

बी एच ई एल 		TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(d)	EMERSON
		(e)	ABB
		(f)	FUJI (AIC)
5.6	NOX / SO2 ANALYSER (IN SITU)	(a)	CODEL, UK
		(b)	FORBES MARSHALL
		(c)	LAND COMBUSTION, UK
5.7	OZONE ANALYSER	(a)	BMT MESSTECHNIK, GMBH
5.8	RESIDUAL OZONE ANALYSER	(a)	ECO SENSORS / KAUFFMANN UMWITTECHNIK .EK
5.9	OZONE LEAK DETECTOR	(a)	OTTPL
6.0	CONTROL VALVES / ACTUATORS / SOLENOID VALVES:		
6.1	ELECTRICAL ACTUATORS FOR REGULATING & OPEN / CLOSE VALVES	(a)	ROTORK CONTROL (INDIA) LTD.,
		(b)	AUMA (INDIA) LTD.,
		(c)	LIMITORQUE INDIA LTD.
6.2	PNEUMATIC ACTUATORS-REGULATING & OPEN / CLOSE	(d)	INSTRUMENTATION LTD., PALGHAT
		(e)	KELTRON CONTROLS, KERALA
6.3	SH/RH SPRAY CONTROL VALVES SH/RH SPRAY BLOCK VALVES FEED CONTROL VALVES	(a)	MIL CONTROLS LTD.
		(b)	INSTRUMENTATION LTD. PALGHAT
		(c)	FISHER SANMAR LTD.
		(d)	CONTROL COMPONENT INC., USA
		(e)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.4	LFO/HFO CONTROL, AND TRIP VALVES, FLOW CONTROL, PRESSURE	(a)	MIL CONTROLS LTD.
		(b)	INSTRUMENTATION LTD. PALGHAT

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	CONTROL, TEMP. CONTROL, AND BURNER TRIP VALVES, BALL VALVES	(c)	FOURESS ENGG (I) LTD, BANGALORE
		(d)	SAMSON CONTROLS , PUNE
6.5	SOOT BLOWER PRESSURE REDUCING VALVE	(a)	MIL CONTROLS LTD.
		(b)	INSTRUMENTATION LTD., PALGHAT
		(c)	FISHER SANMAR LTD.
		(d)	CONTROL COMPONENT INC., USA
		(e)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.6	APRDS CONTROL VALVES	(a)	INSTRUMENTATION LTD.
		(b)	CONTROL COMPONENT INC., USA
		(c)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.7	CONTROL VALVES- NON CRITICAL	(a)	DEZURIK COPES VULCAN LTD., U.K.
		(b)	CONTROL COMPONENT INC., USA
		(c)	FISHER SANMAR LIMITED
		(d)	INSTRUMENTATION LTD
		(e)	MIL CONTROL LTD.
		(f)	FISHER XOMOS SANMAR LTD.
		(g)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.8	SOLENOID VALVE	(a)	ASCO, CHENNAI
		(b)	ROTEX AUTOMATION LTD., GUJRAT
		(c)	AVCON CONTROLS, MUMBAI
6.9	HP/LP BYPASS VALVES	(a)	BOPP & REUTHER SR GMBH CONTROL COMPONENTS INC (CCI)

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6.10	ELECTRO-HYDRAULIC ACTUATOR	(a)	LEONARDO AUTOMATION (INDIA) PVT. LTD.
7.0	<u>ERECTION HARDWARES:</u>		
7.1	LOCAL INSTRUMENT RACK (LIR) AND LOCAL INSTRUMENT ENCLOSURES (LIE)	(a)	PYROTECH, UDAIPUR
		(b)	INSTRUMENTATION LTD., KOTA
		(c)	ELECTRONICS CORPORATION OF INDIA LTD., HYDERABAD
		(d)	CHEMIN CONTROLS, PONDICHERRY
		(e)	PRAMMEN INDUSTRIES
7.2	INSTRUMENT VALVES	(a)	EXCEL HYDRO PNEUMATICS PVT. LTD., MUMBAI
		(b)	BHEL
		(c)	METPRESS ENGINEERING WORKS, KOLKATA
		(d)	BALDOTA VALVE & FITTING CO. PVT. LTD., MUMBAI
		(e)	AURA INC., NEW DELHI
		(f)	INSTRUMENTATION LTD. PALGHAT
		(g)	PRECISION ENGG. INDUSTRIES, MUMBAI
		(h)	VIKAS INDUSTRIAL PRODUCTS, NEW DELHI
7.3	VALVE MANIFOLDS	(a)	EXCEL HYDRO PNEUMATICS PVT. LTD., MUMBAI
		(b)	METPRESS ENGINEERING WORKS, KOLKATA

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		(c)	BALDOTA VALVE & FITTING CO. PVT. LTD., MUMBAI
		(d)	AURA INC., NEW DELHI
		(e)	PRECISSION ENGG. INDUSTRIES, MUMBAI
		(f)	HP VALVES AND FITTINGS, CHENNAI
7.4	COMPRESSION FITTINGS / SOCKET WELD FITTINGS	(a)	SWAGELOCK, USA
		(b)	ASTEC VALVES & FITTINGS PVT. LTD.
		(c)	MET-LOK HYDRO PNEUMATICS PVT. LTD.
7.5	CONDENSATE POTS	(a)	EXCEL HYDRO-PNEUMATICS PVT. LTD., MUMBAI
		(b)	MICROPRECISION, FARIDABAD
		(c)	INSTRUMENTATION LTD. PALGHAT
		(d)	METPRESS ENGINEERING WORKS, KOLKATA
		(e)	BALDOTA VALVES & FITTINGS CO. PVT. LTD., MUMBAI
		(f)	PRECISSION ENGG. INDUSTRIES, MUMBAI
7.6	IMPULSE & SAMPLE PIPINGS	(a)	TPS TECHNITUBE ROHREN WERKE GMBH, GERMANY
		(b)	MAHARASHTRA SEAMLESS LTD.
		(c)	BHEL
		(d)	CHOKSI TUBE COMPANY LTD., INDIA
		(e)	INDIAN SEAMLESS METAL TUBES LTD., INDIA
		(f)	MANNESMANN AG, GERMANY

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		(g)	TOUVAY AND CAUVIN GULF EC, DUBAI
		(h)	JINDAL SAW PIPES LTD., INDIA
		(i)	SUMITOMO CORPORATION, JAPAN / KAWASAKI
		(j)	RATNAMANI METALS & TUBES LTD., AHMEDABAD
7.7	JUNCTION BOX (FRP)	(a)	DEVI POLYMERS, CHENNAI
		(b)	SUCHITRA INDUSTRIES, BANGALORE
		(c)	RITTAL
		(d)	PYROTECH
		(e)	L&T
		(f)	HENSEL ELECTRIC INDIA PVT. LTD., SRIPERUMBUDUR
7.8	AIR CYLINDER	(a)	VELJAN HYDRAIR, HYDERABAD
		(b)	NUCON INDUSTRIES, HYDERABAD
		(c)	PRECISION ENGG. (PREAC), BANAGALORE
		(d)	ASCO, CHENNAI
8.0	<u>CABLES:</u>		
8.1	CONTROL CABLES	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	POLYCAB, DAMAN
		(e)	GAYOLENE, MUMBAI
		(f)	RELIANCE ENGRS, BANGALORE
		(g)	CORDS CABLES, RAJASTHAN

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		(h)	PARAMOUNT CABLES, ALWAR
		(i)	THERMOCABLES, BANGALORE,
		(j)	KEI INDUSTRIES LTD., CHENNAI
8.2	INSTRUMENTATION CABLE	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	POLYCAB, DAMAN
		(e)	GAYOLENE, MUMBAI
		(f)	RELIANCE ENGRS, BANGALORE
		(g)	CORDS CABLES, RAJASTHAN
		(h)	PARAMOUNT CABLES, ALWAR
		(i)	THERMOCABLES, BANGALORE / HYDERABAD
		(j)	KEI INDUSTRIES LTD., CHENNAI
		(k)	CABLE CORPRN OF (I) LTD., CHENNAI
		(l)	RPG CABLES LTD., CHENNAI
		(m)	FORT GLOSTER INDUSTRIES LTD. KOLKATA
		(n)	DECO CABLES, DELHI
		(o)	KRISHNA CABLES, GWALIOR
		(p)	THERMAPADS (P) LTD
		(q)	ELKAY TELELINKS LTD.
		(r)	INCAB INDUSTRIES LTD
		(s)	TORRENT CABLE LTD.
8.3	COMPENSATING CABLES	(a)	DELTON CABLE

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		(b)	TOSHNIWAL, MUMBAI RELIANCE, BANGALORE
		(c)	LAPP INDIA, MUMBAI/ BANGALORE
		(d)	CORDS CABLES, RAJASTHAN
		(e)	PARAMOUNT CABLE
8.4	SPECIAL CABLES (PTFE /FEP INSULATED CABLES)	(a)	TOSHNIWAL CABLE
		(b)	RELIANCE CABLES
		(c)	LAPP INDIA, MUMBAI
		(d)	PARAMOUNT CABLES
		(e)	FINOLEX, PUNE
8.5	POWER CABLES (LT)	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	CORDS CABLES, RAJASTHAN
		(e)	FORTGLASTER INDUSTRIES
		(f)	INCAB, PUNE
		(g)	CCIL, BANGALORE
		(h)	KEI INDUSTRIES LTD., CHENNAI
		(i)	POLYCAB, DAMAN PARAMOUNT CABLES, ALWAR
9.0	<u>UPS / DC SYSTEM:</u>		
9.1	UPS WITH ACDB	(a)	HI-REL ELECTRONICS
		(b)	EMERSON NETWORK (FORMERLY TATA LIEBERT)
		(c)	DB POWER ELECTRONICS
9.2	24 VDC BATTERY CHARGER	(a)	CALDYNE, KOLKATA

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	WITH DCDB	(b)	AMARARAJA, TIRUPATI
		(c)	CHHABI ELECTRICALS, JALGAON
		(d)	HBL POWER SYSTEMS, HYDERABAD
		(e)	MASS TECH CONTROLS
9.3	BATTERY (TUBULAR/PLANTE) (TUBULAR) (TUBULAR)	(a)	EXIDE, KOLKATA
		(b)	HBL NIFE, HYDERABAD UNION BATTERY (BUI PUNE)
9.4	BATTERY (NICKEL- CADMIUM)	(a)	HBL POWER SYSTEMS, HYDERABAD
		(b)	AMCO, BANGALORE
Laboratory Instruments: Bidder shall submit the vendor list with credentials for Mahagenco's approval. NOTE : The vendors indicated in the above list are Mahgenco's approved vendors, however, the product of above vendors proposed for this project shall meet the requirements stipulated in 'Proven Product' Cl. No. 5.0 of Vol. V, Section I of Tender Specification. Notes:- 1) The above sub-vendor list is tentative & reference only. However sub-vendor list is subject to BHEL/end user approval without any commercial/delivery implication. 2) New subvendor if proposed by vendor during contract stage shall be subject to BHEL/end user approval without any commercial/delivery implication.			

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	TITLE :		SPECIFICATION NO. PE-TS-415-174-A001	
	1X660 MW BHUSAWAL TPS, UNIT # 6		SECTION : I	
	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT		SUB-SECTION: IA	
			REV. NO. 00	

Notes:-

1. The sub vendor list above is indicative only and is subject to BHEL and customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.
2. The inspection category will be intimated after award of contract by BHEL/customer. However, the same will be adhered by the bidder without any commercial and delivery implication to BHEL/ customer.

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ANNEXURE III: FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

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1.0 PERFORMANCE GUARANTEES

1.1 GENERAL REQUIREMENTS

- 1.1.1 The equipment shall meet the ratings and performance requirements stipulated for various equipment. The guaranteed performance parameters shall be without any tolerance values and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.
- 1.1.2 All the guarantees shall be demonstrated during performance guarantee test. The various tests which are to be carried out during performance guarantee are listed below. The guarantee tests shall be conducted at site.
- 1.1.3 All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, these shall be calibrated in an independent test Institute. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.
- 1.1.4 Tools and tackles, instruments/ devices including flow devices, matching flanges, impulse piping & valves etc and any special equipment, required for the successful completion of the tests, shall be provided by the bidder.
- 1.1.5 All cost associated with the tests shall be included in the bid price.
- 1.1.6 In case during performance guarantee test(s), it is found that the equipment/ system has failed to meet the guarantees, all necessary modifications and/or replacements shall be carried out to make the equipment/system comply with the guaranteed requirements & the same shall be demonstrated by conducting another performance guarantee test. However, if the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit specified, the equipment will be accepted after levying liquidated damages. If, however, the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed, after the tests have been completed, the Owner will have the right to either of the following:

(I) For Category-I Guarantees

Reject the equipment/system/plant and recover from the contractor.

OR

Accept the equipment/system/plant after levying Liquidated Damages

(II) For Category-II Guarantees

Reject the equipment/system/plant and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category II' Guarantees. Conformance to the performance requirements under Category-II is mandatory.

(III) For Category-III Guarantees

Reject the equipment/system/plant and recover from the Contractor.

OR

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Owner. Such damages shall however be limited to the cost of replacement of the equipment(s)/system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance.

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1.2 GUARANTEES UNDER CATEGORY- I

The performance guarantees which attract liquidated damages are as follows:

Auxiliary power consumption - Summation of power consumption of working drives at their rated capacities for Ozone Generation Plant. Base auxiliary power consumption for Ozone Generation Plant and penalties shall be as per Section III (GPC format). Bidder to furnish its guaranteed auxiliary power consumption with its technical offer (Not in sealed price). Bidder to refer guaranteed auxiliary power requirement for Ozone Generation Plant package in GPC format. The base auxiliary power consumption is specified in the format for guaranteed auxiliary power consumption figures (GPC format).

1.3 GUARANTEES UNDER CATEGORY-II

Not Applicable for Ozone Generation Plant

1.4 GUARANTEES UNDER CATEGORY-III

The parameters/capabilities to be demonstrated for various systems/ equipment shall include but not be limited to the following:

1.4.1 Noise

All the plant, equipment and systems shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779. Maximum permissible noise level for Blowers shall be 85 dB (A)

Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation. Corrections for background noise shall be considered in line with the applicable standards.

1.4.2 PERFORMANCE GUARANTEE PARAMETERS FOR OZONE GENERATION PLANT

The PG Test Procedure shall cover the test to be conducted at site for the entire system / sub-systems and individual equipment covered in Ozone Generation Plant and shall include at least Ozone Generators, Compressors, Air receiver, Oxygen generators, Air driers, oxygen receiver, chillers, all pumps, atmospheric tanks, analyzers, air conditioning and ventilation system, electric hoist all piping and valves, Electrical and Electronic controls including PLC etc.

Objective of the Test: The following minimum objectives will be checked:

- To check healthy working of all the equipment forming the total Ozone Generation Plant.
- To check the capacity of the Ozone generators, Oxygen generators, capacity and head Compressors, pumps etc.
- To log the operating parameters of the Ozone Generators and Compressors with online calibrated instruments at the time of capacity test. Separate calibrated instruments can also be used to measure the parameters other than online instruments
- To check satisfactory operation of all interlock protection devices, trace Ozone analyzers, Oxygen purity analyzer, dew point transmitter, residual ozone analyzer etc.
- To measure the purity of the Oxygen and ozone gas.
- Ozone shall be dosed continuously @ 0.2 ppm in CW system and condenser and residual ozone level of 0.02 ppm shall be maintained in the system.

• **Condition of conductance of Test:**

- PG Test at site shall be conducted by bidder and witnessed by BHEL and/ or customer. The Bidder shall inspect the entire system in advance and make it ready for the test.
- The **entire** responsibility for conducting the test rests with the bidder.

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Test Instruments:

- All instruments required for PG Test as per objective of the test is in bidder's scope. Online instruments installed in the system shall be used for majority of readings. In case any offline instruments are required, the same shall be provided by the bidder free of cost on returnable basis.
- Calibration of all the test instruments (installed online instruments and offline instruments) shall be the responsibility of the bidder.
- Calibration of all the instruments shall be carried out within a period of six months preceding the commencement of test.
- Calibration certificates of all the instruments shall be submitted by bidder to BHEL.
- The instruments to be arranged by the bidder shall however not be limited to those listed above and any other instrument / apparatus required for successful conduction of PG Test as per the objectives of the test shall also be arranged by the bidder free of cost.

PG test Process:

The PG Test of all Ozone Generators and Compressors and their associated equipment shall cover mainly following tests:

- Capacity test of Ozone generators, compressors, Oxygen generators, air driers, pumps, chillers etc.
- Capacity of the ozone generator shall be checked by determining the flow of ozonated water and concentration of ozone in ozonated water.
- Measurement of total Auxiliary power consumption for the item listed in Section III (GPC format).
- Measurement of Oxygen purity at oxygen generator outlet.
- Measurement of Ozone purity at Ozone generator outlet.
- Measurement of residual Ozone.
- All interlocks & logics functioning as per approved interlock logic diagram.
- All the equipment and systems shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified. Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779. Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation. Corrections for background noise shall be considered in line with the applicable standards.
- Ozone dosing and its effectiveness in the Cooling water.

Note: The above mentioned PG test requirements are bare minimum. However, any comments /requirement as required by BHEL/Customer during detailed engineering stage shall be provided by successful bidder without and price and delivery implication to BHEL.

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1X660 MW BHUSAWAL TPS, UNIT # 6

SPECIFICATION NO. PE-TS-415-174-A001

SECTION : I

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GENERATION PLANT

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ANNEXURE IV : DRAWING DOCUMENTS DISTRIBUTION PROCEDURE

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- Bidder shall submit soft copy/hard copy/CD ROMs of all the finally approved drawings and O&M Manuals as required by Customer/Customer consultant/BHEL-site/BHEL-PEM. The exact number of hard copies/CD ROMs of these documents to be submitted shall be notified to the bidder at the time of detailed engineering and bidder shall submit the same without any commercial/delivery implications to BHEL/Customer.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.
- Editable copy of all the drawings and documents shall be provided.
- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copies whichever is later.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.
- Vendor to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.
- Bidder to submit instrument schedule, cable schedule and valve schedule in MS- Excel format during detailed engineering.
- Bidder to also furnish the auto cad copy/MS-Excel/MS-word (as applicable) of the following documents after award of contract. However any other auto cad copy/MS-Excel/MS-word of any other document as per the insistence of BHEL and customer will also be submitted by the bidder without any delivery and commercial implication to BHEL and customer.
 - P&IDs.
 - Equipment lay out of the Ozone Generation Plant.
 - Cable tray lay out.
 - Civil scope drawings.
 - Piping lay out drawing.

Other requirements

- Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system 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.
- 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.
- 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. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.

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S. NO.	DESCRIPTION	CONSULTANT	CUSTOMER HEAD OFFICE	CUSTOMER SITE	BHEL UNIT	BHEL SITE
A	POST CONTRACT CORRESPONDENCE	1	S	1	1	0
		0	1	S	1	1
		0	1	1	S	1
		0	1	1	1	S
B	DRAWINGS/DOCUMENT SUBMISSION					
	A) SUBMISSION	2	11	2	S	2
	B) RETURN OF SUBMISSION WITH COMMENTS/APPROVAL BY KPCL	1	S	1	2	0
	C) RFC ISSUE	2	11	2	S	4
	D) AS BUILT	2	11	2	S	4
	E) ERECTION DRAWINGS	2	11	3	S	5
C	PROGRESS REPORT (MONTHLY)					
	EPC CONTRACTOR'S REPORT	2	11	5	S	4
D	INSTRUCTION MANUALS					
	ERECTION & COMMISSIONING	2	11	3	S	3
	O & M MANUAL	2	1 + 8CD	5 + 11CD	S	2 + 5CD

- Quantity of prints may change during detailed engineering stage based on BHEL / Customer requirement. However, the same will be adhered by the bidder without any delivery/commercial implication to BHEL.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required. Vendor to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.
- Cable schedule in BHEL format (shall be provided during detailed engineering stage).

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TITLE :

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SPECIFICATION NO. PE-TS-415-174-A001

SECTION : I

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SUB-SECTION: IA

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ANNEXURE V: PAINTING SPECIFICATION



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
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openings shall be closed with forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.0 PAINING

15.1 GENERAL

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in



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windy weather or near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment.

Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

The Contractor shall select shop primer for steel and iron surfaces, which will have a continuous operating temperature below 35°C, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35°C.

The Owner/Engineer shall submit the colour scheme during execution of contract for approval.

15.2 PREPARATION

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed.

The priming coat shall be applied without delay.

15.3 DAMAGED PAINTWORK

Any damaged paintwork shall be made good as follows:

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15.3.1 The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

15.3.2 A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.

15.3.3 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming

15.4 PAINTING SYSTEMS

The requirements for the Dry Film Thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

15.4.1 Surfaces subject to Weathering

All surfaces shall have a minimum of four coats of paint made up as follows:

(a)	Primer coat	:	35 micron DFT
(b)	Tie coat	:	35 micron DFT
(c)	Finishing coat (Two Nos.)	:	35 micron DFT per coat
(d)	The total minimum DFT	:	140 micron

15.4.2 Surfaces Inside Buildings

All surfaces shall have a minimum of three coats of paint made up as follows:

(a)	Primer coat	:	35 micron DFT
(b)	Tie coat	:	35 micron DFT
(c)	Finishing coat (Two Nos.)	:	25 micron DFT per coat
(d)	The total minimum DFT	:	120 micron



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The Contractor shall select the type and colour of primer & finish coat after approval by the Owner.

For detail painting on building & structural steel elements, please refer **Volume VI / A & B** of this specification.

16.0 COLOUR CO-ORDINATION & FINISH

16.1 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

16.2 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

16.3 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

16.4 Final colours and finishes shall be to the Approval of the Engineer.

17.0 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

17.1 ENVIRONMENT PROTECTION

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and Stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulates any other conditions not specified hereunder while clearing the project, same shall be complied with by the Contractor.

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ANNEXURE VI: MANDATORY SPARES LIST

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S.No.	Item	Quantity
1.	Suction/Discharge valve for Compressor	Two (2) each
2.	Seal Kits for pneumatic valves	Five (5)
3.	H.T. elements for H.E. of Ozone Electrode	Four Hundred (400)
4.	Dielectric tubes for H.E. of Ozone Electrode	Four Hundred (400)
5.	Viton Gaskets for Ozone Electrode	One (1) set
6.	Compressor Lub oil	Eighty (80) lit
7.	Air/oil filters for Compressor	One (1) each
8.	Rota meter for ozone gas	Two (2)
9.	Drive Motor	One (1)

Mandatory Spares for Electric Hoists (for each type and rating)		
1	Brake linings	Two (2) sets of each type
2	Rope guide and rope tighter	One (1) of each type
3	Limit switch	Two (2) of each type and size
4	Bearings for long travel wheels	Two (2) sets
5	Bearings for gear boxes for each type of hoist	Two (2) sets
6	Break liners for all the brakes	100% of total population of each type & size
7	Oil seals	100% of total population of each type, size rating
8	Brake springs for all brakes	100% of total population of each type, size rating
9	Wire ropes for hooks	100% installed on each crane and hoist
10	Solenoid coils for brakes	Two (2) sets
11	Overload relay for motors	Two (2)
12	Limit switches for hoists and travel mechanisms	Two (2) sets
13	Spare motors for hoists	Two (2)
14	Long travel machinery	
14.1	Gear wheel	One (1) set
14.2	Internal clip	Two (2)
14.3	Pinion	One (1)

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Mandatory Spares for Chain Pulley Blocks (for each type and rating) As Applicable		
1	Load chain wheel	One (1)
2	Load chain stripping fork	Five (5)
3	Hand chain wheel	Two (2)
4	Ratchet pawl	One (1)
5	Locking ratchet wheel	Two (2)
6	Guide roller	Two (2)
7	Brake disc	Two (2)

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<u>SR.NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
	(b) Temperature scanner for 11kV/0.433kV transformers	2 Nos.
6.0	<u>MOTORS</u>	
6.1	<u>11kV MOTORS & 3.3kV MOTORS</u>	
6.1.1	Termination kits (if elastimold type) of each type	1 set For each type & rating of Motor
6.1.2	Termination kits (end connection)	1 set For each type & rating of Motor
6.1.3	Temperature indicators	1 set For each type & rating of Motor
6.1.4	Vibration indicators	1 no. For each type & rating of Motor
6.1.5	Terminal box Teflon glands	3 nos. For each type & rating of Motor
6.1.6	Phase segregated and non phase segregated terminal boxes	1 set For each type & rating of Motor
6.1.7	Heaters	1 set For each type & rating of Motor
6.1.8	Couplings	1 set For each type & rating of Motor
6.1.9	Bearings (DE and NDE)	1 set For each type & rating of Motor
6.1.10	Motor of each type and rating	One number of each type and rating
6.1.11	Cooling fan Internal & External	1 set For each type & rating of Motor
6.1.12	Neutral end terminal bushing with fasteners	1 set For each type & rating of Motor
6.2	<u>415V MOTORS</u>	
6.2.1	Terminal plates for motors upto 30kw for each rating	1 nos. For each type & rating of Motor
6.2.2	Terminal plates for motors above 30kw for each rating	1 nos. For each type & rating of Motor

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<u>SR.NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
6.2.3	Heaters	1 set For each type & rating of Motor
6.2.4	Greasing arrangements	1 set For each type & rating of Motor
6.2.5	Motor of each type and rating	10% of the installed quantity or minimum 1 number whichever is higher
6.2.6	Bearings (DE and NDE)	1 set For each type & rating of Motor
6.2.7	End shield cover driving of non driving end	1 set For each type & rating of Motor
6.2.8	Cooling fan	1 set For each type & rating of Motor
6.2.9	Motor terminal block	1 set For each type & rating of Motor
6.2.10	Complete set of coupling	1 set For each type & rating of Motor
6.3	<u>DC MOTORS</u>	
6.3.1	Carbon brushes of each type	10 sets
6.3.2	Brush assemblies of each type	2 sets
6.3.3	Terminal blocks of each type	2 sets
6.3.4	Heaters of each type	2 sets
6.3.5	Pulley of each type	2 sets
6.3.6	Motor of each type and rating	10% of the installed quantity or minimum 1 number whichever is higher
6.3.7	Bearing (DE and NDE)	1 set For each type & rating of Motor
7.0	<u>11 KV AND 3.3 KV SWITCHGEARS</u>	
7.1	<u>11 kV SWITCHGEAR</u>	

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
3.0	<u>MEASURING INSTRUMENTS</u>	
3.1	<u>ELECTRONIC TRANSMITTERS</u>	
3.1.1	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level etc.)	10% or 2 no. of each type and model, whichever is more
3.1.2	Electronic cards / PCB's for each type and model and model of transmitters	10% or 5 nos. of each type, whichever is more
3.2	<u>TEMPERATURE ELEMENTS</u>	
3.2.1	RTDs of each type & length	10% or 2 nos. whichever is more
3.2.2	Thermocouples of each type like K-type, R-type, metal etc and length	10% or 2 nos. whichever is more
3.2.3	Thermowell for T/C & RTDs	10% or 1 no. of each type, rating, length used in the system whichever is more
3.2.4	Process actuated switch devices Including all types of pressure, differential pressure, flow, temperature, differential temperature, level switch devices	10% or 1 no. of each type and model whichever is more
3.3	<u>INDICATORS/RECORDERS</u>	
3.3.1	Digital Indicators of each model, type & range (including relevant digital indicators of electrical system)	10% or 2 nos. min. whichever is more

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
3.3.2	Vertical Indicators of each type & model	5% or 1 no. of each model whichever is more
3.3.3	Recorders for each type and model	5% or 1 no. whichever is more.
3.3.4	Consumables for continuous recorders Charts Ink capsules	25 rolls per recorder/ 25 nos per recorder/ 20 nos. per recorder / Ink Pads / Pens.
3.3.5	Consumables for multi point recorders	
(a)	Charts	5 nos. per recorder
(b)	Ink pads	5 nos. per recorder
(c)	Print mechanism/ print head assembly	10% or 5 nos. of each type whichever is more
3.3.6	Level transmitters (displacer type)	
(a)	Electronic cards / PCB's of level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(b)	Level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(c)	Electronic water level indicator	10% or 2 nos. min. whichever is more
3.3.7	PD type flow transmitters	10% of total quantity used or 1 for each type/rating whichever is more
3.4	<u>SWITCHES</u>	
3.4.1	Switches (Pressure, DP, Level, Flow, Temperature etc)	10% of each type of total nos. used in the system or minimum 1 no. of each type, model & range whichever is more

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
3.5	Rotameter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more
3.6	<u>SOLENOID VALVE</u>	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more
3.6.1	Assembly	10% of total quantity used or minimum 2 no. of each type whichever is more
3.6.2	Coil	10% of toatal quantity used or 5 no. whichever is more
3.7	E/P Converter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more
3.8	<u>SPECIAL INSTRUMENTS</u>	
3.8.1	Nucleonic /non-nucleonic density meter, solid flow meter etc.	1 no. and spare parts as per manufacturer
3.9	Electrical Transducers	10% of total quantity used or minium 1 no. of each type and range whichever is more

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
5.0	<u>PROCESS CONNECTION PIPING</u> (for impulse piping /tubing, sampling piping/ tubing and air supply piping as applicable)	
5.1	Valves of all types and models	10% or 2 no. of each type, class, size and model whichever is more.
5.2	2 way, 3way, 5way valve manifolds	10% or 2 no. of each type, class size and model whichever is more.
5.3	Fittings	10 nos. of each type
5.4	Purge meters	10 % of each model or 2 Nos. whichever is more
5.5	Filter regulators	10% of each model or 2 Nos. whichever is more
5.6	Impulse pipe & tubing of all type	20 mtrs each type & size
5.7	Impulse line root valve	10% of total quantity used or 4 no. whichever is more for each type and rating of each size
5.8	SS tube	40 mtrs of each type/size
5.9	Fitting for SS tube	40 nos. of each type/size

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
6.0	<u>INSTRUMENTATION CABLE, INTERNAL WIRING AND ELECTRICAL FIELD</u>	
6.1	Pre fabricated cable of each type	10% of installed quantity
6.2	Pre fabricated cable connector	10% or 1 no. of each type and model, whichever is more.
6.3	Other cables	10% of each type, pair and size of actual installed quantity
7.0	<u>ELECTRICAL ACTUATORS</u>	
7.1	Actuators	10% or 1 no. of each type, model and rating, whichever is more.
7.2	Power unit for modulating actuator	10% or 2 nos. of each type, whichever is more.
7.3	DC-DC unit/power pack units	10% or 2 nos. of each type, whichever is more.
7.4	Electronic cards	10% or 5 nos. of each type, whichever is more
7.5	Brake assembly	10% or 2 nos. of each type, whichever is more..
7.6	Brake coils	10% or 2 nos. of each type whichever is more.
7.7	Position feed back transmitters	10% or 2 nos. of each type whichever is more.
7.8	Control unit	10% or 2 nos. of each type whichever is more
7.9	Torque and limit switch assembly of each unit	10% or 2 nos. of each type, whichever is more.
7.10	O-ring	1 set of each size

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
7.11	Motor	1 no. of each type & rating
7.12	Auxiliary contact	10% of total quantity used or 2 nos. whichever is more for each type and rating of each size
7.13	Seal kit	1 set of each type & size
8.0	<u>PLC CONTROL SYSTEM FOR PLANT AUXILIARIES & OFF-SITE PLANTS</u>	
8.1	CPU Card	10% of total quantity of each type used in all systems.
8.2	Communication Processor Module	10% of total quantity of each type used in all systems.
8.3	Binary Input Card	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.
8.4	Pulse Input Card	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.
8.5	Analog Input Card (4 to 20 mA type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.
8.6	Analog Input Card (RTD input type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.
8.7	Binary Output Card for contact	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
8.8	Binary Output Card for Voltage (24VDC)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.
8.9	Analog Output Card (4 to 20 mA type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.
8.10	Interposing Relay	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.
8.11	Output Relay modules/ Relay Board & Auxiliary Relay	10% of total quantity of each type used in the system or minimum 4(four) nos. of each type whichever is more.
8.12	Prefab-cable with connector for CPU, Communication Card and I/O racks	2 No. for each type
8.13	Networking Modules/ Components/ Switch with Power supply module	1No. for each type
8.14	Power Supply Unit for CPU, Communication Card and I/O racks	10% of total nos. used in the system or minimum 2 (two) nos. whichever is more for each type and rating.
8.15	I/O & Processor module chassis	1 (one) no. of each type
8.16	RAM Backup Battery	2 (two) nos. for each type and rating for each system.
8.17	Communication Modules of various types	1No. for each type
8.18	Special Fuse for the Cards	Each type/ rating of fuse, 25% of total nos. used in the system or minimum 25 nos. whichever is more for each system.

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
8.19	Terminal Block	10% of total quantity used in systems for each type and rating
8.20	<u>HMI UNIT</u>	
8.20.1	24" Colour TFT Monitor with Power and signal cable	2 (two) no.s complete set
8.20.2	Key Board	2No.
8.20.3	Mouse/ Trackball	2No.
8.20.4	Complete set of Operators station	2 (two) no.s complete set
8.20.5	Hard Disk Drive for the workstation	2 (two) no.s complete set
8.20.6	UPS for PLC system	1 (one) no.s complete set
8.20.7	Memory Module/ EEPROM chip	10% of total quantity used in the systems or minimum 4 (four) no. whichever is more.
8.20.8	DVD Dual layer Read/ Write type Writer	2 (two) no.s complete set
8.20.9	Blank CD/ DVD	50 (fifty) no.s
8.21	Dot Matrix Printer	2 (two) no.s complete unit
8.22	Dot Matrix Printer's Cartridge	25 (twenty five) no.s
8.23	Toner for Colour Laser Printer	10 (ten) no.s of each colour other than black, and 20 no.s of black toner for each type of laser printer model
8.24	Micro PLC system (i.e. integrated CPU & I/O system, where above mentioned components are not applicable)	One Complete Set
8.25	PLC Network Tap	10% of total quantity for each System

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
8.26	PLC Network End connector	10% of total quantity for each System
8.27	MCB	1 no. of each type and rating.

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
9.8.6	Annunciation System	
(a)	Each type of PCB	1(one) No. each
(b)	Lamp Box with Facia & Lamps (LED type)	5(five)Nos.
(c)	Hooter	1(one) No.
9.8.7	Auxiliary/Power Contactor, Push Button, Indicating Lamp, Fuse etc. for Chiller Unit	10% of total quantity of each type of items used in the system or minimum 2(two) nos. whichever is more.

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
11.0	<u>RADAR TYPE LEVEL TRANSMITTER</u>	
11.1	Transmitter/Receiver	10% or 1 no. of each type transmitter/ receiver
11.2	Electronic card	10% or 1 no. of each type electronic card

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
12.0	<u>CONTROL VALVE</u>	
12.1	<u>NON-CRITICAL CONTROL VALVE</u>	(a) One set of spare control valve stem packing for each control valve.
		(b) Two moulded rubber diaphragms for each control valve.
		(c) 2 no. of gasket for each type/size.
		(d) 100% quantity of lubricants for gaskets for each control valve on one year consumption basis.
		(e) 2 set of limit switches for each control valve.
		(f) One (1) set of valve trims (such as plug, stem, seat ring/cage, guide bushing, stem lock pin, packing retaining ring etc) for each control valve.
		(g) One completes actuator of each type or min. 10% for each type and size whichever is more.

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
12.3	<u>COMMON SPARES AND ACCESSORIES FOR ABOVE VALVE</u>	
12.3.1	Feed back transmitter unit	10% of total quantity used or 2 nos. whichever is more for each type/rating
12.3.2	Electronic positioner	10% of total quantity used or 2 nos. whichever is more for each type/rating
12.3.3	Solenoid valve	10% of total quantity used or 2 nos. whichever is more for each type/rating
12.3.4	Air filter regulator	2 nos
12.3.5	Air lock relay	4 nos of each type
12.3.6	Complete actuator for each type and model	1 set
12.3.7	Volume booster	2 no each type/size

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
17.0	<u>CONTROL PANEL AND LOCAL/REMOTE CONTROL DESK (AS APPLICABLE)</u>	
17.1	Recorder	1(one) No. each type and model
17.2	Bar graph indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
17.3	Digital indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
17.4	Mosaic/Conventional Type Push button Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.5	Mosaic Type Push button Station with LED Indication	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.6	Mosaic Type LED Indication Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.7	Simaphore Indicator	2(two)Nos. each type
17.8	<u>ANNUNCIATION SYSTEM</u> (For offsite / Auxiliary Plants)	
17.8.1	Each type of PCB (for non-PLC driven system)	1(one) No. each

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
17.8.2	Lamp Box with Facia & Lamps (LED type)	10% with minimum 2 nos.
17.8.3	Hooter	1(one) No.
18.0	<u>UPS</u>	
18.1	Fuse	3 (Three) times of total quantity of each type of fuses used in the system.
18.2	SCR	10% of total quantity of each type used in the system or minimum 2 (two) nos. whichever is more.
18.3	Diode	10% of total quantity of each type used in the system or minimum 2 (two) nos. whichever is more.
18.4	IGBT	2 (two) nos.
18.5	<u>ELECTRONIC MODULE/ PCB</u>	
18.5.1	Static Switch	10% of each type of Electronic Card/ PCB/ modules used in the system
18.5.2	Inverter	10% of each type of Electronic Card/ PCB/ modules used in the system
18.5.3	Static voltage Regulator	10% of each type of Electronic Card/ PCB/ modules used in the system
18.5.4	Charger	10% of each type of Electronic Card/ PCB/ modules used in the system
18.5.5	UPS of 2 KVA rating or below.	One Complete set.
18.5.6	Selector Switch	10% of each type
18.5.7	Digital Voltage/ Current Indicator (LCD type)	10% of each type
18.5.8	Indication Lamp- Complete assembly (Red/ Green colour)	10% of each type

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
18.5.9	Cooling Fan - 240 VAC supply	10% of population or min. 2 Nos. whichever max.
18.5.10	Current transformer of each rating	2 Nos.
18.6	<u>UPS BATTERY</u>	
18.6.1	Inter connecting cell strips	10 nos.
18.6.2	Rubber gloves	1 pair
18.6.3	Voltmeter for measuring cell voltage (Center zero type)	1 no.
18.6.4	Apron & Goggles	1 set
18.6.5	Cell lifting puller	1 no.
18.6.6	Insulated socket spanner with handle	1 no.
18.6.7	Terminal screw with bellaville washer	10% of total quantity used
18.6.8	Thermometer	1 no.
18.6.9	Battery cell (Uncharged /dry)	7 nos. for main UPS & 10% of total quantity used for each UPS
18.6.10	Vent plug	10% of total quantity used or minimum 2 no. of each type whichever is more
18.6.11	Hydrometer	1 no.
18.6.12	Funnel	1 no.
18.6.13	Plastic filling bottle	1 no.
18.7	Filtering capacitor used in the output circuit	2 sets

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
18.8	Capacitor resistors, Integrated circuits (Ics)	20% or min. 2 Nos. whichever max.
19.0	Magnetic Pick up type speed probe & switch assembly	10% of total quantity
20.0	Belt Sway Switch assembly	10% of total quantity
21.0	Pull Chord switch assembly	10% of total quantity
22.0	Belt Weighing system	10% of each major hardware items
23.0	Load sensing cell assembly	10% of total quantity

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
27.0	Gauges of all types	10% of total quantity used or 1 nos. whichever is max. for each type/rating
29.0	Power cylinder	
29.1	Actuator Seal Kit	2(two) nos. for each type of Power Cylinder
29.2	Gasket	2(two) nos. for each type of Power Cylinder
29.3	Complete Set of Power Cylinder	1(one) no. each type for all application
29.4	Position Transmitter complete set	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
29.5	Power Cylinder Positioner complete Set	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
29.6	Complete Set of Solenoid Valve for Power Cylinder	2Nos. for each type & ratings

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
29.7	Solenoid Coil for Pneumatic type Power Cylinder	5Nos. for each type & ratings
29.8	Position Limit Switch for Pneumatictype Power Cylinder	10Nos. for each type & ratings
29.9	Air Lock Relay	10Nos. for each type
29.10	Signal Air Booster Unit	2Nos. for each type
30.0	<u>MANDATORY SPARES NOT COVERED ABOVE</u>	Bidder to supply 10% electronic modules/ cards or any other electronic components required for system such as annunciation system for offsite/auxiliary plant, online condensate tube cleaning system, ambient air monitoring system, plant simulator.
NOTES: i) Unless stated otherwise, a "set" or "Lot" means items required for complete replacement in one equipment of each type / size/ range. ii) Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item. iii) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the population of the item required for station, as specified above. iv) All the Mandatory spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main Equipment/components supplied under the contract. v) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments. vi) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise. vii) Inspection of mandatory spares shall be in line with the approved quality plans for the respective Items/equipments. The inspection categorisation of mandatory spares shall also be in line with the approved categorisation plan for the respective items/equipment. viii) In case, mandatory spares are not applicable as per equipment / item selected, bidder has to provide equivalent mandatory spare as per for selected equipment / item in line with list of mandatory spares. ix) In case mandatory spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities in line with list of mandatory spares.		

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1X660 MW BHUSAWAL TPS, UNIT # 6

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SECTION : I

TECHNICAL SPECIFICATION FOR OZONE
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ANNEXURE VII : DRAWING/DOCUMENTS SUBMISSION SCHEDULE

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S.NO.	DRAWING NO	DRG TITLE	APPROVAL CAT	SCH WEEK AFTER LOI	SIZE
1	PE-V0-415-174-A325	PLC DOCUMENTS , GA & WIRING DETAILS OF PLC PANEL, I/O LIST, BOM, MIMIC DIAGRAM, PLC CONTROL SCHEMES (BLOCK LOGIC), CONTROL DESK LAYOUT / GA DRAWING, PLC HEAT DISSIPATION DATA ALONG WITH PROCESS GRAPHIC MANUSCRIPTS, PANEL & ELECTRONIC	A	12	A4
2	PE-ID-415-174-A301	ELECTRICAL LOAD LIST OF OZONE GENERATION PLANT	A	4	A4
3	PE-V0-415-174-A310	TECHNICAL DATA SHEET OF HORIZONTAL PUMPS	A	8	A4
4	PE-V0-415-174-A329	QAP OF OZONE GENERATION PLANT (BALANCE OF ITEMS)	A	4	A4
5	PE-V0-415-174-A303	EQUIPMENT LAYOUT ALONG WITH CIVIL FOUNDATION DETAILS	A	4	A1
6	PE-V0-415-174-A327	QAP AND FAT PROCEDURE FOR PLC	A	10	A4
7	PE-V0-415-174-A332	QUALITY PLAN FOR ELECTRIC HOIST	A	8	A4
8	PE-V0-415-174-A302	PROCESS DESIGN BASIS AND SIZING CALCULATION	A	4	A4
9	PE-V0-415-174-A305	CONTROL PHILOSOPHY OZONE GENERATION PLANT	A	4	A4
10	PE-V0-415-174-A304	SUB VENDOR LIST & INSPECTION CRITERIA	A	4	A4
11	PE-V0-415-174-A308	PIPING LAYOUT	A	8	A1
12	PE-V0-415-174-A318	GA OF ATMOSPHERIC TANKS	A	8	A4
13	PE-V0-415-174-A334	ELECTRIC CIRCUIT DIAGRAM FOR ELECTRIC HOIST	A	8	A4
14	PE-V0-415-174-A314	QAP FOR COMPRESSORS WITH MOTOR	A	4	A4
15	PE-V0-415-174-A312	GA & DATA SHEET OF MOTORS	A	8	A4
16	PE-V0-415-174-A322	DATASHEET FOR SAFETY ITEMS	A	10	A4
17	PE-V0-415-174-A321	MECHANICAL DATASHEET & GA FOR STRAINERS & VALVES	A	10	A4
18	PE-V0-415-174-A311	TECHNICAL DATA SHEET OF COMPRESSORS	A	8	A4
19	PE-V0-415-174-A309	DATASHEET & SLD FOR UPS, UPS SIZING CALCULATIONS, BATTERY SIZING CALCULATIONS	A	10	A4
20	PE-V0-415-174-A338	CABLE SCHEDULE, SUBMISSION OF CABLE INTERCONNECTION DIAGRAM ALONG WITH FIELD JUNCTION BOX TERMINATIONS	A	10	A4
21	PE-V0-415-174-A331	DESIGN CALCULATION AND DATASHEET OF AIR CONDITIONERS	A	8	A4
22	PE-V0-415-174-A328	CABLE TRAY LAYOUT	A	10	A1
23	PE-V0-415-174-A319	GA OF PRESSURE VESSELS	A	4	A4
24	PE-V0-415-174-A324	VALVE SCHEDULE	A	10	A4
25	PE-V0-415-174-A333	GA DRAWING FOR ELECTRIC HOIST	I	8	A4
26	PE-V0-415-174-A320	MECHANICAL DATASHEET & GA FOR AIR DRIER, OXYGEN GENERATOR, CHILLER, VENTURI INJECTOR ETC.	I	8	A4
27	PE-V0-415-174-A341	DEMONSTRATION TEST PROCEDURE	A	12	A4
28	PE-V0-415-174-A313	QAP FOR HORIZONTAL PUMPS WITH MOTOR	A	4	A4

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S.NO.	DRAWING NO	DRG TITLE	APPROVAL CAT	SCH WEEK AFTER LOI	SIZE
29	PE-V0-415-174-A315	DATA SHEET FOR INSTRUMENTS AND ANALYSER ALONG WITH INSTRUMENT HOOK UP DRAWING	A	8	A4
30	PE-V0-415-174-A335	SIZING CALCULATIONS FOR ELECTRIC HOIST	I	8	A4
31	PE-V0-415-174-A301	PIPING & INSTRUMENTATION DIAGRAM OZONE GENERATION PLANT	A	4	A4
32	PE-V0-415-174-A330	DESIGN CALCULATION AND DATASHEET OF VENTILATION FANS.	A	8	A4
33	PE-V0-415-174-A342	O&M MANUAL	A	12	A4
34	PE-V0-415-174-A317	QAP OF OZONE GENERATOR	A	4	A4

Notes:

1. A= APPROVAL. I = INFORMATION.
2. Any additional drawings-documents required during detailed engineering stage shall be provided by bidder without any commercial, technical and delivery implication to BHEL and customer.
3. Non-submission of the document as per attached schedule will attract LD.
4. Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per the Annexure IV of this specification. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end
 - Internet explorer version – Minimum Internet Explorer 7
 - Internet speed – 2 mbps (Minimum preferred)
 - Pop ups from our external DMS IP (124.124.36.198) should not be blocked
 - Vendor's Internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>)
 - DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
 - For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>

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ANNEXURE VIII: WATER ANALYSIS

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<u>SR. NO.</u>	<u>PARAMETERS</u>	<u>UNITS</u>	<u>VALUES</u>
(c)	Na as CaCO ₃	ppm	203
(d)	K as CaCO ₃	ppm	10
	Total Cation	ppm	585
15.0	<u>ANIONS</u>		
(a)	HCO ₃ as CaCO ₃	ppm	400
(b)	Chlorides	ppm	149
(c)	SO ₄ as CaCO ₃	ppm	33
(d)	Fluoride as CaCO ₃	ppm	1
(e)	Nitrate as NO ₃	ppm	2
	Total Anion	ppm	585
16.0	Ammonia	ppm	Absent - Traces
17.0	Silica Colloidal (as SiO ₂)	ppm	< 1 (can be present in summer)
18.0	Silica Non - Colloidal (as SiO ₂)	ppm	36
19.0	Free Chlorine	ppm	Nil
20.0	Total Suspended Solids	ppm	Not Available
21.0	Carbonates as CaCO ₃	ppm	Not Available
22.0	Boron	ppm	less than 1
23.0	Oil & Grease	ppm	Not Available



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ANNEXURE – B

CLARIFIED WATER & FILTERED WATER ANALYSIS

1.0 WATER QUALITY AT CLARIFIER OUTLET

- (a) ~~Residual Chlorine~~ : ~~0.1 ppm as Cl₂~~
- (b) Iron Content : < 0.1 ppm as Fe
- (c) Turbidity : < 15 NTU

2.0 WATER QUALITY AT GRAVITY FILTER OUTLET

- (a) Turbidity : < 2 NTU
- (b) Organic Content : Nil

Note:

a. the cycle of concentration (coc) shall be considered as 5.

b. Data for cooling tower:

- i. Total CW circuit water flow = 77000 Cum/hr.
- ii. Storage/Holdup volume of cooling tower basin=7300 m³.
- iii. Temperature difference across cooling tower is 9.96 Deg C.
- iv. MOC of Condenser tube is Ti (ASTM A249 TP304).
- v. Cooling Tower blow down= 300 M3/Hr.

Note1: Other parameter of clarified and filtered water analysis shall be as per Annexure A above.

Note 2: The service water (clarified water) shall be used for the cooling purpose.

Note 3: Bidder shall include in his scope water softener if required to make the analysis suitable for cooling purpose.

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ANNEXURE IX: LIST OF TOOLS & TACKLES (AS APPLICABLE)

Bidder to consider necessary tools and tackles for mechanical, electrical and control & instrument as per their system requirement. In addition bidder to adhere relevant clauses of tender specification also.

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ANNEXURE X: FORMAT FOR OPERATION AND MAINTENANCE MANUAL

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Bidder to submit operation and Maintenance manual with minimum information as listed in below check list during contract stage.

CHECK LIST FOR OPERATION & MAINTENANCE MANUAL

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

Sl.no. & Sections	Description	Tick (☒)if included in Manual			Remarks
		Yes	No	Not Applicable	
	1.1				
1.	1.2 Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	1.3 Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	1.4 Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	1.5 Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	1.6 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.				

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	to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair, Testing and calibration procedures				
6.0	1.7 Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres, Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				

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ANNEXURE XI: SITE STORAGE AND PRESERVATION

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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

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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,

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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.

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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.

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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.



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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.



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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

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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	

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

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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	

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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.		

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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.

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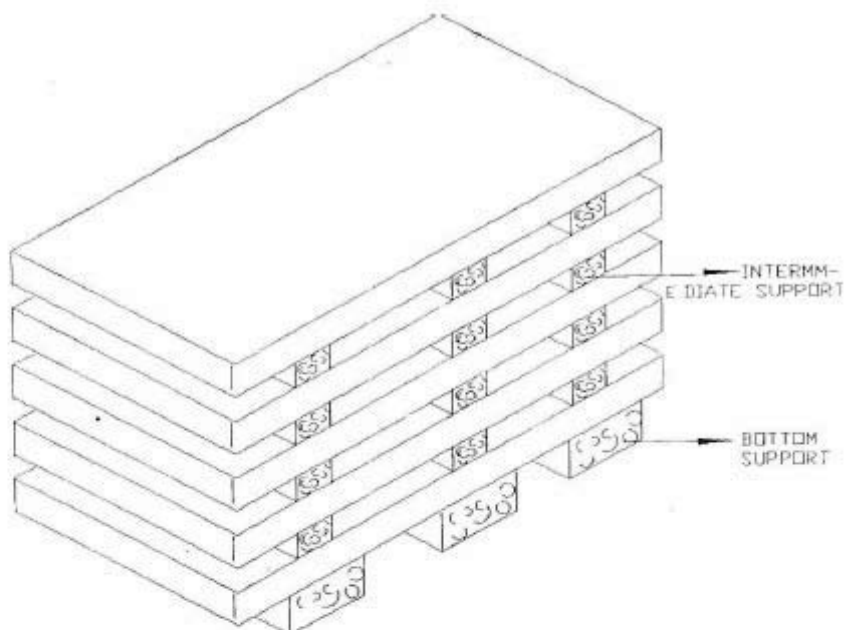


Figure – 1 – PLATE STACKING ARRANGEMENT

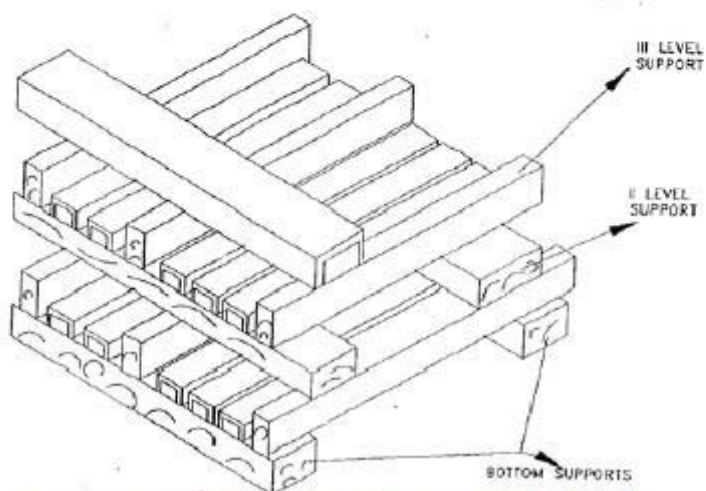


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

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ANNEXURE XII: OPERATION AND MAINTENANCE SERVICES

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1.0 OPERATION AND MAINTENANCE SERVICES

The vendor scope also covers the Operation and Maintenance (O&M) services for Preventive and Breakdown maintenance from the date of successful commissioning till handing over. The date of start of O&M services shall be communicated to successful vendor by BHEL site personnel.

Vendor to note that the spares and consumables required for maintenance of the equipment during this O&M period shall be in vendor's scope of supply. Vendor shall use only genuine parts as mentioned in O&M Manual. Any damage or malfunction caused by the use of unauthentic parts or unqualified personnel shall be responsibility of vendor and as a consequence of above vendor is required to replenish the unauthorised part and abridge the qualified person without any commercial implication to BHEL.

O&M Services scope also covers all regular maintenance by trained service engineers and supply of genuine parts and lubricants as per the original equipment manufacturer's recommendations.

For the purpose of Operation of Ozone Generation Plant, One-day shall be considered as 24 hours i.e. 3 shifts of 8 hours each. The Ozone Generation Plant (along with related accessories) shall be operated on Round-the-clock basis on all the days of the year including Sundays and Public Holidays meeting outlet guarantee parameter along with service run as defined in specification.

O & M Personnel should be acquainted with local language. Governmental / Statutory approval w.r.t. O&M service as applicable shall be in vendor's scope.

Total duration of the Operation and Maintenance services has been envisaged for twelve (12) months for complete Ozone Generation Plant identified in price format/specification. The duration of operation & maintenance services can be increased or decreased as per requirement and payment in such case shall be made on pro-rata basis.

The operation and maintenance services can be continuous or intermittent as per site requirement for complete Ozone Generation Plant identified in price format/specification.

Vendor has to compulsorily maintain log book for the O & M staff engaged for O&M jobs and submit to Engineer in charge for certification for realization of the bills. After certification of the bill by Engineer in charge of BHEL, vendor shall claim the amount after completion of minimum 30 days.

Depending on start of O&M services, there is a possibility that some period of O&M services and Warranty period may overlap. **However, it is clarified that any maintenance required or any spare of Ozone Generation Plant System required to be replaced during Warranty period (as part of warranty clause requirement) shall not be made part of O&M Services. Vendor may take care of this fact while working out the prices of O&M services.**

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Wherever Ozone Generation Plant has been written in O&M Service Specification, the same shall be deemed as complete Ozone Generation Plant.

The vendor shall deploy following minimum manpower for Operation of Ozone Generation Plant.

- i. One qualified and experienced Ozone Generation Plant operator per shift on "Round the Clock" basis throughout the year for all days of the year including Sundays & Public Holidays. There must be minimum 30 minutes overlapping between two shift operators to get familiarize with the status of Ozone Generation Plant.
- ii. Two Helper per shift on " Round the Clock" basis throughout the year for all the days of the year including Sundays and Public Holidays. The helper shall assist the Ozone Generation Plant Operator in day to day operation of Ozone Generation Plant and accessories and shall assist him for keeping Ozone Generation Plant equipment's in neat and tidy condition.
- iii. Wages of all manpower deployed for O&M shall be borne by vendor.

1.1 Responsibility of Ozone Generation Plant Operator

- i. Ozone Generation Plant operator shall be responsible for proper sequential operation of Ozone Generation Plant including operation of standby equipment in a predefined sequence and stopping the same (when necessary) as per the procedural practice. In case of any abnormality (like non availability of power supply at incomer of Ozone Generation Plant), he shall immediately report the matter to BHEL site Engineer for further action. Similarly, any malfunctioning in the system shall be immediately resolved by Ozone Generation Plant operator with suitable corrective action irrespective of time of occurrence of malfunctioning / abnormality in the system in consultation with BHEL site Engineer. A log book of all such outrages shall be maintained by Ozone Generation Plant operator, which shall be shared with BHEL site engineer on periodic basis.
- ii. Ozone Generation Plant operator shall take reading of all the parameters of Ozone Generation Plant periodically as per requirement which shall be mutually discussed and finalised with BHEL site engineer. However, the frequency of taking the reading may change based upon instruction from BHEL site Engineer. All the readings shall be recorded in a logbook register.

1.2 Responsibility of Helper.

- i. The Ozone Generation Plant helper shall assist Ozone Generation Plant operator for day to day smooth operation of plant. He shall be responsible for keeping all the equipment's of plant in clean and tidy condition. He shall also carry out general

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cleaning of all Ozone Generation Plant equipment's including Electrical & Control Panels (Part of Ozone Generation Plant), etc. on regular basis.

- ii. The helper shall work under the control of ozone plant operator and shall always ensure that unusable junk materials are not allowed to be kept in Ozone Generation Plant. Under such eventuality, he will report the matter to Plant Operator, who in turn will take suitable action including reporting the matter to BHEL site Engineer.
- 1.2.1 All the log book registers shall be arranged by vendor. Log book register duly paged and bounded will be maintained in good condition by vendor.
 - 1.2.2 All the necessary tools & tackles and other materials, required for operation of ozone plant shall be kept by vendor under the control of plant operator, which shall be handed over to customer in new condition. Required testing instruments should also be always available with Plant Operator.
 - 1.2.3 In case of any operator / helper being on leave, vendor shall immediately take advance action and provide substitution so that minimum manpower as indicated above is not reduced on any day. In case a particular shift duty plant Operator or helper does not turn up due to any reasons, the earlier duty person shall continue to make sure that Ozone Generation Plant never remains unattended.

2.0 Maintenance of Ozone Generation Plant

- i. Maintenance work under scope of the vendor shall broadly include but in no way limited to the following:
 - a) Preventive maintenance of the plant.
 - b) Servicing of the Ozone Generation Plant and associated equipment's at regular interval.
 - c) Attending to complaints.
 - d) Replacement of worn out or defective components
 - e) Replacing of consumables like greases, oil, lubricants, servo fluids/control fluids, gases, reagents for analysers and etc as and when required.

No consumable or any other items of Ozone Generation Plant shall be arranged by Customer & BHEL and no extra payment shall be made by customer & BHEL in this regard.

- ii. Vendor shall be responsible at all time, during the entire period of contract for satisfactory performance of plant (including accessories) with zero down time. During emergency or breakdown, vendor's Engineer along with related technicians

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shall be available immediately even though it may be beyond normal working hours or on public holidays till the ozone plant is restored back into normal satisfactory condition. Response time for attending breakdown complaints shall not exceed 2 hours.

- iii. Defective / worn out components shall be replaced only by genuine and original parts. OEM or its authorized dealer's invoice shall be submitted as proof of using genuine parts. All common spares required for ozone plant shall normally be kept available in the plant by the vendor. However, for critical spares, the same shall be made available in not more than 72 hours from the time of break-down requiring such spare.
- iv. Preventive Maintenance, servicing of Ozone Generation Plant equipment's and accessories etc. shall be done by vendor in a planned manner in consultation with concerned BHEL engineer. Preventive maintenance and service should be done as per the recommendations / guidelines of various OEMs
- v. Vendor shall arrange and maintain separate logbook register for services / maintenance of ozone plant. Record of work done for services/maintenance repairs etc. shall be recorded by vendor's engineer in this register. This register shall always be with updated records & shall be produced to BHEL engineer on weekly basis or as & when required by him.
- vi. Vendor shall arrange and maintain sufficient stock of spares and consumable at site. Similarly, all necessary tools & instruments required for the purpose of servicing / maintenance / routine testing etc. shall also be arranged by vendor and should be available at site at all times.
- vii. Repairs / servicing works shall normally be done by vendor at site up to maximum possible extent. However, in case any equipment or accessories is essentially required to be taken by vendor out of the plant premises for repairing / servicing, all necessary arrangements including to and fro transportation shall be the responsibility of vendor. Vendor shall also inform concerned BHEL & customer's engineer for doing procedural formalities (like issue of gate pass etc.), prior to taking out the materials out of Plant premises.
- viii. In case vendor fails to supply the spares required for maintenance of the equipment, same shall be provided by BHEL at Vendors risk and cost.
- ix. Vendor shall be fully responsible for safety of his personal at all times. Vendor shall also be responsible for taking all safety precautions at all the times, especially during servicing / preventive maintenance and repairs of Ozone Generation Plant.
- x. Technicians & helpers engaged by the vendor shall wear uniform with nameplate for easy identification, while being within plant premises

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- xi. Vendor's engineer shall be focal point for BHEL & customer. He shall report to BHEL engineer on daily basis, for taking necessary instructions and to update the status of Ozone Generation Plant.
- xii. If any damage to the equipment and its accessories has happened due to improper maintenance by vendor, same shall be recovered from the vendor.
- xiii. Vendor is to arrange all the safety gears like helmets, air plugs, safety shoes, googles, Personal Protection Equipment (PPE)] comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided by vendor etc. during the maintenance for the O&M Staff.
- xiv. Fabrication and erection of platform/extra support for maintenance of any type of Ozone generation plant equipment, if felt necessary during operation and maintenance of the system, has to be done by the vendor.

Notes:

1. The Vendor shall take approval from Engineer-in charge of BHEL by submitting organization Chart of O&M staff for this site clearly indicating man power deployment with their educational background & experience with supporting documents.
2. The Vendor shall be solely and wholly responsible for safety and security of workers engaged in the job and the BHEL property. In case of any accident the contractor shall pay proper compensation to the workers as per workmen's compensation act and repair/replace BHEL property at their own cost & arrangement. The vendor shall also make adequate provision of insurance for their workers at their own cost to cover them against the risk of accident.
3. The Vendor and their workers engaged in the job shall follow all safety rules at the time of execution of work. It shall be responsibility of the vendor to supply all safety equipment as necessary to its O&M staff.
4. Beyond general shift if any trouble/breakdown occurs in the plant, Maintenance team must reach the plant without any delay along with Engineer/Site In-charge.
5. No Person from the list of manpower shall leave the plant site without prior permission from the Engineer in charge of BHEL.
6. However, in operation part, if any person is absent, substitute must be given immediately otherwise proportionate deduction will be made.
7. The replacement / substitute personnel for maintenance, manpower shall have the same educational qualification and experience.
8. If any additional manpower is required during O&M whatsoever under the scope of contract the same shall be made available by vendor in time within the cost. To cater the need of time bound maintenance jobs, the vendor shall depute additional manpower without any cost implication to BHEL

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9. During execution of work if any personnel is found not suitable for the job or his presence inside premises is felt undesirable, the personnel has to be replaced within 15 days by vendor.

10. BHEL will not be responsible for payment towards idle labor charges

Statutory Compliance by the vendor:

All Statutory compliances related to Labor, Health & Safety, Quality & Environment protection and insurance shall be as GCC Rev-07.

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DATA SHEET-A

SL NO.	DESCRIPTION	PARAMETERS
1.0	OXYGEN GENERATION PLANT	
1.1	COMPRESSORS	
1.1.1	No. of Compressors	3 Nos (2 Working +1 Standby)
1.1.2	Type	Multi stage , Screw type, oil free air cooled compressors
1.1.3	Capacity & Head	As per system requirements
1.1.4	Material of construction	
1.1.4.1	Casing	Cast Iron
1.1.4.2	Rotors	Carbon steel
1.1.5	Medium to be handled	Air
1.1.6	Suction temperature	Ambient
1.1.7	Accessories	Intake air filters, drive motor, intake silencer, step up gear box, moisture separator, ducting etc.
1.1.8	Drive motor	Electric drive motor
1.2	AIR RECEIVER	
1.2.1	Numbers	1 No.
1.2.2	Capacity	3.0 M ³ (minimum) or as per system requirement whichever is higher.
1.2.3	Material of construction	Carbon Steel to IS 2062/IS 2002
1.2.4	Design Code for vessel	IS 2825/ASME Sec VIII Div. 1 or equivalent
1.2.5	Type	Vertical self-supporting cylindrical vessel
1.3	AIR DRYERS	
1.3.1	Numbers	As per enclosed P&ID.
1.3.2	Capacity	As per system requirements
1.3.3	Material of construction	Carbon Steel to IS 2062/IS 2002
1.3.4	Design Code for vessel	IS 2825/ASME Sec VIII Div. 1 or equivalent
1.3.5	Desiccant	
1.3.5.1	Type	Activated alumina or equivalent material
1.4	OXYGEN GENERATORS	
1.4.1	Numbers	As per enclosed P&ID.
1.4.2	Capacity	As per system requirements
1.4.3	Material of construction	Carbon Steel to IS 2062/IS 2002
1.4.4	Design Code for vessel	IS 2825/ASME Sec VIII Div. 1 or equivalent
1.5	OXYGEN RECEIVER	
1.5.1	Numbers	1 No for ozone generation Plant
1.5.2	Capacity	2.5 M ³ (minimum) or as per system requirement whichever is higher
1.5.3	Material of construction	Carbon Steel to IS 2062/IS 2002
1.5.4	Design Code	IS 2825/ASME Sec VIII Div. 1 or equivalent
1.5.5	Type	Vertical self-supporting cylindrical vessel
2.0	OZONE GENERATION PLANT	Capacity for CW system and condenser ozonisation is 16 kg/hr (min) and Capacity for PT Plant ozonisation is 2.1 kg/hr (min) .
2.1	OZONE GENERATORS	
2.1.1	Numbers	To meet the overall capacity requirement as per specification.
2.1.2	Capacity of ozone generator	Capacity for CW system and condenser ozonisation is 16 kg/hr (min) and Capacity for PT Plant ozonisation is 2.1 kg/hr (min).
2.1.3	Type	Vertical/horizontal tubular
2.1.4	Material of construction	SS316 Ti
2.1.4.1	Material of Tube	SS316 Ti
2.1.4.2	Material of construction of Electrode	SS316 Ti & should comply as per DIN 19627
2.2	DI ELECTRIC GLASS TUBE	
2.2.1	Type	Cylindrical
2.2.2	Material of construction	Borosilicate glass specifically for ozone generation.
2.2.3	Construction	Close at one end specially for ozone.

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TITLE :

1X660 MW BHUSAWAL TPS, UNIT # 6

SPECIFICATION NO. PE-TS-415-174-A001

SECTION : I

TECHNICAL SPECIFICATION FOR OZONE
GENERATION PLANT

SUB-SECTION: IA

REV. NO. 00

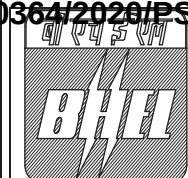
3.0	OZONE DOSING PUMPS	
3.1	Number	2 Nos (2 x 100%) for CW system and condenser ozonisation and 2 Nos (2 x 100%) for PT Plant ozonisation.
3.2	Location	Indoor.
3.3	Fluid to be handled	Ozone with water
3.4	Service	To dose ozonised water in the CW system, inlet of condenser and stilling chamber of PTP
3.5	Type of Pump	Horizontal Centrifugal
3.6	Rated Capacity	As per supplier recommendations
3.7	Head to be developed	As per system requirements
3.8	Operation	Continuous
3.9	Material of construction	
	• Casing	CI to IS 210 Gr. FG 260
	• Impeller	SS316
	• Shaft	SS 410
	• Shaft sleeve material	SS 410
3.10	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, Y-type strainers (SS316), pressure gauges, pulsation dampener.
3.11	Dive motor	Electric drive motor
4.0	COOLING WATER PLANT	
4.1	CHILLED WATER RECIRCULATION PUMPS	
4.1.1	Number	2 Nos (2 x 100%) for Ozonisation system.
4.1.2	Location	Indoor
4.1.3	Type of Pump	Horizontal Centrifugal
4.1.4	Rated Capacity	As per supplier recommendations
4.1.5	Operation	Continuous
4.1.6	Head to be developed	As per system requirements
4.1.7	Material of construction	
	• Casing	SS316
	• Impeller	SS316
	• Shaft	SS 410
	• shaft sleeve material	SS 410
4.1.8	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, Y-type strainers (SS316), pressure gauges, pulsation dampener.
4.1.9	Dive motor	Electric drive motor
4.2	CHILLER	
4.2.1	Numbers	2 Nos (2 x 100%) for Ozonisation system.
4.2.2	Type	air cooled
4.2.3	Capacity	As per system requirements based on supplier recommendations
4.2.4	Material of Construction	Carbon Steel
5.0	PIPING , FITTINGS & FLANGES	
5.1	Material of construction of piping, fittings and flanges handling Compressed air and instrument air.	Piping shall conform to Carbon steel to IS 1239 heavy grade /IS 3589 grade 410 galvanized to IS-4736. For pipe size > 150 NB the thickness shall be as indicated in the P&ID. The material of fittings and flanges shall be either same as the parent material or malleable iron to IS-1879 (galvanised).
5.2	Material of construction of piping, fittings and flanges handling Oxygen and Ozone gas.	Piping shall be of Stainless steel to ASTM A 312 TP 316 sch. 10S (minimum) seamless. The material of fittings and flanges shall be of SS316 class 150 (minimum).

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	TITLE : 1X660 MW BHUSAWAL TPS, UNIT # 6		SPECIFICATION NO. PE-TS-415-174-A001	
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			REV. NO. 00	

5.3	Material of construction of piping, fittings and flanges handling Ozonised water.	Piping shall be of Stainless steel to ASTM A 312 TP 316 sch. 10 (minimum). The material of fittings and flanges shall be of SS316 class 150 (minimum).					
5.4	Material of construction of piping, fittings and flanges handling Motive water. Design pressure of Motive water line shall be 7.5 kg/cm2 (g) and design mechanical temperature shall be 50°C.	• Piping upto and including 50 NB shall be of SS conforming to ASTM-A-312 Gr. 316 SCH 40S. The material of fittings and flanges shall be of SS316 class 150 (minimum). • Piping from 65 NB to 150 NB (including) shall be of SS conforming to ASTM-A-312 Gr. 316 SCH 10S. The material of fittings and flanges shall be of SS316 class 150 (minimum). • Piping 200 NB and above shall be of Carbon steel rolled and welded as per IS:3589 from CS plates as per IS:2062 with PU (Polyurethane) coating internally with minimum 2mm DFT as per AWWA-C-222. The material of fittings and flanges shall be of Carbon steel class 150 (minimum). The thickness of the piping shall be as indicated in P&ID.					
5.5	Material of construction of piping, fittings and flanges handling Potable water. Design pressure of portable water line shall be 10 kg/cm2 (g) and design mechanical temperature shall be 60°C.	Piping less than or equal to 150 NB shall be of carbon steel, ERW conforming to IS: 1239 (Heavy grade) and shall be galvanized as per IS 4736 or Equivalent. Pipe end connections shall be screwed. The material of fittings and flanges shall be of Carbon steel class 150 (minimum).					
6.0	VALVES						
6.1	Valves handling Compressed Air Services & Instrument air: Type of valves shall be inline with the P&ID. The material of all the safety relief valves shall be SS316.	For compressed air application, valve material shall be galvanized cast carbon steel as mentioned below:					
		SIZE	BODY BONNET	DISC/GATE	STEM	HAND WHEEL	VALVE ENDS
		≥ 65 NB	ASTM A 216 Gr. WCB	ASTM A 216 Gr WCB	ASTM A479 Type 410-2	ASTM A47 Gr. 32510	FLANGED RAISED FACE
		≤50 NB	ASTM A 105	13% Cr Steel	ASTM A479 Type 410-2	ASTM A47 Gr. 32510	SCREWED TYPE
6.2	Valves handling handling Oxygen, Ozone, Ozonated water: Type of valves shall be inline with the P&ID. The material of all the safety relief valves shall be SS316.	GATE AND CHECK VALVES					
		Body & Bonnet		SS316			
		Seating surface		SS 316			
		Stem & Disc/Gate		SS 316			
		Hinge pin		SS 316			
		BUTTERFLY VALVES					
		Body & Disc/flange		SS316			
		Shaft		SS316			

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		BALL VALVES (Full bore type)					
		Body & Bonnet		SS316			
		Seating surface		SS316			
		Stem & ball		SS316			
		Hinge pin		SS316			
6.3	Valves handling Motive water, Potable water: The Type of valves shall be inline with the P&ID. The material of all the safety relief valves shall be SS316.	SIZE	BODY BONNET	DISC/GATE	STEM	HAND WHEEL	VALVE ENDS
		≥ 65 NB	A126 CLASS B	A126 CLASS B	ASTM B 124 C 37700	ASTM A47 Gr. 32510	FLANGED FLAT FACE
		≤50 NB	ASTM B62	ASTM B62	ASTM B312 GR. A	ASTM A47 Gr. 32510	SCREWED TYPE

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TITLE :

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SPECIFICATION NO. PE-TS-415-174-A001

SECTION : I

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GENERATION PLANT

SUB-SECTION: IA

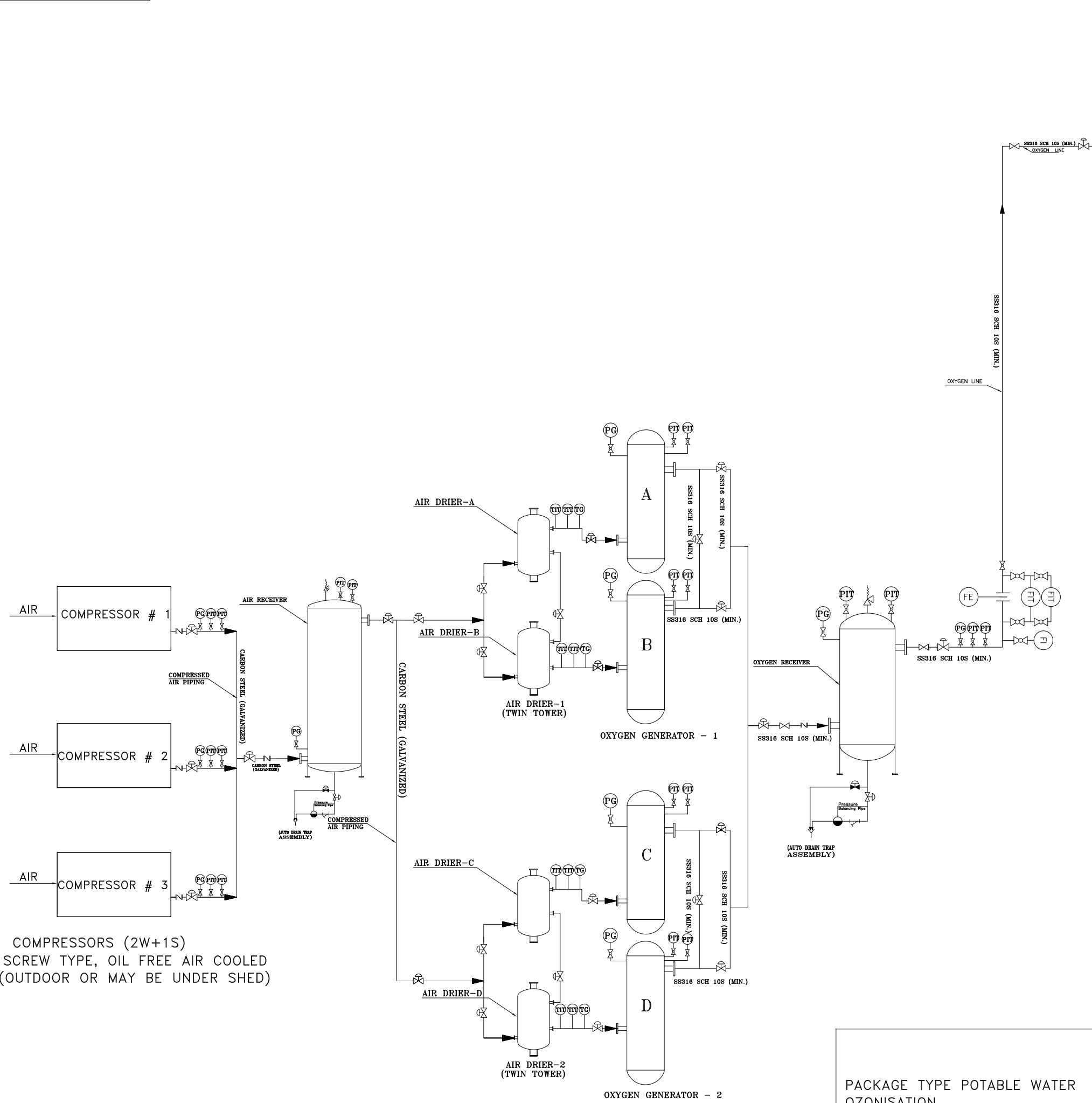
REV. NO. 00

P&ID

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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.

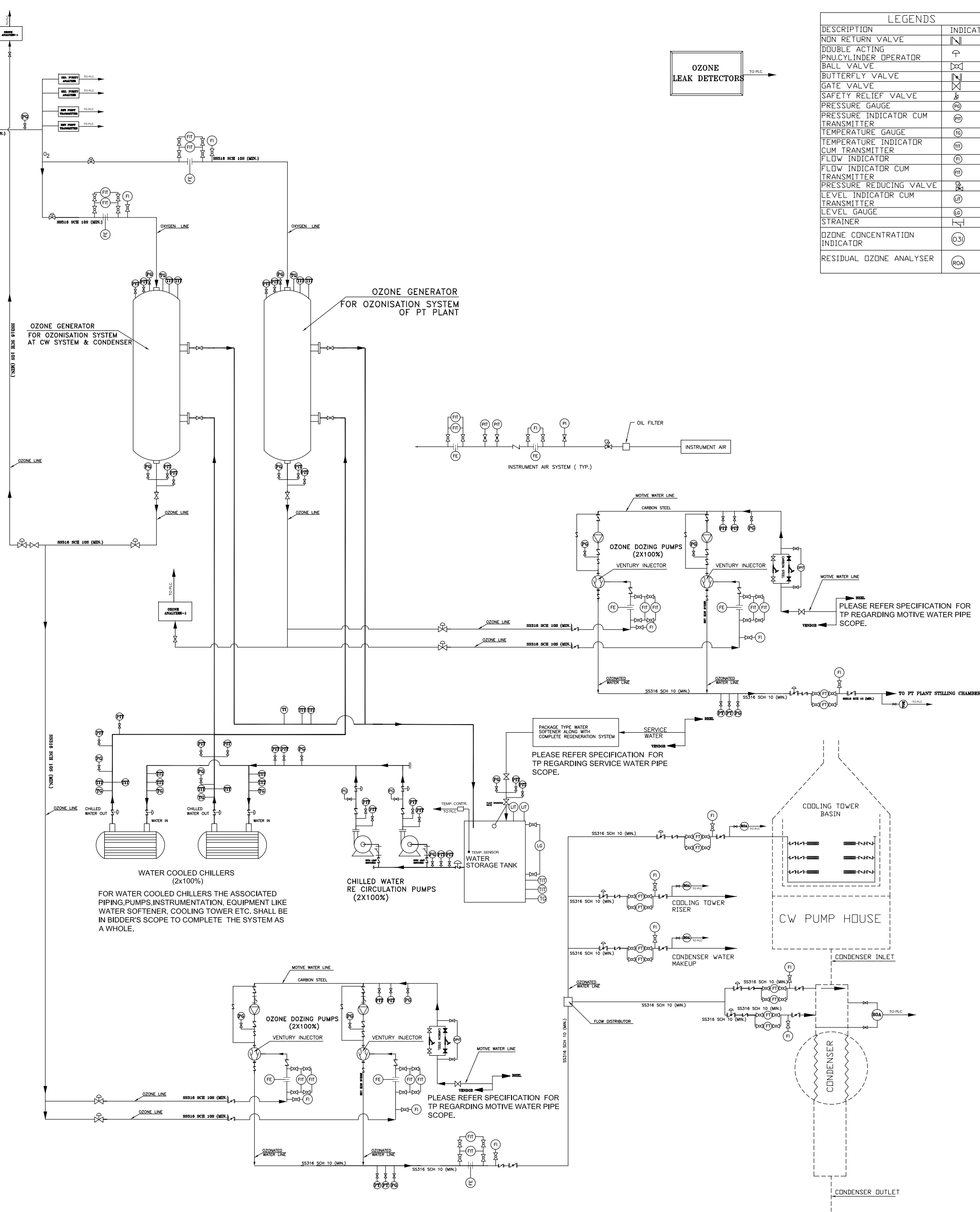
PIPE SIZES OF CARBON STEEL PIPES					
NB	OD	THICK.	NB	OD	THICK.
200	219.1	7.0	500	508.0	8.0
250	273.0	7.0	600	610.0	8.0
300	323.9	7.0	700	711.0	10.0
350	355.6	8.0	800	813.0	10.0
400	406.4	8.0	900	914.0	10.0
450	457.0	8.0	1100	1118	12.0

- NOTES:
- 1) ALL THE VALVES COMING IN SEQUENCE SHALL BE AUTOMATIC VALVES.
 - 2) SOFT SIGNAL INTERFACE TO MAIN CONTROL ROOM CCR FOR MONITORING.
 - 3) ALL THE ISOLATION VALVES OF ALL THE INSTRUMENTS SHALL BE OF SS316.
 - 4) BLANK FLANGES, COUNTER FLANGES & ISOLATION VALVES SHALL BE PROVIDED BY THE BIDDER AT THE TERMINAL POINTS.
 - 5) ALL THE EQUIPMENTS , VALVES, INSTRUMENTS, PIPING ETC SHOWN IN THE P & ID IS IN BIDDER'S SCOPE UNLESS EXCLUSIVELY MENTIONED.
 - 6) ALL THE VALVES, INSTRUMENTS, EQUIPMENTS ETC. SHOWN IN THE P&ID ARE BARE MINIMUM. HOWEVER ANY ADDITIONAL VALVES, INSTRUMENTS, EQUIPMENTS ETC. AS REQUIRED BY BHEL/CUSTOMER DURING DETAILED ENGINEERING/EXECUTION/E&C STAGE SHALL BE PROVIDED BY THE BIDDER WITHOUT ANY DELIVERY AND COMMERCIAL IMPLICATION TO BHEL/CUSTOMER.
 - 7) PIPE SCHEDULE SHOWN (INDICATED) IS MINIMUM.
 - 8) OBTAINING ALL STATUTORY CLEARANCE FOR OZONE GENERATION PLANT SYSTEM AS APPLICABLE AS PER GOVT. RULES/REQUIREMENT SHALL BE IN SCOPE OF BIDDER. ALL ASSOCIATED EXPENSES SHALL BE PART OF BIDDER'S SCOPE.
 - 9) THE MATERIAL INDICATED ABOVE SHALL BE FOLLOWED BY BIDDER.
 - 10) AS WATER AFTER SOFTENER WILL BE CORROSIVE AND HENCE THE METALLURGY SELECTED SHOULD BE SUITABLE TO MEET SYSTEM REQUIREMENT.
 - 11) FOR SOFTENER THE SERVICE WATER SHALL BE GIVEN AT TERMINAL POINT AT PRESSURE OF AROUND 1 TO 1.5 KG/CM2. FOR SOFTENING PLANT ANY PUMPS REQUIRED SHALL BE PART OF BIDDER'S SCOPE.
 - 12) PACKAGE TYPE POTABLE WATER OZONISATION SYSTEM IS ALSO IN BIDDER'S SCOPE PLEASE REFER TECHNICAL SPECIFICATION FOR DETAILS.
 - 13) PLEASE REFER TECHNICAL SPECIFICATION FOR THE SCOPE RELATED TO MISCELLANEOUS TERMINALS POINTS.



PACKAGE TYPE POTABLE WATER OZONISATION

LEGENDS		
DESCRIPTION		INDICATION
NON RETURN VALVE		
DOUBLE ACTING PNEUMATIC OPERATOR		
BALL VALVE		
BUTTERFLY VALVE		
GATE VALVE		
SAFETY RELIEF VALVE		
PRESSURE GAUGE		
PRESSURE INDICATOR CUM TRANSMITTER		
TEMPERATURE GAUGE		
TEMPERATURE INDICATOR CUM TRANSMITTER		
FLOW INDICATOR		
FLOW INDICATOR CUM TRANSMITTER		
PRESSURE REDUCING VALVE		
LEVEL INDICATOR CUM TRANSMITTER		
LEVEL GAUGE		
STRAINER		
OZONE CONCENTRATION INDICATOR		
RESIDUAL OZONE ANALYSER		



JOB NO. : 415		1X660MW BHUSAWAL TPS-UNIT: 6	
STATUS : CONTRACT		MAHARASHTRA STATE POWER GENERATION Co. Ltd.	
DISTRIBUTION :			
TO		DEPT.	NAME
No. OF		CODE	GRN
REV		CHD	CHD
DATE		APPD	APPD
ALTD			
CHD			
APPD			
TITLE			
P&ID OF OZONE GENERATION PLANT			
DEPT.	SCALE	NTS	DRAWING NO.
SIGN			PE-DG-415-174-A001
DATE			SHEET 01 OF 01
		REV.	0

FORMAT SIZE A0

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TITLE :

1X660 MW BHUSAWAL TPS, UNIT # 6

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SUB-SECTION IB - SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

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			REV. NO. 00	

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipment.
- d) Electrical load requirement for Ozone Generation Plant
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “both end equipment in vendor’s scope” shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.
- k) Technical requirements shall be as per specifications listed in Clause 4.1, 4.2, 4.3, 4.4 & 4.5 below.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

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ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)
PACKAGE : OZONE DOSING SYSTEM
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT:1 X 660 MW BHUSAWAL TPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by BHEL except for cabling in vendor scope. 3. Termination at BHEL equipment terminals by BHEL. 4. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands and lugs for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ BHEL approval at contract stage.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)
PACKAGE : OZONE DOSING SYSTEM
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT:1 X 660 MW BHUSAWAL TPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
9	Lighting	BHEL	BHEL	
10	Lightning protection	BHEL	BHEL	
11	Equipment grounding including electronic earthing for PLC Panels.	BHEL	BHEL	Refer note no. 4 for electronic earthing
12	Below grade grounding	BHEL	BHEL	
13	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
14	Mandatory spares	Vendor	-	Vendor to quote as per specification.
15	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
16	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
17	a) Input cable schedules (C&I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for C & I & Electrical systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
18	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
19	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

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			REV. NO. 00	

ELECTRICAL LOAD DATA FORMAT

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[illegible]

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

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

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

(A) SYSTEM VOLTAGE CODES:

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

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

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

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

(C) CABLE CODESPVC Copper

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

PVC Aluminium

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

XLPE Copper

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

XLPE Aluminium

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

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

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	1X660 MW BHUSAWAL TPS, UNIT # 6		SECTION : I	
	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT		SUB-SECTION:IC	
			REV. NO. 00	

SPECIFIC TECHNICAL REQUIREMENTS (CONTROL & INSTRUMENTATION)

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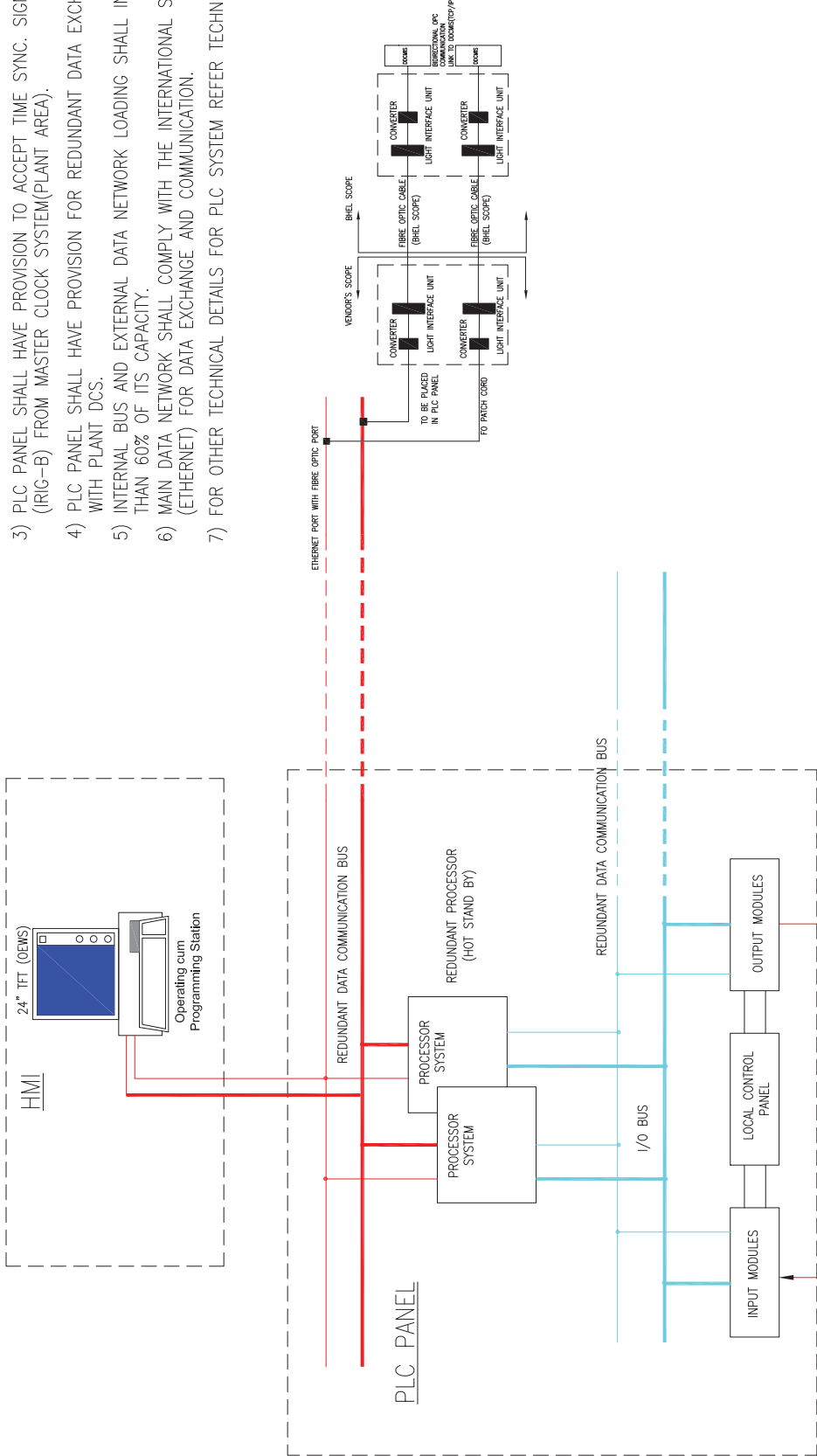
	TITLE :		SPECIFICATION NO. PE-TS-415-174-A001	
	1X660 MW BHUSAWAL TPS, UNIT # 6		SECTION : I	
	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT		SUB-SECTION:IC	
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- The control of Ozonization System shall be through PLC based control system. The PLC panel along with Operating cum Programming Station & Local Control Panel (all in bidder's scope) shall be located in Ozonization Plant Control Room. The PLC system shall be interfaced with DM Plant DCS through softlink.
- All electrical actuators shall be integral type. PLC based control system shall be provided with hot redundant processors.
- The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among
- The solenoid valves shall have limit switches for open/close feedback.
- Interface of MCC, HT SWGR, Actuators, solenoid drives, control valves etc.with DCS based control system shall be as per Drive Control Philosophy attached in the specification.
- The communication between PLC and DM plant DCS shall be OPC compliant (Data Access 2.0) TCP/IP on Fibre Optic link. The communication link between PLC and Main plant DCS shall be redundant. The necessary hardware/software including LIU (Light Interface unit) at PLC end shall be in Bidder's scope. Repeaters, if required for interfacing shall also be provided by the bidder. For communication between DM plant DCS and PLC, the PLC end shall be considered as server and DCS shall be considered as client.
- PLC control system shall be time synchronized with the Master clock system of the main plant to ensure uniform time indication throughout the Plant. The required provision (IRIG-B) shall be made by the bidder at the PLC end to achieve the same.
- The software and hardware for offered PLC system shall be of latest version and shall be upgradable. Bidder to ensure the availability of spares and service support for the offered PLC system. The software tool shall have facility to interface with third party software packages. Easy up gradation and future expansion facility shall be available. All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant and shall be in the name of customer. User shall not have to pay any recurring license fee during the usage period of the system. It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life.
- All the instruments/drives shall be terminated on JB's/Panels in field. JB's/Panels shall be in Bidder's scope. RTD's shall be of duplex type.
- Primary sensor redundancy for Control/measurement shall be decided as per following general criteria:
 - Critical controls and respective measurements- Triple redundant.
 - Non-critical but important control & measurements- Dual redundant.
 - Only measurement- No redundancy.
- Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification.
- For all Off-site plants & plant auxiliary PLC system, 2X100% independent parallel redundant UPS with one set of battery for 60 min. back-up envisaged. For further details, UPS specification attached elsewhere shall be referred.
- Bidder to comply with codes and standards as mentioned in the specification.
- All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.
- Bidder to delegate /depute their persons/experts as per owner/consultant's requirement.
- Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.
- The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.
- Any part/module of the C&I system which are not listed under recommended spares shall be deemed as having life expectancy not less than the expected life of the plant i.e. 30 years.
- Instrument ranges shall be selected to have the normal reading preferably between 50% and 70% of full scale for linear parameters and 70% to 80% for flow measurements. Deviation indicators shall have the null position at midscale. The normal operating parameter shall be identified with a clear green mark.

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
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NOTES:

- 1) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR, COMMUNICATION SYSTEM, POWER SUPPLY, MEMORY MODULES, RACK POWER SUPPLY UNITS, BULK IO POWER SUPPLY UNITS, IO COMMUNICATION MODULES, DATA HIGHWAY AND HIGH SPEED (100Mbps) DATA NETWORK CONNECTING THE OPERATOR STATIONS.
- 2) UPS POWER SUPPLY SHALL BE PROVIDED FOR PLC PANEL(S), OWES, NETWORK COMPONENTS.
- 3) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (IRIG-B) FROM MASTER CLOCK SYSTEM (PLANT AREA).
- 4) PLC PANEL SHALL HAVE PROVISION FOR REDUNDANT DATA EXCHANGE (OPC) WITH PLANT DCS.
- 5) INTERNAL BUS AND EXTERNAL DATA NETWORK LOADING SHALL IN NO CASE BE MORE THAN 60% OF ITS CAPACITY.
- 6) MAIN DATA NETWORK SHALL COMPLY WITH THE INTERNATIONAL STANDARD IEEE-802.3 (ETHERNET) FOR DATA EXCHANGE AND COMMUNICATION.
- 7) FOR OTHER TECHNICAL DETAILS FOR PLC SYSTEM REFER TECHNICAL SPECIFICATION.



LEGEND: -

- PROGRAMMABLE LOGIC CONTROLLER
- DISTRIBUTED CONTROL SYSTEM
- UNINTERRUPTED POWER SUPPLY
- OPERATOR WORK CUM ENGINEERING WORK STATION
- HUMAN MACHINE INTERFACE
- NETWORK TIME PROTOCOL
- OLE PROCESS CONTROL



PLC SYSTEM CONFIGURATION

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REV. No.	DATE	
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SECTION – II

GENERAL TECHNICAL REQUIREMENT

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SECTION – IIA

GENERAL TECHNICAL REQUIREMENT (MECHANICAL)

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1. DESIGN CRITERIA:

Ozone treatment is to be done to prevent growth of biological substances. Ozone generation plant shall comprise of the Ozone generating system including mixing device, ozone generators and its control. Ozone shall be generated using a dry filtered air containing oxygen, which is fed through an electrical discharge created between the two electrodes. The discharge, known as "silent corona discharge" causes the dissociation of some of the oxygen molecules resulting into the formation of ozone. The produced ozone gas is mixed with water and resulted ozonized water is dosed into the Condenser inlet, cooling tower riser, Cooling tower basin, Condenser Make-up water, PT Plant, and potable water storage tank outlet. The ozone concentration shall be of 8-10% (W/W). The design pressure of all the pressure vessels shall be 8kg/cm² (g) minimum.

Note:- Bidder shall refer customer specification enclosed from pg.no 193 to 214. Further, in case of any contradiction between BHEL and customer specification, customer specification shall prevail over BHEL specification.

The ozone generation plant shall consist of at least the following sub systems:

- OXYGEN GENERATION PLANT
- OZONE GENERATION PLANT
- COOLING WATER PLANT
- OZONE DOSING SYSTEM
- MEASURING & MONITORING DEVICES
- PLC BASED CONTROL SYSTEM

The brief description of above mentioned sub systems are as follows:

- **OXYGEN GENERATION PLANT**- Oxygen generation plant is used to feed desired quantity & quality of feed gas to Ozonator. It shall consist of following equipment:
 - **Compressor**: Screw type compressors of suitable capacity along with electrical motor, instruments, ducting arrangement, valves, piping shall be provided by the bidder.
 - **Air Receiver**: Air receiver shall be provided by the bidder along with all the accessories. The capacity of air receiver shall be 3 m3 minimum
 - **Dryer Unit**: Dryer unit along with all the accessories shall be provided by the bidder to remove the moisture from the air. Suitable capacity air drying unit with a heatless type regenerative system to achieve dew point of – 60 Deg C with no purge loss & PSA based.
 - **Oxygen generator**: Oxygen generator along with all the accessories to achieve the pure oxygen shall be provided by the bidder. Online measurement & monitoring facilities of oxygen purity & dew point shall also be provided by the bidder.
 - **Oxygen receiver**: Oxygen receiver shall be provided by the bidder along with all the accessories. The capacity of oxygen receiver shall be 2.5 M3 (minimum).
- **OZONE GENERATION PLANT**- Ozone generator shall be a vertical/horizontal tubular, corona discharge, water cooled, fixed voltage and variable frequency type. Ozone production shall be controlled by varying the applied frequency. However, the design and configuration of ozone generator shall be purely supplier specific. Ozone Generation plant shall consist of at least the following equipment: Ozone generating module shall be a modular vertical/horizontal tubular form of MOC SS 316 Ti and shall comply to DIN 19627 Cooling waterside pressure proof upto 6 bar. Thermal isolation against condensate water. Indirectly cooled dielectric of high grade borosilicate glass free of mechanical or heat generated tensions. High voltage electrodes with individual fuses.

Dielectric glass tube:

 - A. **Material**: Borosilicate glass specifically for ozone generation.
 - B. **Type**: Cylindrical.
 - C. **Construction**: Closed at one end.
 - **Water inlet and outlet connection of heat exchanger**: - SS 316Ti.
 - **Ozone inlet & outlet connection**: - SS 316 Ti
- **COOLING WATER PLANT**: Cooling water plant is provided for removal of excess heat generated during ozone generation from ozone producing cells. Suitable capacity chiller for removal of excess heat generated during ozone generation from ozone producing cells. It shall consist of compressor, cooler, condenser, refrigerant circuit, control center, pump, chilled water piping, condenser water piping, electrical panel, power & control cabling etc. Delta T shall be 6 deg c
- **OZONE DOSING SYSTEM**: Ozone produced from ozone producing cells is mixed with water. This system consists of venture injection to contact the ozone with the cooling water. The water flow through the injector produces a partial vacuum which is utilized to draw ozone into the water stream and mix the two phases vigorously. The water jet exiting the injector with great turbulence from the motive nozzle disperses the gas into a stream of finest bubbles. This action increases the contact surface between gas and water phases tremendously which is essential for optimized mass transfer. The ozonated water will be introduced into the

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inlet to condenser, cooling tower riser, Cooling tower basin, Condenser Make-up water and PT Plant. Static mixtures shall also be provided for the ozone dosing line at the interval of 20 meters. However minimum number of Static mixtures shall be 32 numbers.

• **MEASURING & MONITORING DEVICES:**

Following minimum number of measuring and monitoring devices shall be provided by the bidder

- Outlet ozone gas of each ozone-generating module shall be measured by ozone analyser.
- ozone leak detector shall be placed in the ozone generator room to detect ozone leakage with alarm and cut-off signal on set value.
- Residual Ozone analyser at the condenser inlet, cooling tower riser, Cooling tower basin, Condenser Make-up water and PT Plant.

2. CAPACITY SELECTION:

Total CW Flow	=	77000 m ³ /hr
Ozone dosing rate	=	0.2 ppm
Ozone requirement	=	15.4 Kg/Hr.
Ozone Dosage rate selected	=	16 Kg/hr. (minimum)
Nos of ozone generator	=	1 no.

Total PT Plant Flow	=	2100 m ³ /hr
Ozone dosing rate	=	1 ppm
Ozone requirement	=	2.1 Kg/Hr.
Ozone Dosage rate selected	=	2.1 Kg/hr. (minimum)
Nos of ozone generator	=	1 no.

Ozone shall be dosed continuously @ 0.2 ppm in condenser inlet, cooling tower riser, Cooling tower basin, Condenser Make-up water and 0.02 ppm residual ozone shall be maintained in the system.

3. PLANT OPERATION AND CONTROL

The operation of the Ozone Generation Plant shall be from PLC based complete automatic control system. PLC shall have one OWS+ one OWS with Engineer's station with associated auxiliaries and shall be kept in AC room. The critical parameters shall be sent to plant DDCMIS for monitoring purpose only. It shall be possible to operate the plant in Auto / Semi auto / Manual mode. In 'Auto mode, once the sequence has been initiated, it shall proceed from step to step automatically. In 'Semi auto' mode each step shall be performed only after initiation by the operator. In 'manual' mode complete operation shall be by the operator. However, the detailed control shall be furnished by the bidder during detailed engineering stage. Alarm windows and No. of alarm shall be finalised during detail engineering.

Following minimum alarms shall be provided:

- High gas exit temperature
- High or low gas pressure
- Low chilled water flow
- High chilled water exit temperature
- Frequency drive failure
- Loss of phase detect
- High inverter current trip
- Low feed gas flow
- Door interlock trip
- Ozone concentration (intermittent)
- ORP/ residual ozone

4. LAYOUT CONSIDERATIONS

- Ozone generation plant will be located indoor in a separate building for ozone dosing.

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5. VENTILATION CONSIDERATION:

- Rooms where ozone might be emitted in case of failure shall be effectively monitored by gas detectors with alarms that stop the generation of ozone when activated. Effective monitoring means are the gas detector sensors. Rooms with ozone generators shall be equipped with ventilation actuated automatically by the gas detectors. The number of air changes per hour shall be as follows:

S.No.	Area	Inside Condition	Type of Ventilation	AIR CHANGE PER HOUR (ACPH)
1.	MCC Room	Inside temperature not exceeding 3°C above outside dry bulb temperature.	Supply air through axial fan filter unit and exhaust through gravity damper.	15
2.	All toilets, pantries.	Inside temperature not exceeding 3°C above outside dry bulb temperature.	Mechanical ventilation with propeller type exhaust fan.	20
3.	Battery and battery charger room	Inside temperature not exceeding 3°C above outside dry bulb temperature.	Negative pressurization of 5 mm by means of axial flow exhaust fans with flameproof motors.	30
4.	Compressor House	Inside temperature not exceeding 3°C above outside dry bulb temperature.	Supply air through axial fan filter unit and exhaust through axial exhaust fan.	20
5.	Ozone generation area	Inside temperature not exceeding 3°C above outside dry bulb temperature.	Mechanical exhaust by means of axial flow exhaust fans	30

➤ DESIGN CRITERIA

The outside design conditions considered are as follows:

	Summer	Monsoon	Winter
DBT (°C)	48	29.4	15.6
WBT (°C)	24.7	27.2	11.1

- All ventilation system shall operate on 100% fresh air. All mechanically ventilated areas shall be positively ventilated except battery room by means of supply air fans fitted with filters and/or gravity operated back draft dampers and exhaust fans. MCC, control rooms shall necessarily be pressurized condition. Supply air fan serving electrical areas shall be provided with both pre filter and fine filters and for other areas, supply air fans shall be provided with pre-filter only. Battery room shall be kept under negative pressure by exhaust ventilation system so as to prevent escaping of fumes outside. Exhaust Ventilation system shall be provided for ozonisation area
- The ducting shall be sized to have constant friction drop along its length with air velocity in the ducts normally not exceeding 12 m/sec for ventilation system.
- All air conditioning and ventilation systems etc. are in bidder's scope.
- Noise shall not exceed 85 dB (A).

6. AIR-CONDITIONING CONSIDERATION:

Split type Air conditioners shall be 2 x 60% or 3 x 40% Capacity for other Air-conditioned areas depending on the total cooling load. These air-conditions shall be operated with Push Button Station / Remote type. Minimum capacity and rating of each air conditioner shall be 1.5 TR & 5 star respectively. Heat load calculation for the air conditioning area shall be as per ISHRAE guideline.

7. DESIGN REQUIREMENT FOR PIPING:

- ❖ Sizes of pipelines shall be selected such that the velocity of fluid in pipes does not exceed the following limits under conditions of maximum possible volumetric flow:

Water	
Pump suction	1.5 m/s

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Pump delivery	3.0 m/s
Service/Potable water	1.5 m/s
Gas	
Compressed air	15 m/s

- ❖ Drain and vent connections on pipelines shall be at least of NPS 25 mm size.
- ❖ UNDERGROUND PROTECTION
 - Where pipelines are buried, underground protection shall be provided by the bidder for the piping system as indicated any one of the methods given below:
 - (a) Coal tar primer, coal tar enamel, inner wrap of fibre glass, final outer wrap of enamel impregnated fibre glass. Total thickness of coating shall not be less than 4.0 mm.
 - (b) With anti-corrosive tape of 4 mm thick conforming to IS-10221 and AWWA C 203-93.
 - Pipe surfaces shall be cleaned by shot or sand blasting before application.
 - Tests to be carried out after application
 - Bond/Adhesion test
 - Holiday test

8. DESIGN REQUIREMENT FOR HORIZONTAL CENTRIFUGAL PUMPS

- ❖ Flow rate versus head curve shall have a stable and continuously rising characteristics towards the shut-off head. In case of unstable (drooping) characteristics the duty point shall be well away from the unstable region. Besides the actual flow rate versus head curve, curves for minimum and maximum impeller diameters shall also be shown.
- ❖ The shut-off head shall be at least 110% of the differential head.
- ❖ The required NPSH at duty point shall be at least one (1) metre less than the available NPSH.
- ❖ The rating of the pump driver shall be the larger of the following:
 - (a) The maximum power required by the pump from zero discharge to run-out discharge at site climatic conditions.
 - (b) 110% of the power required at the duty point at site climatic conditions.
- ❖ The corrosion allowance for pressure parts shall be 3 mm.
- ❖ Pumps shall run smooth without undue noise and vibration. Noise level produced individually or collectively shall not exceed 85 dB(A) measured at a distance of 1.0 metres from the source in any direction. The overall vibration level shall be as per zones A and B of ISO 10816-1.
- ❖ Bearing shall be oil-lubricated or grease-lubricated and shall have a life of 40,000 hours of working. In case of oil-lubricated bearing, constant oil leveller with magnetic drain plug shall be provided.
- ❖ For all pumps while calculating the pump head, 20% margin (minimum) shall be considered on the value of friction losses. The static head shall be considered based on the pipe routing, however it shall be minimum 15 m.

9. DESIGN CONSTRUCTION OF AIR COOLED SCREW COMPRESSORS

- ❖ Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.
- ❖ Air compressors will be multi stage oil free, screw type, air cooled.
- ❖ Testing of compressor will be as per ISO: 1217.
- ❖ Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.
- ❖ The continuous motor rating will be at least ten percent (10%) above the maximum load demand of the driven equipment under the entire operating range. When the driver is not directly coupled to the compressor, due consideration will be made for losses in power transmission, in addition to the above margin.
- ❖ Satisfactory operation in parallel will be ensured without any uneven load sharing, undue vibration, noise etc.
- ❖ Noise level shall not exceed 85 dBA plus tolerances as per IS standard to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor. Required acoustic enclosures have to be provided to meet the above condition. The discharge blow off silencer and intake silencers shall be designed to meet the above noise limitation level.
- ❖ Compressed air velocity shall be 10 m/sec.
- ❖ Air ducting arrangement for each compressor shall also be provided by the bidder.
- ❖ ROTORS

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- Rotors will be one-piece construction with a suitable forged carbon steel or stainless steel coated with corrosion resistant material to minimize leakage and wear.
- The rotors will have an asymmetric profile, so as to keep leakage losses to a minimum and ensure high efficiency.
- Highly precise timing gears will be mounted on the rotor shafts to maintain the rotors in correct relative position.
- These gears will be designed to counteract the axial forces incurred in compression.
- Rotors shall be dynamically balanced.
- ❖ INTAKE FILTER
- Dry type suction air filters will be provided at the compressor inlet to prevent dust and dirt from entering the cylinders. The filtering efficiency shall be 99.9 %, down to 03 microns. Sound suppressing characteristics will be considered in the filter design.



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capacity and locking shall be possible while the pumps are in operation. A calibrated scale shall be provided for the above purpose. The pumps shall be capable of operation either intermittently or continuously. Necessary relief valves and discharge pressure gauges shall be provided. 'Y' type strainer shall be provided at the suction of each Injection pump.

3.13 All nuts, bolts etc. in submerged and corrosive application shall be of SS-316.

3.14 Rubbers used for rubber lining of equipment and piping shall be of natural rubber with shore hardness 65 ± 5 in Scale-A.

4.0 DESIGN AND CONSTRUCTION

For design and construction of all equipment, Bidder shall refer to Datasheet-A enclosed with this section. However few criteria are delineated hereinafter for reference:

4.1 OXYGEN GENERATION PLANT

To feed desired quantity & quality of feed gas to Ozonator.

4.1.1 Suitable capacity air drying unit with a heatless type regenerative system to achieve dew point of -60°C with no purge loss & PSA based.

4.1.2 Suitable capacity oxygen generator/concentrator to achieve the oxygen purity upto 92% by volume, gas filtered to $0.1 \mu\text{m}$, Hydrocarbon content less than $<15 \text{ mg/lit}$, PSA/Cryogenic based with online measurement & monitoring facilities of oxygen purity.

4.2 OZONE GENERATION PLANT

Ozone Generation plant of capacity not less than 16 kg/hr with multipoint dosing system.

4.2.1 Ozone electrode:



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Ozone generating module of vertical/Horizontal tabular form of MOC SS 316Ti & should comply as per DIN 19627. Cooling waterside pressure proof upto 6 bar. Thermal isolation against condensate water. Indirectly cooled dielectric of high grade borosilicate glass free of mechanical or heat generated tensions. High voltage electrodes with individual fuses.

(a) Dielectric glass tube:

- (i) **Material :** Borosilicate glass (specially for ozone generation)
- (ii) **Type:** Cylindrical.
- (iii) **Construction:** Closed at one end.

(b) Dielectric gap:

Dimensionally uniform annular gap between H.T electrode and dielectric maintained at 0.5 mm by centering device made up of Teflon as end cap.

(c) Internal fixing:

Each H.V. electrode rests on SS 316Ti high voltage distribution plate at top for centering and identification.

(d) H.V. electrode construction:

- (i) **Material of construction:**

High voltage should be given to Aluminium tubes having MOC as per DIN 17007 - Part 4 through a S.S. Fuse wire of suitable fusing properties (over voltage protected) & gauge standard in order to protect excess load. It should be flexibly suspended by S.S. 316 Ti spring to eliminate mechanical as well as thermal stresses.

- (ii) **Type :** Cylindrical



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Each Aluminium Electrode placed centrally with the help of Teflon cap. High voltage from the Dish End is given to the H.V. electrode through a spring attached with a S.S. fuse wire. The live fuse wire is enclosed by means of teflon tubing. The gas flow pattern should be of dual pass in each ozone producing sub element inside the electrode.

(iii) Isolation:

High voltage dish end is isolated with the rest of the body by means of Glass Chamber.

(e) Gas/Cooling ends:

Water inlet & outlet connection of Heat Exchanger should be of SS 316 Ti where as Ozone inlet & outlet connection should also be of SS 316 Ti.

4.3 COOLING WATER PLANT (CHILLER):

Suitable capacity chiller for removal of excess heat generated during ozone generation from ozone producing cells. It shall consists of compressor, cooler, condenser, refrigerant circuit, control center, pump, chilled water piping, condenser water piping, electrical panel, power & control cabling etc. ΔT shall be 6°C .

~~The cooling water must be of potable quality, non corrosive & have suspended solids <5 ppm.~~

4.3.1 ~~For Material of Construction of pipes envisaged for CW Treatment services Bidder may please refer Section II of this volume.~~

4.3.2 ~~For Pipe lines carrying water, chemical solution and air & its velocities, Bidder shall please refer Section – II of this volume.~~

4.3.3 Socket welded joints shall be used in PVC service. Teflon tape/Litharge/Glycerin cement shall be used in all screwed joints.



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- 4.3.4 All piping above the ground shall be suitably protected from the atmospheric corrosion by adequate painting system or adequate insulation system.
- 4.3.5 All buried pipelines shall be coal tar coated and wrapped. Buried pipes shall be cathodically protected.
- 4.3.6 All joints shall be socket type with solvent welding. For these pipes, laid on the sand level, insulation shall be provided to prevent solar effect and mechanical damages on the pipe.
- 4.3.7 During erection, cutting oil, grease and other foreign materials inside pipe lengths and fittings shall be removed. New valves or other equipment received in an oily condition shall be dismantled, and cleaned before use.

4.4 PAINTING

All mechanical, electrical and structural items included under this section shall be suitably protected with paints and protective coatings as specified in this specification and further as required.

5.0 OPERATION AND CONTROL PHILOSOPHY

- 5.1 Ozone generator shall utilize a redundant Programmable Logic Controller (PLC). PLC software shall be stored in EEPROM and not solely in volatile static RAM. Each ozone generator shall have an automatic and manual control mode. In the automatic mode, the generators power shall be modulated by a command from an external 4-20 milliamps signal from a process controller to the integral PLC. In the manual mode, the operator shall be able to set the inverter frequency via HMI.

5.2 CONTROL FLOW OR SEQUENCE OF OPERATION IN AUTO MODE THROUGH PLC

5.2.1 Procedure for machine start

To start the plant, operator has to turn 'Start' rotary switch to on position, Auto-O-manual switch to Auto; following operation shall take place automatically as described in logic software of PLC.



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- (a) Sump Pump should be started first by which normal water shall flow through the heat exchanger of Chiller. This is for cooling of chiller.
- (b) With delay of 60 seconds, compressed air is to be started.
- (c) After Compressed air with delay of 60 seconds, both Oxygen generators are started.
- (d) With Oxygen Generator, Chiller is to start along with its corresponding Recirculation Pump. There are two Recirculation Pumps, One Working And one Hot Standby. Operator has to decide which pump is to be operated through control switch on the panel. Process of Cooling Water flow from Chiller to Electrode and return to Chiller tank shall take Place.
- (e) As soon as temperature of cooling water reaches its set point, thermostat in chiller water tank shall give the signal. With delay of 60 Seconds to thermostat signal, Oxygen inlet Valve to Electrode and Ozone Outlet valve shall be on. Along with these valves, Dosing pump shall be on.
- (f) PLC Logic shall check interlocks for required Oxygen flow, transformer temperature, cooling water flow, cooling water pressure, any control trip, door open limit switch, drive trip etc. If all the required conditions to start the electrodes are met then electrodes shall be started. Number of electrodes to be consider by vendor, if there is fault in one line then only that particular electrode shall not start and all other shall be on. During run time also if there is fault in one particular line then only that line shall be off rest shall be on. With this Ozone generation takes place.
- (g) During run time if Ozone Leakage is detected through ambient ozone leak detector sensor then whole plant shall be shut down & Exhaust fans fitted in the plant room shall be started automatically to flush ozone air from the room.

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5.2.2	Procedure for machine stop To stop the plant, Operator has to turn 'start' button to off state, following operation shall take place (a) First Electrode shall be shut off. (b) With delay of 30 seconds Chiller shall be off. (c) After chiller with delay of 5 minutes Oxygen inlet valve to Electrode and Ozone Outlet valve from Electrode, recirculation pump & Dosing pumps shall be off. This is required for flushing the electrode and the system. (d) With delay of 20 Seconds all Outputs, Oxygen generator, Compressed air, Sump pump shall be made off. 5.3 <u>CONTROL FLOW OR SEQUENCE OF OPERATION IN MANUAL MODE THROUGH PLC</u> 5.3.1 Procedure for machine start To start the plant operator has to turn rotary switch Auto-O-manual switch to manual; Safety interlocks already considered to avoid any malfunction and damage. Safety interlocks are done using imposition relays in the manual control panel. All switches & push buttons for manual operation are provided on the manual panel along with its indication for ON, OFF & Trip. Operator has to run machine in the procedure described below otherwise next process shall not start due to safety interlocks. (a) First sump pump should be made on by which normal water shall flow through the heat exchanger of Chiller. This is for cooling of chiller. There are two pumps one working & one hot standby, operator has to select one to run, Pressure Switch at compressor side shall be actuated. HMI display at compressor panel shall correspondingly show the status. (b) Compressed air has to be started then and with delay of 60 seconds Oxygen generator has to be started. Along with oxygen generator



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chiller and its recirculation pump is to be started. Two recirculation pumps are provided one running & one standby; operator has to decide which one has to be operated.

- (c) As soon as temperature of cooling water reaches its set point, thermostat in chiller water tank shall give the indication. With delay of 60 Seconds to thermostat signal, Oxygen inlet Valve to Electrode and Ozone Outlet valve shall be made on. Along with these valves Dosing pumps should be started.
- (d) After this electrode is to be started, this shall be started after checking the interlocks for transformer thermostat, oxygen flow, door limit switches and all subsequent interlocks.

5.3.2 Procedure for machine stop

To stop the plant, Operator has to turn 'start' button to off state, following operation shall take place

- (a) Electrode should be turned off first.
- (b) After some delay chiller should be turned off.
- (c) With delay of 5 minutes oxygen valve, ozone valves, dosing pumps, recirculation pump should be turned off.
- (d) After 30 seconds compressed air, oxygen generators & sump pump should be turned off.

5.4 ALARMS AND SAFETY FEATURES

Ozone vessel gas pressure shall be precisely regulated using transducers and PID control. A water back flow prevention device suitable for ozone use shall be installed on the ozone gas out piping. Any electrical cabinet that has a door shall have electrical and mechanical interlocks on that door.

Alarm list

- (a) High gas exit temperature



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- (b) High or low gas pressure
- (c) Low chilled water flow
- (d) High chilled water exit temperature
- (e) Frequency drive failure
- (f) Loss of phase detect
- (g) High inverter current trip
- (h) Low feed gas flow
- (i) Door interlock trip
- (j) Ozone concentration (intermittent)
- (k) ORP/residual ozone

~~5.5 For detail Control & Instrumentation, please refer Volume-V.~~

~~5.6 For detailed PLC specifications, please refer Volume-V.~~



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specifically mentioned but needed to make the system complete in all respects and reliable for safe and smooth operation and guaranteed performance shall also be treated as though included and the same shall be furnished, unless otherwise specifically excluded elsewhere.

2.1 EQUIPMENT AND ACCESSORIES FOR CIRCULATING WATER TREATMENT PLANT

2.1.1 Following are the required equipments and accessories for the Ozonization Plant:

- (a) Oxygen Generation Plant
- (b) Ozone Generation Plant
- (c) Cooling Water Plant
- (d) Power Supply Unit
- (e) Ozone Dosing System
- (f) Measuring & Monitoring Devices
- (g) PLC Based Control Panel

System consists of PLC in the Control Panel, which shall be controlled by the one (1) 24" TFT colour operating station. The operating station shall control the ozone generator depending upon the required output of ozone. The electrodes shall operate from 40 Hz to 72 Hz variable frequency to get required ozone output. Operating station shall control the complete system and required data can be recorded for reference. Auto/Manual both options shall be there in the system for manual operations, if required. Print out of the recorded data can also be taken.

Monitoring & control of all important/critical system parameters is carried out using PLC. This allows for infinite precise control of ozone production as well as the entire Ozone treatment process, if desired. Important signals shall be hardwired to DCS for monitoring purpose.



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2.1.2 Power supply unit :

Sr. No.	Feature	Specification
(a)	Operating Principle	Voltage source Inverter with (PWM) Pulse Width Modulation technique.
		The mode of operation: (i) V/F control. (ii) Sensorless Vector Control. (iii) Sensored Vector Control.
(b)	Type of Inverter	The inverter is Microprocessor based digital type. (i) 32 Characters LCD & 7 segment display Keypad. (ii) Suitable for site ambient temperature – 10°C to 40°C.
(c)	AC Input supply	Input Voltage: Three Phase 380-480 (± 10%). Input Frequency: 50-60 Hz (± 5%)
(d)	Frequency Resolution : Frequency Accuracy:	Digital ref: 0.01 Hz & analog ref: 0.03 Hz. Digital: 0.01% of Max o/p freq. Analog: 0.1% of Max o/p freq.
(e)	Desired Performance Switching Duty Overload:	Normal-4 starts per hour (minimum) Trial run and commissioning: 6 starts per hour
	Speed Holding: Accuracy	150% for 60 secs, 200% for 30 secs The inverter offered is capable to hold the speed accuracy better than ± 0.5% of base speed with voltage/Current feedback.



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	Frequency : Stability	VFD is capable to hold frequency stable with $\pm 0.5\%$
	Acceleration / Deacceleration	(0-666) Sec. Independently adjustable, depending upon the application.
	Voltage dips	The inverter shall be designed to withstand dips in supply voltage for 3.5 sec without damage to semiconductor.
	VFD Efficiency	The efficiency of inverter at rated voltage and speed depends on the rating of the inverter and efficiency should be approx. 97%.
	Safety Factor	Rectifier Bridge PIV (Peak Inverse Voltage) is 1600 V
		Max. operating voltage is 506 V & ratio of PIV/Max. Operating voltage is 3.16
(f)	Operating Parameters	Soft start with adjustable time acceleration. Adjustable Current limits and acceleration & deceleration ramps. DC Injection Braking, jump frequency, second function, slip compensation, reverse rotation protection, auto restart, Inverter bypass, Auto Tuning, PID Control, Internal fault detection. The recommended distance between Electrode & drive is 50 metres. Use output filter to avoid reflected wave phenomenon caused due to long cable distance.
	Protection	(i) Instantaneous over current.



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	(ii)	Over voltage.
	(iii)	Under voltage.
	(iv)	Fan failure VFD.
	(v)	Stall protection.
	(vi)	Fuse Failure.
	(vii)	Inverter overheat.
	(viii)	Input / Output Phase loss protection.
	(ix)	Single-phase protection.
	(x)	AC under voltage protection.
	(xi)	Earth fault protection.
	(xii)	Control and regulated power supply failure protection.
	(xiii)	Communication Error.

2.1.3 Ozone dosing system:

2.1.3.1 Dosing systems as defined designates such part of the plant that mixes water with ozone gas exited from the ozonator. It shall consist of:

2.1.3.2 Ventury Injector of Ozone resistant material with backflow prevention arrangement. With suitable booster pumps on assessing the dosing point location at site.

2.1.3.3 All pipelines, valves, fittings & other metallic parts involved in oxygen concentrator & ozone generator up to dosing point shall be of suitable non-corrosive metallurgy.

2.1.4 Measuring & monitoring devices:

2.1.4.1 Outlet ozone gas of each ozone-generating module shall be measured by a common ozone analyser, of digital display model in gm/Nm³ (range 0 to 200) having accuracy of 0.1 gm/Nm³ based on UV Adsorption technique.



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- 2.1.4.2 Residual ozone measuring device/ORP meter with Digital display, having repeatability ± 0.01 ppm shall be placed at the location after condenser & in the cooling water pond basin.
- 2.1.4.3 Ambient ozone leak detector shall be placed in the ozone generator room to detect ozone leakage with alarm and cut-off signal on set value.
- 2.1.4.4 The above measuring/monitoring devices shall be of standard make.
- 2.2 LIGHTING, AIR CONDITIONING AND VENTILATION SYSTEM:
- 2.2.1 Ozone plant shall be erected in closed building that can be locked. Rooms where ozone might be emitted in case of failure shall be effectively monitored by gas detectors with alarms that stop the generation of ozone when activated. Effective monitoring means the gas detector sensors. Rooms with ozonation plants shall be equipped with ventilation at floor level actuated automatically by the gas detectors. ~~Ventilation shall guarantee at least three complete changes of air per hour. All lighting fixtures, window AC's ventilation systems along with MCC, SLDB's, cables (power, control & Instrument) etc shall be provided.~~
- 2.2.2 The bidder has to confirm and fulfill ozonization capacities and operation of the system as adequate for the following as per the guidelines of Environment Section.
- 2.2.2.1 Unit sharing full load with given limiting parameters of circulating water. The range to be given by bidder.
- 2.2.2.2 Possible interruptions of Ozonization due to problems such as supply failure, interruption in supply of ozone gas etc.
- 2.2.2.3 Unit's start-ups and shut downs-planned/forced. Quick stabilization of the system after any interruption.
- 2.2.3 Dosing points to be selected in such a way that Ozonization is ensured for complete system. It should be ensured that no ozone-depleted pockets are left out in the system.

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2.2.4	The health and safety aspects are required to be elaborated so that proper precautions can be taken during operation and maintenance.
2.3	<u>OPERATIONS :</u>
2.3.1	On the basis of manufacturers operation & maintenance manual, the supplier shall provide instruction for the operation of the ozonating plant & make them accessible to all personnel who work at or near the plant. Such instruction shall include the following indication: (a) instruction on the operation of the parts of the plant (b) starting and shut down sequence (c) action in the event of the faults (d) preventive measures to avoid untoward situation
2.3.2	Safety signs: Safety signs marked shall be in accordance with the safety concerns at the working place.
2.4	<u>ACID INJECTION AND CHEMICAL INJECTION SYSTEMS</u>
2.4.1	One (1) hose station for unloading 98% Sulphuric Acid. The hose station shall have two (2) HDPE hose connections (50 NB each).
2.4.2	Two (2) Sulphuric Acid Transfer Pumps, each complete with drive motor and all other necessary accessories.
2.4.3	Two (2) Sulphuric Acid Storage Tanks, each complete with all necessary accessories.
2.4.4	Two (2) Sulphuric Acid Day Tanks, each complete with all necessary accessories.
2.4.5	Two (2) Sulphuric Acid Injection Pumps, each complete with drive motor and all other necessary accessories.



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- 3.2.5 Three (3 x 50%) Vertical Cooling Tower Makeup pumps for supplying Filtered water to the Cooling Tower for make up purpose.
- 3.2.6 Two (2 x 100%) Vertical Supply water pumps shall convey Filtered water to DM plant.
- 3.2.7 Isolation gates for pump house intake on both sides of reservoir and isolation gates as required for each pump sump.
- 3.2.8 Fixed screens as required for each pump sump.
- 3.2.9 Electric overhead traveling crane.
- 3.3 DEMINERALISED WATER SYSTEM
- The System shall include;
- 3.3.1 Two (2) DM water storage tanks of minimum capacity 1000 m³ each with all required interconnections and necessary instrumentations.
- 3.3.2 Two (2 x 100%) Horizontal type Demineralised Water (DMW) supply Pumps shall convey De-Mineralized water to Condensate Storage Tank.
- 3.4 ~~CW TREATMENT WATER SYSTEM~~
- The System shall include:
- 3.4.1 **One (1x100%) Ozone Treatment System of minimum 16 kg/hr capacity.**
- 3.4.2 ~~Chemical Dosing shall include Scale Inhibitor dosing System, Corrosion Inhibitor dosing System, Biocide Injection System and Sulphuric Acid Dosing System.~~
- 3.5 EFFLUENT WATER TREATMENT SYSTEM
- The system shall include:
- 3.5.1 Clear Water Storage Tank comprising of two (2) compartments.
- 3.5.2 Clear water pump house in the vicinity of Clear water Storage Tank.



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2.1.29 Supply and application of shop painting and final painting at manufacturer's works and at site for the entire Plant as specified elsewhere in this specification.

2.1.30 Supply of first charge of lubricating oil, inhibitor for oil and also adequate quantity of the same consumables for topping up for first six (6) months of initial operation after successful commissioning.

3.0 SALIENT DESIGN FEATURES

3.1 RAW WATER PRE-TREATMENT PLANT

3.1.1 The water analysis to be adopted for the design of Raw Water Pre-Treatment Plant has been furnished in Annexure-I.

3.1.2 Design quality of treated water from Raw Water Pre-Treatment Plant as envisaged has been described under Annexure –II of Volume II.

3.1.3 Each Clariflocculator shall be over ground as much as possible so that sludge disposal arrangement becomes under the ground to the minimum extent possible. The total water loss due to sludge blow down shall be limited to maximum 5% of the total inflow to Clariflocculator. The system shall be suitable to handle sludge with 2% consistency. The system at upstream, inlet and flocculation zone of each Clariflocculator need to be designed to handle excess water to make good for water loss for sludge blow off.

3.1.4 Sludge blow-off shall be affected by the static head of water in the Clariflocculator.

3.1.5 Various chemical preparation and injection systems in the Raw Water Pre - Treatment Plant shall be designed for the dosage rates as follows:

(a) **Ozone** : **1 ppm**

~~(b) Alum : 60 ppm~~

~~(c) Lime : 25 ppm~~

~~(d) Poly -Electrolyte : 5 ppm~~



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- 3.1.6 All the chemicals to be used in the Raw Water Pre -Treatment Plant ~~shall generally conform to the requirement of technical grade as per relevant IS code.~~

Ozone generator shall have a capacity not less **than 2 Kg/hr.**

- 3.1.7 ~~The ground floor of Chemical House shall be used for chemical storage. Storage space needs to accommodate each of the chemicals required, in order to operate 660 MW TPP, for thirty (30) days, on continuous and at full load basis.~~

~~The storage space for each chemical shall be separated from other by partition walls. The stack height (if applicable) for each storage space shall not exceed 2.0 m.~~

- 3.1.8 A minimum of 300 mm freeboard shall be provided in all chemical solution tanks of the Raw Water Treatment Plant.

- 3.1.9 Gravity filters shall be designed for flow rates as specified in Datasheet-A.

Filter boxes shall be water-tight R.C.C. structure.

Two (2) Gravity filters shall be installed for DM & Non-DM respectively. Each filter shall be twin section type and unit shall be capable of handling maximum design flow and reducing turbidity to the extent as specified in Datasheet-A.

Backwashing of gravity filter units shall be carried out once in 24 hours with water taken from Overhead Filter Backwash Water Tank located on the roof of Gravity Filter house. Provision for sectional backwash of filter bed shall be provided. Motorized Butterfly valves shall be provided in backwash of the Gravity filters.

The capacity of the overhead filter backwash water tank shall be sufficient to cater backwash requirement of Gravity Filter unit + 20% margin. The tank shall be provided with level indicator, level switches, vent, drain, overflow etc.



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1.0 SYSTEM DESCRIPTION

The schematic arrangement of Circulating Water Treatment Plant has been detailed in P&I Diagram enclosed with this document.

The proposed plant need to have treatment systems for inhibition of micro - biological fouling as well as scale formation and corrosion with reference to Circulating Water. Further, the control of suspended impurities in CW & ACW Systems should also be given due consideration.

There is a Fore bay for the proposed cooling tower for 1 x 660 MW unit, for which two (2) treatment Systems has been envisaged. Circulating Water Ozonization System as well as Chemical Treatment System shall be located within a Building to be called as C.W. Treatment Building.

1.1 OZONIZATION SYSTEM

~~1.1.1 The following guidelines apply to plants for the generation, transport & use of ozone as a means to treat Cooling Tower recirculating water.~~

1.1.2 Ozonization plants as defined by these specifications comprises the ozone generating plant as a whole including mixing device, ozone producing reactors, its feed gas preparation device & its controls.

1.1.3 Ozone Generation System shall be one in Nos. The ozone system must be capable of producing the required quantities & concentration of ozone & injecting it to process stream on continuous basis.

1.1.4 The area of application is recirculating water intake & other additional points in CW system to protect the water system from biological fouling that affects surface heat transfer & interferes with circulating water flow.

1.1.5 The capacity of ozone system shall be a function of the total ozone demand of the treatment process for particular application. The ozone generation plant shall be designed to generate & deliver to the injection points, an ozone solution @ 0.2 ppm for the maximum design CW for a recirculation water flow at turbine VWO condition; however, a minimum flow of 77,000 m³/hr shall be considered.



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- 1.1.6 The proposed Vertical/horizontal tubular ozone generator provides maximum production efficiency with minimum power consumption. Ozone shall be generated using a dry filtered gas containing oxygen, which is fed through an electrical discharge created between the two electrodes. These electrodes are separated by the discharge gap & a single dielectric.
- 1.1.7 The electrode is always maintained at high voltage & the vessel is connected to the earth. The discharge, known as "silent corona discharge" causes the dissociation of some of the oxygen molecules resulting into the formation of ozone.
- 1.1.8 The ozone content, or ozone concentration, is generally expressed by the ratio of ozone in the outlet gas (% by weight) or the weight of ozone produced per volume of the outlet gas (g/Nm³). The quantity of ozone produced & the ozone concentration are controlled by adjusting the feed gas flow rate & the power applied to the discharge.
- 1.2 C.W. CHEMICAL TREATMENT AND SIDE STREAM FILTRATION SYSTEM
- 1.2.1 Sulphuric Acid shall be dosed in the CW bay to convert scale-forming calcium and magnesium bi-carbonate into corresponding sulphate compounds having higher solubility. Based on make-up water flow, 5 cycles of concentration in CW Circuit and to maintain maximum of 150 ppm of M-alkalinity in CW Circuit, 98% Sulphuric Acid needs to be dosed. The recommended rate of dosage shall be furnished by the Bidder.
- 1.2.2 Sulphuric Acid Injection System shall comprise of two (2) Sulphuric Acid Injection Pumps, two (2) Sulphuric Acid Storage Tanks, and Sulphuric Acid Day Tanks. The Sulphuric Acid Injection System shall be located outdoor.
- 1.2.3 For additional safeguard against scaling as well as corrosion, synthetic polymer based Antiscalant along with some corrosion inhibitor shall also be dosed in CW bay.
- 1.2.4 The Scale Inhibitor Injection System shall consist of two (2) Scale Inhibitor Tanks (one (1) tank as working and one (1) tank as standby), Two Scale Inhibitor Injection Pumps (one (1) Working and one (1) Standby) and all



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- 1.5.2 Pumps and drives in raw water pump house for supplying raw water from the plant one day Raw water storage tank to
- (a) DM/Non –DM Clariflocculation purpose (Vertical)
 - (b) Ash Handling System makeup (Vertical)
 - (c) Horizontal Centrifugal pumps for Fire Fighting System
- 1.5.3 Vertical wet-pit pumps and drives in both Filtered water pump houses for supply of filtered quality water within the plant.
- 1.5.4 Horizontal pumps and drives for transferring DM water from DM Water Storage Tanks to Condensate Storage Tanks.
- 1.5.5 Low pressure and large diameter piping system including valves and specialties for distribution of different quality water to various services within the plant.

For detailed scope, refer to **Volume: III-E1** of this specification.

1.6 **WATER TREATMENT AND EFFLUENT TREATMENT SYSTEM**

1.6.1 Pretreatment System

This plant shall include Two (2) Clariflocculators (one for DM and one for non- DM) followed by Two (2) Gravity Filters (one for DM and one for non-DM) respectively.

The Pre- Treatment Plant shall comprise follows:

- (a) Ozone dosing shall be applied in pre-treatment (1 ppm ozone shall be dosed as minimum in addition to chemical dosing).
- (b) The Filtered water shall be transferred by pumps to inlet of Demineralization Plant, Potable Water Systems for plant, Service water System for plant.

बी एच ई एल 		TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
SR. NO.	ITEM		
23.0	RAW WATER OZONIZATION SYSTEM		
23.1	OZONE GENERATOR		
23.2	Number required	One	
23.3	Description for each ozone generators		
23.4	Ozone generator capacity	Not less than 2 kg/hr	
23.5	Dosing system	multipoint	
	For the other requirement of the Raw water Ozonization system Specification for CW Treatment shall be referred.		



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adjacent to the pump house.

2.2 FILTERED WATER TREATMENT SYSTEM.

The Filtered Water Transportation System shall convey water from Filtered Water Storage Tank for DM & Filtered Water Storage Tank for Non – DM by means of separate sets of vertical wet pit type pumps to the following facilities:

- (a) Plant Potable Water.
- (b) Colony Potable Water.
- (c) Service Water
- (d) Cooling Tower Makeup.
- (e) DM Plant Make-up

2.2.1 Two numbers (2 x 100%) vertical wet pit type Potable water pumps for plant shall convey potable water to the potable water overhead Storage Tank to be located on the roof of TG building. Tank shall be designed for minimum 50 m³ storage.

On line ozonization shall be done on this water at the outlet of the Potable water storage tank.

2.2.2 Three numbers (3 x 50%) vertical wet pit type Cooling Tower makeup pumps shall convey makeup to cooling tower.

2.2.3 Service Water from Filtered Water Storage Tank shall be transferred to the Overhead Service water tank located on TG building roof by means of two numbers (2 x 100%) vertical wet pit type service water pumps. Tank shall be designed for minimum 150 m³ storage.

Service water from Overhead Service water tank to the aforesaid facilities shall flow by gravity.

These three types of pumps namely CT make-up pumps, Potable water

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	TITLE: 1X660 MW BHUSAWAL TPS, UNIT # 6		SPECIFICATION NO. PE-TS-415-174-A001	
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			SUB-SECTION: IIA	
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ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)

Required number of electric hoist / manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

Manual hoists (hand operated) shall be designed to duty class 2 as per IS 3832 and electric wire rope hoist shall be designed as per IS: 3938 (latest).

The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.

Maintenance tools and tackles shall be as per data sheet attached.

DESIGN CRITERIA

- 1.0.0** Hoists shall be provided in all areas where any equipment/ component weighing above half ton is installed and needs to be handled for maintenance purposes. Number of monorail beams shall be such that the centre line of the hoist and the centre line of equipment to be handled shall be not more than half meter. The location and number of hoists is to be finalized during detailed engineering. Final arrangement is subject to approval of Customer.
- The hoist capacity shall be selected considering 25% margin over the weight of heaviest component /equipment to be handled. The hoist parameters (i.e. lift & travel) are subject to change/s, to suit the final layout of the area in which it is intended to be installed.

Electric hoist shall be provided for capacity >1T.

Chain pulley block (Manual hoist) - 500kg to ≤1T, wherever feasible, considering layout constraints.

For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the electrical/ manual hoist with the help of floor operated pendant

Note:

1. Area, type, capacity mentioned are minimum requirement and shall be finalised during detail engineering without any commercial implication
2. Travel and Lift are layout dependent and shall be finalised during detail engineering without any commercial implication
3. Additional electric/manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

2.0 SCOPE OF SUPPLIES

Equipment and services to be furnished by the bidder for the ELECTRIC HOIST/ MANUAL HOIST with accessories as per the details given in the technical specification and data sheet. Any equipment / accessories not specified in the specification but required to make the ELECTRIC HOIST/ MANUAL HOIST complete and efficient operation shall also be under the bidder's scope of work.

Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

- 2.1.0** Electric hoist shall include but not be limited to the following: -
- a) Equipment offered shall be suitable for indoor duty conforming to Class II of IS: 3938.
 - b) Equipment shall be designed to operate in non- hazardous area.
 - c) Electric hoists shall be pendant operated.
 - d) Both hoisting and trolley movement shall be motor driven.
 - e) Wheels shall be single flanged type.
 - f) Hook shall be swivelling type and fitted with a safety latch.
 - g) Control panel shall be hoist mounted.
 - h) Power feeding to the electric hoists shall be thru' PVC shrouded DSL.
 - i) Brakes shall be fail to safety.
 - j) Load/overload testing of the hoists shall be carried out as per IS: 3938.
 - k) All material, castings and forgings will be of tested quality & certificates shall be made available for review

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	TITLE : 1X660 MW BHUSAWAL TPS, UNIT # 6		SPECIFICATION NO. PE-TS-415-174-A001	
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			REV. NO. 00	

as per approved QAP

- l) Lifting lug, eye bolts etc., for handling hoist parts.
- m) Erection hardware.

2.2.0 Erection and Commissioning spares (ELECTRIC HOIST)

The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.

2.3.0 Services to be provided by the bidder

Packing, forwarding and transportation to site, storage and handling at site.

2.4.0 Erection and Commissioning

2.5.0 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant Indian standards)

2.6.0 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.

3.0 Inspection and Testing

As per enclosed reference quality plan and as per IS 3938 (latest revision). Prime inspection agency shall be Consultant/ End Customer. Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement/CHP (Customer Hold Point) at any stage of inspection deemed necessary by Consultant/ End Customer during detailed engineering shall be carried out without any commercial or technical implication.

4.0 Works Excluded

Supply of ISMB monorail.

5.0 PAINTING SPECIFICATION

As per painting details specified elsewhere in specification.

6.0 PACKING

In general packing shall be wooden box packing.

7.0 TESTING AT VENDOR'S WORKS

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP and as per IS 3938 for electric hoist and IS 3832 for manual hoist.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

8.0 MAKE OF SUB - VENDOR ITEMS

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client. (Refer Annexure-I)

9.0 TESTING AT SITE

A) ELECTRIC HOIST:

As required for statutory clearance for operating at site i.e., overload test, load test and other tests as per IS 3938.

Test for Operation -After the supply has been connected, tests shall be carried out to prove the following:

- a) The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavorable conditions;
- b) The correctness of all circuits and interlocks and sequence of operation; and

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c) The satisfactory operation of all protective devices.

Overload Test -After test but before the hoist is put into service, it shall be tested with overload relays appropriately set, to lift and sustain a test load of 125 percent of the working load. During the overload test, the hoist shall sustain the load under full control. The specified speeds need not be attained but the hoist shall show itself capable of dealing with the overload without difficulty.

B) MANUAL HOIST:

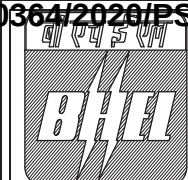
As required for statutory clearance for operating at site with following minimum test i.e., overload and load test.

TECHNICAL DATA SHEET:

A) Technical data sheet-A for ELECTRIC HOIST:

Sr. No.	DESCRIPTION	TECHNICAL PARTICULARS
		Electric hoist with electrically operated trolley
1	Design, duty, fabrication and testing of the crane conform to standard / code number	As per IS: 3938 (latest edition), Class-II duty
2	Area of installation, quantity, rated capacity (Safe Working Load) of cranes	As per Annexure A
3	Margin	The crane/hoist capacity shall be selected considering 25% margin over the weight of heaviest component/ equipment to be handled.
4	Overload Test	125% of Rated capacity (Safe Working Load)
5	Deflection test of crane	NA
6	Operation from	Pendant station - It shall locate the push buttons for controlling the various motions of the crane and shall be hung from the crane trolley to a height of approximately 1 metre above the operating floor
7	Design Ambient temperature	50° C
8	PERFORMANCE	
8.1	Crane speed with full load	
8.1.1	Main hoist	3
8.1.2	Trolley travel (CT)	15
8.1.3	Longitudinal bridge travel (LT)	NA

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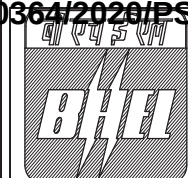
8.2.1	Acceleration values	NA
8.2.2		CT motion (trolley travel) as per IS: 3938
9	Lift in Metres	The lifting rope shall be of sufficient length to permit the main hook to reach the zero level.
9.1	Main Hoist	Shall be suitable as per approved layout
9.2	Hook Approaches	To suit the lifting requirement.
	COMPONENT DETAILS	
10	Trolley	
10.1	Type	Fabricated steel / Cast steel
10.2	Material	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels. Material of construction as per IS: 2062 (Grade A/B).
10.3	Whether jacking pads for lifting trolley provided or not	Yes
11	Rope drums	
11.1	Material (Indicate IS)	Cast steel or mild steel.
11.2	Flange / flangeless	Flanged
11.3	Numbers provided	One
11.4	Type of grooves	Machined grooved identical Right hand and Left hand of proper shape for the rope used. Additional grooves shall be provided as per IS 3177/3938 in rope drum
12	Rope details	
12.1	Construction / Core	The wire ropes shall be of suitable diameter as per Suppliers design of crane. The rope shall confirm to I.S. 1835, 1804 and 2266. The rope shall be parallel right hand lay having 6 x 37 constructions with hemp core. However, this should be in relation with Drum diameter as per IS: 3177. The rope selection procedure shall be as per IS 3177 cl. no. 8.3.2.
12.2	Tensile designation (Rope Grade)	1770 or 1960 (in N/sq. mm)

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12.3	Factor of safety	Not less than 5
13	Sheaves details	
13.1	Material	The sheaves (Pulleys) shall be of carbon steel casting having chemical and mechanical properties as per IS: 1030 (Class 11).
13.2	Type of guards provided	Fabricated from Sheet steel
14	Gear box details	
14.1		Forged steel as per IS 3938
14.2	Hoist Motion / Cross Travel	
14.2.1	Type of mounting of gear box	Horizontal / Vertical
14.2.2	Classification	Suitable for M5 duty
14.2.3	Type of gears	Spur / Helical, hardened and tempered with machine cut teeth
14.2.4	Type of lubrication	Oil splash/ grease lubricated
14.2.5	Hardness (BHN) – gear	568+/-20BHN for alloy steel.
14.2.6	Hardness (BHN) – pinion	568+/-20BHN for alloy steel.
14.2.7	Difference in Gear and pinion hardness	Min 20 BHN
14.2.8	Materials (gear/pinions)	Gears shall be of cast or forged steel and pinions shall be forged steel and shall be machine cut. Gear and pinion teeth shall be treated for resistance to wear.
14.2.9	Casings	Fabricated steel gear boxes which shall be dust proof and firmly sealed to prevent oil leakages. Gearboxes shall have covers split horizontally and arranged such that top half can be removed for inspection. The gear boxes shall be fitted with bolted type machined inspection covers.
14.2.10	Noise level	85 db
14.2.11	Standard conforming to	IS: 4460

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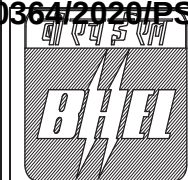
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15	Wheels details	Cross Tavel
15.1	Material	EN-8/9
15.2	Hardness	IS: 3938. Max hardness 200 BHN
15.3	Type	Wheels in trolley unit travel shall be single flanged with straight / taper/ barrel shaped tread to suit the monorail.
15.4	Numbers provided	As per manufacturer's standard.
15.5	Specification conforming to	IS: 3938
15.6	Arrangement of lubrication	Grease
16	Lifting hooks	
16.1	Type	Plain shank trapezoidal section
16.2	Safe lifting capacity	As per Safe Working Load
16.3	Material	Solid, forged, heat treated alloy steel/ carbon steel of rugged construction as per IS:15560
16.4	Standard conforming to	IS: 15560
16.5	Hook can swivel	Yes
16.6	Safety latch on hook provided	Yes
16.7	Locking device on swivelling hook	Provided
16.8	Hook suspension	Ball or roller thrust bearing
17	Buffers	Cross Travel
17.1	Type	Spring or rubber buffers shall be provided on the trolley
17.2	Numbers provided	4

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17.3	Details of end stop	NA
18	Brakes	
18.1		Hoist Motion / Cross Travel
18.2	Type of brake (ac / dc)	DCEM/ ACEM disc type (fail to safety)
18.3	Number provided per motor	1
18.4	Braking capacity (% of full load torque)	150% / 125%
19	Drive system for hoisting	
19.1	Arrangement of drive from motor to rope drum (main)	Through geared steel coupling and gear box
20	Bearings	Hook / Trolley wheels / Rope drum / Gear box / Sheave / Any other assembly
20.1	Type	Antifriction ball / roller bearings
20.2	Lubrication	Grease lubrication
20.3	Bearing life	10,000 working hours.
21	Bridge girder	
21.1	Type & Quantity	NA
21.2	Vertical Deflection and Camber	NA
21.3	Type of connection to end carriage	NA
21.4	End carriage span material	NA
22	Motors	
22.1	Hoist Motions	MH / CT

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22.2	Type	Motor shall be rated for duty S4, CDF 40% and 150 starts per hour. Service class of motor shall be "M8" as per IS: 3177. Conditions given in IS:3938 for hoist motor shall be followed.
22.3	Enclosure	TEFC
22.4	Numbers furnished	One
22.5	Voltage, phase and frequency	Suitable for rated frequency of 50 Hz with a voltage variation of +/-10% and frequency variation of +/-5% occurring separately or combined voltage and frequency variation of 10%.
22.6	Class of protection	IP-55
22.7	Margin	Motor ratings shall be calculated keeping margin of at least 25% over the maximum power requirement. Further, the hoist motors shall be rated to lift 125% of the design load on the hook at the rated speed.
22.8	Class of insulation	All motors shall be totally enclosed, fan cooled type, having class-B stator insulation and class-F rotor insulation for slip ring motors & class-B insulation for squirrel cage motor with temperature rise limited to class-B operation in all cases.
22.9	Overload protection for motors provided	One main electro-magnetic contactor together with magnetic overload relay (hand reset) for each motor circuit shall be housed in the protection panel. The operation of overload relay shall interrupt the main magnetic contactor. Adequate short circuit protection shall be provided for main and individual circuits.
23.10	Space heater requirements	Not required
24	Limit switches	Main Hoist / Cross Travel
24.1	In hoisting motion	Each hoist shall be provided with 2 limit switches. 1. A screw type limit switch with self resetting features which will act in case of over hoisting. 2. A gravity operated hand reset type limit switch as a back-up protection against over-hoist
24.2	In CT/LT motion	Track type limit switches shall be provided on the trolley to prevent over travelling in either direction
24.3	Material of contacts	Double break Silver Cadmium
24.4	Control voltage	110V
24.5	Construction	The limit switches shall be housed in robust metallic oil and dust tight enclosure conforming to IP:65. At least 2 NO and 2 NC contacts shall be provided for each limit switch.
25	Power conductors (DSL)	Shrouded GI type runway conductor.

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25.1	Type	CT travel : PVC shrouded GI conductor bus bar
25.2	Size	Shall be sized with a margin of 10% over load requirement. Voltage drop at motor terminal shall be limited to 3% at extreme positions of cranes. Protective cover over DSL shall be provided.
25.3	Length	Suitable for entire bay length.
26	Isolation switch & Control Panel	Isolation switch shall be provided at operating floor. Protective and control panels shall have IP-54 gasketed enclosure, fabricated from sheet steel, minimum 2 mm thick, suitably reinforced to provide structural rigidity. The panels shall be front connected type with front hinged door for access to wiring and terminals. Engraved name plates shall be furnished for all panels and also for the equipment and device mounted thereon. All panels shall be factory wired and terminated on suitable terminal blocks for external cable connection. All internal wiring shall be identified with numbering ferrules at both ends as per relevant wiring diagram. Terminal blocks shall have 20% spare terminals. Control wiring shall be carried out with 1100 Volt grade flexible, heat resistant, insulated switchboard wires with minimum 2.5 sq.mm stranded copper conductor. Each panel shall have internal illumination with fluorescent lamp and thermostat controlled space heater, suitable for operation on 240V I-ph 50Hz supply. Lamps and heater circuits shall have individual ON-OFF switches.
26.1	Material & size	Rolled sheet steel 2mm size
26.2	DOP	IP 55
26.3	Qty	1 no. per hoist
27	Control for Hoisting operations	
27.1	Creep speed	NA
27.2	Starting torque of VVVF	NA
27.3	Starting current	NA
27.4	Temperature	NA
28	Cable	Power / Control / Trailing

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28.1	Type	The wiring shall be done with 1100 V grade PVC insulated stranded aluminium conductor cable of suitable size not less than 2.5 mm ² nominal equivalent copper area of cross-section. All control and auxiliary circuit wiring shall be done with 1100 V grade PVC insulated, 2.5 mm ² stranded copper conductor. Control wire terminations to the panels shall be made with compression type connectors. Multiway terminal blocks shall be furnished for terminating panel wiring and outgoing cable.
28.2	Voltage drop	Cable from main isolating switch (1.5M above operating floor) to motor terminal shall be so sized that the voltage drop does not exceed 3% of rated voltage with cranes at extreme position.
29	Earthing	Crane structures, motor frames and metal cases of all electrical equipment including metal conduit and cable guards shall be effectively earthed. Electrical system shall be designed for a fault level of 50 kA. Earthing system adopted shall be type TN-CS.
29.1	Material of earthing	G.I / Copper
30	Contactors	AC 4 duty for reversing application. AC 3 duty for non -reversing application.
31	Switches	AC 23 for motor application, AC 22 for other application.
32	Fuses	HRC
33	Power supply	
34	Transformer	Dry type, with insulation class B or better.
34.1	Quantity	3 X 100 % for control
34.2	Voltage Rating	Control 415/110V
34.3	KVA rating	Min. 20% over loading to be considered while sizing the rating

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B) MANUAL HOIST (CHAIN PULLEY BLOCK):

Sr. No.	DESCRIPTION	TECHNICAL PARTICULARS
1	Type	Hand operated chain pulley blocks. Chain pulley blocks shall be with or without the travelling trolley depending upon the layout requirement and intended use.
2	Area of installation	As per Annexure A
3	Design	IS: 3832
4	Duty Class as per IS:3832	Class -II
5	Hoisting Mechanism	Through endless chains
5.1	Type	Hand operated gear transmission
5.2	Type of gear	Spur
5.3	Load Chain	
5.3.1	Type	Link type
5.3.2	Material	Alloy steel (grade 40) as per IS 3109 (part-II)
5.4	Hand Chain	
5.4.1	Type	Link type
5.4.2	Material	Mild steel (grade 30) as per IS 2429 (Part I)
5.5	Load Hook & Hook Block	
5.5.1	Type of load hook	Plain shank- Trapezoidal section
5.5.2	Load hooks conforms to (Std./Code)/ Material	IS: 15560/ Forged steel
5.5.3	Type of hook suspension	Swivelling type fitted with a locking device.
5.5.4	Type of make of bearing of hook suspension	Thrust ball bearing
5.6	Gears	
5.6.1	Type	Spur
5.6.2	Material	Alloy steel / carbon steel
5.6.3	Type of bearing used	Antifriction ball bearing / Roller
5.7	Pinions	
5.7.1	Type of bearing used	Antifriction ball bearing / Roller
5.8	Sprockets	
5.8.1	Type of bearings used	Antifriction ball bearing / Roller
5.8.2	Method of lubrications Used	
5.8.2.1	Bearings	Grease
5.8.2.2	Gearing & Pinions	Grease
5.8.2.3	Sprockets	Grease
5.8.3	Brakes	
5.8.3.1	Type	Screw and friction disc type
5.8.3.2		Chain pulley block shall be fitted with an automatic mechanical ratchet and pawl arrangement to prevent self- lowering of load.
6	Trolley & Bridge Drive	Through endless chains
6.1	Trolley	
6.1.1	Type	Geared (Manually operated)
6.1.2	Material of frame	Rolled structural steel (IS:2062 Grade A or B)
6.2	Drive Chain	
6.2.1	Type	Link type
6.2.2	Material	Steel Gr.30
6.2.3	Wheel	
6.2.3.1	Number of pairs of wheel in each trolley/bridge	Two/four
6.2.3.2	Flange	Wheels in trolley unit travel shall be single flanged with straight / taper/ barrel shaped tread to suit the monorail.
6.2.3.3	Wheel material	Wheels should be preferably of forged steel construction
6.2.3.4	Type of bearings need	Antifriction

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6.3	Gears	
6.3.1	Type	Spur / helical
6.3.2	Material	Alloy/ Carbon steel
6.3.3	Type of bearings used	Antifriction
6.4	Method of lubrication for	
6.4.1	Bearings	Grease
6.4.2	Sprockets	Grease
6.5	Load chain wheel	
6.5.1	Material	SG iron / Steel casting / Pressed sheet steel.
6.6	Hand chain wheel	
6.6.1	Material	SG iron / Steel casting / Pressed sheet steel / Gray iron casting
7	Hoisting and trolley travel effort	As per IS 3832

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality, specially protected against rusting. The following shall be provided as minimum requirement:

S. No.	Description	Qty.
1	Complete set of ring spanners	1 Set
2	Complete set of screwdrivers (Min. 6 nos of suitable sizes)	1 Set
3	Adjustable Spanner	1 No.
4	Insulated pliers	1 No.
5	Wrench spanner	1 No.
6	Grease Gun	1 No.
7	Oil Gun	1 No.
8	Hand Lamp	1 No.
9	Line tester	1 No.

Note: -The tools shall be supplied in one tool box. Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

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SECTION – IIB

GENERAL TECHNICAL REQUIREMENT (ELECTRICAL)



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
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1.0 SCOPE

- 1.1 This section covers the general requirements of the drive motors for power station auxiliary equipment.
- 1.2 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.
- 1.3 In case of any discrepancy, the driven equipment specification shall govern etc.

2.0 STANDARDS

- 2.1 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.
- 2.2 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed
- (a) IS-325
 - (b) IS-12615
 - (c) IEC-34

3.0 SERVICE CONDITIONS

- 3.1 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash canopy to be provided to all outdoor install motors.
- 3.2 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
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- 3.3 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature

4.0 TYPE AND RATING

4.1 A.C. MOTORS

- 4.1.1 Motors shall be general purpose, constant speed, squirrel cage, three phase, induction type.

- 4.1.2 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

- 4.1.3 The motor name-plate rating at 50°C shall have at least 10% margin over the input power requirement of the driven HT equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.

- 4.1.4 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

- 4.1.5 All LT motors used in this project are proposed to be energy efficient type suitable for EFF1 efficiency rating.

- 4.1.6 The motor name plate rating shall have at least 10% margin over the input power requirement of the HT driven equipment and 15% for LT driven equipments at rated duty point.

- 4.1.7 Motors located in hazardous area shall be flame proof type.

4.2 D.C. MOTORS

- 4.2.1 D.C. Motor provided for emergency service shall be shunt/compound wound type.

- 4.2.2 Motor shall be sized for operation with fixed resistance starter for maximum reliability.



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4.2.3 Starter panel complete with all accessories shall be included in the scope of supply.

4.3 For equipment installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in determining the design ambient temperature.

5.0 PERFORMANCE

5.1 RUNNING REQUIREMENTS

5.1.1 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.1.2 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.1.3 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.1.4 Motor shall not be stalled if the supply voltage drops to 70% of the rated voltage for 2 seconds duration.

5.2 STARTING REQUIREMENTS

Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all auxiliaries except boiler feed pump where the starting current shall be limited to 4.5 times. No further tolerances are applicable on starting current specified above for HT motors

5.2.1 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage

5.2.2 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal except BFP motor. In case of BFP motor, it shall



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be 75% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 85% rated voltage at motor terminals.

- 5.2.3 Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day.

Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

- 5.2.4 HT pump motors shall be suitable to start with forward rotation.

- 5.2.5 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage

5.3 STRESS DURING BUS TRANSFER.

- 5.3.1 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

- 5.3.2 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.4 LOCKED ROTOR WITHSTAND TIME

- 5.4.1 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

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5.4.2	Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
5.4.3	Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilizing motor rated capacity
6.0	<u>SPECIFIC REQUIREMENTS</u>
6.1	<u>ENCLOSURE</u>
6.1.1	All indoor motor enclosures shall conform to the degree of protection IP-55 unless otherwise specified and outdoor motor enclosure shall confirm to degree of IPW-55. Motor for outdoor or semi-outdoor service shall be of weather-proof construction.
6.1.2	For hazardous area approved type of increased safety enclosure shall be furnished.
6.2	<u>COOLING</u>
6.2.1	The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).
6.2.2	In case water cooling is required for very large motors, prior approval of the customer is to be obtained before proceeding ahead with design & manufacture.
6.3	<u>WINDING AND INSULATION</u>
6.3.1	All insulated winding shall be of copper.
6.3.2	All motors shall have class F insulation but limited to class B temperature rise.
6.3.3	Windings shall be impregnated to make them non-hygroscopic and oil resistant.

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6.4	<u>TROPICAL PROTECTION</u>
6.4.1	All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
6.4.2	All fittings and hardware shall be corrosion resistant.
6.5	<u>BEARINGS</u>
6.5.1	Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.
6.5.2	Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.
6.5.3	Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
6.5.4	Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.
6.5.5	Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.
6.5.6	Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
6.5.7	Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
6.5.8	Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
6.5.9	Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.



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6.6 NOISE & VIBRATION

6.6.1 The noise level shall be as per statutory acceptance (IS/IEC).

6.6.2 The peak amplitude of the vibration shall be within IS/IEC specified limits.

6.7 MOTOR TERMINAL BOX

6.7.1 Motor terminal box shall be phase segregated (PSTB) type and located in accordance with Indian Standards clearing the motor base- plate/ foundation.

6.7.2 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. For HT motors and 90 Deg. for LT motors unless otherwise approved.

6.7.3 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

6.7.4 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.

6.7.5 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.7.6 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.7.7 The terminal box shall be capable of withstanding maximum system fault current for duration of 0.25 sec.

6.7.8 For 11kV and 3.3kV motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.7.9 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.7.10 The gland plate for single core cable shall be non-magnetic type.



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- 6.7.11 Due to any reason, if the terminal box is found to be not suitable for the approved cable size for either HT/LT motors, then the bidder shall arrange necessary adopter box to facilitate the termination of cables. The adopter box shall be of the same short circuit rating and specifications as the main terminal box. The adopter box shall be located as near as possible to the main terminal box. The interconnecting cabling between adopter box and main terminal box along with providing suitable cable glands and termination kits as applicable shall also be done by the bidder.

6.8 GROUNDING

- 6.8.1 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GS bolts and washer

- 6.8.2 The grounding connection shall be suitable for accommodation of ground conductors as follows :

Motor above 90 kW : 75 x 10 mm GS Flat

Motor above 30 kW up to 90 kW : 50 x 6 mm GS Flat

Motor above 5 kW up to 30 kW : 25 x 6 mm GS Flat

Motor up to 5 kW : 8 SWG GS Wire

- 6.8.3 The cable terminal box shall have a separate grounding pad

6.9 RATING PLATE

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate:

- (a) Temperature rise in Deg.C under rated condition and method of measurement.
- (b) Degree of protection.



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(c) Bearing identification no. and recommended lubricant.

(d) Location of insulated bearings.

6.10 CONSTRUCTION

6.10.1 Stator Core

The Stator Core Lamination shall be made of high-grade silicon/magnetic steel sheet varnished on both sides and pressed to form rigid core.

6.10.2 Rotor

The rotor construction shall be such that in case of dislodging of the rotor bar from the end ring, it should not come out and hit the stator core/stator winding and damage.

7.0 ACCESSORIES

7.1 GENERAL

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application

7.2 SPACE HEATER

7.2.1 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.2.2 The space heater shall be rated 240 V, 1 phase 50 Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.3 TEMPERATURE DETECTORS

7.3.1 All 11kV and 3.3kV motors shall be provided with twelve (12) nos. Simplex type winding temperature detectors, four (4) nos. per phase.



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- 7.3.2 11kV and 3.3kV motor bearing shall be provided with duplex type temperature detectors.
- 7.3.3 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- 7.3.4 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DCS connectivity.
- 7.3.5 Five numbers of Temperature detectors / thermistors shall be provided for L.T. Motors above 90 kW (3 nos. Winding temperatures & 2 nos. bearing temperatures).
- 7.4 INDICATOR/SWITCH
- 7.4.1 Dial type local indicator with alarm contacts shall be provided for the following :
- (a) 11kV and 3.3kV motor bearing temperature
 - (b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor
- 7.4.2 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.
- 7.4.3 Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 5A at 240V A.C.
- 7.5 CURRENT TRANSFORMER FOR DIFFERENTIAL PROTECTION
- 7.5.1 Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 nos. CT for mounting on switchgear side shall be in bidder's scope.



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7.5.2 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.

7.6 ACCESSORY TERMINAL BOX

7.6.1 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.6.2 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit cable connections.

7.7 DRAIN PLUG

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.8 LIFTING PROVISIONS

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.9 DOWEL PINS

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10 PAINTING

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

8.0 TESTS

8.1 ROUTINE AND TYPE TEST:



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Tests are to be conducted for HT and LT motors 60kW and above in presence of Mahagenco representative and contractor as per IS: 325 and required copies of test certificates are to be furnished for approval and despatch clearance. In addition, following tests shall have to be carried out on the motors in presence of MAHAGENCO representative & contractor on LT & HT motors. For Motors below 60kW type and routine test conducted as per IS325 shall be witnessed by contractor and test certificate shall be submitted for review of Mahagenco & Dispatch clearance

8.1.1 FOR HT MOTORS:

- (a) Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-671/IS 14422,1995 test voltages as under

Voltage rating of motor	Impulse Test Voltage
3.3 kV	: 18 kV peak
11 kV	: 49 kV peak

- (b) Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test
- (c) Polarization Index Test as per IS:7816 as routine test
- (d) Tan delta measurement on coils
- (e) Surge withstand test for inter turn insulation.
- (f) Test to diagnose rotor bar failure during manufacture.

Tests indicated at (d), (e), (f) shall be carried out during manufacture of the coils and shall be furnished for verification .

8.1.2 FOR HT & LT MOTORS:

- (a) Test for suitability of IP55/ IPW- 55 as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test,



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provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.

- (b) Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box within last three years.
- (c) Test for noise level as routine test.
- (d) Test for vibration as routine test.
- (e) Overspeed test as type test.

8.2 TEST WITNESS:

Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

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बी एच ई एल 		TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
AC & DC MOTOR			
SR. NO.	ITEM	UNIT	
1.0	AUXILIARY POWER SUPPLY		
1.1	H.T. SUPPLY		
	11kV, 3Ø, 3W, 50 Hz non-effectively earthed		Motors rated 1000 kW and above
	Fault level 44 kA symm		
	3.3kV, 3Ø, 3W, 50 Hz, non-effectively earthed		Motors above 160 kW and below 1000kW
	Fault level 40 kA symm		
1.2	L.T. SUPPLY		
	415V, 3Ø, 3W, 50 Hz effectively earthed		Motors below and including 160kW
	Fault level 50 kA symm		
	240V, 1Ø, 2W, 50 Hz effectively earthed		Lighting, space heating, A.C. control & protective devices
1.3	D.C. SUPPLY		
	220V, 2W, unearthed		D.C. alarm, control & protective devices
	Fault level 25* kA.		
	Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation		
2.0	RANGE OF VARIATION		

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SR. NO.	ITEM	UNIT	
2.1	<u>A.C. SUPPLY:</u>		
	Voltage		± 10%
	Frequency		± 5%
	Combined Voltage & frequency		± 10% (absolute sum)
	During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance		
2.2	<u>D.C. SUPPLY</u>		
	Voltage		198 to 240 Volt



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**GENERAL TECHNICAL REQUIREMENTS
 OF
 CONDUITS AND PIPES
 SPECIFICATION NO. PES-507-27
 REV 0**



**TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)**

1.0 GENERAL

- 1.1 This specification covers the manufacture, inspection & testing at vendor's works and delivery to site of conduits, pipes and their fittings for electrical installation.

2.0 CODES AND STANDARDS

- 2.1 The material, constructional features and various processes involved in manufacture shall comply with currently applicable Indian Standards.
- 2.2 The following Indian Standards shall be applicable, in general. However if Data Sheet A specifies conformance to other international standards, the equivalent IEC/BS/other standards shall be considered.

- | | |
|------------------------|---|
| a) IS:9537 (All Parts) | Conduits for electrical installation. |
| b) IS:3480 | Flexible steel conduits for electrical wiring. |
| c) IS:6946 | Flexible non-metallic conduits for electrical installation. |
| d) IS:1239 | Mild steel tubes, tubulars and other wrought steel fittings.
(for size above 63mm dia of rigid conduits) |
| e) IS:2667 | Fittings for rigid steel conduits for electrical wiring. |
| f) IS:3837 | Accessories for rigid steel conduits for electrical wiring. |
| g) IS:3419 | Fittings for rigid non-metallic conduits. |
| h) IS:6005 | Code of practice for phosphating iron & steel. |
| i) IS:2629 | Recommended practice for hot dip galvanizing on iron and steel. |
| j) IS:4759 | Specification for hot dip zinc coatings on structural steel and allied products. |
| k) IS:6745 | Methods for determination of mass of zinc coating on zinc coated iron and steel articles. |

3.0 DESIGN REQUIREMENTS AND CONSTRUCTIONAL FEATURES

The conduit and conduit accessories shall include conduit plugs & caps, gaskets and box cover etc in addition to any specific requirement given in Data Sheet A. The diameter of conduits and accessories shall be uniform throughout the length.

3.1 Rigid Conduits and Fittings

- 3.1.1 Rigid conduits shall generally conform to the requirements of IS:9537 (Part I & Part II). However conduits above 63mm diameter shall conform to the requirements of IS:1239. Unless specified otherwise in Data Sheet A, all conduits and pipes shall be of medium duty.



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- 3.1.2 The rigid conduits shall be hot dip galvanized inside and outside. Weight of zinc shall be as per IS:4759. Conduits shall be thoroughly cleaned and pretreated, conforming to IS:6005.
- 3.1.3 Conduits shall be supplied in approximate length as specified below
- a) Rigid Conduits 5 metres
 - b) Flexible Conduits 10 - 30 metres
- 3.1.4 Each end of conduit length shall be threaded. The ends of conduits shall be sealed with protective caps to prevent damage to threaded portions and entrance of moisture and foreign material.
- 3.1.5 The inside surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.
- 3.1.6 Conduit fittings shall be made out of tube or cast to the shape as to match with corresponding conduit sizes and meet their purpose without any special adjustment.
- 3.1.7 All fittings shall be screwed type and hot dip galvanized inside and outside.
- 3.2 Flexible Metallic Conduits and Fittings
- 3.2.1 Flexible metallic conduits shall generally conform to the requirements of IS:3480.
- 3.2.2 Flexible conduits shall be made of strip steel which shall be of cold rolled mild steel. The strip shall be of uniform width and thickness throughout.
- 3.2.3 The strip shall be electro galvanized to a minimum thickness of 25 microns as specified in IS:3480. The surface of the strip shall be thoroughly cleaned before application of protective coating. Pretreatment, before galvanization, shall conform to IS:6005.
- 3.2.4 The strip for making flexible conduit shall be wound tightly and so overlapped in subsequent helicals that no openings are seen in normal position.
- 3.2.5 Flexible conduits shall be lead coated for application in high temperature zones, if specifically mentioned in Data Sheet A.
- 3.2.6 The conduit shall have uniform diameter throughout its length. The internal surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.
- 3.3 PVC Conduits
- 3.3.1 PVC conduits shall generally conform to the requirements of IS:9537(Part I & Part III).
- 4.0 INSPECTION
- 4.1 The following stages of manufacture shall be stage inspected by Purchaser or his duly authorized representative.
- 4.1.1 Inspection of manufacturing processes such as shearing, punching, bending, welding, galvanizing etc.
 - 4.1.2 Inspection of packing material and procedure.



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4.1.3 Inspection of finished product.

4.2 The inspection will be carried out as per agreed quality plan.

5.0 TESTING

5.1 Rigid Conduits

- a) Acceptance Tests - as per IS:9537 Part 1 & 2 upto 63mm OD
- as per IS:1239 above 63mm OD
 - i) Dimension checks
 - ii) Bending test (below 32mm OD)
 - iii) Compression test
- b) Special Tests (as acceptance test) as applicable to galvanizing.

5.2 Flexible Steel Conduits

- a) Acceptance Tests - as per IS:3480
 - i) Dimension checks
 - ii) Linear breaking test
 - iii) Test for flexibility
 - iv) Bend fracture test
 - v) crushing test
- b) Special Tests (as acceptance test) as applicable to galvanizing.

5.3 PVC Conduits

- a) Type Tests - as per IS : 9537 (Part 1 & 3)
 - i) Dimension checks
 - ii) Bending test
 - iii) Compression test
 - iv) Impact test
 - v) Collapse test
 - vi) Resistance test
 - vii) Resistance to burning



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viii) Electrical Characteristics

b) Acceptance tests - as per IS:9537 (Part 1 & 3)

i) Dimension checks

ii) Bending test

iii) Compression test

iv) Collapse test

v) Resistance to burning

vi) Electrical characteristics

5.4 Sampling for the tests shall be done as per applicable standards mentioned above.

5.5 The testing shall be carried out as per agreed quality plan.

6.0 PACKING

6.1 The material shall be packed as per manufacturer's standard. Packing procedure shall be to the purchaser's approval.

7.0 DRAWING, DATA AND DOCUMENTS REQUIRED

7.1 The following information shall be furnished within two weeks of award of contract, for purchaser's approval.

a) Manufacturing drawings/details.

b) Recommended Field quality plan covering site handling, storing, laying etc.

c) Final quality plan.

7.3 The following information shall be furnished after testing and inspection

Type Test, routine test and special test certificates in bound volume in requisite number.



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DATASHEET A

SPECIFIC TECHNICAL REQUIREMENTS

- | | | |
|--|---------------------------------------|---|
| 1.0 | APPLICABLE STANDARDS: | IS:9537,IS: 1239, IS:3480 |
| 2.0 RIGID STEEL CONDUITS & STEEL PIPES | | |
| a) | Material: | Cold rolled mild steel to IS:226 |
| b) | Applicable standard | |
| i) | Upto 63mm OD: | IS:9537 Part I & II |
| ii) | Above 63mm OD: | IS:1239 |
| c) | Surface treatment: | Hot dip galvanizing inside & outside as per IS:2629 |
| d) | Wt. of zinc: | as per IS 4759 |
| e) | Duty: | Medium |
| f) | Fittings: | Screw type as per IS:2667 |
| 3.0 FLEXIBLE CONDUITS: | | |
| a) | Material: | Strip steel cold rolled and annealed |
| b) | Standard applicable: | IS: 3480 |
| c) | Surface treatment: | Electro galvanized as per IS: 3480 |
| d) | Whether lead coated: | YES |
| e) | Minimum thickness:
of zinc coating | 25 microns |
| 4.0 PVC CONDUITS | | |
| a) | Material: | PVC |
| b) | Applicable standard: | IS: 9537 (Part I & III) |



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CONSTRUCTIONAL DETAILS OF CABLES SELECTED

(A) LT POWER & CONTROL CABLES

S.NO.	PARTICULARS	DETAILS	
		LT POWER CABLES	LT CONTROL CABLES
1	REFERENCE STANDARD	IS: 7098 -PART -1	IS -1554 PART -1
2	SYSTEM	415 V AC , 240 V AC & 220V DC	220V DC & 110 V AC
3	VOLTAGE GRADE	1.1 KV	1.1 KV
4	CONDUCTOR		
4.1	MATERIAL	STRANDED COMPACTED PLAIN ALUMINIUM CONDUCTOR OF H2 GRADE CLASS 2 / STRANDED HIGH CONDUCTIVITY ANNEALED PLAIN COPPER.	STRANDED, NON COMPACTED, HIGH CONDUCTIVITY ANNEALED PLAIN COPPER
4.2	REFERENCE STANDARD	IS 8130	IS 8130
4.3	SHAPE	CIRCULAR/ SHAPED	CIRCULAR
4.4	MINIMUM SIZE	ALUMINIUM- 16 SQ.MM. COPPER- 2.5 SQ. MM.	2.5 SQ.MM.
4.5	MAXIMUM CONDUCTOR TEMPERATURE WHEN CARRYING CONTINUOUSLY CURRENT	90°C	70°C
4.6	MAXIMUM CONDUCTOR TEMPERATURE AT THE TERMINATION OF SHORT CIRCUIT CURRENT	250°C	160°C
5	NO. OF CORES	1C,2C,3C,3.5C,4C	AS PER CLAUSE 4.2.1
6	INSULATION	EXTRUDED XLPE	EXTRUDED HRPVC, TYPE-C
6.1	REFERENCE STANDARD	IS: 7098 -PART -1	IS -5831 & IS-1554 PART-I
7	CORE IDENTIFICATION	BY COLOR CODING AS PER IS: 7098 -PART -1	i) CONTROL CABLES UPTO 5 CORE- COLOR CODING AS PER IS 1554 (Part-1) (ii) CONTROL CABLES ABOVE 5 CORES- BY NUMBERING AS PER IS 1554 (Part-1). INSULATION TO HAVE BLACK COLOR.
8	INNER SHEATH	EXTRUDED HRPVC FRLS TYPE -ST2 FOR MULTI CORE CABLES. SINGLE CORE SHALL HAVE NO INNER SHEATH.	EXTRUDED HRPVC TYPE -ST2 FRLS FOR MULTI CORE CABLES. SINGLE CORE SHALL HAVE NO INNER SHEATH.
8.1	REFERENCE STANDARD	IS: 5831 & IS-7098 PART-I	IS: 5831 & IS-1554 PART I
9	ARMOUR	NON-MAGNETIC HARD DRAWN ALUMINIUM ROUND WIRE ARMOUR OF H4 GRADE FOR SINGLE CORE CABLES AND GS ROUND STEEL WIRE ARMOUR FOR MULTI- CORE CABLES	GS ROUND STEEL WIRE ARMOUR FOR TWIN & MULTICORE CABLES
9.1	REFERENCE STANDARD	IS:3975 & IS 7098 PART I	IS 3975 & IS-1554 PART I
10	OUTER SHEATH	EXTRUDED FRLSH HRPVC TYPE ST2	EXTRUDED FRLSH HRPVC TYPE ST2
10.1	REFERENCE STANDARD	IS: 5831 & IS-7098 PART-I	IS: 5831
11	MARKING	(i) CABLE SIZE (CROSS SECTION AREA AND NO. OF CORES, VOLTAGE GRADE, WORD 'FRLS', REF. IS, TYPE OF CABLE, TYPE OF INSULATION/ SHEATH, MANUFACTURER'S NAME AND/OR TRADE NAME, YEAR OF MANUFACTURE-AT EVERY 5M (BY EMBOSSING), 'BHEL-PEM' and 'CUSTOMER' Name @5m (by embossing), (ii) PROGRESSIVE SEQUENTIAL MARKING OF LENGTH OF CABLE IN METERS- AT EVERY 1M (BY EMBOSSING/PRINTING)	
12	CABLE DRUMS		
12.1	TYPE OF DRUM	WOODEN (HEAVY CONSTRUCTION) AS PER IS 10418	
12.2	STANDARD DRUM LENGTH	500M FOR LARGER SIZES / 1000M FOR SMALLER SIZES (±) 5% (AS SPECIFIED IN BOQ)	
12.3	PAINTING	ENTIRE SURFACE TO BE PAINTED. ALL FERROUS PARTS USED SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING TO AVOID RUSTING DURING TRANSIT OR STORAGE. WOODEN CABLE DRUMS SHALL BE TREATED BY IMMERSING IN COPPER-NITRATE SOLUTION. DRUM NUMBER SHALL BE INDICATED ON EACH DRUM.	
12.4	OUTERMOST LAYER	TO BE COVERED WITH WATERPROOF POLYETHYLENE	
12.5	CONSTRUCTION	ALL WOODEN PARTS FROM SEASONED WOOD AND FERROUS PARTS SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING. WOODEN DRUM SHALL BE TREATED BY IMMERSING IN COPPER NITRATE SOLUTION.	



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12.6	PARTICULAR INFORMATION ON DRUM	BOTH THE END OF CABLES SHALL BE PROPERLY SEALED WITH HEAT SHRINKABLE SEAL. THE CABLE DRUMS SHALL CARRY THE FOLLOWING DETAILS IN PRINTED FORM: A) MSPGCL B) MANUFACTURER'S NAME OR TRADE MAKE C) TYPE OF CABLE & VOLTAGE GRADE D) YEAR OF MANUFACTURE E) TYPE OF INSULATION E.G. XLPE/HRPVC/IE2 F) NO. OF CORE AND SIZES OF CABLES G) CABLE CODE E.G. FRLS/FS H) SINGLE LENGTH OF CABLE ON DRUM I) DIRECTION OF ROTATION, BY ARROW J) APPROX GROSS MASS
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(B) SCREENED CONTROL CABLES

S.NO.	PARTICULARS	DETAILS
1	VOLTAGE GRADE	1100V
2	TYPE OF CABLES	TYPE F (INDIVIDUAL & OVERALL SCREENED) & TYPE G (OVERALL SCREENED)
3	CODES AND STANDARD	IS-1554 PART-1, IS-5831, IS-8130, IS-694, SEN-4241475, IEC-60332 (I).
3(i)	CONDUCTOR	
(a)	CROSS SECTION AREA	0.5 sq.mm
(b)	CONDUCTOR MATERIAL	STRANDED, TINNED ANNEALED HIGH CONDUCTIVITY COPPER
(c)	CONDUCTOR GRADE	ELECTROLYTIC
(d)	NO. & DIA OF STRANDS	7 X 0.3 mm
(e)	NO. OF PAIRS	0.5 sq.mm. - 2P, 4P, 8P, 12P, 24P
(f)	REFERENCE STANDARD	IS-8130
(ii)	INSULATION	
(a)	MATERIAL	EXTRUDED HR PVC TYPE-C AS PER IS-5831
(b)	THICKNESS IN mm	0.6 (NOMINAL) AS PER IS-694
(c)	VOLUME RESISTIVITY (MIN) IN ohm-cm	i. 1×10^{13} Ohm-cm at 27 deg.C / room temp. (Min). ii. 1×10^{10} Ohm-cm at 85 deg.C (Min.)
(d)	VOLTAGE RATING	1100V
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831
(f)	OD OF COND. INCLUDING INSULATION	AS PER MANUFACTURER'S CALCULATIONS / STD. PRACTICE
(iii)	PAIRING & TWISTING	
(a)	MAX. LAY OF PAIRS (mm)	60
(b)	CONDUCTOR / PAIR IDENTIFICATION	AS PER ATTACHED ANNEXURE D
4	SHIELDING	
(a)	TYPE OF SHIELDING	AL-MYLAR TAPE
(b)	INDIVIDUAL PAIR SHIELDING	TO BE PROVIDED FOR TYPE-F CABLE ONLY
(c)	OVERALL SHIELDING	TO BE PROVIDED FOR BOTH TYPE-F & TYPE-G CABLES
(d)	MINIMUM THICKNESS OF INDIVIDUAL PAIR SHIELDING	28 MICRONS
(e)	MINIMUM THICKNESS OF OVERALL CABLE ASSEMBLY SHIELDING	60 MICRONS
(f)	SHIELDING COVERAGE	100% WITH AT LEAST 25% OVERLAP
5	DRAIN WIRE (To be provided separately for individual pair shield and overall shield.)	
	Material	Multi stranded Annealed tinned copper drain wire.
	Size (No. of strands/ Dia. of each strand)	0.5 sq. mm. (7/0.3 mm.)
6	FILLERS (if applicable)	
(a)	TYPE	NON -HYGROSCOPIC WITH FRLS PROPERTY (AS REQUIRED FOR MAINTAINING CABLE CIRCULARITY)
7	INNER SHEATH	
(a)	MATERIAL	EXTRUDED HR PVC TYPE ST-2 AS PER IS-5831
(b)	THICKNESS	AS PER IS-1554 PART-1
(c)	Whether FR-LSH Applicable	YES
(d)	COLOUR	BLACK
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831
8	RIP CORD	NON-METALLIC RIP CORD UNDER THE INNER SHEATH
9	ARMOUR	GALVANISED STEEL ROUND WIRE / STRIP AS PER IS-3975 & IS-1554 PART-1



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10	OUTER SHEATH		
(a)	MATERIAL	EXTRUDED HR PVC TYPE ST-2 AS PER IS-5831	
(b)	THICKNESS	AS PER IS-1554 PART-1	
(c)	Whether FR-LSH Applicable	YES	
(d)	COLOUR	GREY	
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831	
(f)	MARKING	(i) CABLE SIZE (CROSS SECTION AREA AND NO. OF CORES, VOLTAGE GRADE, WORD 'FRLS', REF. IS, TYPE OF CABLE, TYPE OF INSULATION/ SHEATH, MANUFACTURER'S NAME AND/OR TRADE NAME, YEAR OF MANUFACTURE-AT EVERY 5M (BY EMBOSSING), 'BHEL-PEM' and 'CUSTOMER' Name @5m (by embossing), (ii) PROGRESSIVE SEQUENTIAL MARKING OF LENGTH OF CABLE IN METERS- AT EVERY 1M (BY EMBOSSING/PRINTING)	
11	TECHNICAL PARAMETERS (C & I) AT 20 DEG C	0.5 sqmm (IS & OS) Type F	0.5 sqmm (OS) Type G
(a)	MUTUAL CAPACITANCE (MAX.) AT 0.8 KHz, nF / Km	120	100
(b)	CONDUCTOR LOOP RESISTANCE (MAX.), Ohm / Km	78	78
(c)	INSULATION RESISTANCE (MIN.), M Ohm / Km	100	100
(d)	CROSS TALK ATTENUATION (MIN.) AT 0.8KHz, dB / Km	60	60
(e)	CHARACTERISTIC IMPEDANCE (MAX.) AT 1KHz, Ohm	320	340
(f)	ATTENUATION (MAX.) AT 1KHz, dB / Km	1.2	1.2
12	FR-LSH CHARACTERISTICS		
(b)	SMOKE DENSITY RATING	Max. 60% (As per ASTM D 2843): Area under coverage.	
(c)	ACID GAS EMISSION	Max. 20% by weight (As per IEC-60754-1)	
(d)	OXYGEN INDEX	Min 29 at room temperature (As per ASTM D 2863)	
(e)	TEMPERATURE INDEX	Min. 250 deg.C at oxygen index value of 21 (As per ASTM D 2863)	
13	FLAMMABILITY TEST	(1) AS PER IEC-332-1 (2) Swedish Chimney test SEN-SS-424-1475-F3	
14	TEST VOLTAGE & DURATION (High Voltage Test)		
(a)	Core to core	1.5 kV for 1 minute	
(b)	Core to shield	1 kV for 1 minute	
15	CABLE DRUM DETAILS		
(a)	Material Type	Wooden, as per IS 10418	
(b)	Standard drum length	1000 metres: upto and including 12 Pairs. 500 metres: above 12 pairs.	
(c)	Tolerance on drum length	±5%	
(d)	Painting	ENTIRE SURFACE TO BE PAINTED. ALL FERROUS PARTS USED SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING TO AVOID RUSTING DURING TRANSIT OR STORAGE. WOODEN CABLE DRUMS SHALL BE TREATED BY IMMERSING IN COPPER-NITRATE SOLUTION. DRUM NUMBER SHALL BE INDICATED ON EACH DRUM.	
(e)	Outermost layer	TO BE COVERED WITH WATERPROOF POLYETHYLENE	
(f)	Construction	ALL WOODEN PARTS FROM SEASONED WOOD AND FERROUS PARTS SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING. WOODEN DRUM SHALL BE TREATED BY IMMERSING IN COPPER NITRATE SOLUTION.	



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- | | | | |
|------|---|---|---|
| 1.0 | Design ambient temperature | : | 50 °C |
| 2.0 | Maximum acceptable kW rating of LV motor | : | 160KW |
| 3.0 | Installation (Indoors/ Outdoors) | : | As required |
| 4.0 | Details of supply system | | |
| | a) Rated voltage (with variation) | : | 415V $\pm$ 10% |
| | b) Rated frequency (with variation) | : | 50 Hz (+5% and -5%) |
| | c) Combined voltage & freq. variation | : | 10% (sum of absolute values) |
| | d) System fault level at rated voltage | : | 50 kA for 1 sec |
| | e) Short time rating for terminal boxes | | |
| | o 90 kW and upto 160kW (Breaker controlled) | : | 50 KA for 1 sec. |
| | o Below 90 kW (SFU + Contactor controlled) | : | 50 KA protected by fuse for 0.2 sec |
| | f) LV System grounding | : | Effectively grounded |
| 5.0 | Class of insulation | : | Class 'F', with temp rise limited to class B. |
| 6.0 | Minimum voltage for starting (As percentage of rated voltage) | : | 80% of rated voltage |
| 7.0 | Power cables data | : | Shall be given during Detailed engg |
| 8.0 | Earth Conductor Size & Material | : | Shall be given during Detailed engg |
| 9.0 | Space heater supply | : | 240 V, 1 ϕ , 50 Hz |
| 10.0 | Rating up to which Single phase motor | : | Acceptable below 0.20 kW |
| 11.0 | Additional tests | : | As per QP and customer motor spec |
| 12.0 | Flame-proof motor | | |
| | a) Enclosure suitable (As per IS:2148) | : | As per requirement |
| | b) Classification of Hazardous area (As per IS: 5572 part-I) | : | As per requirement |
| 13.0 | Makes | : | As per ANNEXURE-I |
| 14.0 | Paint shade | : | RAL 7032 |
| 15.0 | Degree of Protection of enclosure (motors): | | INDOOR IP-55
OUTDOOR IPW-55 |
| 16.0 | Energy efficiency | : | IE3 as per IS:12615: 2011 |

❖ **Also detail Customer spec. for Motors to be referred as enclosed with spec.**

80364/2020/PS-PEM-MAX



TITLE :

1X660 MW BHUSAVAL TPS, UNIT # 6

SPECIFICATION NO. PE-TS-415-174-A001

SECTION : I

TECHNICAL SPECIFICATION FOR OZONE
GENERATION PLANT

SUB-SECTION: IIC

REV. NO. 00

SECTION – IIC

GENERAL TECHNICAL REQUIREMENT (CONTROL AND INSTRUMENTATION)



**TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)**

GENERAL REQUIREMENT

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

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

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 In case of any contradiction most stringent clause/condition shall prevail.



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6.0 OZONIZATION PLANT FOR CW TREATMENT PLANT

6.1 OZONE SYSTEM CONTROL

The ozone generator shall utilize a redundant Programmable Logic Controller (PLC). PLC software shall be stored in EPROM and not solely in volatile static RAM. Each ozone generator shall have an automatic and manual control mode. In the automatic mode, the generators power shall be modulated by a command from an external 4-20 milliamps signal from a process controller or based on feedback from residual ozone analyzer to the integral PLC. In the manual mode, the operator shall be able to set the inverter frequency via HMI.

6.2 SCADA :

Supervisory control & data Acquisition control system is used to display all the process parameters on the computer screen. Various screens such as main screen, process screen, alarm screen, manual screen, analyzer data screen, historical fault screen etc are configured.



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Main screen is the entry screen for the application from where the operator can decide to view or control the other screen parameters. In the process screen complete process of ozone generation machine is displayed with colour animation, operator can see the status of the machine. Alarm screen shows the details of alarms if any generated due to malfunction. Status of alarm is displayed in every screen, if any alarm occurs operator can know in any screen. Historical alarm screen will show the alarms in history, if someone wants to have alarms of particular date or time, person can know the history of alarm from this screen. Analyzer screen shows the data of the various analyzers in the plant such as ozone analyzer, dissolved ozone monitoring can be done from this screen. Operator can also control the whole plant manually through Manual mode. Operator can also run individual load through this screen.

6.3 PROGRAMMABLE LOGIC CONTROLLER :

Programmable logic controller is used in ozone generators to control the sequenced operation of the plant as required, Plant can run both in Auto mode as well as Manual mode if desired to run individual loads, Interlocks Which are necessary to run plant in adequate manner such as Dosing Pumps, Air Flow, Cooling water Flow, Cooling water Temperature, Air Pressure, Cooling water Pressure entering the Electrode as well as control circuit safety, Door safety, Ambient ozone Leak Detector in case of any leakage is monitored and many other interlocks and safety points, analog input data 4-20mA/0-10V DC to PLC from ozone gas sensors or ozone residual sensor to monitor and also to control the output of the ozone generator, PLC will correspondingly control the power of the electrode through the Frequency Drive and HT Transformer. All the data will be logged on SCADA for indication of operating status and alarms of the plant. In typical applications where the dosing point is away from the plant building then remote PLC or Remote Input/Output is used to control the Generator output by communicating with the main plant PLC through MODBUS/Ethernet OFC link OPC. Alarms will be generated by the PLC and displayed and logged on SCADA during malfunctioning.

6.4 VARIABLE FREQUENCY DRIVE :

Variable Frequency Drive will feed the power to HT Transformer, HT side of this transformer is connected to electrode. Variable frequency Drive



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having 440Volts 3Phase input and output 0 – 400 Volts, which is **varied** as per the requirement, is connected to the primary of HT Transformer. Frequency of the drive is varied from 30Hz to 80Hz depending upon the required output. Pattern for the Voltage versus frequency curve will be linear. High voltage connection of HT Transformer is connected to Electrode. Maximum of 10000 Volts output power from HT Transformer is given to Electrode. At high voltage, Corona will be produced inside the electrode. One can control the ozone production automatically from PLC control output to Frequency drive input 4-20mA / 0-10Volt DC signal or manually through the potentiometer or LCD text display unit of frequency drive. Variable frequency drives are IGBT based. Output waveform is PWM. These Frequency drives or AC Drives are same as commonly used on Induction motors for regulating speed and energy saving. In Ozone generator systems we are using for regulating power to HT Transformer which in turn regulate power to electrode and **thus** corona discharge in the electrode is controlled. Single Phase frequency drives are used for small ozone generators. Acceleration time, Control output and many other features of Frequency drive have to be considered for smooth operation of the generator.

6.5 MEASURING & MONITORING DEVICE :

- 6.5.1 Outlet ozone gas of each ozone-generating module shall be **measured** by a common ozone analyzer, of digital display model in gm/Nm³ (range 0 to 200) having accuracy of 0.1 gm/Nm³ based on UV ADSORPTION TECHNIQUE.
- 6.5.2 Residual ozone measuring device shall be placed at the location after condenser & in the cooling water pond basin. Digital display, having repeatability ± 0.01 ppm.
- 6.5.3 Ambient ozone leak detector shall be placed in the ozone generator room to detect ozone leakage with **alarm** and cut-off signal on set value.
- 6.5.4 The above measuring/monitoring devices shall be of standard make.
- 6.5.5 Bidder should provide Oxygen purity **analyser**, dew point transmitter, oxygen & ozone flow meters, chillier water flow meters etc.



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6.6 CONTROL FLOW OR SEQUENCE OF OPERATION IN AUTO MODE THROUGH PLC

6.6.1 Procedure for machine start

To start the plant, operator has to turn 'Start' rotary switch to on position, Auto-O-manual switch to Auto; following operation will take place automatically as described in logic software of PLC.

- (a) Sump Pump should be started first by which normal water will flow through the heat exchanger of Chiller. This is for cooling of chiller.
- (b) With Delay of 60 seconds compressed air is to be started.
- (c) After Compressed air with delay of 60 seconds both Oxygen generators are started.
- (d) With Oxygen Generator, Chiller is to start along with its corresponding Recirculation Pump. There are two Recirculation Pumps, One Working And one Hot Standby. Operator has to decide which pump is to be operated through control switch on the panel. Process of Cooling Water flow from Chiller to Electrode and return to Chiller tank will take Place.
- (e) As soon as temperature of cooling water reaches its set point, thermostat in chiller water tank will give the signal. With delay of 60 Seconds to thermostat signal, Oxygen inlet Valve to Electrode and Ozone Outlet valve will be on. Along with these valves for Dosing pump will be on.
- (f) PLC Logic will check interlocks for required Oxygen flow, transformer temperature, cooling water flow, cooling water pressure, any control trip, door open limit switch, drive trip etc. If all the required conditions to start the electrodes are met then electrodes will be started. Number of electrodes to be consider by vendor, if there is fault in one line then only that particular electrode will not start and all other will be on. During run time also if there is fault in one particular line then only that line will be off rest will be on. With this Ozone generation takes place.



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- (g) During run time if Ozone Leakage is detected through ambient ozone leak detector sensor then whole plant will be shut down & Exhaust fans fitted in the plant room will be started automatically to flush ozone air from the room.

6.6.2 Procedure for machine stop

To stop the plant, Operator has to turn 'start' button to off state, following operation will take place

- (a) First Electrode will be shut off.
- (b) With delay of 30 seconds Chiller will be off.
- (c) After chiller with delay of 5 minutes Oxygen inlet valve to Electrode and Ozone Outlet valve from Electrode, recirculation pump & Dosing pumps will be off. This is required for flushing the electrode and the system.
- (d) With delay of 20 Seconds all Outputs, Oxygen generator, Compressed air, Sump pump will be made off.

6.7 CONTROL FLOW OR SEQUENCE OF OPERATION IN MANUAL MODE THROUGH PLC

6.7.1 Procedure for machine start

To start the plant operator has to turn rotary switch Auto-O-manual switch to manual; Safety interlocks already considered to avoid any malfunction and damage. Safety interlocks are done using imposition relays in the manual control panel. All switches & push buttons for manual operation are provided on the manual panel along with its indication for ON, OFF & Trip. Operator has to run machine in the procedure described below otherwise next process will not start due to safety interlocks.

- (a) First sump pump should be made on by which normal water will flow through the heat exchanger of Chiller. This is for cooling of chiller. There are two pumps one working & one hot standby, operator has to select one to run, Pressure Switch at compressor side

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	will be actuated. HMI display at compressor panel will correspondingly show the status. (b) Compressed air has to be started then and with delay of 60 seconds Oxygen generator has to be started. Along with oxygen generator chiller and its recirculation pump is to be started. Two recirculation pumps are provided one running & one standby, operator has to decide which one has to be operated. (c) As soon as temperature of cooling water reaches its set point, thermostat in chiller water tank will give the indication. With delay of 60 Seconds to thermostat signal, Oxygen inlet Valve to Electrode and Ozone Outlet valve will be made on. Along with these valves Dosing pumps should be started. (d) After this electrode is to be started, this will be started after checking the interlocks for transformer thermostat, oxygen flow, door limit switches and all subsequent interlocks.
6.7.2	Procedure for machine stop To stop the plant, Operator has to turn 'start' button to off state, following operation will take place (a) Electrode should be turned off first. (b) After some delay chiller should be turned off. (c) With delay of 5 minutes oxygen valve, ozone valves, dosing pumps, recirculation pump should be turned off. (d) After 30 seconds compressed air, oxygen generators & sump pump should be turned off.
6.8	<u>ALARMS AND SAFETY FEATURES</u> Ozone vessel gas pressure shall be precisely regulated using transducers and PID control. A water back flow prevention device suitable for ozone



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use shall be installed on the ozone gas out piping. Any electrical cabinet that has a door shall have electrical and mechanical interlocks on that door.

Alarm list

- (a) High gas exit temperature
- (b) High or low gas pressure
- (c) Low chilled water flow
- (d) High chilled water exit temperature
- (e) Frequency drive failure
- (f) Loss of phase detect
- (g) High inverter current trip
- (h) Low feed gas flow
- (i) Door interlock trip
- (j) Ozone concentration (intermittent)
- (k) ORP/residual ozone

6.9 For detail operation and control philosophy, refer VOLUME – III E2.

6.10 For detailed PLC specifications refer Volume-V/Section-5.

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2.1	<u>EQUIPMENT AND ACCESSORIES FOR CIRCULATING WATER TREATMENT PLANT</u>
2.1.1	Following are the required equipments and accessories for the CW Ozonization Plant: (a) Oxygen Generation Plant (b) Ozone Generation Plant (c) Cooling Water Plant (d) Power Supply Unit (e) Ozone Dosing System (f) Measuring & Monitoring Devices (g) PLC Based Control Panel
	System consists of PLC in the Control Panel, which shall be controlled by the one (1) 24" TFT colour operating station. The operating station shall control the ozone generator depending upon the required output of ozone. The electrodes shall operate from 40 Hz to 72 Hz variable frequency to get required ozone output. Operating station shall control the complete system and required data can be recorded for reference. Auto/Manual both options shall be there in the system for manual operations, if required. Print out of the recorded data can also be taken.
	Monitoring & control of all important/critical system parameters is carried out using PLC. This allows for infinite precise control of ozone production as well as the entire Ozone treatment process, if desired. Important signals shall be hardwired to DCS for monitoring purpose.



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2.1.2 Power supply unit :

Sr. No.	Feature	Specification
(a)	Operating Principle	Voltage source Inverter with (PWM) Pulse Width Modulation technique.
		The mode of operation: (i) V/F control. (ii) Sensorless Vector Control. (iii) Sensored Vector Control.
(b)	Type of Inverter	The inverter is Microprocessor based digital type. (i) 32 Characters LCD & 7 segment display Keypad. (ii) Suitable for site ambient temperature - 10°C to 40°C.
(c)	AC Input supply	Input Voltage: Three Phase 380-480 ($\pm 10\%$). Input Frequency: 50-60 Hz ($\pm 5\%$)
(d)	Frequency Resolution : Frequency Accuracy:	Digital ref: 0.01 Hz & analog ref: 0.03 Hz. Digital: 0.01% of Max o/p freq. Analog: 0.1% of Max o/p freq.
(e)	Desired Performance Switching Duty Overload:	Normal-4 starts per hour (minimum) Trial run and commissioning: 6 starts per hour
	Speed Holding: Accuracy	150% for 60 secs, 200% for 30 secs The inverter offered is capable to hold the speed accuracy better than $\pm 0.5\%$ of base speed with voltage/Current feedback.



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	Frequency : Stability	VFD is capable to hold frequency stable with $\pm 0.5\%$
	Acceleration / Deacceleration	(0-666) Sec. Independently adjustable, depending upon the application.
	Voltage dips	The inverter shall be designed to withstand dips in supply voltage for 3.5 sec without damage to semiconductor.
	VFD Efficiency	The efficiency of inverter at rated voltage and speed depends on the rating of the inverter and efficiency should be approx. 97%.
	Safety Factor	Rectifier Bridge PIV (Peak Inverse Voltage) is 1600 V
		Max. operating voltage is 506 V & ratio of PIV/Max. Operating voltage is 3.16
(f)	Operating Parameters	Soft start with adjustable time acceleration. Adjustable Current limits and acceleration & deceleration ramps. DC Injection Braking, jump frequency, second function, slip compensation, reverse rotation protection, auto restart, Inverter bypass, Auto Tuning, PID Control, Internal fault detection. The recommended distance between Electrode & drive is 50 metres. Use output filter to avoid reflected wave phenomenon caused due to long cable distance.
	Protection	(i) Instantaneous over current.



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	(ii)	Over voltage.
	(iii)	Under voltage.
	(iv)	Fan failure VFD.
	(v)	Stall protection.
	(vi)	Fuse Failure.
	(vii)	Inverter overheat.
	(viii)	Input / Output Phase loss protection.
	(ix)	Single-phase protection.
	(x)	AC under voltage protection.
	(xi)	Earth fault protection.
	(xii)	Control and regulated power supply failure protection.
	(xlii)	Communication Error.

2.1.3 Ozone dosing system:

2.1.3.1 Dosing systems as defined designates such part of the plant that mixes water with ozone gas exited from the ozonator. It shall consist of:

2.1.3.2 Ventury Injector of Ozone resistant material with backflow prevention arrangement. With suitable booster pumps on assessing the dosing point location at site.

2.1.3.3 All pipelines, valves, fittings & other metallic parts involved in oxygen concentrator & ozone generator up to dosing point shall be of suitable non-corrosive metallurgy.

2.1.4 Measuring & monitoring devices:

2.1.4.1 Outlet ozone gas of each ozone-generating module shall be measured by a common ozone analyser, of digital display model in gm/Nm³ (range 0 to 200) having accuracy of 0.1 gm/Nm³ based on UV Adsorption technique.



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- 2.1.4.2 Residual ozone measuring device/ORP meter with Digital display, having repeatability ± 0.01 ppm shall be placed at the location after condenser & in the cooling water pond basin.
- 2.1.4.3 Ambient ozone leak detector shall be placed in the ozone generator room to detect ozone leakage with alarm and cut-off signal on set value.
- 2.1.4.4 The above measuring/monitoring devices shall be of standard make.

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SPECIFICATION FOR MOTORISED VALVE ACTUATOR	

FORM NO. PEM-6666-0		TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
	Data Sheet A & B		
DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

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GENERAL*	* PROJECT		
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	☐ ON / OFF ☐ INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95% IN HOT HUMID AND TROPICAL ATMOSPHERE AND HIGHLY POLLUTED AT PLACES OF COAL DUST AND FLY DUST.	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY IP:68	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.	
HANDWHEEL	* REQUIRED	☒ YES ☐ NO	
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- INCLUSIVE OF I.S. TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED (BIDDER TO CONFIRM) A: ☒ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐	
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☐ EPOXY ☐	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	

FORM NO. PEM-6666-0

	TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
	Data Sheet A & B	
DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

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	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V		
	@ ENCLOSURE CLASS OF MOTOR	☒ IP 68 ☐ FLAME PROOF		
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B		
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☒ ---THERMOSTAT- 1 NO+1 NC CONTACT ----- -----		
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED(THERMISTOR PTC)		
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED		
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS		
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)		
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED		
	OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED		
	STOP PB	☒ REQUIRED ☐ NOT REQUIRED		
	INDICATING LAMPS(POWER SUPPLY ON/OPEN /CLOSE)	☒ REQUIRED ☐ NOT REQUIRED		
	LOCAL REMOTE OFF S/S	☒ REQUIRED ☐ NOT REQUIRED		
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED		
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (THERMAL O/L RELAY OPERATED, MOTOR THERMOSTAT TRIP,CONT./POWER SUPPLY FAILED, LOCAL/OFF/REMOTE S/S IN LOCAL or OFF MODE , TORQUE OPEN/CLOSE CUT OFF,VALVE JAMMED)		
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☒ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER		
	QUANTITY	☒ 2 NOs. ☐ 3 NOs.		
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC		
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX		
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms		
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos		
	CONTACT TYPE	2 NO + 2 NC		
	RATING	5A 240V AC AND 0.5A 220V DC		
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE		
	ACCURACY	+3% OF SET VALUE		
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN : INT : CLOSE(Total:-06 nos.)	☐ 1 No ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		

FORM NO. PEM-6666-0		TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)	
		Data Sheet A & B	
DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

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POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☒ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☒ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	☒ 24V DC ☐	
	OUTPUT	☒ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	240V AC, 1 PH., 50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING	decided as per load data received tender stage	
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☒ IP 68 @ ☐	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMM, LS/TS FEED BACK, PoT)	☐ REQUIRED ☒ NOT REQUIRED ☐ 2 NOS. ☐	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: decided as per load data received tender stage	
	@ SPACE HEATER CABLE GLAND	SIZE: decided as per load data received tender stage	
	OTHER CONTROL CABLE GLANDS	QUANTITY & SIZE: Cable glands suitable for 8Px0.5 sq mm & 2P x 0.5 sq mm cable.	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

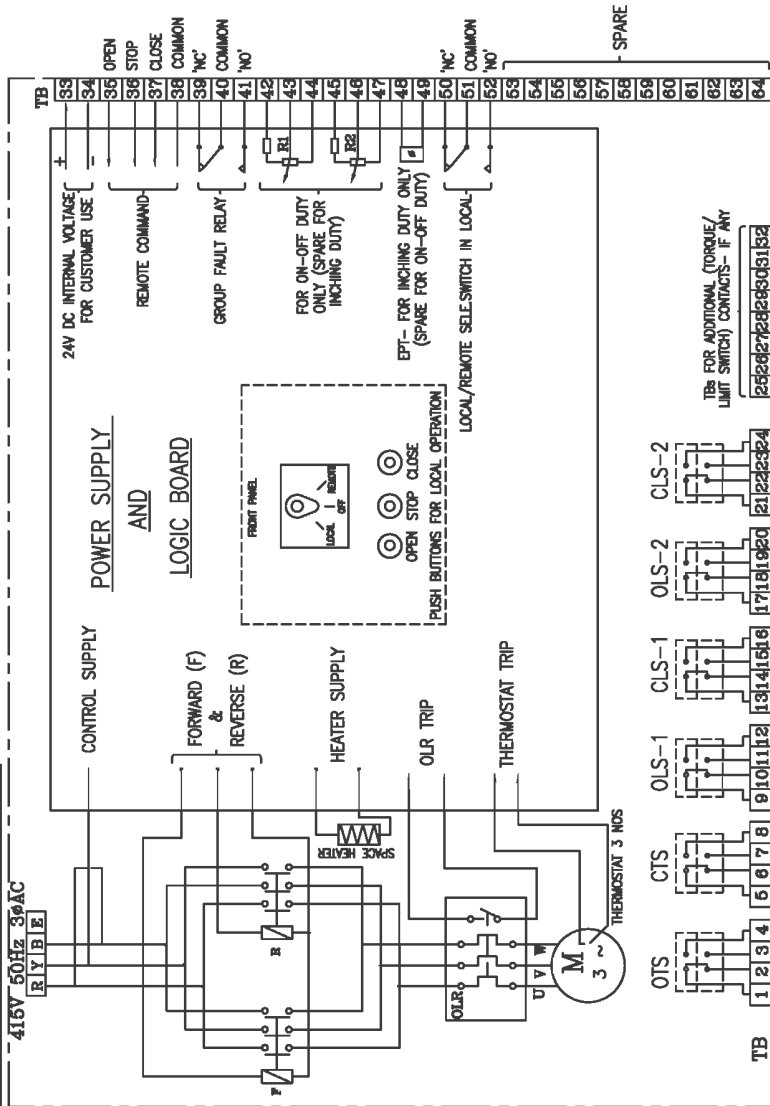
- SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
 - CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
 - TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
 - CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL & TINNED COPPER LUGS SHALL BE PROVIDED.
 - THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
 - THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, +/-5% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING +/-10%.
 - THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE AND RUNNING AT 80 PERCENT OF RATED VOLTAGE AT RATED TORQUE AND 85 PERCENT RATED VOLTAGE AT 33 PERCENT EXCESS RATED TORQUE FOR A PERIOD OF 5 MINUTES EACH.
 - THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
 - COMMANDS SHALL BE LATCHED AT INTEGRAL STARTER END.
 - SS TAG NAME PLATE SHALL BE PROVIDED.
 - CANOPY FOR OUTDOOR SERVICES SHALL BE PROVIDED.
 - CONTROL WIRING SHALL BE OF SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ.MM.
 - THE TERMINAL IN TERMINAL BOX SHALL BE SUITABLE FOR CONNECTION 2.5 SQ.MM COPPER CONDUCTOR.
 - ATTAIN FULL SPEED OPERATION BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
 - ALL ELECTRICAL EQUIPMENT, ACCESSORIES AND WIRING SHALL BE PROVIDED WITH TROPICAL FINISH TO PREVENT FUNGUS GROWTH.
- \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.**
EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
				NAME
				SIGNATURE
				DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.

3- V - MISC - 24227



CONTACT DEVELOPMENT DIAGRAM			
OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL	
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL	
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL	
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL	
OLS-1	9-10	-----	
	11-12	-----	
CLS-1	13-14	-----	
	15-16	-----	
OLS-2	17-18	-----	
	19-20	-----	
CLS-2	21-22	-----	
	23-24	-----	
SWITCH	TERMINAL NO.	VALVE POSITION	
		INTERMEDIATE	FULL CLOSE
-----		INDICATES CONTACT CLOSED	
-----		INDICATES CONTACT OPEN	

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH			
VALVES	OPEN		CLOSE
	MAIN	BACK UP	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS *	OTS *	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS

* - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

TYPE OF PRODUCT ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS	
OR NAME OF CUSTOMER/PROJECT (DRAWN FOR INTERMEDIATE POSITION OF VALVES)	
BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT, TIRUCHIRAPPALLI-600014.	
DEPT 365-121	SCALE 1:1
VL CODE	WEIGHT (KG) APPD
REV DATE	ALTERED CED & APPD
TITLE WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER	
CARD CODE U 01	DRAWING NO. 3-V-MISC-24227
REV	REV

- NOTE:-
1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE.
ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
 2. CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
 3. OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
 4. OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
 5. CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
 6. EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
 7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
 8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
 9. M - MOTOR 3Ø 415V 50 Hz AC SUPPLY

TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)

SPECIFICATION FOR FIELD INSTRUMENTS

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 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.0	<u>FIELD INSTRUMENTS</u>	
	This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.	
1.1	<u>PRESSURE TRANSMITTER</u>	
1.1.1	Working Principle	SMART, HART Protocol.
1.1.2	Type	2 – Wire.
1.1.3	Output Signal	4-20 mA DC.
1.1.4	Signal Processing	Silicon solid state electronic circuitry.
1.1.5	Measuring Element	Capsule/Diaphragm.
1.1.6	Element material	AISI-316 (Stainless Steel) or better.
1.1.7	Static Pressure	150 % of maximum span continuously, without affecting the calibration.
1.1.8	Turn-down ratio	100:1
1.1.9	Span and Zero	Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span.
1.1.10	Enclosure Class	IP-65.
1.1.11	Output Indicator	LCD Type.
1.1.12	Nameplate	Tag number, service engraved in SS tag plate.
1.1.13	Body	Forged Carbon Steel for air and flue gas application and SS for other

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
		application.
1.1.14	Operating Voltage	16 - 48 Volts D.C.
1.1.15	Load	600 Ohms (min.) at 24 Volts D.C.
1.1.16	Ambient Temperature	0 - 50 °C.
1.1.17	Performance :	
	(a) Accuracy	± 0.1% of Span or better.
	(b) Repeatability	± 0.05% of Span or better.
	(c) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (g)
1.1.18	Sealing/Isolation	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
1.1.19	Accessories	(a) Universal mounting bracket suitable for 2" pipe mounting.
		(b) High tensile carbon steel U- bolts.
		(c) Siphon for steam and hot water services.
		(d) ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
		(e) Companion flange with nuts, bolts and gaskets.
		(f) Hand held configuration kit for calibration of SMART Transmitter.
		(g) ½" NPT cable gland.
1.2	<u>DIFFERENTIAL PRESSURE TRANSMITTER/FLOW TRANSMITTER</u>	
1.2.1	Working Principle	SMART, HART Protocol.
1.2.2	Type	2-Wire.
1.2.3	Output signal	4-20 mA DC.
1.2.4	Signal Processing Unit	Silicon solid-state electronic circuitry.
1.2.5	Measuring element	Capsule/Diaphragm.
1.2.6	Element material	AISI-316 (Stainless Steel) or better.
1.2.7	Static Pressure/Overload Pressure	Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy.
1.2.8	Turn-down ratio	100 : 1 minimum.
1.2.9	Span and Zero	Locally adjustable, non-interacting.
1.2.10	Enclosure class	IP-65.
1.2.11	Zero suppression/elevation	At least 100% of Span.
1.2.12	Output Indicator	LCD Type.
1.2.13	Nameplate	Tag number and Service engraved in SS tag plate.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.2.14	Body	Forged Carbon Steel for air and flue gas application and SS for other application.
1.2.15	Ambient temperature	0 - 50 °C.
1.2.16	Operating Voltage	16 - 48 Volts DC.
1.2.17	Load	600 Ohms (min.) at 24 Volts DC.
1.2.18	Performance:	
	(a) Accuracy	±0.1 % of span or better.
	(b) Repeatability	± 0.05 % of span or better.
	(c) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (g)
1.2.19	Sealing / Isolation	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
1.2.20	Accessories	(a) Universal mounting bracket suitable for 2" pipe mounting.
		(b) High tensile carbon steel U-bolts.
		(c) Siphon for steam and hot water services.
		(d) Companion flange with nuts, bolts and gaskets.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
		(e) Hand held configurator kit for calibration of SMART Transmitter
		(f) ½" NPT cable gland.
		(g) ½" NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.
1.3	<u>DISPLACER TYPE LEVEL TRANSMITTERS</u>	
1.3.1	Type	SMART, HART Protocol.
1.3.2	Stages of operation	Continuous.
1.3.3	Material -	
(a)	Displacer	AISI 316 SS.
(b)	Suspension wire	AISI 316 SS.
(c)	Torque tube housing	Carbon steel or SS as per application.
(d)	Torque tube	Inconel.
(e)	Displacer chamber	CS or SS as per process application.
(f)	Transmitter Housing	Die cast Aluminium or better.
1.3.4	Operating Voltage	16-48 Volts D.C.
1.3.5	Transmission	2-wire.
1.3.6	Output Signal	4-20 mA DC.
1.3.7	Signal processing	Solid-state electronic circuitry.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.3.8	Static / overload pressure	Maximum static pressure without permanent deformation or loss of accuracy.
1.3.9	Turn-down ratio	10 : 1 or better.
1.3.10	Zero & Span	Easily accessible (local zero & span adjustment and non-interactive type).
1.3.11	Enclosure Class	IP-65.
1.3.12	Output Indicator	LCD type.
1.3.13	Nameplate	Tag number and Service engraved in stainless steel tag plate.
1.3.14	Ambient Temperature	0 - 50°C.
1.3.15	Load Impedance	600 Ohms at 24 Volts (minimum).
1.3.16	Process Connection	2" Companion flange with nuts, bolts and gaskets.
1.3.17	Performance -	
	(a) Accuracy	±0.5 % of span or better.
	(b) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (g)
1.3.18	Accessories	(a) Counter Flange, nuts, bolts, gaskets etc.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
		(b) Weights for 5 point calibration of instruments.
		(c) Vent and drain plugs.
		(d) Special calibration tool / configuration, if any.
		(e) ½"NPT cable gland.
1.3.19	Preferred Features	(a) Test plug connection and cutout terminals physically separated from other electronics.
		(b) Electronic Damping facility (adjustable).
1.4	<u>MASS FLOW METER</u>	
1.4.1	Sensor	
1.4.1.1	Measuring Principle	Coriolis Mass flow.
1.4.1.2	Primary Element	Flow Tube of 316SS or better.
1.4.1.3	Heating Arrangement	Integral.
1.4.1.4	Temperature Control	For heavy fuel oil application.
1.4.1.5	Process Connection	Flanged of rating as per process requirement.
1.4.1.6	Drain	Self-draining facility.
1.4.1.7	Enclosure	Stainless steel.
1.4.1.8	Accessories	Counter flanges, Mounting nuts, bolts, gaskets etc.
1.4.2	Transmitter	

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.4.2.1	Measured quantities	Mass Flow rate, Total Mass Flow, Density, Temperature.
1.4.2.2	Input Signal Processing	Digital Processing.
1.4.2.3	Display	Digital Display LCD Type.
1.4.2.4	Output	2 off isolated 4-20mA DC output.
1.4.2.5	Load	< 750 ohms.
1.4.2.6	Power supply	240V AC, 50 Hz.
1.4.2.7	Turn Down	100:1.
1.4.2.8	Accuracy	± 0.2 % of measured value.
1.4.2.9	Housing	IP 65.
1.4.2.10	Nameplate	Tag number, service engraved in stainless steel tag plate.
1.4.2.11	Accessories	(a) Handheld configurator.
		(b) Mounting U-bolts, nuts, bolts, prefab cable etc.
		(c) ½"NPT cable gland.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.6	<u>MASS FLOW METER (FOR AIR)</u>	
1.6.1	Sensor	Thermal dispersion
1.6.2	Measuring Principle	The typical thermal mass sensing element contains two thermowell-protected Resistance Temperature Detectors (platinum RTDs). When placed in the process, one RTD is heated and the other RTD senses the process temperature. The temperature difference between the two RTDs is related to the process flow rate as well as the properties of the process medium.
1.6.3	Primary Element	316 stainless steel body with Hastelloy C thermowell sensors, 316 stainless steel compression fitting with teflon or stainless steel ferrule
1.6.4	Pressure (Maximum Operating with Damage)	
1.6.4.1	Stainless Steel Ferrule	-18°C to 121°C
1.6.4.2	Teflon Ferrule	-18°C to 93°C
1.6.5	Process Connection	1/2" MNPT or 3/4" MNPT with stainless steel or Teflon ferrule
1.6.6	Transmitter	
1.6.7	Measured quantities	Mass Flow rate, Total Mass Flow
1.6.8	Input Signal Processing	Digital Processing.
1.6.9	Display	LCD, ± 9999 counts, user scalable to flow rate

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
		engineering units or 0-100%
1.6.10	Output	2 off isolated 4-20mA DC output
1.6.11	Load	< 750 ohms.
1.6.12	Power supply	240V AC, 50 Hz.
1.6.13	Turn Down	100:1.
1.6.14	Accuracy	± 0.2 % of measured value.
1.6.15	Enclosure	NEMA4X (IP67) aluminum, Epoxy coated
1.6.16	Nameplate	Tag number, service engraved in stainless steel tag plate.
	Notes:	
1.	The above on-line flow meter shall not create any obstruction on flow.	
2.	Users' list shall be submitted to support on proven satisfactory performance for similar process applications.	
1.7	<u>PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE</u>	
1.7.1	Type	Bourdon / Bellows / Diaphragm.
1.7.2	Sensing & Socket	AISI-316 SS.
1.7.3	Movement Material	AISI-304 SS.
1.7.4	Case Material	Stainless steel, IP-65.
1.7.5	Dial Size	Generally 150 mm.
1.7.6	Scale	Black lettering on white in 270 ° arc.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.7.7	Window	Shatterproof glass.
1.7.8	Range Selection	Normal process pressure: 50~70% of range.
1.7.9	Over-range Protection	125% of maximum range by internal stop. External stop at zero.
1.7.10	Adjustment	Micrometer screw for zero. Internal micrometer screw for range.
1.7.11	Element Connection	Argon welding.
1.7.12	Process Connection	1/2" NPT(M) Bottom for local, back for panel mounting.
1.7.13	Performance	Accuracy of ± 1.0 % of span or better.
1.7.14	Operating ambient	0 - 50 °C.
1.7.15	Safety Feature	Blow out disc /diaphragm at the back.
1.7.16	Accessories	(a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.
		(b) Stainless steel Diaphragm seals for viscous fluids
		(c) 3-Way SS316 Gauge cock for pressure gauges.
		(d) 5-valve SS316 manifold from barstock for differential pressure gauge.
		(e) Siphons for steam and hot water services.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.7.17	Applicable standard	IS-3624 / 1996.
1.7.18	Nameplate	Tag number, service engraved in stainless steel tag plate.
1.8	<u>TEMPERATURE GAUGE</u>	
1.8.1	Type	Mercury or gas filled.
1.8.2	Sensing Element Material	Bourdon - AISI-316 SS.
1.8.3	Capillary Armoring	Stainless steel flexible.
1.8.4	Movement Material	AISI 304 SS.
1.8.5	Bulb / Stem Diameter	12 mm.
1.8.6	Bulb / Stem Material	AISI 316.
1.8.7	Capillary	Stainless Steel.
1.8.8	Connection to well	½" NPT.
1.8.9	Case Material	Stainless steel.
1.8.10	Dial Size	150 mm in general.
1.8.11	Scale	Black lettering on white in 270 ° arc.
1.8.12	Mounting	Surface/Panel.
1.8.13	Over range Protection	125 % of range or more.
1.8.14	Instrument connection	Bottom for local and back for panel mounting.
1.8.15	Range	Normal temperature – 50~70% of range.
1.8.16	Zero adjuster	Micrometer screw adjustable from front.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.8.17	Window	Shatterproof glass.
1.8.18	Accuracy	± 1 % or better.
1.8.19	Enclosure Class	IP-65.
1.8.20	Capillary	5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel.
1.8.21	Compensation	Capillary and Case Compensation.
1.8.22	Accessories	(a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of Thermowell: (i) SS 316: In general. (ii) Inconel: For flue gas application. (iii) Tungsten carbide: For coal mill application.
1.8.23	Nameplate	Tag number, service engraved in stainless steel tag plate.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.10	<u>RESISTANCE TEMPERATURE DETECTOR</u>	
1.10.1	Type	Platinum (Duplex), Ungrounded.
1.10.2	Resistance	100 ohm at 0 °C.
1.10.3	Base	Wound on ceramic (anti-inductive).
1.10.4	Wiring	3 / 4 Wire.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
1.10.5	Protecting Tube	
(a)	O.D.	8 mm.
(b)	Material	SS-316, Seamless.
(c)	Filling	Magnesium oxide (Purity above 99.4%).
1.10.6	Response time	(a) < 20 seconds for measurement.
		(b) < 10 seconds for control.
1.10.7	Calibration	DIN 43760.
1.10.8	Accuracy	± 0.5%.
1.10.9	Head:	
(a)	Type	IP-65 universal screwed type.
(b)	Material	Die cast aluminium or better.
(c)	Terminal blocks	Nickel plated Brass-screw type / silver plated.
(d)	Cable connection	½" NPT gland and grommet.
(e)	Others	Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells.
1.10.10	Accessories	(a) Adjustable nipple-union-nipple (½" Sch 80 x ½" NPT M) with Thermowell connection.

 TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT (TECHNICAL SPECIFICATION NUMBER: PE-TS-415-174-A001 REV 0)		
SR. NO.	ITEM	DESCRIPTION
		(b) Compression fittings / unions.
		(c) Flanges etc. (for flanged connections only)
		(d) Forged / barstock Thermowell as per ASME PTC code. Process connection M33 x 2 (M). Material of construction of Thermowell: SS 316: In general. Inconel: For flue gas application. Tungsten carbide: For coal mill application.
1.10.11	Name plate	Tag number, service engraved in stainless steel tag plate
1.11	<u>PRESSURE SWITCH</u>	
1.11.1	Type	(a) Piston for high pressure application.
		(b) Bellow / Diaphragm for low pressure application.
1.11.2	Sensing element material	AISI SS-316. All other wetted part SS316.
1.11.3	Case Material	Die-cast aluminium alloy, neoprene gasket.
1.11.4	Setter Scale	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.