

	2 x 660 MW ENNORE SEZ STPP BASIC TECHNICAL FEATURES FOR HT / LT MOTORS (FOR BHEL-PEM SCOPE PACKAGES)	Doc. No.	PE-DC-412-565-E003
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- 3.4.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

Minimum Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

- 3.4.3 The locked rotor current of the HV (11 kV) motors (except MDBFP motors) shall not exceed 650% of full load current inclusive of tolerance as per IS: 325 and for MV (3.3 kV) motors locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.

- 3.4.4 The following frequency of starts shall apply to HV (11 kV), MV (3.3 kV) & LT motors

- i) Two nos. consecutive cold starts in quick succession with third start after 5 minutes in cold condition.
- ii) Two nos. consecutive hot starts in the interval of 15 minutes in hot condition.

- 3.4.5 Locked motor withstand time of motors under hot condition at highest voltage limit shall be as follows:

- a) For motors with starting time up to 20 sec.
 - at least 2.5 sec. more than starting time.
- b) For motor with starting time above 20 secs but not exceeding 45 secs.
 - at least 5.0 sec. more than starting time.
- c) For motors with starting time above 45 secs.
 - at least 10% more than starting time.

The starting time of the motor referred above is at minimum permissible voltage. For motors and in cases where the above requirements are not complied with, speed switches of approved make & type shall be provided to bypass the locked rotor protection for a pre-selected time during starting of motors. The speed switches shall have one NO & one NC contacts having maximum interrupting capacity of 5 Amps at 240V AC and 0.25 amps at 220 V DC.

3.5 Running Requirements

- 3.5.1 Motors shall run satisfactorily at a supply voltage of 80% of rated voltage for 5 minutes with full load without injurious heating to the motor.

- 3.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

3.6 Stress during bus Transfer:



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- 3.6.1 Motors shall withstand the voltage and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.
- 3.6.2 Motor windings shall be adequately braced to satisfactorily withstand the mech. Stresses during above condition.
- 3.6.3 Motors shall be capable of withstanding heavy in-rush transient current caused by bus transfer without damage.
- 3.6.4 Motor and driven eqpt. Shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.7 Noise level

The maximum noise level for motors shall be in line with IS 12065.

3.8 Vibration

The maximum vibration for motors shall be in line with IS: 12075.

3.9 Crane duty motors will be of squirrel cage induction motor and shall suit the duty class S4, cyclic duration factor 40% and 300 starts. Crane duty motors shall be provided with VVFD for speed control.

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4.0 CONSTRUCTIONAL FEATURES

4.1 Degree of Protection

- 4.1.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Canopy shall be provided for outdoor motors. CW motors (in case of screen prot. Drip proof) shall conform to degree of protection IP: 23 as per IS: 4691. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.

- 4.1.2 The stator laminations shall made from suitable silicon steel/magnetic steel sheet varnished on both sides and pressed to form a rigid core.

- 4.1.3 The rotor shall be of rigid cage construction with die cast aluminium / copper alloy / copper bars firmly wedged in bar slots and brazed to the end rings. The rotor cage shall be designed to operate satisfactorily under respective starting and load duty cycle.

4.2 Enclosure and Cooling

- 4.2.1 Motors shall generally have totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) enclosures or Closed Air circuit Air (CACA), the method of cooling conforming to IC-0141 or IC-0151 or IC-0161 of IS: 6362 up to 3000 kW motor. CW Motors may be screen protected drip proof (SPDP).

- 4.2.2 Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.



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4.2.3 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.3 Class of Insulation

HV/MV/LT motors shall have class F insulation. The temperature rise of all motors shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits, 10deg C rise above the temperature limits specified in IS: 325 shall be permissible.

4.4 Bearings

4.4.1 Horizontally mounted motors shall have grease lubricated ball/roller or sleeve bearings. For HV/MV motors, the bearings shall be regreasable type and for LV motors, these bearings can be either sealed life lubricated type or regreasable type as per manufacturer's standard.

4.4.2 The vertical motors shall have a combined thrust and guide bearing on top and guide bearing at bottom. If the ball or roller bearings can take vertical thrust, thrust and guide bearing need not be provided.

4.4.3 After taking all motor driven equipment loads and thrust (if any) into account, the bearings shall be suitable for min. 20,000 working hours. Re-greasable bearings shall be provided with grease nipples and relief holes for on-line re-greasing and shall be suitable for 8000 working hours without changing of the grease.

4.4.4 The bearings of solidly coupled motors shall be of the same type as those of the driven equipment.

4.4.5 For motors below 15 kW shall be provided with sealed ZZ bearing.

4.4.6 Motors rated above 1000kW shall be provided with insulated end shield on non-driving end to prevent flow of shaft current.

4.5 Terminals and Terminal Boxes

4.5.1 Motors of rating 90 kW and up to 160kW will be controlled by air circuit breaker with numerical protection. For all motors of rating up to 90kW shall be provided with MCCBs. The terminal box of motors for HV (11 kV), MV (3.3 kV) & LT motors shall be designed for the maximum fault current for a duration of at least 0.25 secs. **11kV & 3.3kV motors terminals shall be able to withstand 44kA for 0.25 seconds.**

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4.5.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.5.3 For HV/MV motors, the main terminal box shall be of phase-segregated type with clamping arrangement for the terminals.

4.5.4 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A,C,B or V, W & U respectively.

4.5.5 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

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- 4.5.6 Motor terminals and terminal leads shall be fully insulated with no bar live parts.
- 4.5.7 Separate terminal boxes shall be provided for space heaters and temp. Indicators. If this is not possible in case of LT motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material for single core cables) with double compression tinned brass glands shall be provided in terminal boxes.
- 4.5.8 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 180 and 90 degree for HT and LT motors respectively.
- 4.5.9 Cable glands and cable lugs as per selected cable sizes shall be provided in line with cable erection philosophy. For single core cable termination, gland plates shall be of non-magnetic material.
- 4.6 Grounding

Two separate earthing terminals suitable for connecting G.I. strip grounding conductor shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.7 General

- 4.7.1 Motors provided for similar drives shall be interchangeable.
- 4.7.2 An arrow block shall be screwed on the body of the motors on the non-driving end to indicate the direction of rotation of the motors.
- 4.7.3 Motors for Fuel oil unloading and drain oil pumps located in hazardous areas shall be with flame-proof enclosures in accordance with IS 2148 / IEC 60079.

a) Fuel oil area: Group - IIB.

b) Hydrogen generation plant area: Group - IIC

- 4.8 Neutral terminal box of motors rated 1000kW and above shall provision of mounting Neutral CTs of PS class identical to the CTs to be provided at switchgear end. Further the neutral terminals of HV motors rated below 1000kW shall be accessible.

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5.0 ACCESSORIES

5.1 SPACE HEATERS

All motors rated 30KW and above shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

The leads from space heaters of each motor shall be brought out to a separate terminal Box. Space heaters shall be mounted inside the motor in accessible places so that their removal and replacement is simple.

5.2 RESISTANCE TEMPERATURE DETECTORS (RTDs)

- 5.2.1 HV/MV motors stator windings shall be provided with 12 nos. Simplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of winding temperature. The leads from RTDs of each motor shall be brought out to a separate terminal Box.

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5.2.2 For HV/MV motors, each bearing shall be provided with 1 no. Duplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of bearing temperature. The leads from these RTDs shall be brought out to a separate terminal Box or the terminal box same as for winding RTDs.

5.3 DIAL TYPE TEMP. INDICATORS

5.3.1 For HV/MV motors, each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. The indicators shall have 2 nos. NO contacts rated for 5A, 240 V AC and 0.5 A, 220 V DC for alarm/trip purpose.

5.4 Vibration monitoring pads

5.4.1 Provision shall be made in all HV/MV motors for mounting vibration detectors.

6.0 NAME PLATE

Motors shall have stainless steel name plate with all particulars as per IS: 325. In addition bearing identification number and type of lubricant is to be indicated.

7.0 PAINTING

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL 7032).

8.0 TESTING

8.1 Type Tests

For HT & LT Motors, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.

8.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.

SPECIFIC ELECTRICAL REQUIREMENT

SL.NO.	PARAMETERS	UNIT	ENNORE
	MOTOR		
1	DESIGN AMBIENT TEMP	DEG. C	50
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415V, + 10%
3	FREQUENCY WITH VARIATION	Hz	50 (+) 3% to (-) 5%
4	COMBINED VOLTAGE & FREQUENCY VARIATION		10%
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	160 kW
6	SYSTEM FAULT LEVEL AND ITS DUARTION	KA	50 KA, 1 Sec
7	SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F and temp rise limited to Class-B
9	MIN. STARTING VOLTAGE		85%
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		Upto 200W
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.
12	ACCEPTABLE NOISE LEVEL	DB	85dB at 1.0m in line with IS 12065
13	TYPE OF STARTER PROVIDED IN MCC		N.A.
14	DOP OF ENCLOSURE		Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.
15	SPACE HEATER REQUIREMENT		30KW & ABOVE
16	PAINT SHADE		Shall be confirmed during detailed engineering.
17	SPECIAL REQUIREMENT		For HT & LT Motors, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost. All motors shall be subjected to routine tests as per IS: 325 / IS: 12615. The motors shall generally conform to IS: 325 / IEC-60034.
18	ENERGY EFFICIENT		All LV MOTORS ABOVE 10 KW WITH S1 DUTY SHALL BE COMPULSORILY OF ENERGY EFFICIENT LEVEL IE3 AS PER IS 12615:2011

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 1 OF 2

S. No.	Description		Data to be filled by successful bidder
A.	General		
1	Manufacturer & country of origin		
2	Motor type		
3	Type of starting		
4	Name of the equipment driven by motor & Quantity		
5	Maximum Power requirement of driven equipment		
6	Rated speed of Driven Equipment		
7	Design ambient temperature		
B.	Design and Performance Data		
1	Frame size & type designation		
2	Type of duty		
3	Rated Voltage		
4	Permissible variation for		
5	a	Voltage	
6	b	Frequency	
7	c	Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)		
9	Synchronous speed & Rated slip		
10	Minimum permissible starting voltage		
11	Starting time in sec with mechanism coupled		
12	a) At rated voltage		
13	b) At min starting voltage		
14	Locked rotor current as percentage of FLC (including IS tolerance)		
15	Torque		
	a) Starting		
	b) Maximum		
16	Permissible temp rise at rated output over ambient temp & method		
17	Noise level at 1.0 m (dB)		
18	Amplitude of vibration		
19	Efficiency & P.F. at rated voltage & frequency		
	a) At 100% load		
	c) At 75% load		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55\text{KW}$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
		SHEET 1 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			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

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				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
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SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
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				BIDDER/		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :			
		SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE			SECTION		
				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			VOLUME III					
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1	2	3	4	5	6	7	8	9	P	W	V	11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA MA	VISUAL TEST	100% SAMPLE	- MANUF'S SPEC.	NO VISUAL DEFECTS MANUF'S SPEC.	INSPT. REPORT LOG BOOK AND OR SUPPLIER'S TC	3 3	- -	2 2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2.DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA MA MA	VISUAL MEASUREMENT ELECT. & MECH TESTS	100% SAMPLE -DO-	- MANUFR'S DRG. . MANUF'S SPEC./ RELEVANT IS	NO VISUAL DEFECTS (FREE FROM BURS) MANUFR'S DRG. RELEVANT IS	LOG BOOK -DO- SUPPLIER'S TC	3 3 3	- - -	- 2 2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
1.9	CONDUCTORS	1. SURFACE FINISH 2.ELECT. PROP. & MECH. PROP	MA MA	VISUAL ELECT. & MECH.TEST	100% SAMPLES	- RELEVANT IS/ BS OR OTHER STANDARDS	FREE FROM VISUAL DEFECTS RELEVANT IS/ BS OR OTHER STANDARDS	LOG BOOK SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3* 3	- -	2* 2	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

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									P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
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 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			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNES	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-	RELEVANT SPEC./ ASTM-E165	MANUF'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			SPECIFICATION :		
				BIDDER/ :			TITLE			NUMBER :		
				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			REMARKS
									P	W	V	
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	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		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	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	FOR MV MOTOR
		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	
2.6	IMPREGNATION	1.VISCOSITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	THREE DIPS TO BE GIVEN
		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	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
									BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 7 OF 9		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
				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			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY
		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	
		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 SHEET 8 OF 9		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :			
SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE			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			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	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 ^s	1	* NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 ^s	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 ^s	1	* NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	* NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 ^s	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 ^s	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. <u>Legends for Inspection agency</u> 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			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				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
1	2	3	4	5	6	7	8	9	P	W	V	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		
		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			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	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. <u>Legends for Inspection agency</u> 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			

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:

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

(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)

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

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

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

CABLE TRAY ANNEXURE

3.05.04

For CHP following shall also be applicable.

- a) All cable routes shall be overhead along the route of the conveyor gallery by separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600 mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0 M above the grade level except for rail/road crossings where it shall be at 8.0 M above grade level. However in bunker area the bottom of the cable trestle shall be 10 to 14 M depending on boiler/bunker layout.
- b) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches receptacles etc.
- c) Cables for Pull cord switches and belt sway switches shall be taken in cable trays. The trailing cables of the mobile machines shall also be laid in cable trays.

3.05.05

Cable trench shall be allowed only between switchyard control room and 'A' row column of TG building.

4.00.00

EQUIPMENT DESCRIPTION

4.01.00

Cable trays, Fittings & Accessories

4.01.01

Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates, etc.) and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.

4.01.02

These shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.

4.01.03

Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Minimum thickness of mild steel sheets used for fabrication of

4.01.04 Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of minimum thickness 2 mm and shall be hot dip galvanized as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.

4.01.05 Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of 2000 mm unless design is approved for larger span. Cable trays shall be suitable for a cable weight of 100 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/86 microns respectively. The amount of zinc deposit shall not be less than 610 gm per square meter.

4.01.06 Cable trays fabricated from standard rolled sections shall be 50x50x6/75x75x6 sections for runners for supporting spans limited to 2000 mm/more than 2000 mm respectively. Cross support shall be 32x6 mm / 50x6 flat for widths up to 500mm/more than 500mm respectively.

4.01.07 Separate coloured paint strips shall be applied for identification of different type of trays depending upon types of usage/applications/area as below:

11kV/3.3kV equally spaced at 5 metres interval

Instrumentation cables : green strips ----- do -----

4.02.01 Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".

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- a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardware such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.
- b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware's fittings and accessories shall be prefabricated factory galvanised.
- c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanized surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.
- d. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.
- e. The main support channel and cantilever arms shall be fabricated out of minimum 2.5 thick rolled steel sheets conforming to IS.
- f. Cantilever arms of 300 mm, 600 mm and 750 mm in length are required. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.
- g. Cable trays in areas subjected to excessive coal dust or mechanical damage shall have hot dip galvanized sheet steel metal trays cover installed on front tray in vertical run and inverted 'V' type on upper tray in horizontal run with consideration for ventilation.
- h. FRP Cable trays shall be used for areas like intake raw water pump house, Desalination plant, CHP, Battery room, NDCT and chemical house.

4.02.03

The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above are indicative only. Nevertheless, the support system shall be designed by the contractor to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Contractor without any

additional cost. The contractor shall submit the detailed drawings of the system offered by him along with the bid.

4.03.00 Pipes, Fittings & Accessories

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

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

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

4.04.00 Junction Boxes

4.04.01 Junction Boxes shall comprise of a case with hinged door constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3 mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.

4.04.02 Glass Fibre Reinforced Junction Boxes

No. of Ways: 12/24/36/48 with 20% spares terminals.

4.04.03 Junction boxes shall be Glass Fibre Reinforced with saturated polyester conforming to standards like DIN 16911 type 803/16913 type 834, 5 self extinguishing in accordance with ASTM D635/UL 94 VO.

Junction boxes for use in outdoor or damp locations shall be sturdy construction. Temperature resistance shall be between – 10 to 100°C. Impact resistance shall be greater than 7 Nm, (EN 50014). Protective insulation shall be in line with VDE 0100, dielectric strength shall be greater than 10 KV/mm, halogen free toxicity, the enclosure and door cover shall be painted and electro statically power coated (preferably in RAL 7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door.

ANNEXURE III

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SECTION -IC

C & I SPECIFICATIONS FOR DCS BASED FUEL OIL UNLOADING & STORAGE SYSTEM

	TANDECO			
	2X660 MW ENNORE SEZ STPP		DESG	CM
	JOB NO: 412		CHKD	SCS
	REV. NO. 00	DATE: 07.01.17	APPD	SCS

INDEX

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7	SIGNAL EXCHANGE BETWEEN DRIVES & DCS (DCP)
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2X660 MW ENNORE SEZ Supercritical Thermal Power Project

SCOPE OF C&I FOR FUEL OIL UNLOADING & STORAGE SYSTEM

1. FUEL OIL UNLOADING & STORAGE SYSTEM shall be operated from DCS (BHEL's scope).
2. The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire FOHS. 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 the Customer/BHEL's approved vendor list. List of BHEL approved vendors has been enclosed which shall be subject to Customer's approval. 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 enclosed in the specification.
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. All transmitters & electronics items will be explosion proof / intrinsically safe as per hazardous area classification.
10. PG/DPG/PS/PT/LT shall have chemical/diaphragm seal.
11. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of any deviation a No deviation certificate is to be furnished.
12. 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.
13. 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.
14. All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.
15. 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.

2X660 MW ENNORE SEZ Supercritical Thermal Power Project

16. 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.
17. Bidder to furnish electrical load data during detailed engineering
18. Bidder to provide temperature transmitter along with compensating cable, JB/Rack & other erection hardware
19. 415 V AC/230 V AC supply shall be provided by BHEL at a single point, further distribution to various instruments/Equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid.
20. 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.
21. Contractor's C&I representative shall be present at BHEL-PEM for 3 man-days, for preparation of Control scheme of FOHS. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.
22. 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.
23. 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.
24. Interface of MCC, HT SWGR, field instruments, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.
25. Local control panel required for operation shall be in bidder's scope.

C&I GENERAL REQUIREMENT

	SPECIFICATION FOR CONTROL & INSTRUMENTATION FOR AUX PACKAGES	SPECIFICATION NO.:	
		VOLUME	
		SUB SECTION	
		REV. NO.	DATE :
		SHEET	OF

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 & 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.

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.

C&I List of Documents, Deliverables

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR FOHS 2X660 MW ENNORESEZ Supercritical Thermal Power Plant

DOCUMENT NUMBER PE-GL-412-145-I100

SHEET 1 of 1

SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-412-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-412-145-I902	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V0-412-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V0-412-145-I904	INSTRUMENT SCHEDULE with set points	A
5	PE-V0-412-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V0-412-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V0-412-145-I907	FIELD JB/LIE/LIR TERMINATIONS	A
8	PE-V0-412-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V0-412-145-I909	QUALITY PLANS (INSTRUMENTS,VMS, etc.)	A
10	PE-V0-412-145-I910	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
11	PE-V0-412-145-I911	THERMOWELL SIZING CALCULATION	A
13	PE-V0-412-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
14	PE-V0-412-145-I914	ANNUNCIATION & SOE LIST	A

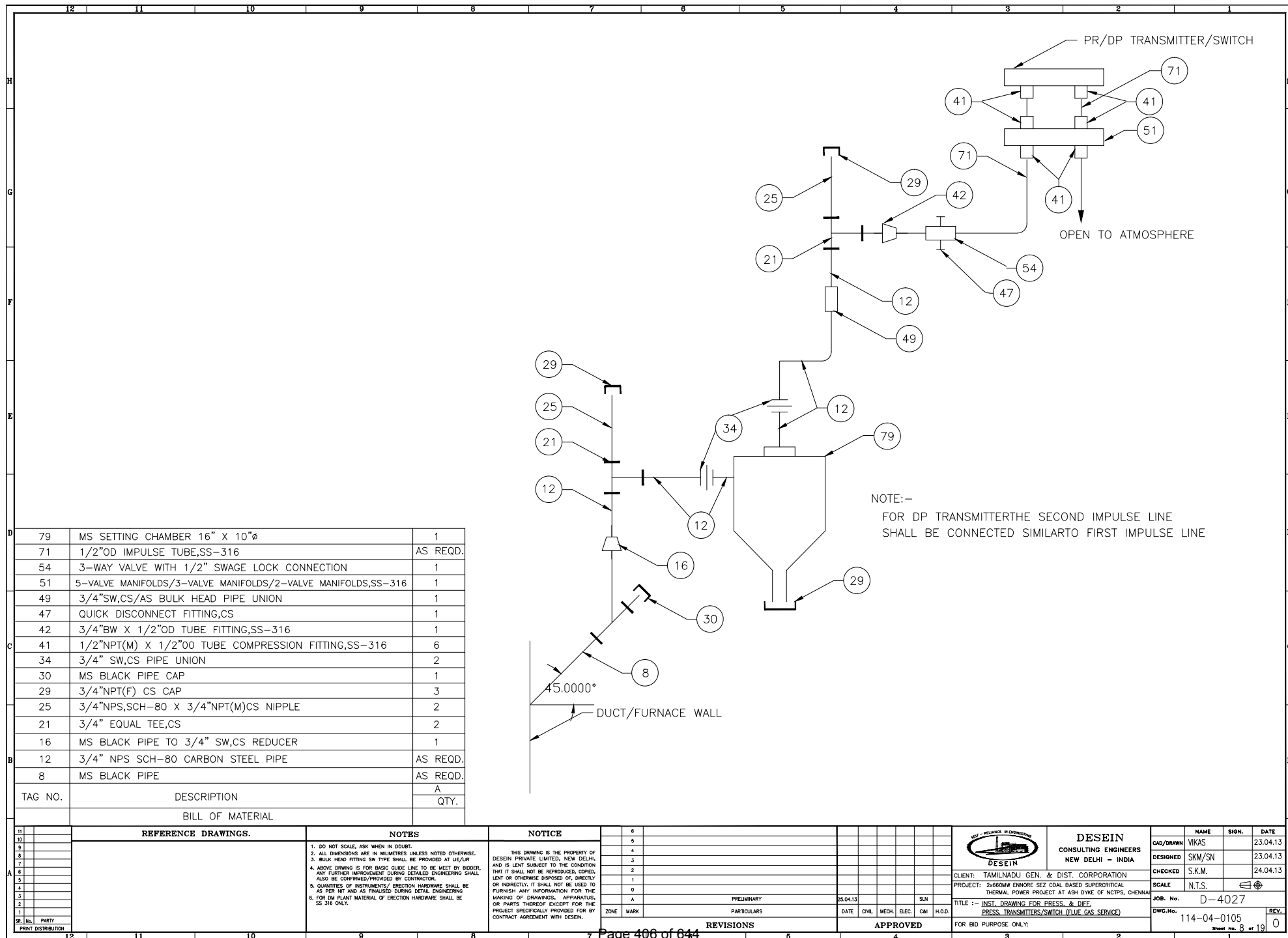
NOTES:

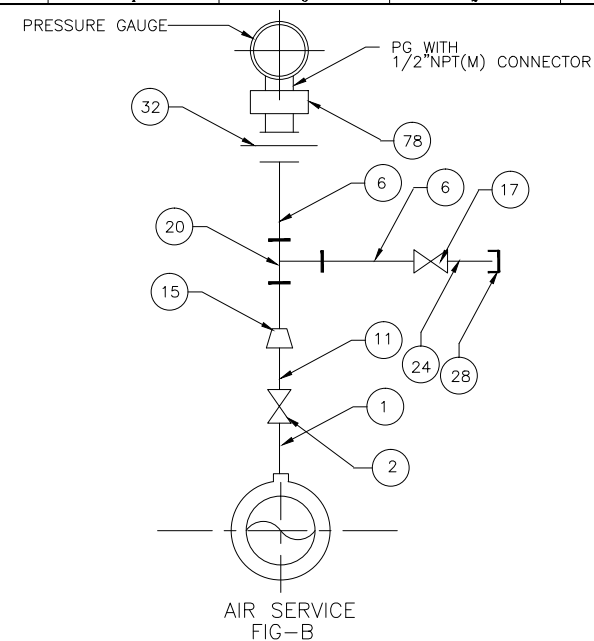
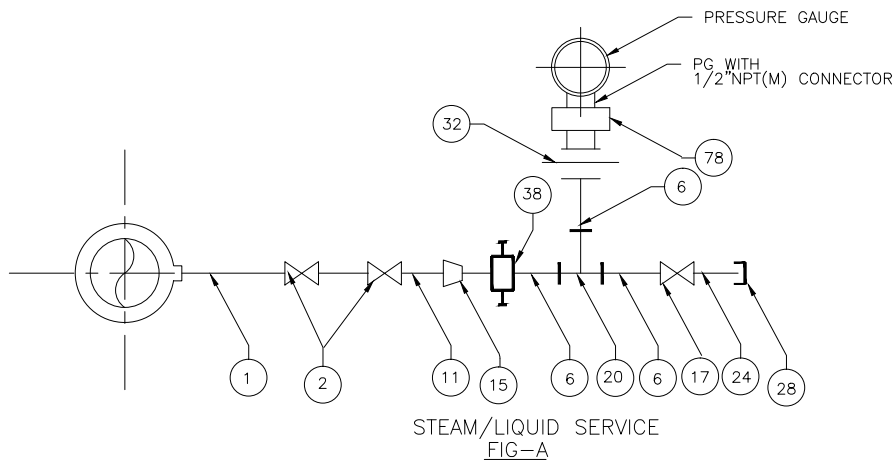
1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/NTPC 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.

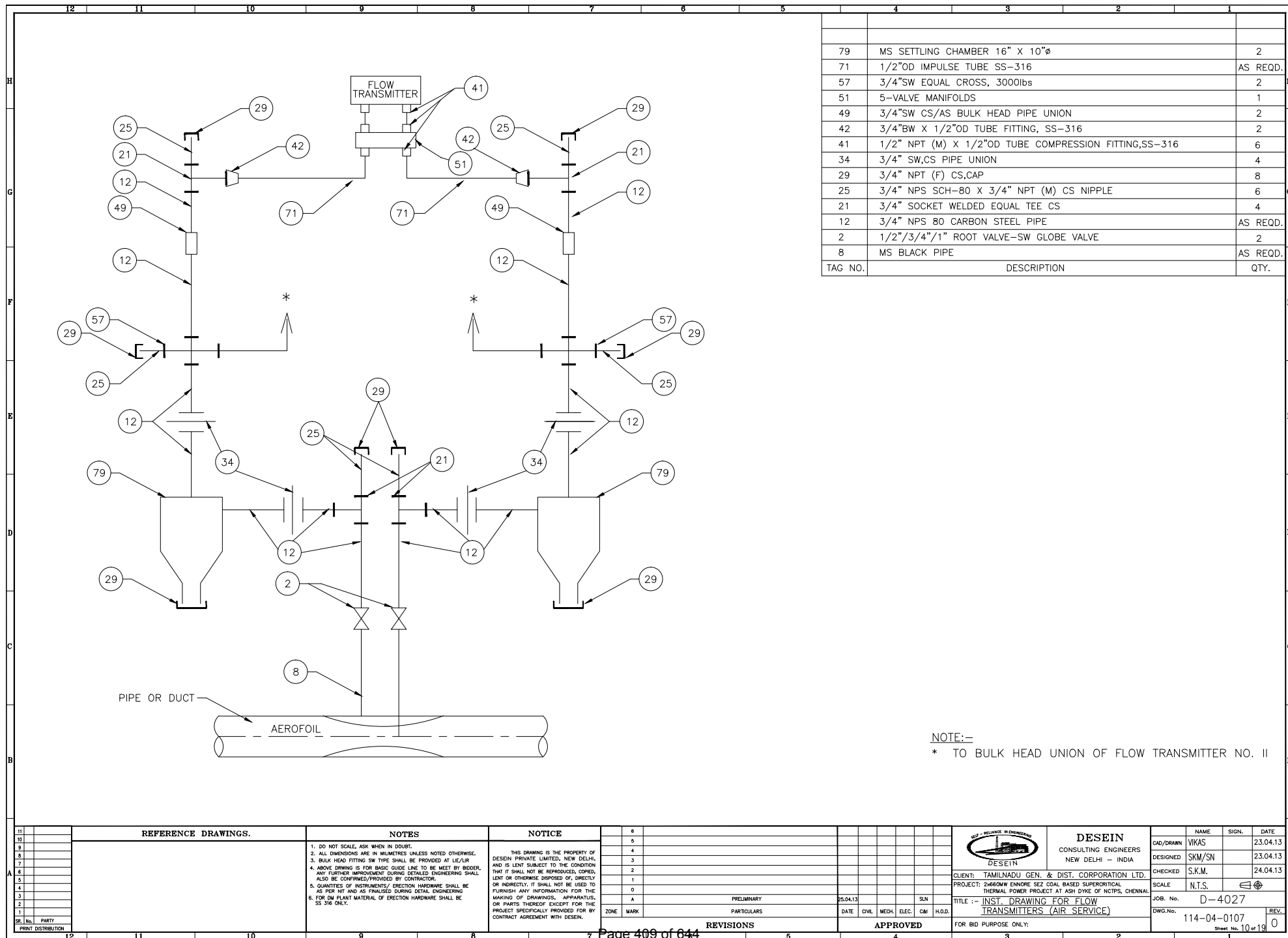
Instrument Hook-up Diagram





78	1/2"NPT(F)X1/2"NPT(M) SNUBBER/PULSATION DAMPER	1	1
59	1/2"SW, STRAIGHT PIPE CONNECTOR, CS/AS	—	—
38	3 WAY GAUGE VALVE 1/2" NB SW	1	—
37	6" COILED SYPHON SCH 80/160 1/2"NB CS/SS	—	—
32	1/2"NPS,3PIECE PIPE UNION WITH 1/2"NPT(F) SCREWED	1	1
28	1/2"NPT (F) CS CAP	1	1
24	1/2"NPS,SCH-80/160X1/2"NPT(M)CS/AS NIPPLE	1	1
20	1/2"SW EQUAL TEE, CS/AS	1	1
17	1/2" SW CS/AS GLOBE VALVE	1	1
15	1" TO 1/2" SOCKET WELDED REDUCER	1	1
11	1" NPS SCH-80/160 CS/AS NIPPLE	1	1
6	1/2" NPS. SCH-80/160 CS/ AS PIPE	AS REQD.	
2	1/2"/3/4"/1" ROOT VALVE-SW GLOBE VALVE	2	1
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.	
TAG NO.	DESCRIPTION	A	B
		QTY.	
BILL OF MATERIAL			

REFERENCE DRAWINGS. 11 10 9 8 7 6 5 4 3 2 1 SHEET NO. PART PRINT DISTRIBUTION		NOTES 1. DO NOT SCALE, ASK WHEN IN DOUBT. 2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE. 3. ABOVE DRAWING IS FOR BASIC GUIDE LINE TO BE MET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR. 4. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING. 5. PRESSURE GAUGE SHALL BE PROVIDED WITH SS-316 MANIFOLDS IN WTO SYSTEM. 6. FOR DW PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.		NOTICE THIS DRAWING IS THE PROPERTY OF DESEIN PRIVATE LIMITED, NEW DELHI, AND IS LENT SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF, DIRECTLY OR INDIRECTLY. IT SHALL NOT BE USED TO FURNISH ANY INFORMATION FOR THE MAKING OF DRAWINGS, APPARATUS, OR PARTS THEREOF EXCEPT FOR THE PROJECT SPECIFICALLY PROVIDED FOR BY CONTRACT AGREEMENT WITH DESEIN.		REVISIONS 6 5 4 3 2 1 0 A PRELIMINARY PARTIOLARS ZONE MARK		APPROVED DATE 25.04.13 CIVIL MECH. ELEC. CM H.O.D.		 DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA CLIENT: TAMILNADU GEN. & DIST. CORPORATION PROJECT: 2x660MW ENCORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCPS, CHENNAI. TITLE :- INST. DRAWING FOR LOCAL PRESSURE GAUGE FOR BID PURPOSE ONLY		<table border="1"> <tr> <th>NAME</th> <th>SIGN.</th> <th>DATE</th> </tr> <tr> <td>CAD/DRAWN VIKAS</td> <td></td> <td>23.04.13</td> </tr> <tr> <td>DESIGNED SKM/SN</td> <td></td> <td>23.04.13</td> </tr> <tr> <td>CHECKED S.K.M.</td> <td></td> <td>24.04.13</td> </tr> <tr> <td>SCALE N.T.S.</td> <td></td> <td></td> </tr> <tr> <td colspan="3">JOB. No. D-4027</td> </tr> <tr> <td colspan="3">DWG.No. 114-04-0106</td> </tr> <tr> <td colspan="3">REV. 0</td> </tr> </table>		NAME	SIGN.	DATE	CAD/DRAWN VIKAS		23.04.13	DESIGNED SKM/SN		23.04.13	CHECKED S.K.M.		24.04.13	SCALE N.T.S.			JOB. No. D-4027			DWG.No. 114-04-0106			REV. 0		
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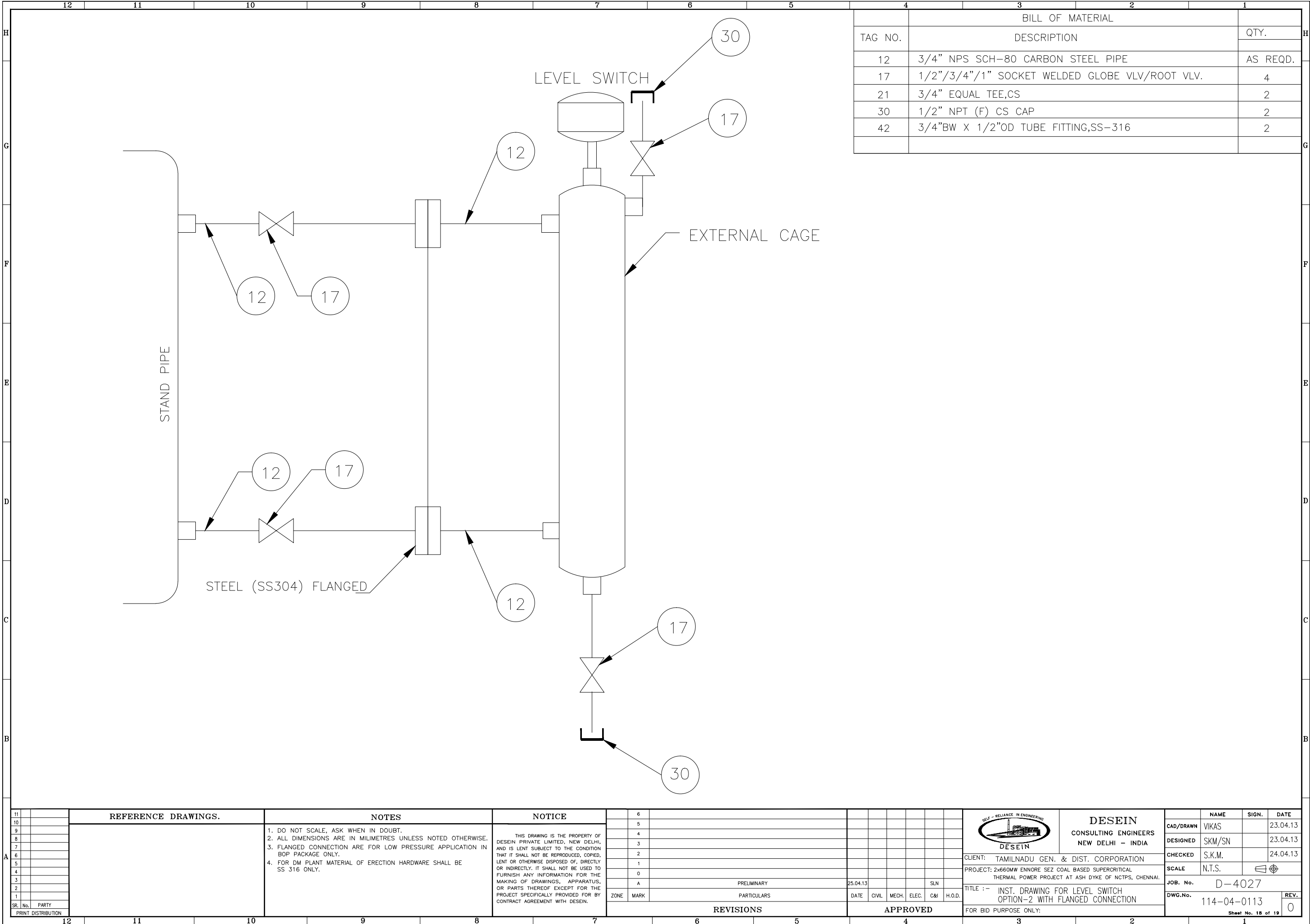


TAG NO.	DESCRIPTION	QTY.
79	MS SETTLING CHAMBER 16" X 10"Ø	2
71	1/2"OD IMPULSE TUBE SS-316	AS REQD.
57	3/4"SW EQUAL CROSS, 3000lbs	2
51	5-VALVE MANIFOLDS	1
49	3/4"SW CS/AS BULK HEAD PIPE UNION	2
42	3/4"BW X 1/2"OD TUBE FITTING, SS-316	2
41	1/2" NPT (M) X 1/2"OD TUBE COMPRESSION FITTING,SS-316	6
34	3/4" SW,CS PIPE UNION	4
29	3/4" NPT (F) CS,CAP	8
25	3/4" NPS SCH-80 X 3/4" NPT (M) CS NIPPLE	6
21	3/4" SOCKET WELDED EQUAL TEE CS	4
12	3/4" NPS 80 CARBON STEEL PIPE	AS REQD.
2	1/2"/3/4"/1" ROOT VALVE-SW GLOBE VALVE	2
8	MS BLACK PIPE	AS REQD.

NOTE:-

* TO BULK HEAD UNION OF FLOW TRANSMITTER NO. II

11	10	9	8	7	6	5	4	3	2	1
11	10	9	8	7	6	5	4	3	2	1
10	9	8	7	6	5	4	3	2	1	
9	8	7	6	5	4	3	2	1		
8	7	6	5	4	3	2	1			
7	6	5	4	3	2	1				
6	5	4	3	2	1					
5	4	3	2	1						
4	3	2	1							
3	2	1								
2	1									
1										
SE. No.	PARTY									
PRINT	DISTRIBUTION									



REFERENCE DRAWINGS.			NOTES			NOTICE			REVISIONS			APPROVED			DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA			NAME SIGN. DATE		
			1. DO NOT SCALE, ASK WHEN IN DOUBT.			THIS DRAWING IS THE PROPERTY OF DESEIN PRIVATE LIMITED, NEW DELHI, AND IS LENT SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF, DIRECTLY OR INDIRECTLY. IT SHALL NOT BE USED TO FURNISH ANY INFORMATION FOR THE MAKING OF DRAWINGS, APPARATUS, OR PARTS THEREOF EXCEPT FOR THE PROJECT SPECIFICALLY PROVIDED FOR BY CONTRACT AGREEMENT WITH DESEIN.			6			DATE			CLIENT: TAMILNADU GEN. & DIST. CORPORATION			23.04.13		
			2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.						5			PROJECT: 2x660MW ENNORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI.			DESIGNED SKM/SN			23.04.13		
			3. FLANGED CONNECTION ARE FOR LOW PRESSURE APPLICATION IN BOP PACKAGE ONLY.						4			TITLE :-- INST. DRAWING FOR LEVEL SWITCH OPTION-2 WITH FLANGED CONNECTION			CHECKED S.K.M.			24.04.13		
			4. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.						3			FOR BID PURPOSE ONLY:			SCALE N.T.S.					
									2			JOB. No. D-4027			DWG.No. 114-04-0113			REV. 0		
									1						Sheet No. 18 of 19					
SR. No. PARTY																				
PRINT DISTRIBUTION																				

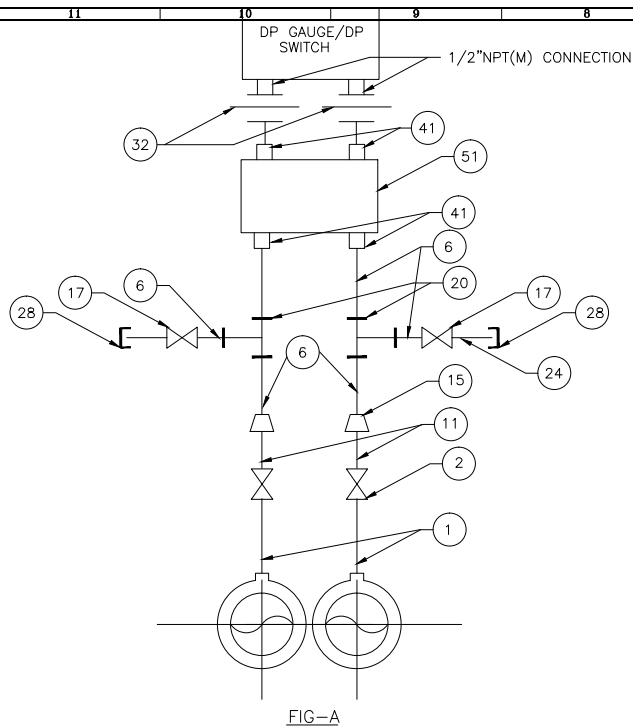


FIG-A

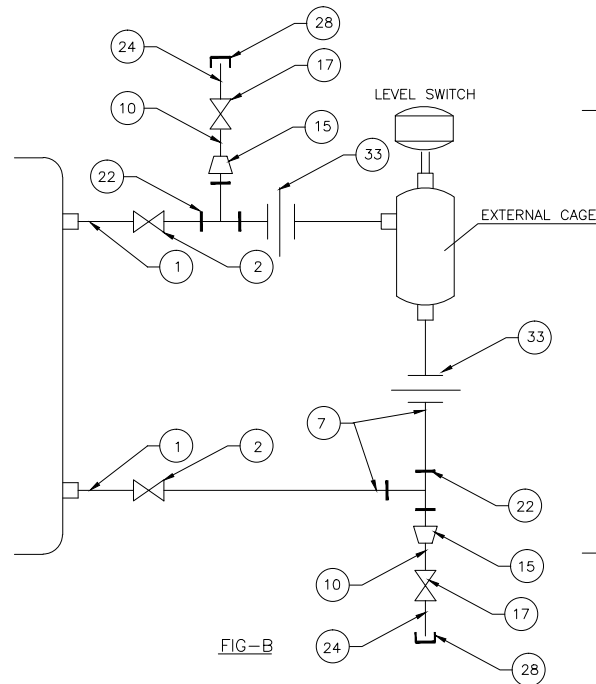


FIG-B

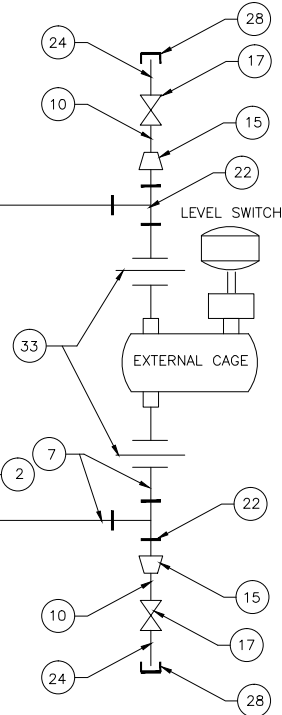


FIG-C

NOTE:-
WITH VALVE OF SIZE 1/2\"/>

TAG NO.	DESCRIPTION	A	B	C
78	1/2" NPT(F) X 1/2" NPT(M) SNUBBER/PULSATION DAMPNER	1	—	—
51	5 VALVE MANIFOLDS, SS-316	—	—	—
41	1/2" NPT(M) X 1/2" OD TUBE COMPRESSION FITTING,SS-316	—	—	—
38	3 WAY GAUGE VALVE 1/2"NB SW	1	—	—
33	1" SW EQUAL PIPE UNION	—	2	2
32	1/2" NPS,3 PIECE PIPE UNION 1/2" NPT(F) SCREWED AND 1/2" SW CONNECTION	1	—	—
28	1/2" NPT(F) CS. CAP	1	2	2
24	1/2" NPS,SCH 80/160 X 1/2" NPT(M) CS/AS NIPPLE	1	2	2
22	1" SW EQUAL TEE CS/AS	—	1	2
20	1/2"SW EQUAL TEE CS/AS	1	—	—
17	1/2" SW,CS/AS, GLOBE VALVE	1	2	2
15	1" TO 1/2" SOCKET WELD REDUCER	1	2	2
11	1"NPS SCH 80/160 CS/AS NIPPLE	1	—	—
10	1/2"NPS,SCH 80/160 CA/AS NIPPLE	—	2	2
6	1/2"NPS,SCH 80/160 CARBON/ALLOY STEEL PIPE	AS REQD.		
7	1" NPS,SCH 80/160 CS/AS STEEL PIPE	AS REQD.		
2	1/2"3/4"/1" ROOT VALVE - SW GLOBE VALVE	2	2	2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL SAME AS THAT OF MAIN PIPE (AS PER PROCESS REQD.)	AS REQD.		
		A	B	C
		QTY.		

REFERENCE DRAWINGS.		NOTES	NOTICE
11		1. DO NOT SCALE, ASK WHEN IN DOUBT.	THIS DRAWING IS THE PROPERTY OF DESEIN PRIVATE LIMITED, NEW DELHI, AND IS LENT SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF, DIRECTLY OR INDIRECTLY. IT SHALL NOT BE USED TO FURNISH ANY INFORMATION FOR THE MAKING OF DRAWINGS, APPARATUS, OR PARTS THEREOF EXCEPT FOR THE PROJECT SPECIFICALLY PROVIDED FOR BY CONTRACT AGREEMENT WITH DESEIN.
10		2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.	
9		3. ABOVE DRAWING IS FOR BASIC GUIDE LINE TO BE MEET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.	
8		4. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING.	
7		5. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.	
6			
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SR. No. PARTY PRINT DISTRIBUTION			

REVISIONS		APPROVED	
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PRELIMINARY		25.04.13	SLN
PARTICULARS		DATE	CIVIL MECH. ELEC. CM H.O.D.
ZONE	MARK		

		NAME	SIGN.	DATE
DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA		CAD/DRAWN	VIKAS	23.04.13
CLIENT: TAMILNADU GEN. & DIST. CORPORATION		DESIGNED	SKM/SN	23.04.13
PROJECT: 2460MW ENNORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI		CHECKED	S.K.M.	24.04.13
TITLE :- INST. DRAWING FOR DIFF. PRESS. SWITCH/GAUGE/LEVEL SWITCHES		SCALE	N.T.S.	
FOR BID PURPOSE ONLY		DWG.No.	114-04-0108	REV. 0
		Sheet No. 11 of 19		

SIGNAL EXCHANGE BETWEEN DRIVES & DCS (DRIVE CONTROL PHILOSOPHY)

	DOCUMENT TITLE DRIVE CONTROL PHILOSOPHY	DOCUMENT NUMBER PE-DM-412-145-I002	
		REVISION NUMBER 05	DATE 20.12.2016
	PROJECT: 2 X 660 MW ENnore SEZ STPP	SHEET 2	OF 12

A. DRIVE CONTROL PHILOSOPHY

The control philosophy for different type of Drives is detailed below:

1 Bi-directional drives with Integral Starter(Open/Close duty and inching/regulating duty)

- a) All bi-directional drives shall have integral starter. These drives shall be operable from Remote i.e. from Central Control Room (CCR). Local operation facility is provided for initial testing/commissioning only.
- b) Remote manual operation of all drives shall be done from Operator Works Station (OWS/LVS).
- c) Remote control commands i.e. open/close generated from DDCMIS/DCS/PLC shall be issued to Integral Starter through interposing relays, mounted in Integral Starter. For open/close duty bi-directional drives Start & stop command shall be latched at integral starter end, except for inching duty bi-directional drives where latching is not required.
- d) Necessary electrical protections shall be realized at Integral Starter, whereas process interlocks and protection shall be realised in DDCMIS/DCS/PLC.
- e) Following signal exchange shall take place between Integral Starter & DDCMIS/DCS/PLC.
- Open & close command
 - Integral Starter Disturbed (Loss of power supply/Loss of control supply/ Motor thermostat trip/ Thermal O/L /Local/off/Remote S/S in Local or Off mode/Stop PB optd/Torque open/close cutoff).
 - Actuator in Remote Mode.
 - Valve status feedback by means of limit switches (open/close).
 - Valve position feedback (4-20mA) for inching duty drives.
- f) The Control & Operation from Backup Control Desk/UCP shall be envisaged for critical Drives.
- g) For Bidirectional drives of ≥ 15 KW, CURRENT TRANSDUCER shall be located in MCC.

The above signal exchanges are diagrammatically represented in sheet no. 7.

2 Unidirectional LT Drives (Contactor Operated)

- a. Unidirectional LT drives shall be operable from Remote i.e. from Central Control Room (CCR). Drives shall be provided with Local Emergency Stop Push Button (EPB). Local start operation of the drive can also be done through the start push button provided near the drive when the drive is in local mode.

	DOCUMENT TITLE DRIVE CONTROL PHILOSOPHY	DOCUMENT NUMBER	PE-DM-412-145-I002		
		REVISION NUMBER	05	DATE	20.12.2016
	PROJECT: 2 X 660 MW ENNORE SEZ STPP	SHEET	3	OF	12



- b. Remote manual operation of all drives shall be done from OWS/LVS and Local/remote selection of drives shall be done in DDCMIS/DCS/PLC. Back up remote operation from PB station mounted on UCP is provided for some essential drives for safe shutdown of plant.



- c. Control commands i.e. start/stop, shall be generated from DDCMIS/DCS/PLC and shall be issued to MCC through interposing relays located in respective MCC. DDCMIS/DCS/PLC output command shall be latched in MCC. EPB (stay put type), in MCC supplier's scope, shall be wired directly to MCC to stop the motor irrespective of motor being in remote/local mode. The EPB shall be provided with press to lock and turn to release type, keyless mechanism. Under its locked position, the drive operation shall be inhibited. The local start push button shall be wired to the DDCMIS/DCS/PLC to ensure interlock/protection requirement.

- d. Necessary electrical protections for the drives shall be realised at MCC, whereas process interlocks and protections shall be realised in DDCMIS/DCS/PLC.

- e. Following signal exchange shall take place between MCC & DDCMIS/DCS/PLC



- i. Drive Start & Stop commands.
- ii. Drive ON & OFF feedback.
- iii. MCC disturbed (Thermal O/L /Control supply fail/ MCC switched off).
- iv. MCC available(In Remote)
- v. EPB operated



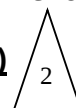
- f. Current transducers, 4-20mA types (in MCC suppliers scope), shall be mounted in the MCC for monitoring the current in DDCMIS/DCS/PLC for all drives ≥ 15 KW and for important drives < 15 KW. Auxiliary power supply to these transducers shall be provided from the control power supply of the respective MCC.



- g. The Control & Operation from Backup Control Desk/UCP shall be envisaged for critical Drives.
- h. Start & Stop command shall be latched at MCC end.

The above signal exchanges are diagrammatically represented in sheet no. 8.

3 Solenoid Operated Drives (24V DC/220V DC/240V AC)



- a. Solenoid operated drives shall be operable from remote i.e. CCR only.
- b. Remote manual operation of all drives shall be done from OWS.

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c. Remote control commands i.e. open/close shall be generated from DDCMIS/DCS/PLC and shall be issued to the respective solenoid through interposing relays located in Interposing Relay panels.

d. Necessary process interlocks shall be realized in DDCMIS/DCS/PLC.

1

e. Following signal exchange shall take place between solenoid operated drive & DDCMIS/DCS/PLC

i. Valve open & close command.

2

ii. Valve status feedback by means of limit switches (open/close), wherever available or from relay contact of interposing relays if limit switches are not provided. 1No. contact for single coil & 2 No. contact for dual coil (open Limit switch & closed limit switch) shall be provided.

3

f. BHEL will take care of de-energize to trip philosophy for fail safe control system (wherever required).

4

g. UCP/backup interface shall be provided for critical solenoid drives.

The above signal exchanges are diagrammatically represented in sh. no. 9.

4 HT/LT Unidirectional Drives (Breaker operated)

1

a. Remote manual operation of Breaker operated drives shall be normally from remote i.e. Station DDCMIS/DCS/PLC in main Control Room through OWS/LVS and Local/remote selection of drives shall also be done in DDCMIS/DCS/PLC. Back up remote operation from PB station mounted on UCP is provided for some essential drives for safe shutdown of plant.

b. Remote/Switchgear (SWGR) selection shall be realized from SWGR mounted R/S selector switch.

c. Following are the operational combinations for breaker operated drives:

-SERVICE POSITION – Drive Operation (Start/Stop) shall be from CCR with R/S (Remote/SWGR) selector switch in Remote position.

-TEST POSITION – SWGR Testing (Start/Stop) from SWGR.

Switchgear mounted 'Trip/Neutral/Close' switch shall be provided for testing of switchgear when 'R/S' selector switch is selected as 'SWGR' and SWGR is in test position.

d. Remote control commands i.e. start/stop, pulse type, shall be generated from DDCMIS/DCS/PLC and shall be issued to Switchgear through interposing relays located in respective Switchgear. Further

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there is Local/remote selection in DDCMIS/DCS/PLC. Local selection in DDCMIS/DCS/PLC means, command from local PB, provided near the drive, will be executed through DDCMIS/DCS/PLC whereas in case of remote mode of selection in DDCMIS/DCS/PLC, the command from OWS will be processed, not through local PB.



- e. The EPB shall be wired directly to switchgear to stop the motor irrespective of motor being in remote/local mode. The EPB (stay put type), in SWGR supplier's scope, shall be provided with press to lock and turn to release type, keyless mechanism. Under its locked position, the drive operation shall be inhibited. The local start push button shall be wired to the DDCMIS/DCS/PLC to ensure interlock/protection requirement.

- f. Necessary electrical protections for the drive shall be realised at Switchgear, whereas process interlocks and protections are realized in DDCMIS/DCS/PLC.

- g. Following signal exchange shall take place between switchgear and DDCMIS/DCS/PLC: -

- i. Drive Start & Stop commands.
- ii. Drive ON & OFF status feedback.
- iii. Switchgear Disturbed (Control power supply fail/Trip coil Unhealthy/Master trip relay operated).
- iv. Switchgear Available (Breaker in Service & Trip ckt Healthy & Master Trip Relay Reset & Spring Charged)
- v. Master Trip Relay (86 Relay) operated.
- vi. Emergency Stop PB operated.
- vii. Local start Push Button shall be wired to DCS from LPBS near Drive.

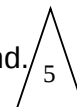


- h. Current transducers, 4-20mA types (in SWGR suppliers scope), shall be mounted in the SWGR for monitoring the current in DDCMIS/DCS/PLC. Auxiliary power supply to these transducers shall be provided from the control power supply of the respective switchgear.



- i. The Control & Operation from Backup Control Desk/UCP shall be envisaged for critical Drives.

- h. Latching as required shall be done at MCC/SWGR end.



The above signal exchanges are diagrammatically represented in sh. no. 10.

B. ANALOG DRIVE CONTROL PHILOSOPHY

Analog Drives Control

- 1.1 A drive control function residing in Distributed Processing Units (DPUs) is used to position the pneumatically operated control valves/Dampers through SMART positioner (conventional positioner for Burner Tilt).

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Interlock and protection Open/Close Commands, originating from field or generated internally in Control Logics (ACS), are interfaced with the drive control function residing in processors.

1.2 Control Valve actuator design shall take care of fail safe condition i.e. bringing valve to full open/full close or stay put mode, on signal (pneumatic/electric) failure.

1.3 Auto/Manual operator control and display for various control loops shall be provided through OWS, using Analog Displays.

1.4 Analog Displays have following functionality:

- Auto/Manual selection with control device “Raise/Lower Buttons”
- Set point indication with “Raise/Lower Buttons”
- Indication for deviation between set point and measured value
- Measured value indication
- Final control element portion indicators



1.5 The Control & Operation from Backup Control Desk/UCP shall be envisaged for critical Drives.

1.6 All required accessories i.e. Solenoid or any other hardware required to achieve the stayput position at controller signal failure shall be provided.



1.7 DI for fault signal of the smart positioner shall be provided.

The above signal exchanges with DDCMIS/DCS/PLC are diagrammatically represented in sh.no. 11.

C. CABLE



For interconnection of analog signals (4-20mA) to DDCMIS/DCS/PLC, in general “armoured” 0.5sq mm color coded individually and over all screened twisted pair shall be used (F Type). However for position feedback signals of bidirectional drives and current feedback signals of HT/LT drives 2P, F type cable shall be used.

For interconnection of binary signals (24V DC) to DDCMIS/DCS/PLC, “armoured” 0.5sq mm color coded over all screened twisted pair cable shall be used (G Type).



D.IO REDUNDANCY

- (1) IO redundancy shall be as per specification requirement.
- (2) Start command/stop command/trip command towards safety of process or process equipment shall be hardwired parallel from two different cards.
- (3) In case of redundant/multi Pumps/Drives for same service, all related Inputs & outputs of main pump/drive shall be in separate I/O cards and



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similarly all related Inputs & outputs of respective standby pump/drive shall be in separate I/O cards. Inputs/outputs of any two same services pumps/drives shall not be mixed in one common I/O car



Notes: 1) (a) Drive Control Philosophy will be generally used for total project except for few cases where OEM recommendations prevail.

(b) This scheme shall be applicable for PLC as well as DDCMIS/DCS/PLC based Offsite packages.



2) Email & Message alert

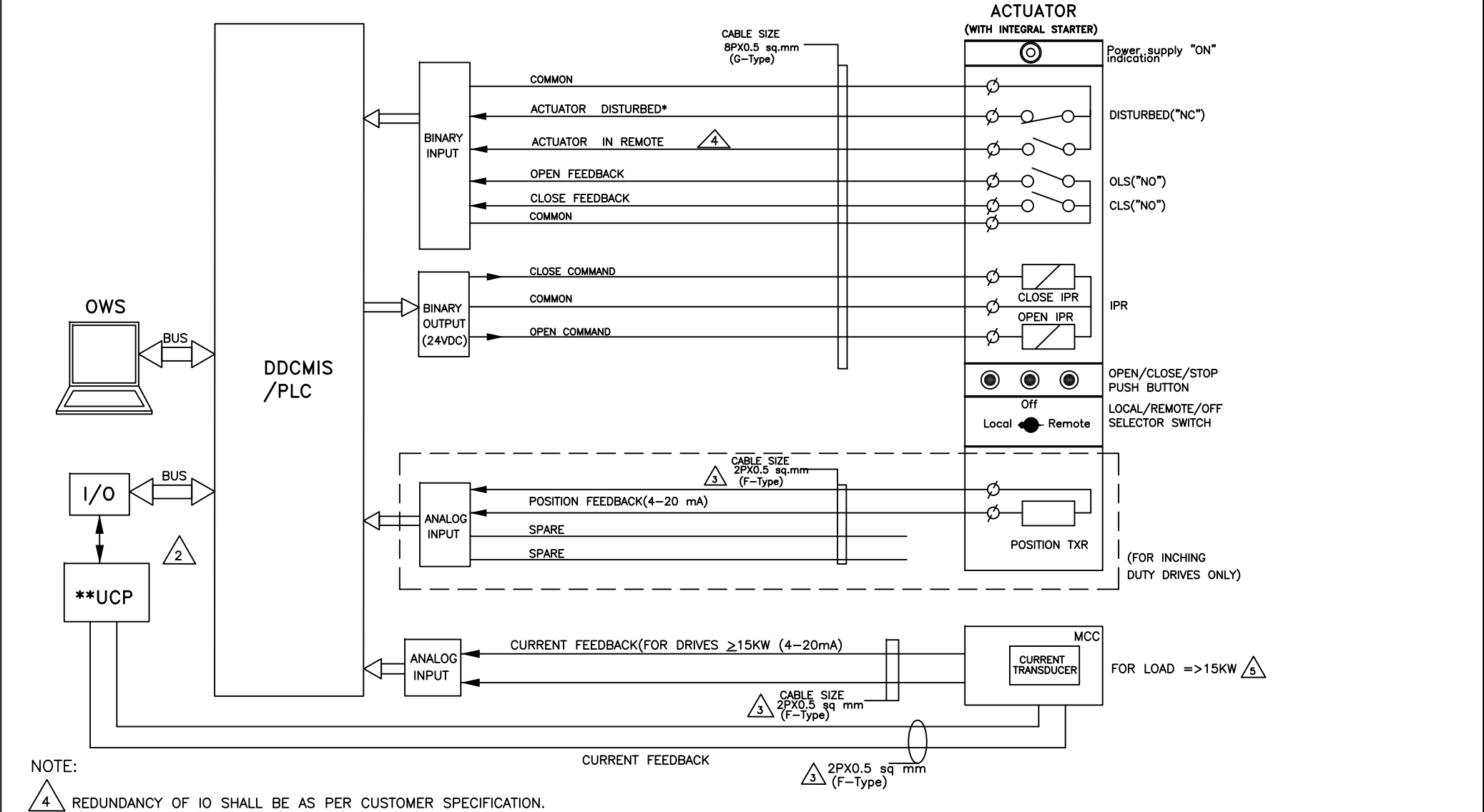
Intimation through message & E-mail shall be provided for tripping of all HT drives & critical LT drives.

3) Drives with VFD will have the following signal exchange:-



- | | |
|-----------------------------------|----|
| a) Speed Input | AI |
| b) Speed Output | AO |
| c) VFD Mode/Bypass Mode selection | DI |
| d) VFD Mode/Bypass Mode command | DO |

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



NOTE:

△ 4 REDUNDANCY OF IO SHALL BE AS PER CUSTOMER SPECIFICATION.

* DISTURBED= Loss of Power supply (1 Phase/3 Phase)/ Loss of control supply/ Motor thermostat trip/Thermal over load/Torque open/close cutoff Local/Off/Remote Sel. switch in local or off mode/Stop PB optd.

△ 2 ** AS APPLICABLE.

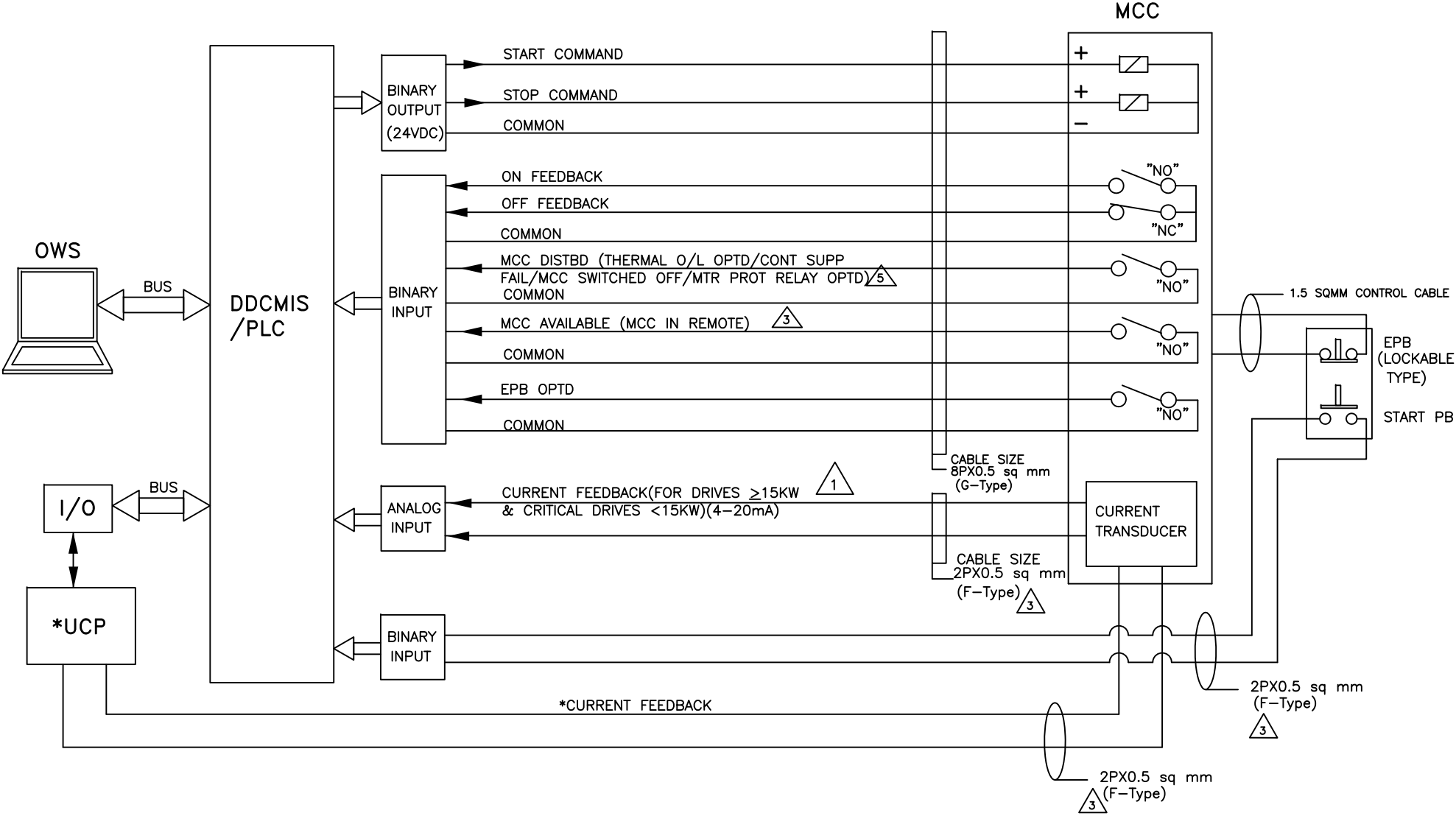


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TITLE DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE

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DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



NOTE:

- * CURRENT FEEDBACK IN DDCMIS SHALL BE PROVIDED FOR ALL DRIVES > 15 KW
AND FOR IMPORTANT DRIVES <15 KW.
I/O REDUNDANCY SHALL BE AS PER SPECIFICATION REQUIREMENTS.

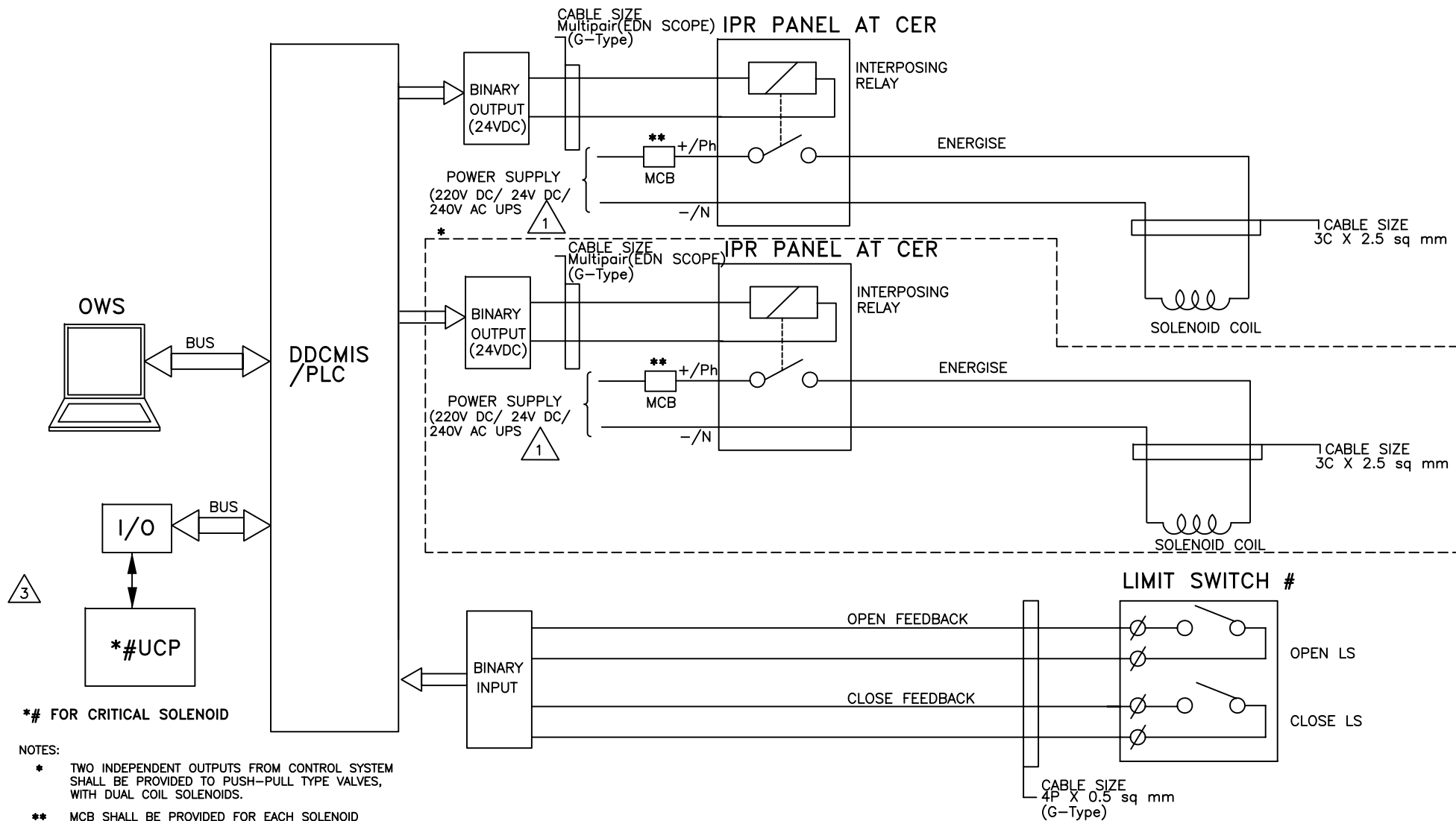


PROJECT: 2X660 MW ENNORE SEZ STPP

TITLE DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE

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DCS INTERFACE FOR SOLENOID DRIVE (220V DC/ 24V DC / 240V AC UPS)



***# FOR CRITICAL SOLENOID**

NOTES:

* TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

FOR ON/OFF TYPE, SOLENOID ACTUATED VALVE. RELAY CONTACTS SHALL BE WIRED AS FEEDBACK WHEREVER LIMIT SWITCH FEEDBACKS ARE NOT AVAILABLE. 1 CONTACT FOR SINGLE COIL & 2 CONTACT FOR DUAL COIL (OPEN LIMIT SWITCH & CLOSED LIMIT SWITCH).

*** BHEL WILL TAKE CARE OF DE-ENERGISE TO TRIP PHILOSOPHY FOR FAIL SAFE CONTROL SYSTEM (WHEREVER REQUIRED)

I/O REDUNDANCY SHALL BE AS PER SPECIFICATION REQUIREMENTS.



PROJECT: 2X660 MW ENNORE SEZ STPP

TITLE

**DDCMIS INTERFACE FOR
SOLENOID DRIVE**

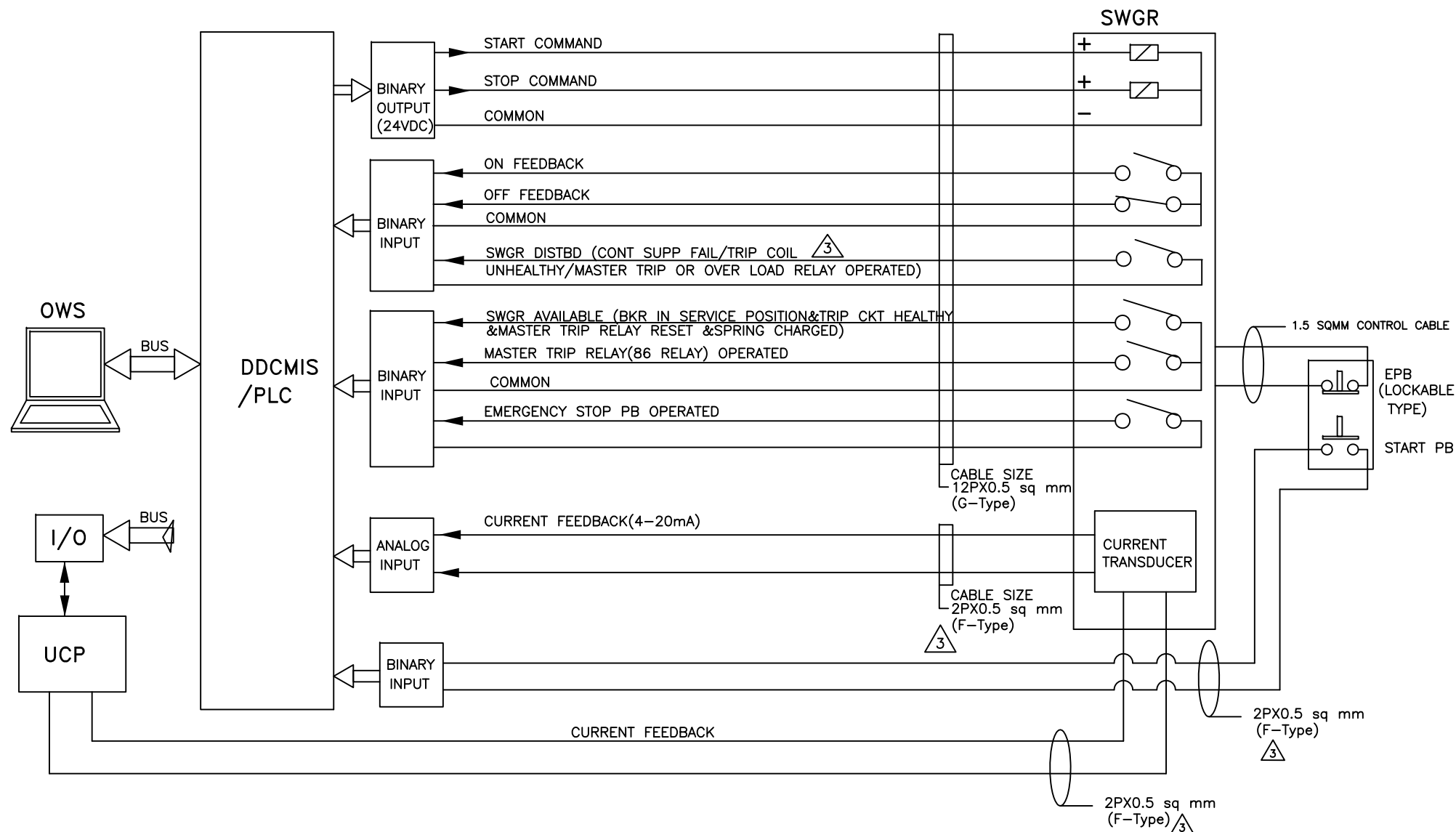
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DCS INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)



NOTE:

- # VIBRATION, WINDING & BEARING SIGNALS SHALL BE INTERFACED WITH DDCMIS AND INCLUDED IN EDN'S DOCUMENT.
- I/O REDUNDANCY SHALL BE AS PER SPECIFICATION REQUIREMENTS.



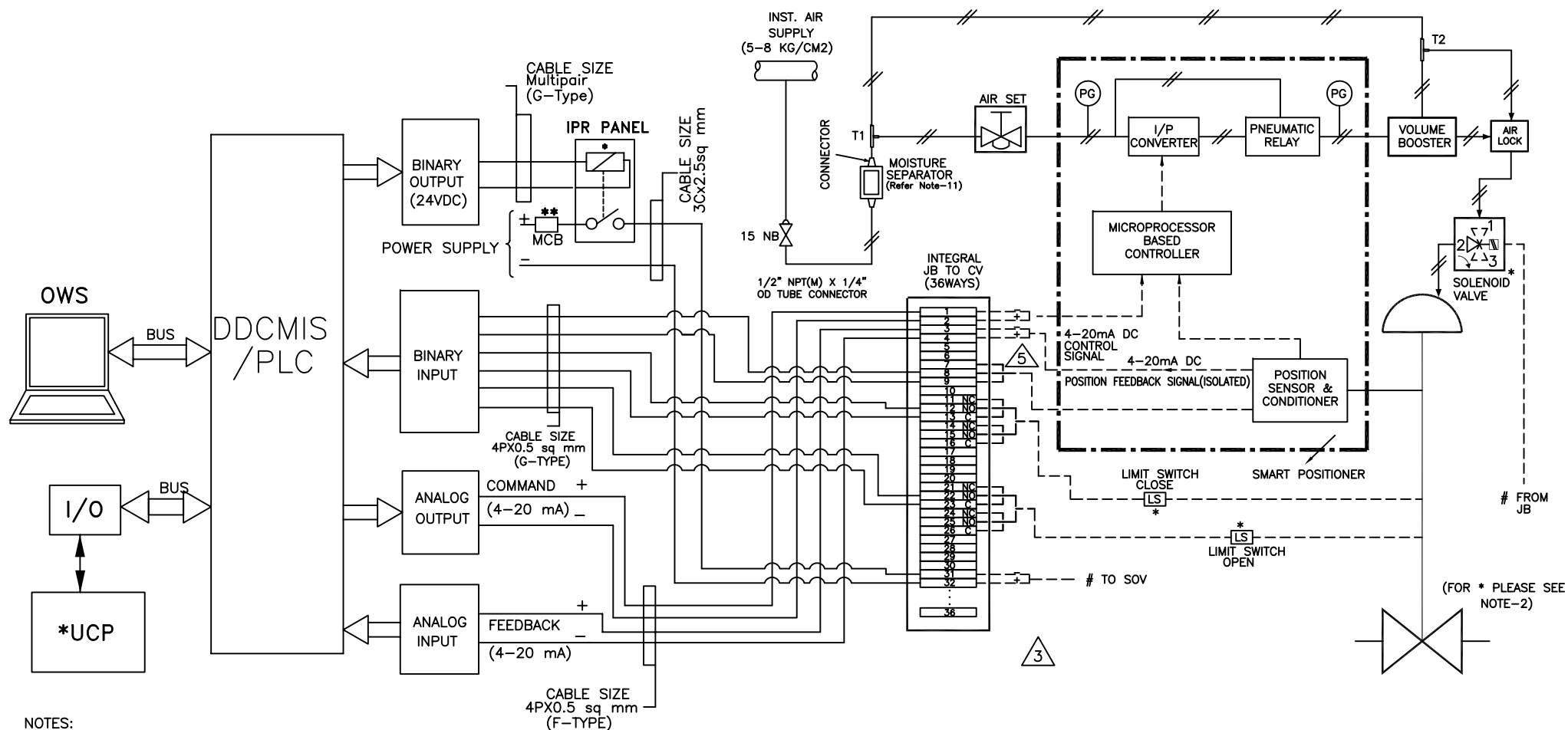
PROJECT: 2X660 MW ENNORE SEZ STPP

TITLE

DDCMIS INTERFACE FOR
UNIDIRECTIONAL HT DRIVE

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DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

* WHEREVER APPLICABLE.

** APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.

3 I/O REDUNDANCY SHALL BE AS PER SPECIFICATION REQUIREMENTS.

ALL REQUIRED ACCESSORIES i.e. SOLENOID OR ANY OTHER HARDWARE REQUIRED TO ACHIEVE THE STAYPUT POSITION AT CONTROLLER SIGNAL FAILURE SHALL BE PROVIDED.

DI FOR FAULT SIGNAL OF THE SMART POSITIONER SHALL BE PROVIDED.



PROJECT: 2X660 MW ENNORE SEZ STPP

TITLE

TYPICAL HOOK-UP DIAGRAM

ANALOG DRIVE (WITH SMART POSITIONER)

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C&I Customer Spec-Instruments, Control Valves,
Electric Actuators

3.03.00 TRANSMITTERS, SWITCHES, GAUGES AND PANEL MOUNTED INSTRUMENTS

3.03.01 Pressure, Differential Pressure, DP type Level and Flow Transmitters (PT, DPT, LT & FT)

Smart Transmitters of the electronic type shall be furnished.

All Transmitter shall be installed in closed LIE in the boiler area. Similarly transmitter for TG shall also be in LIE except the transmitters located in covered area on TG floor and these shall be mounted in LIR.

Transmitters shall be equipped with mounting brackets suitable for a mounting in transmitter enclosures.

In general, Transmitters are envisaged to be grouped at several places as to be decided during detailed engg. stage. For this purpose, suitable enclosures complete with all tubing, fittings, purge meters, loop cable trays etc. shall be provided.

Type/Construction	:	Sealed capacitance/ Inductance/ Silicon resonance type
Material		
- Body	:	Die cast Aluminum with epoxy coating for air & flue gas SS316 for other services
- Diaphragm	:	316 SS
- Measurement element	:	Teflon seal
- Valves	:	Carbon steel for non-corrosive Applications SS316 for corrosive applications.
Output signal	:	4 to 20 mA Amp. DC (Two wires) HART Compatible
Local Indicator	:	LCD indicator (5 digit) with scale of Engg. unit
Overall Accuracy	:	$\pm 0.04\%$ or better of Span for BTG package $\pm 0.065\%$ or better of Span for BO P packages $\pm 0.2\%$ or better of span for remote seal type transmitter.
Turn down ratio	:	100:1 in general
Stability	:	$\pm 0.15\%$ of URL for 5 years.
Response time	:	150 msec.
Power supply	:	24V DC nominal
Drive capability	:	600 Ohms nominal
Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Span and Zero	:	Locally adjustable, non-interacting

Zero suppression / elevation : At least 100% of Span

Connection

- Process : 1. Half (1/2) inch NPT (F)
Quarter (1/4) inch NPT
with/without oval flanges

- Electrical : Suitable for Plug in type connection (Both side of transmitter), unused entry with blind plug.

Accessories

- For Absolute Pressure Transmitters: Two (2) valve SS316 manifold

- For Gauge & Vacuum pressure transmitter : Three (3) valve SS316 manifold

- For DP, level & flow transmitter : Five (5) valve SS316 manifold

- For oil and corrosive liquids : Separator diaphragm seals

- For all transmitters : Mounting bracket

Manifold should not be mounted on the transmitter, Manifold shall be on integral and standalone type. Snubbers/Pulsation dampers shall be used where the process media is unstable for measurement such as the discharge of a pump. Over range protection shall be used where necessary. The coil syphons & condensate pots shall be used for steam services. Transmitters shall be provided with suitable drain & vent points.

3.03.01.01 Transmitters & other HART based instruments shall be supplied along with 3 Nos. of universal type hand held/portable pressure calibrators. Temperature transmitters shall be supplied along with 3 Nos. of hand held/portable mV source generators.

3.03.02 PRESSURE SWITCHES (PS) & DIFFERENTIAL PRESSURE SWITCHES (DPS)

Applicable Standards : IS3624 - 1966/ISA-RP-8.1 except as modified in spec.

Type/Construction : Bourdon/Sealed Diaphragm Piston
Actuated preferable. Indicators with contacts are not acceptable.

Materials

- Bellows : 316 SS

- Bourdon tube : 316 SS

- Movement : 316 SS

- Encloser : Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.

- Protective Diaphragm : Teflon

Accuracy	:	$\pm$ One (1) percent or better
Repeatability	:	$\pm$ 0.5(half) percent or better
Setting & Differential	:	Adjustable

Contact

- Number	:	DPDT /2 SPDT
- Type	:	Auto reset with internal Adjustable snap action micro switch
- Rating	:	5 Amp, 240V AC / 0.2 Amp, 220V DC
Connection - instrument	:	Half (1/2) inch NPT Male Process
Electrical	:	Suitable for Plug in type connection. All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not be terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
- Over range protection	:	One Fifty (150) percent of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

Accessories

- 3 / 5 valve manifold	:	As applicable for all switches
- Self cleaning type pulsation dampners/Snubber (Material SS316)	:	Pump and compressor discharge lines
- Syphon	:	For all steam lines
- Protective separating diaphragm	:	For fuel oil & corrosive liquid lines.
Mounting	:	Local (in LIE/LIR for BTG package).

3.03.03

PRESSURE & DIFFERENTIAL PRESSURE GAUGES (PG & DPG)

Applicable standard	:	IS:3602-1966, IS/3624, ASME B 40.1
Type/Construction	:	
-760 mm to 1.0Kg/cm ²	:	Bellows/Diaphragm
-Above1.0Kg/cm ²	:	Bourdon Tube
- Suction side of pumps	:	Compound gauge

Materials

- Bourdon tube	:	316 SS
- Bellows	:	316 SS
- Movement	:	316 SS
- Case	:	SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating

- Protective Diaphragm	:	shall be provided for corrosive atmosphere. Teflon
Dial size	:	150mm with shatter proof glass
Scale Details	:	Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.
Accuracy	:	$\pm$ One (1) percent or better
Connection - Instrument Process	:	1/2 inch NPT Male Bottom
Mounting	:	Local
	:	1/2 inch NPT Male (Back entry) mounted on local gauge board.
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

Accessories

- 3 way needle valve/manifolds	:	For all gauges
- Self cleaning type	:	Pump and compressor discharge lines
Pulsation dampener/snubber (S316)	:	
- Syphon	:	For all steam lines
- Protective separating	:	For fuel oil and corrosive liquid lines

Other particulars

- External Zero adjustment	:	For all gauges
- Safety device	:	
Ranges 5 to 20 Kg/cm ²	:	Rubber blow out disc with open front construction.
Ranges above 20 Kg/cm ²	:	Neoprene safety diaphragm at the back with solid front construction.
- Over range protection	:	One Fifty (150) percent of full scale

Other Requirments

:	Movement mechanism shall be glycerin filled for oil services & vibration prone area.
:	For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armored capillary of 10 M for Fuel oil & Corrosive liquid service.

- : Contact type pressure gauges are not acceptable for interlock & protection.
- : For condensate storage tank the pressure gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300mm or bigger size** shall be provided.

3.03.04

TEMPERATURE TRANSMITTERS

Type	:	SMART type configurable from control room through HART protocol (HMS System).
Display type	:	Indicating type (5 digit LCD Display),
Accuracy	:	$\pm 0.10\%$,
Ambient temperature error	:	0.1% per 10°C change
Output	:	4-20 mA DC (2 wire system) HART compatible signals for analogue monitoring inputs to the distributed control system (DDCMIS), DCS & PLC.
Protection class	:	NEMA 4/IP66 or equivalent degree of protection for enclosure)/ (Explosion/Flame proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Material of accessories	:	SS316.
Stability	:	$\pm 0.1\%$ or ± 0.1 deg C of reading (whichever is great) for 2 years in case of RTD inputs and for 1 year in case of Thermocouples inputs.
Operating Voltage	:	16 – 48 V DC
Calibration	:	as per NIST monograph 125 for T/C & European Curve Alpha = 0.00385 for RTD .
Ref. Junction compensation	:	Provided
Span/zero adjustment	:	Locally adjustable, Non interacting
Auto calibration	:	Provided
Burn out protection upscale	:	Provided
Input - output isolation	:	Provided
Circuit ungrounded	:	Provided

Any RTD & Thermocouples shall be directly wired to DDCMIS/DCS/PLC for metal temperature application, bearing & winding temp application only.

The Temperature transmitter shall accept Universal dual inputs of all types of thermocouples & RTD, 0-5V input signals etc.

Temp. Transmitter shall be extremely stable against Ambient temperature variation, The accuracy figure shall be inclusive of effect due to ambient temperature variation.

Considering the application & distance involved for monitoring parameters **wireless technology** shall be adopted by interfacing with DDCMIS through OPC connectivity. However Wireless technology as adopted by Bidder shall be reliable and field proven in power plants and same shall be approved by Owner.

3.03.05

RESISTANCE TEMPERATURE SENSORS WITH THERMOWELLS

Applicable Standard	:	ASME PTC 19.3 - Latest Revision DIN EN 60751: 1996, BSEN/IEC60751: 2008
Element	:	Platinum, R0=100 ohm 4-wire Duplex for Process Temp. Measurement Platinum, R0=100 ohm 3-wire Duplex for Bearing & Winding Temp. Measurement
Sheath Material/ Insulation	:	316SS/Compacted Magnesium Oxide
Sheath O D	:	8 MM
- Gauge	:	18 AWG
Terminals	:	Spring loaded high temperature ceramic base with silver plated brass for high vibrating locations.
Calibration	:	As per DIN Standard – 43760, Class A
Head	:	Hex Head, Die Cast Aluminum (Screwed) with galvanized SS chain
Response Time	:	6-10 Sec bare & 30 Sec. With protective sheath/thermowell
Accuracy	:	± 0.35 degree C or Class-A whichever is better.
Electrical connection	:	Gold plated Plug in type. Double entry – one unused entry with blind plug
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

THERMOWELL

Applicable Standard	:	ASME PTC 19.3 TW - 2010
- Construction	:	Tapered drilled from Bar stock (Straight for Air & Gas systems)
- Material	:	- 316 SS/F11/F22/F91 - water and steam Services depending upon process parameters. - Inconel for air & flue gas services For furnace zone, impervious ceramic protecting tube of suitable material along

with Incoloy supporting tubes and adjustable flanges.

For Mill classifier outlet long life solid sintered tungsten carbide material or better of high abrasion resistance.

Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 2010. “All Thermowells in high velocity steam service shall be checked for Strouhal’s frequency limit to arrive at a safer size and design of Thermowells”.

- Process Connection	:	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
- Extension	:	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
Immersion length	:	Within ± 10 mm of center line of pipe and as per ASME – PTC-19.3 - 2010
Extension neck length	:	Minimum 100 mm above insulation of pipe and Minimum 160 mm when there is no insulation on pipe.
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations
Note	:	Extension /Compensating/paired cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

3.03.06 THERMOCOUPLES WITH THERMOWELLS

Applicable standard	:	ASME PTC 19.3- Latest Revision ANSI-MC 96.1 – 1982, IEC 584-2
Element	:	Duplex
- Sheath	:	8 MM OD
- Sheath Material	:	316 SS
- Spring Loaded	:	Yes
- Nipple/Union	:	Yes
- Packed connector	:	Compacted magnesium Oxide ungrounded

- Type	:	i. Type K (Chromel - Alumel) ii. Type S/R (Platinum Rhodium-Platinum) iii. Type T (Cu-CuNi) with special limits of error according to ANSI-96.1 - 1982.
- Gauge	:	16 AWG
Head	:	Die Cast Aluminum
Electrical connection	:	Gold plated Plug in type. Double entry – one unused entry with blind plug
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

Thermowell

- Construction	:	Tapered Drilled from Bar stock (Straight for Air & Gas systems)
- Material	:	- 316 SS/F11/F22/F91 - water and steam Services depending upon process parameters. - Inconel for air & flue gas services For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges. For Mill classifier outlet long life solid sintered tungsten carbide material or better of high abrasion resistance. Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 2010. “All Thermowells in high velocity steam service shall be checked for Strouhal’s frequency limit to arrive at a safer size and design of Thermowells”.
- Process Connection	:	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, gaskets, fasteners etc.
- Extension	:	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends

Accuracy (Special Class as per IEC-751/ANSI-C-96.1)

(For Type K T/C)	:	± 1.1 deg.C (for 0 to 277 deg.C) ± 0.4 percent (for 277 to 1280 deg.C) Class-A
------------------	---	---

For Type S & R T/C	:	± 0.6 deg.C or $\pm 0.1\%$
For Type T T/C	:	± 0.5 deg.C or $\pm 0.4\%$
Accessories	:	Bolts, nuts and gaskets for flanged connections.

Response Time (Bare Thermocouple)

- For SH & RH Temp. Control	:	4-6 Sec.
- All other applications	:	10 Sec.
Immersion length	:	Within ± 10 mm of center line of pipe and as per ASME – PTC-19.3 - 2010
Extension neck length	:	minimum 100 mm above insulation of Pipe and minimum 160 mm when there is no insulation on pipe.
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations.
Note	:	Extension/ Compensating cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

Thermocouples provided for steam services like super heater / de super heater area, where the process pipe is inside the insulation of boiler penthouse, Thermowells are inaccessible and terminal head and connecting cable cannot withstand high temperature, for such services thermocouples shall be provided with flexible extension SS316 Sheath of 10-15 meters.

3.03.07 Metal Temperature Thermocouples

Measuring Medium	:	Metal Temperature
Material of Thermocouple.	:	Chromel Alumel Type K
Type of Thermocouple	:	Duplex with separate hot junctions, ungrounded
Insulation	:	Mineral Insulation Magnesium Oxide.
Thermocouple wire gauge	:	16 AWG
Protective sheath	:	SS 321
Protective sheath dia	:	8 mm O.D

Characteristics of Thermocouple	:	Special limits of error as in ANSI thermocouple MC 96.01.1975
Mounting accessories	:	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310.
Cold end sealing	:	SS pot weal with colour coded PTFE headed sleeve Insulated flexible tails. Sealing compound- Epoxy resin.
Minimum bending radius	:	30 mm
Length of T/C	:	30 Mtr. (minimum)
Enclosure Class		IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

3.03.08 TEMPERATURE SWITCHES (TS)

Type/Construction

- Switch : Industrial type inert gas filled with capillary and separable thermowell and contacts directly connected to Bourdon element/vapor pressure sensing, gas filled bellows type preferred.
- Thermowell : Bar stock

Material

- Bulb : 316 SS
- Capillary : Armored Stainless Steel
- Bourdon : 316 SS
- Bourdon Movement : SS 316
- Casing : Die-cast aluminum with stoved enamel black finish Epoxy coating shall be provided for corrosive atmosphere.

- Setting and Differential : Adjustable
- Accuracy : $\pm$ One (1) percent of setting and differential
- Repeatability : One half(1/2) percent of setting.

Contacts

- Number : DPDT/2 SPDT
- Type : Auto reset with internal Adjustable snap action micro switch
- Rating : 5 Amp, 240V AC / 0.2 Amp, 220V DC

Connection

- Pipe : M33 x 2
- Extension : Threaded union (SS316) 1/2" NPT (F)

with two nipples of SS 316 having 1/2"NPT(M) threads at both ends

Thermowell : To suit Temp. switch with same design criteria as specified for RTDs.
Electrical : Suitable for Plug in type.

All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not be terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.

Other Particulars

- Capillary length : As per requirement (min 10 meters)
- Immersion Length : Within + ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length : Minimum 50 mm above insulation of pipe /As per approved hookup drawings.
- Packing glands : Yes

IBR Certification : For high pressure service, Steam Temp, Fuel oil temp. measurement as per IBR rules and regulations

N.B : Switches designed for cross ambient operation shall be used in applications where the ambient temperature will approximate or exceed the switch set point.

3.03.09 TEMPERATURE GAUGES (TG)

Applicable standard : IS : 3602,BS:5235 ISA:RP:8.1 except as modified in this specification

Type/Construction

- Thermometer : Industrial type, Gas in Filled type with separable thermowell
- Thermowell : Bar stock

Material

- Bulb : 316 SS
- Capillary : Armoured SS (Applicable for capillary Type)
- Casing : SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating

		shall be provided for corrosive atmosphere
Dial Size	:	150mm with shatter proof glass
Scale Details	:	270 degree dial rotation/deflection. Graduations in black lines on white dial provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges
Accuracy	:	$\pm$ One (1) percent or better
Response time	:	Maximum 15 seconds without thermowell and 30 seconds with thermowell
Connection		
- Pipe	:	M33 x 2
- Thermowell	:	To suit instrument with same design criteria specified for RTDs.
- Process Connection	:	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
- Extension	:	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
Other Particulars		
- Capillary length	:	5Meters/10 Meters as required
- Immersion Length	:	Within + ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length	:	Minimum 50 mm above insulation of pipe /As per approved hookup drawings.
- Stop at Maximum value	:	For all gauges of scale
- Pointer	:	Externally adjustable
	:	In general, Contact type Temp. gauges are not acceptable for interlock & protection.
		Contact type Temp. gauges are acceptable for interlock & protection in case of bearing temp. only.
- Over range protection	:	150 percent (%) of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
IBR Certification	:	For high pressure service, Steam

Temp., Fuel oil temp. measurement
as per IBR rules and regulations

3.03.10 TEST THERMOWELLS (TW)

Applicable Standard	:	ASME PTC 19.3 TW - 2010
Type/Construction	:	Machined from Bar Stock
Material	:	316 SS/F11/F22/F91
Connection	:	
- Pipe	:	M33 x 2
- Test Instrument	:	To suit test instruments
Accessories	:	Plug with chain
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations Bidder shall provide calculation for thermowell as per ASME – PTC- 19.3 TW - 2010.

Test wells shall be provided on main steam, reheat steam, extraction steam, feed water, condensate, spray water lines and other piping as required to meet ASME test requirements.

3.03.11 DIRECT MOUNTED LEVEL TRANSMITTERS (LT)

Displacer type level transmitter shall not be used in the process anywhere in the plant.

3.03.12 Ultrasonic Level Transmitter (for Water sump/Tank level, Raw water reservoir level, Cooling water fore bay level measurements)

Principle of Operation	:	Detection of reflected ultrasonic pulse
Measuring Ranges	:	Up to 30 meters (typical)
Signal Processing	:	Microprocessor Controlled Signal Processing
Operating Freq.	:	10 KHz to 50 KHz (typical)
Display	:	Head mounted alpha-numeric back lit LCD/LED
Calibration & Configuration	:	Accessible from front of panel & HART calibrator.
Diagnosis	:	On-line
Status	:	For power, Hi / Lo / V. Hi / V. Lo- level indication, fault etc.
Construction	:	Plug-on board
Power supply	:	240 V AC 50 Hz / 24V DC
Signal Output	:	4-20 mA DC with HART (isolated) - 600 Ohm load.
Hysteresis	:	Fully adjustable preferred
Output contacts	:	2SPDT Potential free changeover contacts @ 8A 230V AC.
Accuracy & Repeatability	:	± 0.25% of span or better
Resolution	:	± 0.1% of span
Temperature Compensation: To be provided with Transducer.		

Operating temp.	:	Transmitter-50 deg C and Sensor – 80 deg C
MOC Sensor	:	Body- PVDF and Face – Polyurethane
Humidity	:	1% to 95% non condensing.
Enclosure	:	IP-67 Epoxy painted die cast Aluminum or SS316L housing.
Cable Connection	:	3/4" ET
Mounting	:	2" – 4" NPT or flanged
Accessories	:	Cable gland, prefab cable, mounting accessories like EPDM seal, SS316 flanged etc.
		Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during detailed engineering.

3.03.13 CAPACITANCE TYPE LEVEL TRANSMITTER

The total system shall consist of capacitance probe, pre-amplifier and transmitter

Type	:	Capacitance type
Probe	:	a) Rod or suspended electrode. b) Rope type probes may be used only where required probe length is greater than 3 meters
Probe Mounting	:	Stainless steel 1-1/2 ANSI RF Flange / 3/4" NPT (M)
Material of construction	:	316 SS
Insulation	:	PTFE Part/Full as per service.
Transmitter	:	The transmitter shall receive output of the preamplifier and convert it into 4-20 mA DC output signal.
Accuracy	:	± 1% of Full scale
Repeatability	:	± 0.5 % of Full scale
Load	:	Min 600 Ohms
Enclosure	:	Powder/Epoxy coated Die cast aluminum. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
Ambient temperature	:	0-60 °C.
Mounting	:	Wall / Surface
Supply voltage	:	240V AC, 50Hz / 24V DC
Response time	:	100 m sec or better
Cable connection	:	3/4" ET
Accessories	:	Counter flange, Cable gland, prefab cable if any
Preferable features	:	Alarm output contacts with adjustable set point facility

3.03.14 GUIDED WAVE RADAR/RADAR LEVEL TRANSMITTER

Type	:	Guided wave Radar (Contact type)/Radar (Non contact type) as finalized by owner.
Application	:	For Turbine Lube oil tank, HFO & LDO tank level,

		Condenser Hotwell, LP heaters, C.B.D. tank level, Stator water expansion level, and other Low pressure, Vacuum vessels.
Environment Class	:	Highly abrasive with Gases and Fumes
Orientation	:	Vertical
Probe Type	:	Flexible Single lead with chuck
Probe Material	:	SS 316L
Connection Size & Type	:	2" Flanged ANSI 300 lb SS316L material
Connection material	:	SS 316L
Accuracy	:	+/- 5 mm
Resolution	:	± 1 mm
Type (Transmitter)	:	SMART, 2 Wire
Operating Principle	:	Time Domain Reflectometry
Output	:	4-20 mA, DC with HART protocol and 600 Ω output load.
Electrical Connection	:	½" NPT
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
Electrical Power	:	11-42 V DC
Housing material	:	Die Cast Aluminum
Vent & Drain Plug material	:	SS
Side Flange Material	:	SS
Local Display	:	Provided (LCD Digital)
Units of Measurement	:	Length M
Electromagnetic compatibility:	:	EN-61326

3.03.15 3 D TYPE ACOUSTIC WAVE LEVEL TRANSMITTER

Type	:	Acoustic Wave Level Transmitter (3 D type)
Application	:	Coal and Ash Bunker Level, Volume & Mass.
Temperature compensation	:	Required for high temp applications
Operating Principle	:	Non - Intrusive acoustic wave transmission & Reflection
Frequency Range	:	3 – 10 KHz
Accuracy	:	+/- 0.25 % for even surface & ± 0.5% for uneven surface.
Resolution	:	1 mm
Output	:	4-20mA DC with HART
Display Unit:		
Type	:	Head mounted LCD Display with Engg. Units
Location	:	Suitable location at bunker / Silo operating floor area
Protection Class	:	IP 65 or better// flame proof (IEC-79.1, Part I) As applicable).
Material Of construction:		

Housing	:	Polypropylene
Flange	:	Polypropylene
Sizes:		
Flange Size	:	2" ANSI 300 # RF SS
Electrical connection size	:	½" NPT (F)
Accessories	:	i. Double compression type Nickel Plated Cable glands
		ii. Suitable Mating Flange, necessary gaskets,
		iii. Local display unit and Suitable mounting brackets, necessary mounting hardware for Local display unit.
		iv. Complete software as required to have 3 D view on monitors.

3.03.16 Electronic Water Level Indicator

Application - HP heaters & Boiler Separator Storage tank

This electronic level indicator shall be provided by bidder, **in addition to continuous level transmitter** used for modulating control of respective level.

Electronic Remote level Monitoring System working on principle of difference in electrical conductivity between steam and water. The Monitoring System shall meet the requirements as indicated below.

The sensing electrodes shall be placed in equal pitch. The maximum distance (gap) between two electrode shall be 50 mm and the electrodes shall be arranged in such a way that the last and the first electrode shall not be at any alarm or trip level.

Both indication and validation system shall be supplied with double isolation valves in water, steam, drain and vent lines.

Each electronics unit shall be provided with 2 x 100% redundant power supply pack converters to be fed from two feeders of 24V DC or 240V AC UPS system as per system requirement. These two power supplies shall be internally fused and failure of one power supply shall not affect the performance of the system. Self-monitoring facility to detect and alarm the loss of power supply shall be provided.

The detector unit, logic units, 2x 100% redundant power supply units/packs shall be housed in separate and independent cubicles for pressure vessel on each side of the tank. The Electronic unit mounted locally should have detector units, logic units etc. & shall be independent for each pressure vessel. The minimum enclosure rating IP 65.

Indication shall be provided at field for both indication and validation system. Remote indication is to be provided for indication system at unit control panel in CCR. Local Indication should be inbuilt in local electronic unit.

Electrode assembly shall have blow out and leakage proof sealing arrangement. Field proven ceramic/zirconia probes with insulation suitable for design pressure and temperature are to be provided.

The system design shall be such that it shall ensure that failure of one probe circuit shall not affect another probe circuit and failure of any electrode will not hamper the system function and operation. Further the entire system shall be of proven fail-safe design.

The logic shall be such that the trip and alarm relay circuits shall be independent for each for Low, Low-Low, High and High-High levels of tank. Monitoring of set time for trip generation and provision of setting time delay shall be available in the system. Trip logic shall be independent and separate from faultfinding logic.

The system shall have fault diagnostic features such as process fault, system hardware fault, probe failure, circuit board failure, shorted wire etc. Further the system shall be able to distinguish between a cable fault and an electrode fault.

The necessary relays and relay modules for the Output Contacts shall be of proven design and each contact shall be rated for 5A, 240V AC/0.25A 220V DC rating. All these contacts shall be 2SPDT type. The **vessel** holding electrodes **shall be IBR certified**. The system shall be proven and approved by Factory mutual, USA of equivalent, IBR etc.

3.03.17 LEVEL SWITCHES (LS)

Type/Construction	:	a) External float cage type with magnetic switch actuator for tanks and vessels. b) Electrode/Capacitance (for oil tanks) c) Displacer -Top mounted for all clean water sumps. d) Conductivity type for high Pressure and high temperature enclosed vessel like drain pot, HP heaters etc.
Materials		
- Body	:	Cast Carbon Steel/Die cast Aluminum suitable for specified pressure and temperature ratings
	:	For corrosive liquids suitable anti-corrosive coat/lining shall be provided.
- Float/Displacer	:	316 SS
- Wire rope	:	316 SS
Differential	:	± 12 mm minimum (Adjustable)
Contacts		
- Number	:	DPDT/2 SPDT
- Type	:	Snap action micro switch Auto reset with internal Adjustable
- Rating	:	5 Amp 240V AC 0.2 Amp 220V DC
Connection - Process	:	One (1) inch SCRD NPT Female Or One (1) inch ANSI Flanged Four(4) inch ANSI Flange for sump services.
Electrical	:	Suitable for Plug in type connection

Temperature/pressure rating :	As per service conditions
Accessories :	Counter flanges, still pipe of requisite length with anticorrosive coating for sump services.

Nuclear, capacitance, or ultrasonic type level switch for bulk material applications shall be provided.

3.03.17.01 Conductivity Type Level Switch

Type	:	Conductivity discrimination.
Mounting	:	Flanged – on standpipe.
Probe MOC	:	Stainless steel with high purity ceramic.
Probe rating	:	> Maximum design pressure of vessel.
Input	:	Four independent channel with selectable switching threshold for water conductivity.
Relay Output	:	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
Contact type & rating	:	2SPDT or 1 DPDT @ 5A 30V DC.
Faults Detection	:	Power Fail/Electrode Connection Open circuit/short circuit to ground, Ground failure. In built Fail Safe Logic.
Indicator	:	One Red LED for steam/ one Green LED for water/ Two no. LED one each for Process & system fault.
Power supply	:	Dual 240V AC, 50 Hz, 1Ph. From UPS
Enclosure	:	IP-65, corrosion resistant & wall mounting type.
Accessories	:	i. PTFE cable from probe to electronics unit. Electronic unit shall be separate. Head mounted electronic unit is not preferred. ii. Mounting accessories iii. standpipe iv. Washer & gasket
Test pressure	:	Two times rated pressure

3.03.17.02 Capacitance Type Level Switch

Type	:	Capacitance type
Probe	:	a) Rod or suspended electrode b) Rope type probes may be used only where required probe length is greater than 3 meters.
Probe Mounting	:	Stainless steel 1-1/2 ANSI RF Flange / ¾" NPT (M)
Material of construction	:	316 SS
Insulation	:	PTFE Part/Full as per service.

Enclosure	:	Powder/Epoxy coated Die cast Aluminium. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
Ambient temperature	:	0-60 °C.
Mounting	:	On Top
Supply voltage	:	240V AC, 50Hz from UPS/ 24V DC
Relay output	:	2SPDT
Contact rating	:	5A min. at 240V AC on resistive load
Response time	:	100 m sec or better
Cable connection	:	3/4" ET
Accessories	:	Counter flange, Cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.

3.03.17.03 RF TYPE LEVEL SWITCH

A. Electronic Controller

1.	Input Supply	:	240 V AC from UPS
2.	Construction	:	Cast Aluminum Housing
3.	Relay Output	:	2 Nos. Relay Changeover Potential Free Contacts(2SPDT)
4.	Contact Rating :	:	5A at 240 V AC & 0.25 at 220 V DC
5.	Class of Protection	:	IP-66
6.	Ambient Temperature	:	55 Deg. C(Max)
7.	Local Indication	:	Local LED Indications
	Green	:	Normal Level
	Red	:	Alarm Level
	Yellow	:	Probe Healthy
8.	Cable Connection	:	3/4" ET(2 Nos.) for Supply and Output 5/8" ET(1 No.) for Probe Connection
9.	Repeatability	:	100%

B. Sensing Probe

1.	Type of Probe	:	Rigid
2.	Material	:	Stainless steel SS 316
3.	Probe Head Housing	:	Cast Aluminum
4.	Insulation (B/W Active & Shield And Shield & Ground)	:	PTFE
5.	Probe Head Protection	:	IP-66
6.	Mounting	:	Side Mounted
7.	Cable Connection	:	5/8" ET(1No.)
8.	Process Connection	:	40 NB BSP THREADED
C.	Signal Cable	:	Coaxial cable for Connection Between Sensing probe and electronic Controller(@ 10 Mtrs. Per Level Probe)

D. Application : Ash Silos

3.03.18

LEVEL INDICATORS (Gauge Glass) (LI)

Type/Construction	:	a) Reflex b) Tubular (For tanks open to atmosphere only)
Material:		
a) Glass	:	Tempered borosilicate resistant to thermal shock
b) Case	:	Carbon steel
c) Integral cocks and	:	i) Forged carbon steel with drain valves stainless steel internals ii) Rubber lined corrosion resistant 316 stainless steel (for Demineralised and Osmosis water service)
d) Fittings	:	i) Forged carbon steel ii) Rubber lined 316 steel/PVC for corrosive liquids Demineralised and Osmosis water service) iii) 304 Stainless Steel for non-corrosive liquids
e) Packing	:	Teflon
Dial size/scale	:	150 mm /1.5 Meters maximum length with
Scale details	:	Aluminum/SS316 scale Graduated in mmwc
Connection	:	25 Nb/40 Nb ANSI Flanged
Accessories	:	a) Integral cocks b) Drain valves c) Bolts, nuts and gaskets d) Illuminating lamps as required e) Periscope as required
Tests	:	Tested at two hundred (200) percent of the maximum process pressure
Other details	:	For larger lengths, additional gauge glasses shall be provided with minimum of 50 mm overlap.

3.03.19

FLOAT & BOARD TYPE LEVEL GAUGE

Type of Instrument	:	Mechanical Type (Float Operated)
Service/ Application	:	As per service requirement
Measuring Range	:	as per requirement
Material Specification		
a) Float Material	:	SS316 having 2 nos. Guide wires
b) Float Wire Pulley	:	Shall comprise of 2 nos. Cast Aluminum Pulley housing Assembly with SS 304 pulley and pulley shaft. Steel ball bearings shall be provided in pulley housing for easier float movement. Float wire material shall be

SS316L. Between 2 pulleys, 1" NB G.I. short pipe with tentative length as per P&ID

c) Guide wire Assembly	:	CS chamber with spring and adjuster having 1" Class 150 ANSI RF MS flange. Guide wire rope shall be SS316L.
d) Counter Weight	:	MS counter – weight with Aluminum Pointer and Brass assembly Pull Chain.
e) Scale	:	SS 316/Aluminum material in mm with 1 % accuracy.
Nozzle Details	:	For float wire pulley assembly, one tapping and for guide wire assembly two tapping at the top of the tank; Size 1" NB (Top Mounting Type)
Process Connection	:	Flanged as per ANSI B 16.5 to suit 1" NB nozzle (Nozzle length - 150 mm for float wire, 100 mm for guide wire)
Accessories (to be supplied with the instrument)		
a) Counter flange	:	All mating Flanges, Nozzle
b) Mounting Accessories	:	All mounting accessories
c) Tag Plate	:	To be provided (material SS316)

3.03.20 MASS FLOW METER

Sensor

Measuring Principle	:	Coriolis Mass flow.
Primary Element	:	Flow Tube of 316SS or better
Heating Arrangement	:	Integral with Flow meter.
Temperature Control For Heating	:	To be provided.
Process Connection	:	ANSI RF Flanged and rating as per process requirement.
Drain	:	Self-draining facility
Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets etc.

Transmitter

Measured quantities	:	Mass Flow rate, Total Mass Flow, Density, Temperature as minimum.
Input Signal Processing	:	Digital Processing.
Display	:	Digital Display (LCD).
Output	:	2 Nos. isolated output of 4-20mA DC selectable from four measured quantities.
Load	:	< 750 ohms.
Power supply	:	240V AC, 50 Hz. From UPS
Accuracy	:	0.15% of measured value for Liquid 0.5% of measured value for Gas
Repeatability	:	0.05%
Housing	:	IP 65 (Explosion proof for NEC Class-1, Division 1 area)
Hazardous duty Version	:	FM Standards.

Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	a) As required for field mounting, Handheld configurator & complete Software, External zero adjustment facility b) Mounting U-bolts, nuts, bolts, prefab cable etc.
Application	:	HFO main line, LDO lines, HFO recirculation lines etc.

3.03.21 Turbine Flow meter

Sensor

Type	:	Turbine (in line full-bore, based on magnetic pick of pulses)
Output Signal	:	Pulse
Material of Construction	:	a) Body : AISI 316 b) Rotor: AISI 431 or 410 c) Bearings: Tungsten Carbide / Stellite Sleeve
Flow rate range	:	As required.
Linearity	:	0.25% or better.
Repeatability	:	0.02% or better.
Ambient temperature	:	50 deg C
Mounting	:	On-Line mounting with ANSI RF flanges of stainless steel.
Enclosure	:	IP 65

Transmitter

Electronics	:	Solid State
Power Supply	:	240V AC, 50Hz. UPS
Input	:	Input from Sensor
Display	:	4 1/2 digit LCD
Output	:	Isolated 4-20mA DC HART
Measuring Accuracy	:	0.5% of full scale range
Totalized Value	:	Required
Housing	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	a) clamping strip, bracket, prefab cable etc. and Calibration or configurator kit.

3.03.22 VORTEX FLOW METER

Sensor

Type	:	Vortex
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Output Signal	:	Pulse
Material of Construction	:	AISI 316
Sensor Seal	:	PTFE / higher based on temperature
Flow range	:	As required.
Linearity	:	0.25% or better.
Repeatability	:	0.02% or better.
Ambient temperature	:	50 deg C
Mounting	:	On-Line mounting with flanges of stainless steel.
Enclosure	:	IP 65
Accessories	:	Nuts, bolts, gaskets etc.

Transmitter

Electronics	:	Solid State
Power Supply	:	240V AC, 50Hz. UPS
Input	:	Input from Sensor
Display	:	4 1/2 digit LCD
Output	:	Isolated 4-20mA DC HART
Measuring Accuracy	:	0.5% of full scale range
Totalized Value	:	Required
Housing	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	Clamping strip, bracket, prefab cable etc. Special tool kit for calibration/ configuration .

3.03.23 Flow Transmitter (Ultrasonic)

Type	:	ULTRA SONIC, 2-wired
Sensing element	:	Non-contact
Output	:	4-20mA with HART Protocol
Accuracy	:	± 0.1% FS
Supply	:	24 V DC
Enclosure class	:	IP-65

Transmitter

Mounting	:	On Nozzle
Mounting position	:	Top mounted
Housing	:	Plastic
Display	:	Head mounted LCD Display and remote LCD display
Process connection	:	NPT/Flanged
Electrical connection :	:	NPT
Turn Down ratio	:	1:100
Measuring range	:	Adjustable (as per process requirement)
Totaliser	:	Required
Accessories	:	As per process requirement Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during

detailed engineering.

3.03.24 **Positive Displacement Flow Transmitter**

Positive displacement flow transmitters shall be offered. An electronic totalizer shall be provided for each flowmeter and the location of the totalizers shall be acceptable to the Owner. Air eliminators shall also be provided to ensure maximum accuracy.

Type	:	Hall Effect Sensor
Body Material	:	AISI 316L/Die Cast Aluminium.
Wetted part Material (Like Piston, Bearing, gear etc)	:	AISI 316L/Die Cast Aluminium.
O ring material	:	PTFE / higher based on temperature
Flow range	:	As required.
Accuracy	:	$\pm 0.5\%$ or better of reading
Repeatability	:	$\pm 0.03\%$ or better.
Ambient temperature	:	50 deg C
Mounting	:	On-Line mounting with flanges of stainless steel.
Electronics	:	Solid State
Power Supply	:	230V AC, 50Hz. UPS
Display	:	4 1/2 digit LCD for Flow rate & totalized value.
Output	:	Isolated 4-20mA DC
Turn Down ratio	:	1:30
Totalized Value	:	Required
Housing	:	IP-65/ (Explosion proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	a) Clamping strip, bracket, prefab cable, battery etc.

- b) Nuts, bolts, gaskets, mesh etc.
Special tool kit for calibration/configuration.

3.03.25 **Electromagnetic Flow meter**

Electromagnetic flow meters shall have separate transmitter having accuracy $\pm 0.2\%$ with zero stability feature, suitable for process medium with ≤ 5 micron Siemens conductivity, flanges material SS-316, electrode & measuring tube material SS-316, liner material Teflon and enclosure IP-66, local digital display configurable as totaliser, 4-20 mA output signal HART compatible with zero and span field adjustable. Application – DM Water and for other application as decided by owner.

3.03.26 **FLOW GAUGES (FG)**

- | | | |
|-------------------|---|---|
| Type/Construction | : | a) On-line type Rotameter for 50 Nb and below lines |
| | | b) Bypass type Rotameter for above 50 Nb lines. |

Material

- For On-line type

- | | | |
|---------------|---|--------------------|
| Metering Tube | : | Borosilicate glass |
| Float | : | 316 SS |
| Packing | : | Teflon |
| End fittings | : | 304 SS |

-For Bypass type

- | | | |
|--------------------------|---|---|
| Metering Tube | : | Borosilicate glass |
| Float | : | 316 SS |
| Packing | : | Teflon |
| End Fittings | : | 304 SS |
| Orifice Plate | : | 316 SS |
| Carrier ring | : | 304 SS |
| Flanges & Mating flanges | : | Same as pipe material, 200 lbs ANSI - RF |
| Impulse pipe | : | Same as pipe material |
| Fittings | : | 2000 ANSI, SW ends to match with pipe material. |
| Dial Size/Scale length | : | 250 mm |
| Scale Details | : | Direct reading type engraved on detachable Aluminum scale |
| Accuracy | : | $\pm$ Two (2) percent |
| Reproducibility | : | Half (1/2) percent |
| Rangeability | : | 1:10 |
| Connection | : | SCRD NPT |

Accessories	:	a) Isolating valves (for Bypass type only)
		b) Bolts, Nuts and Gaskets as required
Tests	:	Shall be tested at two hundred (200) percent of the maximum process pressure

3.03.27 SIGHT FLOW GLASS INDICATORS

Type/Construction	:	Flapper type.
Materials	:	
Body	:	Carbon steel/SS316 as per process requirement
Glass	:	Toughened Borosilicate
Gaskets	:	Neoprene
Bolts & nuts	:	SS
Flappers / Rotating Wheel	:	316 SS
Flappers / Rotating Wheel holder	:	304 SS
Process Connection	:	SW (Socket Welded)
Accessories	:	Scale, Bolts, Nuts, Cover plates and Gaskets as required
Tests	:	Tested at two hundred (200) percent of the maximum process pressure.

3.03.28 SOLID FLOWMETER

Type	:	Online Impact type Microprocessor Based
Measuring Principle	:	The system measurement is basically pertains to the measurement of horizontal deflection using LVDT, created by the impact of solid flow upon online sensing plate. The horizontal deflection being proportional to the impact forces, LVDT convert this horizontal movement into electrical signal. The inbuilt integrator convert this signal into time based flow rate indication & provide totalized flow also.
Sensing plate	:	316 SS
Sensing head	:	Sensing mechanism shall be mounted outside the process flow line.
Enclosure	:	316 SS
Enclosure protection	:	IP 67 class
Accuracy	:	+/-1%
Repeatability	:	+/- 0.2%
Drift	:	Both zero & span $\pm$ 2% / month
Output	:	4-20mA DC isolated, load 600 ohm (min)
Digital communication	:	yes, (HART) facility
Power supply	:	240 V AC, 50Hz. UPS
Ambient condition	:	Temperature -60 ⁰ C, RH-95% Environment – Highly Dusty

Accessories : Shall be complete with all the accessories including digital display for flow rate, integral vents, baffles for air separation, etc. which ever required for satisfactory operation.

Note:-

1. The above on line flow meter shall not create any obstruction on flow.
2. User's list shall be submitted to support on proven satisfactory performance for similar process application.

3.03.29

Instrument Air System

The instrument Air Supply System for various pneumatic Control & Instrumentation devices like pneumatic actuators, power cylinders, I/P converters, pneumatically operated valves etc. shall be complete in all respect with necessary Air Filter Regulators, valves, piping/tubing etc.. Each pneumatic instrument shall have an individual air shut off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built in filter-housing blow down valve.

Filter shall be of minimum 5-micron size & sintered bronze material.

On collection of water in the drains of instrument air lines, mechanical automatic drains and periodically solenoid operated drains (with electronic timer - 15m, 30m, 60m and 2 Hours & Timing adjustable) are to be provided.

For mechanical type & Electrical type, the locations to be provided in the instrument air lines of boiler area, Chimney area, turbine area etc., shall be decided during detailed Engineering.

Bulk header nearby the crowded applications shall be provided and from this bulk header individual air lines with necessary isolation valves are laid to the application.

These bulk header are to be provided with **mechanical / electronic based automatic Drains**.

Individual moisture separator for O₂ analyzer or vital application shall be provided nearby the instrument so as to enhance the cell life or the performance of vital final control elements.

3.03.30

Air Filter Regulator (AFR)

Constant bleed type AFR with an accuracy of $\pm 1.0\%$ inlet pressure range of 5-8 kg/ cm² and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E/P converters and shut off valves for phosphor bronze filter element; Filtering particles above five microns. Weather and water proof enclosure. Material of accessories will be SS316.

Air filter regulators shall be provided in the :

- (a) Air supply line to valve positioners / power cylinders
- (b) Air supply line to electric to pneumatic converters.

- (c) Air supply line to pneumatic interlocked block valves.
- (d) For each instrument rack, field instruments enclosure for purging.

3.03.31 Electro-Pneumatic Convertors (E/P)

Two wire type E/P convertors with an accuracy of $\pm 0.25\%$ accepting 4-20 mA dc signals from control system and converting to 0.2 to 1 kg/cm² air pressure to operate valve positioner of all final control elements; Housed in cast aluminum casing (with polyurethane paint); NEMA 4 or equivalent degree of protection for enclosure. Material of accessories will be S.S. E/P convertors shall have fail freeze (stay put) feature also. Process connection shall be 1/4" NPT (F) and Electrical connection shall be 1/2" NPT (F). Zero/span adjustment facility shall be provided. The E to P converters shall **retain the pneumatic signal (last value) even in failure of control signal** and shall have **self volume boosters**. Necessary air lock devices and pressure switches for air pressure low alarming shall be provided.

3.03.32 Solenoid Valves

Solenoid valves shall be provided with control valves / pneumatic control valves hooked up with process interlock requirements and where direct tripping is involved. The number of ways for solenoid valve shall be provided as indicated below:

- (a) Two (2) way solenoid valves shall be provided, where process line of less than 50 mm with low pressure and temperature application.
- (b) Three (3) way solenoid valve shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder, e.g., Pneumatically operated spray water block valve.
- (c) Four (4) way solenoid valve shall be provided for operating double acting cylinders, e.g., Pneumatically operated on-off type dampers.
- (d) For operation of the fuel oil corner nozzle valves, fuel oil trip valves etc., **double coil solenoid valve** (latch coil & relatch coil) shall be adopted.
Single coil usage requires always power and loss of power leads to closure of above valves resulting the unit trip or loss of generation.
- (e) Solenoid Valve coils shall be Class-H high-temperature or Class-F construction as applicable and shall be designed for continuous duty. Three-way solenoid valves shall be designed for universal operation so that the supply air may be connected to any port. Solenoid enclosures shall be NEMA-4/ (Explosion proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I) As applicable). Body material of solenoid valve shall be Die Cast Aluminum or SS316.
- (f) All solenoid shall be with varistor, LED indication, surge suppress diode and circuits.

3.03.33 Power Cylinders (Pneumatic)

Mounting Type	:	a) Fixed position mounting (End mounting).
	:	b) Trunnion mounting
Control Signal	:	0.2 to 1 Kg/Sq. cm. from I/P converter for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line.

		The Pilot solenoid will have separate coils for open closing purpose.
Supply Air	:	0-7 Kg / Cm ² .
Selection	:	Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.
Casing	:	IP-65.
Accessories (as required)	:	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Positioner with Input, Output and supply pressure gauges. g) Pilot Solenoid Valve (Double Coil type) h) Position Transmitter (4-20 mA DC linear output, LVDT or non contact type).
Fail-safe operation	:	Stay put, open or close position on pneumatic / electrical power supply failure as per process safety criteria.
Repeatability	:	Better than 0.5% of full travel.
Hysteresis	:	Less than 1% of full travel.

3.03.34 Nucleonic Type Density Meter (For Ash Handling Plant):-

Type	:	Nuclear type radiation
Application	:	Abrasive Slurries & Corrosive Chemicals
Accuracy	:	< 1% of Span
Orientation	:	As per requirement.
System Type	:	Radiation Source & Scintillation Detector
Meter Material	:	SS 316L/ Aluminium with PVC coating
Connection material	:	SS 316L
Compensation	:	Temp. Compensation required
Type (Transmitter)	:	SMART, 2 Wire HART based
Operating Principle	:	As the density increase, the lower the radiation field at detector and vice versa.
Output	:	With photomultiplier, 4-20 mA, DC
Electrical Connection	:	½" NPT
Enclosure Class	:	IP 66
Local Display	:	Provided
Accessories	:	Radiation Survey Meter and all erection/installation hardware

3.03.35 Non - Nucleonic (Vibration) Type Density Meter (For DM & AHP Plant):-

Application	:	Liquid Density measurement
Detector		

- | | | | |
|----|----------------------|---|-------------------------------|
| 1. | Orientation | : | As per requirement. |
| 2. | Case Material | : | SS 316/ Cast Aluminium alloy |
| 3. | Wetted part material | : | SS 316 |
| 4. | Operating Principle | : | Vibration Density measurement |

Convector

- | | | | |
|----|-----------------------|---|---|
| 1. | Output | : | 4-20 mA DC isolated. |
| 2. | Electrical Connection | : | ½" NPT |
| 3. | Enclosure Class | : | IP 65 |
| 4. | Local Display | : | Digital 5 digit, density display with temp. compensation. |
| 5. | Accuracy | : | +/- 1% |
| 6. | Response time | : | < 1 minute. |
| 7. | Power Supply | : | 240 V AC, +/- 10%, 50 Hz. From UPS |

3.03.36

PULL CORD SWITCH

- | | | |
|-----------------------|---|--|
| Type | : | Addressable Type |
| Body | : | Cast Iron |
| Contact rating | : | Continuous 10 Amp, Breaking 2 Amp. (240 V AC) |
| No. of contact | : | 2 NO + 2 NC |
| Reset facility | : | Manual Reset |
| Type of enclosure | : | Die Cast Aluminum |
| Degree of protection | : | Flame proof/Explosion proof for NEC class 1, Division 1 area |
| Local trip indication | : | Required |
| Accessories | : | <ol style="list-style-type: none"> 1. Canopy over lever of pull Cord switch. 2. Linking of switches through a single cable for each section. 3. Each pull cord switch shall be provided with red LED indication lamp for prominent visible indication of tripping. 4. <u>"One number indicator panel which shall display the exact number of safety switches (pull cord and belt sway switches) operated in a loop of conveyor. It shall also monitor the condition of field cable connecting the switches in series & generate signal if field cable is found broken or short. The indicator panel shall display the operated switch number. The same indication shall also be available in C H P P L C operator station.</u> |

3.03.37

BELT SWAY SWITCH

Type	:	Addressable Type
Body	:	Cast Iron
Contact rating	:	Continuous 10 Amp, Breaking 2 Amp. (240 V AC)
No. of contact	:	2 NO + 2 NC
Reset facility	:	Auto Reset
Type of enclosure	:	Die Cast Aluminum
Degree of protection	:	Flame proof/Explosion proof for NEC class 1, Division 1 area
Accessories	:	1. Canopy 2. The beltway switches shall be provided with a common bridging push button which may be kept pressed to bypass the limit switch before restarting the conveyor. 3. Same as above 3.03.36 (4).

3.03.38 ZERO SPEED SWITCH

Type	:	Microprocessor Based
Body	:	Cast Iron
Contact rating	:	Continuous 10 Amp. (240 V AC)
No. of contact	:	2 NO + 2 NC
Reset facility	:	Manual Reset
Type of enclosure	:	Die Cast Aluminum
Degree of protection	:	Flame proof/Explosion proof for NEC class 1, Division 1 area
Accuracy	:	+/- 5%
Repeatability	:	+/- 1%
Differential	:	+/- 5%
Accessories	:	Canopy

3.03.39 CHUTE BLOCK SWITCH

Type	:	RF Based
Sensor Material	:	SS 316
Mounting	:	Flanged
Insulation Material	:	PTFE
Contacts	:	2 NO + 2 NC
Type of enclosure	:	Die Cast Aluminum
Degree of protection	:	IP 66
Electrical Connection	:	¾" ET
Repeatability	:	0.05%
Local Indication	:	To be provided
Accessories	:	a) Neoprene Gasket and Stud Bolt b) SS Tag plate, Nickel plated brass double Compression type cable gland

3.03.40 Humidity & Temperature Sensor with LCD display for AC Plant

Humidity Sensor		
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Measurement range	:	0-100%r.h.
Range of use	:	0-100%r.h.
Measurement accuracy at 23° C 0-100% r.h.	:	±2%
Temperature dependency	:	≤0.05% r.h./ ° C
Output signal, linear (terminal I1)	:	DC4-20mA = 0-100%r.h.
Temperature Sensor		
Range of use	:	0-50° C & -35 to 35° C
Sensing element	:	Pt1000 class A
Measurement accuracy at 15-35° C	:	±0.5K
Output signal, linear (terminal I2)	:	DC4-20mA = 0-50° C & -35 to 35° C
General Sensor Data		
Power supply	:	
Operating voltage	:	AC 24V ±20%
Degree of Protection & Safety Class		
Degree of protection of housing	:	
With enclosed cable gland	:	IP 65 to IEC 529
Safety class	:	III to EN 60 730
Environmental Condition		
Temperature (housing with electronics)	:	-40 to 70° C
Humidity	:	5 to 95% r.h. (non condensing)
Location	:	In each A HU room and Control room

3.03.41

DEW POINT METER

Type	:	2 Wire Loop Powered Dew point Transmitter
Overall Range	:	-60°C to +20°C Dew point
Accuracy	:	± 2°C Dew point
Material	:	SS316 (wetted parts)
Features	:	AUTOMATIC CALIBRATION
		- Can be Configured for Linear 4-20mA signal in °C & °F Dew point, ppm(v), ppb(v), g/m3 - Temperature Compensation

- Failure Diagnostics
- Long Term Stability
- Fast Response
- IP 66 / NEMA4X Protection
- Supplied with Calibration Certificate Traceable to National & International Humidity Standards
- Sensor protection with sintered filter
- Local LCD Display for Dew Point

3.03.42 Junction Boxes

v.	Type	:	Flame proof/weather proof
vi.	Enclosure	:	IP-65/Explosion/Flame Proof as per area classification.
vii.	Material	:	FRP with protective Coating
viii.	Cable entry	:	Bottom or Side
ix.	Cable glands	:	Double compression type – Nickel plated brass with PVC hoods.
x.	Mounting	:	Indoor/Outdoor
xi.	No. of terminals	:	As required with standardization with 20% spare of each size & type.
xii.	Terminals	:	Phoenix/Wago (screw less cage clamp type spring loaded)
xiii.	Grounding	:	Two terminals for body and shield ground
xiv.	Door	:	Hinged, lockable type.
xi.	Suitable mounting clamps and other accessories shall be in scope of bidder.		
xii	The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of brass, included in bidder scope of supply. High voltage & insulation resistance test shall also be conducted.		
Xiii	M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.)		
xiv	Gasket (Normal)- Neoprene thickness 6.0 mm		

3.03.43 Interposing Relays (IPR)

Electro magnetic type IPRs with modular design, plug-in type connections, suitable for channel/DIN rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated change over contacts rated for 0.5A 220 V DC/8 A 240 V AC. Free wheeling diode across relay copper coil and self reset type status LED indicator flag (electronic) shall be provided. Manual forcing/override facility is required. The test voltage for relay shall not be less than 4 KV with operating temperature from –20 deg. C to 60 deg. C. The relay shall have the necessary approvals like V O inflammability class in accordance with UL94”, IEC60664/IEC60664A/DIN VDE 0110. Facility to stimulate IPR manually shall be provided. The V A burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing relay shall be of same make only.

3.03.44 RECORDERS (CHARTLESS)

Type	:	Micro-processor based, Digital TFT display type
- No. of Channels	:	Forty Eight (48) point).

		6 Nos. of recorders shall be supplied with BTG packages and the parameters shall be decided during detailed Engineering. Quantities of recorders for BOP packages shall be decided during detailed Engineering. (Simultaneous parameter display preferred)
Input Signal	:	Fully configurable multi range (Programmable) universal (input)
Recording method	:	Continuous with different colour, for each channel
Display colour	:	Selectable from 30 Colours
Bar graph facility	:	To be provided
Digital indication	:	To be provided
Accuracy	:	+/- 0.1 % for reading for DC V Input And 0.1 Deg for TC/RTD input
Programmability	:	Front key board
Data Storage	:	hard disk/ Flash Memory
Data Retrieval	:	Compact 4 GB flash Memory card and USB port with 8 GB USB drive.
Scan rate	:	≤ 20 m second for individual channel. Selection of scan time for individual channel is required.
Power Supply	:	240 VAC 1 Phase UPS
Ambient Temperature	:	0-50 Degrees
Mounting	:	Front panel mounted weather & Dust proof IP 65
Application software	:	Yes, To be provided
Internal Memory	:	400 MB or more
Screen	:	≥ 10.5" colour LCD TFT
Resolution	:	≥ 640 X 480 Pixels
Type of Display	:	i) Trends ii) Bar Graph iii) Digital display/ values
Event Sampling	:	1/2/5/10/30/60/120 sec.
Zoom & Scroll Facility	:	Required
OWS and printer connectivity port	:	Required Necessary software shall be supplied for uploading the data.
Communication	:	Additional MODBUS/PROFIBUS ports connectivity between recorder and third party systems.

3.03.45 DIGITAL INDICATOR

Type	:	Programmable electronic digital indicator with floating point decimal.
Input	:	4-20 mA DC/1-5V DC/RTD/T/C.
Number of inputs	:	One
Range	:	As per requirement/adjustable by end user

		through key pad available on the indicator.
Number of digits	:	Four plus sign
Digit height	:	20 mm or larger
Display	:	Fluorescent red
Input over range/open sensor (T/C)	:	All digits to flash
Input hold time	:	0.7 seconds max.
Accuracy	:	$\pm 0.25\%$ of span
Power supply	:	240V AC, 50Hz
Mounting	:	Flush panel, compatible for mounting on mosaic grid panel
Size	:	96x48 mm
Other Particular	:	Indicator receiving thermocouple signal shall have automatic cold junction compensation.
	:	Retransmission Output 4 -20 mA isolated required.
	:	24 V DC inbuilt power supply
	:	Alarm contact with 2 NO/NC contact (rating 5A/230 V AC)

3.03.46 RECEIVER INDICATORS (SINGLE/DUAL CHANNEL)

Type	:	Analogue indicator
Input Signal	:	Universal input (T/C, RTD, 4-20 mA, Voltage)
Scale	:	Range fully configurable and programmable
Measurement Accuracy	:	$\pm 0.2\%$ of span ± 1 count
Resolution	:	0.5% Span
Dead band	:	$\pm 0.2\%$ of span
Repeatability	:	0.2% of span
Full scale response time	:	Less than two(2)seconds
Power Supply	:	240V AC, 50 Hz
Connection	:	Plug in type
Accessories	:	Mounting Bracket for Bins
Other Particulars	:	Indicator receiving thermocouple Signal shall have automatic cold junction compensation.
	:	Retransmission Output 4 -20 mA isolated required.

3.03.47 Temperature Scanner

Type	:	Microprocessor based Electronic Digital Scanner.
No. of channels	:	16/24 (as per the application)
Input	:	RTD /Thermocouple/4-20mA
Accuracy	:	± 0.1 of FS ± 1 count
Number of digits	:	4 digit (7 segment display with Engg. Units)
Digit height	:	12 mm or larger
Display color	:	Fluorescent red/green
Display mode for	:	