

DDCMIS

MARSHALLING PANEL

G-TYPE 4PAIR 0.5sqmm INST.CABLE

VFD-AC PANEL

BINARY OUTPUT

BINARY INPUT

ANALOG OUTPUT

ANALOG INPUT

OWS

BUS

XB91+ START

XB91- COMMAND

XB92+ STOP

XB92- COMMAND

XB93+ BYPASS ON

XB93- COMMAND

XB11+

XB11-

XB12+

XB12-

XB13+

XB13-

SPEED REFERENCE (4-20mA)

SPEED FEED BACK (4-20mA)

BL

RD

GE

YE

GR

BN

WT

BK

SHIELD BUS

0 0 0 0

ON

FEEDBACK

FAULT

FEEDBACK

BYPASS ON

FEEDBACK

4pX0.5Sqmm 'F-TYPE'

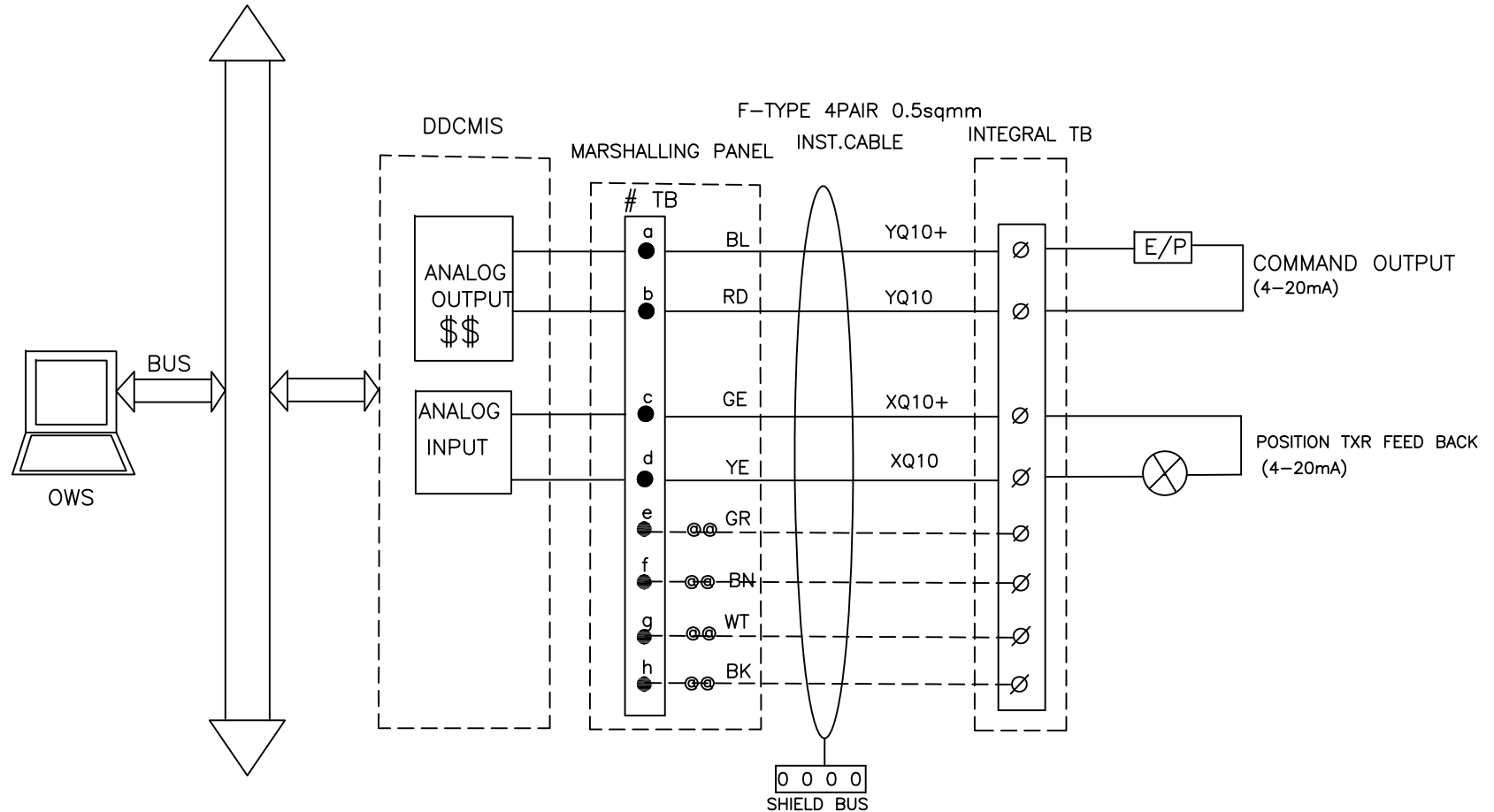
NOTE: 1. ** REDUNDANT OUTPUTS WHERE/EVER APPLICABLE

NOTE:-4 OTHER VFD SIGNALS WILL BE CONSIDERED AS PER IO LIST.



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INTERFACE FOR MODULATING DRIVES - CLCS



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICBLE

NOTE:-2 # 8 LEVEL TERMINAL BLOCK

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

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



UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS

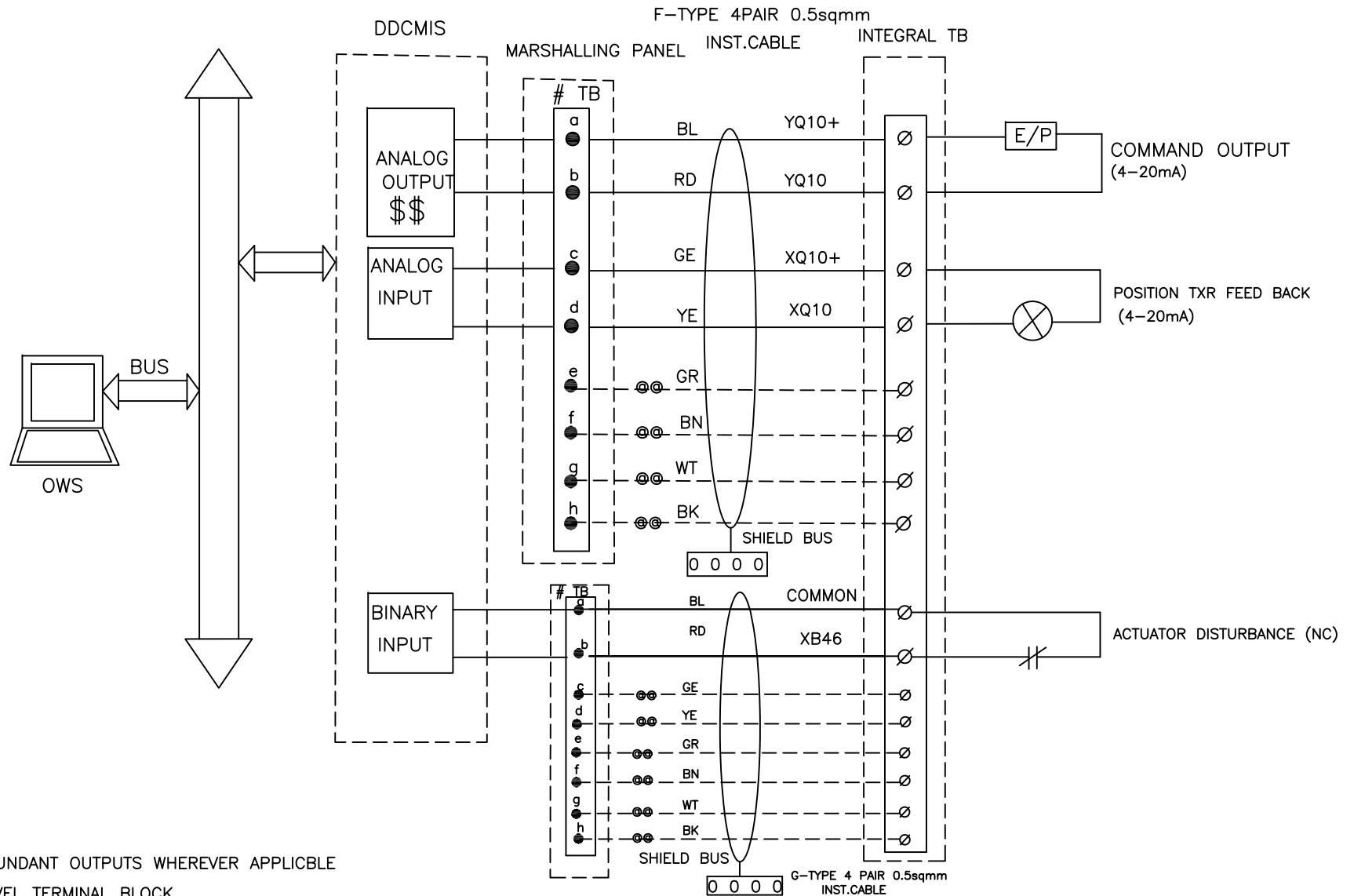
DRG.NO. 9962-001-PE-405-PVI-B-152

INTERFACE FOR MODULATING DRIVES - CLCS

SHT

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452

INTERFACE FOR MODULATING DRIVES - CLCS-M



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

NOTE:-2 # 8 LEVEL TERMINAL BLOCK

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

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



UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS

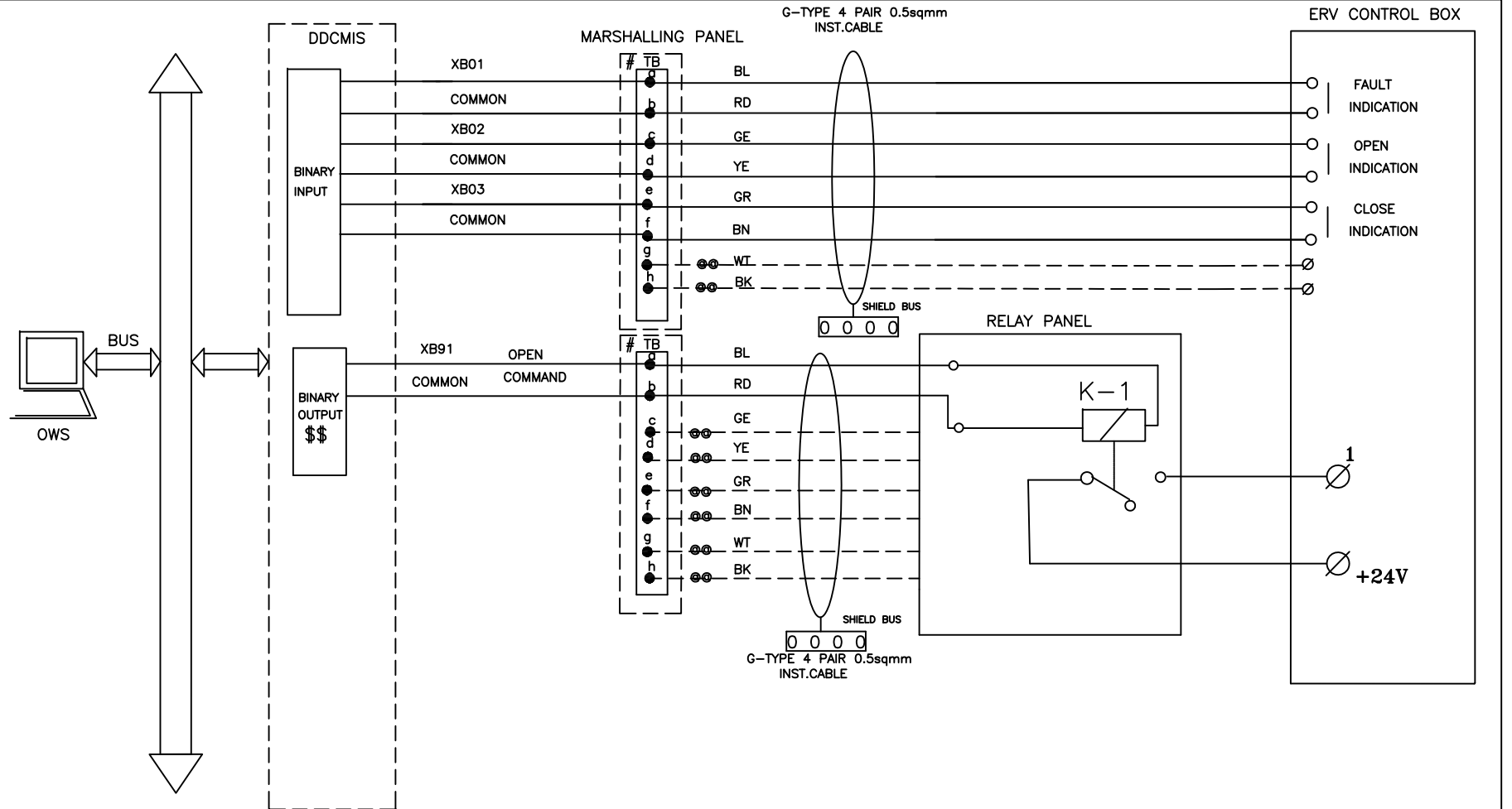
INTERFACE FOR MODULATING DRIVES - CLCS-M

DRG.NO. 9962-001-PE-405-PVI-B-152

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DDCMIS INTERFACE WITH ERV CONTROL BOX (ERV)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.

NOTE:-2 # 8 LEVEL TERMINAL BLOCK.

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



UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH ERV CONTROL BOX

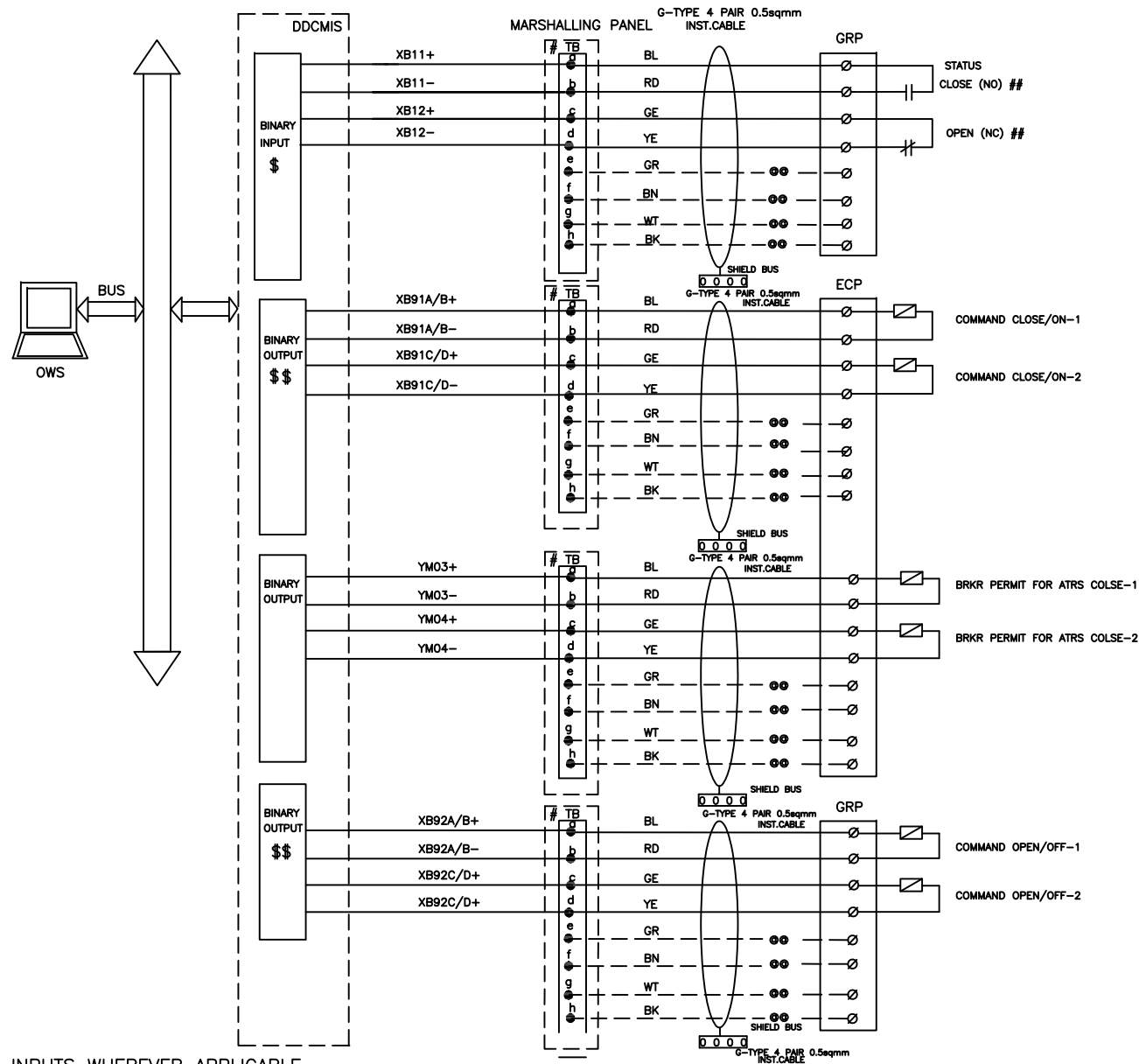
DRG.NO.

9962-001-PE-405-PVI-B-152

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454

DDCMIS INTERFACE WITH EHVCB



NOTE:-1 \$ REDUNDANT INPUTS WHEREVER APPLICABLE

NOTE:-2 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

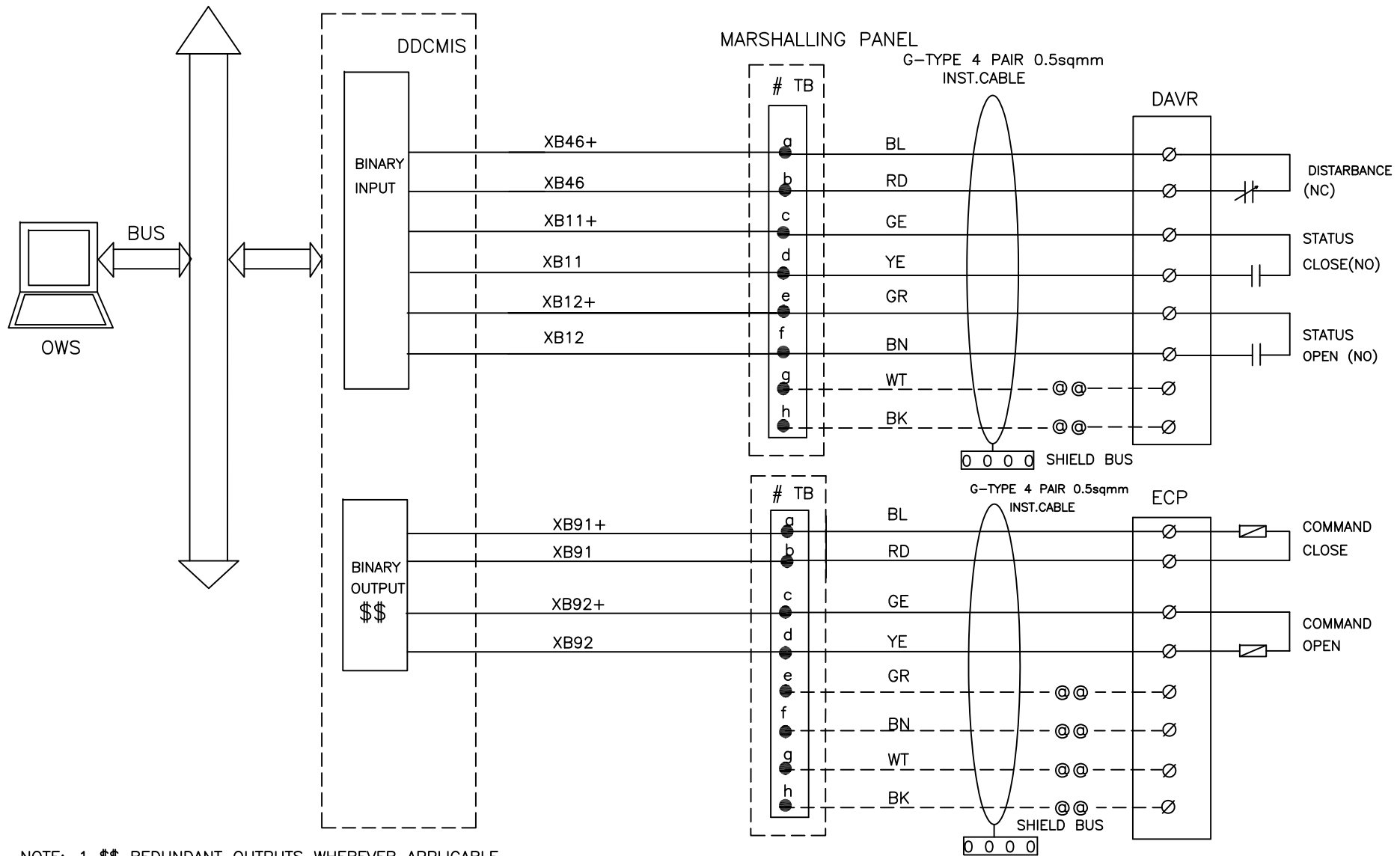
NOTE:-3 # 8 LEVEL TERMINAL BLOCK

NOTE:-4 ## DI-SOE SIGNALS

NOTE:-5 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION

	UP RAJYA VIDYUT UTPADAN NIGAM LTD		DRG.NO.	9962-001-PE-405-PVI-B-152
	1 X 660 MW PANKI TPS		DATE	11.02.2019
	DDCMIS INTERFACE WITH EHVCB		REV.NO.	01
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DDCMIS INTERFACE WITH FIELD BREAKER (FB)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

NOTE:-2 # 8 LEVEL TERMINAL BLOCK

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

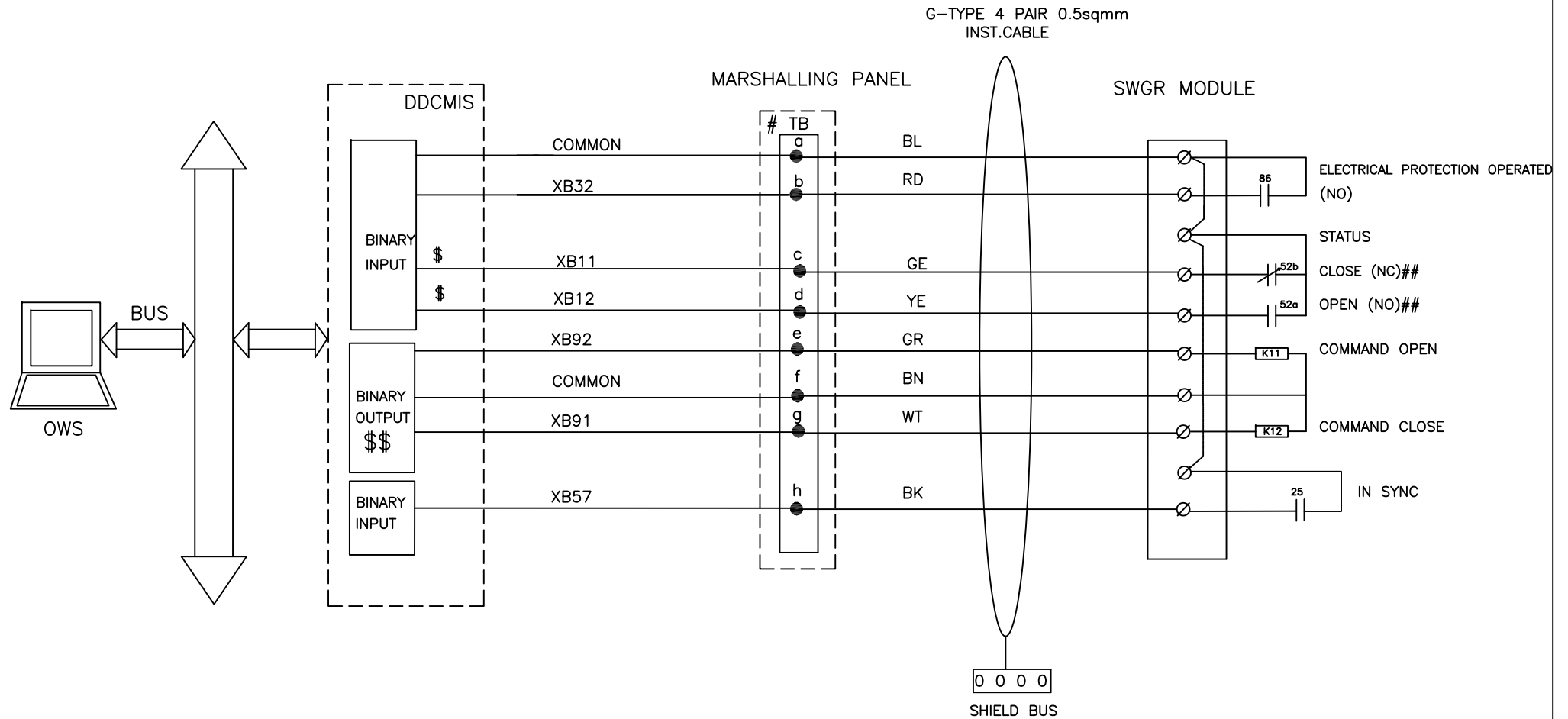


UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH FIELD BREAKER (FB)

DRG.NO.	9962-001-PE-405-PVI-B-152
DATE	11.02.2019
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DDCMIS INTERFACE WITH ELECTRICAL BREAKER (EB-HT-SYNC)



NOTE:-1 \$ REDUNDANT INPUTS FOR UNIT DDCMIS ONLY.
 NOTE:-2 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
 NOTE:-3 # 8 LEVEL TERMINAL BLOCK
 NOTE:-4 ## DI-SOE SIGNALS



UP RAJYA VIDYUT UTPADAN NIGAM LTD
 1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH ELECTRICAL BREAKER (EB-HT-SYNC)

DRG.NO.	9962-001-PE-405-PVI-B-152
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Wiring diagram for the SWGR MODULE:

- Marshall Panel:** 8 terminals (a-h) connected to a 4-pair shielded cable (G-TYPE 4 PAIR 0.5sqmm).
- SWGR Module:**
 - Terminal 86: ELECTRICAL PROTECTION OPERATED (NO)
 - Terminal 52b: STATUS CLOSE (NC)
 - Terminal 52a: STATUS OPEN (NO)
 - Terminal K11: COMMAND OFF
 - Terminal K12: COMMAND ON
 - Common terminal (marked with three circles): Connected to BK (Marshall Panel) and the SHIELD BUS.
- Shield Bus:** Connected to the shield of the cable and the common terminal.

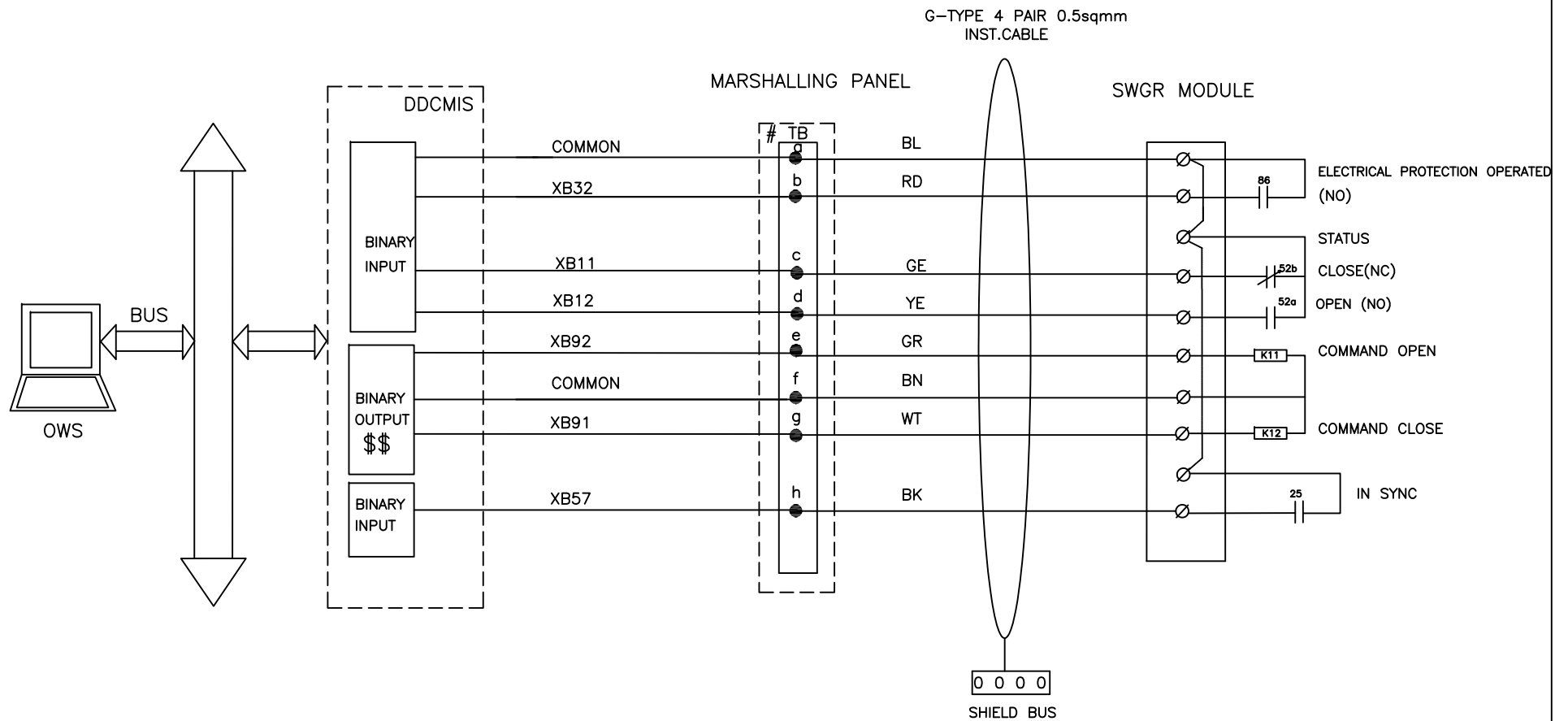
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE
TERMINATION.



DDCMIS INTERFACE WITH ELECTRICAL BREAKER(EB-HT-NONSYNC)

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DDCMIS INTERFACE WITH ELECTRICAL BREAKER (EB-LT-SYNC)



NOTE:-1 \$\$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK

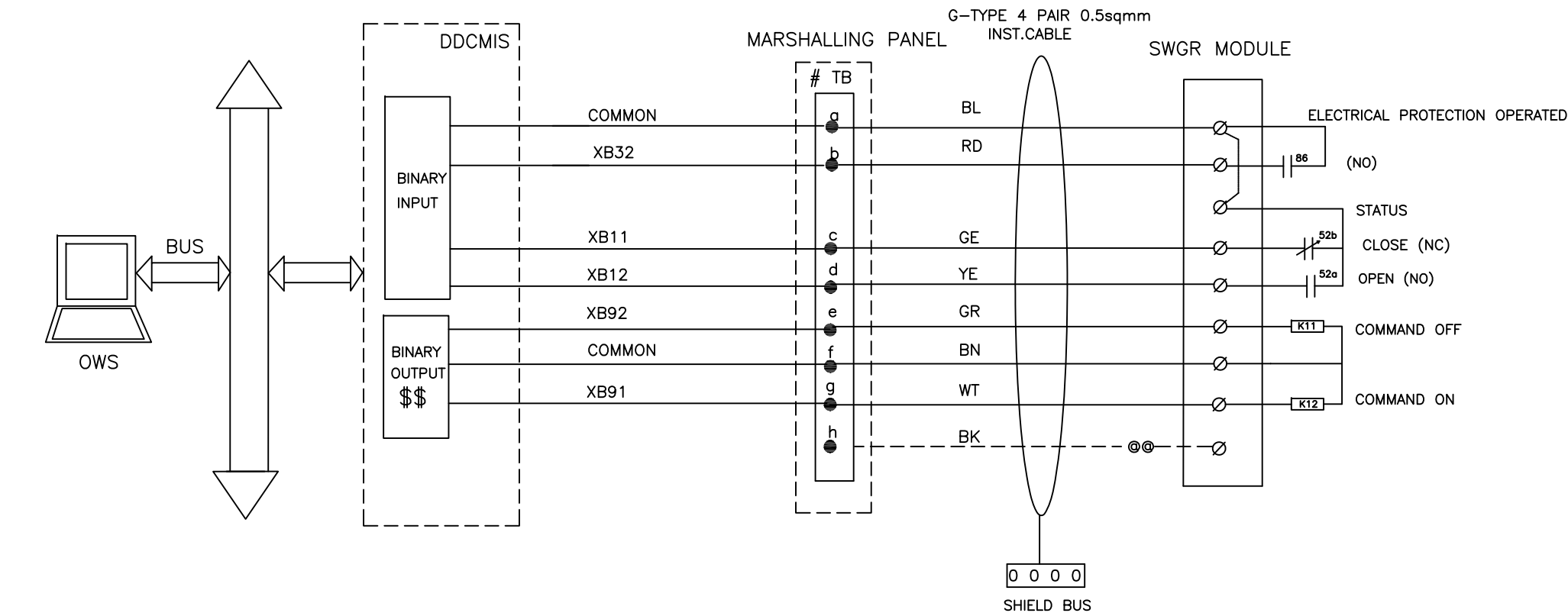


UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH ELECTRICAL BREAKER (EB-LT-SYNC)

DRG.NO.	9962-001-PE-405-PVI-B-152
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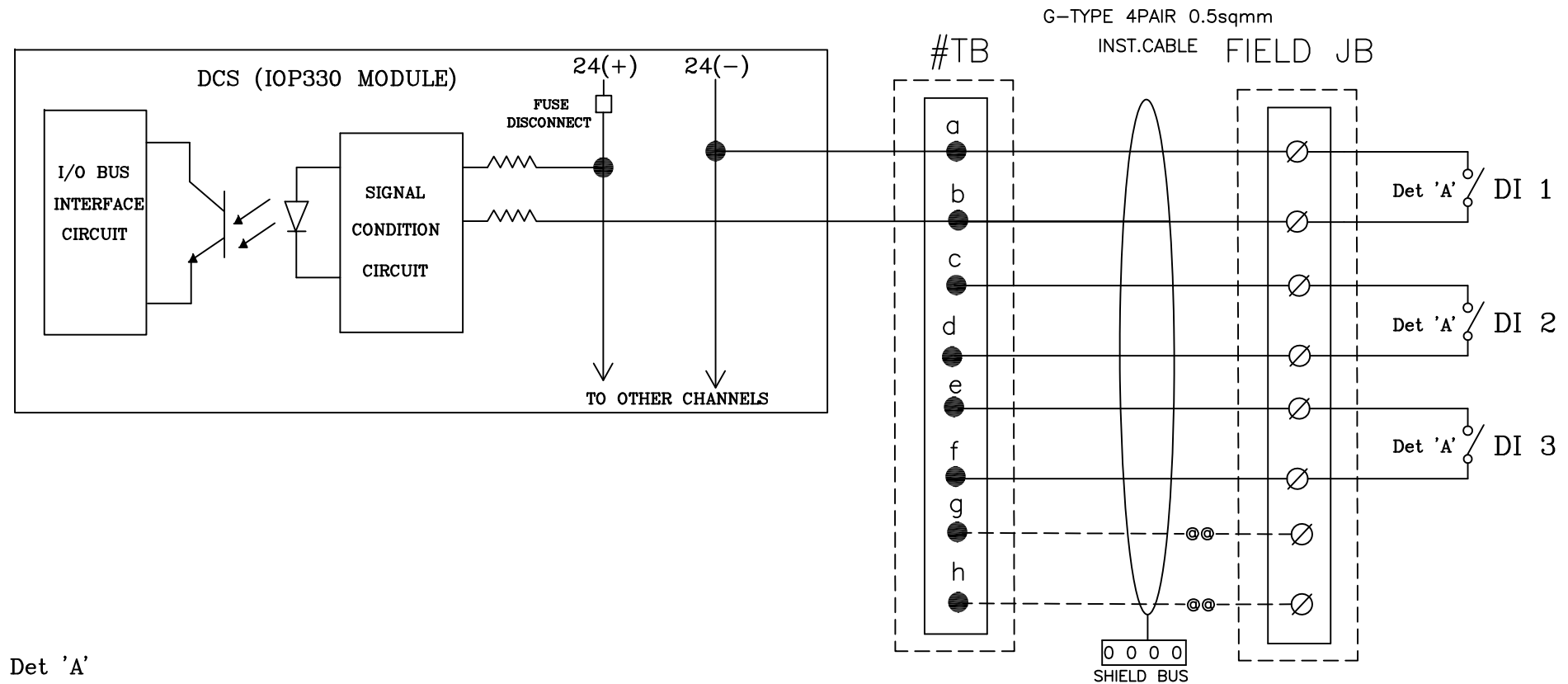
DDCMIS INTERFACE WITH ELECTRICAL BREAKER(EB-LT-NONSYNC)



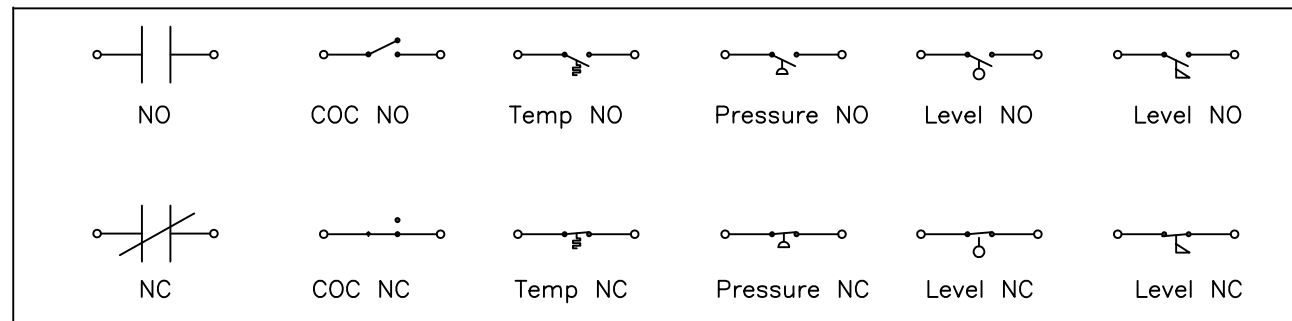
NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE
TERMINATION.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS DDCMIS INTERFACE WITH ELECTRICAL BREAKER(EB-LT-NONSYNC)	DRG.NO.	9962-001-PE-405-PVI-B-152
		DATE	11.02.2019
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DDCMIS INTERFACE WITH DIGITAL INPUT SIGNAL



Det 'A'



NOTE:-1 #8 LEVEL TERMINAL BLOCK.

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

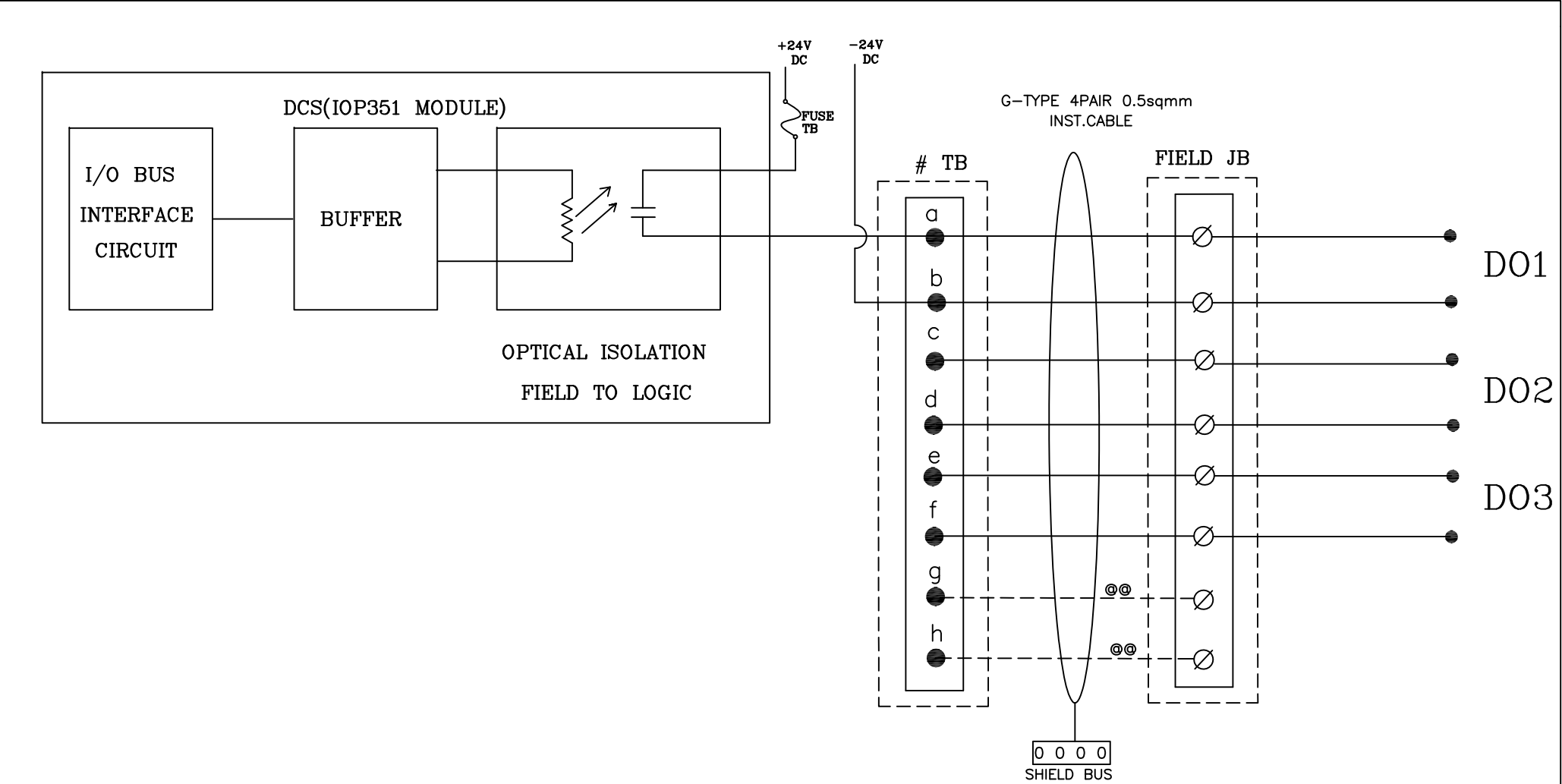


UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH DIGITAL INPUT SIGNAL

DRG.NO.	9962-001-PE-405-PVI-B-152
DATE	11.02.2019
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DDCMIS INTERFACE WITH DIGITAL OUTPUT SIGNAL

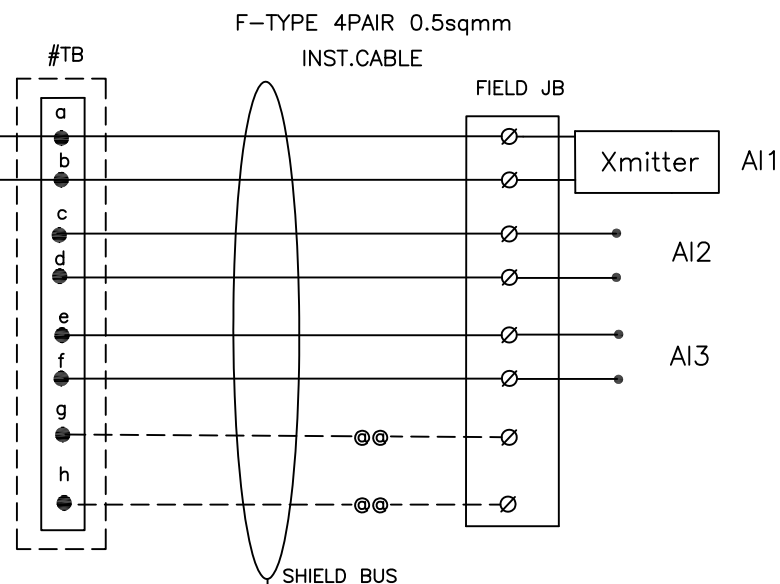
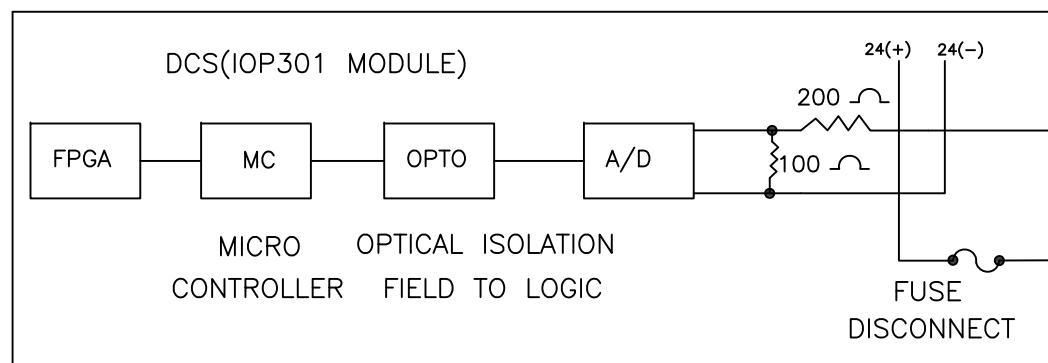


NOTE:-1 #8 LEVEL TERMINAL BLOCK.
NOTE:-2 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

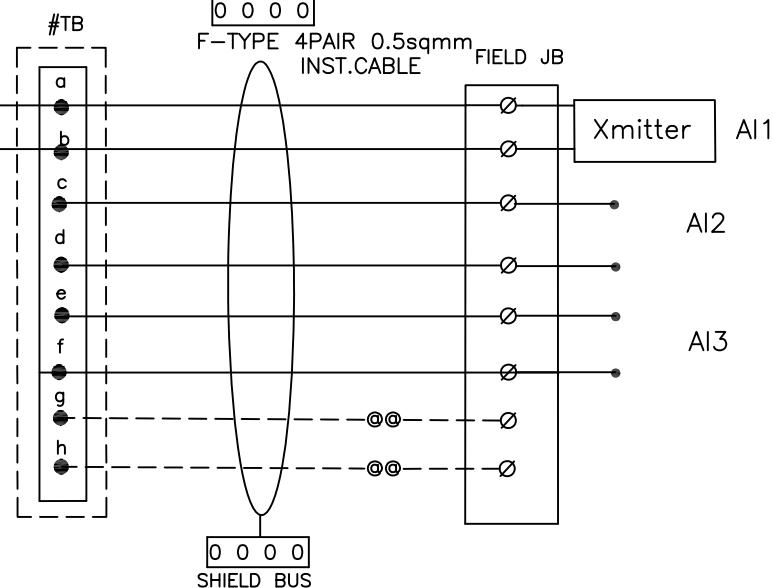
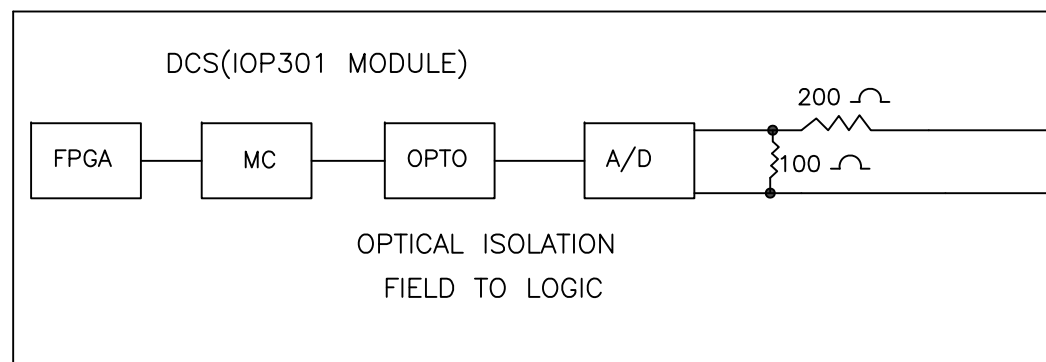
	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO.	9962-001-PE-405-PVI-B-152
	DDCMIS INTERFACE WITH DIGITAL OUTPUT SIGNAL		DATE	11.02.2019
			REV.NO.	01
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DDCMIS INTERFACE WITH ANALOG INPUT SIGNAL

AI INTERFACE(4-20mA POWERED BY SYSTEM)



AI INTERFACE(4-20mA POWERED EXTERNALLY)



NOTE:-1 #8 LEVEL TERMINAL BLOCK.

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

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



UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH ANALOG INPUT SIGNAL

DRG.NO.	9962-001-PE-405-PVI-B-152
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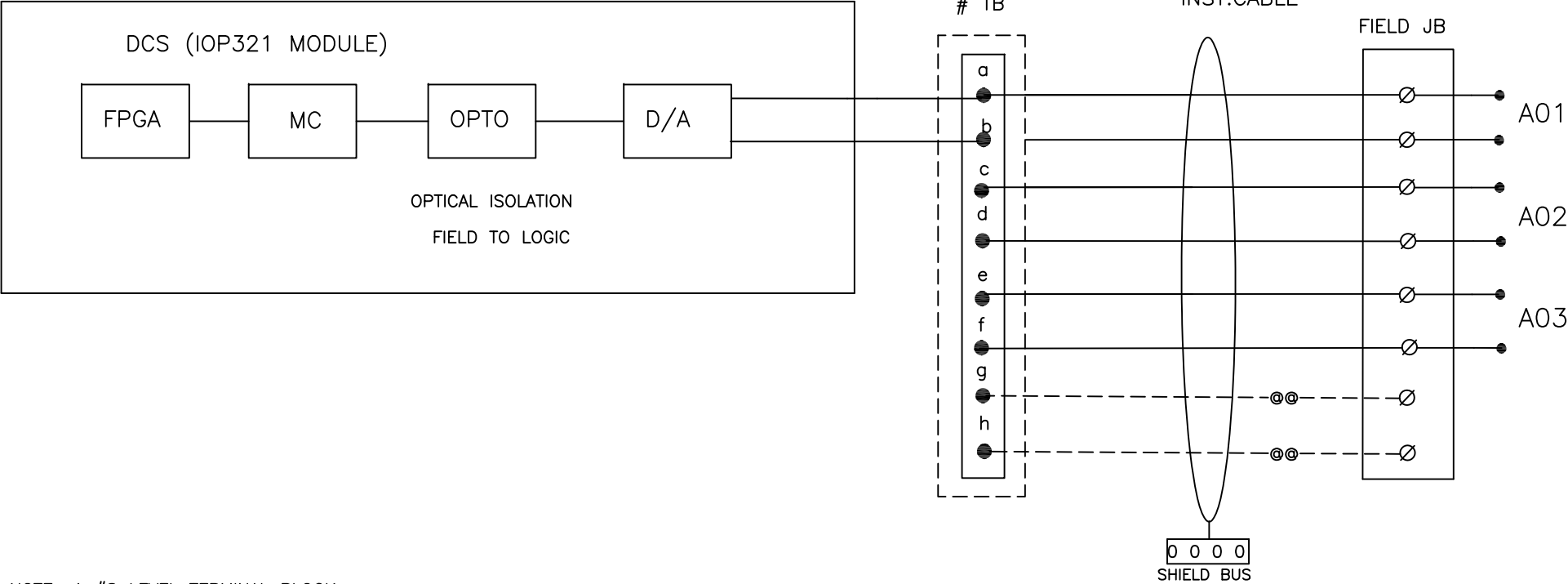
DATE	11.02.2019
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REV.NO.	01
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DDCMIS INTERFACE WITH ANALOG OUTPUT SIGNAL

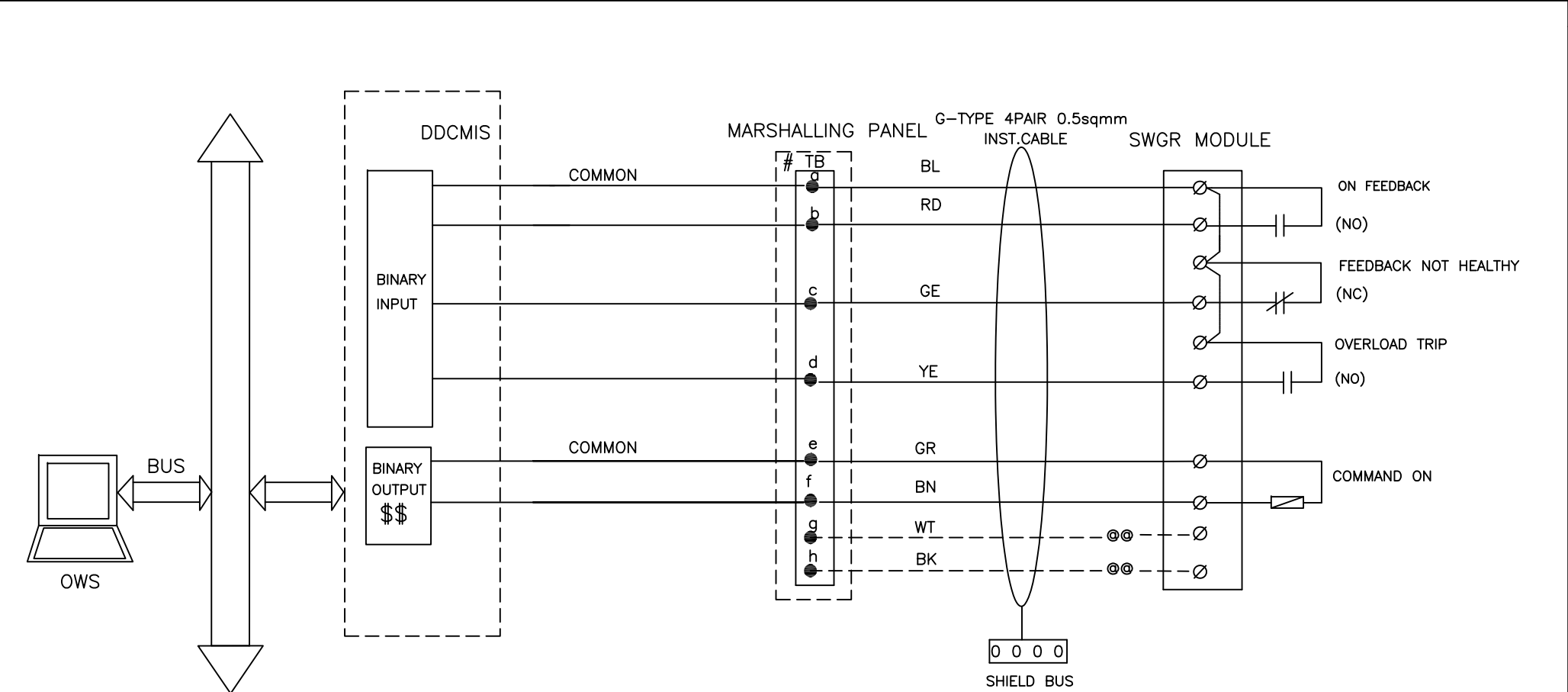
AO INTERFACE



- NOTE:-1 #8 LEVEL TERMINAL BLOCK.
- NOTE:-2 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.
- NOTE:-3 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD		DRG.NO.	9962-001-PE-405-PVI-B-152
	1 X 660 MW PANKI TPS		DATE	11.02.2019
	DDCMIS INTERFACE WITH ANALOG OUTPUT SIGNAL		REV.NO.	01
			SHT	26 OF 34

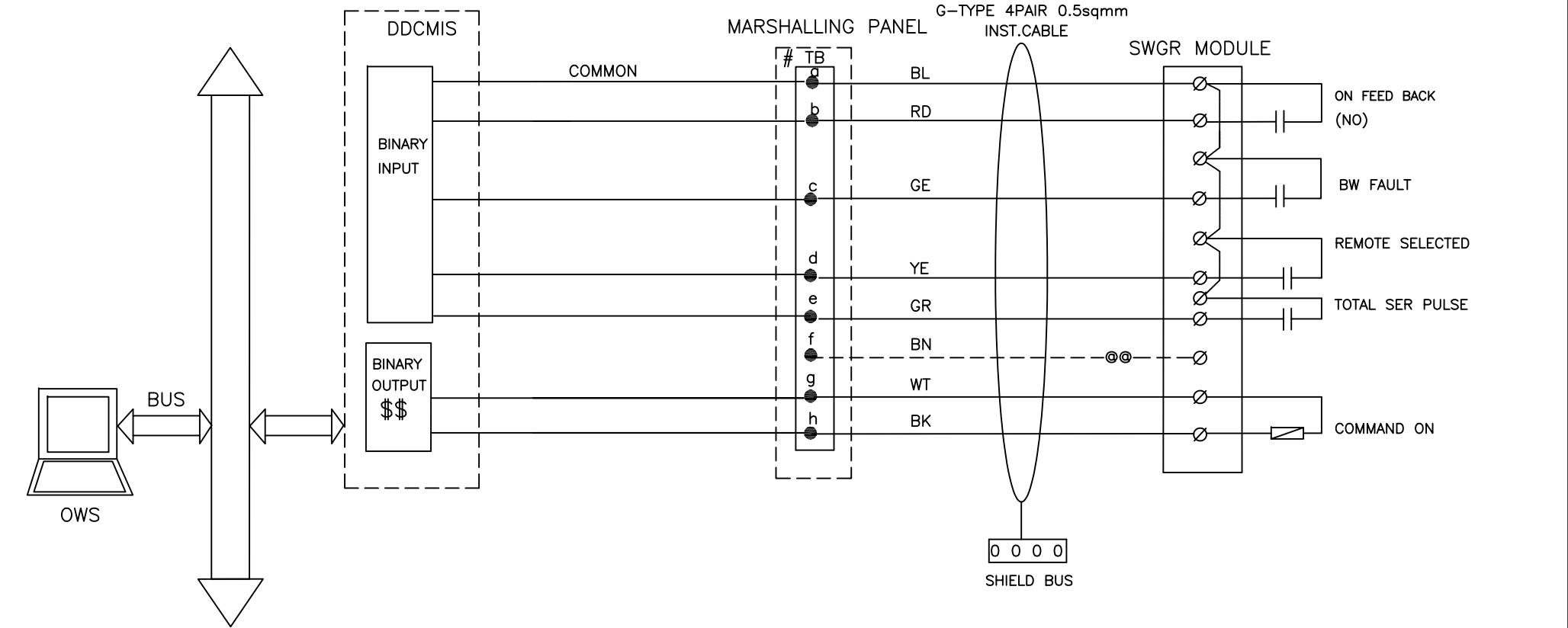
DDCMIS INTERFACE WITH LTCHP (DOL)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD		DRG.NO.	9962-001-PE-405-PVI-B-152
	1 X 660 MW PANKI TPS		DATE	11.02.2019
	DDCMIS INTERFACE WITH LTCHP (DOL)		REV.NO.	01
			SHT	27 OF 34

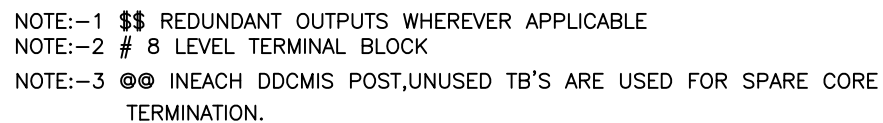
DDCMIS INTERFACE WITH BELT WEIGHER (BW)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE
TERMINATION.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS	DRG.NO.	9962-001-PE-405-PVI-B-152
		DATE	11.02.2019
	DDCMIS INTERFACE WITH BELT WEIGHER (BW)	REV.NO.	01
		SHT	28 OF 466 ³⁴

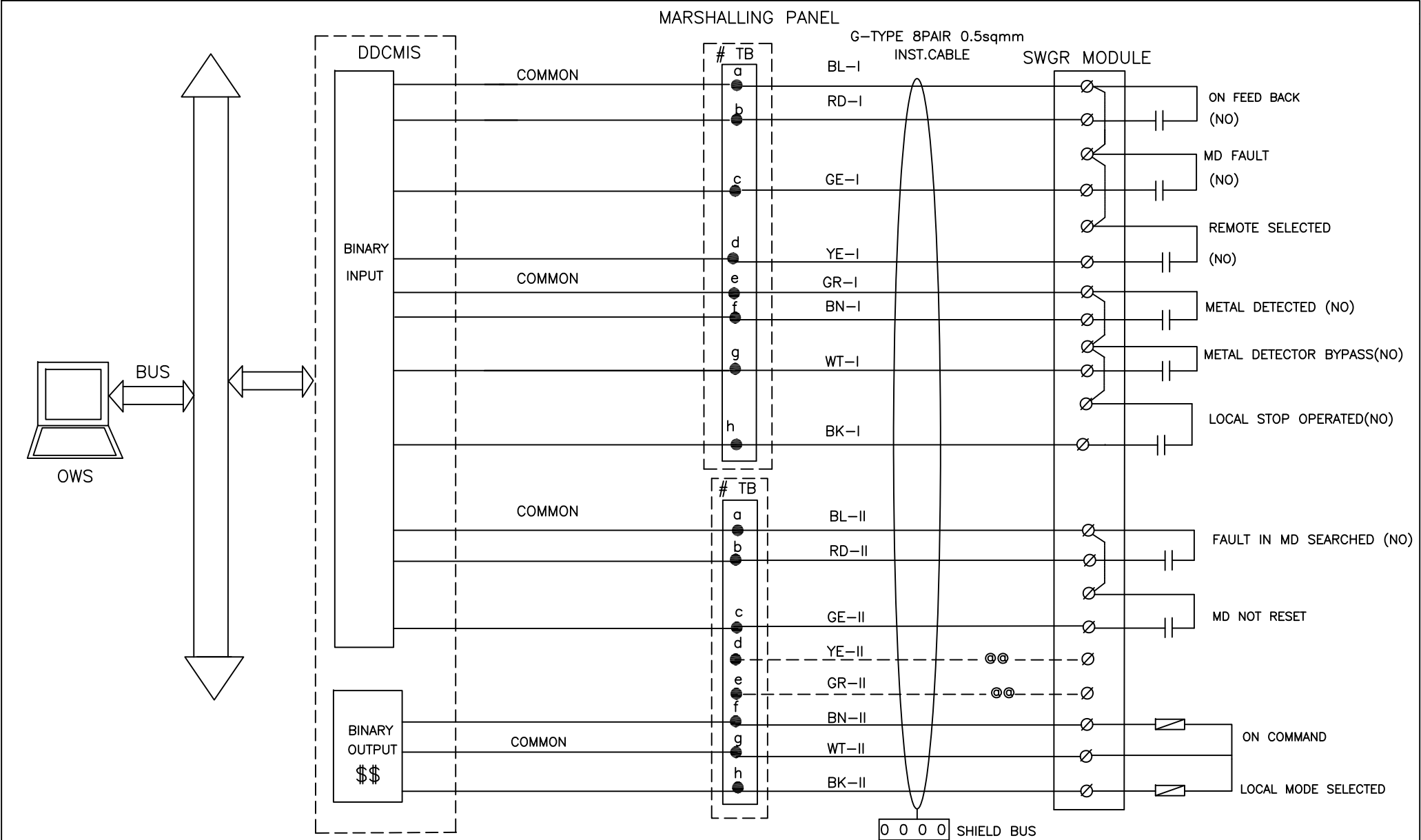
MARSHALLING PANEL G-TYPE 8PAIR 0.5sqmm



DDCMIS INTERFACE WITH SUSPENDE MAGNET (SM)

467

DDCMIS INTERFACE WITH METAL DETECTOR (MD)

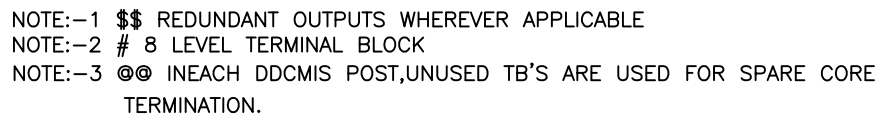


NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.



UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS
DDCMIS INTERFACE WITH METAL DETECTOR (MD)

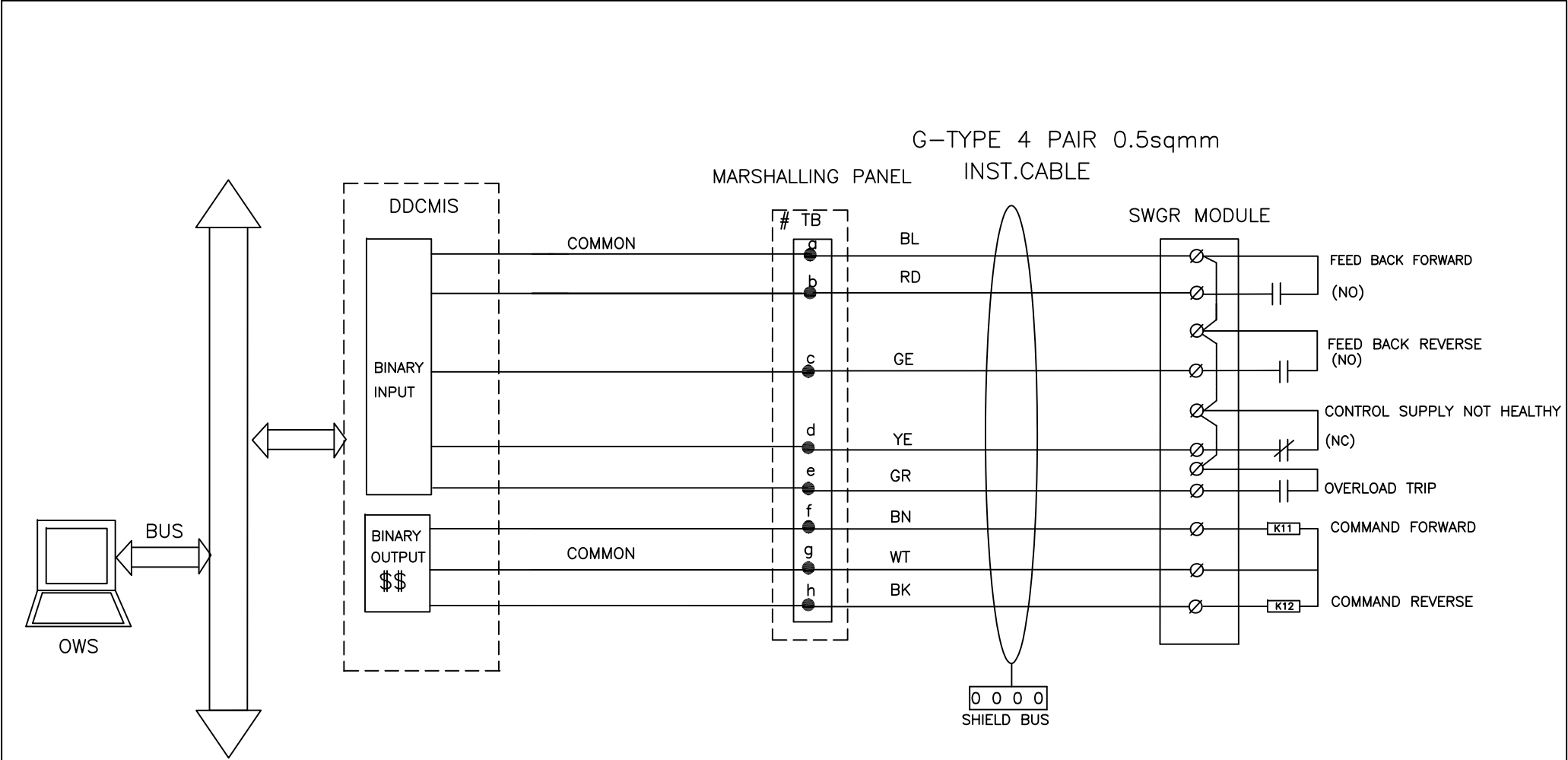
DRG.NO.	9962-001-PE-405-PVI-B-152
DATE	11.02.2019
REV.NO.	01
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MARSHALLING PANEL G-TYPE 8PAIR 0.5sqmm
INST.CABLE

DDCMIS INTERFACE WITH INLINE MAGNETIC SEPERATOR(ILMS)

469

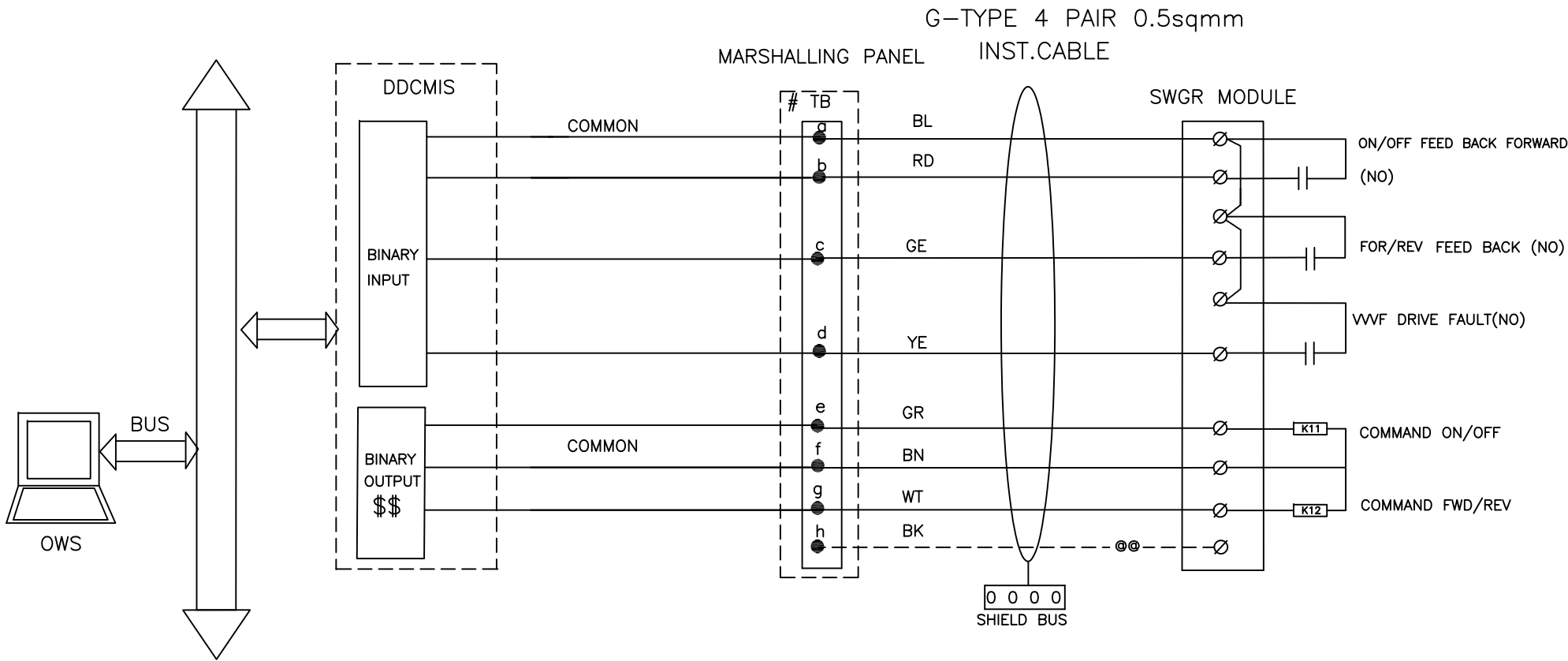
DDCMIS INTERFACE WITH REV (DOL)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO.	9962-001-PE-405-PVI-B-152
	DDCMIS INTERFACE WITH REV (DOL)		DATE	11.02.2019
			REV.NO.	01
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DDCMIS INTERFACE WITH VVVF



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE
TERMINATION.

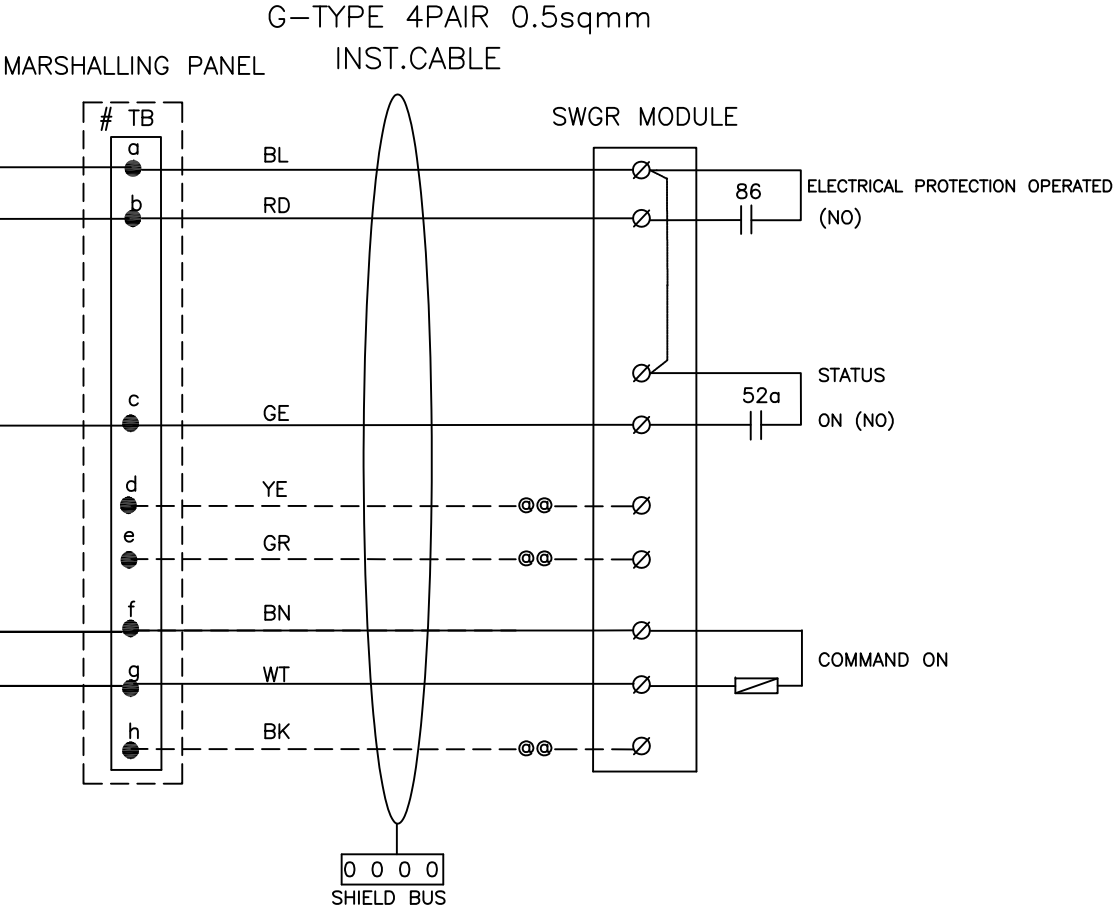


UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH VVVF

DRG.NO.	9962-001-PE-405-PVI-B-152
DATE	11.02.2019
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DDCMIS INTERFACE WITH HTCHP



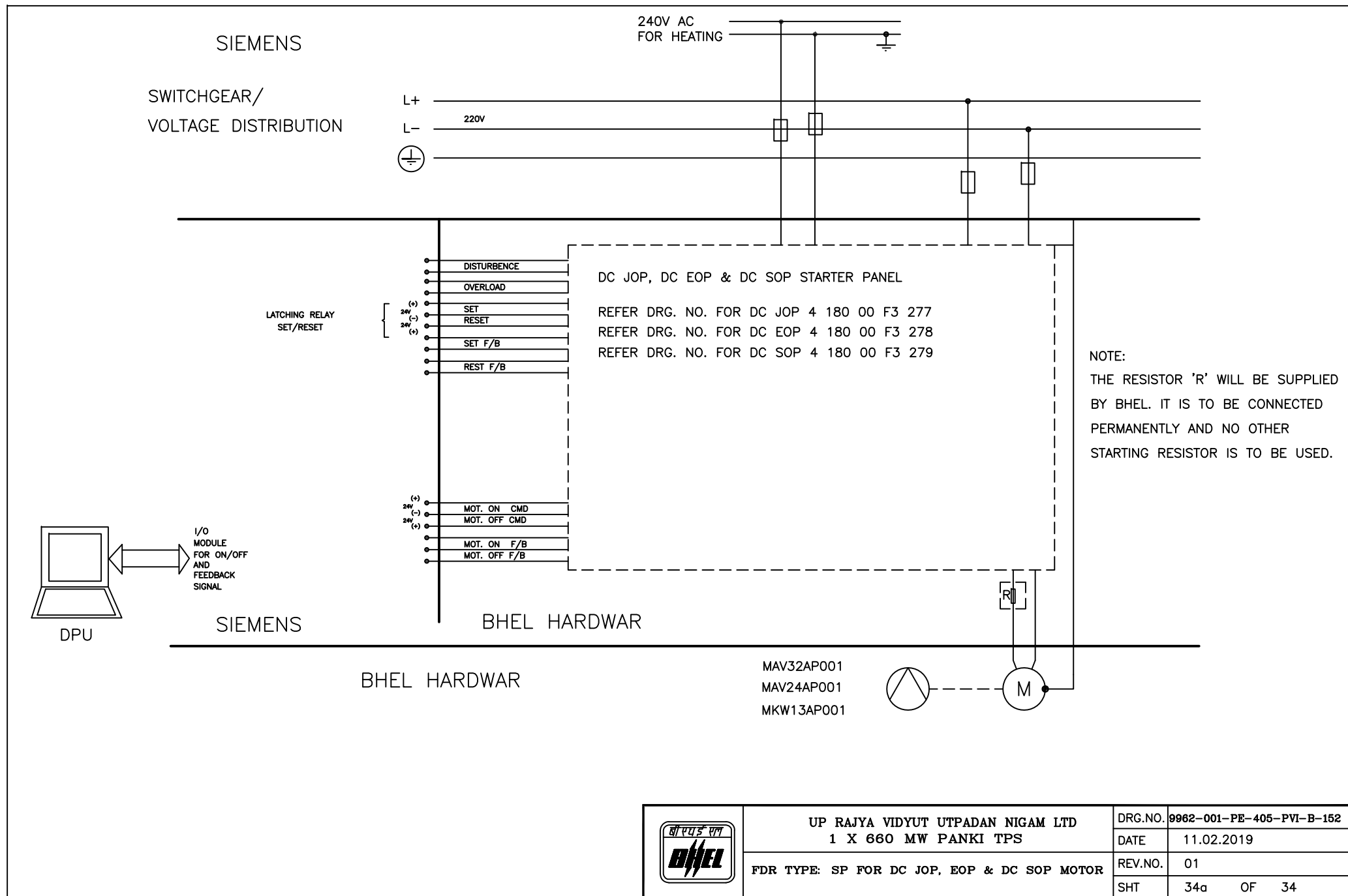
NOTE:-1 \$\$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

NOTE:-2 # 8 LEVEL TERMINAL BLOCK

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

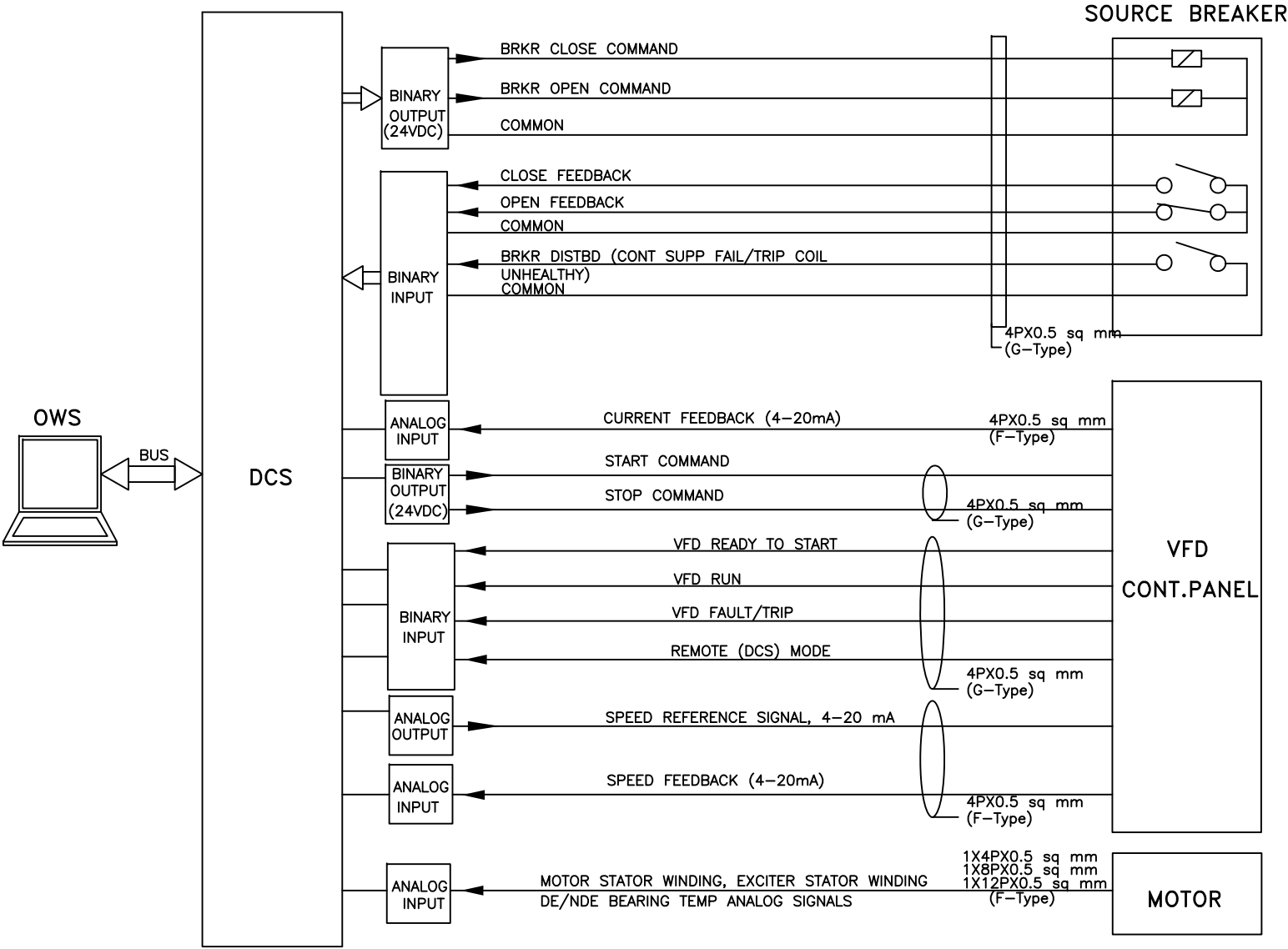
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	DDCMIS INTERFACE WITH HTCHP		DATE	11.02.2019	
			REV.NO.	01	
			SHT	34	OF 34

INTERFACE SP FOR DC JOP, EOP & DC SOP MOTOR



UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO.	9962-001-PE-405-PVI-B-152
FDR TYPE: SP FOR DC JOP, EOP & DC SOP MOTOR		DATE	11.02.2019
		REV.NO.	01
		SHT	34a OF 34

DCS INTERFACE FOR VFD CONTROL DRIVE



	UP RAJYA VIDYUT UTPADAN NIGAM LTD		DRG.NO.	9962-001-PE-405-PVI-B-152
	1 X 660 MW PANKI TPS		DATE	11.02.2019
	DDCMIS INTERFACE FOR		REV.NO.	01
	CEP VFD		SHT	34b

	ANNEXURE- WRITE UP FOR DRIVE CONTROL PHILOSOPHY (STATION C&I)	DOCUMENT NUMBER	PE-DM-426-145-I002		
		REVISION NUMBER	01	DATE	11.02.19
	PROJECT: 1 X 660 MW PANKI TPS				

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).
- b) Remote manual operation of all drives shall be done from Operator Works Station (OWS).
- c) Remote control commands i.e. open/close generated from DCS shall be issued to Integral Starter through interposing relays, mounted in Integral Starter. For open/close duty bi-directional drives, DCS output command shall be latched in DCS, 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 realized in DCS.
- e) Following signal exchange shall take place between Integral Starter & DCS.
 - open & close command
 - Integral Starter Disturbed (Loss of power supply/Loss of control supply/ Motor thermostat trip/ Thermal O/L / Torque open/close cut off/ Local/off/Remote S/S in Local or Off mode/Stop PB optd).
 - Valve status feedback by means of limit switches (open/close).
 - Valve position feedback (4-20mA) for inching duty drives.

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**).
- b. Remote manual operation of all drives shall be done from OWS.
- c. Remote control commands i.e. start/stop, shall be generated from DCS and shall be issued to MCC through interposing relays located in respective MCC.DCS output command shall be latched in MCC. EPB (stay put type), in MCC supplier's scope, shall be wired directly to MCC. The EPB shall be provided with press to lock and turn to release type, keyless mechanism.

	ANNEXURE- WRITE UP FOR DRIVE CONTROL PHILOSOPHY (STATION C&I)	DOCUMENT NUMBER	PE-DM-426-145-I002		
		REVISION NUMBER	01	DATE	11.02.19
	PROJECT: 1 X 660 MW PANKI TPS				

- d. Necessary electrical protections for the drives shall be realised at MCC, whereas process interlocks and protections shall be realised in DCS.
- e. Following signal exchange shall take place between MCC & DCS
 - i. Drive Start & Stop commands.
 - ii. Drive ON & OFF feedback.
 - iii. MCC disturbed (Thermal O/L /Control supply fail/ EPB operated/ MCC switched off).
- f. Current transducers, 4-20mA types (in MCC suppliers scope), shall be mounted in the MCC for monitoring the current in DCS for all drives $\geq$ 30 KW and for important drives <30 KW. Auxiliary power supply to these transducers shall be provided from the control power supply of the respective MCC.

3 Solenoid Operated Drives

- 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.
- c. Remote control commands i.e. open/close shall be generated from DCS and shall be issued to the respective solenoid through interposing relays located in Interposing Relay panels.
- d. Necessary process interlocks shall be realized in DCS.
- e. Following signal exchange shall take place between solenoid operated drive & DCS
 - i. Valve open & close command.
 - ii. Valve status feedback by means of limit switches (open/close), wherever available.

	ANNEXURE- WRITE UP FOR DRIVE CONTROL PHILOSOPHY (STATION C&I)	DOCUMENT NUMBER	PE-DM-426-145-I002		
		REVISION NUMBER	01	DATE	11.02.19
	PROJECT: 1 X 660 MW PANKI TPS				

4 **HT/LT Unidirectional Drives (Breaker operated).**

- a. Remote manual operation of Breaker operated drives shall be normally from remote i.e. Station DCS in main Control Room through OWS.
- 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/CCR.

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

- d. Remote control commands i.e. start/stop, pulse type, shall be generated from DCS and shall be issued to Switchgear through interposing relays located in respective Switchgear.
- e. The EPB shall be wired directly to switchgear. 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.
- f. Necessary electrical protections for the drive shall be realised at Switchgear, whereas process interlocks and protections are realised in DCS.
- g. Following signal exchange shall take place between SWGR and DCS:
 - i. Drive Start & Stop commands.
 - ii. Drive ON & OFF status feedback.
 - iii. Master Trip Relay (86 Relay) operated.
 - iv. Emergency Stop PB operated.
- h. Current transducers (for FD fan, PA fan, ID fan, Mill Motors, MDBFP, CEP & ECW pumps only), 4-20mA types (in SWGR suppliers scope), shall be mounted in the SWGR for monitoring the current in DCS. Auxiliary power supply to these transducers shall be provided from the control power supply of the respective switchgear.
- i. Multifunction relay shall be provided in SWGR which will be connected to DCS through serial link via Data concentrator for transmission of soft signals to DCS including over load alarm, relay fault, motor current, SWGR disturbed(control supply failed or trip coil unhealthy), SWGR available (Selector switch in remote, Breaker spring charged, SWGR is service position).

B. SEQUENCE CONTROL PHILOSOPHY

	ANNEXURE- WRITE UP FOR DRIVE CONTROL PHILOSOPHY (STATION C&I)	DOCUMENT NUMBER	PE-DM-426-145-I002		
		REVISION NUMBER	01	DATE	11.02.19
	PROJECT: 1 X 660 MW PANKI TPS				

1.0 Sequence control is envisaged for startup and shutdown of main drives and their associated drives from OWS. The drives can be operated manually or automatically through group/sub-group control and through process interlocks.

1.1 Sequence Mode Operation

Sequence controls are organized hierarchically in accordance with the operation concept of the plant process. Accordingly following levels of sequence control exists.

- Functional group control
- Sub group control

Functional Group Control logic co-ordinates between functionally cascaded lower level sequence control logics. It performs following functions

- Mode of operation
- Sequential start/stop of sub group.

Sub Group Control performs sequence control strategies on main drive and related drives as required by the process and taking care of the healthiness of each drive e.g. BFP along with its recirculation valve, discharge valve and AOP in a sequence, will form sequence control logic for BFP.

1.2 Sequence Start Up Mode

- 1) **Automatic mode:** - In this mode of operation, once the sequence is initiated, it shall progress without involvement of the operator.
- 2) **Semi-automatic mode:** - In this mode of operation, once the sequence is initialized, the step progressing shall be displayed on the OWS. But the step execution command shall be interlocked and shall be sent by the operator via keyboard. It shall be possible to bypass and/or simulate one or more criteria to enable the program to proceed. This facility shall allow the program to be executed even if some criteria are not fulfilled. It shall be possible to put the system on the auto mode after operating it on semi-auto mode for some steps or vice-versa, without disturbance to the sequence operation.

	ANNEXURE- WRITE UP FOR DRIVE CONTROL PHILOSOPHY (STATION C&I)	DOCUMENT NUMBER	PE-DM-426-145-I002		
		REVISION NUMBER	01	DATE	11.02.19
	PROJECT: 1 X 660 MW PANKI TPS				

- 3) **Operator test mode:** It shall be possible to use the sequential control in operator guide mode / test mode i.e. the complete system runs and receives input from the plant OWS but its command output is blocked. The whole program, in this case shall run in manual mode. This mode shall allow to practice manual operation using step and criteria indications. The actual protection shall remain valid during this mode of operation also.

C. ANALOG CONTROL & MEASUREMENT PHILOSOPHY

1) Analog Drives Control

- 1.1 A drive control function residing in controller is used to position the pneumatically/electrically operated control valves. 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 controller.
- 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

	Technical specification for CONTROL & INSTRUMENTATION 1X660MW PANKI TPS EXTN.		
		SECTION D	
		REV. NO. 00	DATE : 13.07.2018

APPLICABLE CABLE TYPES

Cable Sizes for 1X660MW TPS PANKI EXTN.	
Sl no.	Cable Type
G-TYPE	
1	2P X 0.5 sqmm
2	4P X 0.5 sq mm
3	8P X 0.5 sqmm
4	12P X 0.5 sqmm
F-TYPE	
1	4P X 0.5 sqmm
2	8P X 0.5 sqmm
3	12P X 0.5 sqmm
4	20P X 0.5 sqmm
CONTROL CABLE	
1	3C X 2.5 sqmm



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
STANDARD TECHNICAL SPECIFICATIONS**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : D

REV. 00

SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATIONS



**STANDARD TECHNICAL
SPECIFICATION
FOR
CENTRAL AIR-CONDITIONING**

SPECIFICATION NO.PES-553-01

VOLUME II B

SECTION D

REV. 02

SHEET 1 OF 6

**STANDARD TECHNICAL SPECIFICATION
FOR
CENTRAL AIR-CONDITIONING PLANT**

	STANDARD TECHNICAL SPECIFICATION FOR CENTRAL AIR-CONDITIONING	SPECIFICATION NO.PES-553-01
		VOLUME II B
		SECTION D
		SHEET 2 OF 6

1.	<u>GENERAL</u>
1.1	This specification covers the design, manufacture, testing at Manufacturer’s works, delivery to site, handling at site, installation, commissioning and carrying out acceptance tests and final painting at site of various equipment of the central air conditioning plant, as specified hereinafter.
2.	<u>CODES & STANDARDS</u>
2.1	The design, manufacture and performance of air conditioning equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment are to be installed. The equipment shall also conform to the latest applicable Indian/British/American standards. Nothing in this specification shall be construed to relieve the tenderer of this responsibility. In particular the equipment shall conform to the latest editions of the following standards.
2.1.1	IS-660 : Safety code for Mechanical Refrigeration.
2.1.2	ARI 520-90 : Standard for Positive Displacement Refrigerant compressors and condensing units.
2.1.3	IS-5111 : Code of Practice of Measurement for Testing Refrigeration compressors.
2.1.4	ASHRAE/23-93 : Method of Testing for Rating Positive Displacement Refrigerant compressors and condensing units.
2.1.5	ARI-450: Standard for water-cooled Refrigerant condensers, Remote Type.
2.1.6	ASME : Unfired pressure Vessels Code. (Section VIII)
2.1.7	IS-2825 : -do-
2.1.8	IS-4503 : Shell and tube type heat exchangers.
2.1.9	ASHRAE/22-92 : Method of Testing for rating of Water Cooled refrigerant condensers.
2.1.10	IS-659 : Safety code for Air conditioning.
2.1.11	IS-2379 : Color Code for Identification of pipe lines.
2.1.12	TEMA : Standards of Tubular Exchanger manufacturers Association.
2.1.13	IS-1239 (Part-I) : Seamless steel tubes (Up to & including 168.2 mm OD.).
2.1.14	IS-3589 : For piping above 168.2mm to 2032mm Outside Diameter.
2.1.15	IS-778 : Valves up to 50 MM.
2.1.16	IS-780 : Valves 50 MM to 300 MM.
2.1.17	ASHRAE 24 : Method of Testing for Rating liquid coolers.

	STANDARD TECHNICAL SPECIFICATION FOR CENTRAL AIR-CONDITIONING	SPECIFICATION NO.PES-553-01
		VOLUME II B
		SECTION D
		SHEET 3 OF 6
2.1.18	ARI-480: Standard for refrigerant cooled liquid coolers-Remote type.	
3.	<u>DESIGN & CONSTRUCTION REQUIREMENTS</u>	
3.1	The components of Central air conditioning plant comprising compressor, chiller refrigerant piping, valves and fittings etc. Shall be as given in Data sheet A. The type of all accessories, controls and instrumentation shall also be as indicated in data sheet A.	
3.2	The various equipments supplied under this specification shall be fully compatible with each other & capable of operating as fully balanced integrated system to deliver the specified output under design conditions.	
4.	<u>TESTING AND INSPECTION</u> (Refer standard quality plan)	
4.1	Hydrostatic, Volumetric and refrigerant leak tests etc. shall be carried out at manufacturers works before dispatch of equipment in accordance with the applicable codes and standards. Following minimum tests amongst others shall be conducted.	
4.1.1	Material analysis, testing and identification (Data sheet/ Drg. Shall clearly indicate the specification, grade, class and Heat treatment condition of material for which TC will be furnished)	
4.1.2	Hydrostatic pressure test of all pressure parts.(Testing pressure shall be clearly indicated for each component/ subassembly/ assembly)	
4.1.3	Static and Dynamic balancing test of rotating parts at rated and over speed and to determine vibration & noise level.(Grade of balancing, type- whether dynamic or single plane balancing for components/ subassembly/ assembly shall be clearly indicated in data sheet/ approved drg.. Permissible vibration (velocity and displacement –peak to peak and noise level in dB(A) to be indicated in Data Sheet/Approved Drg.)	
4.1.4	Radiography & magna-flux examination of materials & welds.(Components to be subjected to NDT with applicable, procedures and acceptance norms to be clearly indicated in Data sheet/ approved drg. If in a component only certain areas are to be subjected to NDT same shall be clearly brought out else it will be understood that the entire component is subject to NDT)	
4.1.5	Ultrasonic test of castings & forgings.(Procedure and acceptance norms with areas subject to NDT to be clearly indicated in Quality Plan).	
4.1.6	Performance test including determination of capacity, efficiency & characteristics etc.(Applicable standard, Acceptance norms, Procedure for test (if not covered in applicable standard),performance characteristics with applicable tolerances and drive to be used during shop test to be clearly indicated in Quality Plan). Performance data to be indicated in Approved Drg./ Data Sheet)	

	STANDARD TECHNICAL SPECIFICATION FOR CENTRAL AIR-CONDITIONING	SPECIFICATION NO.PES-553-01
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4.1.7	Functional checks and adjustments of controls & instrumentation. (Functional checks required to be clearly indicated with extent of check and applicable standard in approved check list / Quality plan. Class of instruments / tolerances and performance data to be incorporated in Approved Data Sheet / Drg.)	
4.1.8	Checking of working clearances.(desired working clearances to be indicated in approved Drg.)	
4.1.9	Examination after selective opening up after testing.(basis/ reasons for selective opening up, areas to be examined and parameters to be checked to be brought out in Quality Plan)	
4.2	TESTS AT SITE Tests to prove guaranteed performance of the air conditioning plant, shall also be carried out at site after proper installation. The site test shall include performance testing (as per FQP) of equipment for 72 continuous hours each in all three seasons i.e. Summer, Winter and Monsoon. Unless specified elsewhere. All instruments, tools etc. as may be required to carry out site tests shall be arranged by the tenderer.	
5.	<u>PERFORMANCE GUARANTEE</u>	
5.1	Each equipment of air conditioning system shall be guaranteed for its rated capacity under the specified site conditions.	
5.2	If the shop/site performance tests indicate failure of equipment to meet specified requirement, it would be tenderer's responsibility to carry out required alterations at no extra cost to purchaser. Tests shall be repeated after carrying out the modifications to demonstrate the performance.	
5.3	The air conditioning plant before being taken over by purchaser shall be subjected to running test for a minimum period of one week during which all readings shall be recorded. Any deficiencies noted during this period, shall be rectified by the tenderer /at no extra cost to purchaser. These running tests shall be in addition to the seasonal performance test specified under clause 4.2. The inside design conditions shall be guaranteed throughout the year.	

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6.	<u>DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT</u>	
6.1		
6.2	Drawings including equipment layout, foundation & loading details etc. for civil works for the entire plant. These drawings must cover sufficient details so that design of civil works can be completed.	
6.3	Inspection, operation & Maintenance Manuals.	
6.4	Manuals for method of testing & calibration of all instruments.	
6.5	Equipment description giving complete design calculations, basis of design, selection criteria etc.	
6.6	Schematic piping diagrams.	
6.7	Layout of piping.	
6.8	Electrical drawings.	
6.9	Test Certificates.	
6.10	Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.	

	STANDARD TECHNICAL SPECIFICATION FOR CENTRAL AIR-CONDITIONING	SPECIFICATION NO.PES-553-01
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CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

VOLUME II-B

SECTION D

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SHEET 1 OF 4

DESCRIPTION

DATA

1. GENERAL

- | | | |
|-----|---|---|
| 1.1 | Type of AC plant | : Chilled Water Type. |
| 1.2 | Plant configuration/capacity. | : Refer to Section-C of Specific Technical Requirements. |
| 1.3 | Location of AC plant rooms | : As per Tender drawings. |
| 1.4 | | |
| 1.5 | Electrical work scope: - | |
| | i) MCC for AC plant | : By Others |
| | ii) Power cables / Control cables. | : By Others |
| | iii) Drives | : By Bidder. |
| | iv) Whether separate alarm/annunciation Panel/control panels required | : Yes (By bidder), Refer to Section-C of Specific Technical Requirements. |
| | v) Termination of cabling & earthing at Equipment end. | : By Bidder for bidder supplied equipment. |

2. REFRIGERATION COMPRESSOR

- | | | |
|-------|--------------------------|--|
| 2.1. | Type | : SCREW CHILLE |
| 2.2. | Nos. (working + standby) | : Refer to Section-C of Specific Technical Requirements. |
| 2.3. | Type of capacity control | : Automatic. |
| 2.4. | Type of drive | : Direct driven. |
| 2.5. | Restart after tripping | : Manual. |
| 2.6. | Type of start | : As per manufacturing standard. |
| 2.7. | Shaft Seal | : Mechanical shaft seal. |
| 2.8. | Purge Recovery unit | : As per manufacturing standard. |
| 2.9. | Type of lubrication | : As per manufacturing standard. |
| 2.10. | Refrigerant used | : Environment friendly HCFC,
(CFC is not acceptable) |



CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

SHEET 2 OF 4

3. DESIGN REQUIREMENTS

- | | |
|--|--|
| 3.1. Minimum capacity at Design conditions | : Refer to Section-C of Specific Technical Requirements. |
| 3.2. Capacity control | : Microprocessor based Control Panel sheet metal panel, located on each Compressor/chiller unit including protection devices |
| 3.3. Vibration isolator | : Neoprene rubber pads/Equivalent approved to suit chiller package. |
| 3.4. Type of foundation | : Floating / As per manufacturing standard |

4.0 CONDENSER

- | | |
|---|--|
| 4.1 Type | : Horizontal shell & tube type water-cooled |
| 4.2 Number required | : One no. for each machine. |
| 4.3 <u>Design requirements</u> | |
| 4.3.1 Fluid | : Refrigerant (Shell side) Water (tube side) |
| 4.3.2 Cooling Water Quantity | : To suit requirement. |
| 4.3.3 Capacity of condensers | : To match compressor & to provide at least 2°C sub cooling. |
| 4.3.4 Cooling water inlet temp. | : Refer to Section-C of Specific Technical Requirements. |
| 4.3.5 Leaving Water Differential. | : Refer to Section-C of Specific Technical Requirements. |
| 4.3.6 Max. flow velocity through tubes. | : 2.5 m/sec. |
| 4.3.7 Design fouling factor | : 0.0002 (MKS Unit) |
| 4.3.8 Maximum pressure drop. | : 0.6 Kg/cm ² (g) |
| 4.3.9 Tube wall Thickness | : Not less than 18 SWG |
| 4.4 Materials of construction | |
| i/ Shell | : M.S. Plate fusion welded. |
| ii/ Tube | : Integrally bonded Seamless copper |



CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

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SECTION D

REV 00

SHEET 3 OF 4

- | | |
|---|---|
| iii/ Head ends | : Cast Iron. |
| iv/ Tube sheet material | : Steel |
| v/ Baffle plate | : Steel. |
| 4.5 Accessories required | |
| i/ Purge & drain connections with valves. | : Yes |
| ii/ Relief valves | : Yes |
| iii/ Liquid line shut off valve. | : Yes |
| iv/ Isolating valves on water side. | : Yes |
| v/ Flow switch | : Yes (interlocked with control of individual refrigeration system) |
| vi/ Pressure/temperature gauges at inlet/outlet | : Yes |
| vii/ Descaling tee | : Yes |
| viii/Charging valve | : Yes |
| ix/ MS supporting frame work | : Yes |
| viii/Cooling thermostat | : Yes |
| ix/ MS supporting frame work. | : Yes |
| 5.0 <u>CHILLER</u> (Applicable for chilled water type plant only.) | |
| 5.1 Type | : Horizontal shell & tube flooded type |
| 5.2 Number required/standby | : One no. for each chiller package. |
| 5.3 <u>Design requirements</u> | |
| 5.3.1 Fluid to be cooled | : Water |
| 5.3.2 Water flow rate (Inside tube) | : To suit requirement. |
| 5.3.3 Water inlet temperature | : 12 °C approx. |
| 5.3.4 Water outlet temperature | : 7 °C approx. |
| 5.3.5 Super heating of refrigerant material | : By at least 3 deg. C. |
| 5.3.6 Insulation /thickness/finish | : As per the manufacture standard. |
| 5.3.7 Design fouling factor | : 0.00010(MKS Unit) |



CENTRAL AIR-CONDITIONING PLANT
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SHEET 4 OF 4

- 5.3.8 Maximum pressure drop. : 0.6 Kg/cm² (g)
- 5.3.9 Tube wall Thickness : Not less than 22 SWG.
- 5.4 Materials of construction
- i/ Shell : M.S. Plate fusion welded.
- ii/ Tube : Integrally Seamless copper (internally Corrugated)
- iii/ Head ends : Cast Iron.
- iv/ Tube sheet material : Steel.
- v/ Baffle plate : Steel.
- 5.5 Accessories required
- i/ Purge & drain : Yes
- ii/ Gate valves at water inlet/outlet. : Yes
- iii/ Flow switch : Yes
- iv/ Pressure/temperature gauges at inlet/outlet : Yes
- v/ Anti-freeze thermostat : Yes
- vi/ Thermostatic expansion valves : Yes
- vii/ Pilot solenoid valve : Yes
- viii/ Cooling thermostat : Yes
- ix/ MS supporting frame work. : Yes

Note :-

The system shall also incorporate:

- 1) Auto operation of chilling plant for operation of the whole AC system.
- 2) A Central Control Panel with fault annunciators with provision for remote extension besides local control kiosks.
- 3) Water Chiller package shall be skid-mounted unit with microprocessor based control panel complete with all accessories and controls are assembled at manufacturing works on single unit.
- 4) Screw chiller shall be suitable for 415V $\pm$ 10 %/50 Hz $\pm$ 3%/3 phase operation with voltage & frequency variation as specified with built in starter etc.
- 5) Only supply feeders shall be provided for chillers.

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES-553-02
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STANDARD TECHNICAL SPECIFICATION FOR AIR HANDLING UNITS		

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES-553-02
		VOLUME II B
		SECTION D
		SHEET 2 OF 6
1.	<u>GENERAL</u>	
1.1	This specification covers the design, manufacture, Construction features, installation, commissioning, inspection and performance testing at site of AHUs.	
2.	<u>CODES AND STANDARDS</u>	
2.1	The design manufacture and performance of AHU shall comply with all currently applicable statutes, regulations and safety codes in the locality where the AHU is to be installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this spec. shall be construed to relieve vendor of this responsibility. In particular the equipment shall conform to the latest editions of the following standards:	
2.1.1	IS-659	: Safety code for air conditioning
2.1.2	IS-660	: Safety code for mechanical refrigeration
2.1.3	ASHRAE: Method of testing forced circulation air-cooling and air heating coils. standard 33	
2.1.4	ARI 41	: Standard for forced circulation air cooling and air heating coils.
2.1.5	ARI 430/435	: Air-cooling and air heating coils Central Station AHU / Application of Central Station AHU.
2.1.6	AMCA	: 211 and 311
	In case of any conflict in the standards and this specification the decision of PEM,BHEL shall be final and binding.	
3.	<u>CONSTRUCTION FEATURES</u>	
3.1	The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m³ density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof. Necessary arrangement shall be provided on the casing for measuring temperature and pressure in cooling/heating coil. Class of instruments shall be min. 2.	
3.2	Fan impeller shall be forwardly/backwardly inclined curved blade centrifugal type. Impeller shall be double width double inlet type. Fans shall be preferably low rpm (<=1500) to minimize vibration and noise. Noise shall be within 85 dB(A) at 1 metre distance from AHU casing. Max. Vibration level shall be acceptance and norms to be specified. Two to three wheels (impellers) shall be provided for each AHU. Impeller blades shall be fabricated from (min. 1.0 mm) galvanized/ epoxy powder coated sheet steel. Fan shall be of epoxy powder coated / galvanized sheet steel (min. 1.6	

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES-553-02
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	mm) scroll with die formed inlets for uniform air flow. Fan shafts shall be solid cold rolled carbon steel (EN8 normalised), ground and polished. Fan shaft bearings shall be of heavy duty type selected for average operating life of 100,00 hours. Bearings shall be self-aligning, permanently lubricated type. Make of Brgs(SKF/FAG/NORMA/TATA) to be specified. Bearing Housing shall be of casting of min. IS Gr. 210, split type and suitably supported. The V-belt drive with belt guard shall be provided. Motors shall have minimum 15% margin over maximum BHP in working range.	
3.3	DX or chilled water cooling coils and steam/hot water coils shall be internally corrugated copper/ cupronickel tubes (as per manufacturer's standard) with smooth non corrugated external fins of aluminium (thickness 0.14 mm and grade 1100 as per spec) unless specified otherwise in specification. At least 5 fins /per cm. shall be provided. The chilled water/hot water coils shall have suitable (standardize class, size, threading) drain and vent connections.	
3.4	The filters in the filter section shall be provided as detailed in data sheet A.	
3.5	Humidifier shall be Pan type/as specified in the specification. Pan type Humidifier consisting of SS304/316 tank, heater, geyserstat with piping connection to supply air duct shall be provided unless specified otherwise in data sheet A. Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.	
3.6	Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room. Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized	
3.7	Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU. The AHU shall be provided with 18 G SS drain pan.	

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES-553-02
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		SECTION D
		SHEET 4 OF 6
4. <u>TESTING AND INSPECTION AT MANUFACTURERS WORKS:</u> List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection.		

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES-553-02
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		SHEET 5 OF 6
4.1	Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.	
4.2	Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating. For pipes and fittings compliance report shall be furnished by Manufacturer for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.	
4.3	Shaft: Mechanical and chemical.	
4.4	Motors (of approved make): Routine TC.	
4.5	Workmanship and dimensional check as per manufacturing drg. and approved Drgs.	
4.6	Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked to avoid loosening. Balancing weights and fasteners used shall be galvanized.	
4.7	Performance test of one Centrifugal fan/per type/per size as per AMCA standard (for indigenous make).	
4.8	Centrifugal fans for AHUs will be 100% run tested by main contractor of BHEL. One centrifugal fan/per type/per size will be run tested. Vibration shall be within good zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.	
4.9	Complete assembly of one AHU/per type/ per size (excluding cooling coil and filter) shall be witnessed.	
4.10	Run test of one complete assembly/per type/per size (excluding cooling coil and filter). Vibration shall be within satisfactory zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.	

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES-553-02
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AIR HANDLING UNIT
DATA SHEET - A

VOLUME - II-B

SECTION - D

SHEET 1 OF 2

DESCRIPTION

DATA

- | | |
|--|--|
| 1. Nos. required/working | : Refer to Section-C of Specific technical requirement. |
| 2. Location | : Refer to Section-C of Specific technical requirement. |
| 3. Service/type | : Air Conditioning /Double skin. |
| 4. Fan type | : Centrifugal (forward/backward curve Blade) limit load. |
| a) Capacity | : To Suit as per calculation. |
| b) Static pressure | : To suit but not less than 60 mm wc for AHU's Micro-V filters. |
| c) Discharge direction | : To suit layout. |
| d) Motor | : By Bidder, |
| e) Local push button station (Start/Stop) | : By Others |
| f) Motor location | : Inside AHU Casing. |
| g) Drive | : Belt, pulley, belt guard. |
| 5. Face and Bypass Damper | : Required (Opposed blade type) DX AHU's having |
| 6. Cooling coil | |
| a) Duty sensible heat | : To suit as per calculations |
| b) Duty latent heat | : -do- |
| c) Type of coil | : Chilled Water/DX/Hot Water. |
| d) No. of rows | : To suit but not less than four (4) |
| e) Material of tube /Thickness | : Seamless Copper to ASTM E-75/Equivalent. |
| f) Material of fins | : Aluminium to SAE-1100-/1145-0 |
| g) Number of fins | : Not greater than 5 per cm (13 per inch). |
| h) Max. face velocity | : 2.5 m/sec. |
| i) Air flow quantity | : To suit as per tender drawings/documents. |
| 7. 3 - way motorised mixing valve with thermostat. | : Required with thermostat & actuator for chilled water system for each AHU. |



AIR HANDLING UNIT
DATA SHEET - A

VOLUME - II-B

SECTION - D

SHEET 2 OF 2

- | | | |
|-----|------------------------------|--|
| 8. | Damper at discharge | : Manually operated at discharge of each AHU outlet. |
| | a) Material of construction | : Mild Steel, galvanised. |
| 9. | Filters (Pre-filters) | |
| | a) Type & thickness | : Dry panel type/ 50 mm |
| | b) Filter area. | : To suit as per velocity requirements. "V" - Bank. |
| | c) Filter efficiency | : Average arrestance efficiency of 65-80 % |
| | d) Press drop (Clean) | : Not to exceed 2.5 mmwc when clean & 6.5 mmwc while dirty. |
| 10. | Humidification section | : As per the System requirement. |
| | a) Type | : Pan type, unless otherwise specified. |
| | b) Operation | : Automatic with Humidification. |
| 11. | Fresh air arrangement | : Required. |
| | a) Fresh air fan | : Tube axial flow fans with motor. |
| | b) Accessories | : i) Inlet cone with Bird screen.
: ii) Dry panel pre-filters,
: iii) High efficiency filters for control room areas.
: iv) Volume Control Dampers,
: v) Supports etc. |
| 12. | Vibration isolator required. | : Yes |
| 13. | Type of vibration isolator. | : Neoprene ribbed Rubber for AHU's. |
| 14. | Any other requirement | : i) In addition to dry panel filters on AHU, High efficiency filters(average arrestance efficiency of 80-90 %) shall be provided in supply air duct side of AHU for all control room and allied areas.

: ii) Bidder to also provide suitable electrical strip heaters for winter heating & monsoon reheating with Contactor box etc. Heaters to be interlocked with airstat. |
| 15. | Instrument & controls | : Lot.(including Control box for strip heaters, pan humidifiers etc. in each AHU room.) |
| 16. | Insulation of drain piping | : Lot. |



**STANDARD TECHNICAL
SPECIFICATION
FOR
COOLING TOWER**

SPECIFICATION NO.PES-553-03

VOLUME II B

SECTION D

SHEET 1 OF 5

**STANDARD TECHNICAL SPECIFICATION
FOR
COOLING TOWER**

	TECHNICAL SPECIFICATION COOLING TOWER	SPECIFICATION NO.PES-553-03
		VOLUME II B
		SECTION D
		SHEET 2 OF 5
 1. <u>GENERAL</u>		
1.1	this standard specification covers the design, manufacture assembly, inspection & testing at manufacturer’s works, suitable painting & packing, delivery, erection & commissioning at site of all materials and equipments for mechanical induced draught cooling tower complete with all accessories as specified hereinafter.	
 2. <u>CODES & STANDARDS</u>		
2.1	the design, manufacture, inspection & testing and performance of the cooling tower as specified hereinafter shall comply with the requirements of all applicable latest Indian/British/American standards and codes of practice. the latest editions of the following standards & publications shall be followed in particular:	
2.1.1	Cooling tower institute USA bulletin ATP-10S: Acceptance test procedure for industrial water-cooling tower.	
2.1.2	PTC-23 ASME performance test code for Atmospheric water-cooling equipment.	
2.1.3	In case of any conflict between the above codes & standards and-this specification, the later shall prevail.	
 3. <u>DESIGN REQUIREMENTS</u>		
3.1	the cooling tower shall be designed for continuous operation to cool not less than design flow of water from specified inlet temperature to the outlet temperature at a design ambient wet bulb temperature as indicated under data sheet a.	
3.2	all the components shall be capable of safe, proper and continuous operation at all cooling water flows upto & including those specified under data sheet a & shall be designed with regard to case of maintenance, repair, cleaning & inspection.	
3.3	the cooling tower shall be of induced draught cross flow or counter flow type and with multiple cells (if specified in data sheet a.) the cooling tower shall be suitable for handling the fluid and also for achieving the specified parameter as per data sheet a. the cooling tower shall be designed such that the drift losses & evaporation losses are minimum.	
 4. <u>CONSTRUCTIONAL FEATURES</u>		
4.1	CASING & LOUVERS	
4.1.1	The cooling tower casing shall be made of FRP/as specified in data sheet A. The louvers shall be made of FRP/as specified. Louvers, if provided, shall be designed for air entry to the tower with low velocity for minimum pressure drop & less chance of recirculation of moist air. To eliminate splash out, louvers shall slope to shed water inwards. Air intake shall be all along the base circumference of the casing & hotdip galvanised expanded metal mesh shall be provided to protect the air intake.	

	TECHNICAL SPECIFICATION COOLING TOWER	SPECIFICATION NO.PES-553-03
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4.2	FILL	
4.2.1	Cooling tower fills shall be made of noncombustible PVC/as specified in data sheet A. The design & arrangement of the fills shall be so as to expose maximum air/water surface with minimum pressure drop.	
4.3	Drift Eliminators	
4.3.1	Multi-pass drift eliminators with minimum two pass zig-zag path shall be provided so to minimise the drift losses.	
4.3.2	In case of FRP cooling tower the drift eliminators shall be of multi-blade rotary type.	
4.4	Fans & Accessories	
4.4.1	The fans shall be multiple blade, low speed, high efficiency axial flow type located above the top deck level of the cooling tower. Fan rotating assembly shall be statically & dynamically balanced. The fan blades shall be preferably adjustable in stand still condition for propeller action. The fan shall be either directly mounted on the shaft of a totally enclosed weather proof motor or shall be suitable for V-belt drive.	
4.4.2	The rating of drive motor shall have at least 15% margin over maximum fan power consumption. The design & construction of the drive motor shall be in accordance with enclosed specification for LVAC motors.	
4.5	Water basin	
4.5.1	The material of construction of water basin shall be FRP or RCC as specified in data sheet A. The basin shall be provided as a part of cooling tower in case of FRP construction. The sump shall have sufficient storage capacity for safe operation of AC plant.	
4.6	Hot water distribution system	
4.6.1	Manually operated flow control valves shall be provided in hot water distribution piping such that each cooling tower can be isolated without affecting the operation of other cells.	
4.6.2	The nozzles shall be spaced to give even distribution of water over entire space occupied by top row of fills. The nozzles shall be made of brass /SS 304/316/316L (brass shall be as per manufacturer's standard) unless specified in data sheet A:	
4.6.3	In case of FRP tower water shall be distributed over the fill by means of a multiple area fail safe rotary sprinkler made of PVC pipes fitted on a aluminium alloy (as per manufacturers standard) rotary head and mounted on sealed ball bearings (make) .	
4.7	Access	
4.7.1	A stair case paddle ladder (as per manufacturer's standard) shall be provided external to the cooling tower at one end of each tower along with stairways hand rails etc give safe & convenient access to the top deck from ground level.	

	TECHNICAL SPECIFICATION COOLING TOWER	SPECIFICATION NO.PES-553-03
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		SHEET 4 OF 5
4.8	Painting	
4.8.1	The cooling towers shall be painted with suitable anti-corrosive paint as per approval of purchaser. All galvanized external surfaces shall be painted to match colouring scheme. Before painting galvanized surfaces -etch primer to be applied.	
5.	<u>SHOP INSPECTION & TESTING</u>	
5.1	Compliance certificates for nozzles (Or rotary sprinkler), piping, fill material, drift eliminator, louvers components etc.	
5.2	Certificate of conformance for all other material components.	
5.3	Balancing report for Static & dynamic balancing of fan assembly.	
6.	<u>TESTS AT SITE</u>	
6.1	Hydrostatic testing of complete hot water distribution piping at site.	
7.	<u>PERFORMANCE GUARANTEE</u>	
7.1	The cooling tower shall be guaranteed to meet the performance requirements as specified & when tested in accordance with ATP-105.	
7.2	The vendor shall furnish performance curves for the cooling tower showing variations in performance from design duty point with change in approach to wet bulb temperature, cooling range, water loading of cooling tower.	

	TECHNICAL SPECIFICATION COOLING TOWER	SPECIFICATION NO.PES-553-03
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8. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT		
8.1	General arrangement drawing of complete cooling tower (showing plan, front elevation and side elevation) incorporating principal dimensions, limits of scope of supply of piping, limits of civil works included showing extent of platforms, walkways, handrails, access doors, staircase etc. and the limits of scope of supply of electrical works.	
8.2	General arrangement and sectional assembly drawings pertaining to the following components of the cooling tower: i) Tower fill with supporting arrangement. ii) Drift eliminator installation and details. iii) Complete hot water distribution system including flow regulating valves, distribution basin/pipes and nozzles etc.	
8.3	Cooling tower performance curves showing WBT Vs cold-water temperature for design cooling range, 90% cooling range and 110% cooling range at 100%, 90%, and 110% design flow.	
8.4	Performance curves of cooling tower fans.	
8.5	Test procedure along with details of tests to be conducted for the offered cooling tower.	
8.6	Quality Plan along with complete details of the testing and inspection requirements of mechanical and electrical items of the cooling tower in BHEL format.	
8.7	Operation and maintenance instructions.	



**COOLING TOWER
DATA SHEET - A**

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SHEET 1 OF 2

A. GENERAL DATA

- 1) Service : Cooling of condenser water of AC plant.
- 2) Type : Fibreglass reinforced plastic construction induced draught.
- 3) Quantity : Refer to Section-C of Specific Technical Requirements.
- 4) Place of installation : Refer to Section-C of Specific Technical Requirements.

B. DESIGN DATA

- 1) Capacity at specified conditions. : To suit the system requirement.
- 2) Water flow rate : To suit the system requirement.
- 3) Design wet bulb temperature : 25 Deg. C.
- 4) Hot water inlet temperature : To suit requirement.
- 5) Cooled water temperature : To suit requirement.
- 6) Depth of sump Tank : As per manufacturer's standard.

C. MATERIAL

- 1) Sump tank & Casing : FRP
- 2) Louvers : FRP/PVC/Aluminium.
- 3) Type of fill : Non-combustible PVC/Eq.
- 4) Nozzles : Brass with chrome plating/polypropylene.
- 5) Ladder : Hot dip galvanized steel ladder for each tower.
- 6) Bird screen : 25 mm square made of GI/SS wire mesh of 16 gauge.
- 7) Fan impeller : Cast Aluminium Alloy/FRP propeller type and multi-blade aerofoil construction with adjustable pitch..
- 8) Supporting structure : MS with spray galvanization of epoxy painting.
- 9) Strainer : Plant strainer made of GI/SS wire mesh of 16 gauge.

D. ACCESSORIES

- 1) Make up connection : Yes.



**COOLING TOWER
DATA SHEET - A**

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SHEET 2 OF 2

- 2) Quick fill connection : Yes.
- 3) Overflow & drain & blow down connection : Yes.
- 4) Access door in louvers/fan deck : Yes (if applicable).
- 5) Supports & supporting structure for mounting : Yes.
- 6) Level switch : Yes.
- 7) Rain protection for motor : Yes (suitable Canopy by Bidder)
- E. ELECTRICAL DATA
- i) Power supply : 415 V $\pm$ 10%/50 Hz $\pm$ 3%/3 phase.
- ii) Motor : As per specification attached.
- F. INSPECTION & TESTING : As per approved quality plan.

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
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STANDARD TECHNICAL SPECIFICATION FOR LOW PRESSURE AIR DISTRIBUTION SYSTEM		

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
		VOLUME II B
		SECTION D
		SHEET 2 OF 9

1.

GENERAL

1.1

This specification covers the design, manufacture, construction features, installation, inspection testing and air balancing of air distribution system upto a total pressure of 95mm w.g. The specification is intended to cover the air distribution for air conditioning system and ventilation system not involving localised exhaust.

2.

CODES AND STANDARDS

2.1

The design, construction and performance of complete system shall conform to all currently applicable statutes, regulations, safety codes in the locality where the equipment are to installed

2.2

Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the following standards:-

a) IS: 655

-

Specifications for metal air ducts.

b) IS:277

-

Specifications for galvanised steel sheets.

c) IS:737

-

Specification for wrought aluminium and aluminium alloy sheet and strip.

3.

MATERIAL

3.1

Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.

3.2

The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per technical requirement refer to Section-C of Specific Technical Requirements.

3.3

The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest

4.

CONSTRUCTION/FABRICATION

4.1

The thickness of sheets, the type of bracing and other fabrication details shall generally conform to requirements given hereunder unless specified otherwise in data sheet A and/or indicated on drawings.

4.2

RECTANGULAR DUCTS

4.2.1

S.No.	Max Side	Sheet Thickness	Type of transverse	Bracings



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
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		(mm) GI	(mm) AI	Joint connections	
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None
b)	601 to 750	0.63 (24G)	0.80	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to 1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or 40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to 2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or 40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles, connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

- 4.2.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.
- 4.2.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.
- 4.2.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:
- a) Upto 1000mm - 6 mm dia GI bolts
 - b) 1001 to 1500 - 8 mm dia GI bolts
 - c) 1501 and above - 10mm dia GI bolts

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4.2.5

The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.

4.2.6

MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.

4.3

ROUND DUCTS

4.3.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) Al	
a)	Up to 150	0.63 (24G)	0.80	None
b)	151 to 600	0.80 (22G)	1.00	None
c)	601 to 1000	1.00 (20G)	1.50	40x40x3mm girth MS
d)	1001 to1250	1.00 (20G)	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

4.3.2

The seams on round ducts may be continuously welded or grooved longitudinal seam. In case of welding of GI sheet, zinc rich paint shall be applied on the welded zone.

4.3.3

Round ducts shall either be joined by welding or the ducts shall be swedged 40mm from the ends such that larger end will butt against the swedge and is held in place with sheet metal screws.

4.4

DUCT SUPPORTS

Unless specified otherwise on drawings, rectangular ducts with larger side of 2250mm or above shall be supported by 15mm MS rods and 50x50x3mm and MS angles while those below 2250 mm shall be supported by 10mm MS rods and all angles shall be given a coat of primer paint. The duct supports shall be at a distance not exceeding 1800mm. The MS rods shall be fixed to MS angle cleats, which in turn are fixed to ceiling slab by suitable anchor fasteners. All anchor fasteners, MS angle cleats, coach screws, hooks and other supporting material required shall be provided by vendor.

However, If ducts are thermally insulated, the MS angles and supports shall not be in

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
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	direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.	
4.5	FLEXIBLE CONNECTIONS	Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band 9r (or) collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.
4.6	TRANSFORMATIONS AND BREACHES	All curves, bends, offsets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.
4.7	CAULKING	Wherever duct passes through wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.
4.8	EASEMENT	Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.
4.9	ACCESS DOORS	Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc. All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.
4.10	DAMPERS AND SPLITTERS	
4.10.1		Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.
4.10.2	FIRE DAMPERS	Fire dampers shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
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	sensor or fusible link type.	
4.10.3	VANES	Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.
4.10.4	FLASHING	For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.
4.11	DIFFUSERS AND GRILLS	The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser. Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers. Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.
4.12	PLENUMS AND RA BOXING	All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at appox. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonry construction to which angles are fastened. Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box shall be fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.
4.13	ACCOUSTIC LINING	The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.
4.14	PAINTING	Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
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4.15	THERMAL INSULATION Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.	
5.	<u>INSPECTION AND TESTING</u>	
5.1	INSPECTION & TESTING DURING FABRICATION	
5.1.1	Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting, lamination in angles and channels shall be avoided.	
5.1.2	Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.	
5.1.3	Check for dimensions & mass as per latest IS-277.	
5.1.4	Check for defect, twists, ungalvanised spots as per IS-2629.	
5.1.5	Bend test & wrapping test as per IS-277.	
5.1.6	Zinc coating test on samples as per IS-6745.	
5.2	INSPECTION & TESTING AT SITE.	
5.2.1	The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.	
5.2.2	After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.	
6.	<u>BALANCING</u>	
6.1.1	The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit	
6.1.2	All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.	

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
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7. <u>DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT</u>		
7.1	Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.	
7.2	Test certificates in line with scope of inspection.	
7.3	Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual.	

बीएसईएल 	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
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LOW PRESSURE AIR DISTRIBUTION SYSTEM

DATA SHEET - A

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SECTION D

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Description

Data

- | | |
|--------------------------------|---|
| 1. General (List of areas) | : As per Specification/Tender drawing. |
| 2. GSS Duct Work | |
| a) Type | : GSS as per IS: 277
(Zinc coating as per Section-C of Specific Technical Requirements.) |
| b) Size | : As per Section-C of Specific Technical Requirements and bill of quantity. |
| 3. Acoustic lining | : Up to 5m length from AHU Outlet. |
| 4. Special painting | : Galvanised. |
| 5. Thermal Insulation | : Required in supply air duct in AC entire length. |
| 6. Diffusers (Circular/Square) | |
| 300 mm size | |
| 350 mm size | |
| 450 mm size | |
| 550 mm size | |
| 600 mm size | |
| Any other size | |
| | : Bidder to estimate as per drawings./specification.
All grille frame and louvers shall be manufactured of at least 16 SWG Aluminium |
| 7. SA grilles (for each size) | : To suit air flow as per System requirements / Tender Drawings. |
| 8. RA grilles (for each size) | : -do- |

NOTE:

- Duct sheet thickness shall be as per IS-655
- Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
- Bidder to provide suitable gasketing at each duct flange.
- Fire damper shall be motor operated type, when otherwise specified under Section-C.
- Access door in ducting system shall be provided as required.
- MS Angle (painted) shall be used for duct supports etc.
- Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.



LOW PRESSURE AIR DISTRIBUTION SYSTEM
DATA SHEET - A

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SHEET 2 OF 2

8. All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.

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		SHEET 1 OF 10
STANDARD TECHNICAL SPECIFICATION FOR CENTRIFUGAL PUMPS		

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO.PES-553-04
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1. GENERAL 1.1 This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer’s or his subcontractor’s works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter. 2. CODES AND STANDARDS 2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable): 2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water. 2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump. 2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water. 2.1.4 BS - 599 : Method of testing Pumps. 2.1.5 PTC - ‘6’ : Centrifugal Pumps Power test code 2.1.6 API - 610 2.1.7 Hydraulic Institute Standards of USA Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards. 2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser’s engineering shall be final and binding.		

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO.PES-553-04
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		SECTION D
		SHEET 3 OF 10
3. <u>DESIGN REQUIREMENTS</u>		
3.1	The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability.	
3.2	The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards..	
3.3	All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.	
3.4	The pump shall be suitable for handling the fluid as specified in Data Sheet-A.	
4. <u>CONSTRUCTION FEATURES:</u>		
4.1	PUMP CASING	
4.1.1	Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand 1.5 times the maximum pressure developed by the pump at the pumping temperature.	
4.1.2	Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves or plugged with threaded plugs as required.	
4.1.3	Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.	
4.1.4	Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610	
4.2	IMPELLER	
4.2.1	Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be checked for eccentricity and statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity. Supplier shall ensure during balancing that wall thickness of impeller vane, shroud etc is maintained above the minimum thickness requirement as per design.	
4.3	WEARING RING	
4.3.1	Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend	

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	beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.	
4.4	SHAFT	
4.4.1	Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.	
4.5	BEARING	
4.5.1	Bearings and hydraulic devices, of approved make, (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.	
4.6	STUFFING BOX	
4.6.1	Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer. Tubings used for connections shall be flexible metallic type preferably SS-304/316. PVC/ rubber tubings are not acceptable.	
4.7	SHAFT COUPLING	
4.7.1	The pumps shall be directly coupled to their drives through heavy-duty flexible coupling. Suitable sturdy coupling guards of min. 1.5 mm MS sheet/ Aluminium sheet shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.	
4.8	BASE PLATE AND SOLE PLATE	
4.8.1	Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided. The external corners of the base plate shall be rounded to avoid sharp corners. Drilled holes shall have sufficient space around for proper seating of washer with nut. If required in the data specification sheet, steel sole plates shall be provided, below the base plate.	

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4.9	PRIME MOVER	
4.9.1	The drive motor selected shall conform to the requirements of the enclosed motor specifications.	
4.10	LIFTING ARRANGEMENT	
4.10.1	Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance..	
5.	<u>PERFORMANCE REQUIREMENTS</u>	
5.1	The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.	
5.2	Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.	
5.3	Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.	
5.4	The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.	
6.	<u>DRIVE RATING</u>	
6.1	The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.	
6.2	In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.	
6.3	The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.	
7.	<u>SCOPE OF INSPECTION AND TESTING</u>	
7.1	CASTING	
7.1.1	The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers	

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	unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.	
7.1.2	Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.	
7.1.3	Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.	
7.1.4	Verification of Heat treatment charts (as applicable)	
7.1.5	Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.	
7.1.6	Surface finish of Steel castings shall meet MSS SP-55.	
7.2	FORGING	
7.2.1	Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.	
7.2.2	Verification of heat treatment charts (time temperature) (as applicable).	
7.2.3	Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.	
7.3	FABRICATED ITEMS	
7.3.1	Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.	
7.3.2	Approval of welding procedure specifications and qualifications of weld procedures and personnel as per ASME Sec IX.	
7.3.3	Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8	
7.3.4	Verification of heat treatment charts (time temperature), (as applicable)	
7.3.5	Note: For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.	
7.4	IN PROCESS INSPECTION AND TESTING	
7.4.1	Identification Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. Permissible defects and acceptance norms need to be specified. On static parts acceptance norms are as per ASME Sec.III NB 2546.	
7.4.2	Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness)	

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7.4.3	as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency. Acceptance norms for UT for dynamic duty components. the following defects are unacceptable - Cracks, flakes, seams and laps - Defects giving indications longer than that from a 4mm equivalent flaw. - Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%. - Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.	
7.4.4	For static duty components - as per NB 2542.2 of ASME Sec. III	
7.4.5	Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage. Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures	
7.4.6	Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.	
7.5	PERFORMANCE TEST	
7.5.1	Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked. - Capacity V/s Head - Capacity V/s Power absorbed by pump - Capacity V/s pump efficiency Note : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity.	
7.5.2	NPSH test in case specifically mentioned elsewhere.	
7.5.3	Vibration, noise level and temperature rise measurement. Noise level shall be within 85dB(A) at 1 metre distance. Vibration within satisfactory zone of VDI 2056 Group G machines. Temperature shall not exceed ambient + 40 deg. C.	
7.5.4	Overall dimensions as per GA drawings. One pump/type/size assembly with job motor shall be mounted on base plate, provided the components are ordered on the same manufacturer.	
7.5.5	Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.	
7.5.6	Painting and packing as per technical specification.	

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7.6	TEST AT SITE	
7.6.1	The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.	
7.7	PERFORMANCE GUARANTEE	
7.7.1	The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification. The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head	
8.	<u>CLEANING, PROTECTION , PAINTING & PACKING</u>	
8.1	Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere shall be done to remove all dirt, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere. Flanges, inlet and outlet pipe, etc shall be protected. Packing shall be done as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere.	

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9.	<u>DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL</u>
9.1	Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include: a) Foundation base plate and sole plate details as applicable b) Civil foundation and anchor bolts details and loading data c) Minimum submergence required for the pump (if applicable)
9.2	Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction and/ make with standard applicable codes.
9.3	Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.
9.4	Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.
9.5	Experience list about the supply and successful operation of similar pumps for similar application.
9.6	A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.
9.7	Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer’s works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.
9.8	Data sheet-B with all the particulars filled in.
10.	<u>MANUFACTURERS NAME AND TAG. PLATES</u>
10.1	Each pump shall have a permanently attached brass/ Stainless steel tag on the body indicating the following information both in Hindi and English: a) Manufacturer’s name and trade mark. b) Design Capacity and Head. c) Design. d) Purchaser’s tag no. as furnished during the contract. The purchaser’s tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

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CENTRIFUGAL PUMPS
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

SHEET 1 OF 2

DESCRIPTION

DATA

- | | |
|------------------------------------|---|
| 1. Designation | : Condenser water and Chilled Water pumps for AC plant. |
| 2. Type | : Horizontal, Centrifugal pump or vertical split type casing pump . |
| 3. Quantity | : Refer to section-C of Specific Technical Requirements |
| 4. Installation | : On floating type foundation. |
| 5. Fluid to be handled | : Water |
| 6. Temperature of fluid | : To suit. |
| 7. Capacity M3/hr and TDH at rated | : To suit system requirements but head shall not be less than 25 MWC. |
| 8. Duty | : Continuous (24 hours / day) |
| 9. Suction condition | : Flooded |
| 10. Type of drive | : Direct |
| 11. Prime Mover | : LV AC motor |
| 12. Maximum speed | : 1500 RPM |
| 13. Type of lubrication | : Grease Lubrication |
| 14. Material | |
| a) Impeller | : Bronze to Grade IS: 318 Grade 2 |
| b) Pump shaft | : EN - 8 / Equivalent (Approved). |
| c) Casing | : CAST IRON TO IS: 210 Grade - 260. |
| d) Wearing ring | : Bronze to Grade IS:318 GR-2, Renewable type. |
| e) Shaft Sleeve | : -do- |
| f) Base plate | : Cast Iron to Grade FG-200 IS-210/M.S. fabricated. |
| g) Bolt and nuts. | : MS |
| h) Stuffing Box gland/bush case. | : Deep Bronze packing to be renewable with case. |



CENTRIFUGAL PUMPS
DATA SHEET - A

VOLUME II-B

SECTION D

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SHEET 2 OF 2

- | | |
|--------------------------|--|
| i) Stuffing box Packing. | : Flexible Graphite or PTFE (Asbestos shall not be used) |
| j) Pump motor coupling. | : Flexible. |

15. ACCESSORIES REQUIRED:-

The following accessories shall be provided by the bidder for each pump:

- | | |
|---|--|
| a) Suction & Discharge pressure gauges. | : Yes. |
| b) Vent connection | : Yes. |
| c) Drain piping up to common drain point in plant room. | : Yes |
| d) Companion flanges. | : Yes |
| e) Common base plate. | : Yes. |
| f) Suction strainer. | : Yes |
| g) Isolating valve | : Yes |
| h) NRV at pump outlet at inlet/outlet | : Yes |
| i) Any special requirements | : The Chilled Water pumps shall be suitably insulated as per spec. |
| j) Inspection & Testing | : As per specification enclosed elsewhere. |



**TECHNICAL SPECIFICATION
FOR
PACKAGE CONDITIONING UNIT**

SPECIFICATION NO.PES-553-05

VOLUME II B

SECTION D

SHEET 1 OF 6

**STANDARD TECHNICAL SPECIFICATION
FOR
PACKAGE CONDITIONING UNIT**

	TECHNICAL SPECIFICATION FOR PACKAGE CONDITIONING UNIT	SPECIFICATION NO.PES-553-05
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1

GENERAL

1.1

This specification covers the design, manufacture, inspection and testing at the manufacturer’s works and suitable packing delivery and testing of the packaged air conditioning unit.

2

CODES AND STANDARDS

2.1

The design, manufacture, inspection, testing and performance of the packaged type air conditioning unit shall comply with all statutes, regulations and safety codes currently applicable in the locality where the equipment will be installed. The equipment shall also conform to the latest editions of the codes and standards specified herein under. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

In particular, the packaged air conditioning Unit (max 7.5 TR capacity, ductable or non ductable type) or cassette type (up to 5 TR) shall conform to the latest editions of the following stand-ards:

2.1.1

I.S.660

: Safety code for Mechanical Refrigeration.

2.1.2

I.S.5111

: Code of practice for measurement, and testing of refrigerant compressor.

2.1.3

I.S.659

: Safety code for air conditioning.

2.1.4

I.S.2494

: V Belt for industrial purpose.

2.1.5

I.S.3142

: V grooved pulleys for V Belts.

2.1.6

I.S.4503

: Shell and tube type heat exchanger.

2.1.7

ARI 210

: Standard for/unitary air conditioning equipment

2.1.8

ARI 270

: Standard for application installation and servicing of unitary equipment.

2.1.9

ASHRAE-37

: Standard methods of testing for rating unitary air conditioning and heat pump / equipment.

2.1.10

ANSI-B9-1

: Safety code for mechanical refrigeration.

3

DESIGN AND CONSTRUCTIONAL REQUIREMENTS

3.1

Compressor

The compressor shall be hermetic or semi-hermetic or screw rotary type or scroll type. The same shall be suitable for R410A/R407C/R134A refrigerant. The compressor shall be mounted on anti-vibration spring/rubber pads and shall be positioned in such a way that it is freely accessible with sufficient space all around for easy maintenance. Safety controls like High and Low pressure cut-out overload and single phasing protection for the motors shall be provided. A crankcase heater shall also be provided, if considered necessary by the vendor.

3.2

CONDENSING UNIT

Shell and tube type water cooled condenser or air cooled condenser with adequate area shall be provided as specified in Data Sheet-A. The condensing unit shall be complete with

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	multipass heads and shall be fitted with the following:	
3.2.1	Hot gas inlet and liquid outlet connection with shut off valve for liquid.	
3.2.2	Drain plug, air vent and test valve.	
3.2.3	Water inlet and outlet connection with thermowell and suitable cocks respectively.	
3.2.4	Relief valve and air purge valve (Fusible plug in place of relief valve not acceptable)	
3.2.5	Any other accessory as recommended by the manufacturer for proper functioning of the equipment.	
3.3	AIR HANDLING FAN The air handling fan shall be of the centrifugal type and with forward curved blades. This shall be driven by means of a three phase induction motor through V belt drive. The fan static pressure shall be selected for passing air through high efficiency absolute filters, if specified in Data Sheet-A.	
3.4	FILTERS Filters shall be of dry panel type and shall be cleanable. The velocity of air across the filters shall not exceed 1.75m/sec (350FPM).	
3.5	COOLING COIL The cooling coil shall be of direct expansion type and shall be made of heavy gauge copper with aluminium fins. The fins shall be bonded to the copper tubes under hydraulic pressure. A distributor shall be provided for feeding the refrigerant to different sections of the coil. Rows shall be staggered in the directions of airflow. The velocity of air across coil shall not exceed 2.5M/Sec. (500 FPM).	
3.6	CONTROLS All necessary controls and accessories like thermostatic expansion valve, refrigerant solenoid valve, distributor, filter drier in the liquid lines, shut off valves, HP/LP cut out for compressor, thermostat with adjustable settings, overload and single phasing preventer for motor etc. are to be provided. The microprocessor based control panel shall be provided outside the packaged unit on one side. The control panel shall generally be in line with the specification for control panels given elsewhere. The control shall be so interlocked that the fan shall be started independently first, and then only the compressor. Tripping of the compressor by the thermostat or compressor cut outs shall not trip the fan. The thermostat setting shall be adjustable	
3.7	REFRIGERANT PIPING The refrigerant piping shall be either heavy gauge copper as furnished in Data Sheet-A. The piping shall be completely factory assembled, pressure tested, dehydrated and initially charged with FREON gas and compressor oil. The line accessories shall include liquid line shutoff valve dehydrator, strainer, flow indicator and distributor etc.	
3.8	CABINET All the equipments, except control panel, mentioned above shall be provided within a heavy gauge sheet metal cabinet, of floor/ wall mounted type. This shall be given two coats of anti-corrosive and rust proof paint, finished with two coats of final paint . Painting shall be as per manufacturers std unless specified otherwise in data sheet 'A'. The interior of the cabinet shall be provided with thermal and acoustic insulation of minimum 25mm thick. The insulating material shall be fire proof.	

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The front and back side of the cabinets shall be easily removable providing maintenance to all the interior parts. All the electric wires within the cabinet shall run in flexible conduits and carry identification tags. The bottom side of the panel shall be specially ribbed to take care of the transportation.		
3.9	OTHER ACCESSORIES	
Each packaged air conditioner shall be provided with required number of neoprene rubber isolating pads.		
4	<u>CONTROL AND INTERLOCK REQUIREMENTS</u>	
The compressor shall have all protective devices like HP/LP cutouts, overload protection for the motor, single phasing preventor for motor etc. The interlocking requirement shall be as indicated below:		
4.1		The compressor shall not start, unless condenser water flow is achieved for water cooled condenser. The condenser flow shall be sensed by means of a flow switch.
4.2		The compressor shall not start unless the evaporator fan is started.
4.3		The tripping of compressor on HP/LP, overload or on thermostat shall not trip the fan.
4.4		Strip heater (if provided in the ducting system) shall not be switched on, unless the evaporator fan is started and airflow is established. For this purpose, an air stat on flow switch shall be used. The heater shall be separately controlled by humidistat/thermostat
4.5		A humidifying package, if specified in data sheet A, shall be controlled by humidistat.
5	<u>TEST AND INPSECTION</u>	
5.1		Inspection and Testing at Manufacturer’s Works
5.1.1		static and dynamic test for fans
5.1.2		Hydrostatic static test on condenser and cooling coil.
5.1.3		vacuum/pressure test for the complete refrigeration circuit.
5.1.4		Visual and Free running test of the packaged unit on test bed.
5.1.5		Free running test on compressor.
5.1.6		AIR CAPACITY WITH ANEMOMETER.
5.1.7		NOISE LEVEL- <=85 dB(A).
5.1.8		Other tests as per approved qualities plan/scope of inspection.
5.2		Inspection and Testing at Site
5.2.1		Performance testing of the packaged unit for 72 hours in summer / monsoon & 24-hours in winter- Up-to 3 TR (individual M/c capacity) inside room temperature (Dry & wet bulb) will be checked with all machines in the room operating.
The actual days of testing shall be mutually agreed. During the above testing, the following readings shall be taken to compare the same with guaranteed performance data.		
5.2.1.1		Condenser inlet and outlet pressure and temperature
5.2.1.2		Entering and leaving air temperature of the cooling coil air filters.

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5.2.1.3	Motor current for the compressor and blower.	
5.2.1.4	Air quantity delivered by the fan. This shall be computed by adding air quantity leaving all the grilles entering the air filters. Room temperature (Dry & wet bulb)	
5.2.1.5	Test to ensure all controls and safety instruments are working properly. During the above testing, noise level also will be checked to ensure that the same are within acceptable limits. Any undue vibration detected physically will be corrected. All tools and instruments required for the above testing will be provided by the vendor.	
6	<u>PAINTING:</u> The packaged unit shall be given two coats of primer paint finished with two coats of finish paint as per Manufacturers std. unless specified otherwise elsewhere/ Data sheet 'A'. The colour of finish paint will be as specified in Data Sheet-A.	
7	<u>GUARANTEES</u> The package unit shall be guaranteed for performance measured in terms of the inside temperature maintained. The packaged unit shall also be free from any manufacturing defects and shall be guaranteed as per contract after the first test as per 5.0 is successfully carried out, and the plant taken over by the purchaser.	
8	<u>NAME PLATES</u> Suitable Name plate as per Data Sheet 'A', depicting the equipment number as designated in Data Sheet A shall be provided for each packaged unit and screwed to a prominent position on the packaged unit.	

	TECHNICAL SPECIFICATION FOR PACKAGE CONDITIONING UNIT	SPECIFICATION NO.PES-553-05
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9. <u>DATA TO BE FURNISHED AFTER AWARD OF CONTRACT</u> 9.1 Final technical data as per Data Sheet-B 9.2 G.A. and interior view of packaged unit 9.3 Electrical wiring diagram 9.4 Catalogues for all controls 9.5 O & M Manual 9.6 Erection Manual		



PACKAGE-CONDITIONING UNIT
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

SHEET 1 OF 1

DESCRIPTION

DATA

- | | |
|---|--|
| 1) Capacity of the unit at operating conditions. | : As specified |
| 2) Numbers required | : Refer to Section-C of Specific Technical Requirements |
| 3) Designation of the unit | : Package AC Unit |
| 4) Whether air cooled/water cooled | : Refer to Section-C of Specific Technical Requirements |
| 5) The plant shall be suitable for maximum-
- ambient temp. | : Refer outdoor design condition as specified. |
| 6) Whether a plenum Chamber required | : Units shall be connected to fresh air ducts. |
| OR | |
| Whether to be connected duct system. | : Yes. |
| 7) Whether Humidifier required for humidity-
-control. | : Refer to Section-C of Specific Technical Requirements |
| 8) Whether strip heaters required for winter
heating. | : Refer to Section-C of Specific Technical Requirements |
| 9) Whether strip heater required for Humidity
control. | : Refer to Section-C of Specific Technical Requirements |
| 10) Final painting colour shade
stage. | : Subject to approval / during detail engineering |
| 11) Whether fan static pressure is to be
designed for filters arrangement shown. | : Yes. |
| 12) Installation supporting structure/
drain piping, insulation. | : Required. Drain piping with insulation up to the
nearest drain point. |
| 13) Controls & Instruments | : Yes (Lot) |
| 14) Isolation Switch | : Yes |



**STANDARD TECHNICAL SPECIFICATION
FOR
AIR FILTER**

SPECIFICATION NO.PES-553-06

VOLUME II B

SECTION D

SHEET 1 OF 4

**STANDARD TECHNICAL SPECIFICATION
FOR
AIR FILTER**

	STANDARD TECHNICAL SPECIFICATION FOR AIR FILTER	SPECIFICATION NO.PES-553-06
		VOLUME II B
		SECTION D
		SHEET 2 OF 4

1.

GENERAL

This specification covers the design, manufacture, inspection and testing at manufacturer’s work or his sub-contractor’s works of Air filters to be used for air-conditioning and ventilation system.

2.

CODES AND STANDARDS

This design, manufacture and performance of AIR FILTERS shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to latest applicable Indian/British/USA standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. The following standards, in particular, shall be applicable for certified ratings of filters and for conducting performance test, if required.

a) BS EN - 779 -Methods of test for air filters used in air conditioning and general ventilation.

3.

GENERAL

The enclosed Data sheet A gives the type and other particulars of filters required.

3.1

POLY FIBRE AIR FILTERS

Filtering media shall consist of a suitable fibrous material (e.g. polyethylene extruded sections coir etc.) packed into a 20 gauges GSS framework, complete with handles etc. The filter element shall be supported by galvanised steel wire mesh of 10mm. sq. on either side, Velocity across the filters shall not exceed 2.5 M/sec. Average efficiency Em (%) shall be ≥ 80 as per BS EN - 779.

3.2

DRY FABRIC AIR FILTERS

Filter element shall be pressed felt filter fabric or suitable material recommended by the manufacturer, stitched on to galvanised wire gauge support and crimped to form deep folds. Suitable aluminium spacers shall be provided to ensure uniform distribution of air flow through filters. Filter casing shall be provided with neoprene sponge rubber sealing, The filter shall have Average efficiency Em (%) of ≥ 95 as per BS EN - 779.

3.3

PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

Filter shall consist of V-fold galvanised wire mesh interspaced with flat layers of galvanised wire mesh. The density of media shall increase in the direction of air flow. Edges of wire mesh shall be suitably hemmed to prevent abrasion during handling. The media shall be supported on either side by galvanised expanded metal casing. The framework shall be at least 18 gauge GSS. Filter shall be either dry or wetted type as per data sheet=A. The oil shall be mineral oil of approved quality and make. As a the filter frame made of Aluminium alloy conforming to IS:737 can be considered unless use of aluminium is prohibited otherwise due to site conditions being saline/corrosive.

All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance Am (%) shall be ≥ 90 .

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	However oil wetted air filters shall have Average Efficiency Em (%) ≥ 90 as per BS EN - 779.. 3.4 AUTOMATIC CLEANING FILTERS This shall consist of a filter mat and drop eliminator, driven by a suitably rated geared motor unit being supported on a steel framework. The filter mat shall consist of an endless steel wire mat insets of steel mesh held between an upper & a lower shall drop eliminator shall consist of an endless steel wire without insets of steel mesh. The unit shall include a suitable oil pump, gludge raking mechanism and sludge container and tensioning device. Pressure drop shall be limited to 0.5 / mm WG when clean & 10 mm when dirty. Air velocity across filter shall not exceed 3 M/sec. 3.5 ABSOLUTE FILTERS Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctylphalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame. 3.6 WATER REPELLANT NYLON FILTERS This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only. 4. <u>INSPECTION & TESTING</u> The scope of inspection for air filters shall be as below: 4.1 Dimensional inspection of frame & filter media. 4.2 Witnessing of type tests on one per type per size air filters for the following properties. a) Gravimetric efficiency. b) Pressure drop in clean & dirty (choked - %age to be specified) condition. c) Efficiency as per BS EN - 779. 4.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet).	

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5. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

- 5.1 GA Drawing.
- 5.2 Drawing showing material/construction detail
- 5.3 Installation and\service manual
- 5.4 Rating curves/charts
- 5.5 Test certificates
- 5.6 Elect. diagrams (when automatic cleaning type)



**AIR FILTER
DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

SHEET 1 OF 1

DESCRIPTION

DATA

1) General

- | | |
|------------------------------|--|
| 1.1 Service | : Air Conditioning. |
| 1.2 Location | : Central Air conditioning plant, & package AC plant, fresh air fan system. Also for split AC. |
| 1.3 Nos. | : Refer Section 'C' of Specification. |
| 1.4 Total air flow/type | : Refer Section 'C' of Specification. |
| 1.5 Temperature | : As per project information. |
| 1.6 Relative Humidity | : 100% |
| 1.7 Gas Composition | : Atmospheric Air (Dusty) as prevalent in power Station. |
| 1.8 Filter Media | : Synthetic non-woven |
| 1.9 Efficiency | : Average arrestance efficiency of 65-80 % for Dry Panel filter (pre-filters) and average arrestance Efficiency of 80-90 % for fine filters. |
| 1.10 Allowable pressure drop | : 2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters(prefilters).
12 mm in clean condition for fine filters. |
| 1.11 Frame Work | : 18 G, GSS. |
| 1.12 Mounting | : Ladder Type M.S Angles (galvanised) |
| 1.13 Size | : 600 x 600 mm |

Note:-

- 1) Face velocity of air across the filters shall not exceed 2.5 m/sec.

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08
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STANDARD TECHNICAL SPECIFICATION FOR THERMAL INSULATION FOR COLD SURFACES

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08
		VOLUME II B
		SECTION D
		SHEET 2 OF 6
1.	<u>SCOPE</u>	
		This specification covers design, manufacture, testing at manufacturers works, supply, application & finishing of insulation for cold piping, air conditioning ducting & equipment for low temperature service.
2.	<u>CODES & STANDARDS</u>	
		The design, manufacture and performance of materials covered under this specification shall comply with all currently applicable statues, regulations & safety codes in the locality where the equipment/material are to be installed. The material shall also conform to the latest applicable Indian/British/American codes & standards. Nothing in this specification shall be construed to relieve the vendor of his responsibility. In particular, the material shall conform to the latest editions of the following standards :-
	IS:3069:	GLOSSARY OF TERMS & SYMBOLS & UNITS RELATING TO THERMAL INSULATION
		materials.
2.1	IS:4671:	Expanded polystyrene for thermal insulation purposes.
2.2	IS:3677:	Mineral wool for thermal insulation.
2.3	IS:8183:	Resin bonded mineral wool.
3.	<u>DESIGN REQUIREMENTS</u>	
3.1		The insulating material as well as protective covering shall be new & unused, non-corrosive, vermin/rodent proof and shall be guaranteed to withstand continuously & without deterioration the maximum/minimum temperatures to which they may be subjected to, under specified site conditions.
3.2		The insulation material must be light weight, strong, free from shots & coarse fibre & shall provide high insulation efficiency at low weight & coat. It should be non-hygroscopic & should not rot. It shall not settle or shake down even when subjected to prolonged vibrations.
3.3		The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.
4.	<u>APPLICATION DETAILS</u>	
4.1		The surface to be insulated shall be thoroughly cleaned and allowed to dry. Pressure/hydrostatic tests, if any, shall be carried out before application of insulation.
4.2		A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.
4.3		Hot industrial bitumen of grade 85/40 or 85/25 conforming to latest IS:702 shall be uniformly applied @ 1.5 kg/sq.m on the surface to be insulated. A similar layer shall also be applied on the inside surface & edges of the insulation. A suitable cold adhesive compound may also be used in place of bitumen.
4.4		Insulation in the form of pipe sections/rolls slabs of specified density & thickness shall be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed with

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	bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.	
4.5	In case of double layer application both circumferential & longitudinal joints shall be suitably staggered.	
5.	<u>VAPOR SEALING & INSULATION FINISH</u> The insulation shall be treated for vapor sealing & weather proofing & finished as specified in DATA SHEET A The acceptable types of finishes are outlined below:-	
5.1	FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH	
5.1.1	A thick vapor seal of hot bitumen @ 2.5 kg/Sqm shall be applied on the outer surface of insulation & allowed to dry.	
5.1.2	The surface shall then be wrapped with 20mm (3/4" hexagonal mesh of 24 SWG GI wire, butting all the joints & laced down with 22 SWG GI lacing wire.	
5.1.3	12.5mm (1/2 inch) thick sand cement plaster in the ratio of (1:1) shall be applied in two layers, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.	
5.2	FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.	
5.2.1	The insulation shall be covered with 500 g polythene/polythene bonded Hessians (PBH) with 50mm overlap on longitudinal & circumferential joints. Overlaps shall be sealed with synthetic adhesive in case o-f polythene & liberal coat of bitumen in case of PBH:	
5.2.2	The surface shall then be wrapped with 20mm (3/4") mesh of 24 SWG GI wire butting all the joints & laced down with 22 SWG GI lacing wire.	
5.2.3	12.5mm thick (1/2 inch) sand cement plaster in ratio of(4:1) shall be applied in two layers, the second layer being brought to a smooth & even finish similarly as described above.	
5.3	FINISH III:EXTERNAL INSULATION WITH SHEET METAL FINISH	
5.3.1	The insulation shall be covered with 500g polythene with 50mm overlaps at joints which shall be sealed with synthetic adhesive or equivalent compound.	
5.3.2	The polythene shall be covered with 24 gauge GI/aluminum sheet	
5.3.3	25mm wide x 22 SWG GI/aluminum peripheral straps shall be fixed over the GI/aluminum sheet at 300mm centres to secure.	
5.4	FINISH IV: EXTERNAL INSULATION WITH PLASTER & WATER PROOFING COMPOUND For ducts & piping exposed to atmosphere, the finish shall be as follows:	
5.4.1	A thick vapor seal of hot bitumen at 2.05 kg/sq.m shall be applied on the outer surface of insulation & allowed to dry.	
5.4.2	The surface shall then be wrapped with 20mm (3/4") hexagonal mesh of 24 SWG GI Wire butting all the joints & laced down with 22 SWG GI lacing wire.	
5.4.3	12.5mm thick (1/2 inch) sand cement plaster in ratio of (4:1) shall be applied in two layers, the second layer being brought to a smooth finish with water proofing compound added to the cement.	

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5.4.4	3 mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fiberglass RP tissue & allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire & finally bitumen paint shall be applied over wire netting.	

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6.

INSULATION OF PUMPS & VALVES

6.1

For all inspection covers & hatches on equipment, pump casing & valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge aluminum sheet metal boxes, which shall be bolted together around the equipment to permit easy removal & replacement. Proper care shall be taken to maintain continuity of vapor seal between the static & removable partitions of the insulation.

6.2

The tenderer may offer thickness of insulation & finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser’s approval.

7.

INSPECTION & TESTING (REFER SPEC. NO - PES-553.00)

7.1

All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes & standards, shall be carried out at manufacturer’s works & test certificates including these for material/accessories shall be furnished for purchasers approval.

8.

PAINTING

8.1

Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.2

Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.3

All painting for insulated surfaces shall conform to the requirement specified elsewhere.

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9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT		
9.1	Final version of data sheet 'B' incorporating changes if any along with design data.	
9.2	Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following:- a) Thermal conductivity test. b) Sound absorption coefficient test. c) Corrosion test. d) Sulphur content, moisture content, shot content, moisture absorption etc. e) Compressive strength & cross breaking strength test.	
9.3	Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.	
9.4	Manual dealing with safety aspects & instructions for combating fire arising out of insulation work.	
9.5	Instructions on maintenance of insulation work.	



THERMAL INSULATION
FOR COLD SURFACE
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

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Insulation Material

Insulation	Code	Thermal Conductivity MW/cm °C	Density Kg/m ³
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 °C	At least 24 for duct insulation and 48 for acoustic lining.
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 °C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 10 °C	At least 15

Type of Insulation

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded roll Mineral Wool (IS:8183)		25
ii)	Refrigerant Piping	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
iii)	AHU drain pipe	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	25 25
iv)	AHU drain pan coil section and fan section	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	25 25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
vi)	Chiller	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	100 100
vii)	Chilled Water Pumps	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	50 50
viii)	Expansion tank with pipe	a) Expanded Polystyrene or b) Mineral Wool	Slabs/Pipe Section Slabs/Pipe Section	50 50



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

SECTION-I SUB SECTION -E

LIST OF MAKES OF SUB-VENDOR ITEMS



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

Sl. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	VAPOUR ABSORPTION MACHINE	VOLTAS / THERMAX
3	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMADENTA
4	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
5	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
6	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRIAIRE (FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
7	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
8	CHILLED & CONDENSER WATER PUMP	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
9	COOLING TOWER	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
10	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF / JYOTI / LHP
11	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
13	INSULTATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA / AEROCCELL
14	BALANCING VALVE	ADVANCE
15	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
16	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
17	GATE/GLOBE VALVES	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG/SAMSON CONTROLS PVT. LTD/INSTRUMENTATION LTD./ Koso India Private Limited,



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

18	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY /JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
19	MOTORIZED BUTTERFLY VALVE	ANERGY / ADVANCE / BELIMO / JOHNSON / HONEYWELL / SIEMENS
20	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING
21	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
22	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
23	GI SHEETS FOR DUCTING	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL
24	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
25	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
26	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
27	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
28	RELIEF / PURGE VALVE	BRASSOMATIC
29	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
30	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
31	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
32	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS
33	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA /TRAC / FLOW STAR/ SCIENTIFIC DEVICE
34	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
35	PLC BASED PANEL	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB/ MITSUBISHI ELECTRIC
36	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO
37	PRINTER	HP / CANON / EPSON / XEROX / IBM / LEXMARK
38	UPS	HITACHI-HIREL / APC / DELTA / EMERSON / DB POWER / APLAB
39	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
40	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
41	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
42	METERING PUMP	SHAPO TOOLS / VK PUMPS
43	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
44	PRESSURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM /



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

		TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
45	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL
46	ROTAMETER	CHEMTROLS SAMIL / EUREKA IND / IL / TRANSDUCERS AND CONTROL
47	BATTERY CHARGER	AMARARAJA/ CHHABI ELECTRICAL / DUBAS ENGG. / HBL POWER SYSTEM / STATCON / CALDYNE
48	BATTERY (NI -Cd)	HBL POWER / AMCO SAFT / SAFT
NOTE		
NOTES: 1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED. 2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER. 3. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3, C-4 & C-5 FOR ELECTRICAL, C&I AND HANDLING RELATED EQUIPMENT LIST OF MAKE.		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
199	145-04000-A	CONTROL VALVE	SAMSON CONTROLS PVT. LTD.	Mr. Atul raje-MD D 281, MIDC Ranjangaon Ta Shirur Pune Phone- 02067246600 Pincode : 412220 Email : sales@samsoncontrols.net	Works-1-> Others D 281, MIDC Ranjangaon -Pune- MAHARASHTRA India Phone- 02067246600,8554997963 FAX : Pincode : 412220 Email : sales@samsoncontrols.net		
200	145-04000-A	CONTROL VALVE	FORBES MARSHALL ARCA PVT.LTD.	A-34/35, MIDC ESTATE, H-BLOCK, PIMPRI, PUNE, Phone- 020-27442020, Pincode : 411018 Email : mnadgaundi@forbesmarshall.com	Works-1->Mr. Sanjeev Shinde A-34/35 MIDC Estate,H Block, Pimpri, -Pune-MAHARASHTRA India Phone- 9323176406 FAX : 020-27442040 Pincode : 411018 Email : sshinde@forbesmarshall.com	No technical limit exists except for feed control valve. For feed control valves, approved up to sub-critical power plants of 600 MW rating.	
201	145-04000-A	CONTROL VALVE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALAKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvdiil@gmail.com;fa2@ilpgt.com	Works-1->D.SASIDHARAN, AGM(Works&PPC) KANJIKODE WEST, -PALAKKAD-KERALA INDIA Phone- 0491-2566536 FAX : 0491-2566135 Pincode : 678623 Email : sasidharan@ilpgt.com		
202	145-04000-A	CONTROL VALVE	Koso India Private Limited,	H 33 & 34, MIDC, Ambad, Nashik, Phone- 09650233433 Pincode : 422010, Email : jetmal.gour@koso.co.in	Works-1->P.J.ASHOK KUMAR/SEEMA ANAND Control Valve Division, H-33&34, MIDC, Ambad, -Nashik-MAHARASHTRA India Phone- 91 944 744 3198 FAX : 0491 - 5269914 Pincode : 422010 Email : pja@koso.co.in Works-2->+P.J.ASHOK KUMAR/SEEMA ANAND J-1,MIDC,Ambad -Nashik-MAHARASHTRA India Phone- 91 944 744 3198 FAX : 0491 - 5269914 Pincode : 422010 Email : pja@koso.co.in		
203	145-04000-A	CONTROL VALVE	KSB MIL CONTROLS LTD.	Mr.Jacob Cherian/Mr.Geo Jolly Meladoor, Annamanada P.O. MALA, Thrissur Phone- 0480-2695700 Pincode : 680741 Email : hiiu.simon@ksb.com	Works-1->Mr.Biju Simon/Mr.Jose Paul Meladoor, Annamanada, -Thrissur-KERALA INDIA Phone- 9447555500 FAX : 91 480 2890952 Pincode : 680741 Email : jose.paul@ksb.com		
204	145-04000-A	CONTROL VALVE	SUZHOU DELAN ENERGY SCIENCE & TECHNOLOGY CO., LTD.	No 566 Fangqiao Road Caohu Industrial Park, Xiangcheng Economic Development Zone, Suzhou Phone- 008618012776062 Pincode : 215143 Email : jeanielei@delan-valve.com	Works-1->Mr. Zong Xin CEO No 566 Fangqiao Road Caohu Industrial Park,Xiangcheng E. Z. -Suzhou-Foreign Country CHINA Phone- 008618012776062 FAX : Pincode : 215143 Email : jeanielei@delan-valve.com		
205	145-04000-A	CONTROL VALVE	R.K.CONTROL INSTRUMENTS PVT. LTD.	PLOT NO.A-250, OPP.POLICE STATION, WAGLE INDUSTRIAL ESTATE, THANE Phone- 25820943/2331 Pincode : 400604 Email : rkcipl@vsnl.com ; rkciplv@bhl.net.in	Works-1->SAVITH KUMAR PLOT NO. A-250, OPP.POLICE STATION,WAGLE INDUSTRIAL ESTATE, THANE -THANE- MAHARASHTRA INDIA Phone- 022-66060942 FAX : 022-25820801 Pincode : 400 604 Email : rkadmin@rkcipl.co.in	For subcritical power plant up to 150MW	
206	145-04000-A	CONTROL VALVE	Mascot Valves Pvt. Ltd.	166-167 GIDC Naroda Ahmedabad Phone- 0792282 1619 Pincode : 382330 Email : dom.sales@mascotvalves.com	Works-1->Varun Patel Dir 166-167 ,GIDC Naroda - Ahmedabad-GUJARAT India Phone- 0792282 1619 / 3369 FAX : Pincode : 382330 Email : dom.sales@mascotvalves.com		
207	145-04000-A	CONTROL VALVE	Valvitalia S.P.A. ,	Mr. Salvatore Ruggeri Via Tortona 69, Rivanazzano (Pavia) Phone- +39-03839459875 Pincode : 27055 Email : dario.torluccio@valvitalia.com	Works-1->Mr. Salvatore Ruggeri Via Tortona 69,Rivanazzano (Pavia) -- Italy Phone- +39-03839459875 FAX : Pincode : 27055 Email : dario.torluccio@valvitalia.com; diego.poletti@valvitalia.com; sales@hbhassociates.com		
208	145-04000-A	CONTROL VALVE	BOMAFI SPECIAL VALVE SOLUTIONS PVT LTD	Mr. K.M. Anklesaria/ R. M. Anklesaria Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva Ahmedabad Phone- 079-40083825 Pincode : 382445 Email : info@bomafi-india.com	Works-1->Mr. K.M. Anklesaria/ Mr. R.M. Anklesaria Dir Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva, - Ahmedabad-GUJARAT INDIA Phone- 079-40083825 FAX : Pincode : 382445 Email : info@bomafi-india.com		
209	145-04000-A	CONTROL VALVE	DRESSER VALVE INDIA PVT. LTD	Mr. Raj Raman/Mr. Rajkumar Moria S.F. No: 608,Chettipalayam Road, Echanari Post, Coimbatore Phone- +91-98451 19085 Pincode : 641021 Email : Anoop.Ramachandran@ge.com	Works-1->Mr. Anoop Ramchandran S.F. No: 608,Chettipalayam Road, Echanari Post, -Coimbatore-TAMIL NADU INDIA Phone- +919500978296 FAX : +91 4223011200 Pincode : 641021 Email : Anoop.Ramachandran@ge.com		
210	145-04000-A	CONTROL VALVE	Severn Glocon India Pvt. Ltd.	F96 & F97, Sipcot Industrial Park, Irungattukottai, Chennai, Phone- 044-47104200, Pincode : 602117, Email : info@severnglocon.co.in	Works-1->Mr. K.Kaushik, F96 & F97, Sipcot Industrial Park,Irungattukottai, -Chennai-TAMIL NADU India Phone- 044-47104200, FAX : 044-47100073, Pincode : 602117, Email : info@severnglocon.co.in		
211	145-04000-A	CONTROL VALVE	EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	147, KARAPAKKAM VILLAGE, CHENNAI Phone- 23722184, 23716242 Pincode : 600096 Email : jatinder.singh@emerson.com	Works-1->Mr. Rangarajan (Head - Lean and Manufact 147,Karapakkam Village, -Chennai-TAMIL NADU India Phone- 0444903 4395 FAX : Pincode : 600097 Email : Rangarajan.M@emerson.com		
212	145-04000-A	CONTROL VALVE	WALDEMAR PRUSS ARMATURENFABRIK GMBH	Mr. Winfried Dremhel Schulenburgelandstrasse 261, Hannover Phone- +49-511279260 Pincode : 30419 Email : dremhel@pruss.de; vnigel@pruss.de	Works-1->Mr. Winfried Dremhel CEO Schulenburgelandstrasse 261, -Hannover- GERMANY Phone- +49-511279260 FAX : Pincode : 30419 Email : dremhel@pruss.de		
213	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in	Works-1->C S Shankar 127, Sidco North Phase, Ambattur Estates, -CHENNAI-TAMIL NADU INDIA Phone- 8754491904 FAX : 044-26248849 Pincode : 600050 Email : cservice@switzerinstrument.com		
214	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com			
215	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Welleder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msinoh@barksdale.de			
216	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com			

217	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com		
218	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mkto@indfos.com			
219	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com			
220	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,	Works-1->LARRY DEGARMO/ ROY STUMBROUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com		
221	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : nressure@vsnl.com			
225	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	Works-1->NA NA -- Phone- FAX : Pincode : Email :		OVERALL PENDING ORDER VALUE (EXCLUDING VALUE OF ORDERS ALREADY EXECUTED) FOR ALL PACKAGES FOR WHICH VENDOR IS REGISTERED SHALL NOT EXCEED RS. 1.0
226	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba,Sonarpur Station Road,P.O. -Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_ani@hotmail.com		
227	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosenapanda@vsnl.net	Works-1->Mr. Partha Bose 44, Saheed Hemanta Kumar Bose,Sarani, -Kolkata-WEST BENGAL India Phone- +91 33 2548 7220 FAX : +91 33 2548 0429, Pincode : 700074 Email : parthabosebpi@gmail.com bosenapanda@vsnl.net		
228	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com		
229	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur -BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email : shikahazra@hgurusouth.com		
230	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 Å GIDC Å Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com		
231	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM , -HYDERABAD- TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email : gshrinivasan@forbesmarshall.com		
232	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : nicdelhi@general-gauges.com	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com		
233	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi-GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, bkpadia@nesstech.co.in		
234	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdhpl@vsnl.com	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane -Mumbai- MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com		
261	145-14000-A	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com	Works-1-> PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, -BANGALORE-KARNATAKA INDIA Phone- 080-41586000, FAX : 080-28521442, Pincode : Email : uday.shankar@in.yokogawa.com		
262	145-14000-A	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com		PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER	

263	145-14000-A	TRANSMITTERS	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL AREA, PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com	a)DISPLACEMENT TYPE TRANSMITTERS . b)PRESSURE AND DP TRANSMITTERS	
264	145-14000-A	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : hp@punetechtrol.com		Only for capacitance Type Level Transmitter	
265	145-14000-A	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhpura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate, Makhpura, -Ajmer-RAJASTHAN India Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : raieev.nurta@tipl.com		
266	145-14000-A	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in	Works-1->MR. MOHAN PADWAL 691/A/2, BIBWEWADI INDL ESTATE -PUNE-MAHARASHTRA INDIA Phone- 918600042374 FAX : 912024215670 Pincode : 411037 Email : wm@sbem.co.in	FOR CAPACITANCE TYPE.	
267	145-14000-A	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com	Works-1-> M-171 to 173, MIDC, Waluj, -Aurangabad-MAHARASHTRA India Phone- 9881000474, FAX : 0240-2555179, Pincode : 431136, Email : Narendra.Kulkarni@wetzler.endress.com	"Except Displacement Type Level Transmitters"	
268	145-14000-A	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com	Works-1->Matt Moren/Gina Cruz 16650 Schoenborn St., North Hills -CALIFORNIA- USA Phone- +1 818 894 7111, ext FAX : +1 818 830 5588 Pincode : 91343 Email : ccruz@miinet.com		
269	145-14000-A	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business, Parsiwada, Sahar road, Andheri (East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com	Works-1->Mr. Santosh Shukla Others R-628, TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com	For Pressure and Diff. Pressure transmitter	
270	145-14000-A	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwiji Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	Works-1->Mr. Kedar Tillu 53, 54, 56 & 57, Hadapsar Industrial Estate -PUNE-MAHARASHTRA INDIA Phone- 9665034625 FAX : 020 66039905 Pincode : 411013 Email : kedar.tillu@honeywell.com		
271	145-14000-A	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210, BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	Works-1->Kalpesh Chandan/Hrishikesh Aghor Plot No. A 145/4 TTC IND AREA, MIDC, PAWANE, -NAVI MUMBAI-MAHARASHTRA INDIA Phone- 9619688001 FAX : 022-66736000 Pincode : 400 705 Email : Kalpesh.chandan@emerson.com		
272	145-14000-A	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in		LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.	
273	145-14000-A	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankita.varshney@siemens.com	Works-1->Ankit Varshney Kalwa Works, Thane-Belapur Road, Thane, -MUMBAI-MAHARASHTRA INDIA Phone- FAX : Pincode : 400708 Email :		
274	145-14000-A	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	Works-1->Mr. Praveen Toshniwal 104-115, Electronic Complex, -Indore-MADHYA PRADESH India Phone- 0731-4081305 FAX : 0731-255075 Pincode : 452010 Email : sales@nivocontrols.com	For Capacitance type only	
286	145-21000-A	DIFFERENTIAL PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,			
297	145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net			
298	145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2, OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra_industriesblr@gmail.com	Works-1->B. Srinivas Suchitra Industries, Opp No 53, Muneshwara Black Devinagar, Lottagal hal -BANGALORE- KARNATAKA INDIA Phone- 080-23511247 FAX : Pincode : 560094 Email : suchitra_industries@yahoo.com		
299	145-25000-A	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej- Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com	Works-1->Mr. Pulin Shah/ Mr. Kaloesh Parmar 39 A/3 ,Panchratna Industrial Est, Sarkhej- Bavla Road, Changodhar - Ahmedabad-GUJARAT INDIA Phone- 98250 80339 1 FAX : 079-26932424 Pincode : 382213 Email : sales@sumip.com		
300	145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140, 265003 Pincode : 396424 Email : flexpro@flexproiltd.com	Works-1->Mr. Dineshbhai Zaveri CEO C-1/ 27&37, GIDC, Kabilpore, -Navsari-GUJARAT INDIA Phone- 02637-265140, 265003 FAX : 02637-265308 Pincode : 396424 Email : flexpro@flexproiltd.com	Metal type junction box only	
301	145-25000-A	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG., SHREE NAGESH INDL. ESTATE, STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, imajmera@yahoo.com	Works-1->JIGNESH MAHENDRA AJMERA DENA BANK BLDG., SHREE NAGESH INDL. ESTATE, STATION ROAD, - MUMBAI-MAHARASHTRA INDIA Phone- 022 67973578 FAX : Pincode : 400 088 Email : ajmera@ajmera.net		

303	145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, - NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com	Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs). The registration category & the financial limit may be reviewed after survey in March 2009 and approval thereof. Registered w.e.f. 22.01.2009.
304	145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com	
305	145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : neiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com	
306	145-32000-A	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : nirai@aurainc.com		
340	145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, - NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com	Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs).
341	145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com	
342	145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : nirai@aurainc.com		
343	145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : neiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com	
374	145-45000-A	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com	Works-1->S. Harichandran/ P.S. Pandi B-11, Mugappair Industrial Estate, -CHENNAI-TAMIL NADU INDIA Phone- 044-25252537 FAX : 044-26252538 Pincode : 600037 Email : sales@hpvalvesindia.com	
375	145-45000-A	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com	Works-1->Shahanawaz Khan Vishweshwar Ind. Premises Co-op Soc. Ltd,F-18/19, Pradhikaran,Bhosadi MIDC -PUNE-MAHARASHTRA INDIA Phone- 020-30694134 FAX : 022-23013010 Pincode : 411026 Email : shahanawaz.khan@perfectinstrumentation.com	
376	145-45000-A	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : aryacrafts@vsnl.com		
377	145-45000-A	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : neiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com	
378	145-45000-A	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : nirai@aurainc.com		
379	145-45000-A	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com	Works-1->Miss Sonal Pithadia/Miss Pavan Chavda Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway, Laxmipura - Nandasan-GUJARAT INDIA Phone- 8460848087 FAX : 2764-267036/37 Pincode : 382705 Email : domestic@com-fit.com	
380	145-45000-A	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengn.com	Works-1->Mr. Abbas Bhola Unit No. 16, Supreme Industrial Estate,Kaman Bhiwandi Road,Devdal, -Vasai East-MAHARASHTRA India Phone- 9920044113 FAX : 07303178243 Pincode : 401208 Email : ab@fluidfitengn.com	
381	145-45000-A	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, - NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com	Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs).

382	145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla- MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com		
383	145-45000-A	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com	Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com		

Notes :-

- The above sub-vendor list is tentative & for reference only. However Sub-Vendor List is subject to BHEL/ end user approval without any commercial/ delivery implication.
- New Sub-Vendor if proposed by Vendor during contract stage shall be subject to BHEL/ end user approval without any commercial/ delivery implication.

	1x660MW PANKI STPP STAGE I AIR CONDITIONING SYSTEM MANDATORY SPARE LIST	SPECIFICATION NO. PE-TS-426-553-A001	
		SECTION : I	
		SUB-SECTION : E	
		REV 00	
		SHEET 1 OF 1	

ANNEXURE-II
MANDATORY SPARE LIST
(REFER SUGGESTIVE PRICE FORMAT)



**1X660MW PANKI STPP
AIR CONDITIONING SYSTEM
PAINTING & COLOUR SCHEME**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : E

REV 00

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SECTION-I

SUB SECTION E

ANNEXURE-III

**PAINTING & COLOUR SCHEME
(PLEASE REFER SECTION C2-C)**

	1x660MW PANKI STPP AIR CONDITIONING SYSTEM LIST OF TOOLS & TACKLES	SPECIFICATION No: PE-TS-426-553-A001	
		SECTION : I	
		SUB-SECTION : E	
		REV 00	
		SHEET 1 OF 1	

ANNEXURE-IV
LIST OF TOOLS & TACKLES
(REFER SUGGESTIVE PRICE FORMAT)



**1x660MW PANKI STPP STAGE I
AIR CONDITIONING SYSTEM
DRAWINGS / DOCUMENTS SUBMISSION
PROCEDURE**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : E

REV 00

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SECTION-I

SUB-SECTION-E

ANNEXURE-V

**DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE
(COVERED UNDER SUB-SECTION C2-B)**



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : E

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SECTION-I

SUB-SECTION-E

ANNEXURE-VI

**MASTER DRAWING LIST WITH SCHEDULE OF
SUBMISSION**



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : E

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S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
1.	PE-V0-426-553-A001	INSPECTION CATEGORISATION PLAN FOR AIR CONDITIONING SYSTEM	4
2.	PE-V0-426-553-A002	QAP OF SCREW CHILLER PACKAGE	14
3.	PE-V0-426-553-A006	QAP OF AIR HANDLING UNIT	14
4.	PE-V0-426-553-A007	QAP OF PUMPS FOR AIR CONDITIONING SYSTEM	15
5.	PE-V0-426-553-A008	QAP OF COOLING TOWER FOR AIR CONDITIONING SYSTEM	15
6.	PE-V0-426-553-A009	QAP OF MOTORS FOR AIR CONDITIONING SYSTEM	15
7.	PE-V0-426-553-A011	HEAT LOAD CALCULATION FOR MAIN PLANT, ESP / VFD CONTROL ROOMS AND SERVICE BUILDING ETC FOR AIR CONDITIONING SYSTEM	4
8.	PE-V0-426-553-A012	OPERATION & CONTROL PHILOSOPHY FOR AIR CONDITIONING SYSTEM	12
9.	PE-V0-426-553-A013	PRESSURE DROP CALCULATIONS FOR CHILLED AND CONDENSER WATER PIPING FOR AIR CONDITIONING SYSTEM	10
10.	PE-V0-426-553-A014	TDS AND GA OF SCREW CHILLER ALONG WITH FOUNDATION DETAILS FOR AIR CONDITIONING SYSTEM	16
11.	PE-V0-426-553-A015	TDS AND GA OF VAM ALONG WITH FOUNDATION DETAILS FOR AIR CONDITIONING SYSTEM	18
12.	PE-V0-426-553-A018	TDS AND GA OF COOLING TOWER ALONG WITH FOUNDATION DETAILS FOR AIR CONDITIONING SYSTEM	15
13.	PE-V0-426-553-A019	TDS AND GA OF AIR HANDLING UNITS ALONG WITH FOUNDATION DETAILS FOR AIR CONDITIONING SYSTEM	14
14.	PE-V0-426-553-A020	TDS AND GA OF CONDENSER AND CHILLEDWATER PUMPS ALONG WITH FOUNDATION DETAILS FOR AIR CONDITIONING SYSTEM	15
15.	PE-V0-426-553-A021	TDS AND GA OF PAC / SPLIT AIR CONDITIONER	12
16.	PE-V0-426-553-A022	TDS AND GA OF MOTOR (PUMP, COOLING TOWER, AHU)	15
17.	PE-V0-426-553-A023	TDS OF INSULATION MATERIAL (DUCT INSULATION, DUCT LINING, PIPE INSULATION) FOR AIR CONDITIONING SYSTEM	12
18.	PE-V0-426-553-A024	TDS AND GA OF FRESH AIR FANS FOR AIR CONDITIONING SYSTEM	12

	1x660MW PANKI STPP AIR CONDITIONING SYSTEM MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION		SPECIFICATION No: PE-TS-426-553-A001	
			SECTION : I	
			SUB-SECTION : E	
			REV 00	
			SHEET 3 OF 6	
S. NO.	DRAWING NO	DRG. / DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)	
19.	PE-V0-426-553-A026	TDS AND GA OF AIR COOLED PRECISION AC UNITS ALONG WITH FOUNDATION DETAILS FOR AIR CONDITIONING SYSTEM	12	
20.	PE-V0-426-553-A027	TDS AND GA OF FOR 3-WAY MIXING VALVE FOR AIR CONDITIONING SYSTEM	8	
21.	PE-V0-426-553-A028	TDS AND GA OF HEATERS AND HUMIDIFIER FOR AIR CONDITIONING SYSTEM	7	
22.	PE-V0-426-553-A029	TDS AND GA OF FIRE DAMPER WITH ACTUATOR FOR AIR CONDITIONING SYSTEM	10	
23.	PE-V0-426-553-A030	TDS AND GA OF VALVES (BALANCING VALVE, GATE VALVE, CHECK VALVE , Y ATRAINER) FOR AIR CONDITIONING SYSTEM	9	
24.	PE-V0-426-553-A031	TDS AND GA OF SUPPLY / RETURN AIR DIFFUSER/GRILL FOR AIR CONDITIONING SYSTEM	8	
25.	PE-V0-426-553-A032	TDS OF GI SHEET FOR AIR CONDITIONING SYSTEM	5	
26.	PE-V0-426-553-A033	TDS OF PIPES FOR AIR CONDITIONING SYSTEM	5	
27.	PE-V0-426-553-A034	TDS AND GA OF EXPANSION TANK, MAKEUP WATER TANK AND SOFT WATER TANK FOR AIR CONDITIONING SYSTEM	5	
28.	PE-V0-426-553-A035	TDS AND GA OF FILTERS FOR AIR CONDITIONING SYSTEM	10	
29.	PE-V0-426-553-A036	TDS FOR INSTRUMENTS (GAUGES-TEM, PR, LVL, PRES: SWITCH-TEMP,LVL, DP: SENSORS-TEMP, HUM ETC) FOR AIR CONDITIONING SYSTEM	12	
30.	PE-V0-426-553-A037	PID FOR MAIN PLANT, SERVICE BUILDING ESP ETC FOR AIR CONDITIONING SYSTEM	8	
31.	PE-V0-426-553-A038	TYPICAL Details DUCT FABRICATION DRAWING / SUPPORT / ERECTION. INSULATION OF DUCTING / PIPING & EQUIPMENTS CHILLED AND CONDENSER WATER PIPE ERECTION	7	
32.	PE-V0-426-553-A039	AC DUCT & AHU RMLAYOUT WITH FOUNDATION DETAIL FOR UPS BATTERY CHARGER RM AT 8.5M & SWAS RM AT 0 M	17	
33.	PE-V0-426-553-A040	AC DUCT LAYOUT DRAWING FOR CONTROL RM ARES AT 17M ALONG WITH AHU RM LAYOUT WITH FOUNDATION DETAILS	16	

	1x660MW PANKI STPP AIR CONDITIONING SYSTEM MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-426-553-A001	
		SECTION : I	
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		REV 00	
		SHEET 4 OF 6	

S. NO.	DRAWING NO	DRG. / DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
34.	PE-V0-426-553-A041	AC DUCT LAYOUT DRAWING FOR ESP WITH AHU/PU RM LAYOUT WITH FOUNDATION DETAILS FOR INDR & OUTDR UNITS	18
35.	PE-V0-426-553-A042	AC DUCT LAYOUT DRAWING FOR SERVICE BUILDING WITH AHU ROOM LAYOUT AND FOUNDATION DETAILS	18
36.	PE-V0-426-553-A043	AC DUCT LAYOUT DRAWING FOR ADMINISTRATION BUILDING WITH PU ROOM LAYOUT AND FOUNDATION DETAILS	18
37.	PE-V0-426-553-A044	AC DUCT LAYOUT DRAWING FOR OTHER AUXILIARY BUILDING WITH PU ROOM LAYOUT AND FOUNDATION DETAILS	20
38.	PE-V0-426-553-A045	CHD & COND WATER PIPING LAYOUT WITHIN PLANT ROOM & UPTO VARIOUS AHU ROOMS, & COOLING TOWER AREA FOR POWER HOUSE	20
39.	PE-V0-426-553-A046	AC PLANT ROOM LAYOUT & COOLING TOWER AREA LAYOUT WITH COMPLETE FOUNDATION DETAIL OF ALL EQUIPMENT FOR POWER HOUSE	15
40.	PE-V0-426-553-A052	SPLIT AC SCHEDULE ALONGWITH HEAT LOAD CALCULATION FOR AUXILIARY BUILDING	22
41.	PE-V0-426-553-A054	I/O LIST FOR AC SYSTEM	20
42.	PE-V0-426-553-A055	ELECTRICAL FEEDER LIST FOR AIR CONDITIONING SYSTEM	18
43.	PE-V0-426-553-A056	CABLE SCHEDULE FOR AIR CONDITIONING SYSTEM	22
44.	PE-V0-426-553-A057	PG/ DEMONSTRATION TEST PROCEDURE FOR AIR CONDITIONING SYSTEM	12
45.	PE-V0-426-553-A058	O&M MANUAL FOR AIR CONDITIONING SYSTEM	25
46.	PE-V1-426-XXX-A100	Manufacturing Quality Plan with Sub vendor list for Electric hoist.	14
47.	PE-V1-426-XXX-A101	Mechanism Sizing Calculation with Schematic Circuit Diagram and GA Drawing for Electric Hoist, DSL arrangement and painting details	15
48.	PE-V1-426-XXX-A200	Manufacturing Quality Plan for Manual Hoist (chain pulley block)	14
49.	PE-V1-426-XXX-A201	GA Drawing for CPB with detail BOM with painting details	16

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.

	1x660MW PANKI STPP AIR CONDITIONING SYSTEM MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-426-553-A001	
		SECTION : I	
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		REV 00	
		SHEET 5 OF 6	

2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.

3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.

4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.: -

a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3etc.

f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

j) Bidder to follow the following the drawing submission schedule:

k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 7 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion

	1x660MW PANKI STPP AIR CONDITIONING SYSTEM MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-426-553-A001	
		SECTION : I	
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		SHEET 6 OF 6	
required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.			



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : E

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SECTION-I

SUB-SECTION-E

ANNEXURE-VII

**FORMAT FOR OPERATION AND MAINTENANCE
MANUAL**



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : E

REV 00

SHEET 2 OF 4

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	COVER PAGE				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	INDEX				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	DESCRIPTION OF PLANT/SYSTEM				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 &				



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : E

REV 00

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Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
	bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				

	1x660MW PANKI STPP AIR CONDITIONING SYSTEM FORMAT FOR OPERATION AND MAINTENANCE MANUAL	SPECIFICATION No: PE-TS-426-553-A001			
		SECTION : I			
		SUB-SECTION : E			
		REV 00			
		SHEET 4 OF 4			

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
6.0	MAINTENANCE GUIDELINES FOR PLANT PERSONAL				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

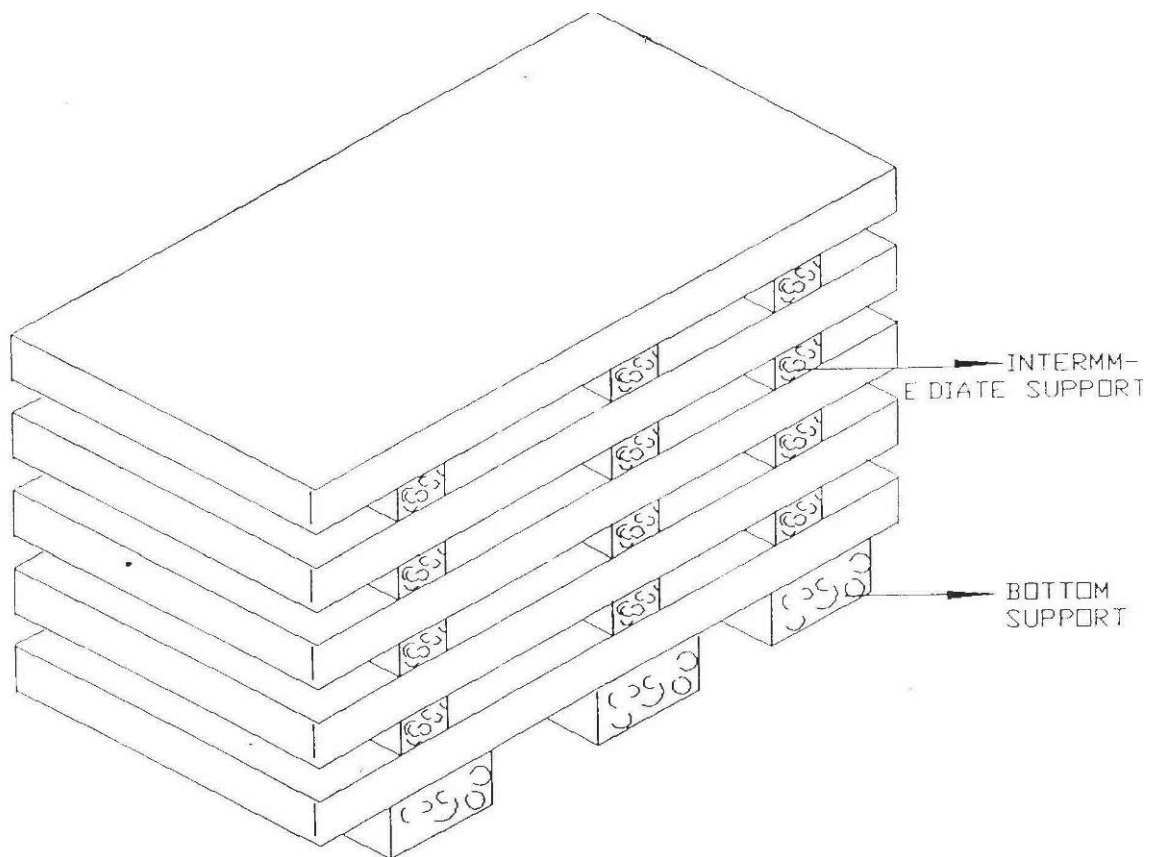


Figure – 1 – PLATE STACKING ARRANGEMENT

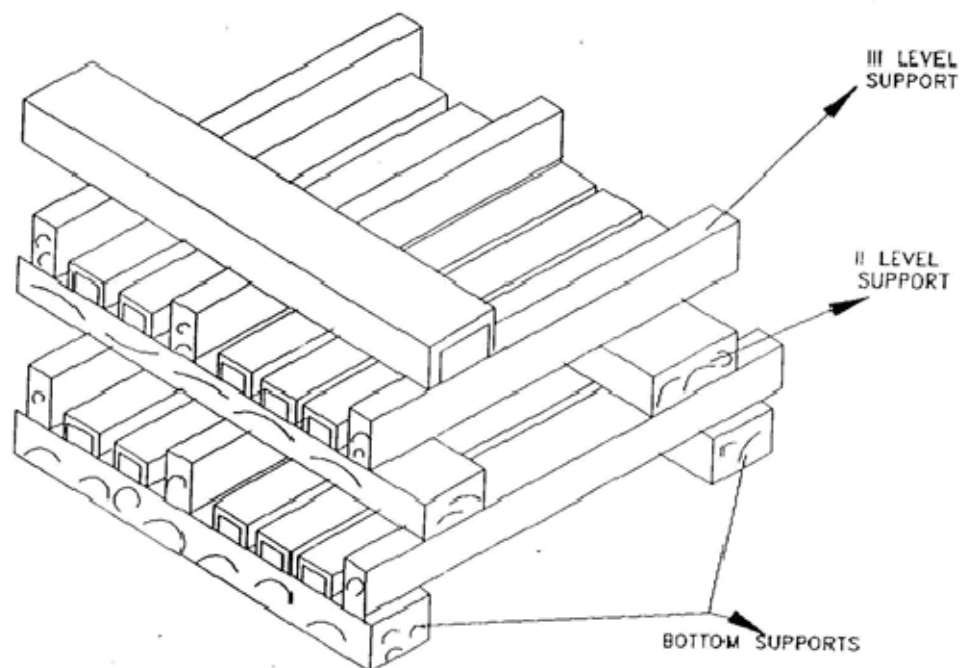


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : E

REV 00

SHEET 1 OF 1

SECTION-I

SUB-SECTION-E

ANNEXURE-IX

PACKING PROCEDURE

(REFER SUB-SECTION C2-B)



**1x660MW PANKI STPP STAGE I
AIR CONDITIONING SYSTEM**

SPECIFICATION No: PE-TS-426-553-A001

SECTION: II

REV. 00

SECTION II



**1x660MW PANKI STPP STAGE I
AIR CONDITIONING SYSTEM
INSPECTION AND TESTING**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : II

SUB-SECTION : 1

REV 00

SHEET 1 OF 4

SECTION-II

SUB-SECTION-1

INSPECTION AND TESTING

	1x660MW PANKI STPP STAGE I AIR CONDITIONING SYSTEM INSPECTION AND TESTING	SPECIFICATION No: PE-TS-426-553-A001	
		SECTION : II	
		SUB-SECTION : 1	
		REV 00	
		SHEET 2 OF 4	
1.01.00	Inspection and Tests during Manufacture.		
1.01.01	The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.		
1.01.02	The Owner’s general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.		
1.01.03	Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.		
1.01.04	Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.		
	The owner’s representative shall have at all reasonable times access to bidder’s or his sub-vendor’s premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.		
	The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.		
	For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.		
1.01.05	Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.		
1.01.06	All the individual and assembled rotating parts shall be statically and dynamically balanced in the works. Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to dispatch from place of manufacture.		
1.01.07	All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the		

	1x660MW PANKI STPP STAGE I AIR CONDITIONING SYSTEM INSPECTION AND TESTING	SPECIFICATION No: PE-TS-426-553-A001	
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Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory Regulations shall be certified by a Competent Authority under the regulations in the specified format.			
1.01.08	All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.		
1.01.09	All necessary non-destructive examinations shall be performed to meet the applicable code requirements.		
1.01.10	All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major but welding joints shall be radiographed unless otherwise stipulated.		
Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.			
1.02.00	Performance Tests at Site		
1.02.01	The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.		
1.02.02	The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.		
1.02.03	The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.		
1.03.00	For details of specific tests required on individual equipment refer to respective section of this specification.		



	1x660MW PANKI STPP STAGE I AIR CONDITIONING SYSTEM LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	SPECIFICATION No: PE-TS-426-553-A001	
		SECTION : II	
		SUB-SECTION : 2	
		REV: 00	
		SHEET 1 OF 1	

BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:

1. Compliance cum confirmation certificate
2. Guaranteed power consumption
3. Un priced format for main package
4. Un priced format for mandatory spare
5. Deviation schedule /No deviation certificate in attached format 'Deviation sheet (Cost of withdrawal)'.
6. Pre bid clarification schedule



**1x660MW PANKII STPP STAGE I
AIR CONDITIONING SYSTEM
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : II

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COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site



**1x660MW PANKII STPP STAGE I
AIR CONDITIONING SYSTEM
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPECIFICATION No: PE-TS-426-553-A001

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SUB-SECTION : 3

REV. NO. 00

SHEET: 2 OF 2

commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.
- m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
PRE-BID CLARIFICATION SCHEDULE**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : II

SUB-SECTION : 4

REV. NO. 00

SHEET: 1 OF 1

PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

DEVIATION SHEET (COST OF WITHDRAWAL)



PROJECT:- 1X660 MW PANKI TPP

PACKAGE:- AC SYSTEM

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
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TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE	

NOTES:

- For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
- For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
- All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
- Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
- Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
- Bidder shall furnish price copy of above format along with price bid.
- The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
- Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
- For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
- Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
- All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
- Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
- In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
- In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

	1x660MW PANKI STPP AIR CONDITIONING SYSTEM GUARANTEE POWER CONSUMPTION			SPECIFICATION No: PE-TS-426-553-A001		
				SECTION : II		
				SUB-SECTION : 6		
				REV. NO. 00		
				SHEET: 1 OF 3		
ANNEXURE 1						
S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY			
		3A	3B	4	5	6=3Ax4x5
1	AC-Plant-1: (CENTRAL CHILLED WATER SYSTEM FOR MAIN CR AREAS,SWAS & UPS room)					
1.1	VAM package	1	0		1	
1.2	Water chilling machine -Screw chiller	0	2		1	
1.3	AHUs for Common control room areas, CER, computer room etc	1	1		1	
1.4	AHUs for UPS room	1	1		1	
1.5	FCUs for SWAS room	1	1		1	
1.6	Cooling tower fans for AC plant	2	1		1	
1.7	Condenser water pumps for AC plant	2	1		1	
1.8	Chilled water pumps for AC plant	2	1		1	
1.9	Fresh air fans for above AHU rooms	2	2		1	
1.10	Water Softening Plant	1	0		1	
1.11	Ac Plant Control Room	2	2		1	
2	AC PLANT-2 (ESP-FGD) Building-UNIT- 1)				1	
2.1	DX-condensing unit water cooled	1	1		1	
2.2	Fresh air fans for AHU	1	0		1	
2.3	AHUs for ESP-FGD Control room	1	1		1	
2.4	Condenser water pumps for AC plant	1	1		1	
2.5	Cooling tower fans for AC plant	1	1		1	
2.6	Water Softening Plant	1	0		1	
NOTES:				TOTAL (KW)		

	1x660MW PANKI STPP AIR CONDITIONING SYSTEM GUARANTEE POWER CONSUMPTION			SPECIFICATION No: PE-TS-426-553-A001		
				SECTION : II		
				SUB-SECTION : 6		
				REV. NO. 00		
				SHEET: 2 OF 3		
ANNEXURE 1						
S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY			
		3A	3B	4	5	6=3Ax4x5
1	Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as 195 KW . So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ Rs 5,84,00/- per KW of additional power over EPC.					
2	Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ Rs 5,84,000/- per KW shall be levied on vendor.					