CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

i) Use 10, 20, 30... To distinguish between main systems having same Alpha Codes. Examples:

a) Main Steam (Left) and Main Steam (Right)

b) BFP – A/B/C

c) ID Fan – A/B, FD Fan A/B, AH – A/B

ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.

iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

i) Valves and Dampers --- *Equipment Code – AA*

		N1	N2 N3
Motorised *(on/off duty)*	-	*0*	*01 to 50*
Motorised (inching duty)	-	*0*	*51 to 99*
Pneumatic (Control)	-	*1*	*01 to 50*
Motorised (thyrestor Control)	-	*1*	*51 to 99*
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99

NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99

ii) Field Instruments

Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			

Example of Numerical Key Usage:

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ……. Where system code is same.

SIGNAL EXCHANGE WITH PLANT SCADA

OPC DATA INPUT FORMAT (FORMAT FOR SOFT SIGNAL EXCHANGE BETWEEN PLC & DDCMIS)

OPC Server IP Address
OPC Server Name

Group No	Tag No	OPC Name in Server	Description	R/W	Type of Signal	Engg Unit	Range
1	1						
	2						
	3						
	4						
2	1						
	2						
	3						

Remote Registration File - File to be sent
and also to be copied in OPC PC under c:\custom\opc
one file for each OPC device to be interfaced

Enter only Numbers under Group No and Tag No in ascending order
OPC Name is reference name by which client will access data
Description is details of a tag
R/W is read or Write or both Function
Type of signal is information type
Ex Process Parameter(Analog value) etc
or Process Status (Digital Value)
Engg units if applicable
Range if applicable
Provide Technical Manual
Reqd. Contents : This document must provide an overview of the device including its intended use(a general technical,communication & electrical details)

CABLE LIST FORMAT

Cable Schedule format

UnitCableNo	FROM	TO	Purpose	CableSize	REMARKS	PATHCABLENO

LIST OF DELIVERABLES

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR MAUX PACKAGES							
2 X 60 MW VYASI HEP							
DOCUMENT NUMBER PE-GL-407-145-I100							
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION							
1	PE-V9-407-XXX-I901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I	
2	PE-V9-407-XXX-I902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I	
3	PE-V9-407-XXX-I903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I	
4	PE-V9-407-XXX-I904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I	
5	PE-V9-407-XXX-I905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I	
PLC PANEL							
1	PE-V9-407-XXX-I906	PLC CONFIGURATION DRAWING	A	A	VENDOR	C&I	
2	PE-V9-407-XXX-I907	PLC PANEL GA (INTERNAL & EXTERNAL) DRAWING	A	-	VENDOR	C&I	
3	PE-V9-407-XXX-I908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I	
4	PE-V9-407-XXX-I909	PLC INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I	
5	PE-V9-407-XXX-I910	UPS BATTERY CHARGER/ BATTERY DATASHEET & SLD	I	$$	VENDOR	C&I	
6	PE-V9-407-XXX-I911	UPS SIZING CALCULATIONS	I	-	VENDOR	C&I	
7	PE-V9-407-XXX-I912	BATTERY SIZING CALCULATIONS	I	-	VENDOR	C&I	
8	PE-V9-407-XXX-I913	CONTROL DESK LAYOUT / GA DRAWING	A	-	VENDOR	C&I	
9	PE-V9-407-XXX-I914	PLC-OWS/PRINTER FURNITURE BOM	A	-	VENDOR	C&I	
10	PE-V9-407-XXX-I915	PLC CONTROL ROOM LAYOUT DRAWING	A	-	VENDOR	C&I	
11	PE-V9-407-XXX-I916	PLC CATALOGUE	I	-	VENDOR	C&I	
12	PE-V9-407-XXX-I917	PLC QUALITY PLAN & FAT PROCEDURE	A	-	VENDOR	C&I	
13	PE-V9-407-XXX-I918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	`	VENDOR	C&I	
14	PE-V9-407-XXX-I919	PROCESS GRAPHIC MANUSCRIPTS PLC	I	-	VENDOR	C&I	
15	PE-V9-407-XXX-I920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I	
16	PE-V9-407-XXX-I921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I	
17	PE-V9-407-XXX-I923	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	-	VENDOR	C&I	
18	PE-V9-407-XXX-I924	PANEL HEAT DISSIPATION DATA	I	-	VENDOR	C&I	
19	PE-V9-407-XXX-I925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I	
20	PE-V9-407-XXX-I926	PLC O & M MANUAL	I	-	VENDOR	C&I	
21	PE-V9-407-XXX-I927	PLC EARTHING SCHEME	I	-	VENDOR	C&I	
	Notes:	407 - Project No					
		XXX -SI No of MAX Package					
		$$ -Approval by BHEL if Vendor BBU Item Approval by Customer if Customer BBU Item					

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS

SECTION-I
SUB SECTION -E

LIST OF MAKES OF SUB-VENDOR ITEMS

PROJECT ; 2X 60MW VYASI HEP

LIST OF MAKES OF SUB-VENDOR ITEMS

AIR CONDITIONING SYSTEM

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	VAPOUR ABSORBTION MACHINE	VOLTAS / THERMAX
3	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMADENTA
4	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
5	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
6	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRYAIRE(FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
7	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
8	CHILLED & CONDENSER WATER PUMP	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
9	COOLING TOWER	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
10	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP
11	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
13	INSULTATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA /AEROCELL
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
18	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY /JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC

PROJECT ; 2X 60MW VYASI HEP

LIST OF MAKES OF SUB-VENDOR ITEMS

AIR CONDITIONING SYSTEM

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 / 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		
	Above sub-vendor are also subjected to Customer approval during detailed engineering.	

LIST OF MAKES OF SUB-VENDOR ITEMS

SL No	ITEM	VENDOR
1	AIR WASHER & UAF*	HYDERABAD POLUTION CONTROL
		SK SYSTEM
		ADVANCE VENTILATION
		DRAFT AIR
		BLUE STAR
		VOLTAS
		STERLING WILSON
		ROOTS COOLING SYSTEM
		C DOCTOR
		TAP
		Pack Plast
		Industrial projects and products
2	CENTRIFUGAL FAN	FLAKT
		KRUGER
		DRAFT AIR
		HYDERABAD POLUTION CONTROL
		ADVANCE VENTILATION
		PATEL AIR
		NICOTRA
		SK SYSTEM
		MARATHON
		CB DOCTOR
		SARLA
		Comefri
3	FRESH AIR/ SUPPLY/ EXHAUST/ RE UNIT FANS / PROPELLAR	HYDERABAD POLUTION CONTROL
		SK SYSTEM
		ADVANCE VENTILATION
		KRUGER
		NICOTRA
		MARATHON
		FLAKT
		CB DOCTOR
		SARLA (SITAL)
		PATEL AIR
		KHAITAN
4	PUMPS	BEST & CROMPTON
		JYOTI
		SAM TURBO
		KBL
		KSB

		M&P
		VOLTAS
		BEACON-WEIR
		WORTHINGTON
		Flowmore
		SULZER PUMPS INDIA LTD.
		BHARAT PUMPS & COMPRESSORS LTD
		FLOWSERVE INDIA CONTROL PVT LTD
		V-FLOW PUMPS & SYSTEMS CO
		Kishore pumps
5	LV MOTORS (FLAME PROOF)	SIEMENS
		ABB
		CGL
		MARATHON
		KEC
		BHARAT BIJLEE
		BHARAT ELECTRIC
		NGEF
		JYOTI
		LHP
6	LV MOTORS (NON FLAME PROOF)	SIEMENS
		ABB
		CGL
		MARATHON
		KEC
		BHARAT BIJLEE
		BHARAT ELECTRIC
		NGEF
		JYOTI
		LHP
7	AIR FILTER	PUROLATOR
		FMI
		ANFILCO
		TENACITY
		JOHN FOWLER
		SPECTRUM
		AIR TECH
		PUROMATIC
8	INSULTATION MATERIAL	BEARDSHEL
		K-FLEX
		PARAMONT
		ARMAFLEX
		SUPREME

		LLOYDS
		UP TWIGA
		AEROCELL
9	FIRE DAMPER	TSC
		CARRYAIRE
		RAVISTAR (SYSTEM AIR)
11	BUTTERFLY VALVES	Audco
		Fouress Engg
		INTER VALVE
		BDK
		WEIR BDK
		TYCO
		CRANE PROCESS
		KEYSTONE
		Fluidline
		INSTRUMENTATION LTD
		R and D MULTIPLES (METAL CAST) PVT LTD
		SURYA VALVES AND INSTRUMENTS MFG CO
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED
		VENUS PUMPS AND ENGG. WORKS
12	NON RETURN VALVE	Leader Valves
		H SARKAR
		Fluidline
		HI-TECH
		CRESCENT VALVES
		A V VALVES
		Bankim
		SHIVADURGA
		SURYA VALVES AND INSTRUMENT MANUFACTURING
		ATAM VALVES
		GM DAULI & SONS
		KBL
		VENUS PUMPS AND ENGINEERING WORKS
13	STEEL GATE/GLOBE/NR VALVES(WATER SYSTEM)	CRESCENT VALVES
		BDK
		Audco
		Fouress Engg
		KIRLOSKAR BROTHERS LTD.
		SANT VALVES

		BOMBAY METAL & ALLOYS
		Bankim
		Leader Valves
		H SARKAR
		AV Valves
		VENUS PUMPS
14	STEEL GATE/GLOBE/NR VALVES(WATER SYSTEM)	Fluidline
		HI –TECH
		SHIVADURGA
		SURYA VALVES AND INSTRUMENT MANUFACTURING
		ATAM VALVES
		GM DAULI & SONS
		KBL
15	Pipes (MS/GI) - ERW	SURYA ROSHNI
		TISCO
		DADU PIPES
		INDUS TUBES
		WELSPUN
		TATA
		BST
		JINDAL
		SAIL
		PSL
		LALIT PROFILE
		SAMSHI PIPE INDUSTRIES
		S MUKUT PIPES
		MANN INDUSTRIES
		SURENDRA ENGINEERING
		PRATIBHA PIPES AND STRUCTURES PVT LTD
		JCO GAS PIPES
		NUKAT TANK AND VESSELS
		GOODLUCK TUBES
		ADVANCE STEEL TUBES
		BIHAR TUBES
		HITECH PIPES
		RATNAMANI
		MAHARASHTRA SEAMLESS
16	GI SHEETS FOR DUCTING	TISCO
		INDIAN IRON & STEEL CO
		RASHTRIYA ISPAT NIGAM LIMITED
		ESSAR
		ISPAT INDUSTRIES

		JSW
		LLOYDS
		Bhushan steels
		TATA
		SAIL
		JINDAL
17	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW
		TSC
		AIR MASTER
		CARRYAIRE
		RAVISTAR (SYSTEM AIR)
18	HUMID STAT	JHONSON CONTROL
		HONEYWELL AUTOMATION
		PENN
19	Y / POT STRAINER	MULTITEX
		GREAVES COTTON
		JAYPEE
		SANT VALVES
		OTOKLIN
		GRAND PRIX
		GUJARAT OTOLIFT
		DS ENGG
		SAROJINI ENTERPRISE
		BHATIA ENGINEERING
		FILTERATION ENGINEERS INDIA PVT LTD
		SUNGOV ENGINEERING
20	LOCAL CONTROL PANEL	INDUSTRIAL CONTROL & APPLIANCE
		Pyrotech Electronics Pvt. Ltd.
		Positronics Pvt. Ltd.
		CONTROL & SWITCHGEAR
		SIEMENS
		L&T
		GE POWER
		RITTAL
		HOFFMAN

LIST OF MAKES OF SUB-VENDOR ITEMS

NOTES:

1. *Designed by Hyderabad Pollution Control / SK SYSTEM/ ADVANCE VENTILATION / DRAFT AIR/BLUE STAR/ VOLTAS/ STERLING WILSON/ROOTS COOLING SYSTEM/ C DOCTOR/ TAP/ Pack Plast/ Industrial projects and products & fabricated by their approved fabricator.

2. 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.

3. 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.

ANNEXURE-II

LIST OF SPARES

LIST OF MANDATORY SPARES - HVAC SYSTEM

S. No.	Description	UNIT	Qty
A	**MECHANICAL**		
1	Air Filters of each type and size	Set	4
2	V-belts of each type and size	Set	2
3	Circulation cooling water pump-motor set	NO.	1
4	Pumps		
4.1	Facing Rings of Mechanical Seals	Set	2
4.2	Protection Sleeve	Set	2
4.3	Inserts for Filters	Set	2
4.4	Bearing, Bushings	Set	2
4.5	Pickings	Set	2
4.6	Roller Bearings & Seals for Rotating Shafts	Set	2
5	Seals, Gaskets and Packings	Set	X
6	Ball Bearings	Set	X
7	Valves (Manually & electrical driven (including drive))	Set	X
7.1	Shut-off valve & Cocks	Set	X
7.2	Globe Valve, Needle Valve & Butterfly valve	Set	X
7.3	Non-Return Valve	Set	X
7.4	Pressure Relief Valve	Set	X
7.5	Safety Valves	Set	X
7.6	Aeration & Venting Valves	Set	X
8	All bolts, screws, nuts, washers, spanner rings & cotters	5% of total population or at least 2 pieces of each, whichever is higher	
9	Paint	5% of total population or at least 1 litre of each type, whichever is higher	
B	**ELECTRICAL**		
1	Air circuit breakers of each type used	Set	1
2	MCCB each type used	Set	1
3	Current tranformer of each type used.	Nos.	10
4	Supporting insulator of each type used.	Nos.	6
5	Bushing of each type used.	Nos.	1
6	Arcing chamber assemblies for each type of circuit breaker.	Sets	2
7	Main contacts for three poles, with spring, bolts, nuts etc. for each type of circuit breaker.	Sets	10
8	Primary isolating contacts used.	Sets	10
9	Coils for tripping and closing of each type used.	Nos.	12
10	Complete motor drives, of each type.	Nos.	4
11	Complete spring closing mechanism for the breakers. (If applicable)	Nos.	13
12	Oil & Winding temperature protection relay for the auxiliary transformers of each type used.	Nos.	1
13	Overload and instantaneous trip mechanism for circuit breakers of each type used.	Nos.	3
14	Indication lamps used including assemblies	Nos. of each type	10

LIST OF MANDATORY SPARES - HVAC SYSTEM

15	Fuses of all type used	Nos. of each type	10
16	Control and instrumentation switches	Nos. of each type	3
17	Contactors of each type used	Nos.of each type	4
18	Indicating instruments	Nos. of each type	2
19	11 kV(SST) &11kV(UAT), 11kV valve house transformer terminal bushing	Nos. each	3
20	415 V, terminal bushing	Sets	1
21	Under voltage relays	Nos.	2
22	Over current and E/F relays	Nos.	2
23	Motor Starters	Set	X
C	**C&I**		
1	Thermometer, manometer, flow meter, level indicator (with and without contacts)	Sets	X
2	Transducer 4/20 mA for position, pressure, temperature, flow	Sets	X
3	Lamps, signal lamps, push button and switches	Sets	X
4	Fuses, clamps	Sets	X
5	Limit switches, auxiliary relays, pressure switches	Sets	X
6	Resistance thermometer without indicator	Sets	X
7	contacts for feeder switches	Sets	X
8	All solenoid valves	Sets	X

LIST OF MANDATORY SPARES - HVAC SYSTEM

Notes:
a) Spares listed is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification apart from specified above, same shall be deemed to have been covered in bidder’s scope of supply.
b) One set corresponds to actual quantity of components and devices as installed for the equipment at Site.
c) All Spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is “not applicable” for particular equipment, then suitable applicable alternate spare has been offered / shall be supplied by the bidder without any financial implication."
d) Any item which is quoted as “not applicable” by the bidder in the above list and is found to be “applicable” at a later date shall be supplied by the bidder without any commercial and delivery implication.
e) One set shall be defined as the total quantity for one assembly:
f) The quantity "X" which shall be furnished is a function of the number "N" of supplied "Assemblies" or "Valves and Gates" identical in type and size. N < 3 X = 1 N < 10 X = 2 N > 10 X = N/10 + 1, rounded&up to the next
g) A set is defined as the total number required for one breaker.

3. SPARE PARTS AND TOOLS

3.1 Spare Parts

All spare parts to be supplied shall be interchangeable with the corresponding parts of all the Works supplied under these Specifications and shall be of the same material and workmanship. They shall be replaceable without cutting or destruction of adjacent components. Before issue of the Taking-Over Certificate the spare parts shall be checked at the Site by the Contractor in presence of the Engineer in charge/Employer.

Acceptance of any spare part will not take place before the Contractor has submitted the complete final detailed list of all spare parts and tools.

All spare parts shall be protected against corrosion and shall be marked with identification labels in English. The identification shall be in accordance with the agreed Works Identification System.

All spare parts, tools and materials shall be delivered in marked boxes of sufficient sturdy construction to withstand long term storage.

3.1.1 General Spare Parts

At least the quantity of general spare parts specified below shall be included in the Total Tender Price and consequently in the scope of Works of the Contract.

If the same spare parts are listed twice under "General Spare Parts" as well as under "Specified Spare Parts", the quantity listed under "Specified Spare Parts" shall take priority over the quantity stipulated under "General Spare Parts".

- Spare Parts subjected to Wear and Tear.

For each installed assembly such as Servomotors, Pumps, Motors, Main Inlet Valves, Pressure Oil Units, Gates, Valves, Compressors, Cranes, Machine Tools etc. the following general Spare Parts shall be delivered.

Two (2) complete sets of:

- Facing rings of mechanical seals
- Protection sleeves
- Carbon brushes for motors (if applicable)
- Inserts of filters
- Bearing bushings
- Brake liners
- Pickings
- Roller bearing for rotating shafts and seals for rotating shafts

- Driving belts
- Wearing parts of couplings
- Frequently actuated springs
- Outdoor installed pressure hoses

Wear and tear items shall be defined as such, which require replacement several times during the service life of the assembly.

- Customary Spare Parts:

For a number of like and identical assemblies the following spare parts shall be delivered, whereas one set shall be defined as the total quantity for one assembly:

- "X" Complete Sets related to "Identical Assemblies"
- Seals, gaskets and packing
- Thermometer, manometer, flow meter, level indicator (with and without contacts)
- Transducer 4/20 mA for position, pressure, temperature, flow
- Indoor installed pressure hoses
- Lamps, signal lamps, push button and switches
- Fuses, clamps
- Limit switches, auxiliary relays, pressure switches
- Roller bearings, sleeves and bushings for movable parts including for spherical joints
- Ball bearings
- Resistance thermometer without indicator
- Motor-starters, contacts for feeder switches
- Springs
- "X" Complete Valves and Gates:

Related to "Identical Installed Standard Valves and Gates" (manually, hydraulically or electrically driven) including Drive like

- Shut-off valves and cocks
- Globe valves, needle valves or butterfly valves
- Non-return valves
- Pressure relieve valves
- Pressure reducing valves
- All solenoid valves
- Safety valves
- Aeration and venting valves

MOHD GULFISHAN
Dy. Ger... (E&M Design-I)
UJV... ...anga Bhawan
Yamu... ...adun-24...01

- Float controlled valves

The quantity "X" which shall be furnished is a function of the number "N" of supplied "Assemblies" or "Valves and Gates" identical in type and size.

N < 3 X = 1

N < 10 X = 2

N > 10 X = N/10 + 1, rounded-up to the next higher whole number

The Contractor shall provide 5%, but at least two pieces of all bolts, screws, nuts, washers, spanner rings and cotters. The quantity may be taken from the surplus handed over to the Employer after completion of the installation as described under 5.2 "Bolts, Screws, Nuts, etc." of this Section.

For all items under this Contract the Contractor shall deliver 5 % of the quantity of painting material, but at least one litre, in new sealed containers, for later repair work other than the Contractor's.

Parts with a special size or properties, as listed below are excluded as General Spare Parts:

- Bolts, screws, nuts, washer, spanner rings and cotters with a nominal diameter of more than 80 mm
- Roller bearings, bearing shells, sleeves and bushings for movable parts including for spherical joints with an inner diameter of more than 200 mm
- All valves and gates with a nominal diameter of more than 600 mm
- Main seals for gates, valves, access doors and openings with a total length of more than 2.40 m in straight length or circumference.

3.1.2 Specified Spare Parts

The required specified spare parts are listed separately in the Particular Technical Specifications. The price for each listed special spare part shall be quoted individually in the Price List; the total price shall be included in the Total Tender Price.

3.1.3 Recommended Spare Parts

If any additional spare parts are recommended by the Contractor, these shall be stated in quantity and description in the Technical Data Sheets for each item.

Orders for recommended spare parts shall be optional to purchase by the Employer for a period of five (5) years after the date of the completion of the project. However optional spare parts will not be considered in tender evaluation.

3.2 Tools and Appliances

The scope of work shall include all customary and special tools, as well as auxiliary devices including lifting devices, ropes, etc. necessary for total assembly and disassembly of all parts of the supplied Works. Furthermore, all accessories for maintenance shall be supplied and included in the Tender. The total price for tools and devices as required by this article shall be included in the Total Tender Price.

The tools, wrenches, etc. shall be unused. Customary tools for erection shall be of the forged and polished chrome-vanadium type. Use of special tools and devices for erection shall be allowed, but shall be approved by the Engineer in each case. Special tools and devices shall be provided with means for ready identification.

All lifting devices and wire ropes slings to be used at site shall be tested at works and test certificate shall be supplied to the Engineer.

Suitable hardwood or steel boards arranged for wall mounting as well as tool carts and/or toolboxes shall be included in the delivery. An itemised list and description of all provided tools, auxiliary devices, storage equipment, etc. shall be included in the Tender. Acceptance of any tool or device shall not take place before the Contractor has submitted the complete final detailed List of Tools and Appliances.

Ropes, slings etc. shall be handed over in new condition. The Employer shall be entitled to take over from the Contractor the entire erection tools, appliances, instruments at mutually agreed conditions.

MOHD. GULFISHAN
Dy. General manager (E&M Design-I)
UJVN Limited, Ganga Bhawan
Yamuna Colony, Dehradun-248001

ANNEXURE-III

LIST OF TOOLS & TACKLES

FLAT D WRENCH - 6 MM TO 32 MM **(12 Pcs)**	SET	1
BOX WRENCHES - 6 MM TO 22 MM **(14 Pcs)**	SET	1
RING SPANNER - 6 MM TO 32 MM **(12 Pcs)**	SET	1
ALLEN KEYS - 2 MM TO 10 MM	SET	1
CRESCENT SCREW SPANNER	NO.	1
SCREW DRIVER SET	NO.	1
OFFSET SCREW DRIVER	NO.	1
INSULATED PLIER	NO.	1
TORCH LIGHT FOR 2 CELL	NO.	1
HAMMER 1 LB	NO.	1
OIL CAN	NO.	1
POCKET THERMOMETER - 0 TO 50 DEG. C)	NO.	1
INSULATION TAPE ROLL	NO.	1
STEEL FOOT RULE - 12"	NO.	1
FEELER GAUGE 9 BLADES	NO.	1
PIPE WRENCH	NO.	1
FLARE NUT (1/4")	NOS.	6
FLARING TOOL	NO.	1
TUBE CUTTER	NO.	1
GAS CHARGING PIPE	NO.	1
NITOGEN CHARGING ADAPTER	NO.	1
FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 0 - 300 MM PSI	NO.	1
FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 30 - 150 MM PSI	NO.	1
PSYCHRO METER	NO.	1
LOCK WITH KEY FOR TOOL BOX	NO.	1
RATCHET 1/4"	NO.	1
MS TOOL BOX	NO.	1
MEASURING TAPE	SET	1
TECHOMETER	SET	1
MULTIMETER	NO.	1
ANIMOMETER	NO.	1

1.00.00 **INSPECTION AND TESTING**

1.01.00 Inspection and Tests during Manufacture.

1.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

1.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

1.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

1.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.

The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.

For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.

1.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

1.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.
Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.

1.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory Regulations shall be certified by a Competent Authority under the regulations in the specified format.

1.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

1.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

1.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major but welding joints shall be radiographed unless otherwise stipulated.

Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.

1.02.00 **Performance Tests at Site**

1.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

1.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

1.02.03 The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to test on completion and commissioning of the complete system/equipment.

1.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required

1.04.00 HEATING, VENTILATION AND AIR CONDITIONING SYSTEM

AT SHOP

1.04.01 Power consumption of chilled & condenser water pumps, chilling units, condensing units, air handling units, package air conditioners & cooling towers of AC system at rated duty point with respective job motors.

1.04.02 Capacity & head of all the fans of HVAC system of all the areas.

AT SITE

1.04.03 HVAC Plant capacity of each area and guaranteed room condition during summer and monsoon for all the Air conditioned area along with the power consumption of air conditioning units.

1.04.04 Parallel operation, vibration & noise level of all rotating equipment.

ANNEXURE-V

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT: **SYSTEM :**

VENDOR : **ITEM :**

SL NO	COMPONENT /OPERATION OPERATIONS	CHARACTERISTICS CHECKED	CATEGORY	TYPE /METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

Legend: **1. BHEL** **2. Vendor** **3. Sub-Vendor**

QP No	**CQS/SQP/31**	**Signature**	**Date**			
	Rev		**Name**			
Page No	**1 of 1**		**Party**	**Customer/Consultant**	**Bhel**	**Vendor**

ANNEXURE-VI

VYASI HYDRO PROJECT
HVAC SYSTEM (AIR CONDITIONING AND VENTILATION)
MASTER DRAWING LIST (MDL)
DOCUMENTS TO BE FURNISHED BY HVAC VENDOR

S. NO.	Drawing / Document No.	Drawing / Document Title	APPROVAL CATEGORY	SOURCE	Submission Schedule (WEEKS) From LOI
1	PE-V0-407-571-11000-A -A001	INSPECTION CATEGORISATION PLAN HVAC	A	VENDOR	4
2	PE-V0-407-571-11000-A -A002	QUALITY PLAN OF CENTRIFUGAL PUMPS	A	VENDOR	5
3	PE-V0-407-571-11000-A -A003	QUALITY PLAN OF AHU	A	VENDOR	6
4	PE-V0-407-571-11000-A -A005	QUALITY PLAN OF CENTRIFUGAL SUPPLY AND EXHAUST FANS	A	VENDOR	7
5	PE-V0-407-571-11000-A -A006	QUALITY PLAN OF AXIAL FANS	A	VENDOR	8
6	PE-V0-407-571-11000-A -A007	QUALITY PLAN OF MOTOR	A	VENDOR	8
7	PE-V0-407-571-11000-A -A008	QUALITY PLAN OF MCC/ SWITCHGEAR	A	VENDOR	8
8	PE-V0-407-571-11000-A -A009	QUALITY PLAN OF CABLES	A	VENDOR	8
9	PE-V0-407-571-11000-A -A101	HEAT LOAD CALCULATION FOR HVAC AREAS	A	VENDOR	4
10	PE-V0-407-571-11000-A -A102	OPERATION AND CONTROL PHILOSOPHY FOR HVAC SYSTEM	A	VENDOR	4
11	PE-V0-407-571-11000-A -A103	PRESSURE DROP CALCULATION FOR COOLING WATER PIPING	I	VENDOR	5
12	PE-V0-407-571-11000-A -A104	VENTILATION FAN SCHEDULE.	A	VENDOR	16
13	PE-V0-407-571-11000-A -A105	SPLIT AC SCHEDULE	A	VENDOR	16
14	PE-V0-407-571-11000-A -A201	DATA SHEET & GA FOR AHU WITH FOUNDATION DETAILS.	I	VENDOR	19
16	PE-V0-407-571-11000-A -A203	DATA SHEET & GA FOR PUMPS WITH FOUNDATION DETAILS.	I	VENDOR	19
17	PE-V0-407-571-11000-A -A204	DATA SHEET & GA FOR PACKAGE / SPLIT AC	I	VENDOR	19
18	PE-V0-407-571-11000-A -A206	DATA SHEET & GA FOR CENTRIFUGAL SUUPLY AND EXHAUST FANS	I	VENDOR	16
19	PE-V0-407-571-11000-A -A207	DATA SHEET & GA FOR AXIAL AND PROPELLAR FANS	I	VENDOR	16
20	PE-V0-407-571-11000-A -A208	DATA SHEET & GA FOR VALVES AND STRAINER.	I	VENDOR	16
21	PE-V0-407-571-11000-A -A209	DATA SHEET FOR INSULATION.	I	VENDOR	9
22	PE-V0-407-571-11000-A -A210	DATA SHEET & GA FIRE DAMPER.	I	VENDOR	13
23	PE-V0-407-571-11000-A -A211	DATA SHEET FOR INSTRUMENTS (PRESSURE GAUGE, TEMP GAUGE, LEVEL GAUGE, PRESSURE SWITCH, LEVEL SWITCH).	I	VENDOR	13
24	PE-V0-407-571-11000-A -A212	DATA SHEET OF PIPE.	I	VENDOR	16
25	PE-V0-407-571-11000-A -A213	DATA SHEET OF GI AND MS SHEET.	I	VENDOR	14
26	PE-V0-407-571-11000-A -A214	DATA SHEET & GA FOR FILTERS.	I	VENDOR	16
27	PE-V0-407-571-11000-A -A215	DATA SHEET & GA FOR MOTORS (Fan, pumps, RE units, Supply and Exhaust axial fans)	I	VENDOR	9
28	PE-V0-407-571-11000-A -A216	DATA SHEET & GA FOR HEATERS	I	VENDOR	9
29	PE-V0-407-571-11000-A -A217	DATA SHEET & GA FOR CYCLONE SEPERATOR	I	VENDOR	14
30	PE-V0-407-571-11000-A -A501	PID FOR HVAC SYSTEM	A	VENDOR	4
35	PE-V0-407-571-11000-A -A502	TYPICAL Details DUCT FABRICATION DRAWING / SUPPORT / ERECTION. INSULATION OF DUCTING / PIPING & EQUIPMENTS PIPE ERECTION	I	VENDOR	10
36	PE-V0-407-571-11000-A -A503	AC DUCT LAYOUT FOR CONTROL ROOM	I	VENDOR	15
37	PE-V0-407-571-11000-A -A504	VENTILATION ROOM & VENTILATION DUCT LAYOUT FOR ALL THE FLOOR FOR POWER HOUSE	I	VENDOR	10
38	PE-V0-407-571-11000-A -A505	VENT. ARRANGEMENT FOR BATTERY ROOM.	A	VENDOR	11
39	PE-V0-407-571-11000-A -A506	VENT. ARRANGEMENT FOR VARIOUS AUXILIARY BUILDING.	I	VENDOR	16
40	PE-V0-407-571-11000-A -A701	ELECTRICAL PANEL DRAWING INCULDING SLD	I	VENDOR	16
41	PE-V0-407-571-11000-A -A702	TDS OF PLC WITH CONFIGURATION DIAGRAM, BILL OF MATERIAL, GA &INTERNAL WIRING DIAGRAM, LOGIC FLOW DIAGRAM, IO WIRING DIAGRAM , PLC ROOM LAYOUT, COMPLETE IN ALL RESPECT ETC.	A	VENDOR	13
42	PE-V0-407-571-11000-A -A703	ELECTRICAL FEEDER LIST.	I	VENDOR	13
43	PE-V0-407-571-11000-A -A704	CABLE SCHEDULE	I	VENDOR	13
44	PE-V0-407-571-11000-A -A705	TDS FOR POWER AND CONTROL CABLES-TYPE TEST CERTIFICATE FOR CALES, TYPE TEST PROCEDUE, CROSS SECTION	I	VENDOR	16
45	PE-V0-407-571-11000-A -A706	TDS AND GA FOR ELECTRICAL PANEL- SCHEME, SLD, BILL OF MATERIAL	I	VENDOR	16
46	PE-V0-407-571-11000-A -A707	TDS FOR CABLING-CABLE TRAY, CABLE SUPPORT, TYPE TEST CERTIFICATE, JOINTING KITS, TRIFOIL CLAMPS, ABOVE GROUND EARTHING	I	VENDOR	16
47	PE-V0-407-571-11000-A -A901	PERFORMANCE TEST PROCEDURE.	I	VENDOR	16
48	PE-V0-407-571-11000-A -A902	O & M MANUAL.	I	VENDOR	16
	NOTE:				
	1. Within15days from date of input drawing by BHEL (typical for all drawings dependent on input drawings).				
	2. BHEL will give comments within 7 days from the submission of documents by Vendor.				
	3. Resubmission of document shall be submitted within 7 days from date of comments by BHEL / Customer				

ANNEXURE-VII

Check List for Operation & Maintenance Manual

Project name:

Project number:

Package Name:

Sl.no. & Sections	Description	Yes	No	Not Applicable	Remarks
1.	Cover page				
1.1	Project Name				
1.2	Customer Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX email address				
1.5	Name and sign of prepared by , checked by & approved by				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant				
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				
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	Transportation and handling 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 and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant 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.				
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.				

Dealing Engineer

Key Resource Person

Section Head

NOTE: FURTHER PLEASE ALSO REFER CLAUSE NO. 2.8 OF CUSTOMER GENERAL TECHNICAL REQUIREMENT

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

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

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1 SCOPE OF THE DOCUMENT

2 PURPOSE OF STORAGE & PRESERVATION

3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION

- a) GENERAL STORAGE REQUIREMENTS
- b) GENERAL PRESERVATION REQUIREMENTS
- c) GENERAL INSPECTION REQUIREMENTS

4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT

5. CONCLUSION

6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

    - Ingress of moisture and corrosion damages.
    - Damage to protective coating.
    - Open ends in pipes, vessels and equipment -
        - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

    - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
    - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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

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

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

iii Open storage (O)

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

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

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

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

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

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

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

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

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

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

5. CONCLUSION

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

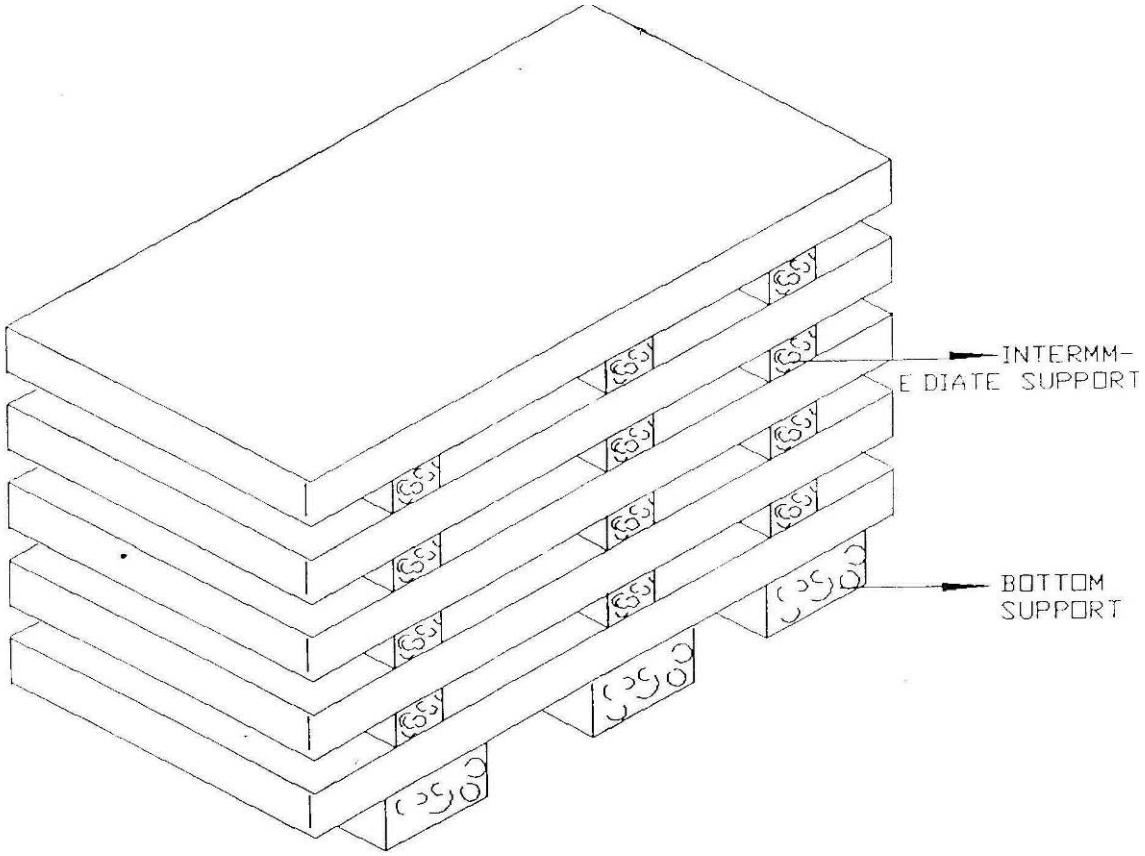


Figure – 1 – PLATE STACKING ARRANGEMENT

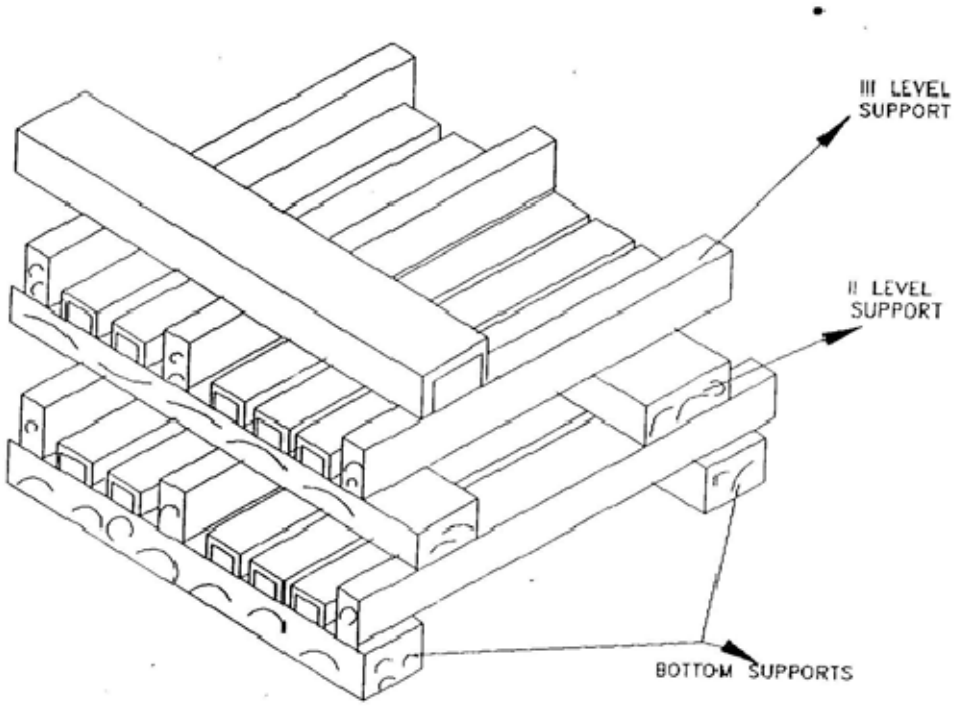


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

1.9. Documentation / record of the work/activities

The preparation and submission of the work under this contract for future reference shall be included in the scope of work.

The contractor shall document all the major activities, milestones related to installation of powerhouse from commencement of work under this contract and shall maintain the documentation/record in chronological order till the completion of the job specified under the contract. The Contractor shall prepare an elaborate documentary film/movie titled "Embedment to Evacuation" of the 120 MW Vyasi HE Project Power House highlighting the panorama of all the major activities in chronological order.

The Contractor shall submit ten copies of above documentation/records and documentary film/movie to the Employer after completion of work under this Contract. The Contract shall be deemed as completed only after the Contractor submits the same.

1.10. Technical documentation

All the technical documents and drawings required to be furnished under this contract as per clause 2 of Section-VIII "General Technical Specifications" shall be prepared in internationally accepted software of latest version used for preparation of documents and drawings. Layout shall be prepared in 3-D form and the Contractor shall furnish software with minimum 10 (ten) user license to Employer's design office to study/review/approve the drawings during detailed engineering stage. The contractor shall also furnish software proposed to be used for documentation and scheduling with minimum 10 (ten) user license to design office. The software shall be compatible with the Windows NT/2000 and MS Office programs.

The Contractor shall submit six copies of drawings along with two reproducible and one copy in electronic form media (editable) for approval / review as per clause 20.3 of General Conditions of Contract. At the time of completion of contract, the Contractor shall submit ten copies along with two reproducible and five copies in electronic form in CD media of approved and as built drawings together with operation and maintenance manual as specified in Clause 8 of Special Conditions of Contract.

All the drawings and documents shall be submitted in presentable folders properly bound and catalogued for easy retrieval / reference. Drawings shall be submitted in A0 / A2 /A3 and all documentation in A4 size.

Besides, the hard copy and electronic media (editable) specified above, all these documents and drawings shall also be incorporated in "Powerhouse Intranet" as specified in Chapter "Control and Monitoring system".

SECTION-D

STANDARD TECHNICAL SPECIFICATIONS

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

8.	Damper at discharge	: Manually operated at discharge of each AHU outlet.
	a) Material of construction	: Mild Steel, galvanised.
9.	Filters (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.

SECTION-D

AIR HANDLING UNITS

1. GENERAL

1.1 This specification covers the design, manufacture, Construction features, installation, commissioning, inspection and performance testing at site of AHUs.

2. CODES AND STANDARDS

2.1 The design manufacture and performance of AHU shall comply with all currently applicable statutes, regulations and safety codes in the locality where the AHU is to be installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this spec. shall be construed to relieve vendor of this responsibility. In particular the equipment shall conform to the latest editions of the following standards:

2.1.1 IS-659 : Safety code for air conditioning

2.1.2 IS-660 : Safety code for mechanical refrigeration

2.1.3 ASHRAE : Method of testing forced circulation air-cooling and air heating coils. standard 33

2.1.4 ARI 41 : Standard for forced circulation air cooling and air heating coils.

2.1.5 ARI 430/435 : Air-cooling and air heating coils Central Station AHU / Application of Central Station AHU.

2.1.6 AMCA : 211 and 311

In case of any conflict in the standards and this specification the decision of PEM,BHEL shall be final and binding.

3. CONSTRUCTION FEATURES

3.1 The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m^3 density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof.

Necessary arrangement shall be provided on the casing for measuring temperature and pressure in cooling/heating coil. Class of instruments shall be min. 2.

3.2 Fan impeller shall be forwardly/backwardly inclined curved blade centrifugal type. Impeller shall be double width double inlet type. Fans shall be preferably low rpm (<=1500) to minimize vibration and noise. Noise shall be within 85 dB(A) at 1 metre distance from AHU casing. Max. Vibration level shall be acceptance and norms to be specified. Two to three wheels (impellers) shall be provided for each AHU. Impeller blades shall be fabricated from (min. 1.0 mm) galvanized/ epoxy powder coated sheet steel. Fan shall be of epoxy powder coated / galvanized sheet steel (min. 1.6 mm) scroll with die formed inlets for uniform air flow. Fan shafts shall be solid cold rolled carbon steel (EN8 normalised), ground and polished. Fan shaft bearings shall be of heavy duty type selected for average operating life of 100,00 hours. Bearings shall be self-aligning, permanently lubricated type. Make of Brgs(SKF/FAG/NORMA/TATA) to be specified. Bearing Housing shall be of casting of min. IS Gr. 210, split type and

suitably supported. The V-belt drive with belt guard shall be provided. Motors shall have minimum 15% margin over maximum BHP in working range.

3.3 Cooling water cooling coils and steam/hot water coils shall be internally corrugated copper/ cupronickel tubes (as per manufacturer's standard) with smooth non corrugated external fins of aluminium (thickness 0.14 mm and grade 1100 as per spec) unless specified otherwise in specification. At least 5 fins /per cm. shall be provided. The cooling water coils shall have suitable (standardize class, size, threading) drain and vent connections.

3.4 The filters in the filter section shall be provided as detailed in data sheet A.

3.5 Humidifier shall be Pan type/as specified in the specification.

Pan type Humidifier consisting of SS304/316 tank, heater, geyserstat with piping connection to supply air duct shall be provided unless specified otherwise in data sheet A.

Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.

3.6 Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room.Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized

3.7 Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU.

The AHU shall be provided with 18 G SS drain pan.

4. TESTING AND INSPECTION AT MANUFACTURERS WORKS:

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection.

4.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.

4.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating. For pipes and fittings compliance report shall be furnished by Manufacturer for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

4.3 Shaft: Mechanical and chemical.

4.4 Motors (of approved make): Routine TC.

4.5 Workmanship and dimensional check as per manufacturing drg. and approved Drgs.

4.6 Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked to avoid loosening. Balancing weights and fasteners used shall be galvanized.

4.7 Performance test of one Centrifugal fan/per type/per size as per AMCA standard (for indigenous make).

4.8 Centrifugal fans for AHUs will be 100% run tested by main contractor of BHEL. One centrifugal fan/per type/per size will be run tested. Vibration shall be within good zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

4.9 Complete assembly of one AHU/per type/ per size (excluding cooling coil and filter) shall be witnessed.

4.10 Run test of one complete assembly/per type/per size (excluding cooling coil and filter). Vibration shall be within satisfactory zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

5. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

5.1 GA drawing of AHU & data- sheet to be submitted along with technical schedules enclosed in Volume III.

5.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.

5.3 Inspection, operation & Maintenance Manuals.

5.4 Equipment description giving complete design calculations, basis of design, selection criteria etc.

5.5 Test Certificates.

5.6 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

5.7 Performance Test Certificates.

DESCRIPTION		DATA
1.	Designation	: Cooling Water pumps for Ventilation plant.
2.	Type	: Horizontal, Centrifugal pump or vertical split type casing pump .
3.	Quantity	: Refer to section-C of Specific Technical Requirements
4.	Installation	: On floating type foundation.
5.	Fluid to be handled	: Water
6.	Temperature of fluid	: To suit.
7.	Capacity M3/hr and TDH at rated	: To suit system requirements but head shall not be less than 25 MWC.
8.	Duty	: Continuous (24 hours / day)
9.	Suction condition	: Flooded
10.	Type of drive	: Direct
11.	Prime Mover	: LV AC motor
12.	Maximum speed	: 1500 RPM
13.	Type of lubrication	: Grease Lubrication
14.	Material	
	a) Impeller	: 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	: Deep Bronze packing to be renewable with case.
	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 Cooling Water pumps shall be suitably insulated as per spec.

j) Inspection & Testing : As per specification enclosed elsewhere.

SECTION-D

CENTRIFUGAL PUMPS

1. GENERAL

1.1 This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer's or his subcontractor's works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter.

2. CODES AND STANDARDS

2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable):

2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water.

2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump.

2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water.

2.1.4 BS - 599 : Method of testing Pumps.

2.1.5 PTC - '6' : Centrifugal Pumps Power test code

2.1.6 API - 610

2.1.7 Hydraulic Institute Standards of USA

Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards.

2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser's engineering shall be final and binding.

3. DESIGN REQUIREMENTS

3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability.

3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards..

3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.

3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A.

4. CONSTRUCTION FEATURES:

4.1 **PUMP CASING**

4.1.1 Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand 1.5 times the maximum pressure developed by the pump at the pumping temperature.

4.1.2 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves or plugged with threaded plugs as required.

4.1.3 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.

4.1.4 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610

4.2 **IMPELLER**

4.2.1 Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be checked for eccentricity and statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity. Supplier shall ensure during balancing that wall thickness of impeller vane, shroud etc is maintained above the minimum thickness requirement as per design.

4.3 **WEARING RING**

4.3.1 Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

4.4 **SHAFT**

4.4.1 Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runway speed.

4.5 **BEARING**

4.5.1 Bearings and hydraulic devices**,** of approved make, (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.

4.6 **STUFFING BOX**

4.6.1 Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer. Tubings used for connections shall be flexible metallic type preferably SS-304/316. PVC/ rubber tubings are not acceptable.

4.7 **SHAFT COUPLING**

4.7.1 The pumps shall be directly coupled to their drives through heavy-duty flexible coupling. Suitable sturdy coupling guards of min. 1.5 mm MS sheet/ Aluminium sheet shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

4.8 **BASE PLATE AND SOLE PLATE**

4.8.1 Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided. The external corners of the base plate shall be rounded to avoid sharp corners. Drilled holes shall have sufficient space around for proper seating of washer with nut. If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 **PRIME MOVER**

4.9.1 The drive motor selected shall conform to the requirements of the enclosed motor specifications.

4.10 **LIFTING ARRANGEMENT**

4.10.1 Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance..

5. PERFORMANCE REQUIREMENTS

5.1 The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.

5.2 Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.

5.3 Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.

5.4 The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.

6. DRIVE RATING

6.1 The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.

6.2 In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.

6.3 The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

7. SCOPE OF INSPECTION AND TESTING

7.1 CASTING

7.1.1 The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.

7.1.2 Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.

7.1.3 Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.

7.1.4 Verification of Heat treatment charts (as applicable)

7.1.5 Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.1.6 Surface finish of Steel castings shall meet MSS SP-55.

7.2 **FORGING**

7.2.1 Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.

7.2.2 Verification of heat treatment charts (time temperature) (as applicable).

7.2.3 Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.3 **FABRICATED ITEMS**

7.3.1 Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.

7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel as per ASME Sec IX.

7.3.3 Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8

7.3.4 Verification of heat treatment charts (time temperature), (as applicable)

7.3.5 **Note:** For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.

7.4 **IN PROCESS INSPECTION AND TESTING**

7.4.1 Identification Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. Permissible defects and acceptance norms need to be specified. On static parts acceptance norms are as per ASME Sec.III NB 2546.

7.4.2 Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness) as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency.

7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable

a) Cracks, flakes, seams and laps

b) Defects giving indications longer than that from a 4mm equivalent flaw.

c) Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%.

d) Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.

7.4.4 For static duty components - as per NB 2542.2 of ASME Sec. III

7.4.5 Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage.

Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures

7.4.6 Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.

7.5 **PERFORMANCE TEST**

7.5.1 Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked.

a) Capacity V/s Head

b) Capacity V/s Power absorbed by pump

c) Capacity V/s pump efficiency

Note : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity.

7.5.2 NPSH test in case specifically mentioned elsewhere.

7.5.3 Vibration, noise level and temperature rise measurement. Noise level shall be within 85dB(A) at 1 metre distance. Vibration within satisfactory zone of VDI 2056 Group G machines. Temperature shall not exceed ambient + 40 deg. C.

7.5.4 Overall dimensions as per GA drawings. One pump/type/size assembly with job motor shall be mounted on base plate, provided the components are ordered on the same manufacturer.

7.5.5 Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.

7.5.6 Painting and packing as per technical specification.

7.6 **TEST AT SITE**

7.6.1 The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.

7.7 **PERFORMANCE GUARANTEE**

7.7.1 The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification. The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head

8. CLEANING, PROTECTION , PAINTING & PACKING

8.1 Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere. Flanges, inlet and outlet pipe, etc shall be protected. Packing shall be done as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere.

9. DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

9.1 Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include:

a) Foundation base plate and sole plate details as applicable

b) Civil foundation and anchor bolts details and loading data

c) Minimum submergence required for the pump (if applicable)

9.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction and/ make with standard applicable codes.

9.3 Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.

9.4 Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.

9.5 Experience list about the supply and successful operation of similar pumps for similar application.

9.6 A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.

9.7 Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.

9.8 Data sheet-B with all the particulars filled in.

10. MANUFACTURERS NAME AND TAG. PLATES

10.1 Each pump shall have a permanently attached brass/ Stainless steel tag on the body indicating the following information both in Hindi and English:

a) Manufacturer's name and trade mark.

b) Design Capacity and Head.

c) Design.

d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

11. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

11.1 Certified GA drawings of pump motor assembly weights, crane.

11.2 Detailed cross sectional drawings of the pump and motor assembly and all equipment & accessories supplied under the this specification along with details of material of construction with applicable standard codes.

11.3 Foundation drawings with details of foundation pocket indicating static as well as dynamic load and other data with dimensions.

11.4 Certified characteristics curves (discharge capacity vs. head, BHP and efficiency) of each type of pump and motor.

11.5 Material and other test certificates as required by the application clauses of this specification.

11.6 Motor speed torque curves super imposed on pump speed torque curves.

11.7 Quality plan along with complete details of testing and inspection requirements of centrifugal pumps in BHEL format. Vendor shall also furnish Field Quality Plan.

11.8 Installation , operation and maintenance manual.

11.9 Other drawings and data, if necessary.

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 PAC 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:

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

SECTION-D

LOW PRESSURE AIR DISTRIBUTION SYSTEM

1. GENERAL

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

2. CODES AND STANDARDS

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

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

a) IS: 655 - Specifications for metal air ducts.

b) IS:277 - Specifications for galvanised steel sheets.

c) IS:737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

3. MATERIAL

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

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

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

4. CONSTRUCTION/FABRICATION

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

4.2 **RECTANGULAR DUCTS**

4.2.1

S.No.	Max Side	Sheet Thickness		Type of transverse Joint connections	Bracings
		(mm) GI	(mm) Al		
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None

b)	601 to 750	0.63 (24G)	0.80	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles,connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

4.2.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.

4.2.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.

4.2.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:

a) Upto 1000mm - 6 mm dia GI bolts
b) 1001 to 1500 - 8 mm dia GI bolts
c) 1501 and above - 10mm dia GI bolts

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

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

4.3 **ROUND DUCTS**

4.3.1

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

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

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

4.4 **DUCT SUPPORTS**

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

However, If ducts are thermally insulated, the MS angles and supports shall not be in direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.

4.5 **FLEXIBLE CONNECTIONS**

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band 9r (or) collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

4.6 **TRANSFORMATIONS AND BREACHES**

All curves, bends, offsets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.

4.7 **CAULKING**

Wherever duct passes through wall, the opening between masonary and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.

4.8 **EASEMENT**

Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.

4.9 **ACCESS DOORS**

Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc.

All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.

4.10 **DAMPERS AND SPLITTERS**

4.10.1 Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.

4.10.2 FIRE DAMPERS

Fire dampers shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal sensor or fusible link type.

4.10.3 VANES

Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.

4.10.4 FLASHING

For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.

4.11 **DIFFUSERS AND GRILLS**

The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser.

Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be

single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.

4.12 **PLENUMS AND RA BOXING**

All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at appox. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonary construction to which angles are fastened.

Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box ~~shall be~~ fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.

4.13 **ACCOUSTIC LINING**

The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.

4.14 **PAINTING**

Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.

4.15 **THERMAL INSULATION**

Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.

5. INSPECTION AND TESTING

5.1 **INSPECTION & TESTING DURING FABRICATION**

5.1.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.

5.1.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

5.1.3 Check for dimensions & mass as per latest IS-277.

5.1.4 Check for defect, twists, ungalvanised spots as per IS-2629.

5.1.5 Bend test & wrapping test as per IS-277.

5.1.6 Zinc coating test on samples as per IS-6745.

5.2 **INSPECTION & TESTING AT SITE.**

5.2.1 The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.

5.2.2 After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.

6. BALANCING

6.1.1 The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit

6.1.2 All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.

7. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT

7.1 Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.

7.2 Test certificates in line with scope of inspection.

7.3 Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual**.**

	TITLE	SPECIFICATION NO. PE-TS-407-571-11000-A006
BHEL	**AIR FILTER**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 | MAY 2019
		SHEET 1 OF 1

DESCRIPTION		**DATA**
1)	**General**	
1.1	Service	: Air Conditioning.
1.2	Location	: Ventilation 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 pressue drop	: 2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters(prefilters). 12 mm in clean condition for fine filters.
1.11	Frame Work	: 18 G, GSS.
1.12	Mounting	: Ladder Type M.S Angles (galvanised)
1.13	Size	: 600 x 600 mm

Note:-

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

SECTION-D

AIR FILTER

1. GENERAL

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

2. CODES AND STANDARDS

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

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

3. GENERAL

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

3.1 POLY FIBRE AIR FILTERS

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

3.2 DRY FABRIC AIR FILTERS

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

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

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

All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance Am (%) shall be >/= 90. However oil wetted air filters shall have Average Efficiency Em (%) >/= 90 as per BS EN - 779..

3.4 AUTOMATIC CLEANING FILTERS

This shall consist of a filter mat and drop eliminator, driven by a suitably rated geared

motor unit being supported on a steel framework. The filter mat shall consist of an endless steel wire mat insets of steel mesh held between an upper & a lower shall drop eliminator shall consist of an endles steel wire without insets of steel mesh. The unit shall include a suitable oil pump, gladge raking mechanism and sludge container and tensioning device. Pressure drop shall be limited to 0.5 / mm WG when clean & 10 mm when dirty. Air velocity across filter shall not exceed 3 M/sec.

3.5 ABSOLUTE FILTERS

Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctyphalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame.

3.6 WATER REPELLANT NYLON FILTERS

This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only.

4. INSPECTION & TESTING

The scope of inspection for air filters shall be as below:

4.1 Dimensional inspection of frame & filter media.

4.2 Witnessing of type tests on one per type per size air filters for the following properties.

a) Gravimetric efficiency.

b) Pressure drop in clean & dirty (choked - %age to be specified) condition.

c) Efficiency as per BS EN - 779.

4.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet).

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

5.1 GA Drawing.

5.2 Drawing showing material/construction detail

5.3 Installation and\service manual

5.4 Rating curves/charts

5.5 Test certificates

5.6 Elect. diagrams (when automatic cleaning type)

TITLE	SPECIFICATION NO. PE-TS-407-571-11000-A009
CENTRIFUGAL FAN	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 00 | MAY 2019
	SHEET 1 OF 2

No.	Particulars	Data
1	**General Information**	
1.1	Fan Designation/application.	Refer schedule of Ventilation system.
1.2	Nos. required/capacity	Refer Section-C of Specific Technical Requirement
1.3	Location	Refer layout drg. Attached.
2.0	**Design Data**	
2.1	Type	DIDW for Ventilation
2.2	Type of blades	backward curved
2.3	Arrangement	To suit application as per layout.
2.4	Discharge direction	To suit application as per layout.
2.5	Duty	Continuous
2.6	Capacity at site (Cubic Meter/hr) & static pressure.	Refer Section-C of Specific Technical Requirement
2.7	Suction pressure (mm Wg)	As per system requirement.
2.8	Fluid	Atmospheric Air.
2.9	Suction Temperature	Refer weather data attached.
2.10	Suction humidity	Refer weather data attached.
3.0	**Materials**	
3.1	Fan Scroll	Heavy Gauge Mild Steet to IS: 2062 with galvanised
3.2	Fan Casing (side plates & stiffeners)	Heavy Gauge Mild Steet to IS: 2062 / IS: 1079 / Eq. Minimum 3 mm thick casing.
3.3	Impeller	Mild Steel/plate to IS: 2062
3.4	Impeller hub	Mild Steet/plate to IS: 2062
3.5	Impeller back plate blade & shroud	Mild Steet to IS: 2062 / IS: 1079 / Eq.
3.6	a) Shaft b) Shaft sleeve	EN-8 or eqv. -do-
3.7	Support frame and structure.	Mild Steet to IS: 2062
3.8	Flexible connection at outlet canvas with MS Flanges and cleats (3mm thick).	Fire resistant type plastic impregnated

3.9	V Belt	ISI marked (Reinforced rubber section to IS: 4776)
3.10	V Pulley	Cast Iron multi groove to grade FG 20 as per IS: 210. Having taper lock type
3.11	Slide rails	M.S./C.I.
3.12	Connection pieces	G.I. according to supplier's design
3.13	Bolts & nuts	M.S. Galvanized / Epoxy painted.
3.14	Vibration isolating pads, washers and spring if any.	Hard synthetic rubber
4.0	**ACCESSORIES**	
4.1	Common base plate	Required.
4.2	Anchor bolts	-do-
4.3	Vibration Isolators	Hard synthetic rubber
4.4	V-belt pulleys	-do-
4.5	V-belts	Reinforced rubber of appropriate section
4.6	Belt guard	Required.
4.7	Outlet damper	Required(M.S. Heavy Gauge)
4.8	Inlet guard	Required.
4.9	Inlet Vane (variable)	Not required.
4.10	Drain valve	Required.
4.11	Acoustic silencers	Not required.
5.0	**Motor**	
5.1	Motor by	Bidder
5.2	Starter by	BHEL
6.0	Painting of fans including base frame	Galvanized / epoxy painting (as per Section-C & painting specifications)

NOTE:

1) Motors shall have 15 % margin on duty power point.

2) Fan shall be designed to operate with in 9% and 25% of system throttling line.

3) Opposed Multiple louvers damper shall be provided at fan outlet.Louvres shall be of 2 mm thick MS (galvanized). Casing shall be of 3.15 mm thick MS (galvanized).

TITLE	SPECIFICATION NO. PE-TS-407-571-A010
VENTILATION FAN (R.E.UNIT)	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 00 | MAY 2019
	SHEET 1 OF 2

General Information

1)	Designation	Roof extractor Units for areas as per schedule of ventilation system.
2)	Nos. required	As per schedule.
3)	Service	Continuous
4)	Location	Roof of respective areas.
5)	Area	As per schedule

Design Data

6)	Type	axial flow type.
7)	Air delivery capacity	as per schedule of ventilation system.
8)	Fluid	Atmospheric Air.
9)	Temperature	50 Deg. C
10)	Static Pressure required	As per Section'C' schedule of ventilation system.
11)	Outlet air velocity	Not more than 12 m/sec.

Materials

12)	Casing/cowl/hood	M.S. Sheet to IS: 2062 /IS: 1079/Eq.
13)	Impeller	Cast A1uminium alloy to A-6M IS-617 Grade LM6
14)	Support frame and structure.	M.S. of adequate thickness (IS-2062).

ACCESSORIES

15)	Vibration isolating pads	Yes.
16)	Base frame for mounting	Yes.
17)	Wire Guard at inlet.	Yes.
18)	Disconnect switch	Yes.
19)	Gravity damper at outlet	Yes

Motor

20)	Motor by	Bidder
21)	Starter by	Bidder

22)	Type of motor	Conforming to IS: 325 latest/as per specification.
23)	Free delivery test	Yes.
24)	Performance test at specified duty point.	Yes
25)	Speed	Not more than 1500 RPM

NOTE:

1. Motors shall have 15% on duty power Point.

TITLE	SPECIFICATION NO. PE-TS-407- 571-11000-A011
Ventilation Fan (Axial Flow Type)	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 00 | MAY 2019
	SHEET 1 OF 2

No.	Particulars	Data
	General Information	
1)	Designation	Supply/Exhaust Fans.
2)	Nos. required	Refer schedule of Ventilation system in section-C under specific technical requirement.
3)	Service	To exhaust warm air/to supply fresh air.
4)	Location	Wall mounted.
5)	Area	Same as above in 2.
	Design Data	
6)	Type supply	Axial fans suitable for 415V/3 phase for Motor.
7)	Air delivery capacity	As per schedule of ventilation system.
8)	Fluid	Atmospheric Air.
9)	Temperature	Refer Section of specific technical requirement
10)	Static Pressure required	As per Section'C' schedule of ventilation system.
11)	Outlet Air Velocity	Not more than 12 m/sec.
	Materials	
12)	Casing	M.S. (IS-2062)
13)	Impeller	Cast A1uminium. (Alloy A-6M, IS-617)
14)	Hub	Al Alloy.
15)	Support frame and structure. (Galvanized/	M.S. of adequate thickness Painted) IS-2062.
16)	Neoprene rubber pads	As required.
17)	Coned inlet for wall exhausters/supply fans	MS (IS-2062)
18)	Supporting frame for mounting.	Required.
19)	Protective screen at inlet.	Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh.
20)	Rain Protection Cowl	Aluminum or hot dip Galvanized after fabrication from M.S.

Motor

21)	Motor by	Bidder
22)	Starter by	BHEL

NOTE:

1) For Battery Room, motor for fan shall be of flame proof type & fan of spark proof construction with Epoxy painting.

2) Gravity type damper shall be provided at the outlet of axial fan for exhaust application.

3) Motor shall have 15% margin over Duty Point.

SECTION-D

VENTILATION FANS

1. GENERAL

This specification covers the design, manufacture, testing of performance at manufacturer's/sub-contractors works, delivery at site, handling at site, erection and commissioning of ventilation fans.

2. CODE AND STANDARDS

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where it is to be installed. The equipment shall conform to latest edition of applicable Indian Standards or their equivalent standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall conform to the latest editions of the Following standards.

2.1.1 IS:4894 -Centrifugal fans

2.1.2 IS:3588 -Electric Axial Flow fans

2.1.3 IS:2312 -Propeller type A.C. ventilation fans

2.1.4 IS-3963 -Roof extractor units

2.1.5 BS:848 -Method of performance test for fans.

2.1.6 AMCA publication 99 standards handbook

2.1.7 AMCA standard 210, Test code for air moving devices.

3. DESIGN AND CONSTRUCTION

3.1 THE ENCLOSED DATA SHEET A GIVES THE NECESSARY DETAILS FOR CENTRIFUGAL/AXIAL/ROOF EXTRACTOR UNITS ETC.

3.2 WELDING PROCESS AND WELDERS EMPLOYED FOR FABRICATION SHALL BE QUALIFIED AS PER ASME SEC. IX

3.3 CASING

3.3.1 The centrifugal fans casing shall be of welded construction fabricated with heavy gauge material (min 3 mm) with flanges (min. 5 mm) on inlet and out let side for direct connection and shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed airtight. Horizontal Split casings shall be provided on large size fans. Casing drain (at bottom) with threaded plug/ with valve shall be provided, as required. All mounting/ connecting holes shall be drilled off centre.

3.3.2 The axial flow casing for supply fans/roof extractors shall be of heavy gauge construction (min 3 mm) properly reinforced for rigidity and shall be complete with suitable supports. Access doors with suitable locking arrangement shall be provided in the casing for easy access to the motor and impeller. External junction box/ Terminal box on casing with IP-55 protection shall be provided, if required. Wiring for motor from external junction box/ Terminal box shall be through flexible conduit.

3.3.3 Suitable motor brackets designed for rigid mounting of motors, shall be provided for roof extractors and wall mounted exhaust/ supply fans.

3.4 IMPELLER

3.4.1 Centrifugal fan impeller shall have die formed, aerofoil or laminar blades welded to the rim and back plate and shall have non-overloading, self cleaning characteristics. Rim shall be spun to have smooth contour. If required, intermediate stiffening rings

shall be provided. Shaft sleeves shall be furnished, if specified. The impeller, pulley and shaft sleeve shall be secured to the shaft by key and/or nuts (threaded opposite to direction of rotation of impeller). The impeller shall be statically and dynamically balanced.

~~3.4.2~~ The axial fan impeller shall be of high efficiency aerofoil design. The blades shall be mounted on a streamlined hub and the impeller shall be mounted directly on the motor shaft. Impeller shall be in one piece however; fabricated blades will be acceptable up to 450 mm impeller diameter.

3.4.3 Roof ventilator impeller may either be centrifugal or axial type. Backward inclined blades shall be provided for centrifugal impellers. Blades may be die-formed or cast. Axial flow impeller shall be directly mounted to motor shaft whereas centrifugal impeller may either be direct-driven or belt-driven. The shaft of belt-driven centrifugal fan shall be solid cold rolled carbon steel, ground and polished. However, direct mounted impellers are preferred.

3.5 BEARINGS:

3.5.1 The centrifugal fan bearing may be ball, roller or sleeve bearings of self-aligning heavy duty type with adequate capacity and life. Make of Bearings to be specified. Bearings shall be oil/grease lubricated and provided with fittings for lubrication from outside and shall be located in easily accessible position to facilitate maintenance.

3.6 INLET CONES AND GUARDS

3.6.1 Centrifugal fans inlet shall be spun to have a smooth contour. Inlet screen, if provided, shall be galvanised wire mesh of 25 mm square with wire thickness of min. 1.5 mm.

3.6.2 Inlet cone, outlet bell and suitably designed guards shall be provided.

3.7 GUIDE VANES:

3.7.1 In case of vane axial fans guide vanes shall be provided on discharge side.

3.8 BASE PLATE AND VIBRATION ISOLATORS

3.8.1 Base plate and vibration isolators, which may be double deflection rubber in shear or rubber in compression type or spring type shall be provided. With each fan rubber bushes, washers wherever needed for vibration isolator in sufficient nos. shall be included, as required, to ensure isolation of foundation from vibration of equipment. For roof ventilators suitable mounting arrangement shall be provided such that there is no ingress of rain water into the building.

3.9 HOOD AND COWL

3.9.1 Roof exhaustors shall be provided with hinge type hood providing easy access to motor and impeller. Weather proof lockable type disconnect switch shall be provided such that hood can open only when the disconnect switch is in'off' position. On larger size of roof ventilators hoods may be of split construction. 15 mm mesh galvanised bird screen shall be provided.

3.9.2 Rain protection cowls shall be designed to suit wall exhausters/supply fans for protecting fans from rain. The cowls shall be provided with bird screen of heavy gauge expanded metal netting.

3.10 SPEED

3.10.1 The speed of axial flow fans/roof ventilators shall not exceed 960 RPM for impeller dia exceeding 450 mm and shall not be greater than 1440 with impeller dia less than 450 mm.

4. MOTORS

Drive motors shall be of totally enclosed type, suitable for horizontal/vertical mounting as applicable and shall comply with the requirments of the specifications furnished elsewhere for motors.

5. ACCESSORIES

Accessories as specified in Data sheet-A and as required for satisfactory trouble free & safe operation of fans shall be provided.

TESTING AND INSPECTION

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection by BHEL

- Visual inspection of sheets/plates, angles, channels etc. – Pitting, lamination in sheets/ plates, angles and channels shall be avoided.- visual inspection by main contractor of BHEL.
- Sheets/ Plates - Test certificate shall be furnished for physical and chemical properties for sheets / plates- for review by BHEL
- Shaft: Mechanical and chemical–– review by BHEL
- Motors (of approved make): Routine TC ,FLP TC if applicable
- Workmanship and dimensional check as per manufacturing drg. and approved Drgs.- by main contractor of BHEL.- Shall be checked by BHEL/ Customer during final inspection.
- Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked/ welded to avoid loosening. - witness by manufacturer - TC to be furnished for review by BHEL(consisting of weight of impeller, radius of correction and balancing rpm). For spare impellers Dynamic Balancing shall be witnessed by BHEL.
- Performance test of one Centrifugal fan or Axial Fan /per type/per size as per applicable standard – by BHEL.
- Centrifugal/ Axial fans 100% run tested by main contractor of BHEL. Run test by BHEL/Customer may be at random or 100%- Vibration shall be within satisfactory zone of VDI 2056 (group- G) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient

SECTION-1

LIST OF DOCUMENTS TO BE SUBMITTED WITH BID

1. Signed and Stamped copy of No Deviation certificate (1 Sets)
2. Signed and Stamped copy of Un-Priced Schedule (1 Sets)
3. Signed and Stamped copy of Guarantee Power consumption (1 Sets)
4. Signed and Stamped copy of Compliance cum Confirmation Certificate (1 Sets)
5. Signed and stamped copy of pre-bid clarifications and/or amendments, if any (1 Sets)

	TITLE:	SPEC. NO.: PE-TS-407-571-11000-A001
	2X60 MW VYASI HEP	VOLUME: **III**
	TECHNICAL SPECIFICATION	SECTION:
	COMPLIANCE CUM CONFIRMATION CERTIFICATE	REV. NO. **00**
		SHEET **1** OF 2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

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

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

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

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

	TITLE	SPECIFICATION NO.PE-TS-407-571-11000-A001
	2x60 MW VYASI HEP	VOLUME: III
	HEATING, VENTILATION AND AIR-CONDITIONING SYSTEM	REV 00
	PRE-BID CLARIFICATION SCHEDULE	**MAY 2019**
		Page 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

SECTION-4

DEVIATION SHEET (COST OF WITHDRAWL)
SECTION-IIID

PROJECT:- 2 x 60MW VYASI HEP

PACKAGE:- HVAC 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 WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

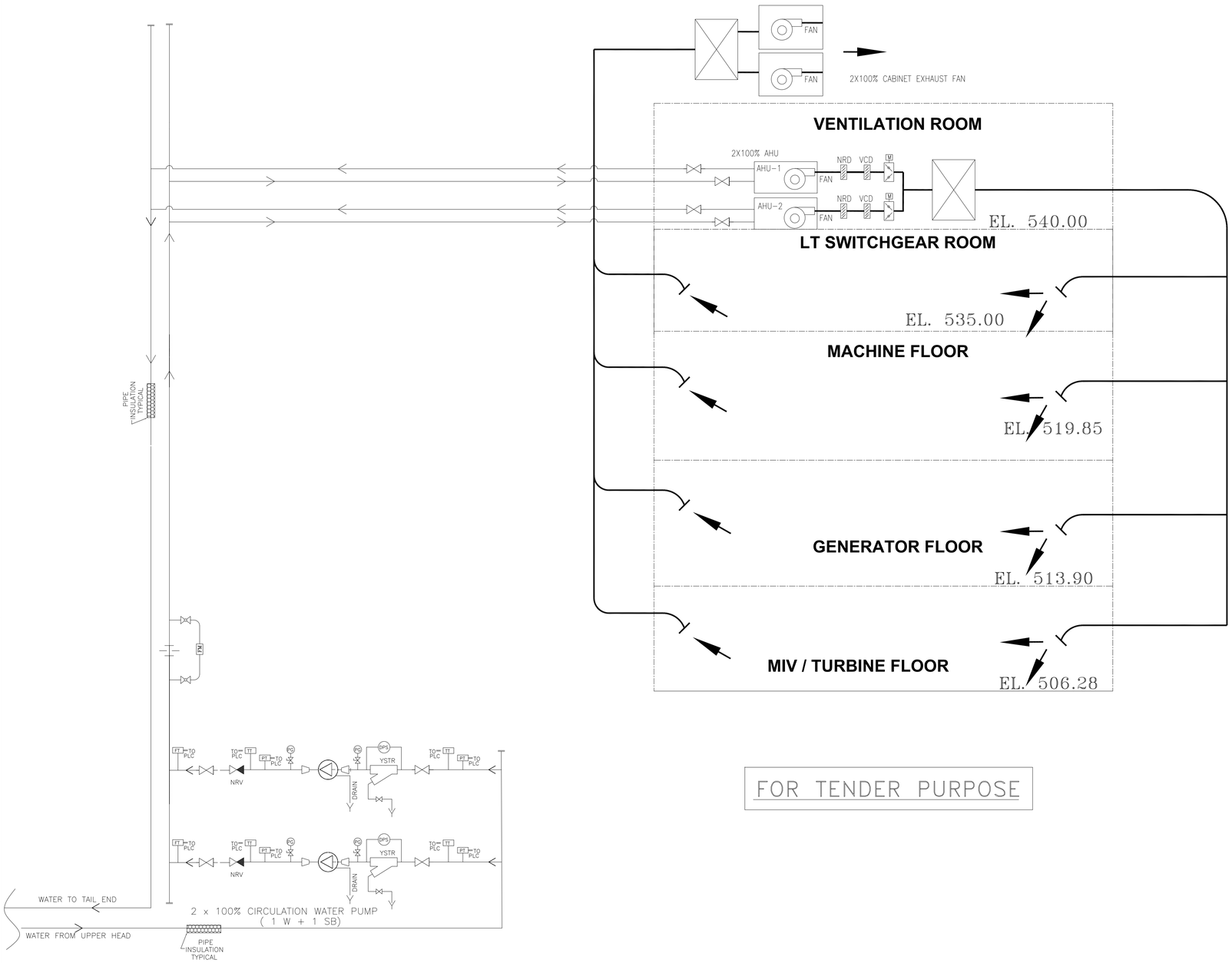
NOTES:

1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. 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 withdrawl of deviation loading as per GCC 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 withdrawl of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. 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.
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.
14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

LIST OF TENDER DRAWING

DRAWING No. PE-DG-407-571-11000-A001

CUSTOMER'S DRAWING No.



FOR TENDER PURPOSE

LEGEND :-

PS	PRESSURE SWITCH	CIRCULATION PUMP OUT
	DUCT	SUPPLY AIR DUCT
	PRE FILTER	AS SHOWN
VCD	VOLUME CONTROL DAMPER	AS SHOWN
NRD	NON RETURN DAMPER	AFTER FILTER PLENUM(EACH AHU)
	PUMP	CIRCULATION WATER PUMP
	PIPE	CIRCULATION WATER PIPE
TG	TEMP.GAUGE.	CIRCULATION WATER PUMP- IN/OUT
PG	PRESSURE GAUGE.	CIRCULATION WATER PUMP- IN/OUT
	FIRE DAMPER(M)	AS SHOWN AT WALL)
	Y- STRAINER	ALL PUMP INLET
	NON RETURN VALVE	ALL PUMP OUT LET
	BALANCING VALVE	ALL AHU CHWTR. RETURN
	GATE VALVE	CIRCULATION WATER PUMP & AHU INLET/OUTLET
	ORIFICE PLATE	CIRCULATION WATER OUTLET LINE
PT	PRESSURE TRANSMITTER	CIRCULATION WATER PUMP INLET/OUTLET
FT	FLOW TRANSMITTER	CIRCULATION WATER PUMP OUTLET
TT	TEMPERATURE TRANSMITTER	CIRCULATION WATER PUMP INLET/OUTLET
NRD	NON RETURN DAMPER	AHU/PAC OUTLET
VCD	VOLUME CONTROL DAMPER	AHU/PAC OUTLET
AT	AIR STAT	PAC OUTLET
GT	GYSER STAT	PAC OUTLET
DPS	DIFFERENTIAL PRESSURE SWITCH	FILTER ACROSS
T+RH	TEMPERATURE & HUMIDITY SENSOR	PAC ROOM

GENERAL:-

1. THIS DRG. SHALL BE READ IN CONJUCTION WITH TECHNICAL SPECIFICATION NO. PE-TS-407-571-11000-A001

NOTES :-

1 PIPING FOR CIRCULATION WATER SHALL BE MS CONFORMING TO IS-1239,PART I HEAVY GRADE OR IS-3589 (DEPENDING UPON PIPE SIZE)

2 ALL CIRCULATION WATER PIPING SHALL BE INSULATED AS PER TECHNICAL SPECIFICATION.

3 ALL EQUIPMENT DRAIN SHALL BE CONNECTED TO NEAREST BUILDING/ PLANT ROOM DRAIN (BY HVAC SUPPLIER)

4 THE STANDBY CIRCULATION WATER PUMPS & AHU'S SHALL BE STARTED AUTOMATICALLY WHEN THE WORKING EQUIPMENT ARE STOPPED / TRIPPED.

5 ALL INSTRUMENT AND TEST POINT SHALL BE PROVIDED WITH ISOLATING ROOT VALVE.

6 TEMPERATURE SENSOR (TS) & RELATIVE HUMIDITY SENSOR (RHS) SHALL BE PROVIDE IN EACH AHU ROOM.

7 ALL PRESSURE GAUGES SHALL BE PROVIDED WITH ISOLATING/ROOT VALVE, TEMPERATURE GAUGES WILL NOT HAVE ISOLATING VALVES.

8 ALL VALVE AND INSTRUMENTS MENTIONED IN THE P&ID ARE INDICATIVE MINIMUM. PLANT ROOM DRAIN (BY HVAC SUPPLIER)

JOB No. 407
STATUS CONTRACT
DISTRIBUTION
TO
No.OFF

REV	DATE	ALTD	CHD	APPD

UTTARAKHAND JAL VIDUT NIGAM LIMITED
2 X 60 MW VYASI

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
A	DRN	YK		28.05.2019
	DESN	VK		28.05.2019
	CHD	LJ		28.05.2019
	APPD	GB		28.05.2019

TITLE
P & I DIAGRAM FOR VENTILATION SYSTEM

MPL	C	MSE	I	MAX	E	DEPT.	SCALE TAL18
						SIGN	
						DATE	

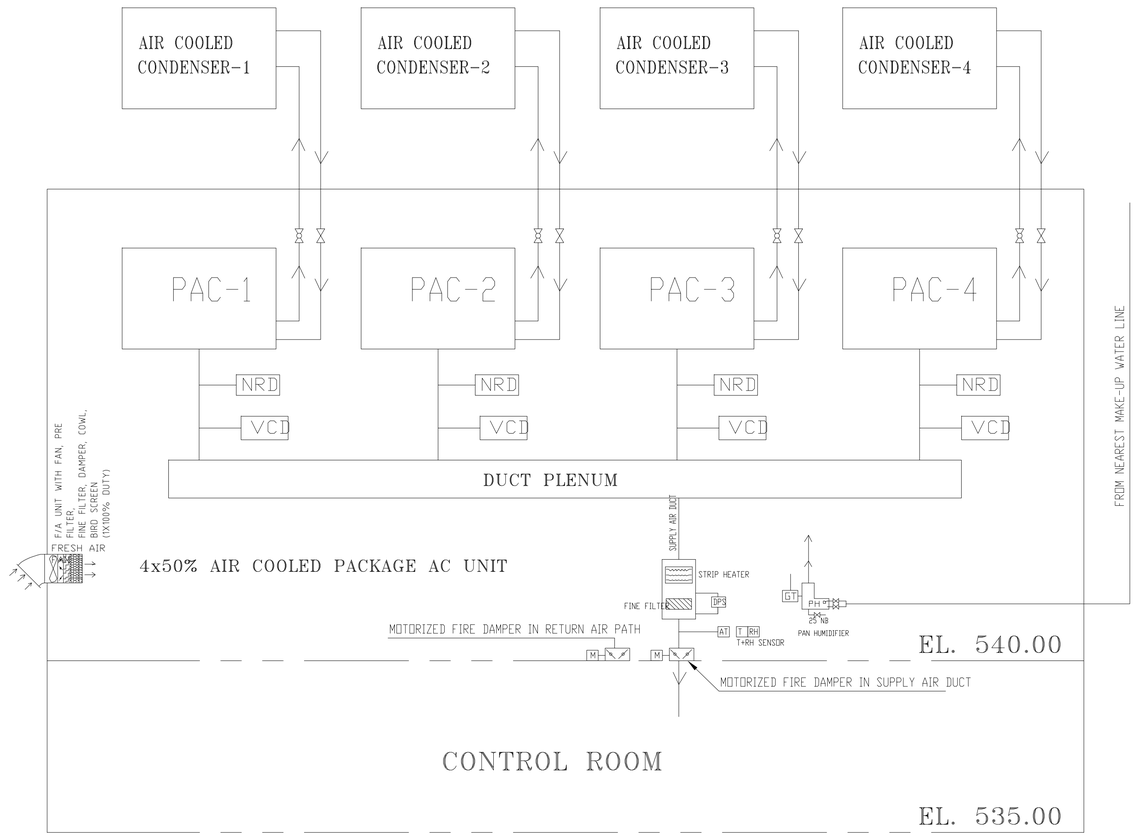
DRAWING No.
PE-DG-407-571-11000-A001

SHEET 01 OF 02 REV 00

SIZE-A1

COMPUTER FILE NAME :

ALL DIMENSIONS ARE IN MM FIRST ANGLE PROJECTION



LEGEND :-

PS	PRESSURE SWITCH	CIRCULATION PUMP OUT
.....	DUCT	SUPPLY AIR DUCT
	PRE FILTER	AS SHOWN
VCD	VOLUME CONTROLDAMPER	AS SHOWN
NRD	NON RETURN DAMPER	AFTER FILTER PLENUM(EACH AHU)
	PUMP	CIRCULATION WATER PUMP
	PIPE	CIRCULATION WATER PIPE
TG	TEMP.GAUGE.	CIRCULATION WATER PUMP- IN/OUT
PG	PRESSURE GAUGE.	CIRCULATION WATER PUMP- IN/OUT
	FIRE DAMPER(M)	AS SHOWN AT WALL)
	Y- STRAINER	ALL PUMP INLET
	NON RETURN VALVE	ALL PUMP OUT LET
	BALANCING VALVE	ALL AHU CHWTR. RETURN
	GATE VALVE	CIRCULATION WATER .PUMP & AHU INLET/OUTLET
	ORIFICE PLATE	CIRCULATION WATER OUTLET LINE
PT	PRESSURE TRANSMITTER	CIRCULATION WATER .PUMP INLET/OUTLET
FT	FLOW TRANSMITTER	CIRCULATION WATER .PUMP OUTLET
TT	TEMPERATURE TRANSMITTER	CIRCULATION WATER .PUMP INLET/OUTLET
NRD	NON RETURN DAMPER	AHU/PAC OUTLET
VCD	VOLUME CONTROL DAMPER	AHU/PAC OUTLET
AT	AIR STAT	PAC OUTLET
GT	GYSER STAT	PAC OUTLET
DPS	DIFFERENTIAL PRESSURE SWITCH	FILTER ACROSS
T+RH	TEMPERATURE & HUMIDITY SENSOR	PAC ROOM

GENERAL:-

1. THIS DRG. SHALL BE READ IN CONJUCTION WITH TECHNICAL SPECIFICATION NO. PE-TS-407-571-11000-A001

NOTES :-

1 PIPING FOR CIRCULATION WATER SHALL BE MS CONFORMING TO IS-1239,PART I HEAVY GRADE OR IS-3589 (DEPENDING UPON PIPE SIZE)

2 ALL CIRCULATION WATER PIPING SHALL BE INSULATED AS PER TECHNICAL SPECIFICATION.

3 ALL EQUIPMENT DRAIN SHALL BE CONNECTED TO NEAREST BUILDING/ PLANT ROOM DRAIN (BY HVAC SUPPLIER)

4 THE STANDBY CIRCULATION WATER PUMPS & AHU'S SHALL BE STARTED AUTOMATICALLY WHEN THE WORKING EQUIPMENT ARE STOPPED / TRIPPED.

5 ALL INSTRUMENT AND TEST POINT SHALL BE PROVIDED WITH ISOLATING ROOT VALVE.

6 TEMPERATURE SENSOR (TS) & RELATIVE HUMIDITY SENSOR (RHS) SHALL BE PROVIDE IN EACH AHU ROOM.

7 ALL PRESSURE GAUGES SHALL BE PROVIDED WITH ISOLATING/ROOT VALVE, TEMPERATURE GAUGES WILL NOT HAVE ISOLATING VALVES.

8 ALL VALVE AND INSTRUMENTS MENTIONED IN THE P&ID ARE INDICATIVE MINIMUM. PLANT ROOM DRAIN (BY HVAC SUPPLIER)

COMPUTER FILE NAME :

JOB No. 407
STATUS CONTRACT
DISTRIBUTION

TO										
No.OFF										
REV	DATE	ALTD	CHD	APPD						

UTTARAKHAND JAL VIDUT NIGAM LIMITED
2 X 60 MW VYASI

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE A

	NAME	SIGN	DATE
DRN	YK		28.05.2019
DESN	VK		28.05.2019
CHD	LJ		28.05.2019
APPD	GB		28.05.2019

TITLE
P & I DIAGRAM FOR AIR CONDITIONING SYSTEM

MPL	C	MSE	I	MAX	E	DEPT.	SCALE TAL18
						SIGN	
						DATE	

DRAWING No. PE-DG-407-571-11000-A001

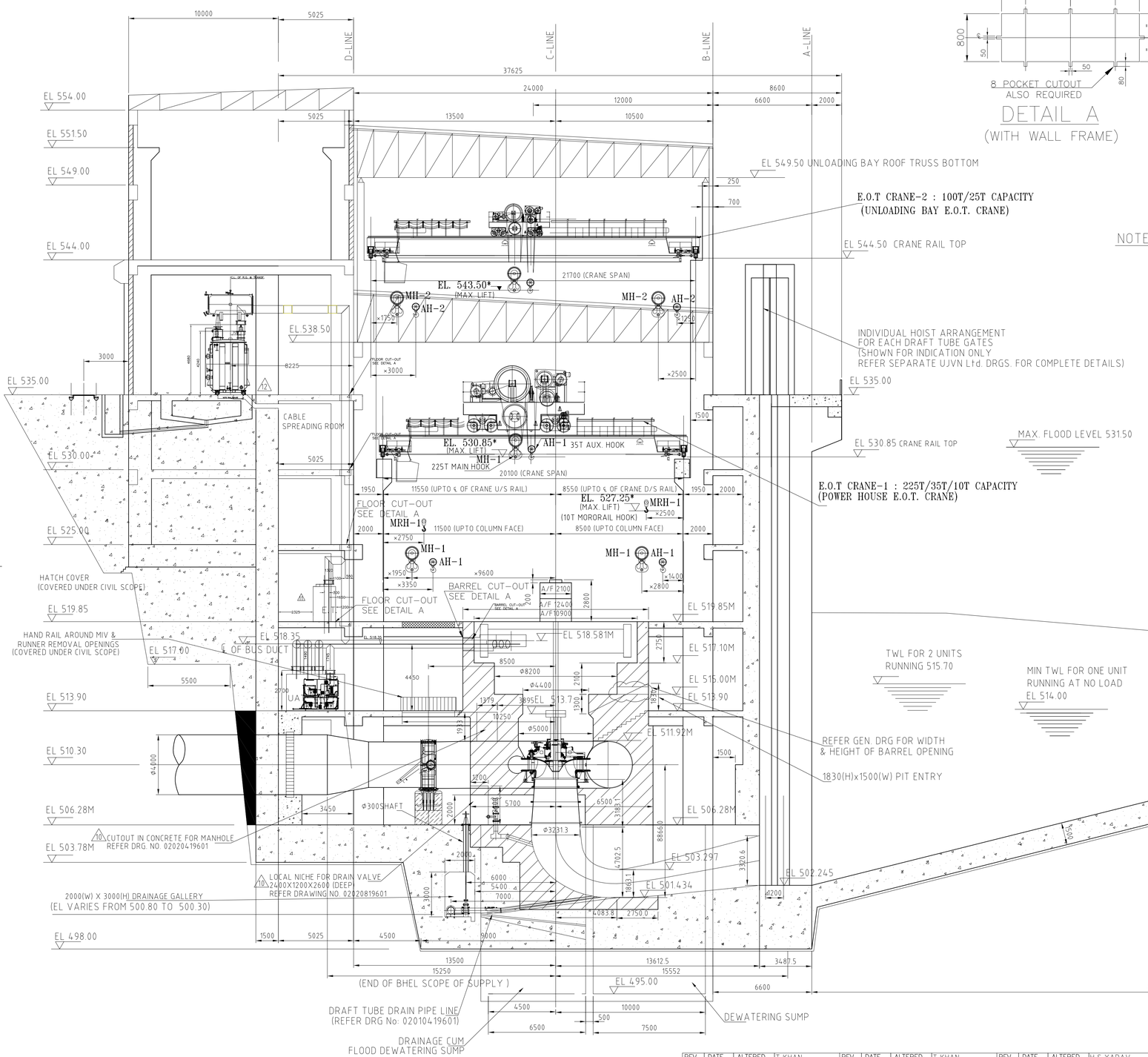
SHEET 02 OF 02 REV 00

SIZE-A1

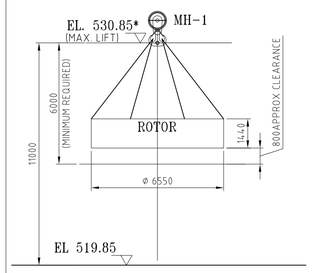
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 1 200 00 196 51 REV. 12

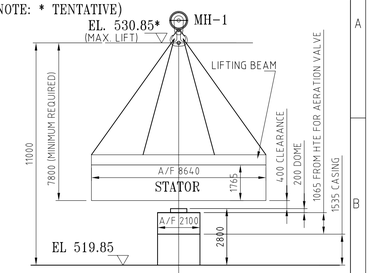


DETAIL A
(WITH WALL FRAME)



LIFTING ARRANGEMENT OF ROTOR
(WEIGHT OF ROTOR (WITHOUT SHAFT)=155T)
(INCLUDING LIFTING TACKLE)

(NOTE: * TENTATIVE)



LIFTING ARRANGEMENT OF STATOR
(WEIGHT OF WOUND STATOR (WITHOUT LIFTING BEAM)=120T)
(WEIGHT OF LIFTING BEAM = 20T APPROX)

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. EQUIPMENT & PANELS SHOWN ARE INDICATIVE ONLY, REFER RESPECTIVE FLOOR LAYOUT DRAWINGS FOR DETAILS.
03. *: DIMENSIONS ARE TENTATIVE. REFER EOT CRANE DRAWINGS NO. PE-DG-407-501-A001,A002 FOR COMPLETE INCLUDING LOCATION OF STOPPER, CABIN & DSL DETAILS.
04. FOR STAGE WISE CONCRETING AND EMBEDMENTS REFER TURBINE DRAWINGS OF BHEL.
05. FOR MIV AND ITS FOUNDATION DETAILS REFER TURBINE DRAWINGS OF BHEL.
06. SIZES OF COLUMNS/BEAMS/SLABS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.
07. # DIMENSION IS INDICATIVE ONLY. REFER CIVIL DRAWINGS FOR COMPLETE DETAILS.
08. $ ELEVATION IS TENTATIVE AND SHALL BE FINALISED WITH REFERNCE TO BEAM DEPTH.
09. ELIVATION INDICATIVE ONLY REFER CIVIL DRAWING FOR DETAILS.
10. W.R.T MOM DATED 28-30.01.2015 HELD BETWEEN BHEL & UJVN LTD., UNIFORM FLOOR LEVEL OF EL 506.28M HAS BEEN PROPOSED.

REFERENCE DRAWINGS:

BHEL DRAWINGS: 1-200-00-186-52 TO 61

LEGEND:

MH-1, MH-2: MAIN HOOK OF CRANES - 1 & 2.
AH-1, AH-2: AUX. HOOK OF CRANES - 1 & 2.
MRH-1: MONORAIL HOOK OF CRANES - 1

POWER HOUSE CROSS SECTION THROUGH MACHINE C.L.

REV.	DATE	ALTERED		REV.	DATE	ALTERED		REV.	DATE	ALTERED		REV.	DATE	ALTERED		REV.	DATE	ALTERED	
12	08.12.18	CHECKED	SHAILESH SAHU	11	24.05.18	CHECKED	SHAILESH SAHU	10	07.04.18	CHECKED	SHAILESH SAHU	09	31.05.17	CHECKED	B SINGH				
		APPROVED	R SINGH			APPROVED	R SINGH			APPROVED	R SINGH			APPROVED	R SINGH				
ZONE	DRG REVISED AS PER LATEST EQUIP.SIZES			ZONE	LOCAL NICHE IS SHOWN FOR DRAFT TUBE DRAIN VALVE			ZONE	LOCAL NICHE IS SHOWN FOR DRAFT TUBE DRAIN VALVE			ZONE	DRG REVISED AS PER CUSTOMER MAIL DATED 15.05.17						

REV.	DATE	ALTERED	B,S.P	REV.	DATE	ALTERED	B,S.P	REV.	DATE	ALTERED	B,S.P	REV.	DATE	ALTERED	T.KHAN	REV.	DATE	ALTERED	T.KHAN	REV.	DATE	ALTERED	T.KHAN
08	18.03.17	CHECKED	B,S.P	07	08.08.16	CHECKED	B,S.P	06	27.5.16	CHECKED	B,S.P	05	04.03.16	CHECKED	B,S.P	04	08.10.15	CHECKED	B,S.P	03	25.02.15	CHECKED	G.C.S
		APPROVED	R.S			APPROVED	R.S			APPROVED	R.S			APPROVED	R.S			APPROVED	R.S			APPROVED	G.C.S
ZONE	DRG REVISED AS PER CUSTOMER MAIL DATED 20.08.16			ZONE	DRG REVISED AS PER CUSTOMER CIVIL DRAWINGS.			ZONE	DRG REVISED AS PER CUSTOMER CIVIL DRAWINGS.			ZONE	DRG REVISED AS PER CUSTOMER CIVIL DRAWINGS. RECEIVED BY EMAIL DATED 13.08.2015			ZONE	DRG REVISED AS PER CUSTOMER CIVIL DRAWINGS. REVISED AS PER UJVNL LETTER NO. 64/UJVNL/---- DATED 13.03.2015			ZONE	DRG REVISED AS PER MOM DATED 28-30.01.2015 & DESIGN REQUIREMENT.		

REV.	DATE	ALTERED	T.KHAN	REV.	DATE	ALTERED	T.KHAN	REV.	DATE	ALTERED	T.KHAN
02	10.12.14	CHECKED	G.C.S	01	26.08.14	CHECKED	G C SEKHAR
		APPROVED	R SINGH			APPROVED	R SINGH
ZONE	DRG REVISED AS PER CUSTOMER COMMENTS DATED 20.09.2014 & DESIGN REQUIREMENT			ZONE	DRG REVISED AS PER CUSTOMER COMMENTS & DESIGN REQUIREMENT		

PROJECT	2X60MW – VYASI HYDROELECTRIC PROJECT, UTTARAKHAND
COSTUMER	UJVN LIMITED
CONSULTANT	–

भारत हेवी इलेक्ट्रिकल्स लिमिटेड, भोपाल
Bharat Heavy Electricals Limited, Bhopal

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	T.KHAN		06/08/14	
CHKD	G.C.SEKHAR		06/08/14	
APPD	R.SINGH		06/08/14	

ADDITIONAL INFORMATION
STATUS OF DRAWING
DISTRIBUTION OF PRINTS

DEPT	HPE	UNTOL. DIMS. GR.	ANGLE	SCALE	WEIGHT(kg)	REF.TO ASSY.DRG.	ITEM NO.	NO.OF ITEMS
CODE	415			1:150				

TITLE: CROSS-SECTION OF POWER HOUSE

DRAWING NO.	REV.
1 200 00 196 51	12
SHEET NO. 01	NO. OF SHEETS. 01

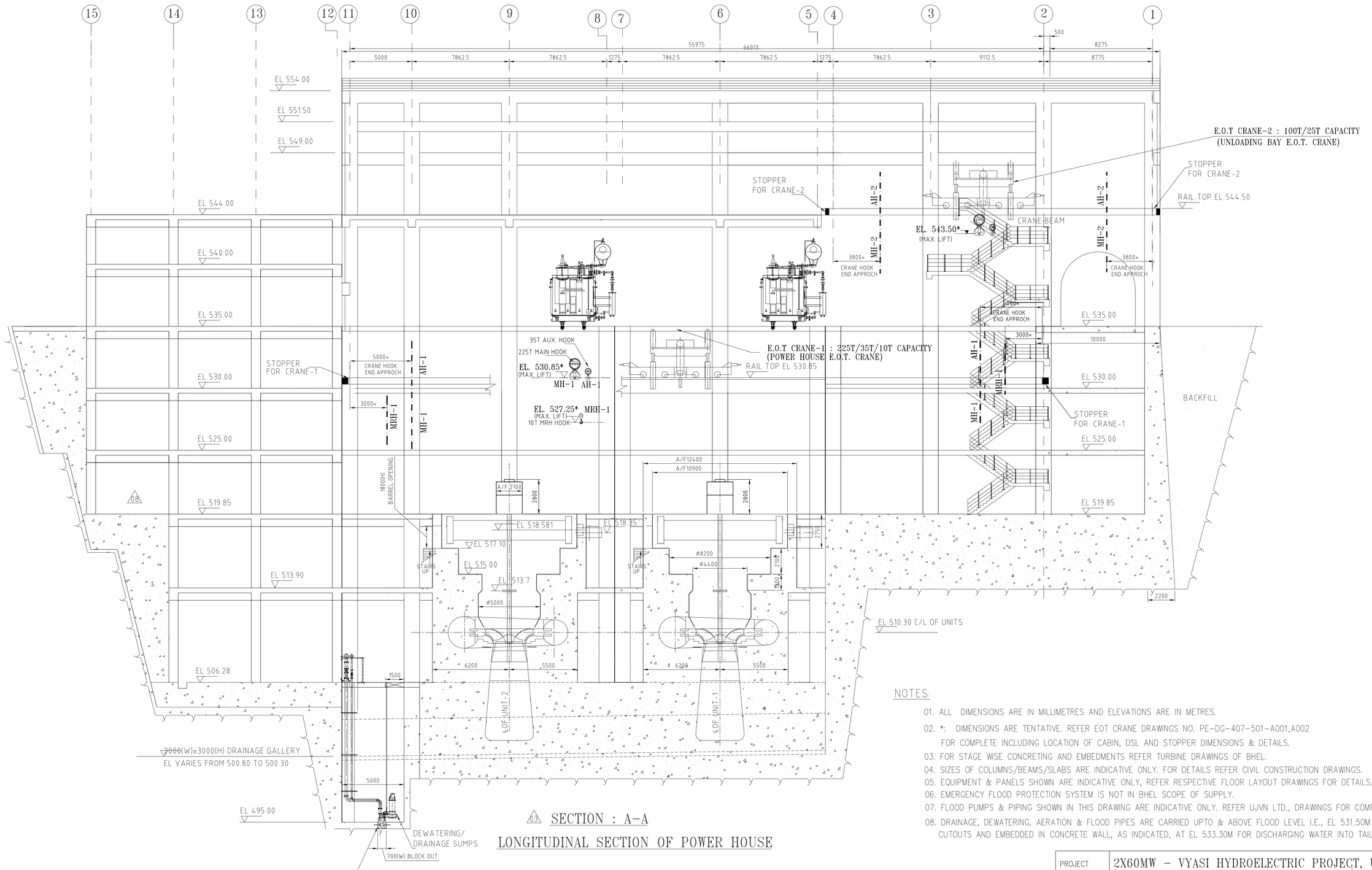
A1 SIZE

REF. DRG. NO. | SIGN. & DATE | INVENTORY NO.

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 1 200 00 196 55 REV. 08



03 SECTION : A-A

LONGITUDINAL SECTION OF POWER HOUSE

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. *: DIMENSIONS ARE TENTATIVE. REFER EOT CRANE DRAWINGS NO. PE-DG-407-501-A001,A002 FOR COMPLETE INCLUDING LOCATION OF CABIN, DSL AND STOPPER DIMENSIONS & DETAILS.
03. FOR STAGE WISE CONCRETING AND EMBEDMENTS REFER TURBINE DRAWINGS OF BHEL.
04. SIZES OF COLUMNS/BEAMS/SLABS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.
05. EQUIPMENT & PANELS SHOWN ARE INDICATIVE ONLY, REFER RESPECTIVE FLOOR LAYOUT DRAWINGS FOR DETAILS.
06. EMERGENCY FLOOD PROTECTION SYSTEM IS NOT IN BHEL SCOPE OF SUPPLY.
07. FLOOD PUMPS & PIPING SHOWN IN THIS DRAWING ARE INDICATIVE ONLY. REFER UJVN LTD., DRAWINGS FOR COMPLETE DETAILS.
08. DRAINAGE, DEWATERING, AERATION & FLOOD PIPES ARE CARRIED UPTO & ABOVE FLOOD LEVEL I.E., EL 531.50M THROUGH FLOOR CUTOUTS AND EMBEDDED IN CONCRETE WALL, AS INDICATED, AT EL 533.30M FOR DISCHARGING WATER INTO TAIL RACE CHANNEL.

LEGEND:

MH-1, MH-2: MAIN HOOK OF CRANES - 1 & 2.
AH-1, AH-2: AUX. HOOK OF CRANES - 1 & 2.
MRH-1: MONORAIL HOOK OF CRANES - 1

REFERENCE DRAWINGS:

BHEL LAYOUT DRAWINGS: 1-200-00-196-51 TO 54,56 TO 61
BHEL CGL DRAWINGS: 1-200-00-196-71 TO 78

PROJECT	2X60MW – VYASI HYDROELECTRIC PROJECT, UTTARAKHAND
COSTUMER	UJVN LIMITED
CONSULTANT	–

भारत हेवी इलेक्ट्रिकल्स लिमिटेड, भोपाल
Bharat Heavy Electricals Limited, Bhopal

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	T.KHAN		06/08/14	
CHKD	G.C.SEKHAR		06/08/14	
APPD	R.SINGH		06/08/14	

REV.	DATE	ALTERED / CHECKED / APPROVED		ZONE
08	06.05.19	ALTERED T.KHAN / CHECKED B.SINGH / APPROVED R.SINGH		DRG REVISED AS PER LATEST CIVIL DRAWING
07	31.05.17	ALTERED H.S YADAV / CHECKED B.SINGH / APPROVED R.SINGH		DRG REVISED AS PER CUSTOMER MAIL DATED 15.05.17
06	18.03.17	ALTERED T.KHAN / CHECKED B.S.P / APPROVED R.S		DRG REVISED AS PER CUSTOMER MAIL DATED 20.08.16
05	08.08.16	ALTERED T.KHAN / CHECKED B.S.P / APPROVED R.S		DRG REVISED AS PER CUSTOMER CIVIL DRAWINGS.
04	08.10.15	ALTERED T.KHAN / CHECKED B.S.P / APPROVED R.S		DRG REVISED AS PER CUSTOMER CIVIL DRAWINGS.
03	25.02.15	ALTERED T.KHAN / CHECKED G.C.S / APPROVED G.C.S		DRG REVISED AS PER MOM DATED 28-30.01.2015 & DESIGN REQUIREMENT.
02	10.12.14	ALTERED T.KHAN / CHECKED G.C.S / APPROVED R.SINGH		DRG REVISED AS PER CUSTOMER COMMENTS DATED 20.09.2014 & DESIGN REQUIREMENT
01	26.08.14	ALTERED T.KHAN / CHECKED G.C SEKHAR / APPROVED R.SINGH		DRG REVISED AS PER CUSTOMER COMMENTS & DESIGN REQUIREMENT

ADDITIONAL INFORMATION

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

DEPT HPE	UNTOL. DIMS. GR.	ANGLE	SCALE 1:150	WEIGHT(kg)	NO.OF ITEMS
CODE 415				REF.TO ASSY.DRG.	ITEM NO.

TITLE: LONGITUDINAL SECTION OF POWER HOUSE

DRAWING NO. 1 200 00 196 55 REV. 08

SHEET NO. 01 NO. OF SHEETS. 01

A1 SIZE

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 1 200 00 196 71 REV. 05

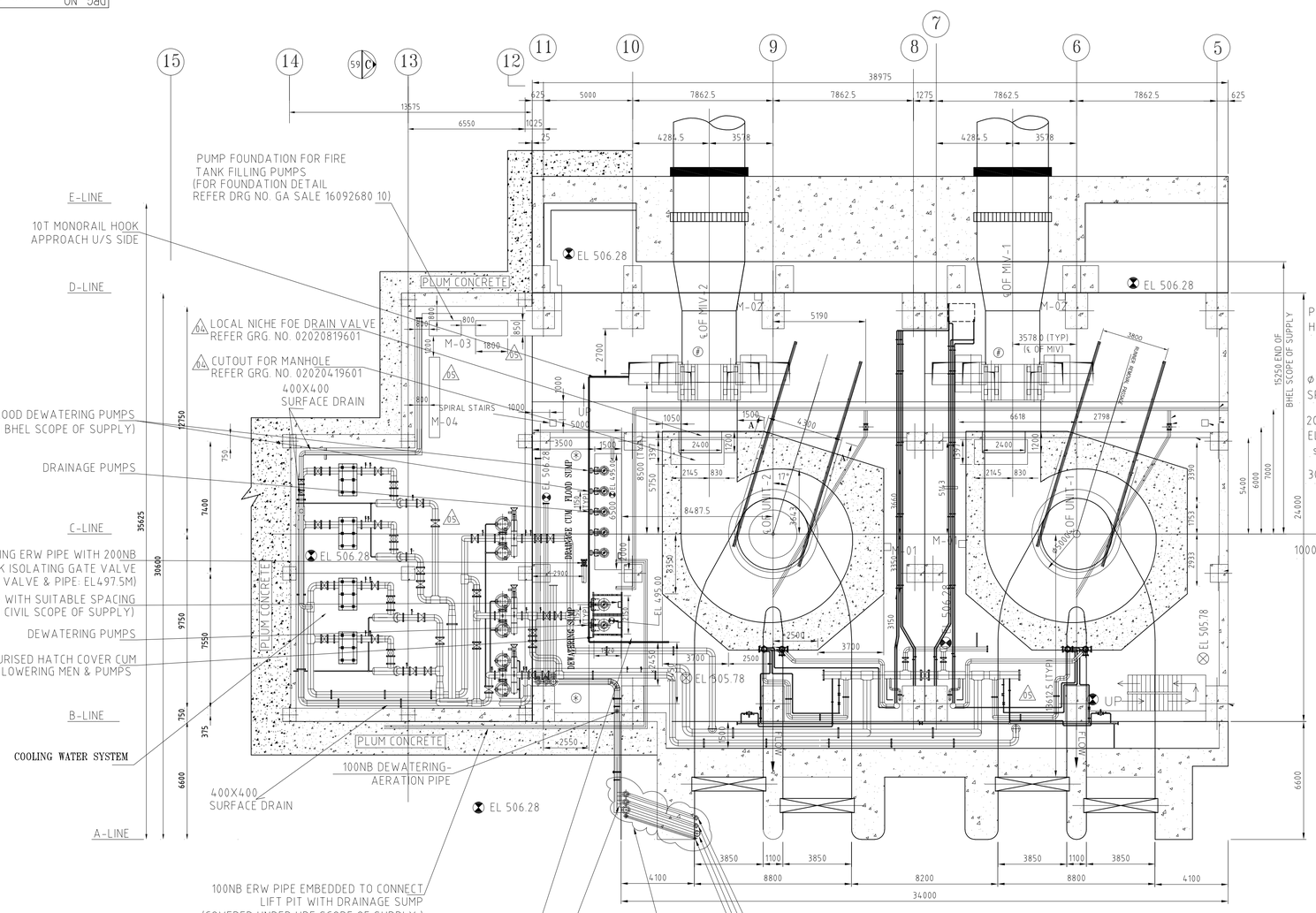


TABLE FOR DIMENSIONS OF EQUIPMENTS (TENTATIVE):

ITEM No	DESCRIPTION	APPROX. SIZE (mm) LENGTH	WIDTH	HEIGHT	WEIGHT (kg)	QUANTITY PER UNIT	TOTAL QUANTITY	REMARKS
M-01	OLU (TURBINE)	400	400	-	-	1	2	GOV
M-02	OLU (MIV)	400	400	-	-	1	2	GOV
M-03	FIRE TANK FILLING PUMP	1800	850	1000	-	1	2	HYD
M-04	FIRE MCC PANEL	4500	600	2500	-	-	1	HYD

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. LIST OF EQUIPMENT & PANELS SHOWN ARE TENTATIVE & INDICATIVE ONLY AND SHALL BE FINALISED DURING DETAIL DESIGN.
03. FOR STAGE WISE CONCRETING AND EMBEDMENTS REFER TURBINE DRAWINGS OF BHEL.
04. FOR MIV AND ITS FOUNDATION DETAILS REFER TURBINE DRAWINGS OF BHEL.
05. SIZES OF COLUMNS, BEAMS, SLABS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.
06. DIMENSIONS OF CONCRETE BARREL BETWEEN EL 506.28M AND EL 513.90M ARE TENTATIVE AND SHALL BE AS PER CIVIL CONSTRUCTION DRGS. HOWEVER, MIN.1000MM THICK CONCTRETE SHALL BE ENSURED AROUND SPIRAL CASING.
07. ITEMS SHOWN FOR D&D SYSTEM ARE INDICATIVE ONLY.
08. FOR PIPING, VALVES, FLOOR CUTOUTS, PUMP FOUNDATIONS, EMBEDMENTS AND OTHER DETAILS OF ARRANGEMENT OF D&D SYSTEM, REFER BHEL D&D DRAWING No: 12110119601, WHICH SHALL BE ISSUED SEPARATELY.
09. EMERGENCY FLOOD PROTECTION SYSTEM IS NOT IN BHEL SCOPE OF SUPPLY.
10. FLOOD PUMPS & PIPING SHOWN IN THIS DRAWING ARE INDICATIVE ONLY. REFER UJVN LTD., DRAWINGS FOR COMPLETE DETAILS.
11. DRAINAGE, DEWATERING, AERATION & FLOOD PIPES ARE CARRIED UPTO & ABOVE FLOOD LEVEL I.E., EL 531.50M THROUGH FLOOR CUTOUTS AND EMBEDDED IN CONCRETE WALL, AS INDICATED, AT EL 533.30M FOR DISCHARGING WATER INTO TAIL RACE CHANNEL.
12. #: DIMENSION IS INDICATIVE ONLY. REFER CIVIL DRAWINGS FOR COMPLETE DETAILS.
13. *: CRANE HOOK/END APPROACHES INDICATED ARE FOR INFORMATION ONLY. REFER CRANE DRAWINGS NO. PE-DG-407-501-A001,A002 FOR COMPLETE DETAILS.
14. W.R.T MOM DATED 28-30.01.2015 HELD BETWEEN BHEL & UJVN LTD. UNIFORM FLOOR LEVEL OF EL 506.28M HAS BEEN PROPOSED.

REFERENCE DRAWINGS:

BHEL LAYOUT DRAWINGS: 1-200-00-186-51, & 53 TO 61

LOADS & FOUNDATION OF BUTTERFLY VALVE & SERVOMOTOR: 0-212-00-19601

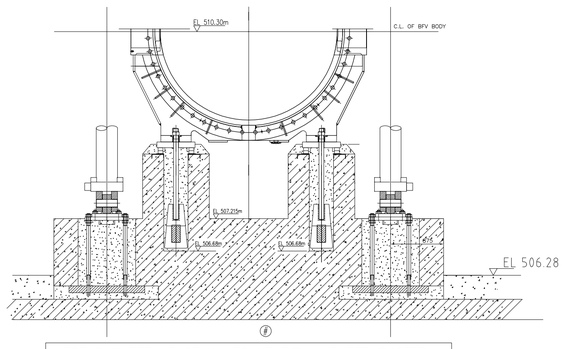
℄ FINISHED FLOOR LEVEL

⊗ UNFINISHED FLOOR LEVEL

AREA BETWEEN GRIDE LINE 05 TO 11 AND LINE D TO B TO BE LEFT UNFINISHED FOR FOUNDATION OF COOLING WATER AND FIRE FIGHTING SYSTEM EQUIPMENTS

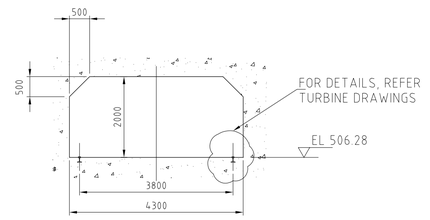
⑥ FOR CIVIL DETAILD OF TOP AND BOTTOM OF DRAINAGE AND DEWATERING PIT REFER DRAWING No.-12110119601

PLAN OF POWER HOUSE AT EL. EL 506.28 /510.30M (MIV / TURBINE FLOOR)



⑥ FOR CIVIL DETAILD OF MIV FOUNDATION AND RERVOMOTER REFER DRAWING No.-02120019601

(TYPICAL ELEVATION WHEN VIEWED FROM DOWNSTREAM SIDE)



SECTION: A-A

(PASSAGE FOR RUNNER REMOVAL)

(ZONE: E-3, E-4)

(NTS)

PROJECT	2X60MW - VYASI HYDROELECTRIC PROJECT, UTTARAKHAND
COSTUMER	UJVN LIMITED
CONSULTANT	-

भारत हेवी इलेक्ट्रिकल्स लिमिटेड, भोपाल
Bharat Heavy Electricals Limited, Bhopal

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	T.KHAN		06/08/14	
CHKD	G.C.SEKHAR		06/08/14	
APPD	R.SINGH		06/08/14	

REV.	DATE	ALTERED / CHECKED / APPROVED		ZONE	DESCRIPTION
05	26.04.18	H S YADAV / SHAILESH SAHU / R.SINGH		ZONE	DRG REVISED AS PER REVISED CW SYSTEM
04	07.04.18	H S YADAV / SHAILESH SAHU / R.SINGH		ZONE	LOCAL NICHE FOR DRAIN VALVE AND CUTOUT FOR MANHOLE ARE SHOWN
03	28.08.17	H S YADAV / R.SINGH / R.SINGH		ZONE	DRG REVISED AS PER CUSTOMER COMMENTS & DESIGN REQUIREMENT
02	14.06.17	H S YADAV / R.SINGH / R.SINGH		ZONE	DRG REVISED AS PER LATEST CIVIL DRAWINGS COMMENTS RECEIVED DATED 26.05.17
01	25.03.17	HS YADAV / RSINGH / R.SINGH		ZONE	DRG REVISED AS PER LATEST CIVIL DRAWINGS RECEIVED DATED 24.0317

ADDITIONAL INFORMATION

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

DEPT	HPE	UNTOL. DIMS. GR.	ANGLE	SCALE	WEIGHT(kg)	REF.TO ASSY.DRG.	ITEM NO.	NO.OF ITEMS
CODE	415							

TITLE: CIVIL GUIDELINES PLAN AT EL. 506.28/510.30M

DRAWING NO. 1 200 00 196 71 REV. 05

SHEET NO. 01 NO. OF SHEETS. 01

A1 SIZE

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

REF. DRG. NO.

SIGN. & DATE

INVENTORY NO.

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 1 200 00 196 72 REV. 06

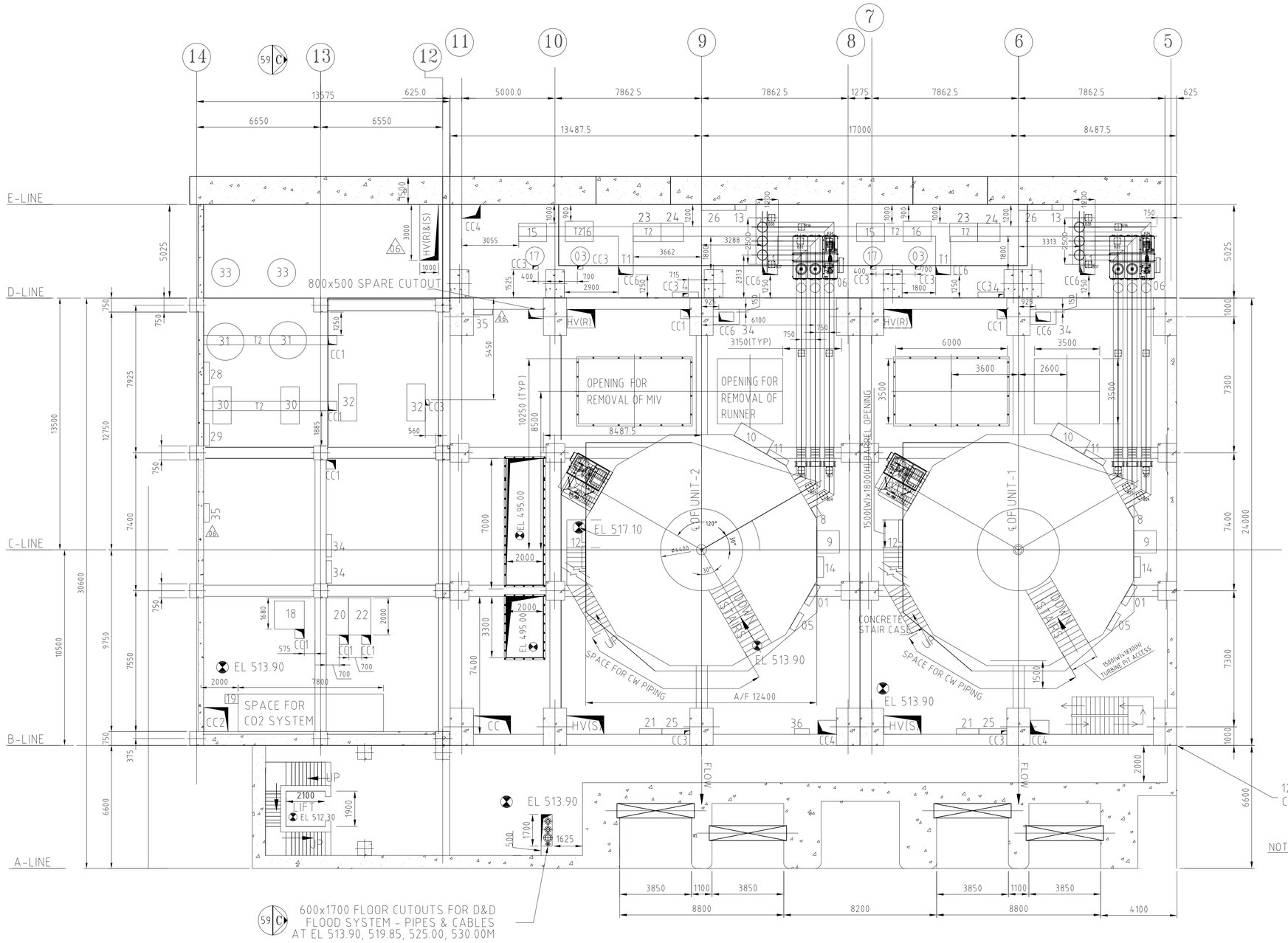


TABLE FOR DIMENSIONS OF EQUIPMENTS (TENTATIVE):

ITEM No	DESCRIPTION	APPROX. SIZE (mm) LENGTH	WIDTH	HEIGHT	WEIGHT (kg)	QUANTITY PER UNIT	TOTAL QUANTITY	REMARKS
01	STARTER PANEL FOR GEN. SPACE HEATER	1200	300	1000	-	1	2	HPE
02	CO2 EQUIPMENT	7800	2000	2500	-	-	2	HGE
03	OIL PRESSURE RECIEVER FOR MIV	φ1000	-	2500	1800	1	2	GOV
04	STARTER PANEL FOR MIV PP SET	1200	300	1200	-	1	2	HPE
05	ST.PANEL FOR CENTRALIZED GREASE LUB. SYSTEM FOR TURBINE & MIV	1000	300	800	-	1	2	HPE
06	LAVT	2400	2400	2200	-	1	2	R'PUR
07	N.G. CUBICLE	2400	1800	2300	-	1	2	-
08	STARTER PANEL BRAKE DUST COLLECTOR	600	300	1000	-	1	2	HPE
09	BRAKE DUST COLLECTION EQUIPMENT	1200	1200	2500	-	1	2	HGE
10	H.S LUBRICATION UNIT	2000	800	800	-	1	2	HGE
11	STARTER FOR H.S LUB. OIL	1200	300	1000	-	1	2	HPE
12	MARSHALLING BOX (WALL MOUNTED)	1200	200	1200	-	2	4	HGE
13	STARTER PANEL FOR OLU (GOV.&MIV)	600	300	1000	-	1	2	HPE
14	BRAKE & JACK CONTROL PANEL	1100	350	1200	-	1	2	HGE
15	OIL SUMP TANK FOR GOV.	1500	1000	800	-	1	2	GOV
16	OIL SUMP TANK FOR MIV	1500	1100	900	3700	1	2	GOV
17	OIL PRESSURE RECIEVER FOR GOV	φ1000	-	2500	1800	1	2	GOV
18	LUBRICATING OIL HANDLING SYSTEM	1600	1500	3000	1700	-	-	GOV
19	CONTROL PANEL FOR CO2 EQUIPMENT	700	500	2300	-	-	1	HGE
20	MOTORISED POWER PACK FOR JACKING	1200	1200	1800	-	-	1	HGE
21	ST.PANEL FOR TOP COVER DRAIN PUMP MOTOR SETS	1200	300	1000	-	1	2	HPE
22	LDB PANEL WITH 100 kVA TRFR (MLDB-1)	2000	1200	2200	-	-	1	PEM
23	HYDRAULIC CONTROL PANEL FOR MIV	1500	1000	2500	1000	1	2	GOV
24	ELEC. CONTROL & INDICATION PANEL FOR MIV	1200	1000	2520	400	1	2	GOV
25	ST.PANEL FOR FOR CW SYSTEM	1500	300	1500	-	1	2	HPE
26	STARTER PANEL FOR GOV.PP SET	1800	300	1200	-	1	2	HPE
27	UAT (500kVA)	2650	1700	2200	3300	-	2	JHS
28	ST.PANEL FOR LP COMPRESSOR MOTOR SETS	1200	300	1300	-	-	1	HPE
29	ST.PANEL FOR HP COMPRESSOR MOTOR SETS FOR TURBINE & MIV	1200	300	1000	-	-	1	HPE
30	L.P. AIR COMPRESSOR	2000	1000	2000	-	-	2	HTE
31	L.P. AIR RECEIVER	φ1900	-	2000	-	-	2	HTE
32	H.P. AIR COMPRESSOR	2000	1000	2000	-	-	2	HTE
33	H.P. AIR RECEIVER	φ1500	1000	2000	-	-	2	HTE
34	MSB FOR UNITS	1400	800	-	-	-	2	HPE
35	MISC SERVICE BOARD (WALL MOUNTED)	1000	300	1400	-	-	2	HPE
36	ST.PANEL FOR FOR BOOSTER PUMP	800	300	1500	-	-	1	HPE
		-	-	-	-	-	-	-

REFERENCE DRAWINGS:

BHEL DRAWINGS: 1-200-00-186-51,52 & 54 TO 61
PIPES AND EMBEDMENTS IN FIRST STAGE: 02010419601
PIPES AND EMBEDMENTS IN SECOND STAGE: 02020819601

LEGENDS:-

HV(S) CUTOUT FOR HVAC SUPPLY DUCT 2000x1000MM.
HV(R) CUTOUT FOR HVAC RETURN DUCT 1500x1000MM.
CC CUTOUT FOR CABLES/PIPES 2000x1000MM.
CC1 CUTOUT FOR CABLES OF EQUIPMENTS 500x500MM.
CC2 CUTOUT FOR CABLES OF EQUIPMENTS 1300x1300MM.
CC3 CUTOUT FOR CABLES OF EQUIPMENTS 200x300MM.
CC4 CUTOUT FOR CABLES OF EQUIPMENTS 1000x750MM.
CC5 CUTOUT FOR CABLES OF EQUIPMENTS 3400x600MM.
CC6 CUTOUT FOR CABLES OF EQUIPMENTS 800x500MM.
T1 TRENCH FOR CABLES OF EQUIPMENTS 800x500 DEEP.
T2 TRENCH FOR CABLES OF EQUIPMENTS 500x300 DEEP.

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. LIST OF EQUIPMENT & PANELS SHOWN ARE TENTATIVE & INDICATIVE ONLY AND SHALL BE FINALISED DURING DETAIL DESIGN.
03. FOR STAGE WISE CONCRETING AND EMBEDMENTS REFER TURBINE& GENERATOR DRAWINGS OF BHEL.
04. SIZES OF COLUMNS/BEAMS/SLABS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.
05. ITEM No. 12 I.E., MRASHALLING BOXES (TWO/UNIT) SHALL BE PLACED BELOW LADNING PLATFORM & STAIRCASE MEANT FOR GENERATOR BARREL ENTRY AT EL 517.10M.
06. MARSHALLING BOXES ARE WALL MOUNTED TYPE AND SHALL BE PLACE AT APPROX. 300MM ABOVE THE FLOOR.

PLAN OF POWER HOUSE AT EL 513.90M
(GENERATOR FLOOR)

PROJECT	2X60MW – VYASI HYDROELECTRIC PROJECT, UTTARAKHAND
COSTUMER	UJVN LIMITED
CONSULTANT	–

भारत हेवी इलेक्ट्रिकल्स लिमिटेड, भोपाल
Bharat Heavy Electricals Limited, Bhopal

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	T.KHAN		06/08/14	
CHKD	G.C.SEKHAR		06/08/14	
APPD	R.SINGH		06/08/14	

REV.	DATE	ALTERED		ZONE	DESCRIPTION
		CHECKED			
		APPROVED			
		CHECKED			
		APPROVED			
06	08.12.18	CHECKED	T KHAN / RSINGH		DRG REVISED AS PER LATEST EQUIP SIZES
		APPROVED	R SINGH		
05	02.05.18	CHECKED	T KHAN / RSINGH		DRG REVISED AS PER LATEST BUS DUCT LAYOUT DRAWING
		APPROVED	R SINGH		
04	23.11.17	CHECKED	HS YADAV / RSINGH		DRG REVISED AS PER CUSTOMER COMMENTS DATED 31.08.17
		APPROVED	R SINGH		
03	28.08.17	CHECKED	HS YADAV / RSINGH		DRG REVISED AS PER CUSTOMER COMMENTS & DESIGN REQUIREMENT
		APPROVED	R SINGH		
02	14.06.17	CHECKED	HS YADAV / RSINGH		DRG REVISED AS PER LATEST CIVIL DRAWINGS COMMENTS RECEIVED DATED 26.05.17
		APPROVED	R SINGH		
01	27.03.17	CHECKED	HS YADAV / RSINGH		DRG REVISED AS PER LATEST CIVIL DRAWINGS RECEIVED DATED 24.0317
		APPROVED	R SINGH		

ADDITIONAL INFORMATION
STATUS OF DRAWING
DISTRIBUTION OF PRINTS

DEPT HPE	UNTOL. DIMS. GR.	ANGLE	SCALE 1:120	WEIGHT(kg)	REF.TO ASSY.DRG.	ITEM NO.
CODE 415						NO.OF ITEMS

TITLE: CIVIL GUIDELINES PLAN AT EL. 513.90

DRAWING NO. 1 200 00 196 72 REV. 06

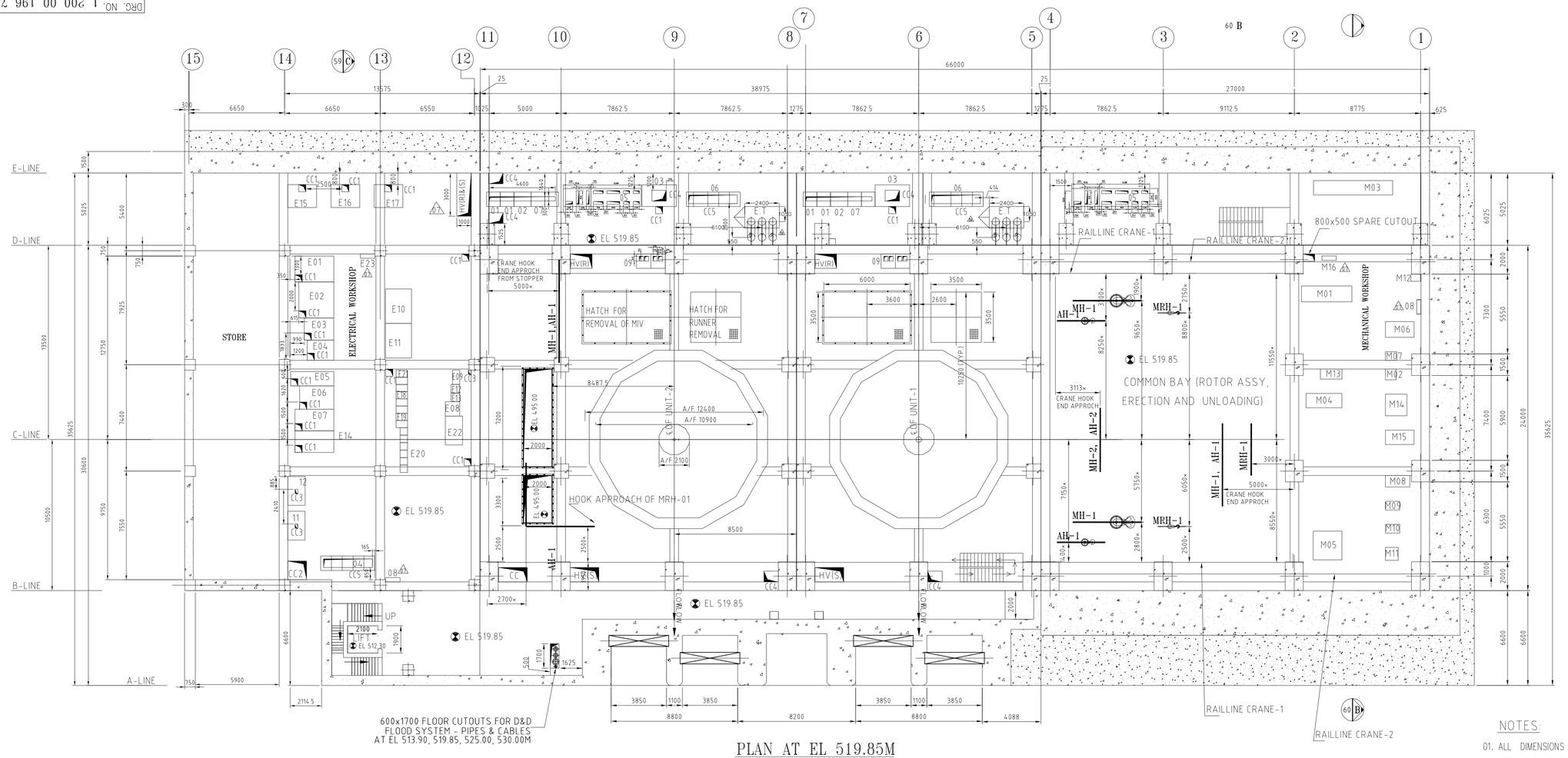
SHEET NO. 01 NO. OF SHEETS. 01

A1 SIZE

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 1 200 00 196 73 REV. 07



PLAN AT EL 519.85M
(SERVICE BAY FLOOR / MACHINE HALL)

TABLE FOR DIMENSIONS OF ELECTRICAL WORKSHOP EQUIPMENTS (TENTATIVE):

ITEM. No	DESCRIPTION	APPROX. SIZE (mm) LENGTH	WIDTH	HEIGHT	WEIGHT (kg)	QUANTITY PER UNIT	TOTAL QUANTITY	REMARKS
E01	ELECTRICAL MEASURING INSTRUMENT PANEL-1	2700	1800	2200	-	-	1	EMRP
E02	ELECTRICAL MEASURING INSTRUMENT PANEL-2	2500	2436	2200	-	-	1	EMRP
E03	ELECTRICAL MEASURING INSTRUMENT PANEL-3	2056	1542	1010	-	-	1	EMRP
E04	ELECTRICAL MEASURING INSTRUMENT PANEL-4	1850	1400	1100	-	-	1	EMRP
E05	ELECTRICAL MEASURING INSTRUMENT PANEL-5	3000	1000	1000	-	-	1	EMRP
E06	ELECTRICAL MEASURING INSTRUMENT PANEL-6	2380	1620	1230	-	-	1	EMRP
E07	ELECTRICAL MEASURING INSTRUMENT PANEL-7	2700	1500	1200	-	-	1	EMRP
E08	AUTOMATIC CAPACITANCE & TAN DELTA KIT	1000	1000	1000	-	-	1	EMRP
E09	PRIMARY CURRENT INJECTION KIT	1000	500	860	-	-	1	EMRP
E10	DC RECTIFORMER	2400	1800	1800	-	-	1	EMRP
E11	HV AC TEST SET	2400	1800	1200	-	-	1	EMRP
E12	SILICA GEL DRYING OVEN	600	600	600	-	-	1	EMRP
E13	MOTOR WINDING DRYING OVEN	600	600	600	-	-	1	EMRP
E14	ELECTRICAL MEASURING INSTRUMENT PANEL-8	1800	1800	1400	-	-	1	EMRP
E15	UNIVERSAL LABORATORY WORKBENCH WITH POWER SUPPLY	2000	1600	900	-	-	1	EMRP
E16	WORKBENCH FOR REPAIR OF HAYDRAULIC/PNEUMATIC DEVICE	2000	1600	900	-	-	1	EMRP
E17	WORKBENCH FOR REPAIR OF ELECTRIC DEVICE	2000	1600	900	-	-	1	EMRP
E18	TOOL LOCKERS OF APPROPRIATE SIZE	3X800	500	900	-	-	1	EMRP
E19	SHEET STEEL LOCKERS OF APPROPRIATE SIZE	3X800	500	900	-	-	1	EMRP
E20	CHAIRS	6X520	520	650	-	-	1	EMRP
E21	RACKS	3X800	500	1800	-	-	1	EMRP
E22	LDB PANEL WITH 50 kVA TRFR (MLDB-5)	2000	1200	2200	-	-	1	PEM
E23	ELECTRICAL TEST LAB BOARD (WALL MOUNTED)	1000	300	1400	-	-	1	HPE

TABLE FOR DIMENSIONS OF MECHANICAL EQUIPMENTS (TENTATIVE):

ITEM. No	DESCRIPTION	APPROX. SIZE (mm) LENGTH	WIDTH	HEIGHT	WEIGHT (kg)	QUANTITY PER UNIT	TOTAL QUANTITY	REMARKS
M01	UNIVERSAL RADIAL DRILLING MACHINE	3500	1100	3500	-	-	1	EMRP
M02	PORTABLE MAGNETIC BASE ELECTRICAL DRILLING MACHINE	750	750	2000	-	-	1	EMRP
M03	LONG LATHE	5500	1000	15000	-	-	1	EMRP
M04	SHORT LATHE	2500	1000	1500	-	-	1	EMRP
M05	UNIVERSAL MILLING MACHINE	2000	2000	2500	-	-	1	EMRP
M06	SHAPER MACHINE	2000	1100	1600	-	-	1	EMRP
M07	DOUBLE ENDED GRINDING MACHINE	800	600	1100	-	-	1	EMRP
M08	POWER HACKSAW	1700	800	1900	-	-	1	EMRP
M09	RECTIFIER TYPE WELDING MACHINE	1000	600	600	-	-	1	EMRP
M10	WELDING GENERATOR	1000	600	600	-			EMRP
M11	HYDRAULIC PRESS	900	900	2500	-			EMRP
M12	BATTERY OPERATED FORK LIFT	700	500	-	-	-	1	EMRP
M13	BATTERY OPERATED HANDLING CART	1500	700	1000	-	-	1	EMRP
M14	HYDRAULIC PLATE FORM	1500	1500	4500	-	-	1	EMRP
M15	WORKBENCHES	2000	1000	700	-	-	1	EMRP
M16	ELEC & MECH WORKSHOP BOARD (WALL MOUNTED)	1000	300	1400	-	-	1	HPE

TABLE FOR DIMENSIONS OF EQUIPMENTS (TENTATIVE):

ITEM. No	DESCRIPTION	APPROX. SIZE (mm) LENGTH	WIDTH	HEIGHT	WEIGHT (kg)	QUANTITY PER UNIT	TOTAL QUANTITY	REMARKS
01	TEMPERATURE & GAUGE PANEL	2x950	1000	2295	200	1	2	EDN
02	EHGC	1200	1000	2520	900	1	2	GOV.
03	HDRO MECHANICAL CABINET	2400	1500	1800	1700	1	2	GOV.
04	LCB UNIT FOR COMMON SERVICES	5x750	1000	2295	-	-	1	EDN
05	SEE CUBICLE	3800	1250	2320	3200	1	2	
06	UNIT CONTROL BOARD	5x750	1000	2295	-	1	2	EDN
07	INSTRUMENTS PANEL	2x950	1000	2295	-	1	2	EDN
08	MISC SERVICE BOARD (WALL MOUNTED)	1000	300	1400	-	-	2	HPE
09	GENERATOR PROTECTION PANEL	2000	1000	2350	-	-	2	SWE
10	EXT. TRANSFORMER (850kVA)	2400	1500	2350	3000	-	2	EDN/JHS
11	DC LDB 6 O/G FDRS (ELDB-1)	2000	1200	2200	-		1	PEM
12	LDB PANEL WITH 100 kVA TRFR (MLDB-2)	2000	1200	2200	-	-	1	PEM

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. LIST OF EQUIPMENT & PANELS SHOWN ARE TENTATIVE & INDICATIVE ONLY AND SHALL BE FINALISED DURING DETAIL DESIGN.
03. *: DIMENSIONS ARE TENTATIVE / INDICATIVE ONLY. REFER EOT CRANE DRAWINGS NO. PE-DG-407-501-A001,A002 FOR COMPLETE INCLUDING LOCATION OF CABIN, DSL & STOPPER DETAILS.
04. SIZES OF COLUMNS/BEAMS/SLABS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.

REFERENCE DRAWINGS:

BHEL DRAWINGS: 1-200-00-186-51,52,53 & 55 TO 61
BHEL DRAWINGS: 3-561-00-5-1504

LEGENDS:-

HV(S) CUTOUT FOR HVAC SUPPLY DUCT 2000x1000MM.
HV(R) CUTOUT FOR HVAC RETURN DUCT 1500x1000MM.
CC CUTOUT FOR CABLES/PIPES 2000x1000MM.
CC1 CUTOUT FOR CABLES OF EQUIPMENTS 500x500MM.
CC2 CUTOUT FOR CABLES OF EQUIPMENTS 2000x2000MM.
CC3 CUTOUT FOR CABLES OF EQUIPMENTS 200x300MM.
CC4 CUTOUT FOR CABLES OF EQUIPMENTS 1000x750MM.
CC5 CUTOUT FOR CABLES OF EQUIPMENTS 3400x600MM.
T1 TRENCH FOR CABLES OF EQUIPMENTS 200x300 DEEP.
MH-1, MH-2: MAIN HOOK OF CRANES - 1 & 2.
AH-1, AH-2: AUX. HOOK OF CRANES - 1 & 2.
MRH-1: MONORAIL HOOK OF CRANES - 1

LEGENDS:-

HV(S) CUTOUT FOR HVAC SUPPLY DUCT 2000x1000MM.
HV(R) CUTOUT FOR HVAC RETURN DUCT 1500x1000MM.
CC CUTOUT FOR CABLES/PIPES 2000x1000MM.
CC1 CUTOUT FOR CABLES OF EQUIPMENTS 500x500MM.
CC2 CUTOUT FOR CABLES OF EQUIPMENTS 1300x1300MM.
CC3 CUTOUT FOR CABLES OF EQUIPMENTS 200x300MM.
CC4 CUTOUT FOR CABLES OF EQUIPMENTS 1000x750MM.
CC5 CUTOUT FOR CABLES OF EQUIPMENTS 3400x600MM.
CC6 CUTOUT FOR CABLES OF EQUIPMENTS 800x500MM.
T1 TRENCH FOR CABLES OF EQUIPMENTS 200x300 DEEP.

PROJECT	2X60MW – VYASI HYDROELECTRIC PROJECT, UTTARAKHAND
COSTUMER	UJVN LIMITED
CONSULTANT	–

भारत हेवी इलेक्ट्रिकल्स लिमिटेड, भोपाल
Bharat Heavy Electricals Limited, Bhopal

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	T.KHAN		06/08/14	
CHKD	G.C.SEKHAR		06/08/14	
APPD	R.SINGH		06/08/14	

REV.	DATE	ALTERED		ZONE	DESCRIPTION
		CHECKED			
		APPROVED			
07	08.12.18	CHECKED	SHAILESH	ZONE	DRG REVISED AS PER LATEST EQUIP.SIZES
		APPROVED	R.SINGH		
06	24.05.18	CHECKED	SHAILESH	ZONE	DRG REVISED AS PER LATEST BUS DUCT LAYOUT DRAWING
		APPROVED	R.SINGH		
05	02.05.17	CHECKED	R.SINGH	ZONE	DRG REVISED AS PER LATEST BUS DUCT LAYOUT DRAWING
		APPROVED	R.SINGH		
04	23.11.17	CHECKED	HS YADAV	ZONE	DRG REVISED AS PER CUSTOMER COMMENTS DATED 31.08.17
		APPROVED	R.SINGH		
03	28.08.17	CHECKED	R.SINGH	ZONE	DRG REVISED AS PER CUSTOMER COMMENTS & DESIGN REQUIREMENT
		APPROVED	R.SINGH		
02	14.06.17	CHECKED	R.SINGH	ZONE	DRG REVISED AS PER LATEST CIVIL DRAWINGS COMMENTS RECEIVED DATED 26.05.17
		APPROVED	R.SINGH		
01	06.04.17	CHECKED	R.SINGH	ZONE	DRG REVISED AS PER LATEST CIVIL DRAWINGS RECEIVED DATED 24.0317
		APPROVED	R.SINGH		

ADDITIONAL INFORMATION
STATUS OF DRAWING
DISTRIBUTION OF PRINTS

DEPT HPE	UNTOL. DIMS. GR.	ANGLE	SCALE 1:150	WEIGHT(kg)	REF.TO ASSY.DRG.	ITEM NO. / NO.OF ITEMS
CODE 415						

TITLE: CIVIL GUIDELINES
PLAN AT EL 519.85M

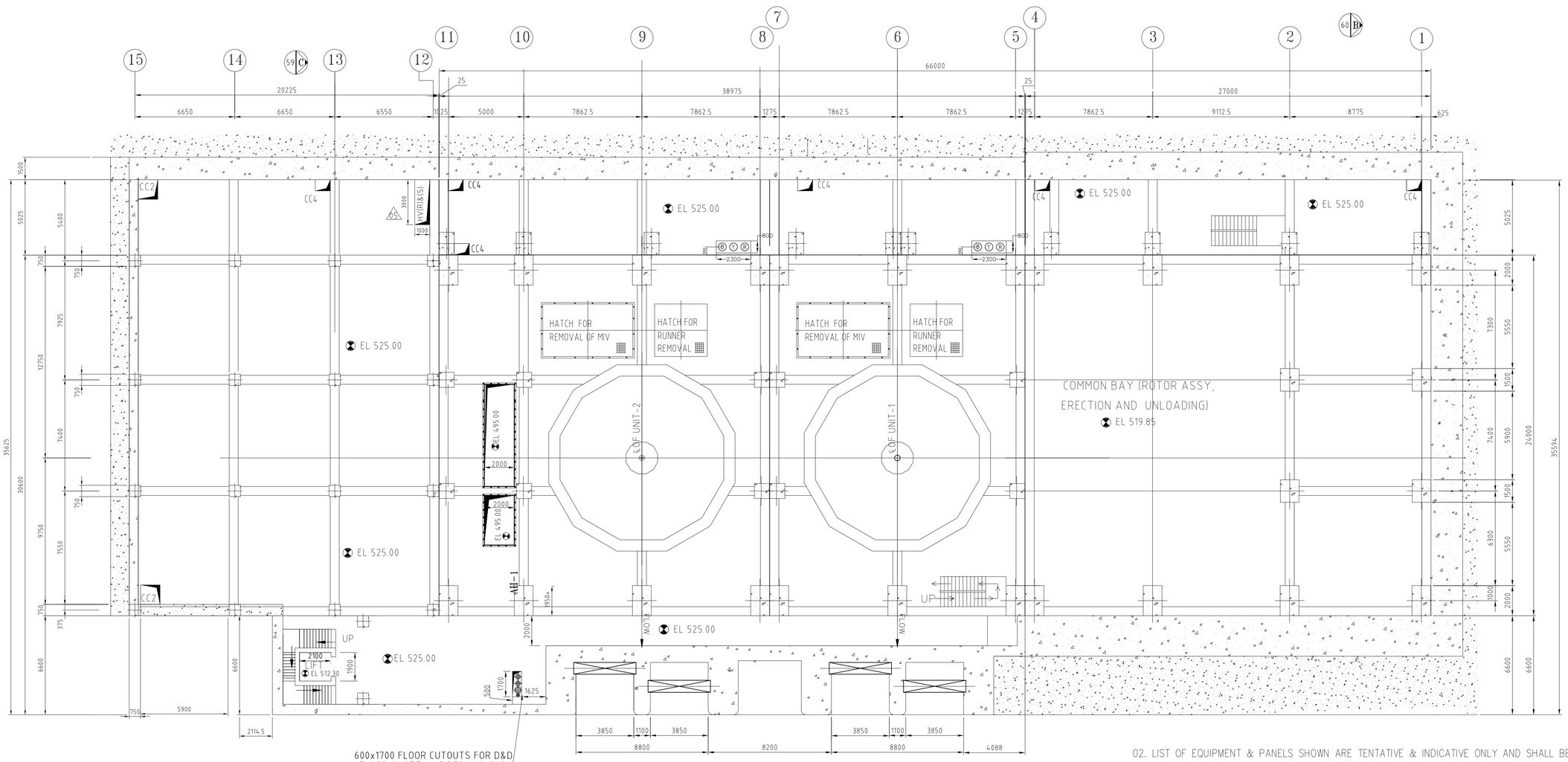
DRAWING NO. 1 200 00 196 73 REV. 07
SHEET NO. 01 NO. OF SHEETS. 01

A1 SIZE

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 1 200 00 196 74 REV. 05



PLAN AT EL 525.00M

02. LIST OF EQUIPMENT & PANELS SHOWN ARE TENTATIVE & INDICATIVE ONLY AND SHALL BE FINALISED DURING DETAIL DESIGN.
03. SIZES OF COLUMNS/BEAMS/SLABS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.

LEGENDS:-

HV(S) CUTOUT FOR HVAC SUPPLY DUCT 2000x1000MM.
HV(R) CUTOUT FOR HVAC RETURN DUCT 1500x1000MM.
CC CUTOUT FOR CABLES/PIPES 2000x1000MM.
CC1 CUTOUT FOR CABLES OF EQUIPMENTS 500x500MM.
CC2 CUTOUT FOR CABLES OF EQUIPMENTS 1300x1300MM.
CC3 CUTOUT FOR CABLES OF EQUIPMENTS 200x300MM.
CC4 CUTOUT FOR CABLES OF EQUIPMENTS 1000x750MM.
CC5 CUTOUT FOR CABLES OF EQUIPMENTS 3400x600MM.
MH-1, MH-2: MAIN HOOK OF CRANES - 1 & 2.
AH-1, AH-2: AUX. HOOK OF CRANES - 1 & 2.
MRH-1: MONORAIL HOOK OF CRANES - 1

REFERENCE DRAWINGS:

BHEL DRAWINGS: 1-200-00-186-51 TO 55,57,58 TO 61

REV.	DATE	ALTERED / CHECKED / APPROVED		ZONE	DESCRIPTION
05	02.05.18	ALTERED	T KHAN	ZONE	DRG REVISED AS PER LATEST BUS DUCT LAYOUT DRAWING
		CHECKED	RSINGH		
		APPROVED	R.SINGH		
04	23.11.17	ALTERED	HS YADAV	ZONE	DRG REVISED AS PER CUSTOMER COMMENTS DATED 31.08.17
		CHECKED	RSINGH		
		APPROVED	R.SINGH		
03	28.08.17	ALTERED	H S YADAV	ZONE	DRG REVISED AS PER CUSTOMER COMMENTS & DESIGN REQUIREMENT
		CHECKED	R.SINGH		
		APPROVED	R.SINGH		
02	14.06.17	ALTERED	H S YADAV	ZONE	DRG REVISED AS PER LATEST CIVIL DRAWINGS COMMENTS RECEIVED DATED 26.05.17
		CHECKED	R.SINGH		
		APPROVED	R.SINGH		
01	01.05.17	ALTERED	H S YADAV	ZONE	DRG REVISED AS PER LATEST CIVIL DRAWINGS RECEIVED DATED 24.0317
		CHECKED	R.SINGH		
		APPROVED	R.SINGH		

ADDITIONAL INFORMATION
STATUS OF DRAWING
DISTRIBUTION OF PRINTS

PROJECT	2X60MW – VYASI HYDROELECTRIC PROJECT, UTTARAKHAND						
COSTUMER	UJVN LIMITED						
CONSULTANT	–						
भारत हेवी इलेक्ट्रिकल्स लिमिटेड, भोपाल Bharat Heavy Electricals Limited, Bhopal		NAME	SIGN	DATE	NO. OF VAR.		
	DRWN	T.KHAN		26/08/14			
	CHKD	G.C.SEKHAR		26/08/14			
	APPD	R.SINGH		26/08/14			
DEPT HPE / CODE 415	UNTOL. DIMS. GR.	ANGLE	SCALE 1:150	WEIGHT(kg)	REF.TO ASSY.DRG.	ITEM NO.	NO.OF ITEMS
TITLE	CIVIL GUIDELINES PLAN AT EL 525.00M				DRAWING NO. 1 200 00 196 74		REV. 05
					SHEET NO. 01	NO. OF SHEETS. 01	

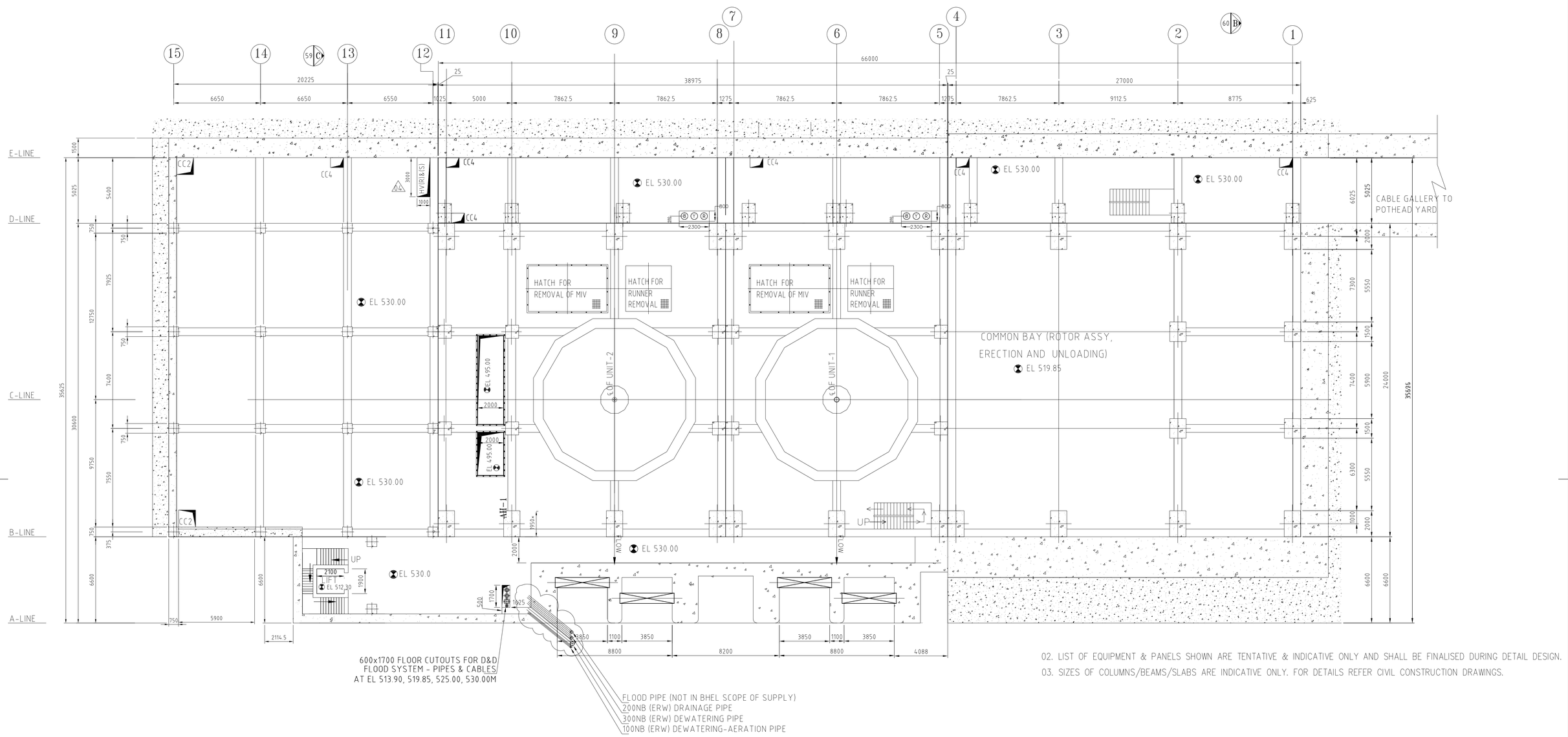
REF. DRG. NO. | SIGN. & DATE | INVENTORY NO.

A1 SIZE

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 1 200 00 196 75 REV. 04



PLAN AT EL 530.00M

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. LIST OF EQUIPMENT & PANELS SHOWN ARE TENTATIVE & INDICATIVE ONLY AND SHALL BE FINALISED DURING DETAIL DESIGN.
03. SIZES OF COLUMNS/BEAMS/SLABS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.
04. DRAINAGE, DEWATERING, AERATION & FLOOD PIPES ARE CARRIED UPTO & ABOVE FLOOD LEVEL I.E., EL 531.50M THROUGH FLOOR CUTOUTS AND EMBEDDED IN CONCRETE WALL, AS INDICATED, AT EL 533.30M FOR DISCHARGING WATER INTO TAIL RACE CHANNEL.

REFERENCE DRAWINGS:

BHEL DRAWINGS: 1-200-00-186-51 TO 56 & 58 TO 61

LEGENDS:-

HV(S) CUTOUT FOR HVAC SUPPLY DUCT 2000x1000MM.
HV(R) CUTOUT FOR HVAC RETURN DUCT 1500x1000MM.
CC CUTOUT FOR CABLES/PIPES 2000x1000MM.
CC1 CUTOUT FOR CABLES OF EQUIPMENTS 500x500MM.
CC2 CUTOUT FOR CABLES OF EQUIPMENTS 1300x1300MM.
CC3 CUTOUT FOR CABLES OF EQUIPMENTS 200x300MM.
CC4 CUTOUT FOR CABLES OF EQUIPMENTS 1000x750MM.
CC5 CUTOUT FOR CABLES OF EQUIPMENTS 3400x600MM.
MH-1, MH-2: MAIN HOOK OF CRANES - 1 & 2.
AH-1, AH-2: AUX. HOOK OF CRANES - 1 & 2.
MRH-1: MONORAIL HOOK OF CRANES - 1

02. LIST OF EQUIPMENT & PANELS SHOWN ARE TENTATIVE & INDICATIVE ONLY AND SHALL BE FINALISED DURING DETAIL DESIGN.
03. SIZES OF COLUMNS/BEAMS/SLABS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.

REV.	DATE	ALTERED		ZONE
04	02.05.18	CHECKED	T.KHAN	
		APPROVED	R.SINGH	DRG REVISED AS PER LATEST BUS DUCT LAYOUT DRAWING
03	23.11.17	CHECKED	R.SINGH	
		APPROVED	R.SINGH	DRG REVISED AS PER CUSTOMER COMMENTS DATED 31.08.17
02	28.08.17	CHECKED	H.S YADAV	
		APPROVED	R.SINGH	DRG REVISED AS PER CUSTOMER COMMENTS & DESIGN REQUIREMENT
01	09.05.17	CHECKED	H.S YADAV	
		APPROVED	R.SINGH	DRG REVISED AS PER LATEST CIVIL DRAWINGS RECEIVED DATED 24.0317

PROJECT	2X60MW – VYASI HYDROELECTRIC PROJECT, UTTARAKHAND
COSTUMER	UJVN LIMITED
CONSULTANT	–

भारत हेवी इलेक्ट्रिकल्स लिमिटेड, भोपाल
Bharat Heavy Electricals Limited, Bhopal

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	T.KHAN		26/08/14	
CHKD	G.C.SEKHAR		26/08/14	
APPD	R.SINGH		26/08/14	

ADDITIONAL INFORMATION
STATUS OF DRAWING
DISTRIBUTION OF PRINTS

DEPT HPE | CODE 415 | UNTOL. DIMS. GR. | ANGLE | SCALE 1:150 | WEIGHT(kg) | REF.TO ASSY.DRG. | ITEM NO. | NO.OF ITEMS

TITLE: CIVIL GUIDELINES
PLAN AT EL 530.00M

DRAWING NO. 1 200 00 196 75 REV. 04

SHEET NO. 01 NO. OF SHEETS. 01

A1 SIZE

REF. DRG. NO. | SIGN. & DATE | INVENTORY NO.