1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT

KARNATAKA POWER CORPORATION LIMITED

TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT REV 00

VOLUME – II-B & III

SPECIFICATION NO.: PE-TS-409-174-14000A-A001

BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, INDIA

VOLUME – IIB

VOLUME-III

SECTION-A

INTENT OF SPECIFICATION

1.0 INTENT OF SPECIFICATION

1.1 The specification covers design, engineering, manufacture, fabrication, assembly, inspection & testing at vendor's & sub-vendor's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, mandatory spares, properly packed for transportation, unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, trail run, preparation and submission of "As Built" drawings, site testing, carrying out performance guarantee tests at site and handover of **OZONE GENERATION PLANT** as per the details in different sections / volumes of this specification for **1x370 MW YELAHANKA CCPP.**

The bidder's scope shall also include any other services, etc. if called for in the succeeding sections of the specification.

2.0 GENERAL TECHNICAL INSTRUCTIONS

2.1 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee testing of **OZONE GENERATION PLANT**.

2.2 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to BHEL who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.

2.3 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

2.4 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

2.5 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification during pre-bid stage **within 10 days of receipt of tender documents.** In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of BHEL / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by BHEL/ Customer as and when brought to their notice either by the bidder or by BHEL/ customer themselves, however, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

2.6 The system supplied must have backup service & spares available in India.

2.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions. All the doubts/clarity (if any) in the scope must be asked during pre-bid clarifications stage only.

2.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Vol – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be considered that deviation stands withdrawn without any cost to BHEL/its customer.

2.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

2.10 For definition of word like Contractor, bidder, supplier, vendor, Customer/ BHEL / Employer, consultant, please referred relevant clause(s) of GCC.

SECTION-B

PROJECT INFORMATION

1.0	Owner	:	Karnataka Power Corporation Ltd Shakthi Bhavan No.82, Race Course Road Bangalore–560 001 Karnataka, India
2.0	Project Title		**370 MW Yelahanka CCPP**
3.0	Location	:	Yelahanka Bangalore Dist Karnataka state, INDIA
4.0	Latitude and Longitude	:	13° 07' N Latitude 77° 35' E Longitude
5.0	Elevation above mean sea level	:	900 meters
6.0	Climatic Conditions		
	(a) Temperature		
	i. Monthly basis		
	Mean of daily maximum temperature	:	37° C
	Mean of daily minimum temperature	:	11.5° C
	ii Highest temperature recorded	:	39^0C
	iii Lowest temperature recorded	:	7.8^0C
	(b) Relative Humidity	:	Varies between 60% and 90%
	(c) Rainfall		
	Annual average rain	:	970 mm
	(d) Wind Speed		
	i. Annual mean wind speed	:	2.82 m/s
	ii. Maximum mean wind speed	:	3.71 m/s in the month of June.
	iii Design Wind Speed	:	33M/sec (As per IS: 875)

7.0	Seismic data		
	Zone	:	Seismic Zone II As per IS 1893

STATION : BANGALORE CITY

	2003					2004				
Month	Temperature in deg.Celsius				Mean RH %	Temperature in deg.Celsius				Mean RH %
	Mean Max	Highest Max.	Mean Min.	Lowest Min.	0830 hrs.	1730 hrs.	Mean Max	Highest Max	Mean Min.	Lowest Min.	0830 hrs.	1730 hrs.
Jan	28.6	31.6	16.0	13.9	80	43	28.8	31.1	16.2	13.7	81	42
Feb	31.7	33.2	18.9	16.9	75	35	31.1	34.1	16.9	15.1	64	31
Mar	33.6	35.4	20.4	17.2	67	33	34.3	36.2	20.0	15.7	58	22
Apr	34.2	36.0	22.3	19.9	74	41	34.2	37.0	22.4	18.7	72	39
May	35.2	37.6	22.8	21.0	71	34	29.9	34.6	20.8	18.7	84	71
Jun	31.6	38.1	21.1	19.5	84	62	29.0	31.2	20.0	19.2	86	65
Jul	29.3	31.3	20.5	19.5	87	68	28.3	31.8	19.8	17.7	89	71
Aug	28.6	31.6	20.3	19.0	88	68	28.1	30.7	19.7	18.9	86	69
Sep	29.1	31.8	19.8	18.7	81	58	28.0	31.1	19.9	18.6	88	72
Oct	28.7	30.6	19.9	17.3	85	72	28.0	31.4	19.4	17.7	86	71
Nov	27.8	29.4	18.0	15.0	80	60	26.8	29.0	17.6	14.8	79	62
Dec	27.8	31.1	16.0	13.0	76	48	28.1	29.9	15.4	13.0	76	46

DIRECTOR
Meteorological Centre
Central Observatory Comple
Palace Road,
BANGALORE 560 001

STATION : BANGALORE CITY

Month	2005					2006				
	Temperature in deg.Celsius				Mean RH %	Temperature in deg.Celsius				Mean RH %
	Mean Max	Highest Max.	Mean Min.	Lowest Min.	0830 hrs.	1730 hrs.	Mean Max	Highest Max.	Mean Min.	Lowest Min.	0830 hrs.	1730 hrs.
Jan	29.3	31.8	16.8	13.9	79	42	28.5	32.5	16.0	13.4	72	42
Feb	31.6	35.9	17.9	14.3	64	29	30.6	34.1	15.5	12.3	59	25
Mar	33.6	36.4	20.5	17.2	68	27	32.0	34.4	19.9	17.9	69	37
Apr	32.7	35.4	21.7	19.9	72	47	33.8	36.3	22.3	19.6	72	37
May	33.9	37.4	21.7	18.5	78	47	32.4	37.0	21.4	19.4	76	55
Jun	30.3	33.8	20.8	19.3	84	60	29.6	32.2	20.4	19.0	83	66
Jul	28.5	30.4	20.2	18.3	89	70	28.5	30.9	20.1	18.5	84	63
Aug	28.1	30.5	19.9	18.6	87	68	29.0	31.6	20.1	19.3	83	62
Sep	28.2	31.5	19.9	18.8	87	66	29.9	32.4	20.5	19.5	91	61
Oct	27.4	30.5	19.7	16.6	91	78	29.5	31.4	20.0	18.8	81	63
Nov	26.2	29.9	17.3	13.5	82	67	27.7	30.6	19.0	16.6	83	68
Dec	26.8	29.4	16.6	13.6	80	61	27.1	28.2	15.8	14.2	83	56

DIRECTOR
Meteorological Centre
Central Observatory Compl
Palace Road,
BANGALORE

STATION : BANGALORE CITY

Month	2007					2008				
	Temperature in deg.Celsius			Mean RH %		Temperature in deg.Celsius			Mean RH %	
	Mean Max	Highest Max.	Mean Min.	Lowest Min.	0830 hrs.	1730 hrs.	Mean Max	Highest Max.	Mean Min.	Lowest Min.	0830 hrs.	1730 hrs.
Jan	28.9	32.1	15.8	14.2	79	40	29.2	31.2	16.1	13.6	77	38
Feb	30.9	33.8	17.3	13.7	73	38	29.9	33.1	18.6	16.0	75	41
Mar	33.9	35.9	20.8	18.6	65	25	30.3	32.6	19.1	14.4	69	44
Apr	34.1	36.4	21.7	18.2	71	34	33.0	36.9	21.5	18.9	71	37
May	33.4	35.8	22.0	20.0	76	52	34.1	36.0	21.6	20.3	76	46
Jun	29.9	34.4	20.9	19.7	81	61	29.5	32.0	20.4	18.7	83	59
Jul	28.8	30.2	20.4	18.8	86	68	28.7	32.4	20.1	18.6	87	67
Aug	27.9	31.7	20.1	19.1	88	71	27.7	29.9	20.2	19.2	89	72
Sep	28.0	31.3	20.0	18.8	88	69	28.5	31.6	19.8	18.4	85	60
Oct	28.5	32.3	19.7	16.7	82	64	28.1	31.4	19.4	14.7	85	70
Nov	27.9	30.1	17.4	12.7	71	56	27.6	30.0	17.9	15.0	78	58
Dec	26.3	29.6	16.5	11.8	81	57	27.3	28.7	16.4	13.9	80	49

DIRECTOR
Meteorological Centre
Central Observatory Complex
Palace road,
BANGALORE 560 001

STATION : BANGALORE CITY

Month	2009						2010					
	Temperature in deg.Celsius				Mean RH %		Temperature in deg.Celsius				Mean RH %	
	Mean Max	Highest Max.	Mean Min.	Lowest Min.	0830 hrs.	1730 hrs.	Mean Max	Highest Max.	Mean Min.	Lowest Min.	0830 hrs.	1730 hrs.
Jan	28.1	31.9	15.3	12.1	78	38	28.1	29.5	17.1	14.1	82	41
Feb	31.8	35.2	17.7	15.3	63	26	31.8	34.4	18.2	14.3	72	29
Mar	33.1	35.5	20.4	17.3	66	28	34.5	35.7	21.3	18.5	68	27
Apr	34.5	37.0	22.2	20.0	70	30	34.5	37.6	22.7	20.3	71	43
May	32.8	36.9	21.6	19.2	79	53	33.0	36.2	22.3	19.3	78	52
Jun	29.7	31.8	20.4	18.4	84	61	29.9	34.0	21.2	19.5	86	66
Jul	27.9	30.0	20.1	19.4	86	66	27.5	30.2	20.3	19.1	89	72
Aug	28.6	31.1	20.3	19.3	87	65	27.4	29.8	20.5	18.8	88	69
Sep	28.1	31.3	20.2	18.2	88	73	27.8	31.8	20.2	18.7	89	67
Oct	28.8	31.0	19.4	17.9	77	53	28.5	30.4	20.4	18.4	87	69
Nov	27.4	29.9	19.3	15.5	84	67	26.4	29.2	19.3	17.5	88	74
Dec	27.0	29.3	17.7	15.0	84	62	26.4	29.9	16.9	12.9	85	56

29.82 37 19.55 12.1

29.65 37.6 20.03 12.9

DIRECTOR
Meteorological Centre
Central Observatory Complex
BANGALORE

STATION : BANGALORE CITY

Month	2011						2012					
	Temperature in deg.Celsius				Mean RH %		Temperature in deg.Celsius				Mean RH %	
	Mean Max	Highest Max.	Mean Min.	Lowest Min.	0830hrs.	1730hrs.	Mean Max	Highest Max.	Mean Min.	Lowest Min.	0830hrs.	1730hrs.
Jan	28.9	31.3	15.7	12.6	71	34	28.9	30.6	16.2	12.0	78	38
Feb	30.1	32.2	16.9	14.0	64	29	31.4	35.4	17.2	14.0	69	25
Mar	33.1	34.8	19.4	15.2	61	22	34.4	35.6	20.6	17.7	66	23
Apr	33.1	34.6	21.6	19.1	78	44	34.9	37.5	22.6	20.7	72	34
May	32.4	34.8	21.3	19.3	80	55	33.0	35.2	22.1	19.5	79	47
Jun	29.0	30.9	20.4	19.2	88	69	30.9	34.1	21.0	20.0	77	51
Jul	28.1	30.4	20.1	18.9	88	68	28.8	32.2	20.4	19.2	84	59
Aug	27.5	30.2	20.1	19.2	89	73	28.5	32.4	20.2	19.5	86	66
Sep	28.3	30.8	20.1	18.2	86	62	29.2	32.5	20.3	19.2	82	56
Oct	29.3	31.0	20.3	18.2	87	71	28.5	32.3	19.6	18.0	81	61
Nov	27.3	29.5	17.9	15.0	78	61	28.1	30.8	17.6	13.3	75	52
Dec	27.4	29.8	16.3	12.8	77	47	28.0	30.7	16.9	14.4	81	48
	29.60	34.8	17.5	12.6			30.36	37.5	19.56	12.0		

DIRECTOR
Meteorological Centre
Central
BANGALORE

SECTION - C

SPECIFIC TECHNICAL SPECIFICATIONS

SECTION – C1: SPECIFIC TECHNICAL REQUIREMENTS FOR MECHANICAL

SECTION – C2: SPECIFIC TECHNICAL REQUIREMENTS FOR ELECTRICAL

SECTION – C3: SPECIFIC TECHNICAL REQUIREMENTS FOR CONTROL AND INSTRUMENTATION

ANNEXURES TO SECTION C

SECTION – C1

SPECIFIC TECHNICAL REQUIREMENTS FOR MECHANICAL

SECTION C1 – A – SCOPE OF SUPPLY & SERVICES, EXCLUSION AND TERMINAL POINTS ETC.

SECTION C1 – B – TECHNICAL REQUIREMENT OF CUSTOMER

SECTION C1 – C – FUNCTIONAL / PERFORMANCE / DEMONSTRATION GUARANTEE

SECTION C1 – D – QUALITY ASSURANCE

SECTION C1 – E – PAINTING SPECIFICATION

SECTION C1 – F – DATASHEET A

SECTION C1 – A

SCOPE OF SUPPLY & SERVICES, EXCLUSION AND TERMINAL POINTS ETC.

1.0 GENERAL

The specification covers design, engineering, manufacture, fabrication, assembly, inspection & testing at vendor's & sub-vendor's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, mandatory spares, properly packed for transportation, unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, trail run, preparation and submission of "As Built" drawings, site testing, carrying out performance guarantee tests at site and handover of **OZONE GENERATION PLANT** as per the details in different sections / volumes of this specification for **1x370 MW YELAHANKA CCPP.**

2.0 REFERENCE DOCUMENTS

A.	PE-DG-409-174-14000A-A001	:	P & ID FOR OZONE GENERATION PLANT
B.	DATASHEET – A	:	FOR ABOVE SYSTEM

3.0 SCOPE OF SUPPLY (MECHANICAL)

Broad scope of work of this package includes all equipment and accessories. Please also refer Mechanical data sheet, P&ID and the respective section of Electrical and C&I sections for respective scopes.

The Ozone generation plant, as specified in Technical specification, Data sheets, P&ID, and shall consist of at least the followings and shall be in the scope of the bidder:

3.1 Screw type water cooled compressors complete with drive motors, silencer, and Intake filters, inter coolers, after coolers, and step up gear box, moisture separator, ducting arrangement (if required) and all other accessories.

3.2 Air receiver with all accessories.

3.3 Air driers unit stream with all accessories.

3.4 Oxygen generators/concentrator stream with all accessories.

3.5 Oxygen receivers (One number per stream) for CW Ozonisation system with all accessories.

3.6 Oxygen receiver for Ozonisation system at raw water reservoir with all accessories.

3.7 Ozone generators for Ozonisation system at Condenser with all accessories along with transformers, rectifiers, VFD etc.

3.8 Ozone generators for Ozonisation system for RO+ CW makeup with all accessories along with transformers, rectifiers, VFD etc.

3.9 Ozone generators for Ozonisation system for Raw water reservoir with all accessories along with transformers, rectifiers, VFD etc.

3.10 Chilled water re circulation pumps for Ozonization system of Condenser and RO + CW Makeup complete with drive motors along with strainers, instruments, isolation valves, piping, flanges, pipe fittings etc.

3.11 Chilled water re circulation pumps for Ozonization system of Raw water reservoir complete with drive motors along with strainers, instruments, isolation valves, piping, flanges, pipe fittings etc.

3.12 Air cooled chillers for Ozonization system of Condenser and RO + CW Makeup with all accessories.

3.13 Air cooled chillers for Ozonization system of Raw water reservoir with all accessories.

3.14 Service water storage tank for Ozonization system of Condenser and RO + CW Makeup along with piping, valves, fittings, instrumentation and accessories associated with the same.

3.15 Service water storage tank for Ozonization system of Raw water Reservoir along with piping, valves, fittings, instrumentation and accessories associated with the same.

3.16 Ozone dosing pumps for Ozonization system at Condenser complete with drive motors along with strainers, instruments, isolation valves, injector, Ozone static mixers, piping, flanges, pipe fittings etc.

3.17 Ozone dosing pumps for Ozonization system for RO + CW Makeup complete with drive motors along with strainers, instruments, isolation valves, injector, Ozone static mixers, piping, flanges, pipe fittings etc.

3.18 Ozone dosing pumps for Ozonization system for Raw water Reservoir complete with drive motors along with strainers, instruments, isolation valves, injector, Ozone static mixers, piping, flanges, pipe fittings etc.

3.19 Piping :

All the piping as listed below shall be in bidder's scope. The below indicated pipes shall be designed, supplied, erected, laid and tested by the bidder. The length of the yard piping has been indicated elsewhere in the specification. Elbows, tees, flanges Hangers and supports, embedment plates with lugs etc required for the below given piping shall also be provided by the bidder.

3.19.1 All piping within the Ozone generation plant as shown in the P&ID (PE-DG-409-174-14000A-A001 Rev00).

3.19.2 Ozonated water dosing piping from Ozone dosing pumps for Ozonization system at Condenser to inlet and outlet of condenser.

3.19.3 Ozonated water dosing piping from Ozone dosing pumps for Ozonization system for RO + CW Makeup to inlet line of RO plant.

3.19.4 Ozonated water dosing piping from Ozone dosing pumps for Ozonization system for RO + CW Makeup to inlet line of CW Makeup.

3.19.5 Ozonated water dosing piping from Ozone dosing pumps for Ozonization system for Raw water Reservoir to inlet line of Raw water reservoir.

3.19.6 Ozonated water dosing piping from Ozone dosing pumps for Ozonization system for Raw water Reservoir to each compartment of raw water reservoir.

3.19.7 Oxygen piping from Oxygen receivers housed in Ozone generation Building -1 to Raw water reservoir Oxygen receivers housed in Ozone generation Building -2.

3.19.8 Service water piping, instrument air piping, service air piping, potable water piping, etc. as applicable as per the Terminal Points.

3.19.9 In addition, any additional piping and associated accessories required to complete the system shall be in bidder's scope.

3.20 All tanks complete with inlet and outlet connections, all fittings, flanges and appurtenances etc. as specified and as required.

3.21 PLC based control system as per details mentioned in other parts of Specification.

3.22 Electrical scope shall be as per "Electrical scope between BHEL and Vendor" enclosed with the technical specification.

3.23 Hangers and supports as per the requirement.

3.24 Bidder to note that the equipment, valves, instruments indicated in the P&ID (PE-DG-409-174-14000A-A001 Rev00) attached in the technical specification are minimum and are in bidder's scope. During detailed engineering, bidder to furnish complete and detailed scheme in all respects including all valves, instrumentation, equipment's etc. for smooth, safe, efficient and trouble free operation of the plant meeting the specification requirement and also considering the applicable statutory requirement.

3.25 All Instrumentation (minimum) as per the enclosed P&ID (PE-DG-409-174-14000A-A001 Rev00) including the electronic on line dew point transmitter, Ozone analyzer, Oxygen purity analyzer, Ozone leak detector, residual ozone analyser, with suitable sampling connections and isolation valves are in Bidder's scope.

3.26 Safety requirement as applicable.

3.27 Automatic type Ventilation system as per details provided elsewhere in technical specification.

3.28 Start-up and commissioning spares as required.

3.29 Mandatory spares as indicated in Annexure – II at Section C.

3.30 All tanks as per P&ID & Data Sheet-A complete with inlet and outlet connections, drain system, inlets water connection, all fittings and appurtenances etc. as specified and as required.

3.31 All special tools necessary for proper maintenance or adjustment of the equipment packed in permanent box.

3.32 Painting as per enclosed painting specification. However, any variation in the painting schedule as finally approved by customer shall be taken care by the bidder without any commercial and delivery implication.

3.33 Finish paints for touch up painting of equipments after erection at site in sealed container.

3.34 All blank flanges/counter flanges, isolations valves, tees, fittings etc. to interconnect the pipes and all terminal points.

3.35 All handling facilities including electric hoist /Manual hoist as per details provided in the specification.

3.36 All necessary structural steel for pipe supporting structure, platforms, permanent ladder for approaching the top of tanks & valves, mechanical plant and equipment, mechanical services and pipe work associated with Ozone generation Plant.

3.37 All steel inserts with lugs, plates, bolts, nuts, sleeves, edge angles, hume pipe, and all other embedding components etc as required to grout in civil works and to support/hold the equipments being supplied under this specification for opening/maintenance purpose.

3.38 Necessary piping, fitting, valves, drains, vents, sampling etc. required for the complete Ozone Generation Plant. Pipe racks shall be provided by BHEL wherever available, wherever pipe racks are not available, pipe shall be laid on pedestal to be provided by BHEL. However all auxiliary steel structure (U-clamps, nuts, bolts, channels etc) for fixing pipes on pedestal or racks shall be in bidder's scope.

3.39 All necessary valves and fittings for the installations with the actuators necessary for their remote operation.

3.40 Embedment plates with lugs shall also be provided by bidder as per system requirement.

3.41 All channels & brackets, mounting plates as required for mounting of motors, pumps, tank etc shall be in bidder's scope.

3.42 All Motorized valves with integral starter as per requirement and as indicated in the P&ID.

3.43 Monitoring gadgets, instruments and equipments required for commissioning & maintenance (till PG test and plant handover).

3.44 Instrument hook up material shall be in bidder's scope.

3.45 Wrapping, coating and protection of the entire buried pipe shall be as per IS 10221 or AWWA C 203-93. Hume pipes is also in bidder's scope as required.

3.46 Any item/work either supply of equipment or erection material which have not been specifically mentioned in but are necessary to complete the woks for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification and shall be in bidder's scope.

3.47 All other items are also included in scope of supply as specified in other part of the specification.

3.48 All required elbow, tee, pipe fittings etc. required for erection of the complete system including piping shall be in bidder's scope. Bidder to provide the detailed BOQ during detail engineering.

3.49 Bidder shall perform the guarantee test as per specification requirement to the satisfaction of owner. The exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with the owner during detailed engineering & mutually agreed.

3.50 All the first fill and one Year's topping requirements of consumable such as greases, oil, lubricants, servo fluids/control fluids etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be in bidder's scope. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.

4.0 SCOPE OF SUPPLY (ELECTRICAL)

Complete electrical as per specification and details indicated in Section C2 (Specific Technical Requirement Electrical).

5.0 SCOPE OF SUPPLY (C&I)

Complete C&I as per specification and details indicated in Section C3 (Specific Technical Requirement C&I).

6.0 SCOPE OF SUPPLY (CIVIL)

Total Civil is in BHEL's Scope of work, however complete grouting for equipment, fixing of equipments shall be in bidder's scope.

Also detailed Civil Input drawing shall be provided by bidder. Successful bidder shall furnish civil assignment drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence

7.0 SCOPE OF SERVICES

The bidder's scope also includes following services for scope under this specification:

7.1 Design and Engineering, Erection and commissioning, unloading, transportation, storage and handling at site.

7.2 Minor civil work like chipping of foundation, grouting below base plate for all structures, equipment, grouting of anchor bolts wherever these are not placed in the foundation during casting of foundation itself. To the extent possible, vendor shall ensure to supply all foundation bolts timely so as to facilitate placement of these bolts while casting the foundation.

7.3 Pre- Commissioning work such as flushing, hydraulic testing etc. Necessary consumables and instrumentation as required for inspection and testing at works as well as at site including pre-commissioning activities shall be arranged by the successful bidder at their own cost.

7.4 Arrangement of all instruments, monitoring gadgets for monitoring, pre-commissioning, carrying out trial run & commissioning and Performance guarantee test.

7.5 Monitoring gadgets, instruments and equipments required for maintenance, performance guarantee test etc.

7.6 All personnel required during maintenance, Commissioning and Performance guarantee test.

7.7 Trial run for requisite period as required.

7.8 Performance guarantee testing.

7.9 Painting shall be as specified in Painting Specification of this technical specification. Bidder to note that paint shed shall be finalized during detailed engineering as per customer & BHEL requirement and any variation in the painting schedule as finally approved by customer shall be taken care by bidder without any commercial and delivery implication.

7.10 Final touch up paint at site. Bidder shall also provide one final coat additionally of same DFT as specified in tender specification at site after completion of erection of each equipment / item.

7.11 Preparation & submission of all drawings as per details indicated elsewhere in technical specification.

7.12 Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.

7.13 All other facilities/ services as described in section on site services in specification and related to Ozone Generation Plant scope of work.

7.14 Relevant requirements as per GTR, GCC, ECC & SCC.

7.15 Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system as well as to meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of services.

8.0 TERMINAL POINTS

8.1 25 NB Instrument air supply at 5 to 7 kg/cm2 (g) – At 5 meter distance from the Ozone generation plant Building -1 area. However distribution and piping inside Ozone generation plant Building -1 area shall be in bidder's scope.

8.2 25 NB Instrument air supply at 5 to 7 kg/cm2 (g) – At 5 meter distance from the Ozone generation plant Building -2 area. However distribution and piping inside Ozone generation plant Building -2 area shall be in bidder's scope.

8.3 Service water (RO water) connection at 5 meter distance from Ozone generation plant Building -1 area. Piping inside Ozone generation plant Building -1 area for mentioned services will also be in bidder's scope. The Service water analysis (Annexure – IV at Section C) has been attached elsewhere in the specification.

8.4 Service water (RO water) connection at 5 meter distance from Ozone generation plant Building -2 area. Piping inside Ozone generation plant Building -2 area for mentioned services will also be in bidder's scope.

8.5 Motive water line for dosing at Condenser at 5 meter distance from Ozone generation plant Building -1 area. Piping inside Ozone generation plant Building -1 area for mentioned services will also be in bidder's scope.

8.6 Motive water line for dosing at RO + CW MAKEUP at 5 meter distance from Ozone generation plant Building -1 area. Piping inside Ozone generation plant Building -1 area for mentioned services will also be in bidder's scope.

8.7 The Ozone dosing pumps for Raw water reservoir ozonisation system (dosing in each compartment of raw water reservoir & inlet line to raw water reservoir) shall be housed near Raw water storage tank. The inlet line from the common Raw water reservoir pit to ozone dosing pumps shall also be in bidder's scope. The piping distance between ozone dosing pumps and common Raw water reservoir pit shall be 50 meters.

8.8 All drains: Drains from all the systems shall be terminated at one point.

8.9 The Yard piping as per details provide in below table:

Sr. No.	PIPING	TOTAL PIPING LENGTH IN METERS (BIDDER'S SCOPE)
8.9.1	Ozonated water dosing piping from Ozone dosing pumps for Ozonization system at Condenser to inlet and outlet of condenser.	180 Meters.
8.9.2	Ozonated water dosing piping from Ozone dosing pumps for Ozonization system for RO + CW Makeup to inlet line of RO plant	250 Meters.
8.9.3	Ozonated water dosing piping from Ozone dosing pumps for Ozonization system for RO + CW Makeup to inlet line of CW Makeup	180 Meters
8.9.4	Ozonated water dosing piping from Ozone dosing pumps for Ozonization system for Raw water Reservoir to inlet line of Raw water reservoir	250 Meters
8.9.5	Ozonated water dosing piping from Ozone dosing pumps for Ozonization system for Raw water Reservoir to each compartment of raw water reservoir	The dimensions of raw water reservoir has been indicated in the GA drawing of raw water reservoir attached elsewhere in the technical specification. The piping shall be provided for each compartment of raw water reservoir all along the periphery as shown in the drg. The network of piping in each compartment of raw water reservoir shall be designed in such a way so that proper mixing and distribution can be done of Ozonated water in each compartment of raw water reservoir. However the total piping length shall be **1350 meters.**
8.9.6	Oxygen piping from Oxygen receivers housed in Ozone generation Building -1 to Raw water reservoir Oxygen receivers housed in Ozone generation Building -2	**1000 Meters.** The pressure of the compressors shall be selected considering the pressure drop thorough this piping in addition to other process requirements. The minimum static head to be consider shall be 12 meters.

8.10 Suitable size and numbers hume pipe for road crossing shall also be in Bidder's scope, refer plot plan for details. Minimum number of hume piping required has been listed in below table:

Sr. No.	PIPING	MINIMUM NUMBER OF HUME PIPE REQUIRED (BIDDER'S SCOPE)
8.10.1	Ozonated water dosing piping from Ozone dosing pumps for Ozonization system for RO + CW Makeup to inlet line of RO plant	Minimum 6 numbers each for 6 meter road crossing
8.10.2	Ozonated water dosing piping from Ozone dosing pumps for Ozonization system for RO + CW Makeup to inlet line of CW Makeup	Minimum 4 numbers each for 6 meter road crossing

8.10.3	Oxygen piping from Oxygen receivers housed in Ozone generation Building -1 to Raw water reservoir Oxygen receivers housed in Ozone generation Building -2	Minimum 8 numbers each for 6 meter road crossing

9.0 EXCLUSIONS

9.1 All civil works including foundation of equipment. However complete grouting for equipment, fixing and any concreting inside vessels and lining shall be in the scope of the bidder.

9.2 Instrument air & service air up to terminal points.

9.3 Air conditioning.

9.4 Other exclusions are mentioned in the electrical & C&I parts of this specification.

9.5 Drinking water (or potable water), service water up to terminal points.

9.6 excavation & filling of earth for buried pipes if and as required

10.0 QP AND SUB VENDOR APPROVAL

10.1 The quality assurance plan is enclosed elsewhere in technical specification**.** However requirement of detailed QP, inspection checklist, certificate of conformance etc. for each equipment and sub-vendor shall be finalized during detailed engineering stage; decision of BHEL/customer shall be binding on vendor in this regard. Any changes/additional tests insisted upon by Owner during approval of QAP's shall be accepted by bidder without any commercial and delivery implication to BHEL/Customer. Bidder shall submit the quality plans in BHEL format during detailed engineering stage. Bidder to note further that during detailed engineering all the QAP's/check lists etc. shall be submitted to Customer/BHEL for approval. All inspection & testing etc. shall be carried out accordingly. The cost of third party inspection for all imported components shall also be in bidder's scope.

10.2 The sub vendor list (Annexure- I at Section D) enclosed is indicative only and is subject to approval / acceptance by customer. Bidder to propose his sub vendor list with back up documents (experience list, end user performance certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

11.0 PERFORMANCE GUARANTEE TEST

The Performance guarantee test shall be as per Section-C2-B.

12.0 DESIGN/ CONSTRUCTION

In addition to the requirements of Section C & D the following shall also be complied under scope of this specification.

The P&IDs (Dwg.No.- PE-DG-409-174-14000A-A001 REV 00) is enclosed herein in this section for bidders compliance.

The material of construction specified in data sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subject to BHEL / Customer approval during detail engineering without any commercial & delivery implication to BHEL.

The technical specification requirement for items which are not included shall be subject to customer/BHEL approval during detailed engineering stage. Vendor will submit all the back up documents for prooveness of the technical details selected.

13.0 DRAWING/DOCUMENTS REQUIREMENT

For the Drawings/Documents submission schedule, please refer ANNEXURE-VI.

For the Drawings/Documents Submission Procedure, please refer ANNEXURE-V. The bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

14.0 SPARES

14.1 All the 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.

14.2 The quality plan and the inspection requirement finalized for the main equipment will also be applicable to the corresponding spares.

14.3 MANDATORY SPARES

14.3.1 The list of mandatory spares considered essential by the BHEL & Customer is indicated in Annexure II at Section D.

14.3.2 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.

14.3.3 Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.

14.3.4 The Bidder shall note that if there in any change/ variation in equipment / system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

14.4 START-UP AND COMMISSIONING SPARES

14.4.1 Start-up and Commissioning spares are those which would be required during plant or equipment testing, start-up and commissioning. All spares used until the plant is finally handed over by the Contractor to the Owner come under this category. All start-up and commissioning spares as required shall be in Bidder's scope.

14.4.2 Bidder shall be responsible for the ready and timely availability for all the start-up and commissioning spares as required during various stages of erection, testing, cleaning and commissioning upto handing over of plant.

14.5 RECOMMENDED SPARES

14.5.1 Bidders shall furnish a recommended spare parts schedule which the Bidder considers necessary and which has not been specified in the list of mandatory spares for the normal and trouble free plant operation for 3 years operation along with their offer for all equipment under the scope. The list of spares shall include such spares which are to be stored to achieve the plant availability level indicated by the bidder. The unit price of each recommended spares shall be indicated separately and shall not be quoted along with the lumpsum price. The price indicated for the recommended spares shall not be considered for the purpose of evaluation.

14.6 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to be replacements. The spares shall be treated and packed for long storage under climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with dissicator packs as necessary.

14.7 **Maintenance Tools and Tackles**

14.7.1 One set of all special tools shall be furnished and shipped with each piece of equipment for dismantling, maintenance, adjustment, and calibration of the equipment. The tools shall be shipped in separate heavily constructed wooden boxes provided with hinged covers and padlock hasps.

14.7.2 The Contractor shall supply under this contract all maintenance tools for each piece of equipment / system and it shall be boxed separately and the boxes shall be appropriately marked for shipment and identification of contents.

14.7.3 A weather-proof itemised list of the contents shall also be attached to the outside of each container.

14.7.4 Necessary temporary piping, desuperheater etc. for wet steam washing of the steam turbine generator shall be included in bidders scope.

14.7.5 The maintenance tools shall include all special handling rigs, bars, slings, cable and all specialised equipment for control system maintenance such as extender boards, scopes, and all software and hardware. Further, Bidder shall also include a full set of regular maintenance tools and tackles required. Bidder shall also include all maintenance tools and tackles in their scope. Total price of all the maintenance tools and tackles shall be included in the quoted lumpsum price.

15.0 ADDITIONAL REQUIREMENT

15.1 The Ozone generation plant shall consist of feed gas preparation unit purifier and compressor, ozone generator drier and contact system of adequate capacity and necessary piping and associated systems.

The plant shall be designed for automatic service with modern link system / remote monitoring and analytical work.

The plant shall also be designed for automatic service with each pump and compressors combination while ensuring reasonably uniform flow conditions.

Online analyser for measurement of residual ozone in the cooling tower and raw water shall be provided by the bidder. Residual ozone will be 0.02 ppm at CT basin and 0.02 ppm at Raw water reservoir.

The Bidder shall furnish the details of high-tension transformers, power supply units and electrical control.

15.2 For selection of pump head during detailed engineering, Bidder will consider 12 m static head + 20% margin in addition to the losses in straight length and bend in pipes and valves etc. while.

15.3 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.

15.4 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.

15.5 Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder

shall be responsible for the correctness of details w.r.t. existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

15.6 Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.

15.7 Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor".

15.8 The complete system shall be proven and necessary design documentation in support of proveness shall be submitted by the successful bidder in support of the systems, if asked by the customer without any price and delivery implication to BHEL and customer.

15.9 Vendor to attend regular engineering meeting with BHEL and customer fortnightly in BHEL or customer office as decided during detail engineering. Vendor will depute all his concerned engineering representative along with the project manager for discussion and approval. Meeting can be held at site also.

15.10 The total space available for the complete Ozone generation plant Area -1 (Building + Shed) is 21 Meters X 21 Meters. The total space available for the complete Ozone generation plant Area -2 (Building + Shed) is 13.5 Meters X 10.5 Meters. Bidder to accommodate entire Ozone generation plant within this space. All the arrangements for the same is in bidder's scope.

15.11 Bidder to submit BBU during detailed engineering after approval of Basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to BHEL / CUSTOMER for the same. None of the items supplied for the project as non-billable. Incomplete BBU shall not be review by BHEL.

15.12 KKS numbering as per BHEL/Customer requirement shall be provided by the Bidder during detailed engineering stage without any commercial/delivery implication to BHEL.

15.13 Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope.

15.14 In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

15.15 Latest version of all codes and standards to be followed.

15.16 Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the works for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.

15.17 All drawings/documents shall be approved by BHEL/Customer during detailed engineering stage. Successful vendor shall comply with the comment of the customer/BHEL without price & delivery implication.

15.18 Site facility as available or as extended by Customer shall only be provided.

SECTION – C1-B

TECHNICAL REQUIREMENT CUSTOMER

DESIGN PHILOSOPHY AND OTHER TECHNICAL DETAILS OF OZONE GENERATION PLANT

1.0 DESIGN PHILOSOPHY:

Ozone dosing is to be done for raw water & Cooling Water to prevent growth of biological substances. Bidder shall provide ozonisation plant to control / prevent fouling and organic growth in the complete cooling water system and raw water system.Ozone Generation Plant shall comprise of the Ozone generating plant as a whole including mixing device, ozone generator(s), its feed gas preparations device & its controls. Ozone shall be generated using a dry filtered gas containing oxygen, which is fed through an electrical discharge created between electrodes. The discharge, known as “silent corona discharge” causes the dissociation of some of the oxygen molecules resulting into the formation of ozone. The ozone concentration shall be of 8-10% (W/W).

Following Ozonisation system shall be provided:

1. Ozonisation system for cooling water of Condenser herein after called as Ozonisation system at Condenser.
2. Ozonisation system for RO plant and CW make up herein after called as RO + CW make up Ozonisation system.
3. Ozonisation system for raw water reservoir herein after called as raw water reservoir Ozonisation system.

The above ozone generation plant shall consist of following sub systems:

- **OXYGEN GENERATION PLANT** (Common for Ozonisation system at Condenser, RO + CW make up Ozonisation system & raw water reservoir Ozonisation system).
- **OZONE GENERATION PLANT** (Separate for Ozonisation system at Condenser, RO + CW make up Ozonisation system & raw water reservoir Ozonisation system).
- **COOLING WATER PLANT** (Common for Ozonisation system at Condenser & RO + CW make up Ozonisation system and Separate for Raw water reservoir Ozonisation system).
- **OZONE DOSING SYSTEM** (Separate for Ozonisation system at Condenser, RO + CW make up Ozonisation system & raw water reservoir Ozonisation system).
- **MEASURING & MONITORING DEVICES** (Common for Ozonisation system at Condenser, RO + CW make up Ozonisation system & raw water reservoir Ozonisation system).
- **PLC BASED CONTROL SYSTEM** (Common for Ozonisation system at Condenser, RO + CW make up Ozonisation system & raw water reservoir Ozonisation system).

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

- **OXYGEN GENERATION PLANT (Common for Ozonisation system at Condenser, RO + CW make up Ozonisation system & Raw water reservoir Ozonisation system)-**

Common Oxygen generation plant shall be provided for Ozonisation system at Condenser, RO + CW make up Ozonisation system & raw water reservoir Ozonisation system. Oxygen generation plant is used to feed desired quantity & quality of feed gas to Ozonator. It shall consist of at least the following equipments:

- **Compressor:** Two numbers (2X100%) screw type water cooled compressors of suitable capacity along with electrical motor, instruments, ducting arrangement, valves, piping etc. shall be provided by the bidder.

- **Air Receiver:** One number air receiver shall be provided by the bidder along with all the accessories. The capacity of air receiver shall be 10 % of flow capacity in m3/min or 1.3 M3 whichever is higher.

- **Dryer Unit:** Two numbers (2X100%) Dryer unit per stream (total 4 numbers for both the streams) along with all the accessories shall be provided by the bidder to remove the moisture from the air. The dryer shall be based on adsorption phenomenon using activated alumina or equivalent material based on supplier recommendations.

- **Oxygen generator:** Two numbers (2X100%) oxygen generator / concentrator per stream (total 4 numbers for both the streams) along with all the accessories to achieve the pure oxygen shall be provided by the bidder. Purity of Oxygen at outlet of Oxygen generators shall not be less than 92%. Online measurement & monitoring facilities of oxygen purity & dew point shall also be provided by the bidder.

- **Oxygen receivers:** Two nos (2x100%) oxygen receivers shall be provided by the bidder along with all the accessories. The capacity of each oxygen receiver shall be based on the Cycle time of Oxygen generation plant or 2.8 M3 whichever is higher. One number Oxygen receiver of 1.0 M3 capacity shall also be provided by the bidder along with all the accessories separately for raw water reservoir Ozonisation system.

- **OZONE GENERATION PLANT (Separate for Ozonisation system at Condenser, RO + CW make up Ozonisation system & Raw water reservoir Ozonisation system)-**

  Separate Ozone Generator(s) shall be provided for Ozonisation system at Condenser, RO + CW make up Ozonisation system & raw water reservoir Ozonisation system. Ozone generator(s) shall be vertical/horizontal shell and tube, corona discharge, water cooled, fixed voltage and variable frequency type. Ozone shall be generated by passing oxygen through a gap formed between power connection and SS tube. 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 following equipments:

  - **Ozone electrode:** Ozone generator shall be vertical/Horizontal tubular form of MOC SS316 Ti.
  - **Dielectric glass tube:**

    A. **Material :** Borosilicate glass/ equivalent based on supplier recommendations

    B. **Type:** Cylindrical.

    C. **Construction:** Closed at one end.

- **COOLING WATER PLANT (Common for Ozonisation system at Condenser & RO + CW make up Ozonisation system and Separate for Raw water reservoir Ozonisation system)-**

  Cooling water plant Common for Ozonisation system at Condenser & RO + CW make up Ozonisation system and Separate for Raw water reservoir Ozonisation system shall be provided. Cooling water plant is provided for removal of excess heat generated during ozone generation from ozone producing cells. Suitable capacity air cooled Chiller for removal of excess heat generated during ozone generation from ozone producing cells shall be provided. Ozone system shall be water cooled. Service water is used for removal of excess heat from the ozone producing cells. The water analysis of Service water has been attached elsewhere in the specification.

- **OZONE DOSING SYSTEM (Separate for Ozonisation system at Condenser, RO + CW make up Ozonisation system & Raw water reservoir Ozonisation system)-**

  Separate Ozone Dosing system shall be provided for Ozonisation system at Condenser, RO + CW make up Ozonisation system & raw water reservoir Ozonisation system. Ozone produced from ozone producing cells is mixed with water. This system consists of venture injection to contact the ozone with the motive water. The water flow through the injector produces a partial vacuum which is utilised 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 steam of finest bubbles. This action increases the contact surface between gas and water phases tremendously which is essential for optimized mass transfer. Separate Ozone dosing pumps for RW and CW shall be provided as shown in the P&ID. The ozonated water will be introduced as per below given table: Static mixtures shall also be provided by the bidder for all the ozone dosing line at the interval of 20 meters.

DOSING SYSTEM	DOSING POINTS
CW DOSING SYSTEM	At Condenser Inlet & Outlet.
RW DOSING SYSTEM	• At Inlet header to RO plant. • At Inlet header to CW makeup. • At Inlet header to Raw water reservoir. • At each compartment Raw water reservoir.

- **MEASURING & MONITORING DEVICES (Common for Ozonisation system at Condenser, RO + CW make up Ozonisation system & Raw water reservoir Ozonisation system):**

a. Outlet ozone gas of ozone generator(s) provided for Ozonisation system at Condenser, RO + CW make up Ozonisation system shall be measured by ozone analyser as shown in the P&ID.

Outlet ozone gas of ozone generator(s) provided for Raw water reservoir Ozonisation system shall be measured by a common ozone analyser as shown in the P&ID.

b. Residual ozone measuring device / ORP meter shall be provided to measure the residual ozone in CW system & RW system as shown in the P&ID.

c. 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.

2.0 CAPACITY SELECTION:

3.1 CAPACITY SELECTION OF OZONISATION SYSTEM AT CONDENSER:

Total CW Flow	=	19784 m^3/hr
Ozone dosing rate	=	0.3 ppm
Ozone requirement	=	5.94 Kg/Hr.
Ozone Dosage rate selected	=	6 Kg/hr.

3.2 CAPACITY SELECTION OF RO + CW MAKE UP OZONISATION SYSTEM:

Total RW inlet flow at RO Plant + CW makeup	=	65 m^3/hr (RO plant) + 496 m^3/hr (CW makeup) = 561 m^3/hr
Ozone dosing rate	=	3.0 ppm
Ozone requirement	=	1.68 Kg/Hr.
Ozone Dosage rate selected	=	2.0 Kg/hr.

3.3 CAPACITY SELECTION OF RAW WATER RESERVOIR OZONISATION SYSTEM:

Total RW inlet flow at RW reservoir/ RW inlet line	=	600 m^3/hr
Ozone dosing rate	=	3.0 ppm
Ozone requirement	=	1.80 Kg/hr.
Ozone Dosage rate selected	=	2.00 Kg/hr.

4.0 <u>PLANT OPERATION AND CONTROL SYSTEM (Common for Ozonisation system at Condenser, RO + CW make up Ozonisation system & Raw water reservoir Ozonisation system)</u>

The operation of Ozonisation system at Condenser, RO + CW make up Ozonisation system & Raw water reservoir Ozonisation system shall be from common PLC based control system.

The control for the Ozonisation system at Condenser, RO + CW make up Ozonisation system shall be from PLC located in the Control Room at Ozonisation system at Condenser, RO + CW make up Ozonisation system building. One (1) operator work station (OWS) and one (1) operator cum engineering work station (OEWS) for Ozonisation system at Condenser, RO + CW make up Ozonisation system are envisaged.

For Raw water reservoir Ozonisation system Remote IO located in the RIO Room at Raw water reservoir Ozonisation system building shall be considered which shall be interfaced with Ozonisation system at Condenser, RO + CW make up Ozonisation system PLC. One (1) operator work station (OWS) for Raw water reservoir Ozonisation system is envisaged for operation.

HMI based alarm system is envisaged. Alarms shall be driven by PLC and shall be displayed on alarm windows/annunciator mounted on PLC panel.

For further information, please refer attached PLC system Configuration diagram. However, the detailed control shall be furnished during detailed engineering stage based on supplier recommendations.

UPS: PLC shall be powered from 2x100% parallel redundant dedicated UPS Power supply with 60 minutes battery back-up for Ozonisation system at Condenser, RO + CW make up Ozonisation system & Raw water reservoir Ozonisation system. Please refer attached Power Supply Arrangement for PLC Based Control System.

Soft signal exchange between ozone PLC & main plant DCS is envisaged for monitoring purpose only.

All the pumps/compressors /heat exchanges shall have inlet and outlet process measurement at locals as well as in remote (PLC-OWS).

All the valves coming in sequence shall be automatic valves.

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

5.0 LAYOUT CONSIDERATION:

5.1 The Ozonisation system at Condenser, RO + CW make up Ozonisation system (oxygen generation plant, ozone generator(s), oxygen receiver, PLC, dosing pumps, Water storage tank, and chiller pumps) shall be housed in a building herein after called as Ozone Generation plant Building-1. However air receiver, air compressors and chillers shall be housed inside shed. All the outdoor panels shall be housed as per IP55.

5.2 The Raw water reservoir Ozonisation system (ozone generator(s), OWS, Water storage tanks, Oxygen receiver -3 and chiller pumps shall be housed in a separate building near Raw water pump house herein after called as Ozone Generation plant Building-2. However chillers shall be housed inside shed.

5.3 The Ozone dosing pumps for Raw water reservoir ozonisation system (dosing in each compartment of raw water reservoir & inlet line to raw water reservoir) shall be housed near Raw water storage tank. The inlet line from the common Raw water reservoir pit to ozone dosing pumps shall also be in bidder's scope. Necessary canopy etc. shall also be provided for these pumps by the bidder. All the outdoor panels shall be housed as per IP55.

5.4 Complete Air Drying Plant and Oxygen generation plant equipment shall be mounted on a skid and located indoor.

6.0 DESIGN REQUIREMENT FOR PIPING:

6.1 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
Pump delivery	3.0 m/s

Service/Potable water	1.5 m/s
Gas	
Compressed air	15 m/s

6.2 Drain and vent connections on pipelines shall be atleast of NPS 25 mm size.

6.3 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

(a) Bond/Adhesion test

(b) Holiday test

7.0 DESIGN REQUIREMENT FOR VALVES:

7.1 All gate and globe valves shall be of rising stem, outside screw and yoke type.

7.2 Check valves of sizes 400 mm NB and larger shall have dash pot arrangement.

7.3 All gate and globe valves shall have back-seating arrangement to facilitate easy replacement of packing with the valve in service.

7.4 All valves shall be so designed that the hand-wheel moves in a clockwise direction to close the valve. The face of the hand-wheel shall be clearly marked with the words 'OPEN' and 'CLOSE' and an arrow to indicate the direction for opening. All hand-wheels shall be fitted with name plate.

7.5 All gate, globe, Y-type and angle valves intended for manual operation and falling under the following categories shall be equipped with a gear operator for ease of operation and to ensure fast and tight closure:

ANSI PRESSURE RATING	**VALVE SIZES FOR WHICH GEAR OPERATOR IS REQUIRED**
Class 300 and below	350 mm and larger
Class 600 and above	200 mm and larger

7.6 All gate valves falling in the following categories shall be provided with integral bypass valve. Bypass size shall conform to MSS-SP-45 as a minimum standard unless otherwise specified. The bypass valve shall be hand operated unless otherwise specified. Pipe for bypass shall be at least Schedule 80 seamless and of a material of the same nominal chemical composition and physical properties as that used for the main line. Orientation of bypass arrangement shall be subject to the approval of BHEL/Customer.

ANSI PRESSURE RATING	**VALVE SIZES FOR WHICH BYPASS IS REQUIRED**
Class 600 and over	200 mm and larger
Class 300 & 150	350 mm and larger

7.7 All gate valves of ANSI pressure rating class 150 and 300 shall have solid or flexible wedge and ANSI pressure rating class 600 and above shall have flexible or parallel slide type of wedge.

7.8 Valves that are to be kept in full ‘OPEN’/'CLOSE' position shall be provided with a non-detachable locking arrangement.

7.9 Valves operating under vacuum conditions shall have glands with water sealing. The inlet and outlet connections shall be NB 15mm. The bidder shall indicate the maximum and minimum sealing water pressure and the required flow rate.

8.0 DESIGN REQUIREMENT FOR HORIZONTAL CENTRIFUGAL PUMPS

8.1 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.

8.2 The shut-off head shall be at least 110% of the differential head.

8.3 The required NPSH at duty point shall be at least one (1) metre less than the available NPSH.

8.4 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.

8.5 The corrosion allowance for pressure parts shall be 3 mm.

8.6 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.

8.7 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.

8.8 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 12 m.

9.0 DESIGN CONSTRUCTION OF WATER COOLED SCREW COMPRESSORS

9.1 Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.

9.2 Air compressors will be multi stage oil free, screw type,air cooled.

9.3 Testing of compressor will be as per ISO: 1217.

9.4 Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.

9.5 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.

9.6 Satisfactory operation in parallel will be ensured without any uneven load sharing, undue vibration, noise etc.

9.7 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.

9.8 Compressed air velocity shall be 10 m/sec.

9.9 Air ducting arrangement for each compressor shall also be provided by the bidder.

9.10 ROTORS

- 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.

9.11 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.

10.0 DESIGN CONSTRUCTION OF PRESSURE VESSELS AND ATMOSPHERIC TANKS:

10.1 The design pressure of all the pressure vessels shall be 8kg/cm^2 (g) minimum.

10.2 Design temperature of all pressure vessels and storage tanks shall be 10 deg. C higher than the maximum temperature that any part of the vessel/tank is likely to attain during operation.

10.3 All vessels / tanks without inside rubber lining shall have a corrosion allowance of minimum 2 mm and mill allowance (minimum 0.3 mm) for shell and dished ends. Thinning allowance of 2 mm (minimum) shall be

considered for dished end. Vessel / tanks ends shall be of dished design and constructed by forging, pressing or spinning process. Conical or flat ends shall not be accepted. All dished ends shall be stress relieved.

10.4 All the atmospheric tanks shall have sufficient free board above the “Level High”/”Normal Level” as the case may be. The overflow level shall be kept at least 20 cm or 10% of vessel height above the “Level High”/”Normal Level”. Further, a minimum 300 mm free board shall be provided above the top of overflow level to the top of the tank. Wall thickness of atmospheric tanks shall not be less than 6 mm.

10.5 All vessels of diameter 1200mm or greater shall be provided with a minimum of 4 lifting lugs. Smaller vessels shall be provided with at least 2 lifting lugs.

10.6 All internal fasteners shall be of type 316 stainless steel and heavy duty locknuts shall be used throughout.

10.7 **LINING**

All internal lining of vessels provided under this specification shall be of natural rubber, meeting the following minimum requirements.

- **Hardness**

  - Lining used may be soft rubber having a shore durometer reading or 4070 on the D scale, or semi-hard rubber having a durometer reading of 4570 on the D scale. Variations in hardness of the rubber lining between the different areas of a specific tank shall be within +/-5 durometer reading.

- **Thickness**

  - The lining shall be applied in three layers, resulting in a total thickness of not less than 4.5 mm anywhere on the internal surfaces of the vessels. The lining shall extend over the full face of all flanged connections and shall have a minimum thickness of 3 mm in all such external areas.

- **Surface Preparation**

  - Prior to rubber lining all surfaces must be prepared in the following manner.

    a) Degrease surface prior to blasting.

    b) The surface is to be blasted with steel grit or sharp silica sand to a white and bright metal surface.

    c) All traces if grit and dust should be removed with a vacuum cleaner or by brushing. Care must be taken to avoid contaminating the surface.

    d) Immediately after blasting and removal of grit, the first coat of primer or cement shall be applied and allowed to dry.

- **Protection**

  After the lining is completed the vessels shall not be subjected to any prolonged exposure to direct sunlight in course of it’s transportation erection, etc. They shall not also be stored in direct sunlight. No further welding or burning shall be carried out on the vessel, after application of the lining.

  All lining projecting outside of the vessel, shall be protected adequately from mechanical damages during shipment, handling, storage etc.

  Suitable warning, indicating the special care that must be taken with respect to these lined vessels, shall be stenciled on their outside surfaces with the letter at least 12mm high.

  Example:

  “Warning – Tank is lined”

"Do not weld or Burn"

"Do not Store in Direct Sunlight" etc.

11.0 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. All the ventilation fans alongwith ozone gas leak detectors is in Vendor's scope.

SECTION – C1-C

FUNCTIONAL / PERFORMANCE / DEMONSTRATION GUARANTEE

1.0 PG TEST PROCEDURE

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 receivers, chillers, all pumps, atmospheric tanks, analyzers, air conditioning and ventilation system, electric hoist all piping and valves, Electrical and Electronic controls including PLC etc.

1.1 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 total power consumption of the Ozone Generators, Compressors, Chillers, pumps etc at rated capacity of the respective equipment.
- 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 analyser etc.
- To measure the purity of the Oxygen and ozone gas.
- To measure residual ozone at Cooling Tower basin and Raw water reservoir. Residual ozone will be 0.02 ppm at CT basin and 0.02 ppm at Raw water reservoir.

1.2 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.

1.3 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.

2.0 PG test Process:

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

- Capacity test of Ozone generators, compressors, Oxygen generators, air driers, pumps, chillers etc.
- Checking the ability of Ozone generators, compressors, Oxygen generators, air driers, pumps, chiller etc.to operate continuously at rated capacity and rated discharge pressure.
- 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.
- Parallel operations of streams.
- Noise level and vibration of compressors.
- Power consumption.
- 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.

SECTION – C1-D

QUALITY ASSURANCE

QUALITY ASSURANCE PLAN FOR PRESSURE VESSELS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Reference Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Initial Procedure Qualifications :												
a	Welding Procedure Qualification Tests	Procedure Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPS - QW 482 & PQR - QW 483	P	V	V	**Note 1**
b	Welder Performance Qualification Tests	Performance Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPQ - QW 484	P	V	V	**Note 1**
II) Raw Material Inspection :												
a	Raw Material Identification for Shell, D/Ends, Pipes & Flanges	Verification of MTC & Chemical, Mechanical Properties	Major	Chemical & Mechanical Check	1 Per Heat / Lot	App.Drg. / Relevant code	ASME SEC II Part A for D/ends & IS 2062 for Shell	Mfr TC / Check Test Report	P	V	V	**Note 2 & 3**
b	Surface Defects	Verification of Surface	Major	Visual	100%	No Pitting / Corrosion	No Pitting & Corrosion	SIR	P	V	V	
III) Inspection of Dished Ends :												
a	Dimension & Visual Check	Dimensional Conformance, Thinning after forming & Visual	Major	Measurement & Visual	100%	App.Drg.	ASME SEC VIII / IS 4049	SIR	P	V	V	Thickness Check by De meter
b	DP Check on KR, SF & Edge	DPT	Major	Visual	100%	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
c	RT on D/end cordial seam	RT	Major	Visual	100%	ASME SEC V	ASME SEC VIII DIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
IV) In Process Inspection :												
a	Shell Fabrication	Marking, Edge Preparation, rolling & Fit up	Major	Dimensional Conformance & Root Gap	100%	App.Drg.	App.Drg.	SIR	P	V	V	
b	Joint Preparation, Weld set-ups & Nozzles fittings	Alignment & Dimensions	Major	Measurement & Visual	100%	App.Drg.	App.Drg.	SIR	P	V	V	
c	Welding of shells, shell to D/ends & nozzles	Weld Parameter	Major	Visual	100%	AWPS & ASME SEC IX	AWPS & ASME SEC IX	Log Book	P	V	V	
d	DP Check on Butt Joints & Fillet Joints	DPT	Major	Visual	100% on Butt Joints & 10% on Fillet Joints	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
e	RT on T Joints & Butt Joints	RT	Major	Visual	As per Spec. / Drg	ASME SEC V	ASME SEC VIII ADIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
f	Air Leak Test (Soap Bubble Test) for Nozzle RF Pads	Weld Soundness	Major	Visual	100%	App.Drg. / Relevant code	No Leakage / Bubbles	FIR	W	V	V	Bubble Test @ 1.05 kg/cm2 (g)

Contd…2

QUALITY ASSURANCE PLAN FOR PRESSURE VESSELS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	Bidder	BHEL	CUSTOMER	Remarks
V) Stage Inspection												
a	Dimension Check	Dimensional	Major	Measurement	100%	App.Drg.	App.Drg.	FIR	P	W	V	
b	Visual Check	Visual	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	W	V	
c	Hydro Static Pressure Test / Water Fill Test (As Applicable)	With stand of Hydro Test / Water Fill Test	Critical	Visual Inspection	100%	App.Drg.	No Leakage or Seapage	FIR	P	W	W	NOTE 4
d	Painting	DFT	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	V	V	
e	Stamping / Stenciling	To identify the Equipment	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	V	V	
f	Review of Testing and Measuring Instruments	To ensure the accuracy	Minor	Verification	100%	Calibration Certificate	National & International	TC	V	V	V	

NOTE 1: Only qualified welders & WPS to be used. In case welders are already qualified by customer / BHEL / LRIS / BVQI / DNV & doing similar jobs re-qualification is not required.

NOTE 2: Check Test shall be carried out on plates where ever corelation of TC with material is not available. Sample shall be identified & test Certificates shall be Verified by BHEL & CUSTOMER.

NOTE 3: All plates of pressure vessels shall be ultrasonically tested as follows:

(a) For nominal thickness 20 mm and higher when used for fabrication of dished ends

(b) For nominal thickness 40 mm and higher when used for fabrication of shells

(c) For nominal thickness 50 mm and higher when used for blind flanges

All thicknesses, when used for body flanges

NOTE 4: All test reports / Inspection reports related to the tank shall be furnished for BHEL / CUSTOMER review.

NOTE 5: Hydro test duration shall be 1hr at 1.5 times of design pressure or 2 times of working pressure whichever is higher & No Leakage will be permitted.

NOTE 6: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVATIONS:

TC: Test Certificate
DFT: Dry Film Thickness
W: Witness
SIR: Stage Inspection Report
App.Drg. Approved Drawing
V : Verify Documents
FIR: Final Inspection Report
P: Perform

QUALITY ASSURANCE PLAN FOR ATMOSPHERIC TANKS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Reference Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Initial Procedure Qualifications :												
a	Welding Procedure Qualification Tests	Procedure Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPS - QW 482 & PQR - QW 483	P	V	V	**Note 1**
b	Welder Performance Qualification Tests	Performance Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPQ - QW 484	P	V	V	**Note 1**
II) Raw Material Inspection :												
a	Raw Material Identification for Shell, D/Ends, Pipes & Flanges	Verification of MTC & Chemical, Mechanical Properties	Major	Chemical & Mechanical Check	1 Per Heat / Lot	App.Drg. / Relevant code	ASME SEC II Part A for D/ends & IS 2062 for Shell	Mfr TC / Check Test Report	P	V	V	**Note 2 & 3**
III) Inspection of Dished Ends :												
a	Dimension & Visual Check	Dimensional Conformance, Thinning after forming & Visual	Major	Measurement & Visual	100%	App.Drg.	ASME SEC VIII / IS 4049	SIR	P	V	V	Thickness Check by De meter
b	DP Check on KR, SF & Edge	DPT	Major	Visual	100%	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
c	RT on D/end cordial seam	RT	Major	Visual	As per Appd. Drg	ASME SEC V	ASME SEC VIII DIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
IV) In Process Inspection :												
a	Shell Fabrication	Marking, Edge Preparation, rolling & Fit up	Major	Dimensional Conformance & Root Gap	100%	App.Drg.	App.Drg.	SIR	P	V	V	
b	Joint Preparation, Weld set-ups & Nozzles fittings	Alignment & Dimensions	Major	Measurement & Visual	100%	App.Drg.	App.Drg.	SIR	P	V	V	
c	Welding of shells, shell to D/ends & nozzles	Weld Parameter	Major	Visual	100%	AWPS & ASME SEC IX	AWPS & ASME SEC IX	Log Book	P	V	V	
d	DP Check on Butt Joints & Fillet Joints	DPT	Major	Visual	100% on Butt Joints & 10% on Fillet Joints	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
e	RT on T Joints & Butt Joints	RT	Major	Visual	As per Spec. / Drg	ASME SEC V	ASME SEC VIII DIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
f	Air Leak Test (Soap Bubble Test) for Nozzle RF Pads	Weld Soundness	Major	Visual	100%	App.Drg. / Relevant code	No Leakage / Bubbles	FIR	W	V	V	Bubble Test @ 1.05 kg/cm2 (g)

Contd…2

QUALITY ASSURANCE PLAN FOR ATMOSPHERIC TANKS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
V) Stage Inspection before Rubber Lining :												
a	Dimension Check	Dimensional	Major	Measurement	100%	App.Drg.	App.Drg.	FIR	P	W	V	
b	Visual Check	Visual	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	W	V	
c	Hydro Static Pressure Test / Water Fill Test (As Applicable)	With stand of Hydro Test / Water Fill Test	Critical	Visual Inspection	100%	App.Drg.	No Leakage or Seapage	FIR	P	W	W	NOTE 4
f	Painting	DFT	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	V	V	
g	Stamping / Stenciling	To identify the Equipment	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	V	V	
h	Review of Testing and Measuring Instruments	To ensure the accuracy	Minor	Verification	100%	Calibration Certificate	National & International Standards	TC	V	V	V	

NOTE 1: Only qualified welders & WPS to be used. In case welders are already qualified by customer / BHEL / LRIS / BVQI / DNV & doing similar jobs re-qualification is not required.

NOTE 2: Check Test shall be carried out on plates where ever corelation of TC with material is not available. Sample shall be identified & test Certificates shall be Verified by BHEL/CUSTOMER.

NOTE 3: All test reports / Inspection reports related to the tank shall be furnished for BHEL / CUSTOMER review.

NOTE 4: Hydro test duration shall be 1hr at 1.5 times of design pressure or 2 times of working pressure whichever is higher & No Leak shall be permitted.

NOTE 5: For Rubber Lining refer separate QAP. Rubber Lining shall be carried out after Hydro Test and clearance from BHEL.
NOTE 6: Hydro test will be conducted before Rubber Lining.
NOTE 7: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVATIONS:

TC: Test Certificate
DFT: Dry Film Thickness
W: Witness
SIR: Stage Inspection Report
App.Drg. Approved Drawing
V : Verify Documents
FIR: Final Inspection Report
P: Perform

QUALITY ASSURANCE PLAN FOR RUBBER LINNING

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of	Reference Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
I) RUBBER SHEET :												
a	Rubber Sheet Inspection	Surface and Thickness check	Major	Visual & Measurement	100%	App.Drg.	App.Drg	SIR	P	V	V	
b	Tensile Strength & % Elongation	Strength	Major	Mechanical Test	1 Sample per Batch	IS 3400 Part 1	TS > 120 kg/cm2 & Elongation > 350%	TC	P	V	V	
c	Resistance to Bleeding Test	Resistivity	Major	Chemical Test	1 Sample per Batch	IS 3400 Part 1	No Discoloration & Weight gain limit -0% to +2%	TC	P	V	V	**Note 1**
II) IN PROCESS INSPECTION												
a	Surface Preparation	Blast Clean Surface free from foreign matls.	Major	Visual Inspection	100%	App.Drg. / IS4682	App.Drg / IS4682	SIR	P	V	V	
b	Adhesive Coat I	--	Major	Visual Inspection	100%	App.Drg. / IS4682	App.Drg / IS4682	SIR	P	V	V	
c	Adhesive Coat II	--	Major	Visual Inspection	100%	App.Drg. / IS4682	App.Drg / IS4682	SIR	P	V	V	
d	Continuity of Lining	Spark Test	Major	Visual Inspection	100%	App.Drg. / IS4682	No spark at 5KV / mm of lining thk	FIR	P	V	V	
e	Curing of Rubber Lining	Control of Pressure / Temperature / Time of Steam / Water	Major	Measurement & visual	100%	IS4682	IS4682 Part 1	Log book	P	V	V	
III) FINAL INSPECTION FOR LINED VESSELS												
a	Visual Check	Visual	Major	Visual Inspection	100%	App.Drg.	App.Drg / IS4682	FIR	P	W	V	
b	Adhesion Test	Adhesion Strength*	Critical	Measurement & visual	100%	App.Drg. / IS4682	IS 4682 Part 1	FIR	P	W	V	*1 test piece per lot
c	Thickness Verification	Thickness	Major	Measurement	Random	App.Drg.	Thk Tolerance = -10% to +15%	FIR	P	W	V	
d	Hardness Check	Hardness Shore A	Major	Visual Inspection	100%	App.Drg. / IS4682	App.Drg	FIR	P	W	V	
e	Continuity of Lining	Spark Test	Major	Visual Inspection	100%	App.Drg. / IS4682	No spark at 5KV / mm of lining thk	FIR	P	W	V	
f	Review of Testing and Measuring	To ensure the accuracy	Minor	Verification	100%	Calibration Certificate	National & Intl. Standards	TC	V	V	V	

NOTE 1: **Sample to be kept in 33% HCl, 48% NaOH & DM Water for 72Hrs at 50 Deg C and shall pass as per Acceptance standard.**

NOTE 2: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVATIONS:

TC:	Test Certificate	SIR:	Stage Inspection Report	FIR:	Final Inspection Report	P:	Perform
DFT:	Dry Film Thickness	App.Drg.	Approved Drawing	RW:	Random Witness	R:	Review
W:	Witness	V :	Verify Documents				

QUALITY ASSURANCE PLAN FOR CENTRIFUGAL PUMPS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Raw Material Inspection :												
a	Raw Material Identification for Casing, Impeller, Shaft, Casing Wearing ring & Shaft sleeve.	Chemical Analysis & Mechanical Tests	Major	Chemical Analysis & Mechanical Tests	1 Per Heat / Lot	App.Drg. / Relevant code	App.Drg. / Relevant code	Mfr TC / IR	P	V	V	**Note 1 & 3**
b	Check for Surface defects and Dimensional conformity of the Raw materials.	Dimensional & Visual	Major	Visual & Measurement	100%	App.Drg. / Relevant code	App.Drg. / Relevant code	Mfr TC / IR	P	V	V	
c	Motors	Speed, Power, IP, Mounting Type	Major	Visual	100%	As Per IS 325	Relevant code	Routine Test Report	R	V	V	
II) In Process Inspection :												
a	Machining of Casings, Impeller	Dimensions & Alignment	Major	Visual & Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg	SIR	P	V	V	
b	DP Check on Machined Surface	DPT	Major	Visual	100%	ASME SEC V	ASME SEC VIII & Appendix 8	SIR	P	V	V	
c	Hydro test for casings	With stand of Hydro Static	Critical	Hydro	100%	Appd. Drg & Data Sheet / IS 5120	Appd. Drg & Data Sheet / IS 5120 & No Leakage	SIR	P	W	V	**Note 4**
d	Dynamic Balancing of Impeller	Dynamic / Static Balancing	Critical	Visual & Measurement	100%	ISO 1940 Gr.6.3	Relevant code	SIR	P	V	V	
e	Assembly of Pump	Alignment, Fitment	Major	Visual & Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg	--	P	V	V	
III) Final Inspection :												
a	Dimension Check	Dimensions	Major	Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg	FIR	P	W	V	**NOTE 5**
b	Performance Test (With Job Motor)	Capacity vs Head, Capacity vs Power and Capacity vs Efficiency	Major	Measurement	100%	Appd. Drg & Data Sheet / HIS	Appd. Drg & Data Sheet / HIS	PTR	P	W	W	
		Temperature raise in Oil & Bearing Hsg.	Critical	Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet		P	W	W	
		Vibration & Noise Level	Major	Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet		P	W	W	
c	Strip Down Test	Wear & Tear(In case of Unusual vibration)	Major	Visual / Strip test	100%	IS 5120	As per IS 5120	FIR	P	W	V	
d	Rotor Run out Test	Alignment	Major	Visual & Measurement	100%	IS 5120	As per IS 5120	FIR	P	W	V	

Contd…2

QUALITY ASSURANCE PLAN FOR CENTRIFUGAL PUMPS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
IV) Painting :												
a	Surface Preparation	Roughness / Free from foreign matls.	Major	Visual	100%	Approved Drg. & Data Sheet	Approved Drg. & Data Sheet	SIR	P	V	V	
V) Stamping / Stenciling :												
a	Identification	To identify the Equipment	Major	Visual	100%	Approved Drg. & Data Sheet	Approved Drg. & Data Sheet	SIR	P	V	V	
VI) Testing and Measuring Equipment :												
a	Calibration status of equipments	To ensure the accuracy	Major	Verification	100%	National & Intl Standards	National & Intl Standards	Calibration Certificates	P	V	V	

NOTE 1: UT shall be carried out for plates thickness 20mm and above & Forgings 50mm dia and above.
NOTE 3: MTC shall be provided for metallic parts.
NOTE 4: Hydro Test on casings shall be carried out at 2 times of rated head or 1.5 times of shut off head which ever is higher and the test pressure shall be maitained for 30 minutes & No Leakage shall be permitted.
NOTE 5: The duration of performance test shall be minimum 1 hour.
NOTE 6: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVATIONS:

TC:	Test Certificate	SIR:	Stage Inspection Report	FIR:	Final Inspection Report	P:	Perform
PTR:	Performance Test Report	Appd. Drg.	Approved Drawing	RW:	Random Witness	R:	Review
W:	Witness	V :	Verify Documents	Mft's Std.	Manufacturer's Standard		

QUALITY ASSURANCE PLAN FOR CHECK VALVES

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	SCOPE OF CHECK			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Raw Material Inspection :												
a	Material identification for Body, Plate Castings	Material Properties	Major	Chemical & Mechanical	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	FOUNDARY TC/COC	P	V	V	
			Major	Physical	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	FOUNDARY TC/COC	P	V	V	
			Major	Dimension & Surface Check	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Inspection Reports	P	V	V	
b	Hinge/ Stop Pin	Material Properties	Major	Chemaical Analysis	1 sampel per Heat number	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	MTC/COC	P	V	V	
			Major	Visual Inspection	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Inspection Report	P	V	V	
c	Spring	Material Properties	Major	Chemaical Analysis	1 sampel per Heat number	Relevant Mtrl.specs	Relevant Mtrl.specs	MTC/COC	P	V	V	
II) In Process Inspection :												
a	Body & Plate Machining	Dimensions	Major	Measurement	Sample	Manufacturing drng	Manufacturing drng	SIR	P	V	V	
		Finish	Major	Visual	100%	Manufacturing drng	Manufacturing drng	-	P	V	V	
		DPT	Major	Visual	100%	As per ASME Sec V.	As per ASME Sec V.	DPT Report	P	V	V	
b	Rubber Lining on body	Vulcanising Soundness	Major	Visual, Spark leak Test & Hardness	100%	As per Procudure for Rubber Linign	As per Procudure for Rubber Linign	Inspection Report	P	V	V	
III) Final Inspection :												
a	Assembly of Valve	Dimensions & Overall Finishing	Major	Measurement	100%	Appd.Drg/Datas sheet.	Appd.Drg/Dtas sheet.	FIR	W	V	V	
b	Hydrostatic Test	Body Hydro Test	Major	Pr.Test Hydro	100%	Appd.Drg/Datas sheet/No Leakage. API 598	Appd.Drg/Datas sheet/No Leakage. API 598	FIR	W	W	W	Test pressure and duration is to be mentioned
		Seat Hydro Test	Major	Pr.Test Hydro	100%	Appd.Drg/Datas sheet/No Leakage. API 598	Appd.Drg/Datas sheet/No Leakage. API 598	FIR	W	W	W	Test pressure and duration is to be mentioned
c	Performance Test	Smooth Operation of Plates	Critical	Operational(open-close)	100%	Appd. Drg & Data Sheet, API 594 / API 598	Appd. Drg & Data Sheet, API 594 / API 598	FIR	W	W	W	
d	Surface Preparation	Painting	Major	Visual	100%	Appd.Drg/Data sheet.	Appd.Drg/Data sheet.	Test Certificate	W	V	V	

NOTE 1: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVATIONS:

TC: Test Certificate
SIR: Stage Inspection Report
FIR: Final Inspection Report
P: Perform
W: Witness
Appd. Drg. Approved Drawing
V : Verify Documents
COC: Certificate of Compliance

QUALITY ASSURANCE PLAN FOR BUTTERFLY VALVES (MANUAL / ACTUATED)

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	SCOPE OF CHECK			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Raw Material Inspection :												
a	Material identification for Body, Disc & Wetted Parts	Mechanical & chemical Property Check	Major	Verification with respect stds	100%	Appd. drg., Appd. Data Sheet & Relevant code	Appd. drg., Appd. Data Sheet & Relevant code	Mfr. TC or Check Test Report	P	V	V	**Note 1 & 2**
b	Receiving Inspection of Bought outs	Visual Defects	Major	Verification with respect stds & Visual Check	100%	Appd. drg. & Relevant code	Appd. drg. & Relevant code	Receiving Inspection	P	V	V	
II) In Process Inspection :												
a	Machining of Body, Disc ,Components &Actuators.	Dimensions & Alignment	Major	Visual & Measurement	100%	App.Drg.	App.Drg.	SIR	P	V	V	
b	DP Check on Machined Surface & Actuators	Surface Defects	Major	Visual	100%	ASME SEC V	ASME SEC VIII	DP Report	P	V	V	
III B) Assembly Check :												
a	Assembly of Valves	Verification of all stages	Major	Verification with equipment drg	100%	Assy. Procedure, Equip. drg & Appd. Data Sheet	Assy. Procedure, Equip. drg & Appd. Data Sheet	--	P	V	V	
b	Assembly of Actuators	Verification of all stages	Major	Verification with Appd. Drg	100%	Assy. Procedure, Appd. drg & Appd. Data Sheet	Assy. Procedure, Appd. drg & Appd. Data Sheet	--	P	V	V	
IV) Final Inspection :												
a	Dimension Check	Dimensions	Major	Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	V	V	
b	Operational Check	Smooth Movement	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	W	
c	Pneumatic Test for Valve Seat	Leakage Proof	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	V	V	
d	Hydro Static Pressure Test on Seat & Body	With stand of Hydro Static & Leak Proof	Critical	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	W	**Note 3 & 4**
e	Actuator performance (Job Actuator)	Leak tightness,Accuracy& simulation(Air to open/close)	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	W	
V) Painting :												
a	Surface Preparation	Roughness / Free from foreign matls.	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	SIR	P	V	V	
VI) Stamping / Stenciling :												
a	Identification	To identify the Equipment	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	SIR	P	V	V	
VII) Testing and Measuring Equipment :												
a	Calibration status of equipments	To ensure the accuracy	Major	Verification	100%	National & Intl Standards	National & Intl Standards	Calibration Certificates	P	V	V	

NOTE 1 : UT shall be carried out for plates thickness 20mm and above & Forgings 50mm dia and above (Only for Metallic).
NOTE 2: MTC shall be provided for metallic parts.
Note 3: Hydrostatic test for seat and body-1.1 X Maximum working pressure for seat and 1.5 X Maximum working pressure for shell& No Leakage will be permitted.
Note 4: Seat Leakage Test should be done in both the directions
Note 5: Proof of Design and Disc strength as per AWWAC-504 requirements needs to be conducted.
NOTE 6: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHE

ABBREVATIONS:

TC: Test Certificate SIR: Stage Inspection Report FIR: Final Inspection Report P: Perform
W: Witness Appd. Drg. Approved Drawing V : Verify Documents UT: Ultrasonic Testing

QUALITY ASSURANCE PLAN FOR BALL VALVES (MANUAL / ACTUATED)

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	SCOPE OF CHECK			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Raw Material Inspection :												
a	Material identification for Body,Ball,&stem.	Material Properties	Major	Chemical+Mechanical	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	FOUNDARY TC/COC	P	V	V	
			Major	Physical	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	FOUNDARY TC/COC	P	V	V	
II) In Process Inspection :												
a	Body,Ball & Stem	Dimensions	Major	Measurement	Sample	Manufacturing drng	Manufacturing drng	SIR	P	V	V	
		Finish	Major	Visual	100%	Manufacturing drng	Manufacturing drng	-	P	V	V	
		UT for shaft (Dia>50 mm)	Critical	Visual &Measurement	100%	ASTM A388	BE>80 & DE<20%	Test Report	P	V	V	
III) Final Inspection :												
a	Assembly of Valve	Dimensions	Major	Measurement	100%	Appd.Drg/Dtas sheet.	Appd.Drg/Dtas sheet.	FIR	W	V	V	
b	Operational Check	Smooth Movement	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	V	
c	Pneumatic Test for Valve Seat	Leakage Proof	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	V	
d	Hydro Static Pressure Test on Seat & Body	Body Hydro Test	Major	Pr.Test Hydro	100%	Appd.Drg/Dtas sheet/No Leakage.	Appd.Drg/Dtas sheet/No Leakage.	FIR	W	W	V	Note 1
		Seat Hydro Test	Major	Pr.Test Hydro	100%	Appd.Drg/Dtas sheet/No Leakage.	Appd.Drg/Dtas sheet/No Leakage.	FIR	W	W	V	Note 1
e	Actuator performance (Job Actuator)	Leak tightness,Accuracy& simulation(Air to	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	V	
f	Surface Preparation	Painting	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	Test Certificate	V	V	V	

Note 1: Hydrostatic test for seat and body-1.1 X Maximum working pressure for seat and 1.5 X Maximum working pressure for shell & No Leakage will be permitted.

NOTE 6: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVATIONS:

TC: Test Certificate
SIR: Stage Inspection Report
FIR: Final Inspection Report
P: Perform
W: Witness
Appd. Drg. Approved Drawing
UT: Ultrasonic Testing
V : Verify Documents

QUALITY ASSURANCE PLAN FOR OZONE GENERATOR

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Reference Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Initial Procedure Qualifications :												
a	Welding Procedure Qualification Tests	Procedure Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPS - QW 482 & PQR - QW 483	P	V	V	**Note 1**
b	Welder Performance Qualification Tests	Performance Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPQ - QW 484	P	V	V	**Note 1**
II) Raw Material Inspection :												
a	Raw Material Identification for Shell, D/Ends, Pipes & Flanges	Verification of MTC & Chemical, Mechanical Properties	Major	Chemical & Mechanical Check	1 Per Heat / Lot	App.Drg. / Relevant code	ASME SEC II Part A for D/ends & IS 2062 for Shell	Mfr TC / Check Test Report	P	V	V	**Note 2 & 3**
b	Surface Defects	Verification of Surface	Major	Visual	100%	No Pitting / Corrosion	No Pitting & Corrosion	SIR	P	V	V	
III) Inspection of Dished Ends :												
a	Dimension & Visual Check	Dimensional Conformance, Thinning after forming & Visual	Major	Measurement & Visual	100%	App.Drg.	ASME SEC VIII / IS 4049	SIR	P	V	V	Thickness Check by De meter
b	DP Check on KR, SF & Edge	DPT	Major	Visual	100%	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
c	RT on D/end cordial seam	RT	Major	Visual	100%	ASME SEC V	ASME SEC VIII DIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
IV) In Process Inspection :												
a	Shell Fabrication	Marking, Edge Preparation, rolling & Fit up	Major	Dimensional Conformance & Root Gap	100%	App.Drg.	App.Drg.	SIR	P	V	V	
b	Joint Preparation, Weld set-ups & Nozzles fittings	Alignment & Dimensions	Major	Measurement & Visual	100%	App.Drg.	App.Drg.	SIR	P	V	V	
c	Welding of shells, shell to D/ends & nozzles	Weld Parameter	Major	Visual	100%	AWPS & ASME SEC IX	AWPS & ASME SEC IX	Log Book	P	V	V	
d	DP Check on Butt Joints & Fillet Joints	DPT	Major	Visual	100% on Butt Joints & 10% on Fillet Joints	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
e	RT on T Joints & Butt Joints	RT	Major	Visual	As per Spec. / Drg	ASME SEC V	ASME SEC VIII ADIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
f	Pneumatic Test	Pressure Test	Major	Measurement	100%	App.Drg. / Relevant code	App.Drg. / Relevant code	Test Certificates, Inspection Reports	W	V	V	Bubble Test @ 1.05 kg/cm2 (g)

Contd…2

QUALITY ASSURANCE PLAN FOR OZONE GENERATOR

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	Bidder	BHEL	CUSTOMER	Remarks
V) Stage Inspection												
a	Dimension Check	Dimensional	Major	Measurement	100%	App.Drg.	App.Drg.	FIR	P	W	V	
b	Visual Check	Visual	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	W	V	
c	Hydro Static Pressure Test	With stand of Hydro Test	Critical	Visual Inspection	100%	App.Drg.	No Leakage or Seapage	FIR	P	W	W	NOTE 5
d	Stamping / Stenciling	To identify the Equipment	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	V	V	
e	Review of Testing and Measuring Instruments	To ensure the accuracy	Minor	Verification	100%	Calibration Certificate	National & International	TC	V	V	V	

NOTE 1: Only qualified welders & WPS to be used. In case welders are already qualified by customer / BHEL / LRIS / BVQI / DNV & doing similar jobs re-qualification is not required.

NOTE 2: Check Test shall be carried out on plates where ever corelation of TC with material is not available. Sample shall be identified & test Certificates shall be Verified by BHEL & CUSTOMER.

NOTE 3: All plates of pressure vessels shall be ultrasonically tested as follows:

(a) For nominal thickness 20 mm and higher when used for fabrication of dished ends

(b) For nominal thickness 40 mm and higher when used for fabrication of shells

(c) For nominal thickness 50 mm and higher when used for blind flanges

All thicknesses, when used for body flanges

NOTE 4: All test reports / Inspection reports related to the tank shall be furnished for BHEL / CUSTOMER review.

NOTE 5: Hydro test duration shall be 1hr at 1.5 times of design pressure or 2 times of working pressure whichever is higher & No Leakage will be permitted.

NOTE 6: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVATIONS:

TC: Test Certificate
DFT: Dry Film Thickness
W: Witness
SIR: Stage Inspection Report
App.Drg. Approved Drawing
V : Verify Documents
FIR: Final Inspection Report
P: Perform

QUALITY ASSURANCE PLAN FOR COMPRESSORS

SR. NO.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD		AGENCY			REMARKS
											M	C	N	
1	2	3	4	5	6		7	8	9	D	10			11
					M	C/N								
A	MATERIAL INSPECTION													
1.1	ROTOR	PHYSICAL PROPERTIES	MAJOR	MECH. TEST	1/ BATCH		APPD DRG/DATA SHEET	IN COMPLIANCE WITH "7"	EN 10204-CI-2.2	√	V	V	V	A- AIRPOWER
		CHEMICAL COMPOSITION	"	CHEMICAL ANALYSIS			"	"						
		HARDNESS	"	HARDNESS CHECK			"	"						
		INTERNAL DEFECTS	CRITICAL	ULTRASONIC TESTING	100%		AC STANDARD	AC STANDARD	COC	√	V	V	V	A- AIRPOWER
		DIMENSION	MAJOR	MEASUREMENT	100%		MFG DRG	MFG DRG	Log book		V	V	-	
1.2	COMPRESSOR CASING / ROTOR HOUSING	CHEMICAL COMPOSITION	MAJOR	CHEMICAL ANALYSIS	1/BATCH		APPD DRG/DATA SHEET	IN COMPLIANCE WITH "7"	EN 10204-CI-2.2	√	V	V	V	A- AIRPOWER
		DIMENSION	MAJOR	MEASUREMENT	100%		MFG DRG	MFG DRG	Log book		V	V	-	
1.3	TIMING GEARS	PHYSICAL PROPERTIES	MAJOR	MECH. TEST	1/ BATCH		APPD DRG/DATA SHEET	IN COMPLIANCE WITH "7"	EN 10204-CI-2.2	√	V	V	V	A- AIRPOWER
		CHEMICAL COMPOSITION	"	CHEMICAL ANALYSIS			"	"						
		HARDNESS	"	HARDNESS CHECK			"	"						
		DIMENSION	MAJOR	MEASUREMENT	100%		MFG DRG	MFG DRG	Log book		V	V	-	
1.4	STEP UP GEARS	PHYSICAL PROPERTIES	MAJOR	MECH. TEST	1/ BATCH		APPD DRG/DATA SHEET	IN COMPLIANCE WITH "7"	EN 10204-CI-2.2	√	V	V	V	A- AIRPOWER
		CHEMICAL COMPOSITION	"	ANALYSIS			"	"						
		HARDNESS	"	HARDNESS CHECK			"	"						
		DIMENSION	MAJOR	MEASUREMENT	100%		MFG DRG	MFG DRG	Log book		V	V	-	
1.5	DRIVE SHAFT	PHYSICAL PROPERTIES	MAJOR	MECH. TEST	1/ BATCH		APPD DRG/DATA SHEET	IN COMPLIANCE WITH "7"	EN 10204-CI-2.2	√	V	V	V	A- AIRPOWER
		CHEMICAL COMPOSITION	"	CHEMICAL ANALYSIS			"	"						
		HARDNESS	"	HARDNESS CHECK			"	"						
		INTERNAL DEFECTS	CRITICAL	ULTRASONIC TESTING	100%		AC STANDARD	AC STANDARD	COC	√	V	V	V	A- AIRPOWER
		DIMENSION	MAJOR	MEASUREMENT	100%		MFG DRG	MFG DRG	Log book		V	V	-	
1.6	INTERCOOLER TUBES AFTER COOLER TUBES INTERCOOLER SHELL AFTER COOLER SHELL	MATERIAL CHECK	MAJOR	COMPOSITION TENSILE STRENGTH	1/ BATCH		APPD DRG/DATA SHEET	IN COMPLIANCE WITH "7"	COC	√	V	V	V	A- AIRPOWER
1.7	OIL COOLER PLATE TYPE	MATERIAL CHECK	MAJOR	COMPOSITION TENSILE STRENGTH	1/BATCH		APPD DRG/DATA SHEET	IN COMPLIANCE WITH "7"	COC	√	V	V	V	A- AIRPOWER
		DIMENSION CHECK	MAJOR	MEASUREMENT	100%		MFG DRG	MFG DRG	Log book		V	V	-	

LEGEND: * Records indentified with " Tick" ( ) shall be essentially included by supplier in QA documentation.
** M: Manufacturer / Sub Supplier C: Supplier nominated inspection agency, N: RPCL , P: Perform, W: Witness and V: Verification
As appropriate.CHP: RPCL : Shall identify in column "N"

QUALITY ASSURANCE PLAN FOR COMPRESSORS

SR. NO.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY				REMARKS
											M	C	N	
1	2	3	4	5	6		7	8	9	D	10			11
					M	C/N								
B	INPROCESS INSPECTION													
2.1	OIL COOLERS INTERCOOLER AFTERCOOLER	TIGHTNESS	MAJOR	HYDROSTATIC	100%		1.5 X DESIGN PRESSURE FOR 5 MIN.	NO LEAKAGE	COC (SEE NOTE2)	√	V	V	V	A- AIRPOWER
2.2	SAFETY VALVE	SET PRESSURE	MAJOR	MEASUREMENT	100%		AC STANDARD	AC STANDARD	COC	√	V	V	V	A- AIRPOWER
2.3	ROTOR ELEMENT	SURFACE FINISH	MAJOR	VISUAL	100%		AC STANDARD	AC STANDARD	COC	√	P/V	V	V	A- AIRPOWER
		COATING QUALITY	MAJOR	MEASUREMENT	100%		AC STANDARD	AC STANDARD	COC	√	P/V	V	V	A- AIRPOWER
		DYNAMIC BALANCING	MAJOR	BALANCING	100%		ISO 1940	ISO 1940 (grade 6.3 OR BETTER)	COC (SEE NOTE 3)	√	P/V	V	V	A- AIRPOWER
2.4	COMPRESSOR CASING / ROTOR HOUSING LP & HP	DIMENSION CHECK	MAJOR	MEASUREMENT	100%		APPROVED DRG/ MFG DRG	IN COMPLIANCE WITH "7"	COC	√	P/V	V	V	A- AIRPOWER
		TIGHTNESS	MAJOR	HYDROTEST	100%		HYDROTEST 1.5 X DESIGN PR	NO LEAKAGE	COC (SEE NOTE2)	√	P/V	V	V	A- AIRPOWER
2.5	AIR ENDS [HP & LP MODULE	RUN TEST- FAD, LEAKAGE, ABNORMAL NOISE	MAJOR	FAD LEAKAGE ABNORMAL NOISE	100%		AIRPOWER STDS. / ISO 1217	IN COMPLIANCE WITH "7"	COC	√	P	V	V	A- AIRPOWER
2.6A	ELECTRONIKON MICROPROCESSOR MODULE	FUNCTIONAL INTERLOCKS ALARMS	MAJOR	FUNCTIONAL TEST	100%		INT.DRAWING	IN COMPLIANCE WITH "7"	COC	√	V	V	V	A- AIRPOWER
2.6B	CONTROL PANEL (ELECTRONIKON + ** CONTACTORS + ** WIRING HARNESS)	FUNCTIONAL CHECK : DISPLAY, INTERLOCKS, ALARMS ETC HV & IR	MAJOR	MEASUREMENT	100%		APPRD DRG/ INT.DRAWING	APPRD DRG/ INT.DRAWING	INSP REPORT	√	P	V	V	** B - AC INDIA
2.7	OIL FILTER AIR FILTER	FITMENT / APPEARANCE	MAJOR	VISUAL	1/BATCH		INT.DRAWING	INT.DRAWING	COC	√	V	V	V	A- AIRPOWER
	THROTTLE VALVE	PERFORMANCE		VERIFICATION	1/BATCH				COC	√	V	V	V	A- AIRPOWER
	OIL PUMP	PERFORMANCE		VERIFICATION	100%				COC	√	V	V	V	A- AIRPOWER
2.8	CANOPY	COMPLETENESS	MAJOR	VISUAL	100%		APPRD DRG/ INT.DRAWING	APPRD DRG/ INT.DRAWING	INSP REPORT	√	P	V	V	B - AC INDIA
	BASE FRAME	DIMENSIONS		MEASUREMENT	100%		"	"						
	VENTILATION FAN	FUNCTIONAL CHECK					INT.DRAWING	PROPER MOUNTING						

LEGEND: " Records indentified with " Tick" ( ) shall be essentially included by supplier in QA documentation.
** M: Manufacturer / Sub Supplier C: Supplier nominated inspection agency, N: RPCL P: Perform, W: Witness and V: Verification.
As appropriate CHP: RPCL Shall identify in column "N"

QUALITY ASSURANCE PLAN FOR COMPRESSORS

SR. NO.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY				REMARKS
											M	C	N	
1	2	3	4	5	6		7	8	9	D	10			11
					M	C/N								
C	FINAL INSPECTION													
3.0	OVERALL ASSLY. ALONG WITH MOTOR, CONTROL PANEL AND OTHER ACC	DIMENSION COMPLETENESS	MAJOR	MEASUREMENT VISUAL	100%	100%	APPROVED DRG	APPROVED DRG	INSP. REPORT	√	P	W	W	B-AC INDIA
		TIGHTNESS OF AIR/OIL/WATER LINE	MAJOR	VISUAL	100%	100%	NO LEAKAGE	NO LEAKAGE	INSP. REPORT	√	P	W	W	B- AC INDIA
3.1	RUN TEST AND PERFORMANCE TEST	FREE AIR DELIVERY AIR OUTLET PRESSURE SPECIFIC POWER NOISE & VIBRATIONS (SEE NOTE 5)	CRITICAL	OPERATION & CONFORMANCE	100%	100%	APPD. DATA SHEETS / DRGS & ISO 1217	APPD. DATA SHEETS / DRGS	INSP. REPORT	√	P	W	W	CHP- TESTING WITH CONTRACT MOTOR AND CONTROL PANEL AT AC INDIA Sveanagar, Dapodi Pune 411012
D	PACKING AND DESPATCH													
4	PACKING SHIPPING	PACKING AND TRANSPORTATION	MAJOR	VERIFICATION	100%		AS PER PACKING PROCEDURE	AS PER PACKING PROCEDURE	ALL SHIPPING DOCUMENTS		P/V	V	-	B - AC INDIA

REMARKS
A- PERFORMED / ISSUED BY BIDDER
B- PERFORMED / ISSUED BY BIDDER

NOTE 1	MATERIAL SHALL BE AS PER APPROVED DRG/TDS. INCASE NOT MENTIONED IN APPROVED DRG/TDS THEN AC STANDARDS SHALL BE APPLICABLE
NOTE 2	SPECIFIC CONFIRMATION FROM AIRPOWER REGARDING THE HYDROTEST PRESSURE
NOTE 3	SPECIFIC CONFIRMATION FROM AIRPOWER REGARDING THE BALANCING STD AND THE GRADE OF BALANCING
NOTE 4	EN 10204 CL 2.2 CERTIFICATE : DOCUMENT IN WHICH MANUFACTURER DECLARES THAT THE PRODUCTS SUPPLIED ARE IN COMPLIANCE WITH THE REQUIREMENTS OF THE ORDER AND IN WHICH HE SUPPLIES TEST RESULTS BASED ON NON SPECIFIC INSPECTION
NOTE 5	NOISE & VIBRATION MEASURED AT SHOP FOR REFERENCE PURPOSE. HOWEVER VALUES SHALL BE DEMONSTRATED AT SITE, AS PER APPROVED TDS
NOTE 6	DRIVE MOTOR INSPECTION AND TESTING AS PER SEPARATE APPROVED QP
NOTE 7	CALIBRATION STATUS OF MEASURING INSTRUMENTS USED FOR PERFORMANCE TESTING SHALL BE VERIFIED DURING INSPECTION

NOTE 8 The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

SECTION – C1-E

PAINTING SPECIFICATION

1.0 SCOPE

1.1 This section covers the painting requirements for the Ozone generation plant as applicable.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job:

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of piplines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:6278	:	Code of practice for white washing and colour Washing
IS:3140	:	Code of practice for painting asbestos cement building products
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and heat resisting
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS: 2932	:	Enamel , synthetic, exterior (a) undercoating (b) finishing

3.0 PREPARTION OF SURFACES

All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale , dust , rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out sand scrapping may be permitted with steel wire brushes and /or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the CUSTOMER /CUSTOMER RESPRESENTATIVE. The sheet steel of electrical and instrumentation panels shall be pre-treated through chemical cleaning (7 tank) process of rinsing, degreasing, rinsing, derusting, rinsing, phosphating and rinsing. However, in case mechanical cleaning is also required Bidder shall carry out the same to get a smooth finish.

4.0 PRIMER PAINT

After the surface is prepared one coat of Zinc Phosphate primer conforming to IS 2074 shall be applied. After this first coat is dried up completely, second coat of primer shall be applied. Primer shall be applied by brushing, spray, roller as per manufacture recommendation to ensure a continuous film. The dry film thickness of each coat shall be as indicated in Annexure-A enclosed. Insulated surfaces will have only primer coating and no finish painting.

5.0 **FINISH PAINT**

Synthetic enamel paint conforming to IS 2932 shall be used for finish coats. The colour /shade shall be as approved by BHEL/Customer. After cleaning the dust on the dried up primer, first coat of synthetic enamel shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint shall be applied.

6.0 **PAINTING AND CORROSION PROTECTION FOR PIPES & FITTINGS**

6.1 All uninsulated piping systems, hangers and supports shall have two coats of Zinc Phosphate Primer (conforming to IS 2074) and finish paint using synthetic enamel paint to give a finish coat. Shades shall be as per IS 5 or as indicated by BHEL/Customer. Service of the pipeline designations shall be painted on all pipes at visible locations.

6.2 Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot grease, rust etc.

6.3 All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint.

6.4 Shop fabricated equipment/items shall be dispatched with final paint. Necessary touch up shall be done at site. Site fabricated equipment/items shall be dispatched with primer painting only and final painting shall be applied at site.

7.0 **PAINTING AND CORROSION PROTECTION FOR VALVES & SPECIALTIES**

Two coats of primer of thickness as indicated in Annexure-A shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion before dispatch. The use of grease or oil, other than light grade mineral oil, for corrosion protection is prohibited. Bores of all vales shall be covered immediately after testing, draining and drying with suitable plastic end covers to avoid ingress of foreign materials.

8.0 **Suggested Colour Codes for Painting**

Suggested colour codes has been enclosed for adherence. Colour codes for piping shall be as per IS 2379 with necessary modifications. Where band colour is specified for piping, same shall be provided at 30 metre intervals on long uninterrupted lines and also adjacent to valves and junctions.

9 <u>PAINTING SCHEDULES</u>

9.1 Painting schedules for various systems/ items are furnished as per enclosed Annexures-A . Vendors will furnish detailed painting schedule for customer approval during detail engineering stage as per specification.

ANNEXURE - A

Paint Reference Scheme	Surface Preparation Grade / Surface Profile	Primer Coat			Intermediate Coat			Finish Coat			Total DFT in microns
		Premier Paint	No. of Coats	DFT in Microns	Intermediate Paint	No. of Coats	DFT in Microns	Finish Paint (See Note)	No. of Coats	DFT in Microns	
Various type of equipment /valve, etc. (Temp. upto 90°C)	Degreasing and Mech. Cleaning with wire brushing/hand tool (Sa1/St2/St3 as applicable)	HB Zinc Phosphate (alkyd Medium) as per IS:2074	2	35-45 per coat	- NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110 - 140
LP Piping/structurals/ Vessels, etc. (Temp. upto 90°)	- do -	HB Zinc Phosphate as per IS:2074 (alkyd medium)	2	35 – 45 per coat	- NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110-140
Equipment with (Temp. upto 250°)	- do -	Heat resistant Al – paint	2	20 per coat	- NA	-	-	NA	Insulated	NA	40
Equipment in corrosive areas.	Blast clean to Sa $2^1/2$	HB Epoxy resin based zinc phosphate primer	1	50 per coat	Epoxy based MIO pigmented paint	1	50 per coat	Polyamide cured Epoxy finish coat	2	25 – 35 per coat	150 - 170
Elect. / Control Panels, etc.	Seven tank process	HB Zinc phosphate (alkyd Medium) as per IS:2074	2	35 – 45 per coat	-NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110 - 140

Notes:

1. Surface preparation shown is as per Swedish Standards SIS 05-5900 or equivalent Indian std. Degreasing will be as per Standard SSPC-SP1.
2. Incase of insulated surfaces, only primer coats shall be applied.
3. GM/SS items with piping and G.I. pipes will not be painted. Further SS/GI piping shall be given necessary colour banding for identification as per colour scheme.
4. All instruments shall be painted as per manufacturer standard practice.
5. All structural steel items shall be painted at site. Piping shall go with primer coating & finish paint shall be applied at site.
   Equipment shall be finish painted at shop.
6. Method of painting application shall be as per paint manufacturer's recommendation.
7. Based on above detailed painting schedule will be prepared by Ozone Generation plant supplier and will be submitted to BHEL for their approval.
8. The above mentioned painting requirements are bare minimum. Any variation as required by BHEL/customer during detailed engineering stage shall be adhered by the bidder without any delivery/commercial implication to BHEL.

SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5 Grade	COLOUR (BAND)	IS-5
1.0	Structures, platforms, galleries, ladders and handrails	Dark Admirality Grey	632	-	-
2.0	Crane				
2.1	Crane structure	Golden Yellow	356	-	-
2.2	Trolley and hook	Crimson	540	-	-
3.0	Fans, pumps, motors, compressors	Light Grey	631	-	-
4.0	Tanks (without insulation and cladding)				
4.1	Outdoor	Aluminium	-	-	-
4.2	Indoor	Light grey	631	-	-
5.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
6.0	Control & relay panels	Light grey	631/7078 of IS 1650	-	-
7.0	Transformers	Aluminium	-	-	-
8.0	Machinery guards	Signal red	537	-	-
9.0	Piping				
9.1	Potable, Service water & Ozonated water	Sea green	217	French blue	166
9.2	Compressed air, Oxygen, Ozone, instrument air	Sky blue	101	White	-
9.3	Vacuum pipes	Sky blue	101	Black	-
9.4	Drainage	Black	-	-	-

Notes:

1. This colour code basically refers to IS:2379 for piping with necessary modifications

2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

3. The above mentioned painting requirements are bare minimum. Any variation as required by BHEL/customer during detailed engineering stage shall be adhered to the bidder without any delivery/commercial implication to BHEL.

SECTION – C1-F

DATA SHEET- A

DATA SHEET-A

SL NO.	DESCRIPTION	PARAMETERS
1.0	**OXYGEN GENERATION PLANT (Common for Ozonisation system at Condenser, RO + CW make up Ozonisation system & Raw water reservoir Ozonisation system)**	
1.1	**COMPRESSORS**	
1.1.1	No. of Compressors	Two (2) Numbers (2 x 100%) (1working + 1 standby)
1.1.2	Type	Screw type water cooled, oil free compressors
1.1.3	Capacity & Head	As per system requirements based on supplier recommendations
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	Operation	Continuous
1.1.7	Suction temperature	Ambient
1.1.8	Location	Outdoor under shed in Ozone Generation plant Building-1 area
1.1.9	Accessories	Intake air filters, drive motor, intake silencer, step up gear box, moisture separator, ducting etc.
1.1.10	Dive motor	Electric drive motor
1.2	**AIR RECEIVER**	
1.2.1	Numbers	One (1) Number
1.2.2	Capacity	10 % of flow capacity in m3/min or 1.3 M3 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
1.2.6	Location	Outdoor under shed in Ozone Generation plant Building-1 area
1.3	**AIR DRYERS**	
1.3.1	Numbers	Two (2) Numbers (2 x 100%) (1working + 1 standby) per stream. Total 4 nos for both the streams.
1.3.2	Capacity	As per system requirements based on supplier recommendations
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
1.3.6	Location	Ozonisation system at Condenser, RO + CW make up Ozonisation system building (Ozone Generation plant Building-1)
1.4	**OXYGEN GENERATORS**	
1.4.1	Numbers	Two (2) Numbers (2 x 100%) (1working + 1 standby) per stream. Total 4 nos for both the streams.
1.4.2	Capacity	As per system requirements based on supplier recommendations
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
1.4.5	Location	Ozonisation system at Condenser, RO + CW make up Ozonisation system building (Ozone Generation plant Building-1)
1.5	**Oxygen receiver for Ozonisation system at Condenser, RO + CW make up Ozonisation system**	
1.5.1	Numbers	Two (2) Numbers (2 x 100%) (1working + 1 standby)
1.5.2	Capacity	Cycle time of Oxygen generation plant or 2.8 M3 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
1.5.6	Location	Ozonisation system at Condenser, RO + CW make up Ozonisation system building (Ozone Generation plant Building-1)
1.6	**Oxygen receiver for Raw water reservoir Ozonisation system**	
1.6.1	Numbers	One (1) Number
1.6.2	Capacity	1.0 M3 (Minimum)
1.6.3	Material of construction	Carbon Steel to IS 2062/IS 2002
1.6.4	Design Code	IS 2825/ASME Sec VIII Div. 1 or equivalent
1.6.5	Type	Vertical self-supporting cylindrical vessel
1.6.6	Location	Raw water reservoir Ozonisation system building (Ozone Generation plant Building-2)

2.0	**OZONE GENERATION PLANT (Separate for Ozonisation system at Condenser, RO + CW make up Ozonisation system & Raw water reservoir Ozonisation system)**	
2.1	**OZONE GENERATOR (S) FOR OZONISATION SYSTEM AT CONDENSER**	Total working Capacity = 6 Kg/hr
2.1.1	Numbers	N (Working)+1(Stand by) *
2.1.2	Capacity	Supplier Specific *
2.1.3	Type	Vertical/Horizontal tubular
2.1.4	Material of construction of shell	SS316 Ti
2.1.5	Material of construction of Tube	SS316 Ti
2.1.6	Material of construction of Ozone Electrode	SS316 Ti
2.1.7	Location	Ozonisation system at Condenser, RO + CW make up Ozonisation system building (Ozone Generation plant Building-1)
2.2	**OZONE GENERATOR (S) FOR RO + CW MAKE UP OZONISATION SYSTEM**	Total working Capacity = 2 Kg/hr
2.2.1	Numbers	N (Working)+1(Stand by) *
2.2.2	Capacity	Supplier Specific *
2.2.3	Type	Vertical/Horizontal tubular
2.2.4	Material of construction of shell	SS316 Ti
2.2.5	Material of construction of Tube	SS316 Ti
2.2.6	Material of construction of Ozone Electrode	SS316 Ti
2.2.7	Location	Ozonisation system at Condenser, RO + CW make up Ozonisation system building (Ozone Generation plant Building-1)
2.3	**OZONE GENERATOR (S) FOR RAW WATER RESERVOIR OZONISATION SYSTEM**	Total working Capacity = 2 Kg/hr
2.3.1	Numbers	N (Working)+1(Stand by) *
2.3.2	Capacity	Supplier Specific *
2.3.3	Type	Vertical/Horizontal tubular
2.3.4	Material of construction of shell	SS316 Ti
2.3.5	Material of construction of Tube	SS316 Ti
2.3.6	Material of construction of Ozone Electrode	SS316 Ti
2.3.7	Location	Raw water reservoir Ozonisation system building (Ozone Generation plant Building-2)
2.4	**DI ELECTRIC GLASS TUBE FOR ALL THE OZONE GENERATORS**	
2.4.1	Type	Cylindrical
2.4.2	Material of construction	Borosilicate glass tube/ equivalent based on supplier recommendations
2.4.3	Construction	Close at one end based on supplier recommendations
3.0	**OZONE DOSING PUMPS (Separate for Ozonisation system at Condenser, RO + CW make up Ozonisation system & Raw water reservoir Ozonisation system)**	
3.1	**OZONE DOSING PUMPS FOR OZONISATION SYSTEM AT CONDENSER (DOSING AT CONDENSER INLET AND OUTLET)**	
3.1.1	Number	Two (2) Numbers (2 x 100%) (1working + 1 standby)
3.1.2	Location	Ozonisation system at Condenser, RO + CW make up Ozonisation system building (Ozone Generation plant Building-1)
3.1.3	Fluid to be handled	Condenser Cooling water
3.1.4	Service	To dose ozonised water in the inlet & outlet of condenser.
3.1.5	Type of Pump	Horizontal Centrifugal
3.1.6	Rated Capacity	As per supplier recommendations
3.1.7	Speed	1500 RPM
3.1.8	Head to be developed at rated capacity	As per system requirements
3.1.9	Operation	Continuous

3.1.10	**Material of construction**	
•	Casing	CI, IS 210, Gr. FG 260
•	Impeller	SS 316 / Bronze ASTM B 584, alloy no. 905
•	Shaft	SS410 / Steel 080 M 36, BS 970, Part 1
•	Impeller ring & casing ring	SS410 / Leaded Bronze
•	Stuffing box packing	As per supplier recommendations
•	Base plate	MS IS:2062, epoxy painted
3.1.11	Pressure gauge	One for each pump with teflon diaphragm seal.
3.1.12	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y- type strainers (SS316), pressure gauges, pulsation dampener.
3.1.13	Dive motor	Electric drive motor
3.2	**OZONE DOSING PUMPS FOR RO + CW MAKE UP OZONISATION SYSTEM (DOSING AT RO PLANT AND CW MAKE UP)**	
3.2.1	Number	Two (2) Numbers (2 x 100%) (1working + 1 standby)
3.2.2	Location	Ozonisation system at Condenser, RO + CW make up Ozonisation system building (Ozone Generation plant Building-1)
3.2.3	Fluid to be handled	Raw water
3.2.4	Service	To dose ozonised water at RO plant and CW make up
3.2.5	Type of Pump	Horizontal Centrifugal
3.2.6	Rated Capacity	As per supplier recommendations
3.2.7	Speed	1500 RPM
3.2.8	Head to be developed at rated capacity	As per system requirements
3.2.9	Operation	Continuous
3.2.10	**Material of construction**	
•	Casing	CI, IS 210, Gr. FG 260
•	Impeller	SS 316 / Bronze ASTM B 584, alloy no. 905
•	Shaft	SS410 / Steel 080 M 36, BS 970, Part 1
•	Impeller ring & casing ring	SS410 / Leaded Bronze
•	Stuffing box packing	As per supplier recommendations
•	Base plate	MS IS:2062, epoxy painted
3.2.11	Pressure gauge	One for each pump with teflon diaphragm seal.
3.2.12	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y- type strainers (SS316), pressure gauges, pulsation dampener.
3.2.13	Dive motor	Electric drive motor
3.3	**OZONE DOSING PUMPS FOR RAW WATER RESERVOIR OZONISATION SYSTEM (DOSING IN EACH COMPARTMENT OF RAW WATER RESERVOIR & INLET LINE TO RAW WATER RESERVOIR)**	
3.3.1	Number	Two (2) Numbers (2 x 100%) (1working + 1 standby)
3.3.2	Location	Near Raw water reservoir (Outdoor)
3.3.3	Fluid to be handled	Raw water
3.3.4	Service	To dose ozonised water in each compartment of Raw water reservoir & inlet line to raw water reservoir+
3.3.5	Type of Pump	Horizontal Centrifugal
3.3.6	Rated Capacity	As per supplier recommendations. However minimum capacity of each pump shall not be less than 50M3/hr.
3.3.7	Speed	1500 RPM
3.3.8	Head to be developed at rated capacity	As per system requirements
3.3.9	Operation	Continuous
3.3.10	**Material of construction**	
•	Casing	CI, IS 210, Gr. FG 260
•	Impeller	SS 316 / Bronze ASTM B 584, alloy no. 905
•	Shaft	SS410 / Steel 080 M 36, BS 970, Part 1

•	Impeller ring & casing ring	SS410 / Leaded Bronze
•	Stuffing box packing	Asbestos
•	Base plate	MS IS:2062, epoxy painted
3.3.11	Pressure gauge	One for each pump with teflon diaphragm seal.
3.3.12	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y- type strainers (SS316), pressure gauges, pulsation dampener.
3.3.13	Dive motor	Electric drive motor
4.0	**COOLING WATER PLANT (Common for Ozonisation system at Condenser & RO + CW make up Ozonisation system and Separate for Raw water reservoir Ozonisation system)**	
4.1	**COOLING WATER PLANT (COMMON FOR OZONISATION SYSTEM AT CONDENSER & RO + CW MAKE UP OZONISATION SYSTEM)**	
4.1.1	**CHILLED WATER RECIRCULATION PUMPS**	
4.1.1.1	Number	2 Numbers (2 x 100%) (1working + 1 standby)
4.1.1.2	Location	Ozonisation system at Condenser, RO + CW make up Ozonisation system building (Ozone Generation plant Building-1)
4.1.1.3	Fluid to be handled	Service water
4.1.1.4	Type of Pump	Horizontal Centrifugal
4.1.1.5	Rated Capacity	As per supplier recommendations
4.1.1.6	Head to be developed at rated capacity	As per system requirements
4.1.1.7	Operation	Continuous
4.1.1.8	**Material of construction**	
•	Casing	SS304
•	Impeller	SS316
•	Shaft	SS 410
•	Shaft sleeve material	SS 410
4.1.1.9	Pressure gauge	One for each pump with teflon diaphragm seal.
4.1.1.10	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y- type strainers (SS316), pressure gauges, pulsation dampener.
4.1.1.11	Dive motor	Electric drive motor
4.1.2	**CHILLER**	
4.1.2.1	Numbers	2 Numbers (2 x 100%) (1working + 1 standby)
4.1.2.2	Type	Air cooled
4.1.2.3	Capacity	As per system requirements based on supplier recommendations
4.1.2.4	Material of construction	Carbon steel
4.1.2.5	Location	Outdoor under shed in Ozone Generation plant Building-1 area
4.1.3	**WATER STORAGE TANK**	
4.1.3.1	Numbers	One number
4.1.3.2	Design Standard	IS 803 or acceptable equivalent international standard
4.1.3.3	Capacity	20 minutes detention time or 9.0 M3 whichever is higher.
4.1.3.4	Material of construction	Carbon Steel Rubber lined.
4.1.3.5	Location	Ozonisation system at Condenser, RO + CW make up Ozonisation system building (Ozone Generation plant Building-1)
4.1.3.6	Thickness	6 mm (minimum).
4.1.3.7	Type	Vertical cylindrical with dished bottom.
4.1.3.8	Accessories	Top hinged cover, drain, sample connection, operating platform, ladders , lifting lugs (4 nos minimum) etc.
4.2	**COOLING WATER PLANT (Separate for Raw water reservoir Ozonisation system)**	
4.2.1	**CHILLED WATER RECIRCULATION PUMPS**	
4.2.1.1	Number	2 Numbers (2 x 100%) (1working + 1 standby)
4.2.1.2	Location	Raw water reservoir Ozonisation system building (Ozone Generation plant Building-2)
4.2.1.3	Fluid to be handled	Service water

4.2.1.4	Type of Pump	Horizontal Centrifugal
4.2.1.5	Rated Capacity	As per supplier recommendations
4.2.1.6	Head to be developed at rated capacity	As per system requirements
4.2.1.7	Operation	Continuous
4.2.1.8	**Material of construction**	
•	Casing	SS304
•	Impeller	SS316
•	Shaft	SS 410
•	Shaft sleeve material	SS 410
4.2.1.9	Pressure gauge	One for each pump with teflon diaphragm seal.
4.2.1.10	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y- type strainers (SS316), pressure gauges, pulsation dampener.
4.2.1.11	Dive motor	Electric drive motor
4.2.2	**CHILLER**	
4.2.2.1	Numbers	2 Numbers (2 x 100%) (1working + 1 standby)
4.2.2.2	Type	Air cooled
4.2.2.3	Capacity	As per system requirements based on supplier recommendations
4.2.2.4	Material of construction	Carbon steel
4.2.2.5	Location	Outdoor under shed in Ozone Generation plant Building-2 area
4.2.3	**WATER STORAGE TANK**	
4.2.3.1	Numbers	One number
4.2.3.2	Design Standard	IS 803 or acceptable equivalent international standard
4.2.3.3	Capacity	20 minutes detention time or 1.0 M3 whichever is higher.
4.2.3.4	Material of construction	Carbon Steel Rubber lined.
4.2.3.5	Location	Raw water reservoir Ozonisation system building (Ozone Generation plant Building-2)
4.2.3.6	Thickness	6 mm (minimum).
4.2.3.7	Type	Vertical cylindrical with dished bottom.
4.2.3.8	Accessories	Top hinged cover, drain, sample connection, operating platform, ladders , lifting lugs (4 nos minimum) etc.
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 or equivalent. 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). However pipe conveying the Oxygen for Ozone generation plant building-1 to Ozone generation plant building-2 shall be of Stainless steel to ASTM A 312 TP 316 sch. 80S (minimum) seamless.
5.3	Material of construction of piping, fittings and flanges handling Ozonated 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 50^0C.	• Piping upto and including 150 NB shall be of Carbon steel ERW, IS: 1239 heavy grade. The material of fittings and flanges shall be of Carbon steel class 150 (minimum). • Piping >150 NB shall be of Carbon steel IS 2062, plates rolled and welded as per IS:3589. 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	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

	water line shall be 10 kg/cm2 (g) and design mechanical temperature shall be 60^0C.	(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		
		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	Cast carbon steel to A126 CLASS B	ASTM A182 Gr F6a	IS320 HT2	ASTM A47 Gr. 32510	FLANGED FLAT FACE
		≤50 NB	Forged Carbon steel (A105)	ASTM A182 Gr F6a	ASTM B312 GR. A	ASTM A47 Gr. 32510	SCREWED TYPE

Note:

1) *The numbers and capacity of each ozone generator(s) including stand by stream shall be based on supplier recommendations

PUMPS AND PIPE SELECTION CRITERIA

		Velocity in m/sec.		
		Pipe Size		
Sr. No.	**Pipe Size**	**Below 50 mm**	**50 - 150 mm**	**200 mm & above**
a)	Pump Suction for Water	-	1.2 - 1.5	1.2 - 1.8
b)	Pump Discharge for Water	1.2 - 1.8	1.8 - 2.5	2.1 -2.5
c)	Header for Water	-	1.5 - 2.4	2.1 - 2.4
d)	Pump suction for chemical solution	0.8 - 1.2	0.8 - 1.3	-
e)	Pump discharge for chemical solution	1.2 - 1.4	1.3 – 1.5	-

The following " C" Value shall be used in WILLIAM & HAZEN formula for calculating the friction loss in piping systems.

i) Carbon Steel pipe - 100

ii) C.I Pipe / Ductile Iron - 100

iii) Rubber lined steel pipe - 120

iv) PVC / HDPE pipes - 140

SECTION-C2

TECHNICAL SPECIFICATION FOR ELECTRICAL

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 equipments.

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.

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.

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor (Annexure –I)
b) BASIC TECHNICAL FEATURES FOR LT MOTORS
c) Datasheets-A for motors
d) Datasheets-C for motors
e) Quality plan for motors.
f) Electrical Load data format (Annexure –II)
g) BHEL cable listing format (Annexure –III)
h) STANDARD SPECIFICATION - LV MOTORS

ELECTRICAL SCOPE BETWEEN BHEL & VENDOR
(ANNEXURE-I)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: OZONE GENERATION PLANT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1 X 370 MW YELAHANKA CCPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V PMCC/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	415V Local PLC based Control Panel	Vendor	Vendor	
3	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
4	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. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
5	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.
6	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
7	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.
8	Cable glands ,lugs and bimetallic strip for equipment 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 and control cables.
9	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.
10	Lighting	BHEL	BHEL	
11	Equipment grounding (including electronic earthing) & lightning protection	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	Power supply arrangement (battery/ battery charger) for control system/ panel	Vendor	Vendor	Only 415 V AC/ 240 V AC supply to the power supply equipment for control system shall be provided by BHEL at outgoing switchgear

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: OZONE GENERATION PLANT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1 X 370 MW YELAHANKA CCPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
				terminals. All downstream equipment (eg. battery, battery charger, distribution board etc.) shall be in the package vendor's scope.
15	Mandatory spares	Vendor	-	Vendor to quote as per specification.
16	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
17	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
18	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
19	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
20	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 without any commercial implication to BHEL.
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.

ELECTRICAL LOAD DATA FORMAT
(ANNEXURE- II)

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
ANNEXURE-II																				

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	409	ORIGINATING AGENCY		PEM (ELECTRICAL)
	PROJECT TITLE	1X370MW YELAHANKA TPS	NAME		DATA FILLED UP ON
	SYSTEM	OZONE GENERATION PLANT	SIGN.		DATA ENTERED ON
	DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

CABLE SCHEDULE FORMAT

ANNEXURE- III

UNIT CABLE NO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLE SIZE	PATH CABLE NO	TENTATIVE CABLE LENGTH

BASIC TECHNICAL FEATURES FOR LT MOTOR

	1 X 370 MW YELAHANKA COMBINED CYCLE POWER PLANT BASIC TECHNICAL FEATURES FOR LT MOTOR	Doc. No.	PE-DC-409-565-E003
		Rev. No.	01
		Dated	06-05-2016
		Page	1 of 5

1.0 This document covers the basic technical features of low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in 1 X 370 MW YELAHANKA COMBINED CYCLE POWER PLANT.

2.0 CODES AND STANDARDS

All motors shall conform to the latest applicable standards as listed below;

1) Three phase induction motors: IS: 325, IEC: 60034
2) Single phase AC motors: IS: 996, IEC: 60034
3) Crane duty motors: IS: 3177, IEC: 60034
4) Energy Efficient motors: IS 12615 or IEC: 60034-30 with Efficiency class IE3

3.0 DESIGN REQUIREMENTS

3.1 General Requirements

The design ambient temperature shall be 50 deg C.

3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
Upto & including 200 kW	415 V	415 V

3.2.1 Supply voltage & variations shall be as follows:-
Voltage variation (+/-) 10%
Frequency variation (+) 3% to (-) 5%
Combined V & F variation 10% (sum of absolute values)

3.2.2 Motors shall be capable of running continuously at rated output for each of the conditions specified.

3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the drive equipment. Motors shall be continuously rated at the design ambient temperature of 50 deg C. Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment at duty point or 10% margin over the continuous maximum demand of the driven equipment under entire operating range, whichever is higher.

3.4 Starting Requirements

3.4.1 Motor shall start smoothly and rapidly. Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.4.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value of 85 (eighty five) percent rated voltage.

3.4.3 Continuous duty LT motors up to 200 KW Output rating (at 50 deg. C ambient temperature), shall be Premium efficiency (IE3) as per IEC: 60034-30/ IS: 12615 and the locked rotor current of motors shall as per IS 12615.

3.4.4 The following frequency of starts shall apply

i) Three cold starts in succession with the motor being initially at a temperature not exceeding the ambient temperature.

ii) Two hot starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

iii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature.(not to be repeated in the second successive hour)

3.4.5 Locked motor withstand time of hot motors at 110% rated voltage shall be as follows:

a) For motors with starting time upto 20 sec.

- at least 3 sec. more than starting time.

b) For motor with starting time above 20 secs but not exceeding 45 secs.

- at least 5.0 sec. more than starting time.

c) For motors with starting time above 45 secs.

- at least 10%. more than starting time.

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

3.5 Running Requirements

3.5.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.5.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 1 secs. The pull-out torque of the motor shall be at least 205% of full load torque to meet this requirement.

3.6 Stress During bus Transfer

3.6.1 Motors shall withstand the voltage and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.6.2 Motor windings shall be adequately braced to satisfactorily withstand the mech. Stresses during above condition.

3.6.3 Motors shall be capable of withstanding heavy in-rush transient current caused by bus transfer without damage.

3.6.4 Motor and driven eqpt. Shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.7 Noise level

Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed 85 db (A) in line with IS 12065.

.

3.8 Vibration

The max. Vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 CONSTRUCTIONAL FEATURES

4.1 Degree of Protection

4.1.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691.Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. The degree of protection for terminal boxes shall be IP 55 as per IS 4691. Outdoor or semi-indoor motors shall be installed under a suitable canopy.

1

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

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

4.2 Enclosure and Cooling

4.2.1 Motors shall generally have totally enclosed fan cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

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

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

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

4.3 Class of Insulation

Tropicalised insulation material of Class ‘F’ shall be used .The temperature rise shall be limited to the limits applicable to Class ‘B’ insulation. In case of continuous operation at extreme voltage limits, 10deg C rise above the temperature limits specified in IS: 325 shall be permissible.

4.4 Bearings

4.4.1 In general all LV motors, bearings can be either sealed life lubricated type or regreasable type as per manufacturer's standard. However horizontally mounted motors shall have grease lubricated ball/roller or sleeve bearings.

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

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

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

4.4.5 For motors upto 2 kW, double sealed type bearings shall be provided.

4.5 Terminals and Terminal Boxes

4.5.1 Motors of rating 100 kW & above shall be controlled by circuit breaker, motors below 100 kW shall be controlled by Switch Fuse-contactor. The terminal box of LT motors shall be designed for the fault current of 50 kA, 0.2 secs for motors 100 kW & above (Breaker controlled), for motors below 100 kW (Contactor controlled) shall be 50 KA protected by fuse.

1

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

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

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

4.5.6 Motor terminals and terminal leads shall be fully insulated with no bar live parts.

4.5.7 Separate terminal boxes shall be provided for space heaters and temp. Indicators. If this is not possible in case of LT motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression tinned brass glands shall be provided in terminal boxes.

4.5.8 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LT motors.

4.5.9 Cable glands and cable lugs as per selected cable sizes shall be provided in line with cable erection philosophy. For single core cable termination, gland plates shall be of non-magnetic material.

4.6 Grounding

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

4.7 General

4.7.1 Motors provided for similar drives shall be interchangeable.

4.7.2 An arrow block shall be screwed on the body of the motors on the non-driving end to indicate the direction of rotation of the motors.

4.7.3 Motors for hazardous areas shall be with flame-proof enclosures in accordance with IS 2148 / IEC 60079. Classification of Hazardous area shall be as per IS: 5572 part-I.

5.0 ACCESSORIES

5.1 SPACE HEATERS

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

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

6.0 NAME PLATE

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

7.0 PAINTING

The paint shall be epoxy based. The colour of finish shall be as per IS: 5 for motors. Shade shall be decided during detailed engineering.

8.0 TESTING

8.1 Type Tests

For LT Motors above 55kW, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.

8.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615.

	TITLE : **GENERAL TECHNICAL REQUIREMENTs FOR LV MOTORS**	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : **II-B** REV NO. : **00** DATE : SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE : GENERAL TECHNICAL REQUIREMENTs FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : **II-B**
		SECTION : **D**
		REV NO. : **00** DATE :
		SHEET : 1 OF 4

1.0 INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

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

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

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

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

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

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

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

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

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

DATA SHEET A – MOTORS

1.0	Design ambient temperature		:	50 °C
2.0	Maximum acceptable kW rating of LV motor		:	200 KW
3.0	Installation (Indoors/ Outdoors)		:	As required
4.0	Details of supply system			
	a)	Rated voltage (with variation)	:	415V ± 10%
	b)	Rated frequency (with variation)	:	50 Hz + 3 % to - 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		
		○ 100 kW and above (Breaker Controlled)	:	50 KA for 0.2 sec.
		○ Below 100 kW (Contactor Controlled)	:	50 KA protected by fuse
	f)	LV System grounding	:	Solidly
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)		:	(a) 85% of rated voltage
7.0	Power cables data		:	Shall be given during detailed engg.
8.0	Earth Conductor Size & Material		:	As per attached Datasheet of Earthing.
9.0	Space heater supply		:	240 V, 1¢, 50 Hz
10.0	Rating up to which Single phase motor		:	Acceptable below 0.20 kW
11.0	Locked rotor current			
	a)	Limit as percentage of FLC	:	As per IS 12615*
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	Paint shade		:	Shall be given during detailed engg.
14.0	Degree Of protection for motor/ terminal box		:	IP 54/ IP 55

15.0 * Continuous duty LT motors up to 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium efficiency (IE3) as per IEC: 60034-30/ IS: 12615

16.0 TESTING

16.1 Type Tests

For LT Motors above 55kW, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years from the date of bid opening shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.

16.2 Routine Tests

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

DATA SHEET C– MOTORS

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

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

QUALITY PLAN (MOTOR)

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 1 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 2 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	

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

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 3 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULA-TION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	

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

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 4 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	

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

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 5 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	

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

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

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

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

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 7 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	

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

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 8 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1$	1	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1$	1	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

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

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

NOTES:

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

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

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

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

Legends for Inspection agency

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

P. PERFORM
W. WITNESS
V. VERIFY

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

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

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01	SPECIFICATION : TITLE :
	SHEET 2 OF 2	SYSTEM	ITEM AC ELECT. MOTORS BELOW 55KW (LV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

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

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

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

Legends for Inspection agency

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

P. PERFORM
W. WITNESS
V. VERIFY

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

TECHNICAL SPECIFICATION
(C&I PORTION)

BHEL	**SPECIFIC TECHNICAL REQUIREMENT FOR** OZONE GENERATION PLANT **1X370 MW YELAHANKA CCPP**	SPECIFICATION NO. VOLUME **II-B** SECTION : **C** REV. NO. 00 DATE: 25.04.2016 SHEET 1 OF 4

1. **Complete** Control & Instrumentation for OZONE GENERATION PLANT is in Vendor scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by Vendor.

2. A common PLC based control system cum Annunciation panel with solid state annunciation windows shall be in Vendor scope of supply.

3. Vendor to ensure necessary provision and hardware requirement in the PLC panel for complete OZONE GENERATION PLANT.

4. Field instrumentation along with necessary fittings, accessories and valve manifold etc. and Field Junction Box (JB's), are in Vendor's scope. Each instrument/ equipment shall have a unique KKS Tag no. Field instrument specification and Data Sheet are given elsewhere in this specification. Vendor to provide local control panel wherever required.

5. All fields cabling for instruments/motor/pump/blower to JB is in Vendor's scope. The field I/O s to be grouped together in JBs suitably and a common trunk cable shall be taken to the panel.

6. Cable schedule, cable interconnection details and wiring diagram where one end equipment and/or both end equipments are in Vendor scope shall be provided by the Vendor.

7. Instrument installation drawings are to be provided by Vendor. All instrument fitting and erection hardware/racks as per instrument installation diagram shall be in Vendor's scope.

8. All manual valves at pump discharge shall be provided with Open and Close Limit Switches.

9. All wetted part of Level Switch, Level Gauge, Pressure gauge, Pressure switch, differential pressure switch etc. shall be of SS316.

10. PLC control system as defined in the enclosed specification and Data Sheets shall be in Vendor scope. The PLC system shall comprise of (i) PLC based local panel with Redundant hot standby processor (ii) Operator interface in the form of CRT, keyboard and OWS along with required furniture (iii) laser printer with OWS.

11. PLC shall have the facility to synchronize its time with BHEL plant master clock system using IRIG-B signals. Necessary Hardware (IRIG-B port) for same at PLC end to be provided by Vendor. The cable connecting PLC and plant master clock system shall be in BHEL scope.

12. Soft-link communication between PLC and DDCMIS shall be redundant Bi-directional link. Bidder shall supply required hardware and software. Communication protocol between PLC end & DDCMIS shall be MODBUS on RS-485 and the maximum communication time for receipt of signal at DDCMIS end should not exceed 2

second. Necessary Patch Chord/ Converters, LIU at PLC end, shall be in bidder scope.

13. Bidder shall provide redundant UPS with 60 minutes Lead Acid battery backup & necessary redundant power packs for PLC panel and PC, OWS, printer etc.

14. VMS to be included in bidder's scope for HT drives, if applicable.

15. Bidder shall include measurement and control instruments of transmitters only. No switches shall be considered. All the control measurement and analysers and interlocks shall have redundant sensors along with Transmitter.

16. All furniture (tables, chairs etc.) required for PLC operator HMI shall be in Vendor's scope. Chairs shall be capable of being adjusted for height and position of backrest. The chairs shall be mounted on five castors, shall swivel and shall have arm rests'. One table and chair shall be provided for each operator station and separate table for each printer.

17. The requirements given below are to be read in conjunction with detailed Technical specification enclosed. In case of any contradictions, the more stringent requirement shall prevail subject to BHEL approval.

18. For instrument and control cable scope of supply, refer 'Electrical scope split sheet' in Electrical portion of the specification.

19. Vendor shall provide at least 20% or minimum two numbers, whichever are higher, spare channels as hot on rail spares in each configured I / O modules. In addition to this 10% or minimum one number, whichever is higher, extra assigned complete spare I / O modules mounted on rails in sub racks as hot on rail spare for each category of installed I / O modules shall also be provided. Spare modules shall be distributed over each controller group. Spare channel and modules shall be fully wired up to termination cabinets.

20. Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

21. Supplied system shall have provision for hardwired connectivity with plant DCS of critical signals. Same shall be decided during detailed engineering.

22. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.

23. Provision for earthing of the panel to be provided by vendor.

24. Vendor to submit GA drawing of control panel indicating layout of instruments, construction details, wiring diagram, class of protection for enclosure, paint type,

paint color, thickness and material of enclosure sheet, control scheme during detailed engineering.

25. Layout & space requirement of panel to be specified during detailed engineering.

26. All bidirectional drives (Motor Operated Valves, MOVs) are integral starter type. Typical Hook Up diagram of all types of drives is attached for use(subject to Customer approval).

27. Vendor shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. Also, Cable Interconnections details for Complete System shall be in Vendors' scope.

28. 240V AC (supply feeder)/415 V AC (3phase 4 wire) supply shall be provided by BHEL at a single point as per 'Electrical scope split sheet' in Electrical portion of the specification. Further distribution to various instruments/Equipment shall be in Vendor's scope. Vendor to include the necessary power distribution board in his scope. Any power supply other than the above, if required for any instrument/equipment has to be derived from the above supply & all the necessary hardware for the same shall be in Vendor's scope.

29. Vendor to provide all control panels, system cabinets, termination & relay cabinets complete with all accessories, wiring and all mounting and erection hardware including junction boxes, canopies, structural steel as required. All instruments/drives shall be terminated on Junction Boxes/Panel in Vendor scope of supply. 20% Spare terminals shall be provided on Junction Boxes.

30. Vendor to delegate/depute their person/experts as per owner/consultant requirements.

31. The make of all the items shall be from approved sub-vendor list/ Reputed Make only.

32. The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE, IS etc.

33. Vendor shall provide the signal exchange, to Plant DCS in BHEL prescribed format to be furnished during detailed engineering.

34. Specification for Instruments used in PID other than specified in this specification (i.e. O3 analyser, O2 purity analyser, dew point transmitter etc.) shall be evaluated during detail engineering. All Data sheets submitted by bidder are subject to customer approval.

35. Distance between Main PLC Panel Room and RIO room shall be approximately 800 mtr.

36. Hardwired alarm windows shall be provided.

37. Control valves shall be provided with Smart positioner (Non contact type)

NOTES:

01. All equipment items shall be of latest design with proven on track record from reputed experienced manufacturers of specified type and range of equipment. The make/model of various instruments/items/systems and instrument sub-vendor shall be subject to approval of BHEL/Customer during detailed engineering stage.

02. 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 Vendor without any technical, commercial and delivery implication to BHEL.

03. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the Vendor without any price/time implication.

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I** VOLUME SECTION REV. NO. 00 | DATE : 25.04.2016 SHEET OF

PLC SPECIFICATION

Form No. PEM-6666-0

	TITLE:	SPECIFICATION NO. PES-145-36	
BHEL	**SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM** **1X370MW YELAHANKA CCPP**	VOLUME **II-B**	
		SECTION **D**	
		REV. NO. 00	DATE: 25.04.2016
		SHEET 1	OF 8

1. SCOPE

This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to site, erection & commissioning, site acceptance test of the PLC Control & Monitoring System comprising PLC Control panel/Remote I/O panel (housing Processors, I/O cards, power supply packs etc.), Operator workstations(OWS), Printers, Annunciation system, cables and all other equipment and accessories required for completeness of the system as mentioned in different sections of this specification.

2. GENERAL

2.1. The offered PLC shall be of Industrial Grade and from Original Equipment manufacturer (OEM).

2.2. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, math functions, input quality checking engineering unit conversion, Boolean functions & PID control (Analog logic function) etc.

2.3. The system shall be redundant in processor, power supply and communication interfaces unless otherwise specified. The control of all drives and equipment shall be effected through the keyboard/mouse / panel mounted push button / control switches as per Data sheets-A&B. The system shall include self-diagnostic features not limited to the following:-

- Memory Faults, both PROM and EPROM
- Processor Faults
- Communication Faults
- I/O interface or address faults
- Voltage signal discrepancy on input and output
- Power supply faults
- Output loop check
- Channel level diagnostics such as fault monitoring, contact bounce filtering etc.
- Failure of main or I/O processor

2.4. The system shall have facility for connecting to Main Plant's Distributed control system (DCS) using hardware/software interface for two-way transfer of signals.

2.5. The mimic shall be displayed on the OWS screen and may also be provided on the control desk/panel (as per Datasheet).

2.6. In case OWS is provided, HMI functions like trends, curves, bar charts, historical storage of data, logs and reports etc. shall be provided in addition to Plant schematics. The necessary catalogue / literature elaborating the features of HMI shall be supplied along with the bid.

2.7. It shall be possible to use the same OWS as programming station.

2.8. The PLC system shall be sized to meet process/system requirements as per the approved P&IDs and Control write-up.

2.9. The PLC system shall be designed to ensure that no single device failure should result in failure of any other device.

2.10. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.

2.11. Bidder shall provide all software on CDs along with required software licenses .The original CDs of installed operating & application software shall be maintained by bidder. Software modification and up gradation (as & when required) shall also be covered under the vendor scope without any cost implication.

2.12. PLC programming console shall be provided with industry proven antivirus software with perpetual license (free version not acceptable).

3. TECHNICAL REQUIREMENTS

Details of various PLC system components shall be inclusive of but not limited to the following:

3.1. CODES AND STANDARDS

3.1.1. The equipment covered under this specification shall meet the requirements of latest edition of all applicable codes and standards like ANSI, NEMA, IEEE, IEC, NEC & IS.

3.1.2. PLC shall conform to IEC: 61131

3.1.3. The offered PLC shall comply with safety standards as per Data sheet-A&B.

3.2. CONTROL PANEL

3.2.1. PLC control panel shall be freestanding type with provision for mimic display, push-button stations, control switches, indicating lamps, metering instruments like Indicators, ammeters etc. and facia windows for critical alarms.

3.2.2. The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 2.5 mm for load bearing sections (mounted with instruments) and not less than 1.6 mm for others
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.2.3. Each panel shall be identified by a name plate, which shall be of non-rusting metal or three ply lamicold, with engraved lettering.

3.2.4. Vendor shall indicate earthing details along with bid.

3.2.5. 25 x 6 mm Copper ground bus to be provided for each panel.

3.2.6. 240V AC single phase, thermostatically controlled space heaters shall be provided. Each free standing panel shall have a door switch operated fluorescent lamp and a 240V AC plug point.

3.2.7. Painting treatment shall be as per IS: 6005. Two coats of lead oxide primer shall be followed by powder coating. Paint shade shall be as specified in the “Data sheet for PLC system”-Data Sheet-A&B. Project specific paint shade, if applicable, shall be followed.

3.2.8. Panel internal wiring shall be as per NEC and NEMA standard.

3.2.9. TB points in terminal block shall be cage clamp type/screw type.

3.2.10. The annunciation system shall be facia window type, driven by the PLC. Audible alarm, Acknowledge, Reset and lamp test facility shall be provided as per ISA sequence – S18.1, M.

3.3. PROCESSORS

3.3.1. The microprocessors shall be 32 bit, and Hot redundant.

3.3.2. Hot redundancy: PLC shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete operation automatically. This transfer from main processor to standby processor shall be bump less and shall not cause any disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processor as master and other as standby.

3.3.3. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements.

3.3.4. The standby processor shall be updated automatically in line with the changes made in the working processor.

3.3.5. In the event of any replacement of the processor, synchronization of the replaced processor shall be automatic upon live insertion.

3.3.6. The cycle time for input scanning, execution of logics, overheads and output scan shall not exceed 120 m sec.

3.3.7. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions.

3.3.8. The memories shall be field expandable. Memory capacity shall be sufficient for complete system operation and have a capability for at least 20% expansion in future.

3.3.9. Memory shall be non-volatile, preferably EEPROM type. However, in case volatile memory is provided, battery backup shall be provided for a minimum of three months to keep the stored program intact. Battery drain indication shall be provided at least 1 week before the battery gets drained and same shall be annunciated in OWS.

3.4. INPUT / OUTPUT Modules

3.4.1. Input/output card assignments shall be modular i.e. no single card shall be assigned with more than one drive of a particular sub-system. The maximum number of channels per I/O module shall be as follows.

- Analog Input Module: 16
- Analog Output Module: 16
- Binary Input Module: 32
- Binary Output Module: 32
- Analog Input/output combined: 16
- Binary Input/output combined: 32

3.4.2. On line module replacement (hot swappable): All modules cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching off the power supply.

3.4.3. Each I/O shall be protected against the reversal of polarity of the power voltage to I/O.

3.4.4. 10% spare capacity shall be ensured in each card channel assignment. Overall minimum 20% spare channels shall be provided.

3.4.5. Output command to MCC/Switchgear shall be through coupling relays, whose mounting location shall be as per “Data sheet A & B for PLC System”. In case coupling relays are located in PLC Panel, the same shall be in PLC vendor’s scope of supply.

3.4.6. Status feedback from MCC shall be in the form of potential free contact.

3.5. DATA BUS/ I/O BUS

3.5.1. The Data bus connecting PLC and HMI work stations shall be TCP/IP on Ethernet.

3.5.2. The Data bus and I/O bus communication medium shall be twisted pair shield copper conductor for indoor locations and those areas not subjected to induced signals. Repeaters/signal amplifiers shall not be used. Copper conductor cable used shall be Category-5 or better. The communication medium shall be Fibre optic cable in the event any portion of communication cable run is in outdoor or where distances are beyond 500 meters.

3.6. OPERATOR WORK STATION (OWS)

3.6.1. The OWS and Keyboard shall be desktop mounted and shall be used for controlling, monitoring and programming function.

3.6.2. Colour CRT(s) with keyboard and mouse shall be as per Data Sheet-A&B. CRT shall have graphic display facility.

3.6.3. The OWS shall be with Windows based operating system having necessary Engineering/Configuring software.

3.6.4 Specification of OWS

(a) CPU

1.	Processor	32 Bit or better
2.	Main Memory	Min. 1 GB and expandable to at least 4 GB
3.	Hard drive	Min 160 GB
4.	~~Floppy drive~~	~~3.5", 1.44 MB~~
5.	Removable bulk storage	DVD (R/RW)
6.	Graphic memory	Min. 16 MB
7.	Auto controller	16 bit or better
8.	Operating system	Window XP or better
9.	Communication ports	2 serial, 1 parallel, 8 Nos. USB, Dual 100 MB Ethernet
10.	Expansion slot	3 Nos. or more

(b) Monitor

1.	Type	LCD colour monitor (TFT based)
2.	Screen diagonal	24" (approx.) flat
3.	Display	XGA or better
4.	Degree of Protection	IP-30
5.	External controls	Brightness, Contrast, Horizontal/vertical amplification & shift
6.	Power supply	240 VAC, 50 Hz, 1 phase
7.	Version	Industrial grade

(c) Keyboard & Mouse

1.	Type	Flat spill membrane or positive depression type ASCII
2.	Life expectancy	50 Million cycles per key
3.	Version	Industrial
4.	Mouse	Optical

3.7. PRINTER

Printers shall be provided as per Data Sheet-A&B.

3.8. COMMUNICATION WITH PLANT DCS/ THIRD PARTY SYSTEM

3.8.1. The PLC system shall be provided with hardwired/serial interface for communication with plant DCS. Hardwired outputs from PLC shall be isolated. Necessary isolators shall be part of PLC.

3.8.2. Serial communication to / from DCS where provided shall be engineered to ensure that signal communication time from / to DCS shall not exceed 1 seconds for control / feedback.

3.8.3. Serial communication to DCS shall be MODBUS protocol on RS 485 network.

3.8.4. Data transmitted from PLC to DCS shall include all information necessary for the DCS graphic displays to monitor and control the process equipment and PLC. Such data may include pertinent analog and digital status information, interlock, alarms and maintenance conditions. Data transmitted from DCS to the PLC shall include necessary signals to provide operator control interface from DCS for the process/ equipment being controlled by PLC.

3.9. POWER SUPPLY Scheme

3.9.1. BHEL shall provide 2 feeders of UPS category. Further distribution shall be in vendor's scope. Terminal point will be power TBs of PLC panel. Input feeder failure shall be monitored in the PLC system. Necessary redundant power pack and transformers shall be provided (in the PLC panel) to derive the power supply for control desk, PLC panel and input / output cabinets, Remote I/O Panels, OWS and associated HMI peripherals, etc.

4. DRAWING/DOCUMENT AND DATA TO BE FURNISHED AFTER AWARD OF THE CONTRACT:

4.1. For Approval:

- PLC system configuration drawing along with functional write-up.
- Input/output signal list.
- BOM of PLC
- List of PLC controlled devices
- Control panel/control desk GA drawings.
- Control desk/panel component layout drawing.
- Control panel/control desk Foundation detail and cutout drawings.

- Power distribution scheme.
- Block logic diagrams/ Ladder diagram mimic.
- Annunciation list.
- PLC control room layout drawing.
- List of soft signal exchange with Plant DCS.
- List of mandatory spares.
- Load list
- Quality plan
- FAT
- CRT display
- Power supply scheme for PLC system, HMI & peripherals, Remote I/O etc.

4.2. For Information:

- Cable schedule and cable interconnection drawing(in BHEL approved format)
  - Between Field and PLC
  - Between Field and MCC
  - Between MCC and PLC
- Electronic earthing requirements.
- Panel Heat dissipation data
- Product/component catalogues.
- Operation & Maintenance Manual on CDs.
- Softcopy of Final/As-built drawings on CDs.
- Calculation for Processor, Memory & Data bus loading

The above list is the minimum requirements. Additional documents/calculations required shall be finalized during contract stage.

5. DRAWINGS AND DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID

- Proposed PLC system configuration drawing with write-up
- Product catalogues and specifications for PLC as well as HMI application.
- Proposed power supply schemes for PLC system, peripherals, and Remote I/O panels.

6. TESTING AND INSPECTION

6.1. The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

6.2. BHEL's standard Quality Plan for PLC is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.

6.3. The complete PLC system, including all instrument and devices shall be subjected to standard factory tests (i.e. Type Tests and Routine Tests) as per relevant IS, NEMA, IEEE, IEC.

6.4. Factory Acceptance Test-FAT (Functional Tests) shall be performed prior to shipment and Owner/Purchaser shall be notified 15 days before the schedules dates of the test.

6.5. The certificates for following type tests, as per IEC Standard, shall be submitted: -

- Surge protection test as per IEC-225-4
- Dry heat test as per IEC-68-2-2
- Damp Heat test as per IEC-68-2-3
- Vibration Heat test as per IEC-68-2-6
- Electrostatic discharge test as per IEC-801-2 or equivalent
- Radio frequency Immunity test as per IEC-801-6 or equivalent
- Electromagnetic Immunity test as per IEC-801-3 or equivalent

7. SPARES AND CONSUMABLES

7.1. Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

7.2. Mandatory Spares

The bidder shall offer along with main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

7.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

7.4. Special Tools & Tackles

The bidder shall supply all Special Tools & Tackles 'as required' during Start-up and further maintenance of the system, as part of the main equipment supply.

7.5. Spares, Service support

Bidder shall provide availability of spares and service support for minimum 15 years after guarantee period.

8. MARKING AND PACKING

8.1. Marking:

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag/serial Number and salient technical specification.

8.2. Packing:

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain, moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in transit and storage in open.

9. PERFORMANCE AND GUARANTEE

The PLC system shall be guaranteed to meet the performance requirement as specified and also for trouble-free continuous operation for 12 months from the date of commissioning or 18 months from the date of delivery at site whichever is later unless specified otherwise in Vol-IIB Section - B or Section - C.

10. APPLICABLE DATA SHEET FORMS

This document shall be read with the following data sheet forms :

- Data Sheet A & B for PLC system - PE-DC-999-145-I036-1

FORM NO. PEM-6666-0

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I** VOLUME SECTION REV. NO. 00 DATE : 25.04.2016 SHEET OF

PLC DATA SHEET

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PLC SYSTEM FOR OZONE GENERATION PLANT** **1X370MW YELAHANKA CCPP**	SPECIFICATION NO.: PE-TS-409- VOLUME II B SECTION D REV. NO. 00 DATE: 25.04.2016 SHEET 1 OF 1

Data Sheet No.: **PES-145-36-DS1-0**

Data Sheet A&B

DATA SHEET – A FOR PLC SYSTEM **(TO BE FILLED BY PURCHASER)**			DATA SHEET – B **TO BE FILLED BY BIDDER)**
GENERAL	PROJECT	1X370MW YELAHANKA CCPP	
	SERVICE	OZONE GENERATION PLANT	
	QUANTITY	☐ UNITISED ■ COMMON	
	LOCATION	■ INDOOR ☐ OUTDOOR ■ AC ☐ NON-AC	
PLC EQUIPMENT	MAKE / MODEL NO.	BIDDER TO INDICATE	
	PROCESSOR	REDUNDANT WITH HOT STANDBY	
	DATA BUS (HMI)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (REMOTE I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	FIELD CONTACTS INTERROGATION VOLTAGE	■ 24 V DC ☐ 48 V DC ☐ 110 V AC	
	LOCATION OF COUPLING RELAYS	■ MCC ☐ PLC PANEL	
	DESKTOP OWS QUANTITY (OWS and EWS shall be as per PLC Configuration diagram attached elsewhere in the specification)	☐ ONE ■ THREE ☐ _____ ■ DESKTOP VERSION ☐ SERVER VERSION ☐ WORK STATION VERSION REQUIREMENT OF OWS IN CCR ☐ YES ☐ NO QUANTITY_____	
	DESKTOP MONITOR TYPE	☐ 19" ■ 24" TFT/CRT MONITOR ☐ GIU ☐ OTHERS	
	PRINTER	INKJET ☐ A3___NOS ☐ A4___NOS LASER B/W ☐ A3___NOS ☐ A4___NOS DOT MATRIX ☐ A3___NOS ■ A4 01 NOS COLOR LASER ■ A3/A4 01NOS	
	PROGRAMMING / CONFIGURATION FACILITY (OWS and EWS shall be as per PLC Configuration diagram attached elsewhere in the specification)	A) ☐ HAND HELD ☐ LAPTOP B) ENGINEERING SOFTWARE ■ TWO OWS ☐ ALL OWS ☐ _____	
	SAFETY STANDARD	To be compliant with safety standard of Ozone system	
	COMPUTER FURNITURE	BOQ ■ YES ☐ NO INDUSTRIAL GRADE ■ YES ☐ NO	
SPARE LIST	SPARE LIST	☐ START UP & COMMISSIONING ☐ MANDATORY SPARE ☐ RECOMMENDED	
	SPARE LIST ATTACHED	☐ YES ☐ NO	
REDUNDANCY	CPU	■ YES ☐ NO	
	POWER SUPPLY	■ YES ☐ NO	
	COMMUNICATION	■ YES ☐ NO	
	I/O CARD	☐ YES ☐ NO	
	OTHER ELECTRONICS	☐ YES ☐ NO	

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PLC SYSTEM FOR OZONE GENERATION PLANT** **1X370MW YELAHANKA CCPP**	SPECIFICATION NO.: PE-TS-409- VOLUME II B SECTION D REV. NO. 00 DATE: 25.04.2016 SHEET 1 OF 1

Data Sheet No.: **PES-145-36-DS1-0**

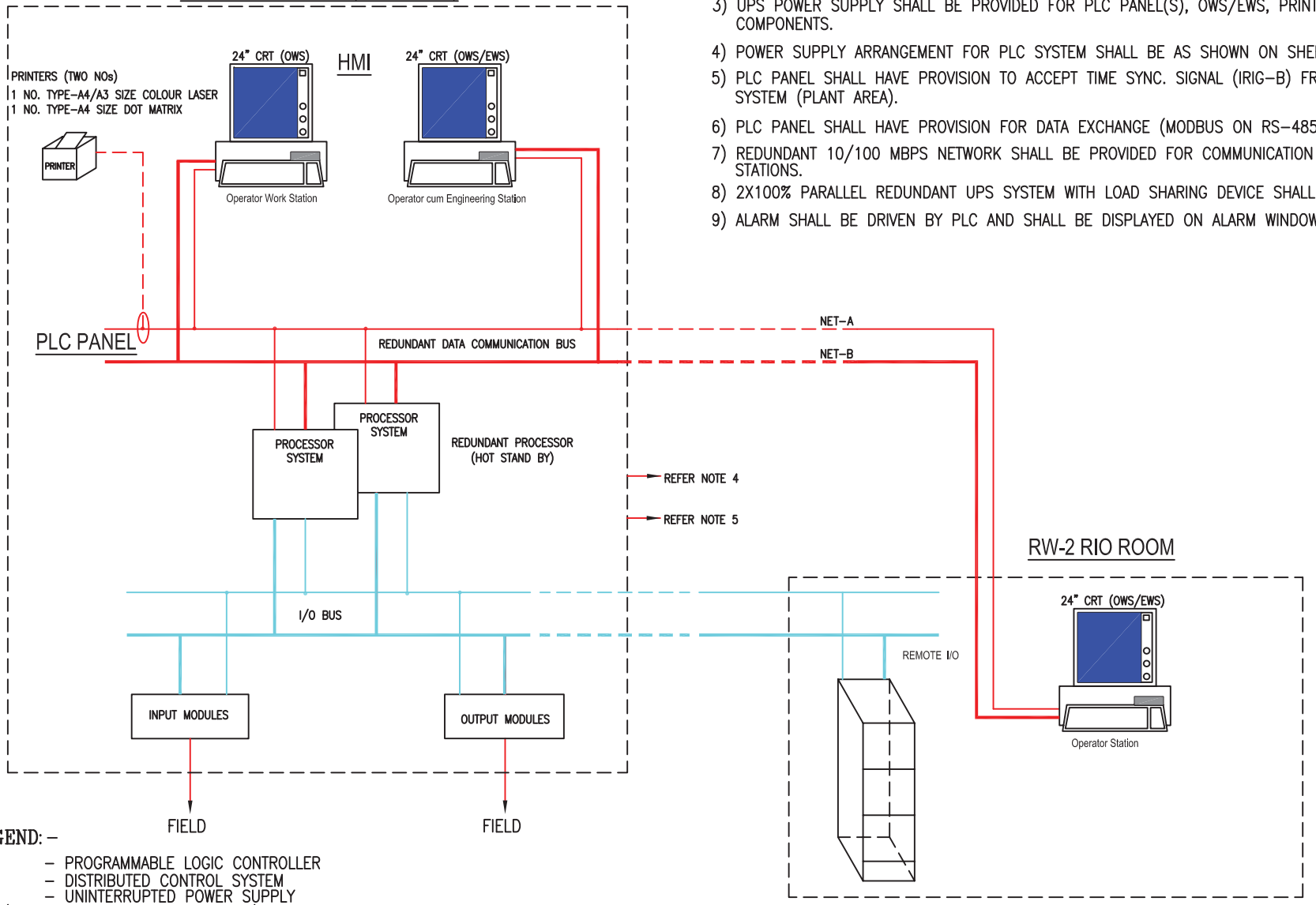
Data Sheet A&B

		DATA SHEET – A FOR PLC SYSTEM **(TO BE FILLED BY PURCHASER)**	DATA SHEET – B **TO BE FILLED BY BIDDER)**
No. of CHANNELS PER CARD	ANALOG INPUT	☐ 8 NOs ■ 16 NOs	
	ANALOG OUTPUT	☐ 8 NOs ■ 16 NOs	
	BINARY INPUT	☐ 16 NOs ■ 32 NOs	
	BINARY OUTPUT	☐ 16 NOs ■ 32 NOs	
	RTD**	4 NOs	
	THERMOCOUPLE**	8 NOs	
	ELECTRONIC CARD ISOLATION	■ GALVANIC ☐ OPTICAL ☐ OTHER	
PANEL	QUANTITY	BIDDER TO INDICATE	
	CLASS OF PROTECTION(Refer Location of PLC)	■ IP-42	
	REMOTE I/O PANEL	■ YES ☐ NO AC REQUIREMENT ☐ YES ☐ NO	
	COLOUR#	RAL 7032	
	BACK-UP DESK	☐ YES ■ NO	
	MIMIC	☐ YES ■ NO IF YES,THEN ☐ PANEL MOUNTED GUI ☐ ACRYLIC	
	CONTROL HARDWARE	☐ PB ☐ INDICATORS ■ FACIAS 25 Nos. ☐ OTHERS	
	CONFORMAL COATING	☐ YES ■ NO	
COMMUNICATION WITH OTHER SYSTEM	HARDWIRED	■ YES (Critical signals) ☐ NO	
	PURPOSE	☐ CONTROL ■ MONITORING	
	MEDIUM	■ UTP ☐ FIBRE OPTIC ☐ OTHERS	
	TIME SYNCRONIZATION SIGNAL FORMAT	☐ PULSE ☐ RS-485 ■ IRIG-B ☐ NTP	
	SOFTLINK	■ MODBUS ☐ OPC IF MODBUS THEN ■ RS-485 ☐ ETHERNET	
	SERIAL LINK	COMMUNICATION PORT TYPE _____	
POWER SUPPLY INPUT FEEDER	PLC PANEL	BIDDER TO INDICATE LOAD DATA	
	REMOTE I/O PANEL	BIDDER TO INDICATE LOAD DATA	
POWER SUPPLY	SOURCE	☐ UPS(INDUSTRIAL GRADE) ☐ 24V DC CHARGER	
	BATTERY TYPE	☐ Ni-Cd ■ LEAD ACID ☐ OTHERS	
	BACK-UP TIME	☐ 30 MINS ■ 60 MINS ☐ OTHERS	
	BATTERY CONFIGURATION	■ 1X100% ☐ 2X100% ☐ 2X50%	
CUSTOMER TRAINING	TRAINING	■ REQUIRED ☐ NOT REQUIRED	
	NO OF DAYS	3 DAYS	
	LOCATION	☐ VENDOR'S WORK ■ PROJECT SITE ☐ OTHERS	

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I**	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 25.04.2016
		SHEET OF	

PLC CONFIGURATION

PLC ROOM FOR RW-1 + CW + RW-2 (RIO ROOM)



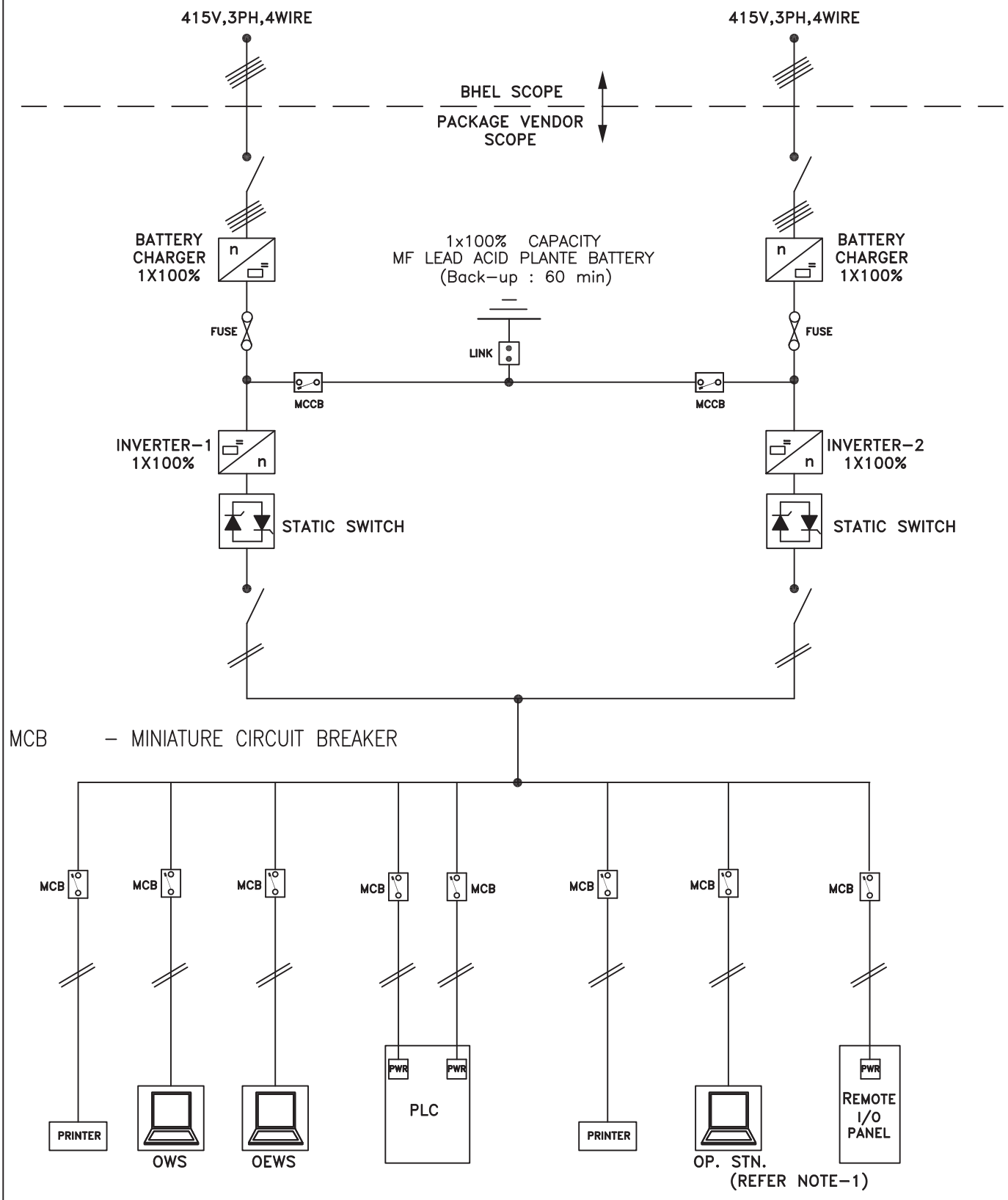
NOTES:

1) TABLE TOP OWS/EWS SHALL BE 24" OR AS PER AVAILABLE INDUSTRY STANDARD, WHICHEVER IS HIGHER.
2) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR, COMMUNICATION SYSTEM AND POWER SUPPLY.
3) UPS POWER SUPPLY SHALL BE PROVIDED FOR PLC PANEL(S), OWS/EWS, PRINTER AND NETWORK COMPONENTS.
4) POWER SUPPLY ARRANGEMENT FOR PLC SYSTEM SHALL BE AS SHOWN ON SHEET 2 OF 2.
5) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (IRIG-B) FROM MASTER CLOCK SYSTEM (PLANT AREA).
6) PLC PANEL SHALL HAVE PROVISION FOR DATA EXCHANGE (MODBUS ON RS-485) WITH PLANT DCS.
7) REDUNDANT 10/100 MBPS NETWORK SHALL BE PROVIDED FOR COMMUNICATION BETWEEN PROCESSOR/WORK STATIONS.
8) 2X100% PARALLEL REDUNDANT UPS SYSTEM WITH LOAD SHARING DEVICE SHALL BE PROVIDED.
9) ALARM SHALL BE DRIVEN BY PLC AND SHALL BE DISPLAYED ON ALARM WINDOWS.

LEGEND: –

PLC – PROGRAMMABLE LOGIC CONTROLLER
DCS – DISTRIBUTED CONTROL SYSTEM
UPS – UNINTERRUPTED POWER SUPPLY
OWS/EWS – OPERATOR WORK STATION/ ENGINEERING WORK STATION
HMI – HUMAN MACHINE INTERFACE
RIO – REMOTE INPUT OUTPUT
RW – RAW WATER
CW – COOLING WATER

बीएचईएल BHEL	PLC SYSTEM CONFIGURATION	DRG. NO.	PE-DM-409-145-I900
		REV. No.	DATE 04.04.16
		SHEET	01 OF 02



NOTEs: –

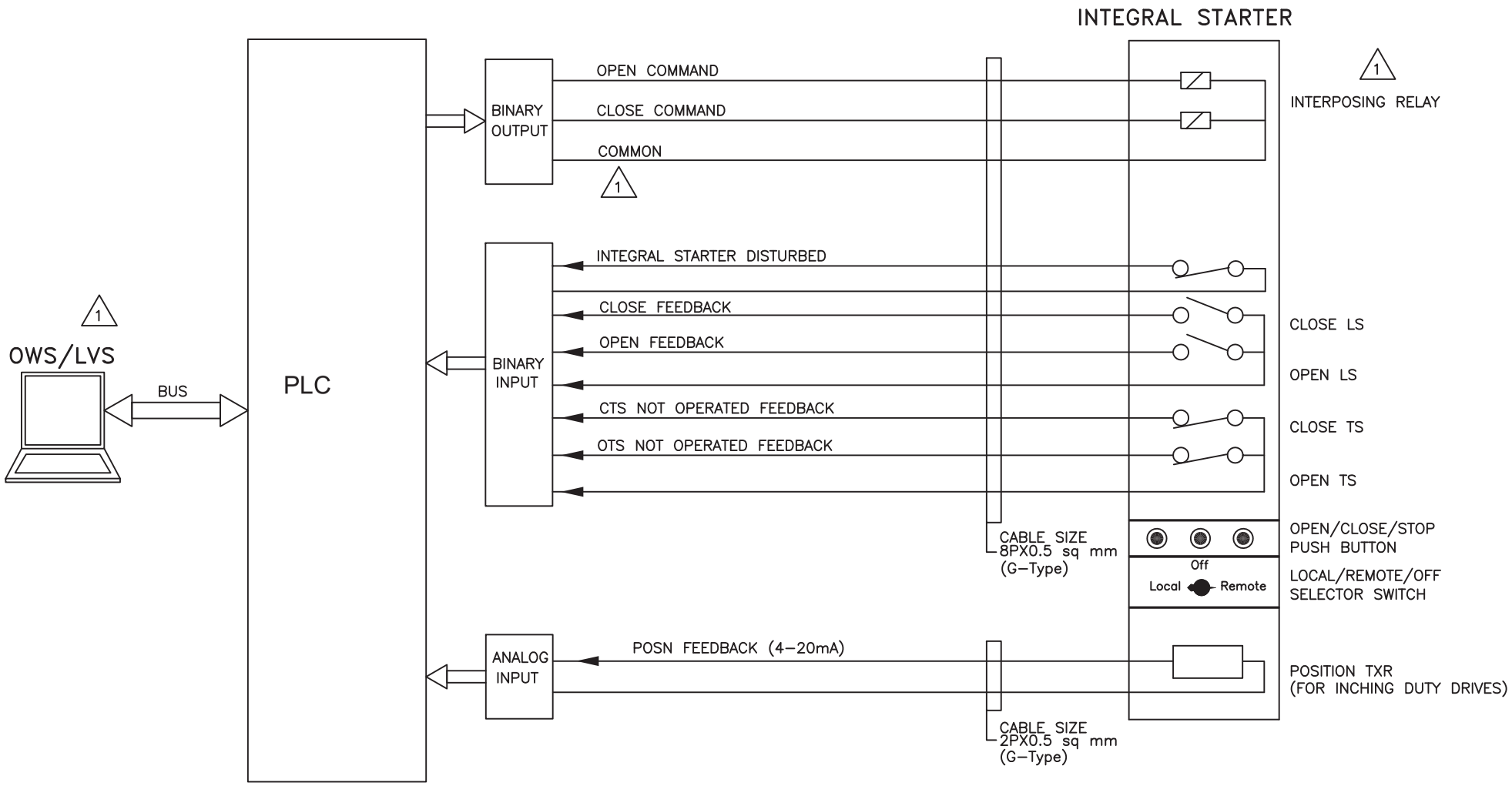
1) SEPARATE UPS MAY BE CONSIDERED IF REQUIRED.

BHEL	TITLE:– POWER SUPPLY ARRANGEMENT FOR PLC BASED CONTROL SYSTEM	DRG. NO.	PES–145–36A
		REV. No.	DATE 04.04.16
		SHEET	02 OF 02

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I** VOLUME SECTION REV. NO. 00 | DATE : 25.04.2016 SHEET OF

Drive Control Philosophy

PLC INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)



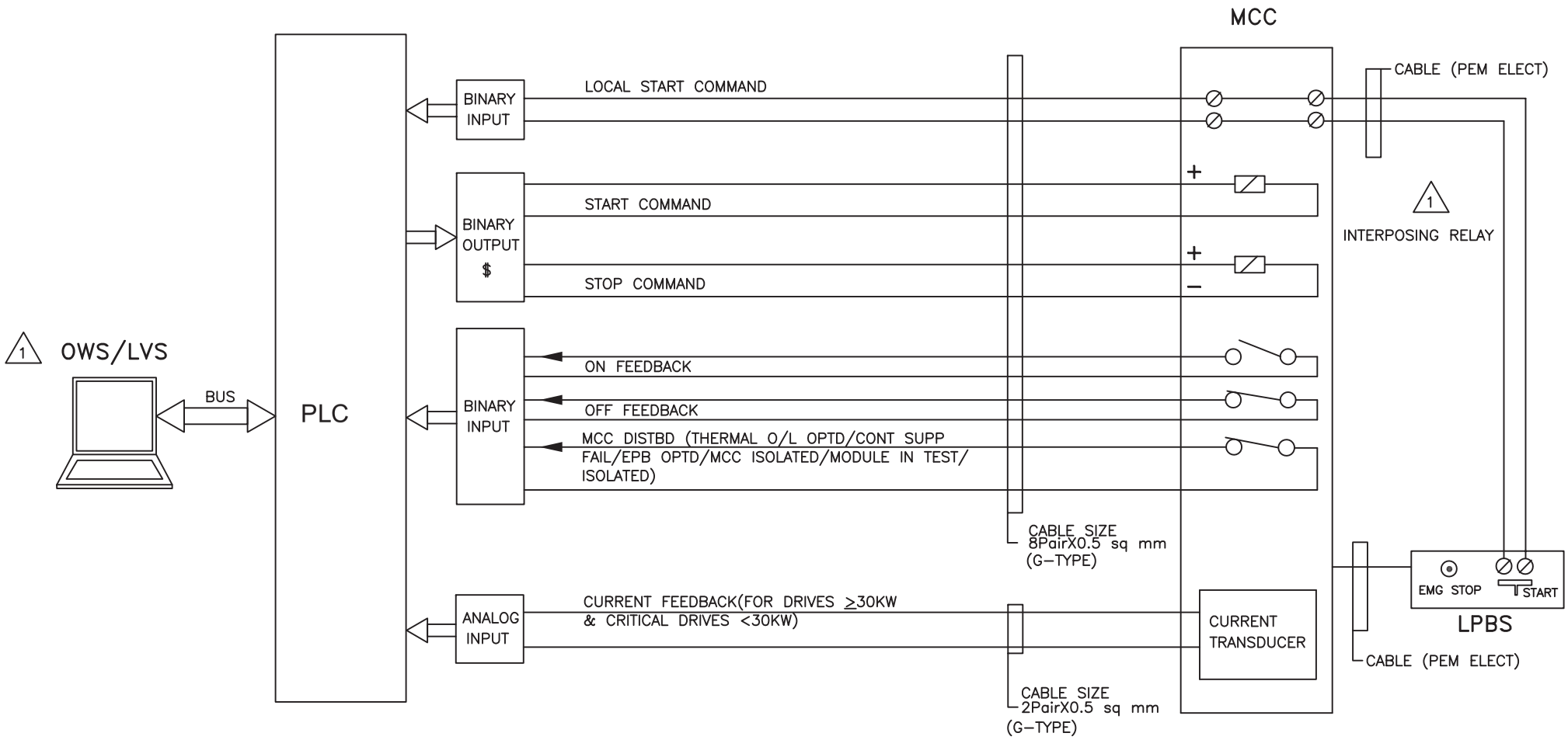
NOTE:

1. DISTURBED= Loss of Power supply (1 Phase/3 Phase), Loss of control supply, Motor thermostate trip, Thermal over load relay trip, TS open/close cut off, Local/Off/Remote S/S in local or Off mode etc.

1

BHEL	PROJECT: KARNATAKA POWER CORPORATION LIMITED 1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT	DRG.NO.	PE-DM-409-145-I002
		DATE	23.02.2016
	TITLE: PLC INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	01
		SHT	8 OF 13

PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE–CONTACTOR OPERATED



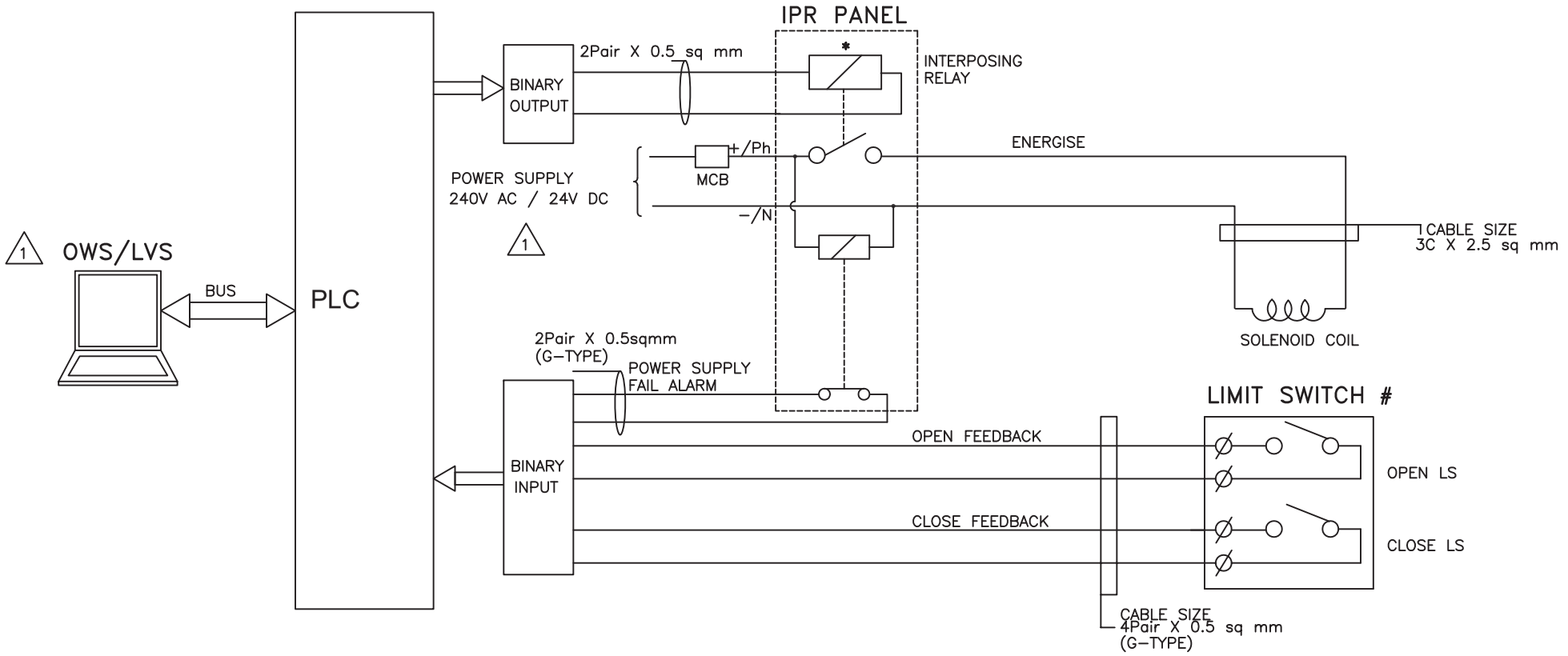
1

NOTES:

$ Redundant output for Critical Drives.

BHEL	PROJECT: KARNATAKA POWER CORPORATION LIMITED 1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT	DRG.NO.	PE–DM–409–145–I002
		DATE	23.02.2016
	TITLE PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE–CONTACTOR OPERATED	REV.NO.	01
		SHT	9 OF 13

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



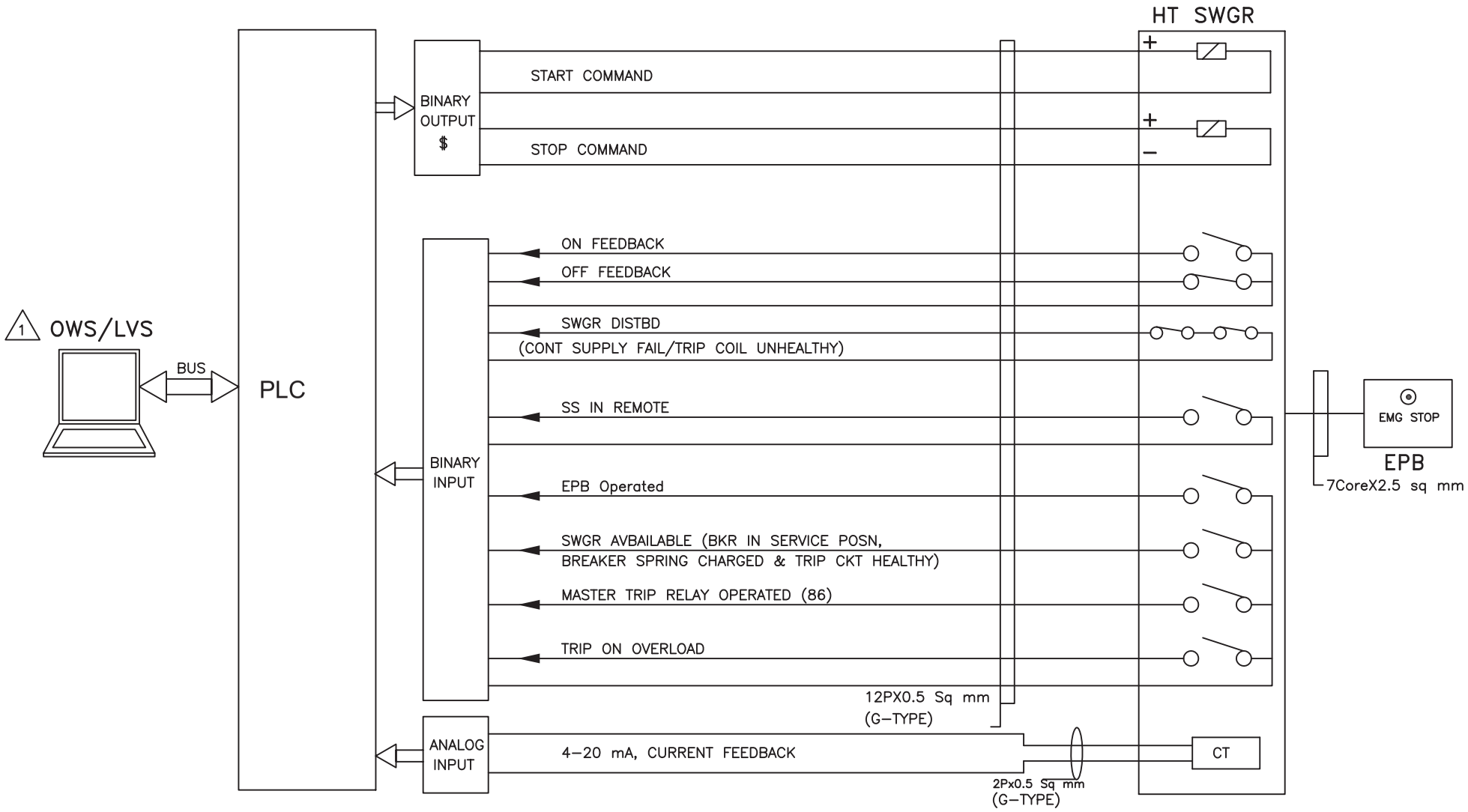
NOTES:

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

\# FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

BHEL	PROJECT: KARNATAKA POWER CORPORATION LIMITED 1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT	DRG.NO.	PE−DM−409−145−I002
		DATE	23.02.2016
	TITLE: PLC INTERFACE FOR SOLENOID DRIVE	REV.NO.	01
		SHT	10 OF 13

PLC INTERFACE FOR UNIDIRECTIONAL HT/LT DRIVE-BREAKER OPERATED



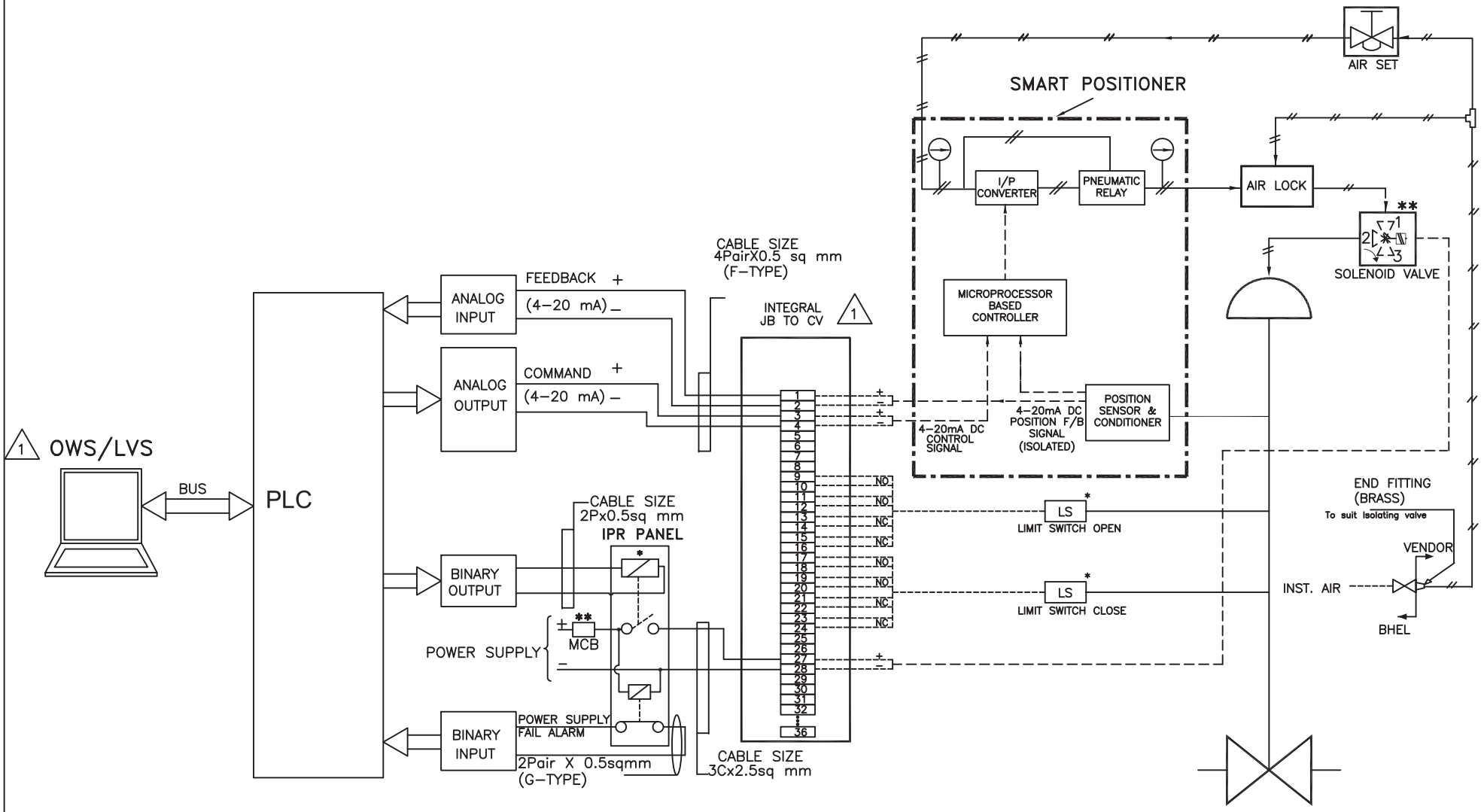
1

NOTES:

$ Redundant output for Critical Drives.

BHEL	PROJECT: KARNATAKA POWER CORPORATION LIMITED 1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT	DRG.NO.	PE-DM-409-145-I002
		DATE	23.02.2016
	TITLE PLC INTERFACE FOR UNIDIRECTIONAL HT/LT DRIVE-BREAKER OPERATED	REV.NO.	01
		SHT	11 OF 13

PLC INTERFACE FOR ANALOG DRIVE



NOTE:-

** WHEREVER REQUIRED

* WHEREVER REQUIRED LIMIT SWITCHES SHALL BE WIRED TO DCS FOR INTERLOCK (RECIRCULATION VALVES, ON/OFF DUTY CONTROL VALVES & WHEREVER REQUIRED FOR INTERLOCK).

BHEL	PROJECT: KARNATAKA POWER CORPORATION LIMITED 1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT	DRG.NO.	PE-DM-409-145-I002
		DATE	23.02.2016
	TITLE: TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE	REV.NO.	01
		SHT	12 OF 13

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I** VOLUME SECTION REV. NO. 00 | DATE : 25.04.2016 SHEET OF

INSTRUMENTATION DATA SHEET

2.16 General Guidelines for Provision of Instruments

FIELD INSTRUMENTS SHALL BE SUPPLIED AS PER AGREED PID :

- PRESSURE TRANSMITTERS
- DIFF. PRESSURE TRANSMITTERS
- DISPLACEMENT TYPE LEVEL TRANSMITTERS
- THERMOCOUPLES WITH THERMOWELLS
- RESISTANCE TEMPERATURE DETECTORS (PT 100)
- PRESSURE GAUGES
- DIFFERENTIAL PRESSURE GAUGES
- TEMPERATURE GAUGES
- LEVEL GAUGES
- PRESSURE SWITCHES
- DIFFERENTIAL PRESSURE SWITCHES
- LEVEL SWITCHES
- ~~SIGHT FLOW INDICATOR~~
- ~~OIL FLOW METER~~
- ~~ROTAMETERS~~
- FLOW SWITCH
- ~~ANUBAR~~

TECHNICAL SPECIFICATIONS FOR FIELD INSTRUMENTS, PLC, VMS, CCTV AND OTHER EQUIPMENT/SYSTEMS

- All instruments offered by the Contractor shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven as mentioned in design criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance. They shall comply with the 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 specifications.

- The Contractor shall furnish all Instrumentation/ Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/ erection of these transmitters shall be furnished, even if not specifically asked for, on as required basis. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm

Smart Electronic Transmitters for Measurement of Pressure, Differential Pressure(DP) & Flow/Level(DP Type):

- Micro-processor based indicating type (LCD display), rack mounted with accuracy of +/- 0.1% of span, Repeatability :+0.05% of FSR or better, Linearity :+0.1% of FSR or better. Hystersis: +0.1% of FSR or better. external zero and span adjustment, self diagnostics, temperature sensor for compensation. Power supply 24 V DC; output signal of 4- 20 mA DC. IP 65 or equivalent degree of protection with epoxy coating, 316 SS/ haste alloy/ other suitable sensing element. Accessories like snubbers for pump discharge applications and chemical diaphragm with 15 m PVC covered SS armoured capillary for corrosive and oil services, etc. Material for accessories will be SS. HART protocol output shall be available in each transmitter. In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold. LVDT type is not acceptable.

- Wherever, the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application

<u>In Detail Technical Specification:</u>

1)Type of Transmitter: Microprocessor based 2 wire type HART protocol compatible, .

2) Accuracy : - +/- 0.1 % of span

3) Output Signal Range: 4-20 mA DC(Analog) Super imposed digital on HART protocol
4)Turn Down Ratio : 10:1 for vacuum/very low pressure applications
30:1/100:1 for other applications
5) Stability: +/-0.1% of calibrated span for 6 months up to 70 KSC &
+/- 0.25% for range more than 70 KSC(g).
6) Zero and Span Drift: +/- 0.015% per Deg.C at max. span and
0.11% per Deg.C at Minimum Span
7) Load Impedance: 500 ohm (Min)
8) Housing: Weather proof as per IP-65 with durable corrosion resistant coating
9) Over Pressure - 150 % of Max. operating pressure
10) Connection(Electrical)- Plug and socket type
11) Process Connection - 1/2 inch NPT (F)
12) Span and Zero: Continuous, tamper proof, Remote Adjustability as well as manual from instrument with zero suppression and elevation facility.
13) Accessories a) Diaphragm seal, pulsation dampeners syphon etc. as required by service and operating condition.
b) 2/3/5 Valve manifold as applicable
14 Diagnostics: Self Indicating Feature
15) Power Supply: 24 V DC +/- 10%
16) Adjustment : Calibration facility via Centralized PC based HART management system

In addition to the transmitters 6 Nos. of hand held calibrators for configuration shall be provided for maintenance of units

2.16.1 **Pressure indicators** shall be provided for

Suction and discharge lines of pumps including on header section if two or more pumps are employed for the same service and transmitters.

2.16.2 **Pressure switches** shall be provided for

(a) On all process lines / equipment where parameter abnormality / status including pre-trips alarms to be communicated to the operator in control room.

(b) For all permissives and protection conditions governed by safety operation of the equipment e.g., pressure adequate, pressure very high / low conditions.

(c) For all interlock conditions which governs starting of standby equipment or subsequent equipment for safety operation of the system.

(d) 3 switches shall be employed for protection in case of critical applications.

Inlet and outlet of filters / strainers.

2.16.3 **Differential Pressure Switches** shall be provided

(a) Across filters / strainers for remote monitoring

(b) Across condenser CW line for remote monitoring and interlocks.

2.16.4 **Differential pressure indicators** shall be provided

(a) Across filters / strainers for local monitoring.

(b) Across condenser CW line for local monitoring

2.16.5 **Pressure Transmitters** shall be provided

(a) At suction and discharge of all major pumps.

(b) For all control applications as demanded by the process. It shall be noted that for all critical control applications, 3 transmitters shall be provided.

(c) Pressure conditions of all major vessels / tanks like deaerator, hotwell, HP / IP / LP drums, etc.

(d) All inputs for equipment / unit performance calculation.

2.16.6 **Differential pressure transmitters** shall be provided for

(a) all the requirements of differential pressure, flow and level measurements.
(b) control applications.

All inputs for equipment / unit performance calculation.

2.16.7 **Temperature indicators (Thermometers)** shall be provided.

(a) On all process lines where local indication is warranted by the system either for monitoring or testing.

(b) On the inlet / outlet equipment such as heaters, desuperheaters, Heat exchangers and coolers for both the fluid media.

2.16.8 **Temperature switches** shall be provided

(a) On all process lines where parameter abnormality is to be communicated to the operator in control room.

(b) For all permissive, interlock and protection conditions governed by the safety operation of the equipment. For all critical services 3 nos., shall be provided for protection application.

2.16.9 **Resistance temperature detectors (RTD's)** shall be provided for all services where maximum temperature does not exceed 150 degree centigrade. RTD shall be 3 wire type, duplex with thermowell.

E.g., Suction / Discharge of pumps, inlet / outlet of heat exchangers, pump / motor bearings, motor windings, etc. RTD is employed for remote display, for control applications and density correction for flow measurement.

2.16.10 **Thermocouple**: Shall be provided for all services where normal operating temperature exceeds 150^0C.

(a) The element shall be duplexed integral with thermowell, K-type for temperature upto 600^0C and R-type for temperature above 600^0C.

(b) The thermocouple is employed for remote display, for control applications and density correction for flow measurements.

(c) Compensating cable shall be provided with all thermocouples as required to make the system complete.

2.16.11 **Temperature transmitters**: Shall be provided where thermocouples / RTD are used for control application. For bearing temperature, winding temperature and metal temperature, field located remote multiplexing units with digital communication to control room electronics can be considered. Otherwise, thermocouples with compensating cable to control room also can be run.

Temperature transmitters shall be mounted in marshalling cabinets in electronic cubicle room, compensating cables shall be run from the temperature element to the temperature transmitters.

2.16.12 **Level gauges:** Shall be provided on all tanks and the maximum length of one gauge glass shall not exceed 1 metre. The gauge glasses shall be stacked to cover the complete height of the tanks including over flow level. All high pressure vessel shall be provided with level gauges on either end as per Boiler statutory requirement.

2.16.13 **Level switches** : The instrument shall be provided on all equipment (storage vessel) where parameter abnormality / status to be communicated to the operator in the control room.

All permissive, interlock and protection conditions governed by the safety operation of the equipment. For all critical services, 3 switches shall be provided for protection application.

The instrument shall be external cage type with SW connection with isolation facility for surface mounted tanks and top mounted with still pipe for all sumps.

2.16.14 Level transmitters shall be provided on process equipment where continuous remote monitoring and/or control of level is envisaged.

The instrument shall be differential pressure type or displacement type.

2.16.15 Flow Glasses shall be provided at the outlet of the pipe line shall be employed under the following conditions:

Coolant from the equipment (coolers).

The instrument shall be rotary type with glass mounted for indication.
Upto 4 inch on-line flow glasses shall be supplied and above 4 inch bypass type flow glasses shall be provided.

2.16.16 Flow Switches shall be provided at different outlet header of identical equipment to alarm in the event of inadequate coolant requirement. (or) lub oil.

2.16.17 Flow elements shall be provided as mentioned below.

Orific plate shall be provided as shown in the PID.

2.16.18 Control valves shall be provided for all control application as required and in line with the system requirement. If the process

(b) **Gas analysers**

The following gas analysers shall be provided at the location indicated below:

- HRSG stack for each HRSG: SO_2, NOx, SPM.

2.16.25 **Transmitter racks**

All the pressure, flow and level transmitters shall be grouped depending the geographical locations and mounted on transmitter racks.

2.16.26 **Junction boxes shall be provided for :**

(a) Termination of all sensors and transmitters located area-wise.

(b) Termination of transmitters mounted on the transmitter racks.

(c) Termination of both the contacts of switches and duplex elements of temperature measurement.

2.17 **Instrumentation and Control Cables**

Instrumentation and control cables and power cables shall be supplied to :

(a) Connect field instruments to marshalling cabinets in the control room through field junction boxes.

(b) Connect limit switches, torque switches, proximity switches, and position transmitters to their respective motor control centres / switchgears and marshalling cabinets through field junction boxes.

(c) Connect interposing relay contacts from relay cabinet in the control room, the motor control centres / switchgears and solenoid valves through power supply distribution board.

(d) Control desk cabling, annunciation/SER system cabling, power supply cables from distribution board to system cabinet.

Specification for cables is covered in Electrical Section.

2.18 Impulse Pipes and Fittings

Impulse pipes, tubes, fittings and air supply and signal piping / tubing shall be supplied for all the instruments under the scope of this specification as per Table 1 in this section.

2.19 Selection of Ranges for Instruments

The ranges of the instruments shall be selected based on the philosophy indicated below:

(a) For pressure and draft measurements, the maximum operating pressure shall be within 70 to 80% of the maximum scale range. All pump suction measurement will cover the negative pressure range also and all draft gauges will cover the negative pressure as well as the positive pressure as the case may be.

(b) For temperature measurement, the maximum operating temperature will be within 80 to 90% of the maximum scale range.

(c) For pressure switches and temperature switches, the set points shall fall within 40% to 70% of the scale range selected.

(d) For level measurement, the maximum of the range will cover the overflow point or six inches from the top of the vessel and the minimum of the range will be stacked with overlap to cover permissive, alarm and trip levels.

2.20 Performance Test Points

(a) Pressure, temperature and flow test points shall be provided in line with performance test code requirements

(b) Pressure test points shall be complete with root valves and shall terminate with a nipple

(c) Temperature test points shall be provided with thermowell.

(d) All instruments required for performance testing to prove the performance of the Instrumentation and Control Equipment shall be provided by the Contractor for the duration of the performance test. These test instruments shall have test certificates from reputed test house valid for the duration of the performance test.

2.22.3.6 Tables suitable for dot matrix/laser/inkjet printers shall be provided. The exact details shall be finalised& approved during detailed engineering.

2.23 Specifications for Instruments

2.23.1 Pressure Indicators

Direct reading, pipe mounted Pressure gauges of aluminium casing with 150 mm inch phenolic dial (white dial with black numerals), 316 SS Bourdon tube, nylon movements and micrometer type adjustable pointer, accuracy of ±0.5% of span including accessories like syphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services and name plate. Material of accessories will be SS. IP65 or equivalent degree of protection for enclosure. Over range protection will be 25% above maximum pressure. Armoured capillary of 15m shall be provided. Boudon tube shall be drawn tube for pressure < 70 bar (g) and bored tube for > 70 bar (g).

2.23.2 Pressure Switches

Non indicating type, field mounted Pressure Switches of aluminium casing (epoxy coated), and 316 SS element and accuracy of ±1% of span, including accessories like syphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services, name plate and mounting brackets. Material of accessories will be SS. Auto reset micro switch with internal adjustment for set values with 2 SPDT contacts rated for 0.2 A at 220 V DC. IP 65 or equivalent degree of protection for enclosure. Over range protection 50% above maximum pressure. Scale for setting shall be provided repeatibility shall be ± 0.5% of full scale range.

2.23.3 Pressure Transmitters

Micro-processor based **Smart Electronic Transmitters**, rack mounted with accuracy of ±0.1% of span, field zero and span adjustment, self diagnostics, temperature sensor for compensation. Power supply 24 V DC; output signal of 4-20 mA DC and digital signal with HART protocol. Two nos. HART communicator with pre-loaded device program shall be provided for smart pressure / differential pressure transmitters. IP 65 or equivalent degree of protection. Aluminium housing with epoxy coating, 316 SS sensing element. Accessories like snubbers for pump discharge applications and chemical diaphragm with 15 m PVC covered SS armoured capillary for corrosive and oil services. Material for accessories will be SS.

2.23.4 **Differential Pressure Indicators**

Direct reading type, pipe mounted, bellows or diaphragm operated differential pressure indicators; aluminium casing (epoxy coated) with 150 mm dial, 316 SS pressure element; accuracy of ±0.5% of span including accessories like snubbers for pump discharge application, chemical diaphragm with 15 m PVC covered SS armoured capillary for each limb for corrosive and oil services and 3 way manifold. Material of accessories will be SS. IP 65 or equivalent degree of protection. Over range protection will be 50% above maximum pressure.

2.23.5 **Differential Pressure Switches**

Bellows or diaphragm operated non-indicating field mounted type; aluminium casing (epoxy coated); 316 SS pressure element nylon movement; accuracy of ±1% of span with an adjustable contact including accessories like snubbers for pump discharge applications, chemical diaphragm with 15 m capillary for each limb for all corrosive and oil services and 3 way manifold. Material of accessories will be SS. Auto reset micro switch with tamper proof external adjustable set values with 2 SPDT contacts rated for 0.2 A at 220 V DC. IP 65 or equivalent degree of protection over range protection 50% above maximum pressure. Repeatability shall be ±0.5% FSR.

2.23.6 **Smart Electronic Transmitters for Measurement of Pressure, Differential Pressure(DP) & Flow/Level(DP Type):**

Micro-processor based indicating type (LCD display), rack mounted with accuracy of +/- 0.1% of span, Repeatability :+0.05% of FSR or better, Linearity :+0.1% of FSR or better. Hystersis: +0.1% of FSR or better external zero and span adjustment, self diagnostics, temperature sensor for compensation. Power supply 24 V DC; output signal of 4- 20 mA DC. IP 65 or equivalent degree of protection with epoxy coating, 316 SS/ haste alloy/ other suitable sensing element. Accessories like snubbers for pump discharge applications and chemical diaphragm with 15 m PVC covered SS armoured capillary for corrosive and oil services, etc. Material for accessories will be SS. HART protocol output shall be available in each transmitter.

In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold. LVDT type is not acceptable.

Wherever, the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2.23.7 **Thermometers**

Indicating type, field mounted, filled system with ten (10) metres capillary and six (6) inch white dial with black numerals with micrometer pointer housed in aluminium casing (epoxy coated) with an accuracy of ±1% of span, response time of 2-4 seconds, auto temperature calibration, linear calibration over the range and 316 SS thermowell having a process connection of M33 x 2 thread. Material of accessories will be SS. IP 54 or equivalent degree of protection for enclosure. Thermowell with Hex head of fabricated assembly for air and flue gas system for rest of the services bar stock assembly. The thermowell construction shall meet the ANSI 19.3 (latest) requirements.

2.23.8 **Thermowells**

Pipe/equipment mounted temperature test wells of 316 SS (SS 446 for flue gas services) with a process connection of M33x2 thread. Material of accessories will be SS. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly. In case flanged wells are required for any specific application, the same shall be supplied as required. The thermowell construction shall meet the ANSI 19.3. (latest) requirements.

2.23.9 **Temperature Switch**

Non-indicating type, field mounted, filled system with ten (10) metre capillary housed in Aluminium casing (epoxy coated) with an accuracy of ± 1% span, auto temperature calibration, linear calibration over the range and 316 SS thermowell having a process connection of M33x2 thread. Micro switch with reset type with adjustable set values with 2 SPDT contacts rated for 0.2 A, 220 V DC. IP 54 or equivalent degree of protection for enclosure. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly. Material of accessories will be SS. The thermowell construction shall meet the ANSI 19.3 (latest) requirements. Scale shall be provided for setting. Repeatability shall be ± 0.5% of full scale. For ambient temperature applications switches designed for cross ambient operation shall be used.

2.23.10 **Thermocouple Assembly**

Duplex type with accuracy of ±0.5% of span, response time of 2 to 6 sec, Spring loaded mineral insulated thermocouple assembly with 316 SS thermowell housed in aluminium casing (epoxy coated) having a process connection of M33 x 2 thread. Material of accessories will be SS. IP 54 or equivalent degree of protection for enclosure. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly with ungrounded junction. For metal temperature measurement weldable thermocouple pads shall be provided with thermocouple extension wires of required length. Element size shall be 18 AWG. Insulation resistance at 540°C shall not be less than 5 M Ω. Temperature devices provided with thermowells shall be calibrated with the associated thermowell as an assembly construction and shall meet the ANSI 19.3 (latest) requirements.

2.23.11 **Resistance Temperature Detectors (RTD)**

Duplex type with accuracy of ±0.5% of span, response time 1-2 seconds; Spring loaded mineral insulated three (3) wire RTD assembly with 316 SS Thermowell housed in aluminium casing (epoxy coated) having a process connection of M33 x 2 thread. IP 54 or equivalent degree of protection for enclosure. Material of accessories will be SS.

2.23.12 **Temperature Transmitters Smart Electronic Transmitters:**

Temperature transmitters shall be provided where thermocouples/ RTD'S are used for control application.

Indicating type, control room mounted temperature transmitters with an accuracy of ±0.25%, ref. junction compensation, span/zero adjustment, burn out protection upscale, input/output isolation, circuit ungrounded, ambient temperature error 0.1%/10°C to provide linear output of 4-20 mA DC (2 wire system). Nema 4 or equivalent degree of protection for enclosure. Material of accessories will be SS.

2.23.13 **Level Gauges**

Reflex / tubular type with automatic ball check valves, illuminator, pyrex / borosilicate glass, guard rods and Holders. Material of accessories will be SS.

2.23.14 **Level Switches**

External magnetic float operated level switches for tanks and vessels and top mounted level switches for sumps and underground tanks. Micro switch with 2 SPDT contacts rated for 0.2 A, 220 V DC. Material of float will be 316 SS and the material of accessories will be SS. IP 54 or equivalent degree of protection for enclosure.

2.23.15 **Displacement Type Level TransmittersSmart Electronic Transmitters:**

Displacement type level transmitters of float length of 14 inches or 32 inches with an accuracy of ±0.5% of span, 4-20 mA DC output (2 wire system), +24 V DC supply, isolated and ungrounded electrical circuits, zero adjustment (100% of sensing element) for control application and measurement purposes. IP 54 or equivalent degree of protection for enclosure. Displacer / float material of 316SS. The material of accessories will be SS.

2.23.16 **Flow Glasses**

Online flow glasses for pipe size up to 80 mm with a rotary wheel (not a flapper type) suitable for installation on vertical or horizontal pipe lines, material pyrex tempered glass. The material of accessories will be SS.

2.23.17 **Flow Elements**

316 SS long radius, weld in flow nozzles with D and D/2 pressure tappings; 316SS flow orifice plate assembly with flange tap connections; β ratio of 0.5 to 0.7. Element material of SS 316. The material of accessories will be SS. End connections for flow elements will be butt welded except orifice plate on condensate return line to CST which will be flanged. The flow elements shall be designed in accordance with ISO 5167 / BS 1042. The accuracy of the flow element for steam flow / feed water flow measurement shall be ± 2% or better. Unit of measurement shall be metric tonnes / hour.

2.23.18 **Air Filter Regulator (AFR)**

Constant bleed type AFR with an accuracy of ±0.1%, inlet pressure range of 5-8 kg/ cm2 and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E/P convertors and shut off valves for phosphor bronze filter element; Filtering particles above five microns. Weather and water proof enclosure. Material of accessories will be SS.

2.23.19 **Electro-Pneumatic Convertors (E/P)**

Two wire type E/P convertors with an accuracy of ±0.5% accepting 4-20 mA dc signals from control system and converting to 0.2 to 1 kg/cm2 air pressure to operate valve positioner of all final control elements; Housed in cast aluminium casing (with polyurethane paint); NEMA 4 or equivalent degree of protection for enclosure. Material of accessories will be SS.

2.23.20 **Pressure and Differential Pressure Transmitter Racks**

Open type transmitter racks to mount all pressure, differential pressure and flow transmitters with vibration damper (Keldur); air supply lines and header will be provided with bulk head fittings to receive impulse lines; Also provided with blow down/drain header. The material of accessories will be SS.

2.23.21 **Junction Boxes**

Wall/column mounted junction boxes having screwed terminals and cable entry only at the bottom and sealed with fire proof compound; The material of accessories will be SS. IP 54 or equivalent degree of protection for enclosure. Separate terminal blocks shall be used for analog and digital signals and also for signals with different voltages.

2.23.22 **Interposing Relays (IPR)**

Electro magnetic type IPRs with plug-in type connections, suitable for channel/rail mounting in cabinets; coil rating 24V D.C; 2 set of change over contacts rated for 0.2A 220 V DC. Free wheeling diode across relay coil and self reset type status indicator flag (electronic) shall be provided.

2.23.23 **System Cabinets**

Indoor located, free standing vertical type system cabinets with 3 mm thick sheet metal of cold rolled steel; double doors; antivibration pads of 15 mm thick; Fluorescent lighting; cooling fans in each cabinet fire proof compound for sealing cable entry; fire detector for each cabinet; space heater for each cabinet (strip type). Door locking facility shall be provided. Beacon lamp shall be provided in each row of cabinet to indicate the cabinet having fault condition. The racks in system cabinets shall have provision along with plug in sockets / back plane to house atleast 10% additional cards, to accommodate for engineering flexibility or future expansion.

		SECTION: D
	TITLE **INSTRUMENTATION AND CONTROL SYSTEMS - CONTROL VALVES SPECIFICATION**	SHEET 1 of 1

Control Valves

Balanced, modulating, globe type cage guided, diaphragm type of actuator, provision for hand wheel operation with accessories viz. Air filter regulator, air lock device, solenoid valve, position transmitters, limit switches. Valves shall be sized to have an opening of 15% at minimum flow condition and 85% maximum flow condition. Trim exit velocity shall be limited as per ISA standard. Anti – cavitation trims shall be used to limit trim velocity for all critical applications where flashing or cavitation is expected. Noise level shall not exceed 85 dBA at distance of about 1.5 M from the valve. In case of predicted noise level above 85 dBA, suitable low noise trim shall be provided. Noise abatement shall be obtained by valve body and trim design, and not by use of silencer.

Leakage class for double seated valve shall not exceed 0.05% and single seated valve shall not exceed 0.01%.

Either extended type bonnet or cooling fin type bonnet shall be provided for service above 200^0C and for other service the bonnet type shall be standard.

The end connections shall be socket welded for sizes below 50 NB and butt welded for sizes 50 NB and above. Flanged connection shall be provided for DM services.

Water seal shall be provided for valves that could be subjected to below atmospheric conditions.

Material of trim shall be minimum 316 SS with guide bushings of hardened SS such as 17-4 pH, 440C or 316SS Stellite faced. Valve stem shall preferably be of chrome plated 316 SS.

The body material for control valves shall generally be as follows:

HP/IP steam services	-	WC9
HP/IP Feed water services	-	WCC
DM water services	-	SS 316
Condensate, Spray water LP feed water, LP steam, Gland steam, Air, Fuel, Gas and lube / control oil services	-	WCB

ISSUE
R0

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I** VOLUME SECTION REV. NO. 00 | DATE : 25.04.2016 SHEET OF

JUNCTION BOX SPECIFICATION

	TITLE:	SPECIFICATION NO. PES-145-070	
	STANDARD TECHNICAL SPECIFICATION (CONTROL & INSTRUMENTATION)	VOLUME II B	
		SECTION D	
		REV. 00	DATE: 31.12.2008
		SHEET 2 OF 3	

JUNCTION BOXES (JB) METAL TYPE

01. The Junction box enclosures shall comprise of a case and cover/door constructed from cold rolled sheet steel of thickness 3 mm. The construction shall ensure adequate strength and rigidity. Junction boxes and pull boxes shall be hot dipped galvanized and confirm to meet IP 65 class as per IS : 2147 with providing all facilities as below .

02. The junction boxes shall also be meet the following minimum requirements :

a) Junction boxes shall be provided with lockable door on the front side. The locks of the junction boxes shall be(Industrial Type) identical and operable by one key . Top of the boxes shall be arranged to slope towards rear of the box. Junction box shall have gland plate of 3mm sheet at bottom for indoor mounted boxes with neoprene/synthetic gasket lining of 6mm thick including door lining also. Suitable industrial type hinges & MS handle shall be provided for opening of the boxes smoothly & able to take load of door without any trouble /hampering IP 65 protection class.

b) All the junction boxes shall be suitable for mounting on walls, columns, structures etc. The brackets, nuts, bolts, screws. Glands and lugs required for erection shall be included in Supplier's scope of supply.

c) M6 Ni plated brass earthing stud 3 nos (2 external & 1 inside the JB)shall be provided for each junction boxe.

d) Terminal blocks shall be of **Cage Clamp Terminal blocks of Wago/Phoenix Make suitable for 2.5 mm2 cable shall be** properly arranged inside JB with end plate & end clamp in DIN rail mounted & marked up with TB nos from top to bottom to facilitate easy termination of the cables. Adequate space from left/right hand ,top/bottom side of wall of JB to TB end & in between TB's shall be min. **100mm** gap all around shall be provided.

e) 20 % Spare terminals shall be provided for each of the junction boxes distributed overall terminal blocks.

f) Construction details shall be as per enclosed drawing attached in page 03 of 03 of this technical requirements. The exact size and dimensions of junction boxes shall be as decided during detailed during detailed engineering stage keeping in view the nos of terminals required etc. The same shall be subject to approval during detailed engineering stage.

g) The Supplier shall furnish general arrangement, cross section details of junction boxes and the same shall be subject to BHEL/CUSTOMER's approval during detailed engineering stage.

h) The color of the Junction Boxes shall be Exterior Epoxy based to shade **Opaline Green to shade 275 of IS 5(Semi glossy)** , interior **brilliant white**(Glossy) & paint thickness shall be 100-150 micron.

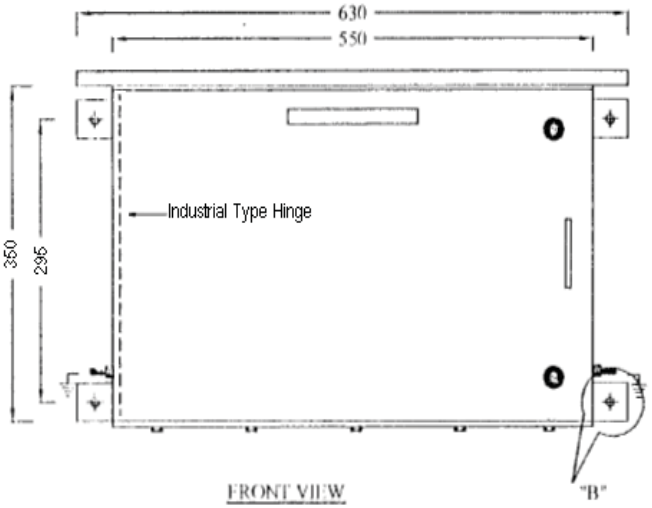
03 **REMARKS**

Subsequent to order, bidder to furnish filled in BOM schematics / GA drgs etc.

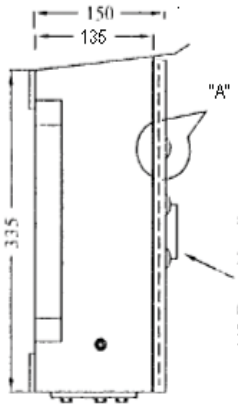
04 TESTING

High voltage & Insulation Resistance test. & IP 65 (if not conducted earlier)

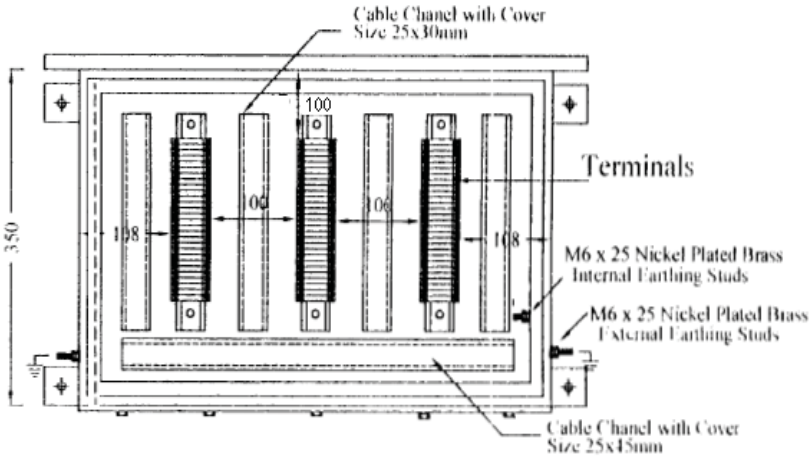
Typical Drg. for 72 Ways JB



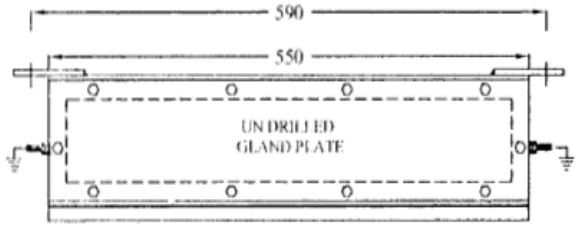
FRONT VIEW



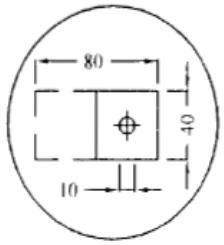
SIDE VIEW



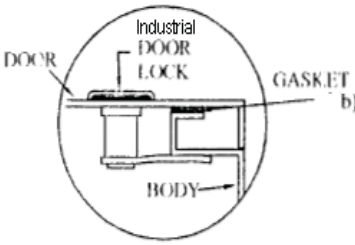
OPEN DOOR VIEW



BOTTOM VIEW



VIEW "B"



VIEW "A"

NOTE :

All Dimensions are in mm.

1) Sheet Thk . 3.0mm CRCA
2) Protection IP65
3) Paint :
   a) Hot Dip Galvanizing.
   b) External:- Epoxy based to shade Opaline Green to shade 275 of IS 5(Semi glossy)
   Internal:- Brilliant white(Glossy)
4) Panels are Wall mounting type with smooth finish.
5) All doors are open throughhinged with handle & lock arrangment.
6) All doors ,gland plate &removables are to be gasketed.
7) Fixing Bolts : 4 Set of zinc plated Fasterners each Set Consists of 1No - M10 x 60mm Bolt ,1 No - Spring washer, 2 Nos Plain washer & 1No - M10 nut.
8) Terminal blocks are be provided with number markers Continuously from top to Bottom
9) Paint thickness shall be 100-150 micron.80-100 micron for Powder coating.
10) Door locks for all the boxes will have identical with a common key
11) Quantity - As per scope of supply.

BILL OF MATERIAL

Sl	Description	Make	Qty
1	2.5 Sq.mm Cage Clamp type With 6.6 Polyamide Terminal block	WAGO / Phenix	87 Nos.

			Name	Date	Sign	Customer			
		Drw.				Project			
01		Ckd. Appd.				Title	GA FOR 72 WAY JUNCTION BOX	Sheet No. - 01/01	Rev.
Rev.								Scale - N.T.S.	

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I** VOLUME SECTION REV. NO. 00 | DATE : 25.04.2016 SHEET OF

MOTOR OPERATED VALVE ACTUATOR DATASHEET

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-999-145-I007 VOLUME II B SECTION D REV. NO. 03 DATE: 20.06.13 SHEET 1 OF 3

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT	1x370 MW YELAHANKA CCPP	
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	■ ON / OFF ■ INCHING	AS REQUIRED
	* 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%	
	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, IP:55	
	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	
	@ 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	

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-999-145-I007 VOLUME II B SECTION D REV. NO. 03 DATE: 20.06.13 SHEET 2 OF 3

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ ENCLOSURE CLASS OF MOTOR	■p IP 67 ☐ FLAME PROOF	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ☐ ----------	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	■ REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	■ CONTACTORS ☐ THYRISTORS	
	TYPE	■ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	IF SMART		
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐.....	
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC	
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....	
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP	
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	■ REQUIRED	
	OPEN / CLOSE PB	■ REQUIRED ☐ NOT REQUIRED	
	STOP PB	■ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	■ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	■REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	■ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)	
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	■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

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-999-145-1007	
		VOLUME	II B
		SECTION	D
		REV. NO. 03	DATE: 20.06.13
		SHEET 3	OF 3

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☐ REQUIRED ☐ NOT REQUIRED	AS 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)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@☐ IP 68 @☐.....	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ■ NOT REQUIRED☐ ☐ 2 NOS. ☐ ----------	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:----------	
	@ SPACE HEATER CABLE GLAND	SIZE:----------	
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :----------	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION 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
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. 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.
6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

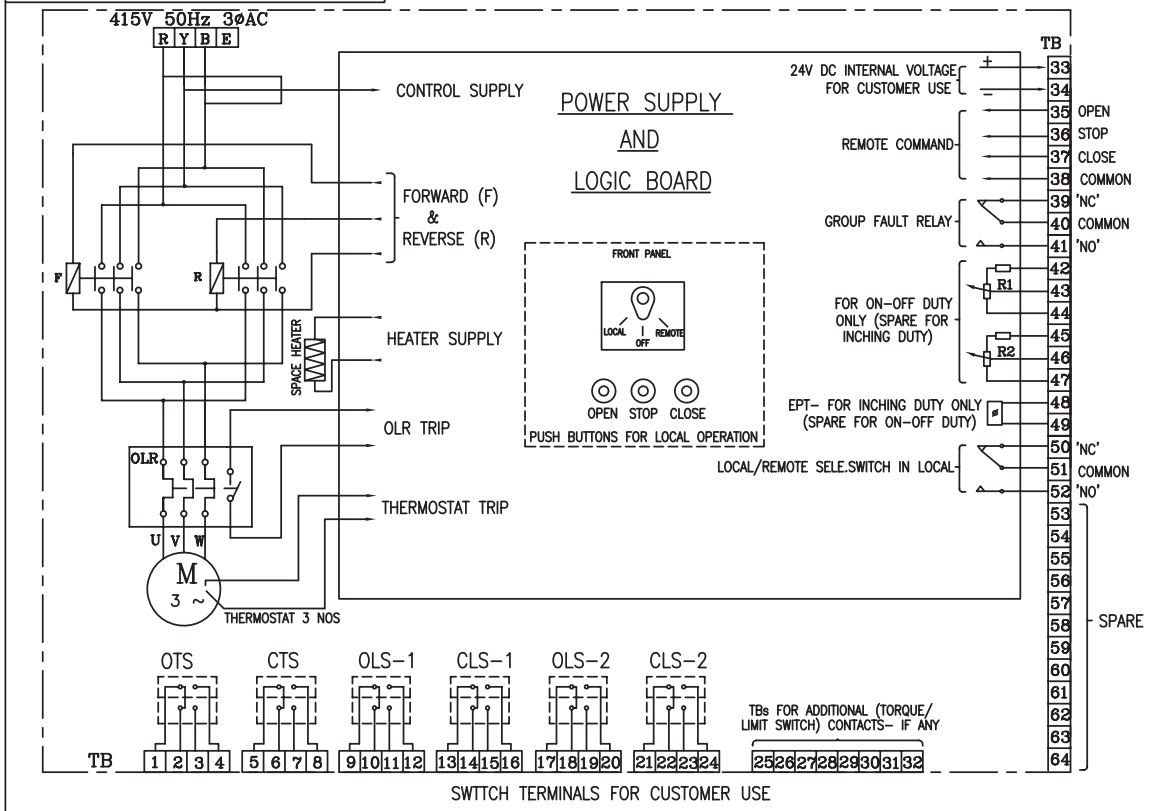
EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME	PRAG JAIN	S.S.BANSALA	M.A.MANSOORI	NAME
SIGNATURE	28/3/16		29/03/16	SIGNATURE
DATE	28.03.2016	28.03.2016	28.03.2016	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.

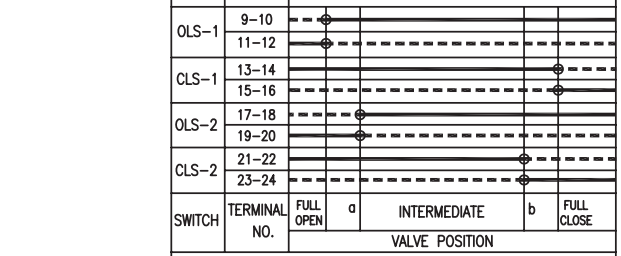
DRAWING NO. 3-V-MISC-24227



SWTTCH TERMINALS FOR CUSTOMER USE

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	



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	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	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)

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 TRAMSMITTER (CONTACTLESS TYPE, FOR INTCHING 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

REV	DATE	ALTERED
		CHD & APPD

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.
365-121

	NAME	SIGN	DATE	NO.OF VAR.
DRN	N.P.ESWAR	N.P	07.10.04	
CHD	D.DINAKARAN	D.D	07.10.04	
APPD	K.ARUNACHALAM	K.A	07.10.04	

DEPT VL | CODE | SCALE | WEIGHT (KG). | REFERENCE INFORMATIONS | NO. OF ITEMS

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER

CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24227

REV: 0

Size A3

FORM NO. PEM-6666-0

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I** VOLUME SECTION REV. NO. 00 | DATE : 25.04.2016 SHEET OF

Instrumentation Check list

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to carry out ROUTINE TEST on 100 %.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR	ONE / LOT		P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I**	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 25.04.2016
		SHEET OF	

FURNITURE SPECIFICATION

FORM NO. PEM-6666-0

	Technical specification for Furniture 1X370 MW YELAHANKA CCPP	SPEC NO.: **PE-TS-409-145-I**	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 25.04.2016
		SHEET 1 OF 1	

SPECIFICATION FOR FURNITURE

1. 3 Nos. cushioned revolving, independently adjustable seat and back chairs. Chairs shall be capable of being adjusted for height and position of backrest. The chairs shall be mounted on five castors, shall swivel and shall have arm rests'. One table and chair shall be provided for each operator station and separate table for each printer.

2. Glass top Teak wood / MDF table for mounting Operator Station monitors.

3. Printer tables.

4. Glass top Teak wood / MDT table for System Engineering Room / Engineering stations with drawer at end.

5. Glass top teak wood / MDF table with vertical file mounting arrangement (two layer to house approx. 40 Nos of files and lockable drawers at both end for System Engineering Room / Engineers.

6. Dimensions of the tables shall be as follows :-

DIMENSIONS	WIDTH X DEPTH X HEIGHT (mm)
PC TABLE	1500 X 750 X 735
COLOR LASER PRINTER table	900 X 650 X 740

FORM NO. PEM-6666-0

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I** VOLUME SECTION REV. NO. 00 DATE : 25.04.2016 SHEET OF

SIGNAL EXCHANGE FORMAT TO PLANT DCS

Tag name (Maximum 15 Char.)	Tag Description (Maximum of 32 Char.)	Point Type (Note-1)	DCS (Engg.) Range		Modbus Range		Engg. Unit	Alarm Requirement (Y / N)	Alarm Priority (URGENT/HI/LO)	Alarm SetPoint	State text for 0 condition	State text for 1 condition	Normal State (State 0 or State 1)	History Required (Y/N)	Data Format (Note-3)	Device ID (Address)	Modbus address	Function Code / Register Type (Note-4)
			Min	Max	Min	Max												

Notes:
1. Data type (AI/AO/DI/DO) shall be specified with respect to DCS.
2. For Digital points (IOs) please indicate the alarm state.
3. Data Format : SIGN16, USIGN16, SIGN32, USIGN32, FLOAT32, LONG32, BOOL, LOGIC
4. Function code: 1-Coil Status, 2-Input Status, 3-Holding Register, 4- Input Register, 5-Force single Coil, 6-Preset Single Register, **as per Modbus Standard**

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I**	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 25.04.2016
		SHEET OF	

APPLICABLE CABLE TYPES

CABLE SIZES FOR 1X370 MW CCPP AT YELHANKA	
Sl no.	Cable Type
G-TYPE	
1	2P X 0.5 sqmm
2	4P X 0.5 sq mm
3	8P X 0.5 sqmm
F-TYPE	
1	4P X 0.5 sqmm
2	8P X 0.5 sqmm
3	12P X 0.5 sqmm
4	20P X 0.5 sqmm
CONTROL CABLE	
1	3C X 2.5 sqmm

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I** VOLUME SECTION REV. NO. 00 | DATE : 25.04.2016 SHEET OF

KKS PHILOSOPHY

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A	A	Y	Y	B	B	B

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-**1.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

1) Ozone Generation Plant: PBB

ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level
CM	Humidity
CQ	Analysis (SWAS)

CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

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

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

b) BFP – A/B/C

c) ID Fan – A/B, FD Fan A/B, AH – A/B

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

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

B) Numerical keys at Equipment Code level:

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

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

		N1	N2 N3
Motorised *(on/off duty)*	-	*0*	*01 to 50*
Motorised (inching duty)	-	*0*	*51 to 99*
Pneumatic (Control)	-	*1*	*01 to 50*
Motorised (thyrestor Control)	-	*1*	*51 to 99*
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99
NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99

Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99

ii) Field Instruments

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

Example of Numerical Key Usage:

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

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I** VOLUME SECTION REV. NO. 00 | DATE : 25.04.2016 SHEET OF

LIST OF DELIVERABLES

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR MAUX PACKAGES							
1 X 370MW YELAHANKA CCPP							
DOCUMENT NUMBER PE-GL-409-145-I100							
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION							
1	PE-V9-409-XXX-I901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I	
2	PE-V9-409-XXX-I902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I	
3	PE-V9-409-XXX-I903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I	
4	PE-V9-409-XXX-I904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I	
5	PE-V9-409-XXX-I905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I	
PLC PANEL							
1	PE-V9-409-XXX-I906	PLC CONFIGURATION DRAWING	A	A	VENDOR	C&I	
2	PE-V9-409-XXX-I907	PLC PANEL GA (INTERNAL & EXTERNAL) DRAWING	A	-	VENDOR	C&I	
3	PE-V9-409-XXX-I908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I	
4	PE-V9-409-XXX-I909	PLC INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I	
5	PE-V9-409-XXX-I910	UPS BATTERY CHARGER/ BATTERY DATASHEET & SLD	I	$$	VENDOR	C&I	
6	PE-V9-409-XXX-I911	UPS SIZING CALCULATIONS	I	-	VENDOR	C&I	
7	PE-V9-409-XXX-I912	BATTERY SIZING CALCULATIONS	I	-	VENDOR	C&I	
8	PE-V9-409-XXX-I913	CONTROL DESK LAYOUT / GA DRAWING	A	-	VENDOR	C&I	
9	PE-V9-409-XXX-I914	PLC-OWS/PRINTER FURNITURE BOM	A	-	VENDOR	C&I	
10	PE-V9-409-XXX-I915	PLC CONTROL ROOM LAYOUT DRAWING	A	-	VENDOR	C&I	
11	PE-V9-409-XXX-I916	PLC CATALOGUE	I	-	VENDOR	C&I	
12	PE-V9-409-XXX-I917	PLC QUALITY PLAN & FAT PROCEDURE	A	-	VENDOR	C&I	
13	PE-V9-409-XXX-I918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	`	VENDOR	C&I	
14	PE-V9-409-XXX-I919	PROCESS GRAPHIC MANUSCRIPTS PLC	I	-	VENDOR	C&I	
15	PE-V9-409-XXX-I920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I	
16	PE-V9-409-XXX-I921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I	
17	PE-V9-409-XXX-I923	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	-	VENDOR	C&I	
18	PE-V9-409-XXX-I924	PANEL HEAT DISSIPATION DATA	I	-	VENDOR	C&I	
19	PE-V9-409-XXX-I925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I	
20	PE-V9-409-XXX-I926	PLC O & M MANUAL	I	-	VENDOR	C&I	
21	PE-V9-409-XXX-I927	PLC EARTHING SCHEME	I	-	VENDOR	C&I	
	Notes:	409 - Project No					
		XXX -SI No of MAX Package					
		$$ -Approval by BHEL if Vendor BBU Item Approval by Customer if Customer BBU Item					

FORM NO. PEM-6666-0

	Technical specification for **CONTROL & INSTRUMENTATION** **1X370 MW YELAHANKA CCPP**	SPEC NO.: **PE-TS-409-145-I** VOLUME SECTION REV. NO. 00 | DATE : 25.04.2016 SHEET OF

QUALITY PLAN

PEM :: C&I

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-I036___**
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 24.08.2007
SHEET 1 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.0	**Materials /Components**											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection • Identification Labels • Physical Damages • Quantity • Spare Capacity	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL 2 - Vendor 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-I036___**

VOLUME IIB

SECTION D

REV. NO. 01 DATE: 24.08.2007

SHEET 2 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.

1 - BHEL 2 - Vendor 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-I036___**
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 24.08.2007
SHEET 3 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
2.0	**Assembly**											
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2	1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2	2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2	1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100%	FAT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2	2	1	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-I036___**
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 24.08.2007
SHEET 4 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
3.0	**Factory Acceptance Test (FAT)**											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL 2 - Vendor 3 - Sub-vendor

FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

a) Technical Specification of PLC.

b) PLC System Configuration

c) General Assembly Drawings.

d) Panel Wiring Diagrams.

e) Bill of Quantity for PLC System.

f) Logic Diagram.

g) HMI Schematics.

h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, to the inspecting agency, his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. Check online replacement of cards, processors, power supply etc.

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

i) Redundancy

ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.
Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-I036___**			
VOLUME IIB			
SECTION D			
REV. NO. 00		DATE: 23.03.2005	
SHEET 7	OF	8	

6. Control Panel /Desk Verification

i) PLC driven annunciation system should be checked by alarm signal simulation.

ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.

iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes

ii). Engineering features:-
a) Online changing of parameters, set points.
b) Online modification in Control Logic Diagrams.
c) Online configuration of Graphics, Trends, Logs, HSR.

iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.:	**PE-QP-999-145-I036___**
VOLUME	IIB
SECTION	D
REV. NO. 00	DATE: 23.03.2005
SHEET 8	OF 8

ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.

PEM :: C&I

STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.:	**PE-QP-999-145-I 006**
VOLUME	IIB
SECTION	D
REV. NO.	06 DATE: 05.09.2013
SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.0	**MATERIAL**											
1.1	Body & Bonnet casting / forgings, plug, valve stem, seat ring/cage.	1. Physical, Chemical properties	MA	Physical, Chemical tests	One/ Heat(HT Batch)	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3	---	2,1	
		2. Heat Treatment	MA	Review of H.T. Chart	Each H.T.	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3/2	2	1	IBR Certification (if applicable) to be verified by BHEL
		3. Internal quality of castings	MA	RT for Body & UT for Bonnet(NDT)	100%	ASME B 16.34	ASME B 16.34	Test Report / FILM	3/2	2	1	Only for rating ANSI 900 and above. Applicable for Body and Bonnet only. For Lower rating only if called for in specification.
		4. Surface Quality	MA	1. Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	---	2,1	
				2. MT/PT	100%	ASME B 16.34	ASME B 16.34	Test Certificate	3	2	1	After Machining on machined surface only

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: **PE-QP-999-145-I 006**
VOLUME IIB
SECTION D
REV. NO. 06 DATE: 05.09.2013
SHEET 2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
		5. Pressure test for shell	MA	Hyd. Test	100%	ISA-S-75.19/ ASME B 16.34	ISA-S-75.19/ ASME B 16.34	Test Certificate	2	2	1	For Body & Bonnet after machining
1.2	Diaphragm	1. Surface Quality	MA	Visual	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1	
		2. Hardness	MA	Measurement	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1	
		3. Endurance / Life cycle	MA	Cyclic test 10,000 cycles	One / Type	10,000 cycles/ Mfr. standard.	No damage	Test Certificate	3/2		2,1	
1.3	Spring	1. Composition	MA	Chemical-Analysis	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
		2. Mech. Properties	MA	Mech. Test	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
		3. Performance	MA	1. Stiffness ratio	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				2. Scragging	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				3. Cyclic test (Endurance)	One / type	10,000 cycles	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				4. Dimension (Measurement)	One sample/ Lot	Mfr. standard	Appd Drg	Record	3	---	2,1	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.:	**PE-QP-999-145-I 006**
VOLUME	IIB
SECTION	D
REV. NO.	06 DATE: 05.09.2013
SHEET	3 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.4	Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)]	1. Routine Test	MA	HV, IR, Continuity function	100%	Rele. Standards	Rele. Standards	Test Certificate	3	---	2,1	In case TC is not available, Actual test shall be conducted
		2. Degree of protection	MA	IP/NEMA Tests	One sample / type	Approved Data sheet	Approved Data sheet	Test Certificate	3	---	2,1	
1.5	Pressure Gauges	1. Performance	MA	Review of calibration certificates	100%	Mfr. Standard	Mfr. Standard	Test Certificate	3	---	2,1	
		2. Marking	MA	Visual	100%	Mfr. standard	Mfr. standard	Records	3	---	2,1	
2.0	**IN PROCESS INSPECTION**											
2.1	After machining, i, Body ii Bonnet iii Plug iv Valve Stem v seat ring/cage	1. Surface flaws	MA	Visual & MT/PT	100% (on accessible surfaces)	ASME B 16.34	ASME B 16.34	Test Records	2	---	1	Butt weld ends shall be included.
		2. Dimensional checks	MA	Measurement	100%	Mfr. Standard	Mfr. Standard	Records	2	---	1	
		3. Hard facing (wherever applicable)	MA	Hardness Measurement	One sample/Lot	Mfr. Standard	Mfr. Standard	Records	2	---	1	
2.2	Lapping	Machining surface contact	MA	Blue Matching	One sample/lot	------	Proper Physical Contact	---	2	---	---	
3.0	**TESTS ON COMPLETED VALVE**											

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test

$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.

1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: **PE-QP-999-145-I 006**
VOLUME IIB
SECTION D
REV. NO. 06 DATE: 05.09.2013
SHEET 4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
3.1	Actuator Chamber	Leakage & Strength	MA	Pneumatic test	100%	Mfr. Standard	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.2	Body	Leakage and Pressure test (Body Mount Leakage)	MA	Hydro test	100%	ISA - S-75.19	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.3	Seat leakage test for completed valve	Seat Leakage	MA	Pneumatic Test	100%	FCI-70.2	FCI-70.2	Test Certificate	2	1	1	Refer Note-4
4.0	**OPERATION TEST ON COMPLETED VALVE (Final inspection)**	1. Valve Travel	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		2. Opening/Closing time	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		3. Linearity/cam characteristic	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		4. Repeatability	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		5. Hysteresis	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		6. Sensitivity	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		7. Accuracy (Overall)	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		8. Control Valve characteristics / CV Test	MA	♦Measurement (Press. vs. discharge and discharge vs. opening 0-100% in steps of 10%)	One per type	As per specs/ Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Certificate	2	--	1	♦Size = Body & port size Or Body size & CV for non std port. Refer Note 1.

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.:	**PE-QP-999-145-I 006**
VOLUME	IIB
SECTION	D
REV. NO.	06 DATE: 05.09.2013
SHEET	5 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
		9. Operation of limit switch & solenoids and other accessories	MA	Function	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Report	2	1	1	On assembled valve Refer Note-4
		10. Overall dimensions	MI	Visual and dimensional	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Records	2	1	1	Refer Note-4
		11. Pre defined valve position in case of air failure	MA	Visual	100%	As per spec & Appd drg	As per spec & Appd drg	Test Certificate	2	1	1	
		12. Cleanliness, painting, stamping (for direction of flow), Tag No.	MA	Visual and dimensional	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Certificate	2	1	1	
5.0	**AUXILIARY ITEMS (Performance test of auxiliary items shall be performed on the completely assembled valve)**											
5.1	Positioner	Overall leakage after assembly including Nozzles leakage	MA	Leak Test (in the steady state input signal)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	Overall leakage including tubing
5.2	Air filter regulator	1. Normal air consumption	MA	Measurement	Each type	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
		2. Overall leakage	MA	Visual (soap solution)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
5.3	Air lock relay	Performance Test	MA	Leakage test	100%	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
5.4	Electronic position transmitter(not applicable if provided integral to smart positioner)	1. Accuracy	MA	Operation	100%	Approved data sheet /	Approved data sheet /	Test Certificate	2	1	1	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: **PE-QP-999-145-I 006**
VOLUME IIB
SECTION D
REV. NO. 06 DATE: 05.09.2013
SHEET 6 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
5.5	Current to Pneumatic converter(not applicable for smart positioner)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1	
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1	
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		4. Hysterisis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
5.6	Smart Positioner (As Applicable)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1	
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1	
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		4. Hysterisis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		5. Calibration with Hand Held Communicator	MA	Measurement	Each type	Approved data sheet / Mfr. Standard	Approved data sheet / Mfr. Standard	Test Certificate	2	1	1	
6.0	**PAINTING**	Soundness of Painting	MA	Visual and Measurement	100%	BHEL specn. / Mfr. Standard	BHEL specn. / Mfr. Standard	Inspection Report	2	---	---	Refer Note-2
7.0	**PACKING**	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-3

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I	STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)	QUALITY PLAN NO.: **PE-QP-999-145-I 006**
		VOLUME IIB
		SECTION D
		REV. NO. 06 DATE: 05.09.2013
		SHEET 7 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	

NOTES:

1. In case valid CV test certificate for a similar control valve(Same type, Same size, Same CV) is not submitted to BHEL by the vendor, CV test shall be conducted at FCRI/Any govt. approved laboratory/ BHEL approved Laboratory.
2. In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
3. Sea worthy packing shall be provided, if applicable.
4. The quantum of check shall be 100% for manufacturer and 10% for BHEL/BHEL nominated inspection agency.
5. IBR certificates in Form III-C shall be submitted if called for in the specification/datasheet.
6. Copies of all TC's(Test Certificates) for materials duly correlated with Heat Nos., TC's for electrical items and mechanical tests(Leak/Operation) shall be submitted to BHEL for verification and acceptance.

LEGEND:
* CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test
PT – Dye penetrant Test; MT- Magnetic Test
$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

ANNEXURES TO SECTION C

ANNEXURE – I

INDICATIVE SUB VENDOR LIST

SL NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	OIL FREE SCREW COMPRESSOR	ATLAS COPCO	PUNE	
		KOBELCO (KPC)	PUNE	
		ELGI	COIMBTORE	
		INGERSOLL RAND	AHMADABAD	
2.	AIR RELEASE VALVES	H.SARKER & COMPANY		
		LEADER VALVES LTD.		
		R&D MULTIPLES (METAL CAST) PVT. LTD.		
		A.V. VALVES LIMITED		
		G.M.DALUI & SONS PVT.LTD.		
3.	MS ROD FOR BELOW GROUND EARTHING	STEEL AUTHORITY OF INDIA LIMITED		
		RASHTRIYA ISPAT NIGAM LIMITED		
4.	CHAIN PULLEY BLOCK	BRADY & MORRIS ENGINEERING CO. LTD.	AHMEDABAD	
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 10 TONNE.
		TRACTEL TIRFOR INDIA PVT. LTD.	FARIDABAD	
		TECHNO INDUSTRIES	AHMEDABAD	
		UNIVERSAL HOIST-O-FABRIK	THANE	
5.	ELECTRIC HOISTS	ALPHA SERVICES	BHIWADI	
		BRADY & MORRIS ENGINEERING CO. LTD.	AHMEDABAD	
		CONSOLIDATED HOISTS PVT LTD	PUNE	
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		MANGLA HOISTS PVT LTD	NEW DELHI	
		MEEKA MACHINERY PVT. LTD.	AHMEDABAD	
		REVA INDUSTRIES LTD.	FARIDABAD	UPTO 25.0 T CAPACITY.
		ROCKWELL HOISTO CRANES PVT. LTD.	BAHADURGARH	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 15 TONNES.
		TECHNO INDUSTRIES	AHMEDABAD	
		UNIVERSAL HOIST-O-FABRIK	THANE	
6.	BALL VALVES	AKAY INDUSTRIES PVT.LTD.		
		FLOW CHEM INDUSTRIES		

SL NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		FISHER SANMAR LIMITED		
		KIRLOSKAR BROS. LTD.		
		LEADER VALVES LTD.		
		KSB PUMPS LTD.		
		MICROFINISH VALVES PVT LTD.		
		MICON VALVES (INDIA) PVT.LTD		
		PEC VALVES PVT.LTD.		
		VIRGO ENGINEERS LTD.		
		A.V. VALVES LIMITED		
		FLUIDLINE VALVES COMPANY PRIVATE MUMBAI		
		STEELSTRONG VALVES (I) PVT.LTD.,MUMBAI		
		B.D.K. ENGINEERING INDUSTRIES LTD.		
		SURYA VALVES &INSTRUMENTS MANUFACTURING COMPANY, CHENNAI		
		VAL TECH INDUSTRIES ,MUMBAI		
		FEDERAL HARDWARE ENGINEERING CO PTE LTD., SINGAPORE		
		CRESCENT VALVES MFG. CO. PVT. LTD.		
7.	**CONTROL VALVE**	DEZURIK -COPES VULCAN LTD., U.K		
		CONTROL COMPONENT INC., USA		
		DRESSER VALVE INDIA PVT. LTD UP TO 45KSC ONLY		
		FOURESS ENGG.INDIA LTD.UP TO 45KSC ONLY		
		FISHER SANMAR LTD		
		INSTRUMENTATION LTD. UP TO 45KSC ONLY		
		MIL. CONTROLS LTD.		
8.	**STEEL GATE /GLOBE/NRV VALVES**	A.V. VALVES LTD		
		NITON VALVE INDUSTRIES PRIVATE LTD		
		WEIR VALVES & CONTROLS M.E.		
		BABCOCK BORSIG ESPANA, S.A.		
		B.D.K. ENGINEERING INDUSTRIES LTD.		
		KIRLOSKAR BROTHERS LTD.		
		LEADER VALVES LTD.		
		KSB PUMPS LTD.		
		MICON VALVES (INDIA) PVT. LTD		
		OSWAL INDUSTRIES LTD.		
		PETROL VALVES S.R.L. ITALY		
		FOURESS ENGG. INDIA LTD.		
		FLUIDLINE VALVES COMPANY PRIVATE LTD., MUMBAI		
		STEEL STRONG VALVES (I) PVT. LTD., MUMBAI		
		VALTECH INDUSTRIES ,MUMBAI		
		SURYA VALVES AND		

SL NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		INSTRUMENTS MANUFACTURING COMPANY, CHENNAI		
		FEDERAL HARDWARE ENGINEERING CO PTE LTD.,SINGAPORE		
		CRESCENT VALVES MFG. CO. PVT. LTD.		
9.	CAST IRON/ GATE/GLOBE/NRV/SAFETY RELIEF VALVES	A.V. VALVES LTD		
		H.SARKER & COMPANY		
		G.M. DALUI & SONS PVT. LTD.		
		KIRLOSKAR BROS. LTD.		
		LEADER VALVES LTD.		
		MICON VALVES (INDIA) PVT. LTD		
		FLUIDLINE VALVES COMPANY PRIVATE		
		FEDERAL HARDWARE ENGINEERING CO PTE LTD., SINGAPORE		
		CRESCENT VALVES MFG. CO. PVT. LTD.		
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY, CHENNAI		
10.	BF VALVES (WATER SERVICE)	ADVANCE VALVES PVT. LTD		
		B.D.K. ENGINEERING INDUSTRIES LTD.		
		INTER VALVE (INDIA) LTD.		
		FOURESS ENGG. INDIA LTD.		
		INSTRUMENTATION LTD.		
		LARSEN & TOUBRO LTD.		
		KIRLOSKAR BROS. LTD.		
		MICON VALVES (INDIA) PVT. LTD		
		R&D MULTIPLES (METAL CAST) PVT. LTD.		
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY, CHENNAI		
		STAFFORD CONTROLS LIMITED, PUNE		
		FLUIDLINE VALVES COMPANY PRIVATE LTD., MUMBAI		
		TYCO VALVES & CONTROLS INDIA PVT.LTD.,HALOL		
11.	A/C SYSTEM	ABB,LTD.		
		BLUE STAR LTD.		
		VOLTAS LTD.		
12.	VENTILATION SYSTEM	ASEA BROWN BOVERI LTD.		
		ALSTOM LTD.		
		BLUE STAR LTD.		
		HYDERABAD POLLUTION CONTROLS LTD.		

SL NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		VOLTAS LTD.		
		C. DOCTOR & CO. PVT. LTD.		
13.	FLOW ELEMENT	ENGINEERING SPECIALTIES PRIVATE LTD		
		INSTRUMENTATION LTD.		
		MICRO PRECISION PRODUCTS		
		STAR-MECH CONTROLS (I) PVT.LTD		
14.	PUMPS (HORIZONTAL)	BEST & CROMPTON ENGG. LTD.		
		FLOWMORE LTD.		
		JYOTI LTD.		
		KIRLOSKAR BROS. LTD.		
		MATHER & PLAN PUMPS LTD.		
		KSB PUMPS LTD.		
		SULZER PUMPS INDIA LTD.		
		WPIL LIMITED		
		SAM TURBO INDUSTRY LTD.		
15.	PROGRAMMABLE LOGIC CONTROLS	SIEMENS LTD		
		ABB LIMITED		
		SCHNEIDER ELECTRIC INDIA PVT. LTD., NEW DELHI		
16.	ROTAMETER	CHEMTROLS SAMIL (INDIA) PVT. LTD., MUMBAI		
17.	DIAPHRAGM VALVE	BDK VALVES –HUBLI		
		CRANE FLOW PROCESS-SATARA		
18.	CHECK VALVES (FLAT TYPE SIZE UPTO 50 NB)	B BDK VALVES –HUBLI		
		H SARKAR-HOWRAH		
		LEADER-JALANDHAR		
		MAJESTIC WORKS, MUMBAI		
19.	DUAL PLATE NON RETURN VALVES (SS & CI UPTO 100 NB CLASS 150)	ADVANCE VALVES-NOIDA		
		R&D MULTIPLES-VALSAD		
		B BDK VALVES –HUBLI		
20.	SOLENOID VALVES	ROTEX AUTOMATION-BARODA		
		ASCO - CHENNAI		
21.	Y-TYPE STRAINER	OTOKLIN-MUMBAI		
		GRAND PRIX-NEW DELHI		
		JAYPEE-NEW DELHI		
		GREAVES COTTON-MUMBAI		
		MULTITEX- NEW DELHI		
22.	MS PIPES (IS: 1239 & 3589)	SAIL-ROUR KELA		
		JINDAL (UPTO 350 NB)-GHAZIABAD		
		TISCO (UPTO 150 NB)-JAMSHEDPUR		
		MSL (FOR IS 3589-200 NB TO 500		

SL NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		NB)-RAIGAD		
23.	MS PLATES	SAIL		
24.	LEVEL GAUGES	SIGMA INSTRUMENTS	MUMBAI	
		LEVCON	KOLKATA	
		SBEM	PUNE	
		V. AUTOMAT	NEW DELHI	
25.	LEVEL TRANSMITTER (FOR ULTRA SONIC TYPE)	EMERSON PROCESS MANAGEMENT (I) LTD		
		SIEMENS		
26.	ANALYSERS	POLYTRON	FRANCE	
		HACH ULTRA	FRANCE	
		ABB	UK	
		ORION	USA	
		SWAN	USA	
		EMERSON PROCESS MANAGEMENT	CHENNAI	
27.	PRESSURE / DP TRANSMITTER	EMERSON PROCESS MANAGEMENT	USA/DAMAN	
		FUJI ELECTRIC	JAPAN	
		HONEYWELL	USA	
		YOKOGAWA	JAPAN	
		ABB	ITALY/FARIDABAD/BANGALORE	
28.	PRESSURE AND DIFFERENTIAL PRESSURE GAUGE	A.N.INST	KOLKATTA	
		WAREE	MUMBAI	
		SWITZER INSTRUMENTS	CHENNAI	
		GENERAL INSTRUMENTS CONSORTIUM	GOA / MUMBAI	
		MANOMETER	MUMBAI	
29.	TEMPERATURE GUAGE	A.N.INST	KOLKATTA	
		H.GURU (SI) P LTD	BANGALORE	
		GIC	GOA/MUMBAI	
		PYRO ELECTRIC INSTRUMENTS P LTD	GOA	
30.	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM	NEW DELHI	
		PYRO ELECTRIC	GOA	
		TOSHINWAL BROS	NEW DELHI	
31.	TEMPERATURE TRANSMITTER	SOR INC	USA	
		DELTA CONTROLS LIMITED	USA	
		ABB	CHENNAI	
32.	PNEUMATIC ACTUATORS (POWER CYLINDER)	INSTRUMENTATION LTD		
		KELTRON CONTROLS		
		ROTEX MANUFACTURERS & ENGINEERS PVT LTD		
33.	LT MOTORS	BBL	MUMBAI	

SL NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		CGL	MUMBAI/ AHEMDABAD	
		ALSTOM	KOLKATTA	
		KEC	BANGALORE/ HUBLI	
		SEIMENS	MUMBAI	
		ABB	FARIDABAD	
34.	**UPS**	HITACHI	GANDHI NAGAR	
		EMERSON PROCESS MANAGEMENT	CHENNAI	
35.	**AGITATOR/STIRRER**	FIBRE & FIBRE	MUMBAI	
36.	**FITTINGS**	BHARAT FORGE	PUNE	
		RELIANCE FORGE	PUNE	
37.	**FLANGES**	BHARAT FORGE	PUNE	
		RELIANCE FORGE	PUNE	
38.	**220V DC LEAD ACID BATTERIES (TUBULAR AND PLANTE)**	EXIDE INDUSTRIES LTD		
		HBL NIFE POWER SYSTEMS LTD.		
39.	**INSTRUMENT FITTINGS**	AURA INCORPORATED	NEW DELHI	
		ASTEC VALVES & FITTINGS PVT. LTD.,	MUMBAI	
		ARYA CRAFTS & ENGINEERING PVT. LTD.	MUMBAI	
		COMFIT & VALVE PVT. LTD.	GUJARAT	
		FLUIDFIT ENGINEERS PVT. LTD.	MUMBAI	
		FLUID CONTROLS PVT. LTD.	MUMBAI	
		HP VALVES & FITTINGS INDIA PVT. LTD.	CHENNAI	
		PRECISION ENGINEERING INDUSTRIES	MUMBAI	
		PANAM ENGINEERS,	MUMBAI	
		PERFECT INSTRUMENTATION CONTROL (INDIA) PVT. LTD.	MUMBAI	
		VIKAS INDUSTRIAL PRODUCTS	NOIDA	
40.	**JUNCTION BOX**	AJMERA INDUSTRIAL & ENGINEERING WORKS	MUMBAI	
		FLEXPRO ELECTRICALS PVT. LTD.	GUJARAT	(METAL TYPE JUNCTION BOX ONLY)
		K.S.INSTRUMENTS PVT.LTD.	BANGALORE	
		SUCHITRA INDUSTRIES	BANGALORE	
		SHRENIK & COMPANY,	AHMEDABAD	
41.	**CABLE GLAND**	COMET		
		DOWELL		
		CHETNA		

SL NO.	ITEM	SUPPLIERS	PLACE	REMARKS
42.	CABLE LUGS	ELECTRO BILLETS		
		COMET		
		DOWELL		
		CHETNA		
43.	PAINT	ASIAN PAINTS (I) LTD.		
		BERGER PAINTS INDIA LTD		
		GOODLASS NEROLAC		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		SHALIMAR PAINTS LTD.		

NOTES-

1. All the finally selected sub vendors shall be subject to customer approval during detailed engineering without any delivery/ commercial implications to BHEL/ Customer (KPCL).

2. The sub vendor list enclosed is indicative only and is subject to approval / acceptance by customer (KPCL).

3. Bidder to propose his sub vendor list with back up documents (experience list, end user certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any technical, commercial & delivery implication to BHEL or customer.

   Bidder to propose sub vendor within 4 weeks of placement of LOI. Thereafter no request for additional sub vendor shall be entertained.

4. 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 (KPCL).

ANNEXURE – II

MANDATORY SPARE LIST

Sr. No.	Item	Unit	Quantity
1.0	**Essential spares of dielectrode of the working Ozone Generators**	**Nos.**	**10 %**
2.0	**FOR EACH SIZE, TYPE AND CATEGORY OF PUMP COVERED IN THE CONTRACT**		
2.1	Impeller with its nuts and other associated parts of one pump	Set	One
2.2	Bushes and wear rings for one pump	Set	One
2.3	Shaft, Shaft sleeves and shaft seals of one pump	Set	One
2.4	Gaskets of one pump	Set	One
2.5	Glands and mechanical seals as applicable of one pump	Set	One
2.6	Complete set of bearings for one pump	Set	One
2.7	Coupling complete with all nuts, bolts, etc. for one pump	Set	One
3.0	**415V Motors**		
3.1	Bearings	Set	2 sets of each type
3.2	Cooling fan	Nos.	2 Nos. of each type
3.3	Motor	Nos.	1 No. of each type, rating & frame size

Notes:

1) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), unless specified otherwise and the fraction will be rounded off to the next higher whole number.

2 Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed and the break up for these shall be furnished during detailed engineering stage.

3) Identification: Each spare shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

ANNEXURE – III

LIST OF TOOLS & TACKLES

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. List of tools and tackles to be furnish by bidder during bid submission.

ANNEXURE-IV

COOLING WATER ANALYSIS & SERVICE WATER ANALYSIS

COOLING WATER ANALYSIS

SL NO	PARAMETERS	UNIT	RESULTS
A	QUANTITY	CUM/HR	NIL
1	Colour	Hazen Units	<5
2	Odour		Unobjectionable
3	Turbidity	NTU	<0.6
4	pH Value		7.1-7.3
5	BOD	ppm	1.2
6	COD	ppm	4.9
7	Total Suspended Solids	ppm	4
8	Total dissolved solids	ppm	800
9	Alkalinity	ppm	24.7
10	Chloride as Cl	ppm	41.45
11	Sulphate as SO4	ppm	129
12	Silica-Dissolved as SiO2	ppm	23.5
13	Silica-Colloidal as SiO2	ppm	3
14	Ca Hardness as CaCO3	ppm	140
15	Mg Hardness as CaCO3	ppm	94
16	Total Hardness as CaCO3	ppm	234
17	% sodium	ppm	12.14
18	Ammonical Nitrogen	ppm	6.57
19	Iron as Fe	ppm	0.31
20	Manganese as Mn	ppm	0.05
21	Total Kjeldhal Nitrogen	ppm	3.4
22	Total Residual Chlorine	ppm	<0.5
23	Phosphate as PO4	ppm	1.3
24	Free Ammonia	ppm	0.1
25	Total phosphorus	ppm	0.56
26	Oil and Grease	ppm	<1.0
27	Nitrate Nitrogen	ppm	1.3
28	Sulphide	ppm	<0.05
29	Fluoride as F	ppm	0.39
30	Copper as Cu	ppm	<0.05
31	Zinc as Zn	ppm	<0.05
32	Lead as Pb	ppm	<0.02
33	Total Chromium as Cr	ppm	<0.05
34	Mercury as Hg	ppm	<0.001
35	Cyanide as CN	ppm	<0.05
36	Phenolic components	ppm	<0.05

SL NO	PARAMETERS	UNIT	RESULTS
	as C6H5OH		
37	Nickel as Ni	ppm	<0.05
38	Arsenic as AS	ppm	<0.001
39	Coliform Organisms/100 ml	ppm	15X10^6
40	Faecal Coliform Organisms/100 ml	ppm	15X10^6
41	MPN count/100	ppm	2
42	E-coil	ppm	Present
43	Temperature	Deg C	28

NOTE:

A. THE CYCLE OF CONCENTRATION (COC) SHALL BE CONSIDERED AS 3.

SERVICE WATER ANALYSIS

SL NO	PARAMETERS	UNIT	RESULTS
1.	TDS	ppm	80 - 100
2.	pH	-	5 – 6

ANNEXURE-V

DRAWINGS/DOCUMENTS SUBMISSION PROCEDURE

- 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 copes 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 CW Treatment plant area.
    - 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.

DRAWING / DOCUMENT DISTRIBUTION SCHEDULE

S. NO.	DESCRIPTION	CONSULTANT	KPCL HEAD OFFICE	KPCL 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

KPCL- KARNATAKA POWER CORPORATION LIMITED
CONSULTANT –TRACTEBEL ENGINEERING PVT. LTD.
S SOURCE
CD SOFT COPY

.

Note:

- 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.
- Initial submission of drawings / documents will be in soft format (pdf only) through email followed by Thirteen (07) hard copies.
- 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 (KPCL) requirement in a short notice.
- Bidder to also furnish the auto cad copy of the following documents after award of contract. However any other auto cad copy of any other document as per the insistence of BHEL / customer will also be submitted by the bidder without any delivery/commercial implication to BHEL.
  - Equipment lay out.
  - Cable tray lay out.
  - Civil scope drawings.
  - Piping lay out drawing.
- Cable schedule in BHEL format (shall be provided during detailed engineering stage).

ANNEXURE-VI

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

DRAWING/DOCUMENTS SUBMISSION SCHEDULE

After award of LOI/LOA, following minimum drawing/documents shall be submitted by the bidder for BHEL/Customer approval. However any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.
For the Drawings/Documents Submission Procedure, please refer following Annexure-A. Bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. The number of drawing/documents to be submitted by the bidder shall be as per enclosed Annexure-V.

Every revised submission incorporating comments shall be resubmitted within 7 days.

BHEL shall provide observation / approval within 15 days from the date of document submission by bidder.
Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. Engineering meeting shall be held fort nightly, for which the bidder shall depute his concerned engineers along with project manager to PEM office or at customer office without fail.

Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account.

ANNEXURE – A

SL. NO.	BHEL DRAWING/ DOCUMENT NUMBER	DRAWING/ DOCUMENT TITLE	NO. OF WEEKS FOR DRAWING/ DOCUMENT SUBMISSION AFTER PLACING LOI/LOA	SIZE OF DRAWING/ DOCUMENT
1.	PE-V13-409-174-14000A-A001	PIPING & INSTRUMENTATION DIAGRAM	4	A0
2.	PE-V13-409-174-14000A-A002	PROCESS DESIGN BASIS AND SIZING CALCULATION	4	A4
3.	PE-V13-409-174-14000A-A003	EQUIPMENT LAYOUT	6	A0
4.	PE-V13-409-174-14000A-A004	SUB VENDOR LIST & INSPECTION CRITERIA	4	A4
5.	PE-V13-409-174-14000A-A005	CONTROL PHILOSOPHY WITH PLC SYSTEM CONFIGURATION DIAGRAM	4	A4
6.	PE-V13-409-174-14000A-A006	CIVIL ASSIGNMENT DRAWING	8	A0
7.	PE-V13-409-174-14000A-A007	ELECTRICAL LOAD LIST	4	A4
8.	PE-V13-409-174-14000A-A008	PIPING LAYOUT	8	A0
9.	PE-V13-409-174-14000A-A009	DATASHEET & SLD FOR UPS, UPS SIZING CALCULATIONS, BATTERY SIZING CALCULATIONS	10	A4
10.	PE-V13-409-174-14000A-A010	TECHNICAL DATA SHEET OF HORIZONTAL PUMPS	8	A4
11.	PE-V13-409-174-14000A-A011	TECHNICAL DATA SHEET OF COMPRESSORS	8	A4
12.	PE-V13-409-174-14000A-A012	GA & DATA SHEET OF MOTORS	8	A4

13.	PE-V13-409-174-14000A-A013	QAP FOR HORIZONTAL PUMPS WITH MOTOR	4	A4
14.	PE-V13-409-174-14000A-A014	QAP FOR COMPRESSORS WITH MOTOR	4	A4
15.	PE-V13-409-174-14000A-A015	DATA SHEET FOR INSTRUMENTS AND ANALYSER ALONG WITH INSTRUMENT HOOK UP DRAWING	8	A4
16.	PE-V13-409-174-14000A-A016	DATASHEET & GA OF OZONE GENERATOR	8	DATASHEET - A4, GA- A2
17.	PE-V13-409-174-14000A-A017	QAP OF OZONE GENERATOR	4	A4
18.	PE-V13-409-174-14000A-A018	GA OF ATMOSPHERIC TANKS	8	A2
19.	PE-V13-409-174-14000A-A019	GA OF PRESSURE VESSELS	4	A2
20.	PE-V13-409-174-14000A-A020	MECHANICAL DATASHEET & GA FOR AIR DRIER, OXYGEN GENERATOR, CHILLER, VENTURI INJECTOR ETC.	8	DATASHEET - A4, GA- A2
21.	PE-V13-409-174-14000A-A021	MECHANICAL DATASHEET & GA FOR STRAINERS & VALVES	10	A4
22.	PE-V13-409-174-14000A-A022	DATASHEET FOR SAFETY ITEMS	10	A4
23.	PE-V13-409-174-14000A-A023	INSTRUMENT SCHEDULE	10	A4
24.	PE-V13-409-174-14000A-A024	VALVE SCHEDULE	10	A4
25.	PE-V13-409-174-14000A-A025	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 EARTHING REQUIREMENT, PLC CATALOGUE, PLC PROGRAMMING, LADDER SCHEME, PLC OWS/PRINTER FURNITURE BOM	12	A4 & A2 AS REQUIRED.
26.	PE-V13-409-174-14000A-A026	LIST OF SOFT SIGNAL EXCHANGE WITH DDCMIS & FIELD JB TERMINATIONS	12	A4
27.	PE-V13-409-174-14000A-A027	QAP AND FAT PROCEDURE FOR PLC	4	A4
28.	PE-V13-409-174-14000A-A028	CABLE TRAY LAYOUT	10	A1
29.	PE-V13-409-174-14000A-A029	QAP / ICL OF OZONE GENERATION PLANT (BALANCE OF ITEMS)	4	A4
30.	PE-V13-409-174-14000A-A030	DESIGN CALCULATION AND DATASHEET OF VENTILATION FANS.	8	A4
31.	PE-V13-409-174-14000A-A031	QUALITY PLAN FOR ELECTRIC/MANUAL HOIST	8	A4
32.	PE-V13-409-174-14000A-A032	GA DRAWING FOR ELECTRIC/MANUAL HOIST	8	A2
33.	PE-V13-409-174-14000A-A033	ELECTRIC CIRCUIT DIAGRAM FOR ELECTRIC HOIST (IF APPLICABLE)	8	A4
34.	PE-V13-409-174-14000A-A034	SIZING CALCULATIONS FOR ELECTRIC/MANUAL HOIST	8	A4
35.	PE-V13-409-174-14000A-A035	DOWN SHOP LEAD ARRANGEMENT OF ELECTRIC HOIST FOR STRAIGHT PATH (IF APPLICABLE)	8	A4

36.	PE-V13-409-174-14000A-A036	ERECTION PROCEDURE	8	A4
37.	PE-V13-409-174-14000A-A037	CABLE SCHEDULE, SUBMISSION OF CABLE INTERCONNECTION DIAGRAM ALONG WITH FIELD JUNCTION BOX TERMINATIONS	10	A4
38.	PE-V13-409-174-14000A-A038	PAINTING SCHEDULE	8	A4
39.	PE-V13-409-174-14000A-A039	ENGINEERING BOQ	10	A4
40.	PE-V13-409-174-14000A-A040	PG TEST PROCEDURE	12	A4
41.	PE-V13-409-174-14000A-A041	O&M MANUAL	12	A4,A2,A1,A0 AS REQUIRED.

Note:

- Bidder to note that drg/doc submission shall be through web based Document Management System. 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.

  a. Internet explorer version – Minimum Internet Explorer 7

  b. Internet speed – 2 mbps (Minimum preferred)

  c. Pop ups from our external DMS IP (124.124.36.198) should not be blocked

  d. Vendor's Internal proxy setting should not block DMS application's link

  (http://124.124.36.198/wrenchwebaccess/login.aspx)

ANNEXURE –VII

Format 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.	Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				

3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				

6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

ANNEXURE-VIII

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

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

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

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

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
    - Ingress of moisture and corrosion damages.
    - Damage to protective coating.
    - Open ends in pipes, vessels and equipment -
        - In case any open ends are noticed, same shall be capped.

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

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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

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

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

iii Open storage (O)

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

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

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

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

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

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

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

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

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

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

5. CONCLUSION

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

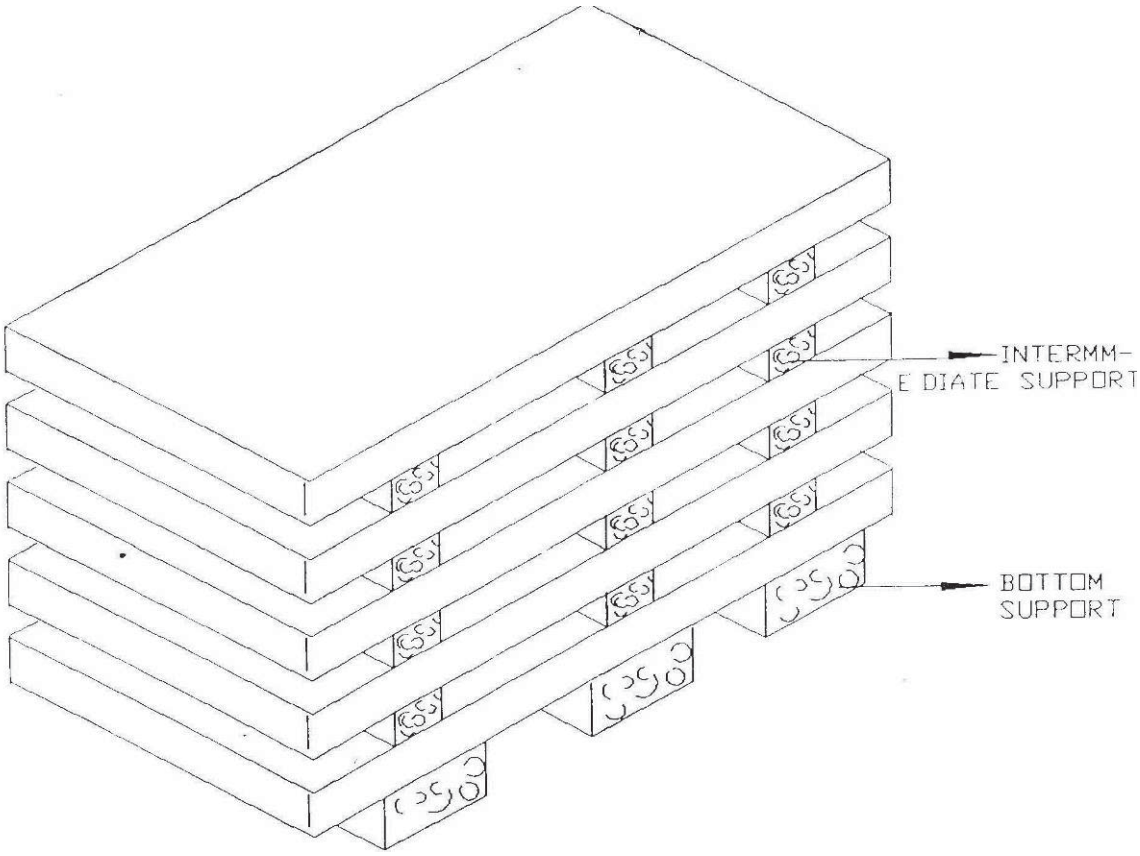


Figure – 1 – PLATE STACKING ARRANGEMENT

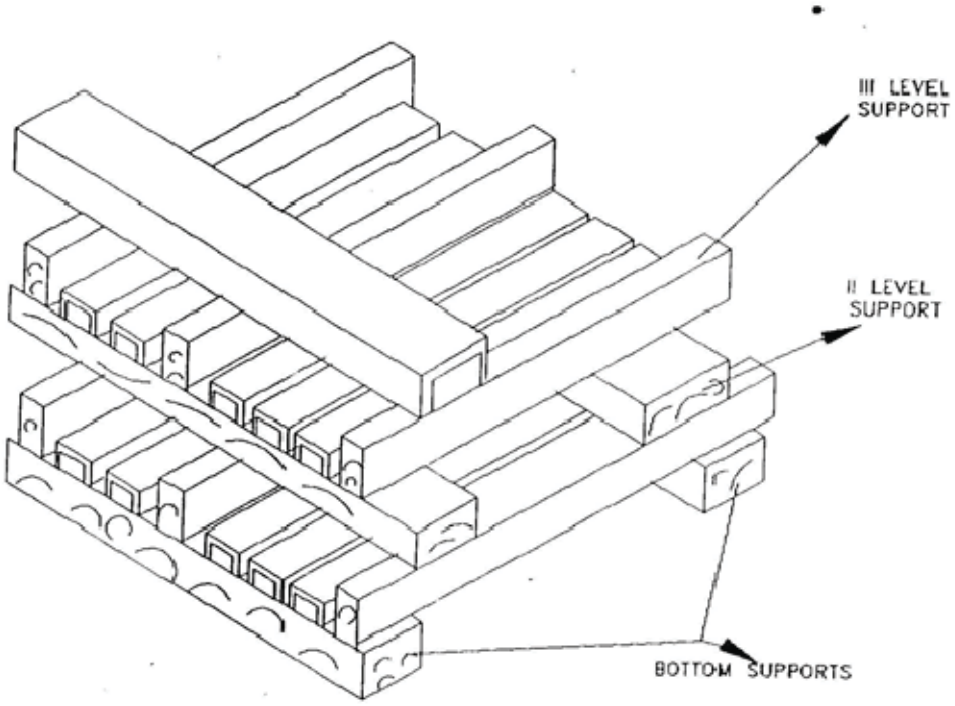


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

ANNEXURE – IX

PERCENTAGE BREAK UP OF SUPPLY PRICES

THE BREAK-UP (%) OF SUPPLY PRICES OF OZONE GENERATION PLANT PACKAGE IN THE BBU SHALL BE IN LINE WITH THE BELOW PROVIDED DETAILS:

Break-up (%) of Supply prices (Refer Sr. No. 2.1 of Price Schedule) Ozone Generation Plant package. (To be used during contract execution for payment).		
1.	Lumpsum firm price for supply of Ozonators with accessories inclusive of all taxes, duties and other levies as applicable.	35% of Sr. No. 2.1 of Price Schedule
2.	Lumpsum firm price for supply of Compressor with accessories inclusive of all taxes, duties and other levies as applicable.	12% of Sr. No. 2.1 of Price Schedule
3.	Lumpsum firm price for supply of Oxygen Generation plant (air receiver, air dryer, oxygen generator, oxygen receiver) with accessories inclusive of all taxes, duties and other levies as applicable.	20% of Sr. No. 2.1 of Price Schedule
4.	Lumpsum firm price for supply of Tanks, Pumps, Valves, piping and chillers with accessories inclusive of all taxes, duties and other levies as applicable.	15% of Sr. No. 2.1 of Price Schedule
5.	Lumpsum firm price for supply of PLC and instruments with accessories inclusive of all taxes, duties and other levies as applicable.	15% of Sr. No. 2.1 of Price Schedule
6.	Lumpsum firm price for supply of Miscellaneous scope with accessories inclusive of all taxes, duties and other levies as applicable.	3% of Sr. No. 2.1 of Price Schedule

VOLUME-III

1.0 DRAWINGS/DOCUMENTATION REQUIREMENT ALONG WITH BID.

Bidder to furnish 4 sets of techno-commercial bid including following documents/information **(For Electrical and C&I please refer the respective section of the specification).**

a) Deviation if any in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed)
b) Compliance cum confirmation certificate.(Stamped & Signed)
c) Schedule of Declaration. (Stamped & Signed)
d) Un Price Schedule duly filled in. (Stamped & Signed).
e) List of start-up, erection & commissioning spares, if any, (Stamped & Signed).
f) List of tools & tackles,if any, (Stamped & Signed).

Bidder to note that if bidder has taken any deviation from the technical specification requirements, the same shall be clearly mentioned in the bid in the BHEL prescribed format of Schedule of Deviations attached as Volume - III of this technical specification.

In case of no deviation, Bidder to furnish signed and stamped copy of “Schedule of Deviations with cost of withdrawal” stating **“No Deviation**”.

No other technical document is required along with bidder’s offer. Any other document submitted by bidder shall not be evaluated by BHEL and shall be considered as withdrawn.

Bidder to note that any un-declared deviation mentioned in bidder offer other than specified in the scheduled of Deviations shall be considered as null and void.

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

DEVIATION SHEET (COST OF WITHDRAWL)

PROJECT:- 1x370 MW YELAHANKA CCPP

PACKAGE:- OZONE GENERATION PLANT

TENDER ENQUIRY REFERENCE:-

NAME OF BIDDER:-

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

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

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

NOTES:

1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.

2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.

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

PRE-BID CLARIFICATION SCHEDULE

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

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

Signature: _____

Name: _____

Designation: _____

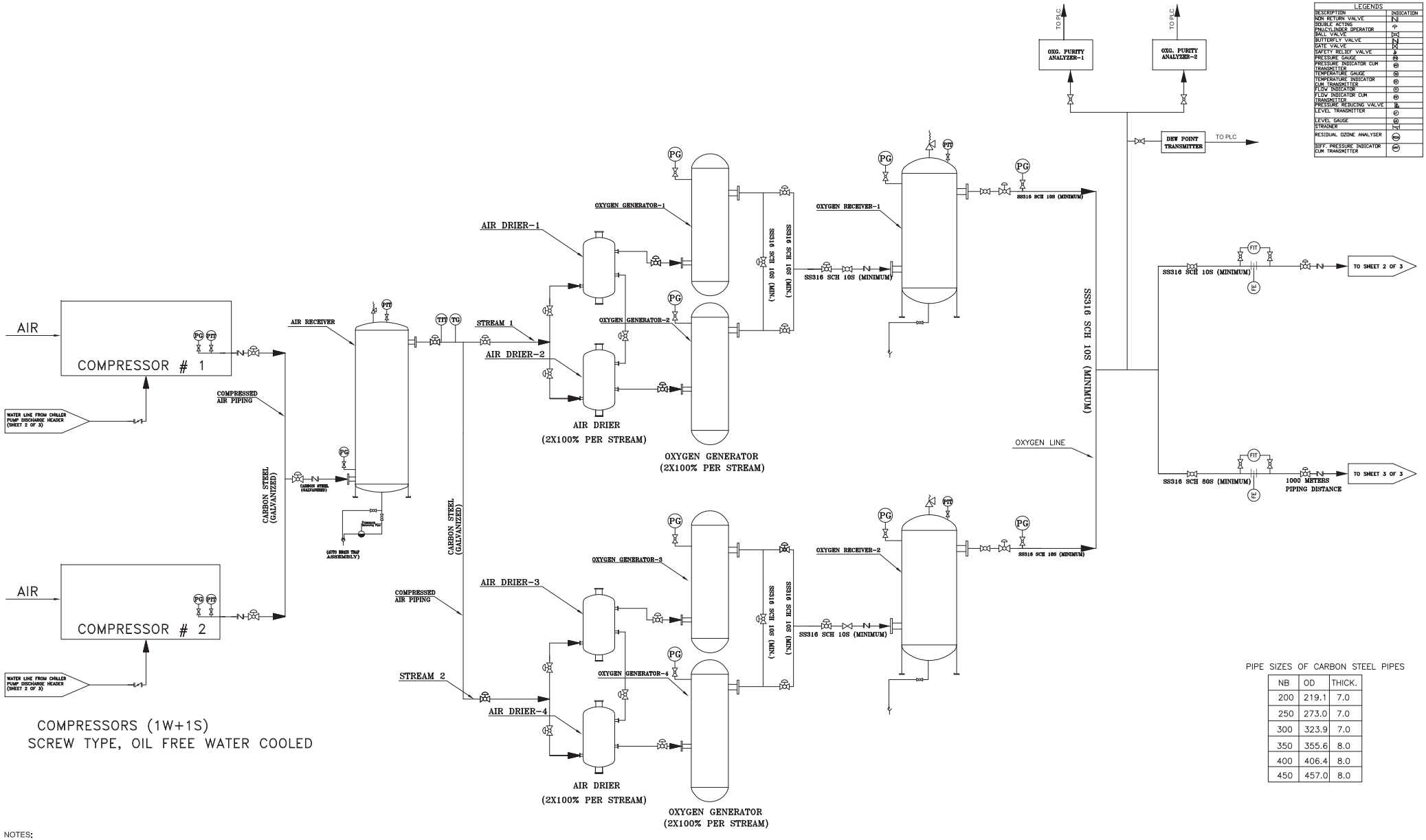
Company: _____

Date: _____

Company Seal

SUGGESTIVE PRICE FORMAT FOR OZONE GENERATION PLANT: 1x370 MW YELAHANKA CCPP		
Sl. No.	**DESCRIPTION OF EQUIPMENT / ITEM**	**TOTAL PRICE FOR "FOR" SITE**
(1)	**(2)**	**(3)**
1.0	Total lump sum firm price on FOR site basis for design, engineering, manufacture, fabrication, assembly, inspection & testing at vendor's & sub-vendor's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, mandatory spares, properly packed for transportation, unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, trail run, preparation and submission of "As Built" drawings, site testing, carrying out performance guarantee tests at site and handover inclusive of all prevailing taxes, duties and other levies as required of **OZONE GENERATION PLANT** and as defined in the technical specification **(PE-TS-409-174-14000A-A001 REV 00)** for **1X370 MW YELAHANKA CCPP.**	
	NOTES:	
a	Bidder to note that total price indicated above at 1.00 shall be considered for evaluation and hence, should be complete in all respect for the full scope defined and considering all terms and conditions agreed.	
b	In case, price indicated above does not match with item wise break-up given at 2.00, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.	
2.0	**BREAK-UP OF PRICES GIVEN IN 1.00 ABOVE**	
2.1	Total lump sum firm price for EQUIPMENT (SUPPLY) for design, engineering, manufacturing, painting, inspection & testing, supply, delivery, installation, packing and forwarding of equipments to site, complete with all accessories including start up and commissioning spares, inclusive of all taxes & duties for the complete scope of supply of **OZONE GENERATION PLANT** and as defined in the technical specification **(PE-TS-409-174-14000A-A001 REV 00)** for **1X370 MW YELAHANKA CCPP.**	
2.2	Total lump sum price for supply/delivery of Mandatory spares of **OZONE GENERATION PLANT** as defined in Annexure-II in the technical specification **(PE-TS-409-174-14000A-A001 REV 00)** for **1X370 MW YELAHANKA CCPP.**	
2.3	Total lump sum firm price for all services including unloading, handling & transportation at site , insite transportation, Erection & Commissioning, trial run, preparation & submission of "As Built" drawings, etc, required for completion of **OZONE GENERATION PLANT** and as defined in the technical specification **(PE-TS-409-174-14000A-A001 REV 00)** for **1X370 MW YELAHANKA CCPP.**	
2.4	Total lump sum price for carrying out performance guarantee tests at site and handover in flawless operating condition to end customer of the entire of **OZONE GENERATION PLANT** as defined in the technical specification **(PE-TS-409-174-14000A-A001 REV 00)** for **1X370 MW YELAHANKA CCPP.**	
3.0	Total lump sum price for Recommended spares (optional item) of **OZONE GENERATION PLANT** as defined in the technical specification **(PE-TS-409-174-14000A-A001 REV 00)** for **1X370 MW YELAHANKA CCPP.**	

DRAWINGS



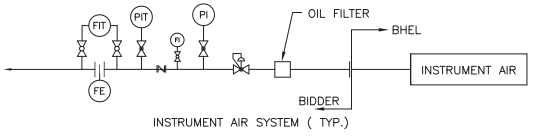
COMPRESSORS (1W+1S)
SCREW TYPE, OIL FREE WATER COOLED

LEGENDS	
DESCRIPTION	INDICATION
NON RETURN VALVE	
DOUBLE ACTING PNAUCYLINDER OPERATOR	
BALL VALVE	
BUTTERFLY VALVE	
GATE VALVE	
SAFETY RELIEF VALVE	
PRESSURE GAUGE	PG
PRESSURE INDICATOR CUM TRANSMITTER	PIT
TEMPERATURE GAUGE	TG
TEMPERATURE INDICATOR CUM TRANSMITTER	TIT
FLOW INDICATOR	FI
FLOW INDICATOR CUM TRANSMITTER	FIT
PRESSURE REDUCING VALVE	
LEVEL TRANSMITTER	LT
LEVEL GAUGE	LG
STRAINER	
RESIDUAL OZONE ANALYSER	ROA
DIFF. PRESSURE INDICATOR CUM TRANSMITTER	DPIT

PIPE SIZES OF CARBON STEEL PIPES

NB	OD	THICK.
200	219.1	7.0
250	273.0	7.0
300	323.9	7.0
350	355.6	8.0
400	406.4	8.0
450	457.0	8.0

NOTES:
1) * THE NUMBERS AND CAPACITY OF EACH OZONE GENERATOR INCLUDING STANDBY STREAM WILL BE BASED ON SUPPLIER RECOMMENDATION
2) PLC SHALL BE PLACED IN AC ROOM. REDUNDANT UPS SUPPLY TO BE USED FOR PLC.
3) ALL THE VALVES COMING IN SEQUENCE SHALL BE AUTOMATIC VALVES.
4) SOFT SIGNAL INTERFACE TO MAIN CONTROL ROOM CCR FOR MONITORING.
5) ALL THE ISOLATION VALVES OF ALL THE INSTRUMENTS SHALL BE OF SS316.
6) BLANK FLANGES, COUNTER FLANGES & ISOLATION VALVES SHALL BE PROVIDED BY THE BIDDER AT THE TERMINAL POINTS.
7) ALL THE EQUIPMENTS , VALVES, INSTRUMENTS, PIPING ETC SHOWN IN THE P & ID IS IN BIDDER'S SCOPE UNLESS EXCLUSIVELY MENTIONED.
8) 2-VALVE MANIFOLD FOR PRESSURE MEASURING INSTRUMENTS/3-VALVE MANIFOLD FOR DP MEASURING INSTRUMENTS/ 5-VALVE MANIFOLD FOR DPTS, BALL VALVE FOR FLOW INDICATORS/ANALYTICAL INSTRUMENT SHALL BE PROVIDED.
9) 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.



INSTRUMENT AIR SYSTEM (TYP.)

--------NOT IN BIDDER SCOPE

COMPUTER FILE NAME : D:\OFFICIAL\Contract\(6. YELAHANKA\1. OZONE\YELAHANKA OZONE SPEC\3. SECTION C\COMMON RW + CW OZONE PID REV 03.dwg

JOB NO. : 409
STATUS : CONTRACT
DISTRIBUTION :

No.OF REV	DATE	ALTD	CHD	APPD
TO				

370 MW KPCL YELAHANKA CCPP
KARNATAKA POWER CORPORATION LIMITED

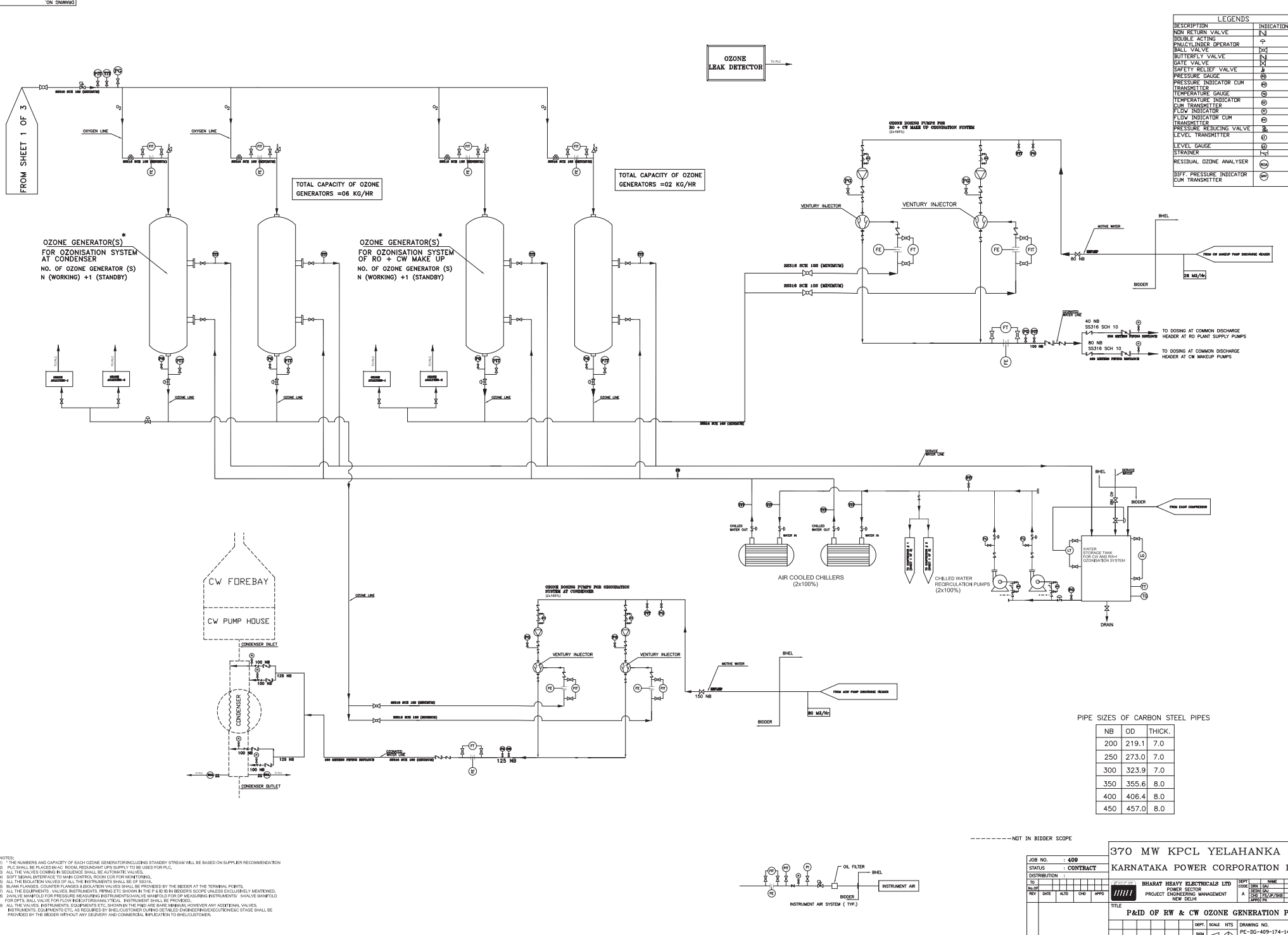
BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE	NAME	SIGN	DATE
A	DRN GAJ		
	DESN GAJ		
	CHD TS/JP/SKB		
	APPD PK		

TITLE
P&ID OF RW & CW OZONE GENERATION PLANT

DEPT.	SCALE NTS	DRAWING NO.
SIGN		PE-DG-409-174-14000A-A001
DATE		SHEET 01 OF 03 REV. 00

FORMAT SIZE A0



LEGENDS

DESCRIPTION	INDICATION
NON RETURN VALVE	
DOUBLE ACTING PNUCYLINDER OPERATOR	
BALL VALVE	
BUTTERFLY VALVE	
GATE VALVE	
SAFETY RELIEF VALVE	
PRESSURE GAUGE	PG
PRESSURE INDICATOR CUM TRANSMITTER	PIT
TEMPERATURE GAUGE	TG
TEMPERATURE INDICATOR CUM TRANSMITTER	TIT
FLOW INDICATOR	FI
FLOW INDICATOR CUM TRANSMITTER	FIT
PRESSURE REDUCING VALVE	
LEVEL TRANSMITTER	LT
LEVEL GAUGE	LG
STRAINER	
RESIDUAL OZONE ANALYSER	ROA
DIFF. PRESSURE INDICATOR CUM TRANSMITTER	DPIT

PIPE SIZES OF CARBON STEEL PIPES

NB	OD	THICK.
200	219.1	7.0
250	273.0	7.0
300	323.9	7.0
350	355.6	8.0
400	406.4	8.0
450	457.0	8.0

NOTES:
1) * THE NUMBERS AND CAPACITY OF EACH OZONE GENERATOR INCLUDING STANDBY STREAM WILL BE BASED ON SUPPLIER RECOMMENDATION
2) PLC SHALL BE PLACED IN AC ROOM, REDUNDANT UPS SUPPLY TO BE USED FOR PLC.
3) ALL THE VALVES COMING IN SEQUENCE SHALL BE AUTOMATIC VALVES.
4) SOFT SIGNAL INTERFACE TO MAIN CONTROL ROOM CCR FOR MONITORING.
5) ALL THE ISOLATION VALVES OF ALL THE INSTRUMENTS SHALL BE OF SS316.
6) BLANK FLANGES, COUNTER FLANGES & ISOLATION VALVES SHALL BE PROVIDED BY THE BIDDER AT THE TERMINAL POINTS.
7) ALL THE EQUIPMENTS , VALVES, INSTRUMENTS, PIPING ETC SHOWN IN THE P & ID IS IN BIDDER'S SCOPE UNLESS EXCLUSIVELY MENTIONED.
8) 2-VALVE MANIFOLD FOR PRESSURE MEASURING INSTRUMENTS/3-VALVE MANIFOLD FOR DP MEASURING INSTRUMENTS/ 5-VALVE MANIFOLD FOR DPTS, BALL VALVE FOR FLOW INDICATORS/ANALYTICAL INSTRUMENT SHALL BE PROVIDED.
9) 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.

--------NOT IN BIDDER SCOPE

JOB NO.	: 409
STATUS	: CONTRACT
DISTRIBUTION	:

REV	DATE	ALTD	CHD	APPD

370 MW KPCL YELAHANKA CCPP
KARNATAKA POWER CORPORATION LIMITED

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT	NAME	SIGN	DATE
CODE	DRN. GAJ		
	DESIGN GAJ		
A	CHD TS/JP/SKB		
	APPD PK		

TITLE
P&ID OF RW & CW OZONE GENERATION PLANT

DEPT.	SCALE NTS	DRAWING NO.
SIGN		PE-DG-409-174-14000A-A001
DATE		SHEET 02 OF 03 REV. 00

FORMAT SIZE A0

COMPUTER FILE NAME : D:\OFFICIAL\Contract\6. YELAHANKA\1. OZONE\YELAHANKA OZONE SPEC\3. SECTION C\COMMON RW + CW OZONE PID REV 03.dwg

COMPUTER FILE NAME : D:\OFFICIAL\Contract\v6 - YELAHANKA\1. OZONE\YELAHANKA OZONE SPEC\3. SECTION C\COMMON RW + CW OZONE PID REV 03.dwg

DRAWING NO.

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

OZONE LEAK DETECTOR

TO PLC

LEGENDS	
DESCRIPTION	INDICATION
NON RETURN VALVE	
DOUBLE ACTING PNUCYLINDER OPERATOR	
BALL VALVE	
BUTTERFLY VALVE	
GATE VALVE	
SAFETY RELIEF VALVE	
PRESSURE GAUGE	PG
PRESSURE INDICATOR CUM TRANSMITTER	PIT
TEMPERATURE GAUGE	TG
TEMPERATURE INDICATOR CUM TRANSMITTER	TIT
FLOW INDICATOR	FI
FLOW INDICATOR CUM TRANSMITTER	FIT
PRESSURE REDUCING VALVE	
LEVEL TRANSMITTER	LT
LEVEL GAUGE	LG
STRAINER	
RESIDUAL OZONE ANALYSER	ROA
DIFF. PRESSURE INDICATOR CUM TRANSMITTER	DPIT

TOTAL CAPACITY OF OZONE GENERATORS =02 KG/HR

OZONE GENERATOR(S) *
FOR OZONISATION SYSTEM OF RAW WATER RESERVOIR
NO. OF OZONE GENERATOR (S)
N (WORKING) +1 (STANDBY)

OXYGEN RECEIVER-3

SS316 SCH 10S (MINIMUM)

FROM SHEET 1 OF 3

OIL FILTER
BHEL
INSTRUMENT AIR
BIDDER
INSTRUMENT AIR SYSTEM (TYP.)

OZONE LINE

SERVICE WATER LINE

CHILLED WATER OUT
WATER IN

AIR COOLED CHILLERS
(2x100%)

CHILLED WATER RECIRCULATION PUMPS
(2x100%)

WATER STORAGE TANK FOR RW+C OZONEATION SYSTEM

BHEL
SERVICE WATER
BIDDER
DRAIN

OZONE DOSING PUMPS FOR RAW WATER RESERVOIR OZONISATION SYSTEM
(DOSING IN EACH COMPARTMENT OF RAW WATER RESERVOIR)
(2x100%)

VENTURY INJECTOR
VENTURY INJECTOR

MOTIVE WATER

FROM RAW WATER RESERVIOUR

125 NB

50 M3/Hr

SS316 SCH 10S (MINIMUM)
SS316 SCH 10S (MINIMUM)

100 NB

COMPARTMENT # 1
RAW WATER RESERVOIR

COMPARTMENT # 2
RAW WATER RESERVOIR

100 NB
SS316 SCH10S PIPING DISTANCE

TO DOSING AT INLET LINE AT RW RESERVOIR

--------NOT IN BIDDER SCOPE

PIPE SIZES OF CARBON STEEL PIPES

NB	OD	THICK.
200	219.1	7.0
250	273.0	7.0
300	323.9	7.0
350	355.6	8.0
400	406.4	8.0
450	457.0	8.0

NOTES:
1) * THE NUMBERS AND CAPACITY OF EACH OZONE GENERATOR INCLUDING STANDBY STREAM WILL BE BASED ON SUPPLIER RECOMMENDATION
2) PLC SHALL BE PLACED IN AC ROOM. REDUNDANT UPS SUPPLY TO BE USED FOR PLC.
3) ALL THE VALVES COMING IN SEQUENCE SHALL BE AUTOMATIC VALVES.
4) SOFT SIGNAL INTERFACE TO MAIN CONTROL ROOM CCR FOR MONITORING.
5) ALL THE ISOLATION VALVES OF ALL THE INSTRUMENTS SHALL BE OF SS316.
6) BLANK FLANGES, COUNTER FLANGES & ISOLATION VALVES SHALL BE PROVIDED BY THE BIDDER AT THE TERMINAL POINTS.
7) ALL THE EQUIPMENTS , VALVES, INSTRUMENTS, PIPING ETC SHOWN IN THE P & ID IS IN BIDDER'S SCOPE UNLESS EXCLUSIVELY MENTIONED.
8) 2-VALVE MANIFOLD FOR PRESSURE MEASURING INSTRUMENTS/3-VALVE MANIFOLD FOR DP MEASURING INSTRUMENTS/ 5-VALVE MANIFOLD FOR DPTS, BALL VALVE FOR FLOW INDICATORS/ANALYTICAL INSTRUMENT SHALL BE PROVIDED.
9) 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.

JOB NO.	: 409
STATUS	: CONTRACT
DISTRIBUTION	:

TO					
No.OF REV	DATE	ALTD	CHD	APPD	

370 MW KPCL YELAHANKA CCPP
KARNATAKA POWER CORPORATION LIMITED

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

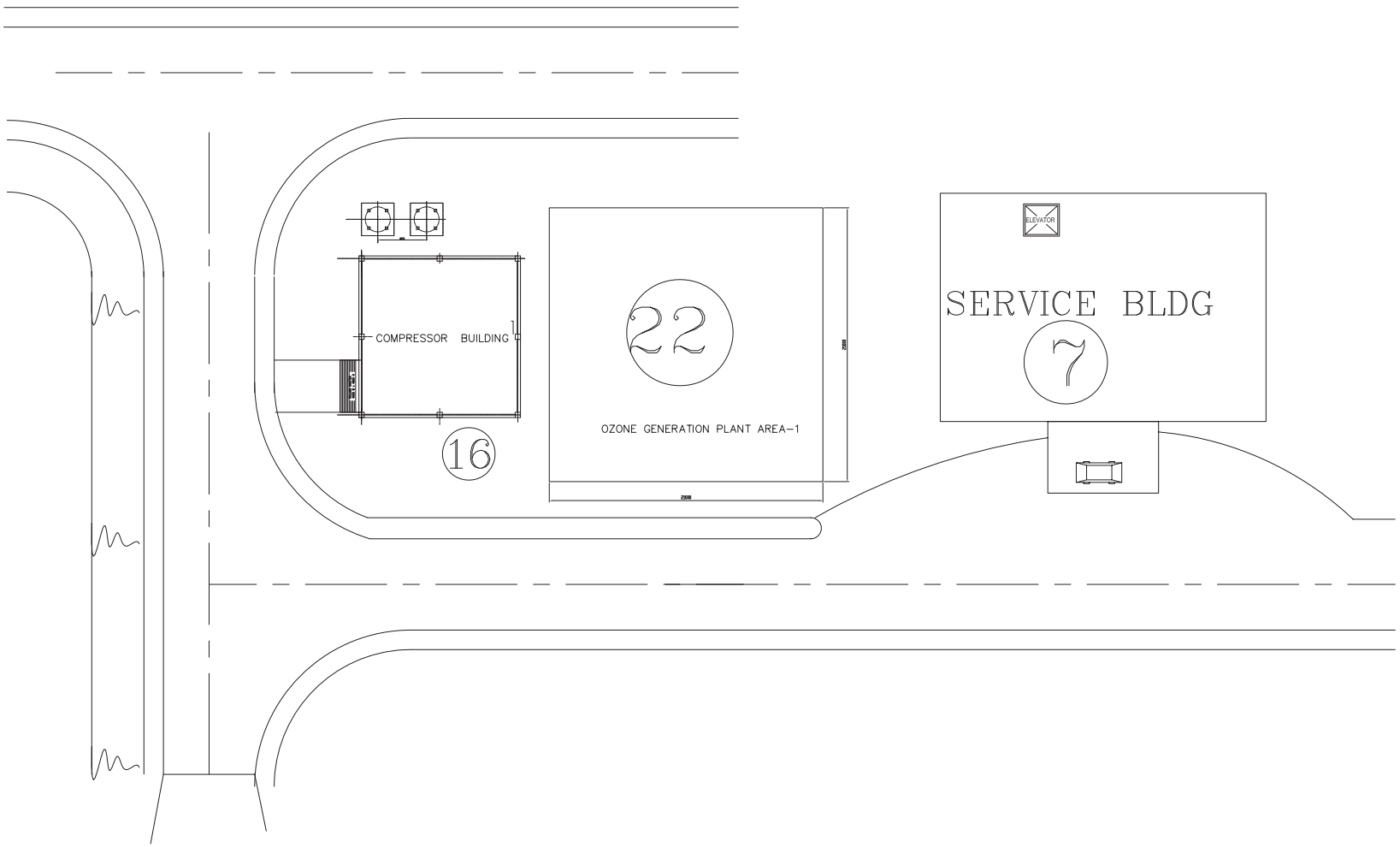
DEPT	NAME	SIGN	DATE
CODE	DRN GAJ		
	DESN GAJ		
A	CHD PS/JP/SKB		
	APPD PK		

TITLE
P&ID OF RW & CW OZONE GENERATION PLANT

DEPT.	SCALE	NTS	DRAWING NO.
SIGN			PE-DG-409-174-14000A-A001
DATE			SHEET 03 OF 03 REV. 00

FORMAT SIZE A0

CONSTRUCTION NORTH



NOTES:

1. ALL THE DIMENSIONS ARE IN MM.
2. BIDDER TO ACCOMMODATE ALL THEIR EQUIPMENTS IN THE SPACE SHOWN.

KEY PLAN OF OZONE GENERATION PLANT AREA-1

JOB NO.	: 409
STATUS	: CONTRACT
DISTRIBUTION	:

REV	DATE	ALTD	CHD	APPD

370 MW KPCL YELAHANKA CCPP

KARNATAKA POWER CORPORATION LIMITED

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

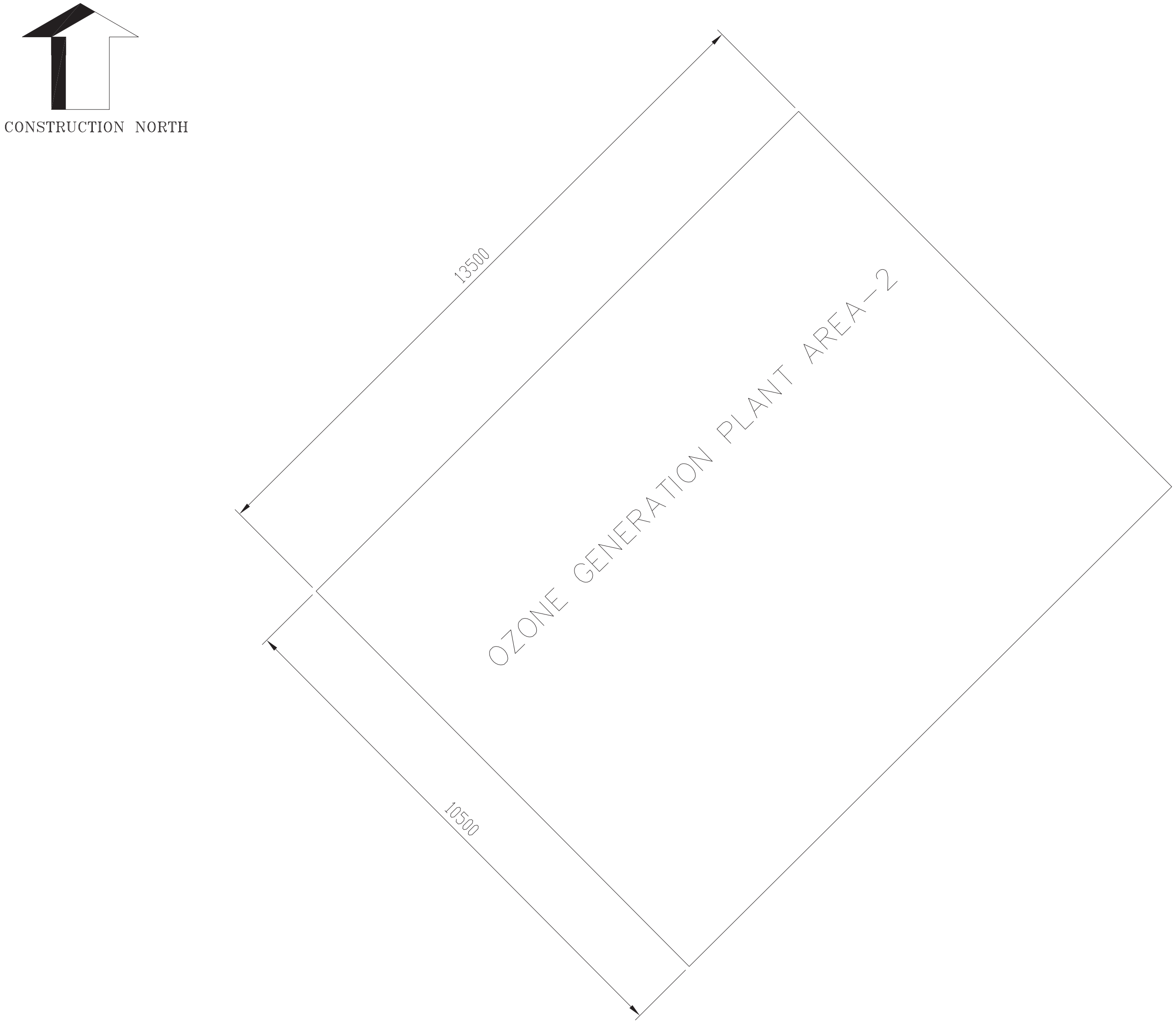
DEPT	NAME	SIGN	DATE
CODE	DRN. GAJ		
	DESN. GAJ		
A	CHD. PK/JP/SKB		
	APPD. PK		

TITLE
KEY PLAN OF OZONE GENERATION PLANT AREA-1

DEPT. SCALE NTS
SIGN
DATE
DRAWING NO. PE-DG-409-174-14000A-A002
SHEET 01 OF 01 REV. 00
FORMAT SIZE A0

COMPUTER FILE NAME : D:\OFFICIAL\Contract\6. YELAHANKA\1. OZONE\YELAHANKA OZONE SPEC\VOL III\KEY PLANS AND RW RESERVOUR GA DRG.dwg

COMPUTER FILE NAME : D:\OFFICIAL\Contract\6. YEHLANKA\1. OZONE\YEHELENKA OZONE SPEC\VOL III\KEY PLANS AND RW RESERVIOUR GA DRG.dwg



NOTES:

1. ALL THE DIMENSIONS ARE IN MM.
2. BIDDER TO ACCOMMODATE ALL THEIR EQUIPMENTS IN THE SPACE SHOWN.

KEY PLAN OF OZONE GENERATION PLANT AREA-2

370 MW KPCL YELAHANKA CCPP
KARNATAKA POWER CORPORATION LIMITED

JOB NO. : 409
STATUS : CONTRACT
DISTRIBUTION :

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

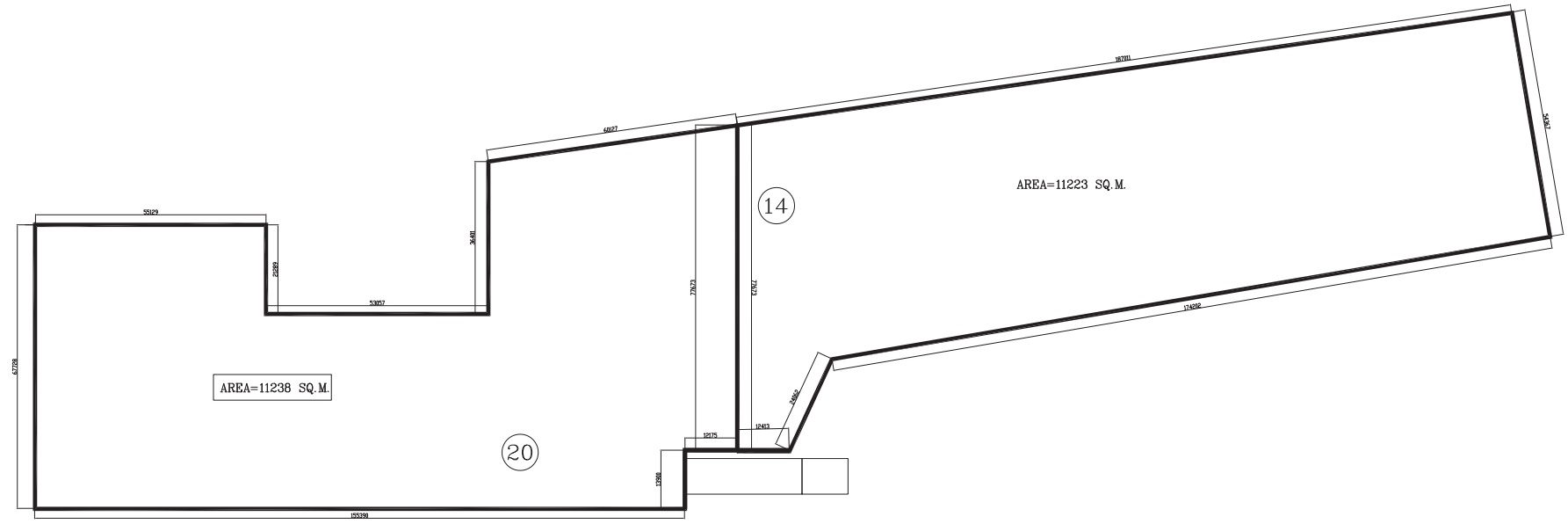
DEPT CODE A — DRN GAJ; DESN GAJ; CHD FS/JP/SKB; APPD PK

TITLE: KEY PLAN OF OZONE GENERATION PLANT AREA-2

SCALE NTS
DRAWING NO. PE-DG-409-174-14000A-A003
SHEET 01 OF 01 REV. 00
FORMAT SIZE A0

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

CONSTRUCTION NORTH



NOTES:

1. ALL THE DIMENSIONS ARE IN MM.
2. BIDDER TO ACCOMMODATE ALL THEIR EQUIPMENTS IN THE SPACE SHOWN.

JOB NO.	: 409
STATUS	: CONTRACT
DISTRIBUTION	:

TO					
No.OF REV	DATE	ALTD	CHD	APPD	

370 MW KPCL YELAHANKA CCPP

KARNATAKA POWER CORPORATION LIMITED

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT	NAME	SIGN	DATE
CODE	DRN GAJ		
	DESN GAJ		
A	CHD TS/JP/SKB		
	APPD PK		

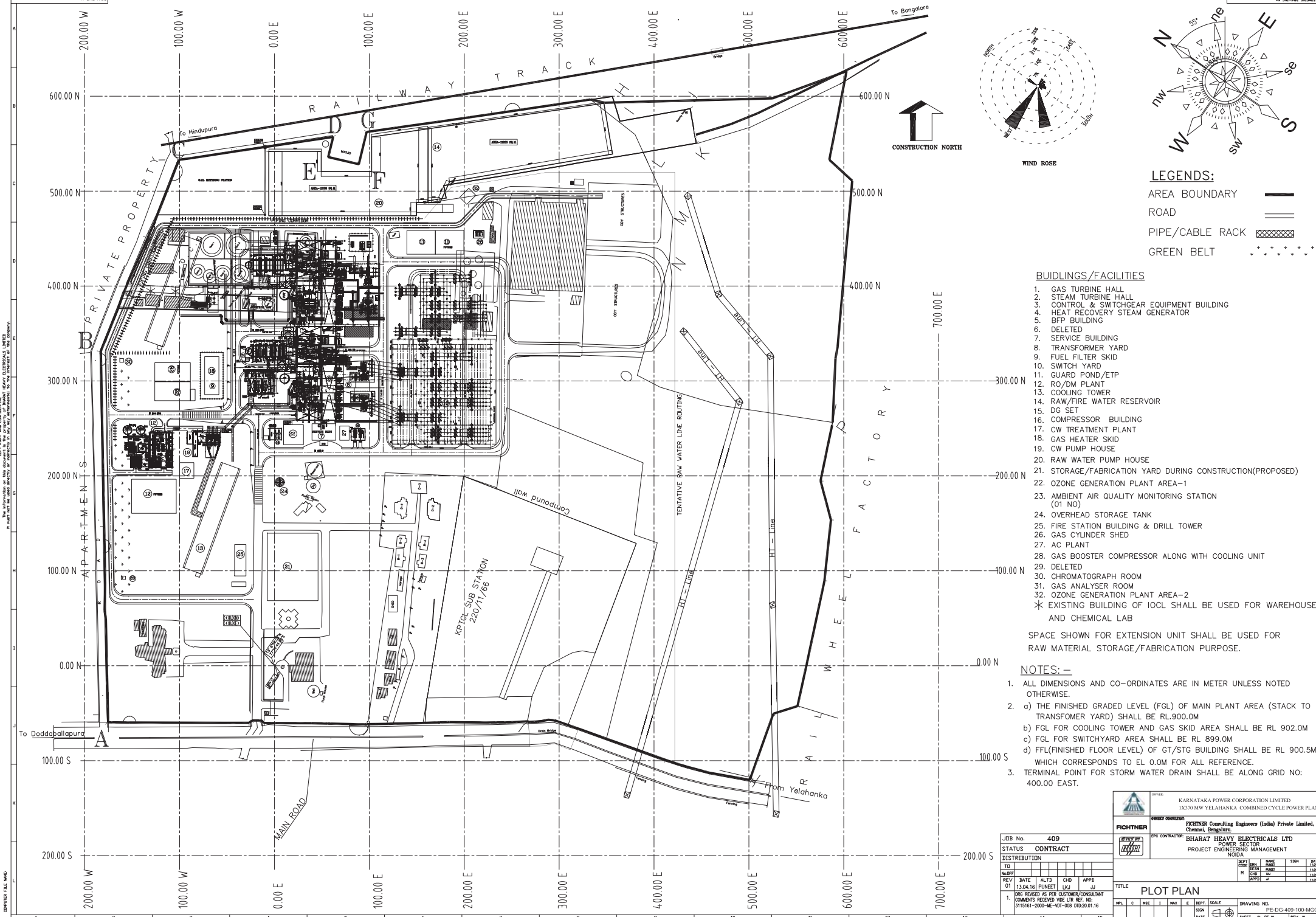
TITLE

GA DRAWING OF RAW WATER RESERVOIR

DEPT.	SCALE	NTS	DRAWING NO.
SIGN			PE-DG-409-174-14000A-A004
DATE			SHEET 01 OF 01 REV. 00

FORMAT SIZE A0

COMPUTER FILE NAME : D:\OFFICIAL\Contract\(6. YELAHANKA\1. OZONE\YELAHANKA OZONE SPEC\VOL III\KEY PLANS AND RW RESERVOUR GA DRG.dwg



LEGENDS:

- AREA BOUNDARY
- ROAD
- PIPE/CABLE RACK
- GREEN BELT

BUIDLINGS/FACILITIES

1. GAS TURBINE HALL
2. STEAM TURBINE HALL
3. CONTROL & SWITCHGEAR EQUIPMENT BUILDING
4. HEAT RECOVERY STEAM GENERATOR
5. BFP BUILDING
6. DELETED
7. SERVICE BUILDING
8. TRANSFORMER YARD
9. FUEL FILTER SKID
10. SWITCH YARD
11. GUARD POND/ETP
12. RO/DM PLANT
13. COOLING TOWER
14. RAW/FIRE WATER RESERVOIR
15. DG SET
16. COMPRESSOR BUILDING
17. CW TREATMENT PLANT
18. GAS HEATER SKID
19. CW PUMP HOUSE
20. RAW WATER PUMP HOUSE
21. STORAGE/FABRICATION YARD DURING CONSTRUCTION(PROPOSED)
22. OZONE GENERATION PLANT AREA-1
23. AMBIENT AIR QUALITY MONITORING STATION (01 NO)
24. OVERHEAD STORAGE TANK
25. FIRE STATION BUILDING & DRILL TOWER
26. GAS CYLINDER SHED
27. AC PLANT
28. GAS BOOSTER COMPRESSOR ALONG WITH COOLING UNIT
29. DELETED
30. CHROMATOGRAPH ROOM
31. GAS ANALYSER ROOM
32. OZONE GENERATION PLANT AREA-2

✳ EXISTING BUILDING OF IOCL SHALL BE USED FOR WAREHOUSE AND CHEMICAL LAB

SPACE SHOWN FOR EXTENSION UNIT SHALL BE USED FOR RAW MATERIAL STORAGE/FABRICATION PURPOSE.

NOTES: –

1. ALL DIMENSIONS AND CO-ORDINATES ARE IN METER UNLESS NOTED OTHERWISE.
2. a) THE FINISHED GRADED LEVEL (FGL) OF MAIN PLANT AREA (STACK TO TRANSFOMER YARD) SHALL BE RL.900.0M
   b) FGL FOR COOLING TOWER AND GAS SKID AREA SHALL BE RL 902.0M
   c) FGL FOR SWITCHYARD AREA SHALL BE RL 899.0M
   d) FFL(FINISHED FLOOR LEVEL) OF GT/STG BUILDING SHALL BE RL 900.5M WHICH CORRESPONDS TO EL 0.0M FOR ALL REFERENCE.
3. TERMINAL POINT FOR STORM WATER DRAIN SHALL BE ALONG GRID NO: 400.00 EAST.

JOB No.	409
STATUS	CONTRACT
DISTRIBUTION	
TO	
No.OF?	

REV	DATE	ALTD	CHD	APPD
01	13.04.16	PUNEET	LKJ	JJ

1- DRG REVISED AS PER CUSTOMER/CONSULTANT COMMENTS RECEIVED VIDE LTR REF. NO: 3115161-2000-ME-VDT-008 DTD:20.01.16

OWNER: KARNATAKA POWER CORPORATION LIMITED
1X370 MW YELAHANKA COMBINED CYCLE POWER PLANT

OWNER'S CONSULTANT: FICHTNER Consulting Engineers (India) Private Limited, Chennai, Bengaluru.

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT	NAME	SIGN	DATE
CONT	DEN PUNEET		11.05.16
DESN	PUNEET		11.05.16
M CHD	LKJ		11.05.16
APPD	JJ		11.05.16

TITLE: PLOT PLAN

MPL	C	MSE	I	MAX	E	DEPT. SIGN DATE	SCALE

DRAWING NO. PE-DG-409-100-MG01

SHEET 01 OF 01 REV. 01

SIZE-A0