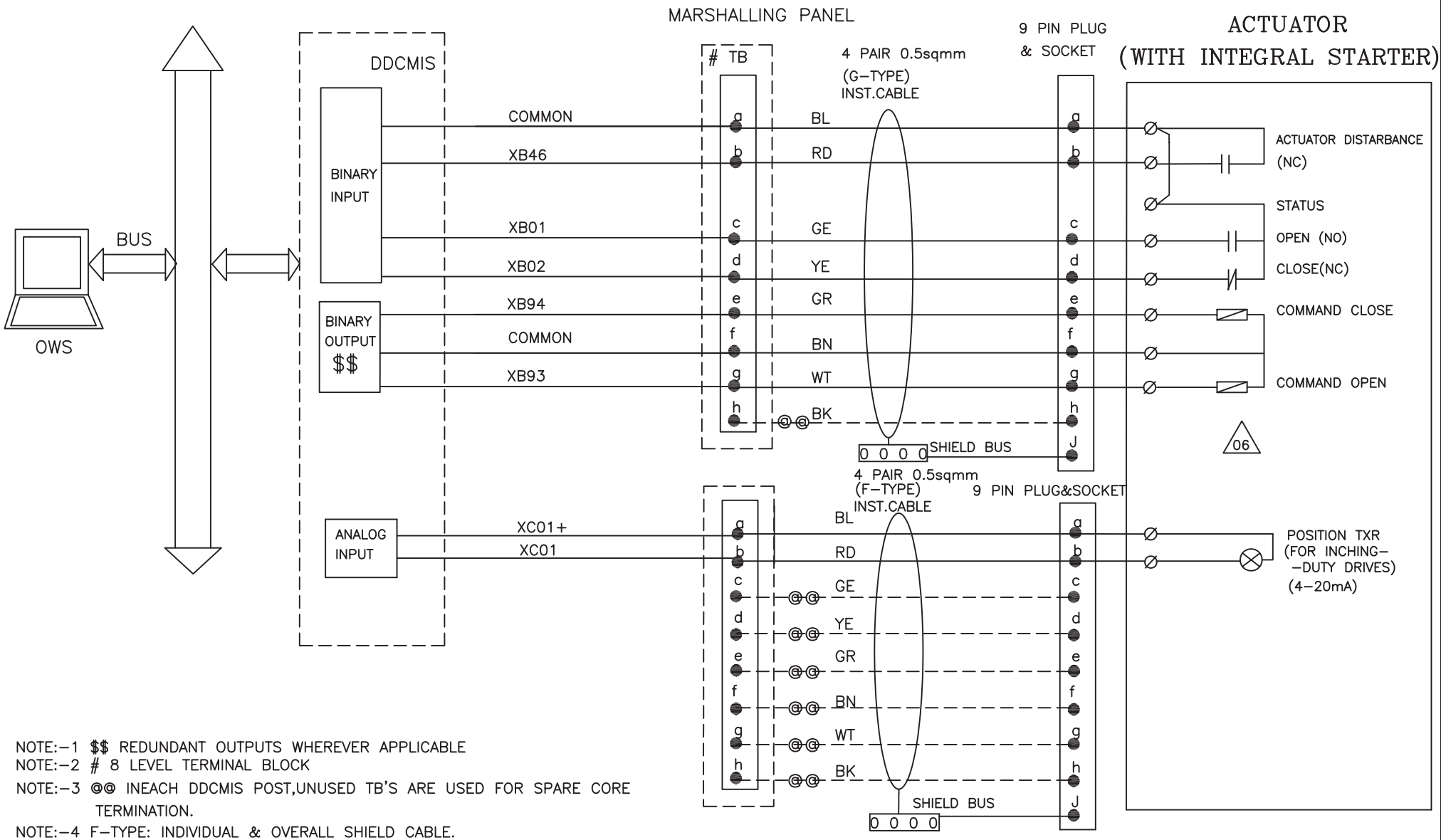
DDCMIS INTERFACE WITH BID/MOV/MOD



NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * DISTURBANCE=LOSS OF POWER SUPPLY(1PHASE/3PHASE)/LOSS OF CONTROL SUPPLY/MOTOR THERMOSTAT TRIP/THERMAL OVER LOAD/ TORQUE SWITCH OPERATED, LOCAL/OFF/REMOTE SWITCH IN LOCAL/OFF POSITION

BHEL	3X800 MW NTPC PATRATU STPP PHASE-I	DRG.NO.	9585-001-405-PVI-B-152B
	DDCMIS INTERFACE WITH BID	SHT	06 OF 26

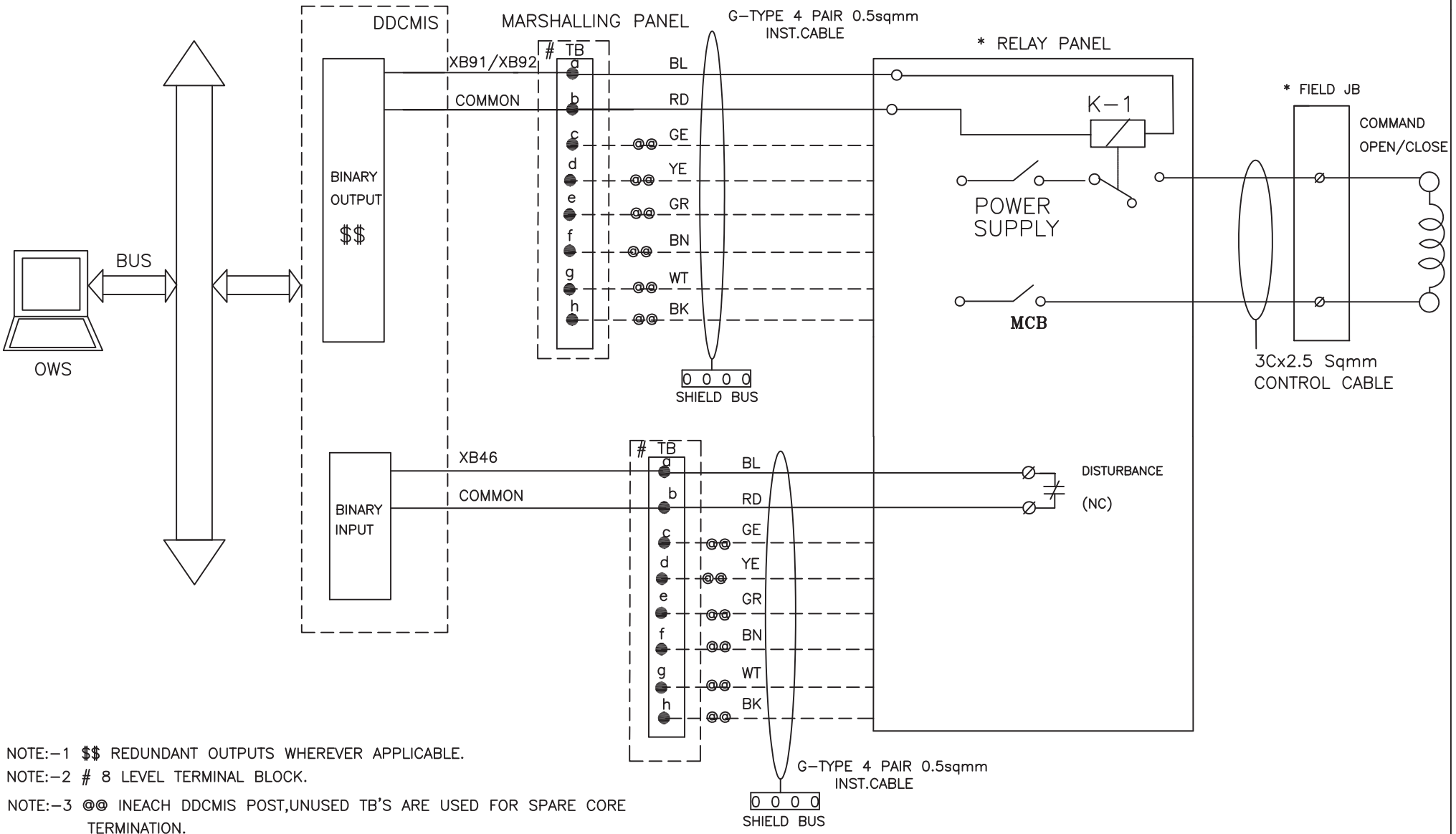
DDCMIS INTERFACE WITH BIDI/MODI/MOVI



NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:–2 # 8 LEVEL TERMINAL BLOCK
NOTE:–3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:–4 F–TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.
NOTE:–5 *DISTURBANCE=LOSS OF POWER SUPPLY/LOSS OF CONTROL SUPPLY/ MOTOR THERMOSTAT TRIP/THERMAL OVERLOAD/TORQUE SWITCH OPTD/ LOCAL/OFF/REMOTE SWITCH IN LOCAL/OFF POSITION

BHEL	3X800 MW NTPC PATRATU STPP PHASE–I	DRG.NO.	9585–001–405–PVI–B–152B
	DDCMIS INTERFACE WITH BIDI	SHT	07 OF 34

DDCMIS INTERFACE WITH SOV/O/SOV/C(WITH OUT FEEDBACKS)



NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.

NOTE:–2 # 8 LEVEL TERMINAL BLOCK.

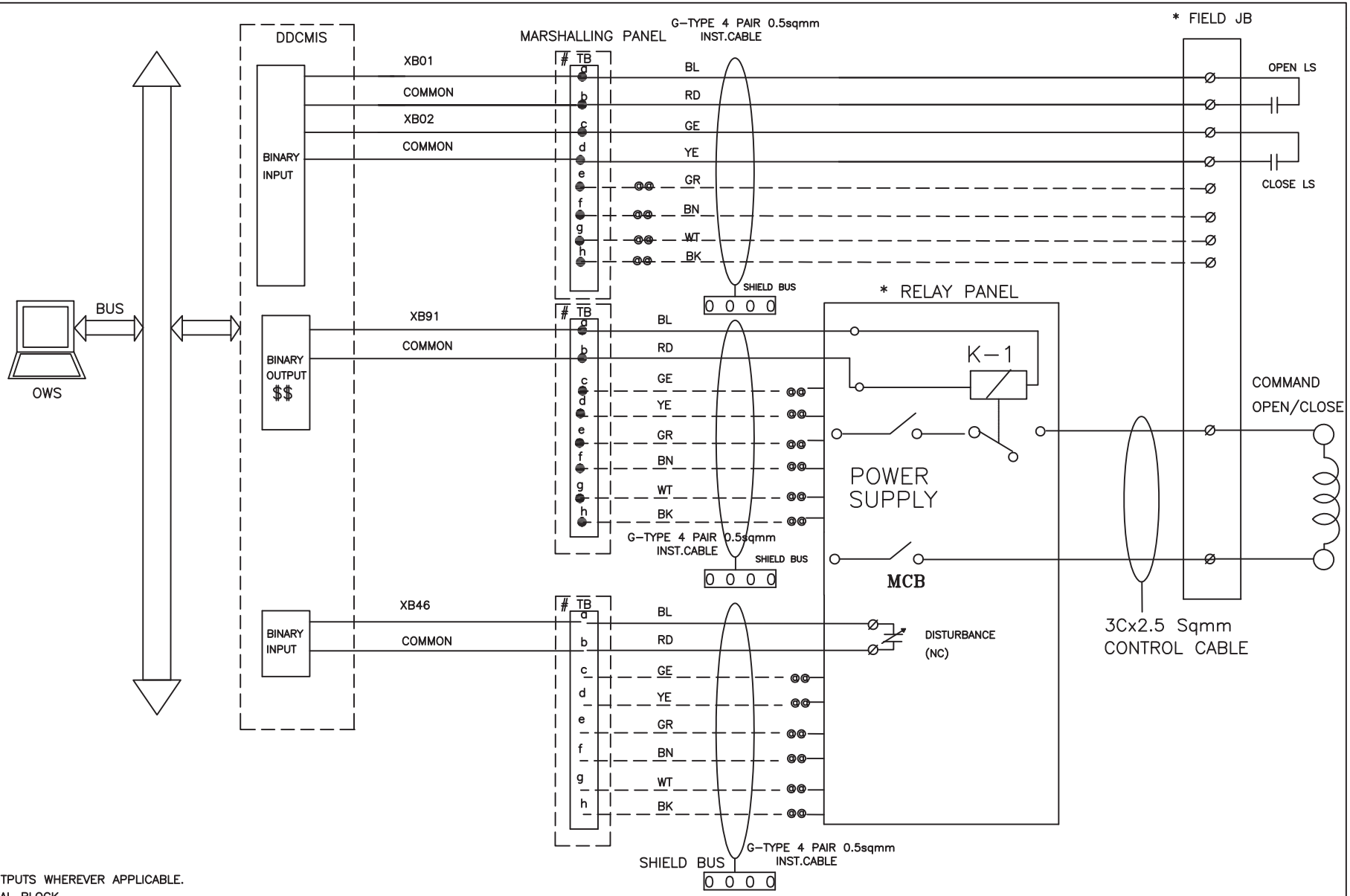
NOTE:–3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

NOTE:–4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHELING PANEL.

NOTE:–5 FOR ON/OFF TYPE,SOLENOID ACTUATED CONTROL VALVE.

BHEL	3X800 MW NTPC PATRATU STPP PHASE–I	DRG.NO.	9585–001–405–PVI–B–152B
	DDCMIS INTERFACE WITH SOV/O/SOV/C(WITHOUT FEEDBACKS)	SHT	11 OF 34

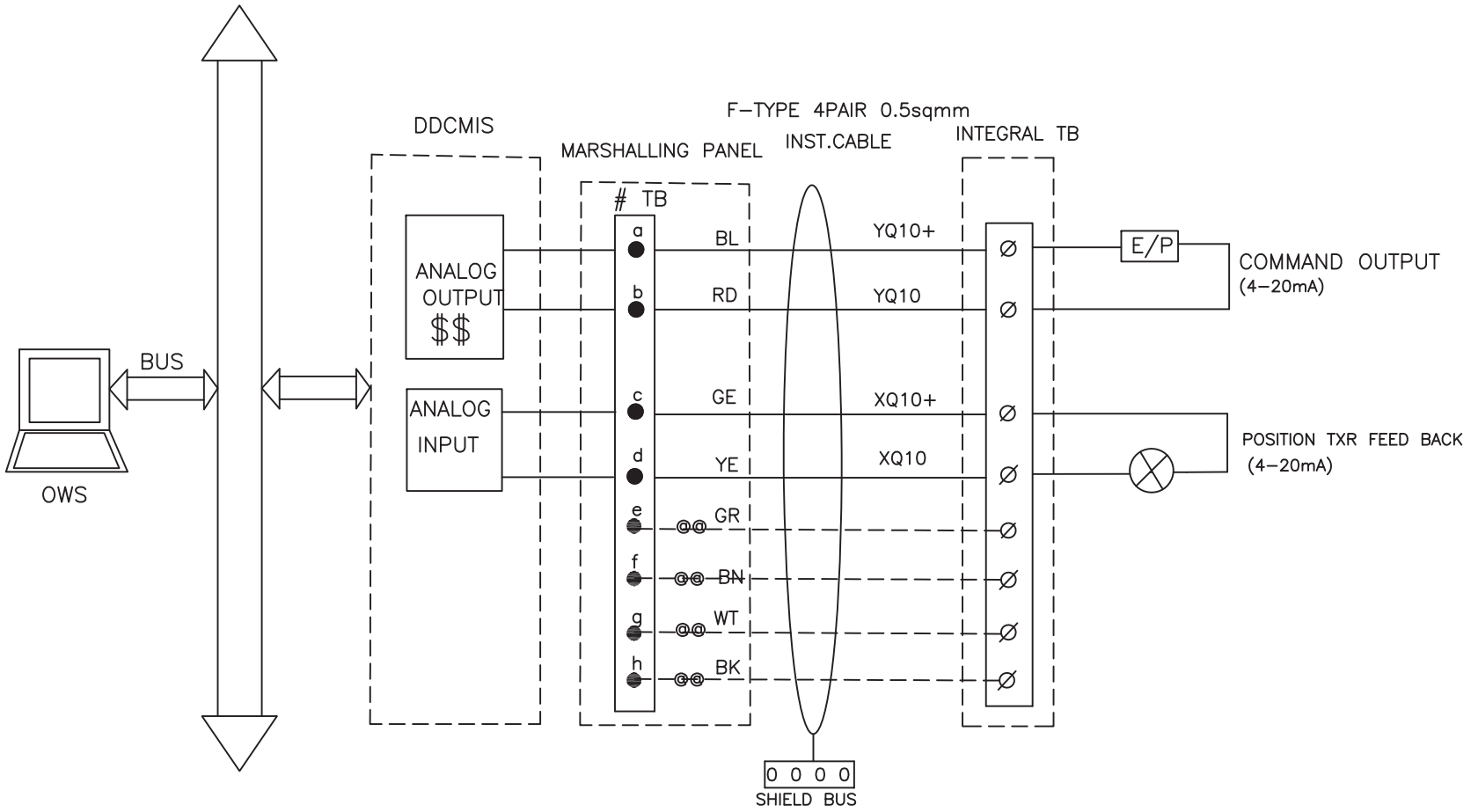
DDCMIS INTERFACE WITH SOV/O/L(WITH FEED BACKS)



NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.
NOTE:-2 # 8 LEVEL TERMINAL BLOCK.
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/ MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHALING PANEL.
NOTE:-5 FOR ON/OFF TYPE,SOLENOID ACTUATED CONTROL VALVE.

BHEL	3X800 MW NTPC PATRATU STPP PHASE-I	DRG.NO.	9585-001-405-PVI-B-152B
	DDCMIS INTERFACE WITH SOV/O/L(WITH FEEDBACKS)	SHT	12 OF 34

INTERFACE FOR MODULATING DRIVES – CLCS



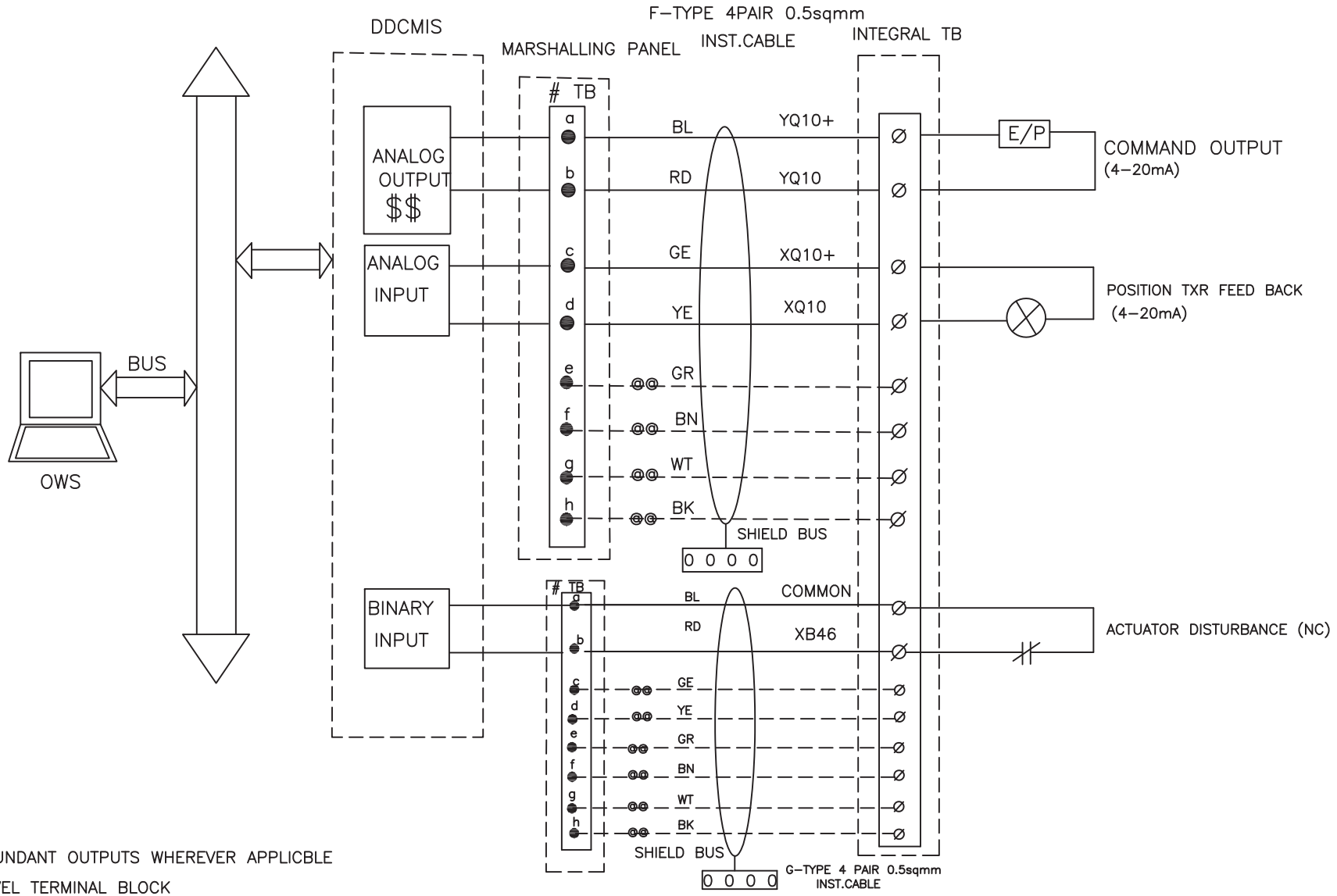
NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICBLE
NOTE:–2 # 8 LEVEL TERMINAL BLOCK

NOTE:–3 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

NOTE:–4 F–TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

BHEL	3X800 MW NTPC PATRATU STPP PHASE–I	DRG.NO.	9585–001–405–PVI–B–152B
	INTERFACE FOR MODULATING DRIVES – CLCS	SHT	14 OF 34

INTERFACE FOR MODULATING DRIVES – CLCS–M



NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICBLE

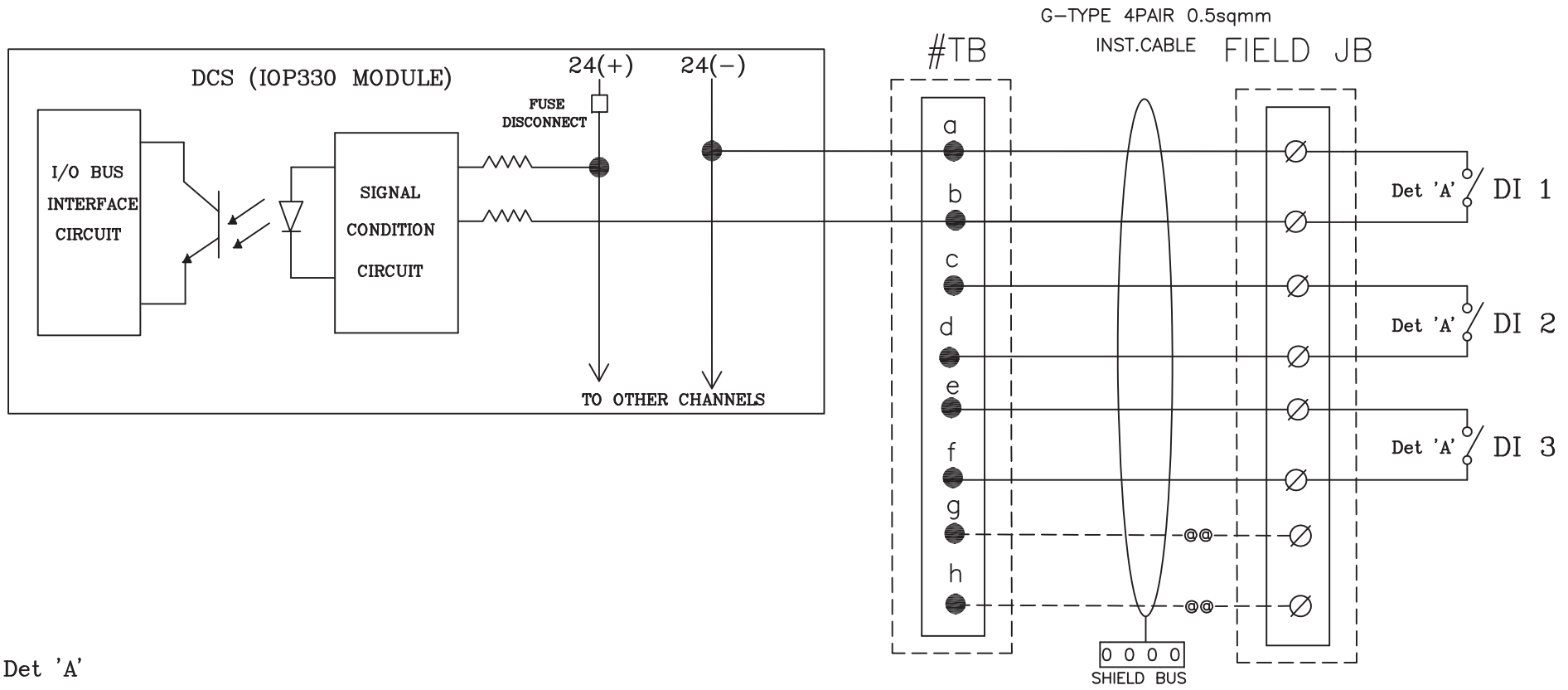
NOTE:–2 # 8 LEVEL TERMINAL BLOCK

NOTE:–3 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

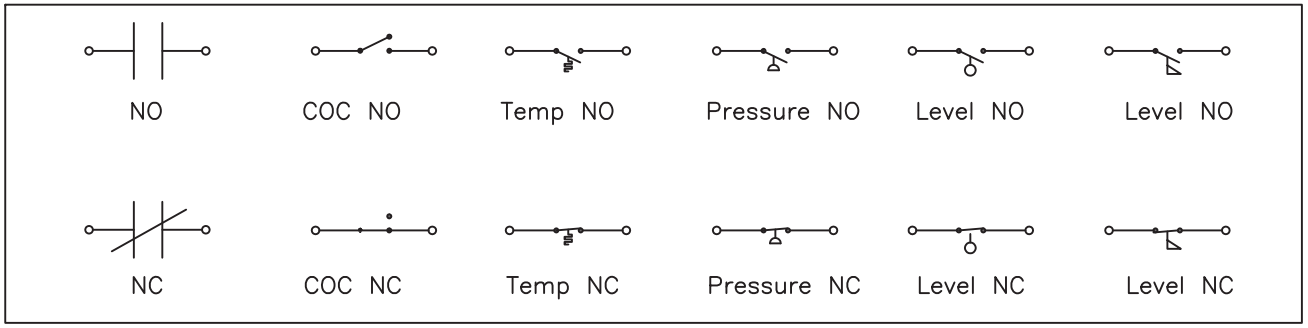
NOTE:–4 F–TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

BHEL	3X800 MW NTPC PATRATU STPP PHASE–I	DRG.NO.	9585–001–405–PVI–B–152B
	INTERFACE FOR MODULATING DRIVES – CLCS–M	SHT	15 OF 34

DDCMIS INTERFACE WITH DIGITAL INPUT SIGNAL



Det 'A'

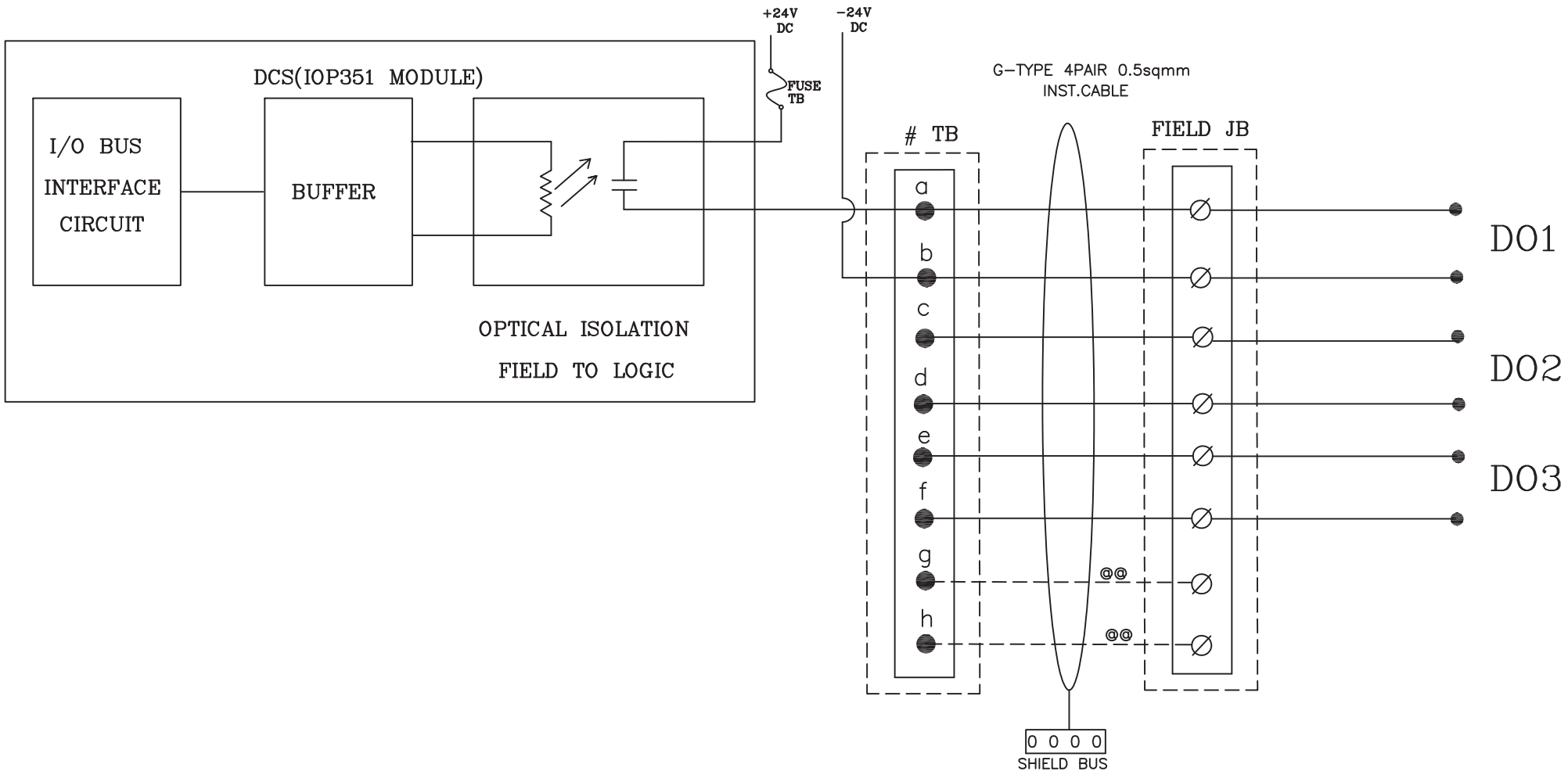


NOTE:–1 #8 LEVEL TERMINAL BLOCK.

NOTE:–2 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

BHEL	PROJECT: 3X800 MW PATRATU STPP STAGE–I	DRG.NO.	9585–001–405–PVI–B–152B
		DATE	08.02.2019
	DDCMIS INTERFACE WITH DIGITAL INPUT SIGNAL	REV.NO.	06
		SHT	23 OF 34

DDCMIS INTERFACE WITH DIGITAL OUTPUT SIGNAL

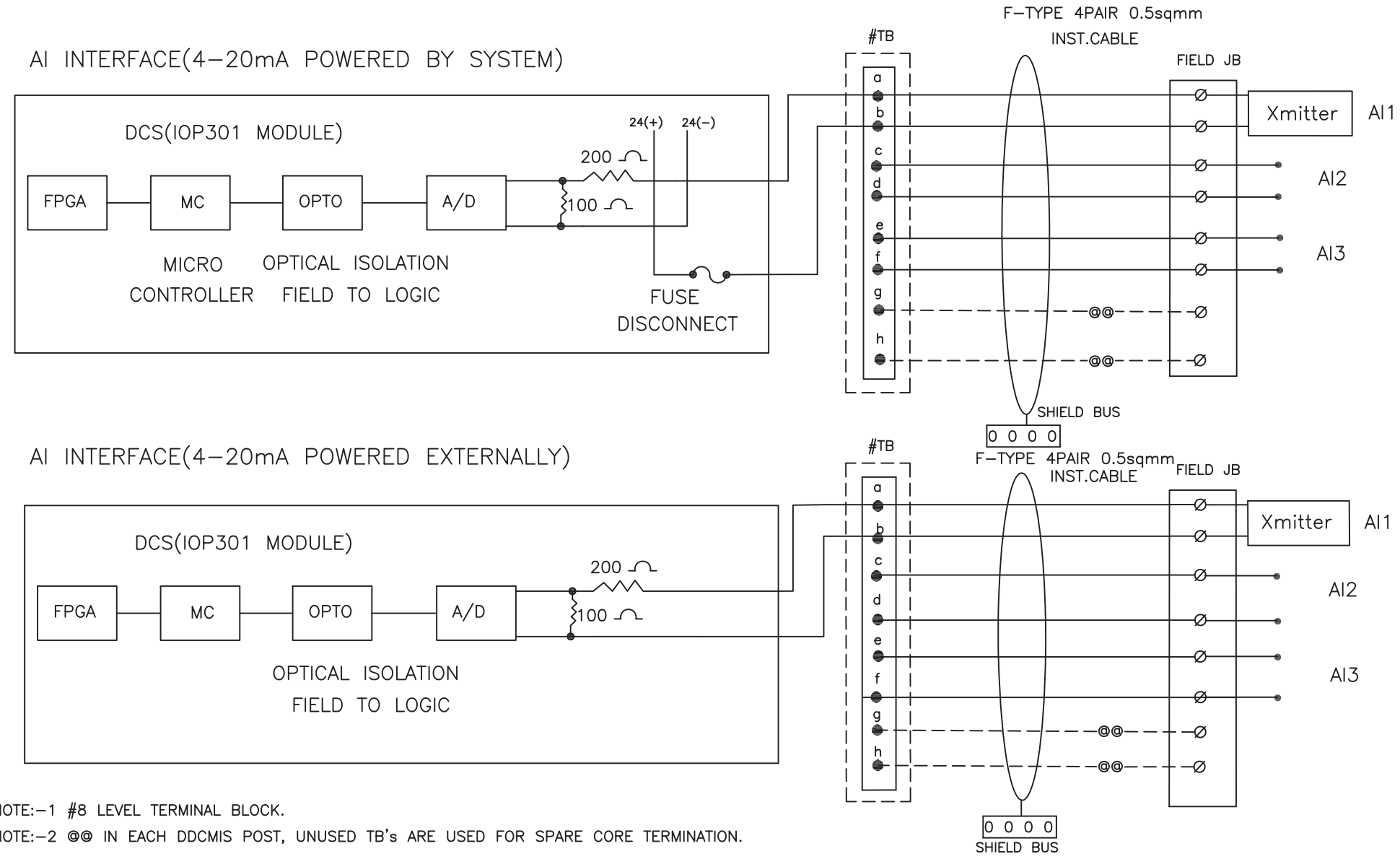


NOTE:-1 #8 LEVEL TERMINAL BLOCK.

NOTE:-2 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

BHEL	PROJECT: 3X800 MW PATRATU STPP STAGE-I	DRG.NO.	9585-001-405-PVI-B-152B
		DATE	08.02.2019
	DDCMIS INTERFACE WITH DIGTAL OUTPUT SIGNAL	REV.NO.	06
		SHT	24 OF 34

DDCMIS INTERFACE WITH ANALOG INPUT SIGNAL



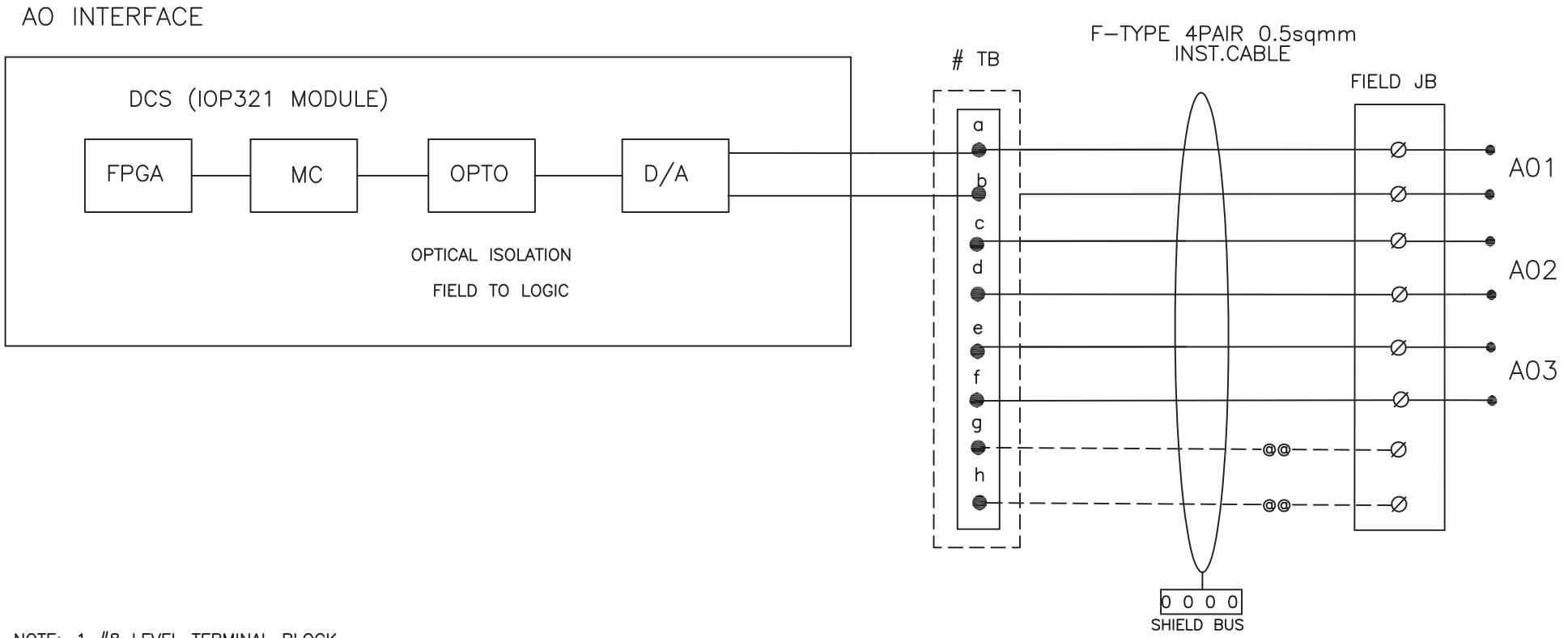
NOTE:–1 #8 LEVEL TERMINAL BLOCK.

NOTE:–2 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

NOTE:–3 F–TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

भेल BHEL	PROJECT: 2X800 MW PATRATU STPP STAGE–I	DRG.NO.	9585–001–405–PVI–B–152B
		DATE	08.02.2019
	DDCMIS INTERFACE WITH ANALOG INPUT SIGNAL	REV.NO.	06
		SHT	25 OF 34

DDCMIS INTERFACE WITH ANALOG OUTPUT SIGNAL



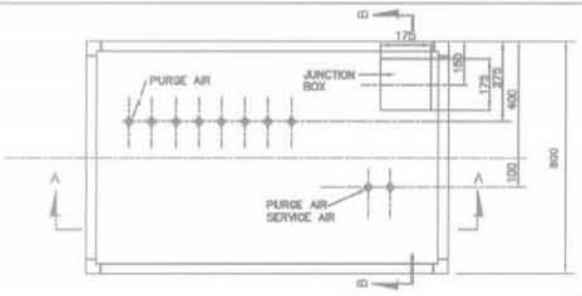
NOTE:-1 #8 LEVEL TERMINAL BLOCK.

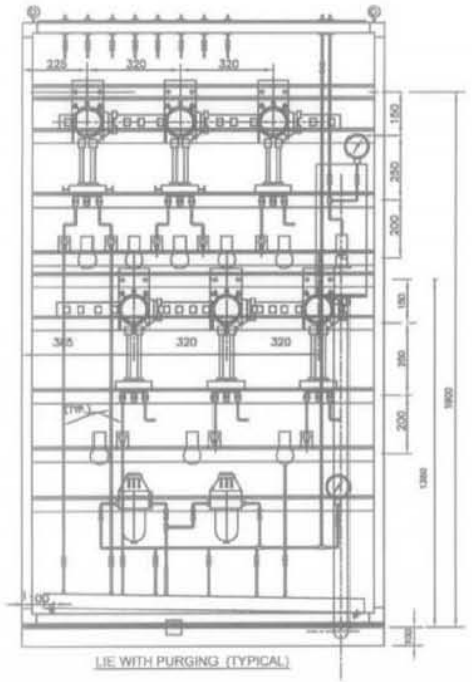
NOTE:-2 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

NOTE:-3 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

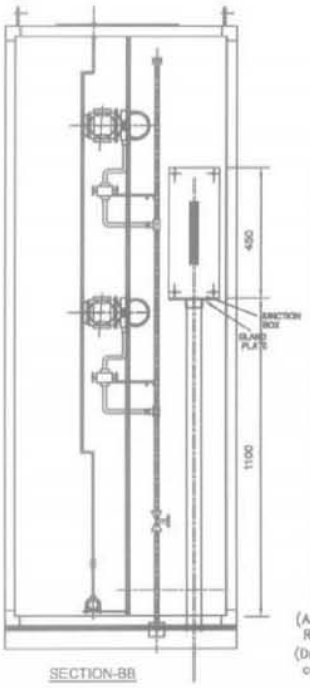
BHEL	PROJECT: 3X800 MW PATRATU STPP STAGE-I	DRG.NO.	9585-001-405-PVI-B-152B
		DATE	08.02.2019
	DDCMIS INTERFACE WITH ANALOG OUTPUT SIGNAL	REV.NO.	06
		SHT	26 OF 34

DRIVE AND INSTRUMENT INTERFACE DIAGRAM





LIE WITH PURGING (TYPICAL)



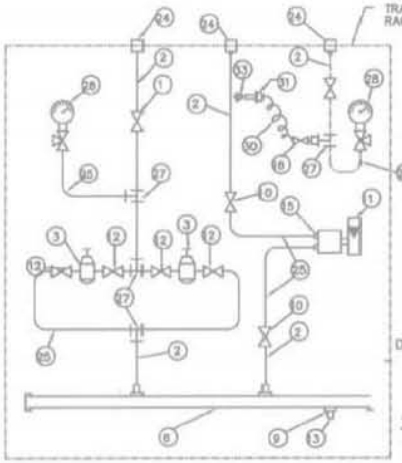
SECTION-BB

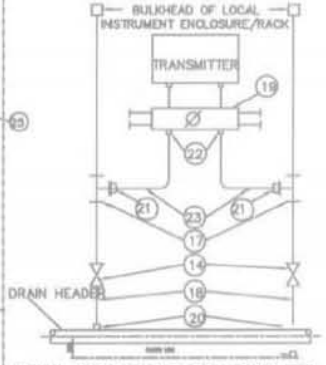
LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	ISOLATION VALVE(gate/globe). SS.
2.	SEAMLESS SS PIPE.
3.	AIR FILTER REGULATOR.
6.	INST. AIR HEADER SS.
10.	COMP. NEEDLE VALVE SS.
11.	AIR PURGE SET.
12.	COMP VALVE SS.
13.	PLUG SS.
15.	TUBE SS CONNECTOR.
16.	TUBE COMP. EQUAL TEE UNION.
24.	BULKHEAD–SS SUITABLE FOR GI PIPE CONNECTION
25.	SEAMLESS TUBE SS.
27.	BRANCH TEE SS.
28.	PR. GAUGE.
30.	NYLON FLEX. HOSE BRAIDED WITH SS WIRE.
31.	HOSE BARBED CONN. SS.
33.	QUICK DISCONNECT SS (PURGE AIR CONNECTION TO INSTRUMENT SOURCE END).

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
14.	SW GLOBE VALVE.
17.	SW EQUAL TEE
18.	S.S. NIPPLE
19.	5 VALVE MANIFOLD
20.	SW HALF COUPLET CS
21.	PIPE x TUBE UNION
22.	SUITABLE ADAPTER
23.	SS TUBE





TYPICAL ARRANGEMENT OF DP TRANSMITTER (Inside LIE/LIR) (MOUNTED BELOW INSTRUMENT SOURCE POINT)

TYPICAL PURGE AIR CONNECTION INSIDE THE INST. ENCLOSURE

(APPLICABLE FOR MILL, AIR & FLUE GAS SERVICE INSTRUMENTS REQUIRING PURGE AIR)

(Drain Header of each LIE/LIR shall be connected to nearest plant drain)

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ENGINEERING DIVISION

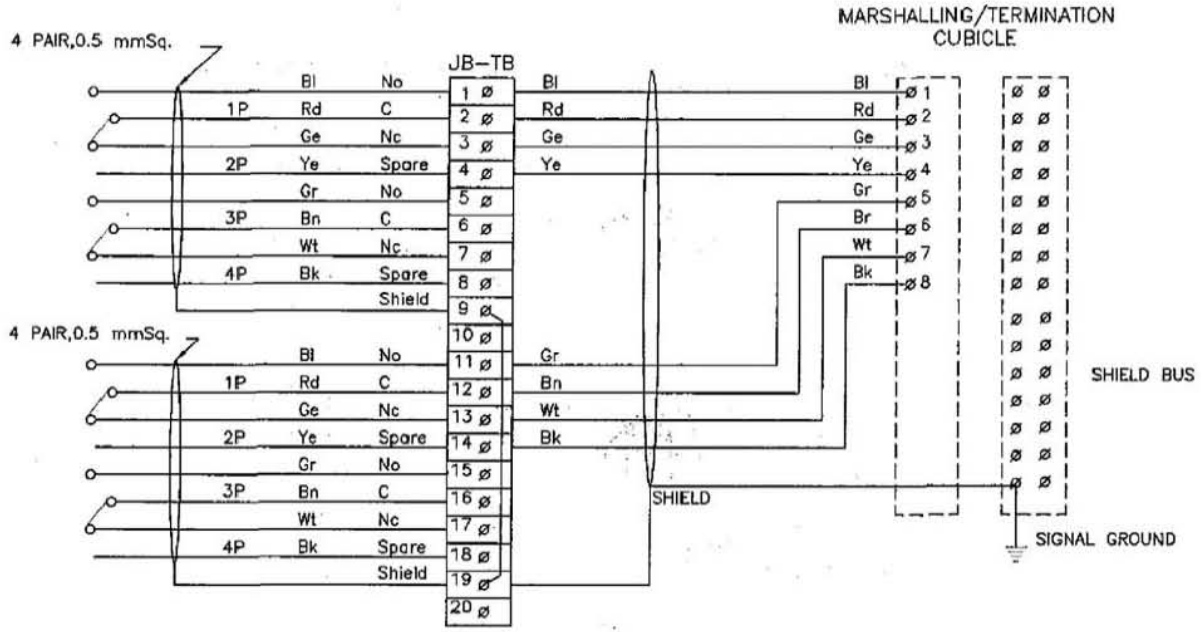
PROJECT: TYPICAL THERMAL POWER PROJECT (TURNKEY EPC PACKAGE)

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE, PURGING SCHEME, DP TRANSMITTER

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	GM	ARCH.	APPD	DATE
A	FIRST ISSUE										08.02.19

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A2	N.T.S.	0000-999-POI-A-036	A



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NTPC LIMITED
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ENGINEERING DIVISION

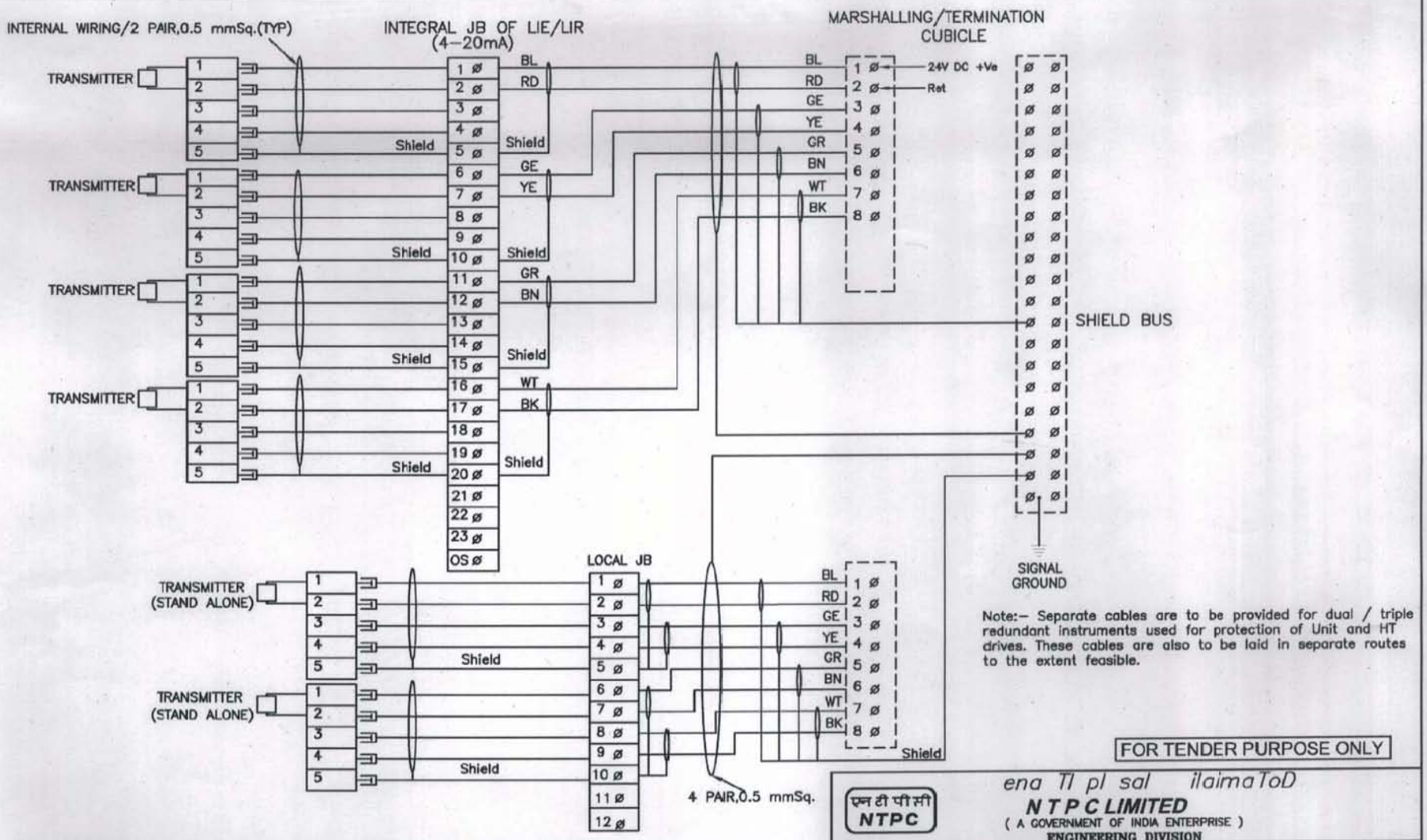
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS/ SWGR SWITCH (COC) TERMINATION DETAILS

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.08

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 01 OF 14	A



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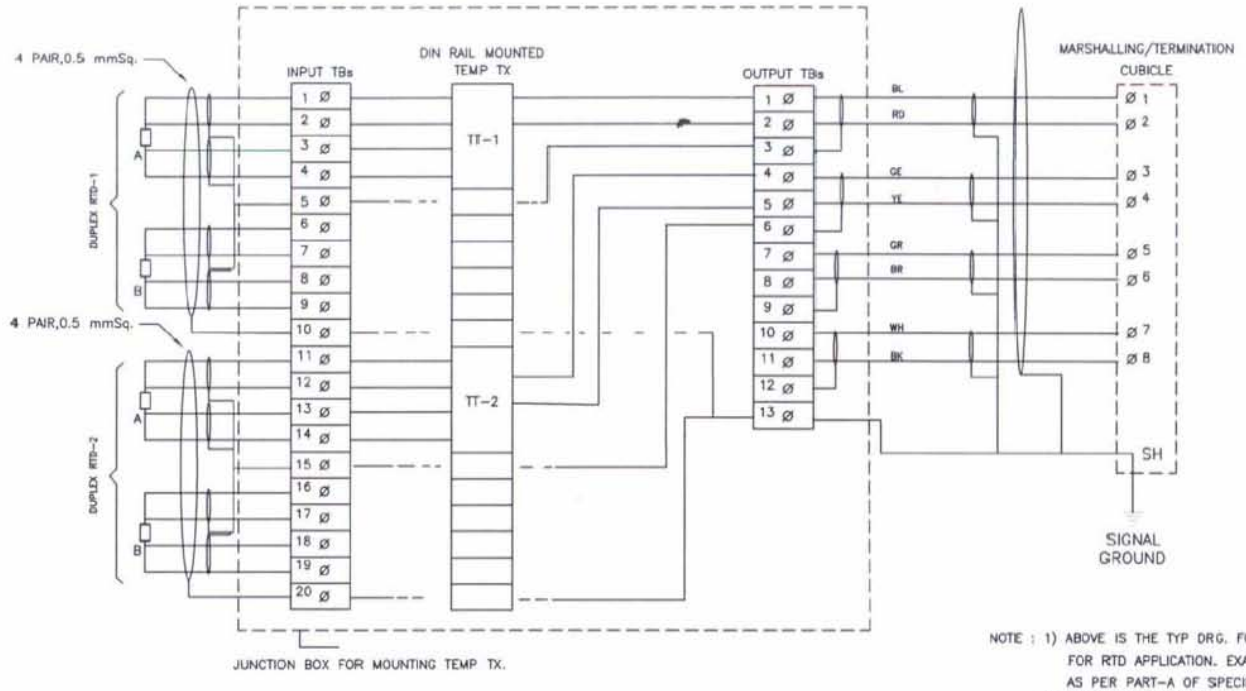
ENGINEERING DIVISION

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
C	NOTE REGARDING CABLE IS ADDED.										10.12.13
B	INTERNAL WIRING FOR LIE/LIR MOUNTED SHOWN WIRING OF STAND ALONE TXTR SHOWN										10.12.06
A	FIRST ISSUE										12.1.05
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS 4-20mA

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 04 OF 14	C



NOTE : 1) ABOVE IS THE TYP DRG. FOR DIN RAIL MOUNTED TEMP TRANSMITTERS FOR RTD APPLICATION. EXACT TYPE OF TEMP TRANSMITTER SHALL BE AS PER PART-A OF SPECIFICATION.
2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISED DURING DETAILED ENGG. STAGE.

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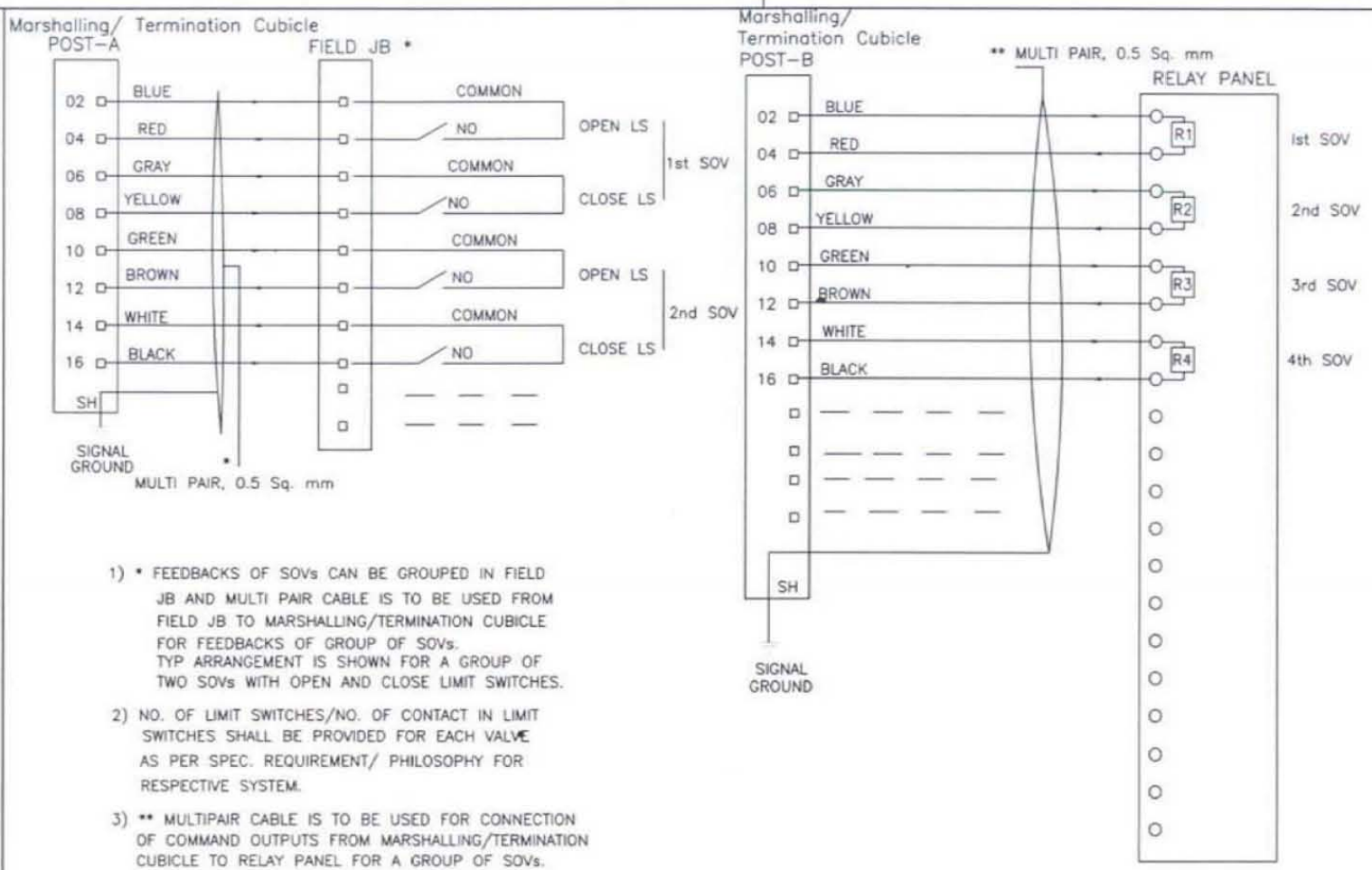
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS INJBs

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.08

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-99S-POI-A-065 SH 06 OF 14	C



1) * FEEDBACKS OF SOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF SOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO SOVs WITH OPEN AND CLOSE LIMIT SWITCHES.

2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.

3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF SOVs.

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National Thermal Power Corporation Ltd.
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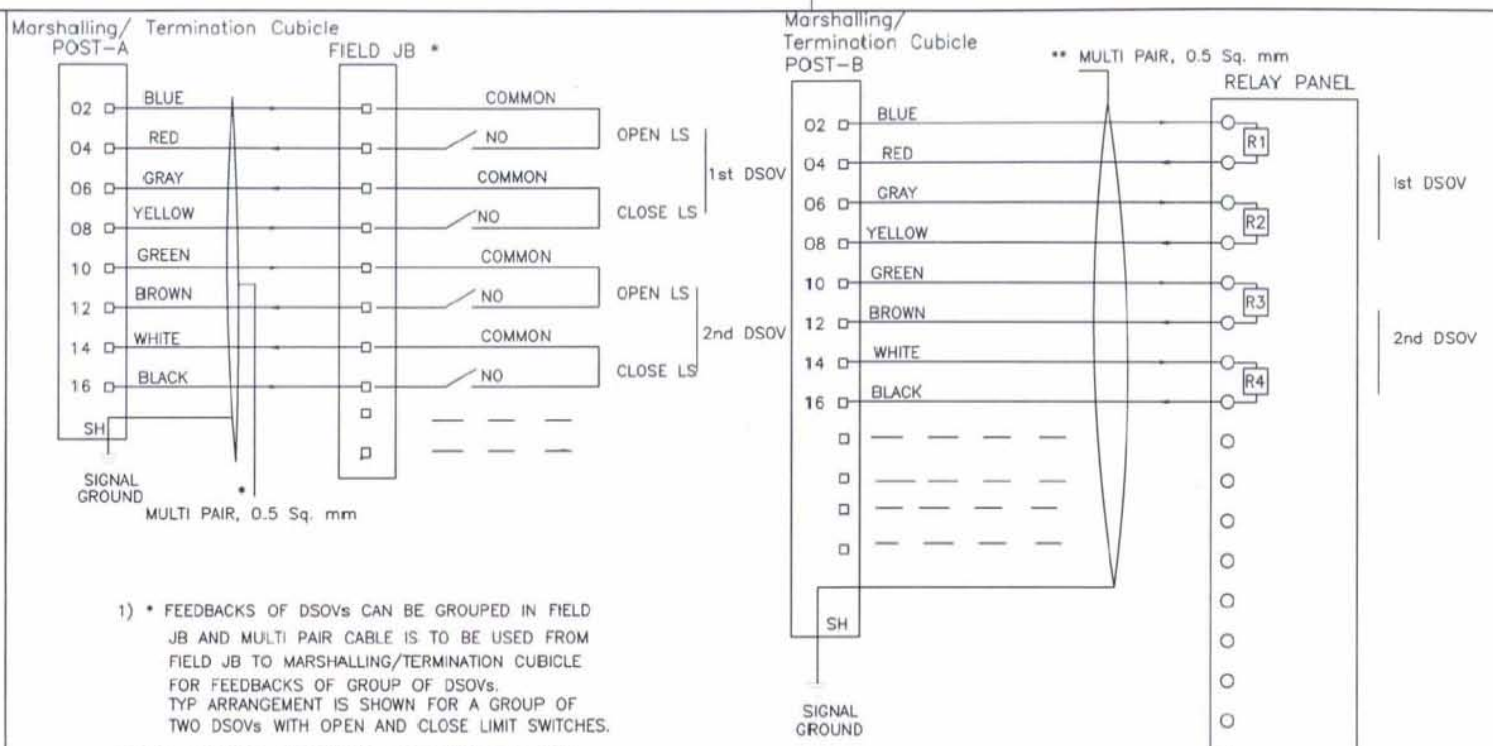
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(SINGLE COIL SOLENOID)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
B	FIRST ISSUE				CLEARED BY						30.10.02

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 08 OF 14	C



1) * FEEDBACKS OF DSOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF DSOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO DSOVs WITH OPEN AND CLOSE LIMIT SWITCHES.

2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.

3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF DSOVs.

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National Thermal Power Corporation Ltd.
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ENGINEERING DIVISION

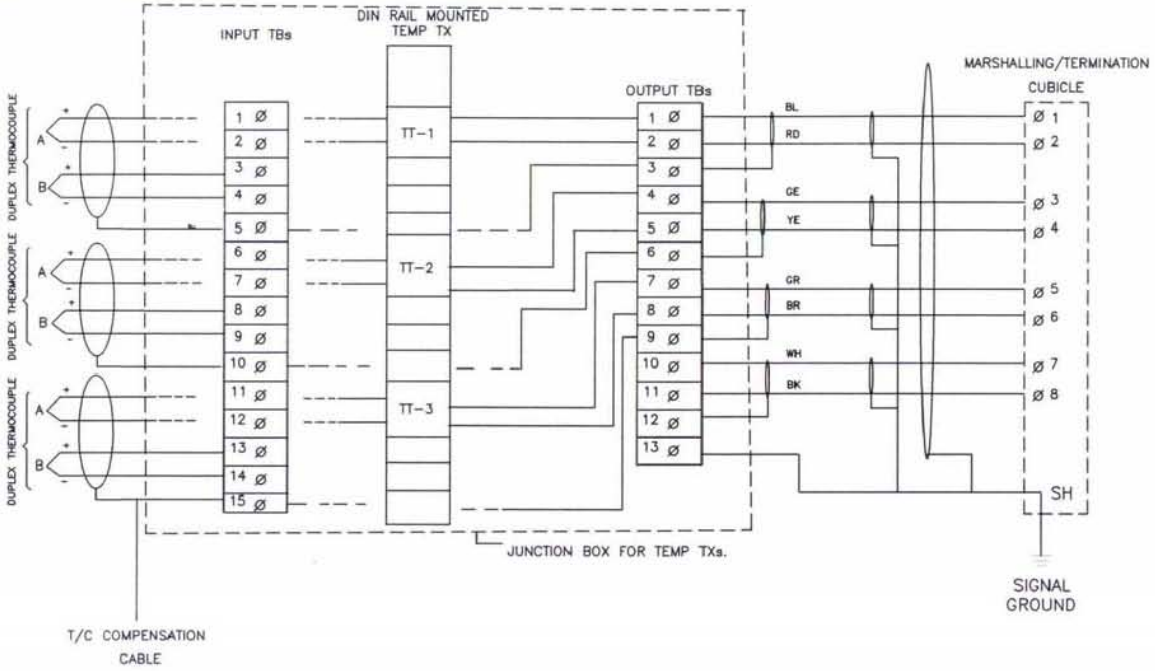
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(DOUBLE COIL SOLENOID)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
B	FIRST ISSUE										30.10.02

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 09 OF 14	C



NOTE: 1) ABOVE IS THE TYP DRG. FOR DIN RAIL MOUNTED TEMP TRANSMITTER FOR T/C APPLICATION. EXACT TYPE OF TEMP TRANSMITTERS SHALL BE AS PER PART-A OF SPECIFICATION.

2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISED DURING DETAILED ENGG. STAGE.

3) AFTER GLANDING OF T/C CABLES ON JB, THE CABLE PAIR OF FIRST ELEMENT WILL BE DIRECTLY CONNECTED TO TT AND FOR CABLE PAIR OF SECOND ELEMENT LOOP SHALL BE KEPT, BEFORE TERMINATION AT INPUT TBs FOR FUTURE USE.

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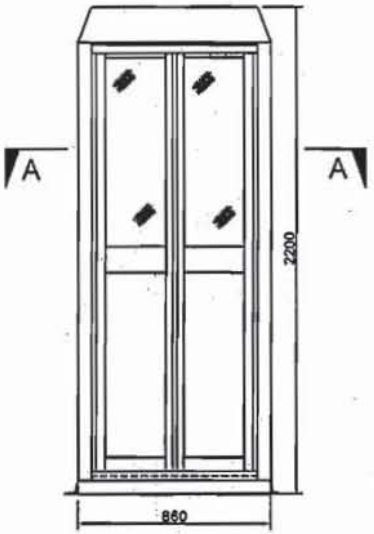
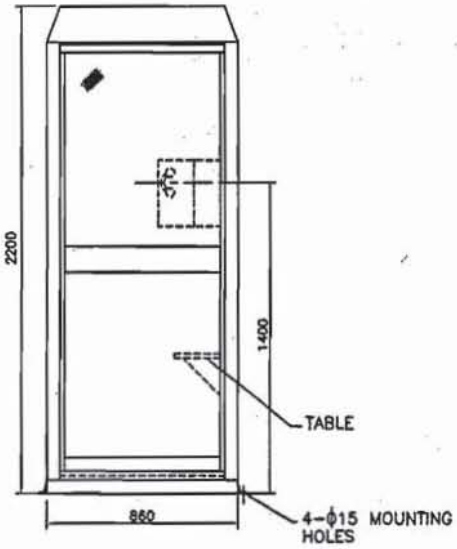
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
					CLEARED BY						
A	FIRST ISSUE										29.04.06

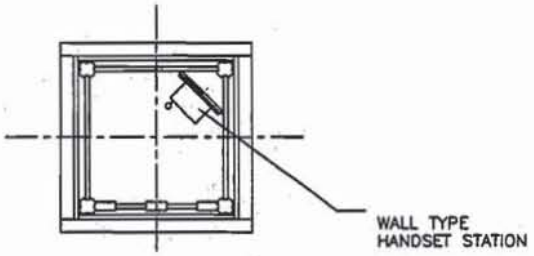
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
TYPICAL T/C CONNECTION WITH TEMP TXs IN JBs

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 11 OF 14	C







SECTION A–A

NOTES

1. LOCATIONS SHALL BE FINALISED DURING DETAILED ENGINEERING.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: ACOUSTIC HOOD OUT LINE

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-070	A

QUALITY ASSURANCE

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)	IBR Certification (if applicable)(R)	Hydro Test(R)	Material Test certificate ®
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 (IEC – 754 / ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD(IEC-751)	Y	Y	Y	Y	Y	Y			
14. Thermowell	Y		Y				Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

: Note: **1) Detailed procedure of Environmental Stress Screening shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization**

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.

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)	IBR Certification (if applicable)(R)	Hydro Test(R)	Material Test certificate ®
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			
14. Thermowell	Y		Y				Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

:

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)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
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. Impact head type element	Y	Y	Y					Y				Y
19. Level transmitter/float type switch	Y	Y	Y	Y					Y	Y	Y	Y
20. Flue Gas analyser	Y	Y	Y	Y								
21. Dust emission monitors	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.

SUB-SECTION–E-65

PROCESS CONNECTION & PIPING

PROCESS CONNECTION AND PIPING

TESTS / ITEMS	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	Paint Shade/thickness ®	Flattening,flaring,hydrotest,hardness check as per ASTM standard (A)	Component Ratings ®	Wiring ®	Make, Model, Type, Rating®	IR & HV ®	Review of TC for instrument/devices (R)	Accessability of TBs/Devices ®	Illumination,grounding ®	Tubing ®	Leak/Hydro test(A)	Chemical/physical properties of material (A)	Proof pressure test,Dismantling & reassembly test,Hydrulic impulse and vibration test (R)	Tests as per standards & specification
Local Instrument enclosure	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Local instruments racks	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box	Y	Y	Y	Y*		Y		Y	Y								
Gauge Board	Y	Y	Y	Y		Y		Y		Y			Y	Y			
Impulse pipes and tubes	Y		Y		Y			Y							Y		
Socket weld fittings ANSI B-16.11	Y		Y					Y							Y		Y
Compression fittings	Y		Y					Y						Y	Y	Y	
Instrument valves & Valve manifolds	Y		Y					Y						Y	Y		
Copper tubings ASTM B75	Y							Y									Y

*-applicable for painted junction boxes.

Note: R-Routine Test A- Acceptance Test Y – Test applicable

Note: 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.

SUB-SECTION–E-66

INSTRUMENTATION CABLE

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 items.

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)
- ** Characterisitic 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.

SUB-SECTION–E-67

CONTROL VALVE ACTUATORS & ACCESSORIES

CONTROL VALVE ACTUATORS AND ACCESSORIES.

TESTS / ITEMS	Make,model, tag (R)	Dimension®	Surface finish®	Heat Treatment®	Material Test Certificates®	IBR Certificates®	Hydraulic Test®	UT/Radiography for >900 lb rating®	MPI/DP®	Pressure Resistance®	Seat leakage®	Timeing Open/Close®	Linearity/Hysterisis®	Functional Test, review for make and TC of accessories®
CONTROL VALVE AND ACTUATOR														
Overall	Y	Y	Y			Y	Y				Y	Y	Y	Y
Body		Y	Y	Y	Y			Y	Y	Y				
Bonnet		Y	Y	Y	Y									
Trim		Y			Y			Y*						
Pneumatic actuator	Y	Y								Y				
Electro pneumatic positioner	Y													Y

R- Routine Test A - Acceptance Test Y - Test Applicable

Y* - **UT on spindle dia >= 40 mm.**

Note : **1)** Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme General Technical Conditions

2) 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 finalisation for all item.

SUB-SECTION–E-68

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

Test/Attributes Characteristics / ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	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. Requirement of test and procedure finalized during QP finalization

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

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

ITEM/ COPONENT/ 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	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 Burn-in and Elevated Temperature 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

CONTROL PANEL

Attributes/ Characteristics / Item , Components Sub System Assembly	Electrical Properties	Mechanical Properties	Chemical Properties	Dimensions / Finish	Type/ Rating/Functional check	HV/IR	Routine test as per relevant std.	Constructional Features	Relevant standard ,Seven tank process	Paint finish/ shade/thickness adhesion	Mountings / BOM/ Make, Completeness	Interlock Functional & Operation Testing / Simulation check	Degree of Protection Test	Specification requirement
Sheet Steel		Y	Y	Y										
Aluminum / Copper Bus-bar	Y	Y	Y	Y										
Support Insulator (BS-2782/IEC-660)	Y	Y	Y	Y										
Control / Selector Switch					Y	Y	Y							
Contractor/ MCB					Y	Y	Y							
O/L Protection relays					Y		Y							
C.T /V.T/ Indicating Meter					Y	Y	Y							
Fuse/ Fuse carrier					Y	Y	Y							
Terminals/lugs/pvc wires	Y			Y	Y	Y	Y							
Timers					Y	Y	Y							
LVS, Mosaics														Y
Push Button/ Lamp/ (Relevant standard)					Y	Y	Y							
Control Transformer					Y	Y	Y							
Mimic, Annunciator					Y		Y							
Gasket		Y	Y	Y	Y		Y							
Fabrication								Y						
Pretreatment & Painting									Y	Y				
Control panel										Y	Y	Y	Y	Y

NOTE:

1. This is an indicative list of Test/ Checks. The manufacturer to furnish a detailed Quality Plan indicating the practice and procedure along with supporting documents.
2. All major Bought Out Items will be subject to Employer approval.

TYPE TEST REQUIREMENT

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. If the bidder proposes a different standard/code from that indicated at table 3.00.00, same is acceptable provided the equivalence of the proposed standard is established by the bidder. 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.

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.

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	Transducers	As per standard (col 4)	IEC-60688,IS12784	No	Yes
3	Thermocouple	Degree of protection test	IS-13947	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	No
7	Dust emission monitor	Degree of protection test	IS-13947	No	Yes
8	Instrumentation Cables Twisted & Shielded*				
	-Conductor	Resistance test	VDE-0815	No	Yes
		Diameter test	IS-10810	No	Yes
		Tin Coating test (Persul-phate test)	IS-8130	No	Yes
	-Insulation	Loss of mass	VDE 0472	No	Yes
		Ageing in air ovens**	VDE 0472	No	Yes

		Tensile strength and elongation test before and after ageing**	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
	-Inner sheath***	Loss of mass	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Cold bend/ cold impact test	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
	-Outer sheath	Loss of mass	VDE 0472	No	Yes
		Ageing in air ovens**	VDE 0472	No	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
		Colour fastness to water	IS-5831	No	Yes

		Cold bend/ cold impact test	VDE-0472	No	Yes
		Oxygen index test	ASTMD-2863	No	Yes
		Smoke Density Test	ASTMD-2843	No	Yes
		Acid gas generation test	IEC-60754-1	No	Yes
	-fillers	Oxygen index test	ASTMD-2863	No	Yes
		Acid gas generation test	IEC-60754-1	No	Yes
	-AL-MYLAR shield	Continuity test		No	Yes
		Shield thickness		No	Yes
		Overlap test		No	Yes
	-Over all cable	Flammability Test	IEEE 383	No	Yes
		Swedish Chimney Test	SEN 4241475	No	Yes
		Noise interference	IEEE Trans-actions	No	Yes
		Dimensional checks	IS 10810	No	Yes
		Cross talk	VDE-0472	No	Yes
		Mutual capacitance	VDE-0472	No	Yes
		HV test	VDE-0815	No	Yes
		Drain wire continuity		No	Yes