




KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D4.6 VOLUME - V
	TITLE PART G : COOLING TOWER	SHEET 6 OF 13
9.0	FOUNDATIONS	
9.1	The design and construction of cooling tower foundations shall be in accordance with the requirements stipulated in IS:1080/IS:2911/IS:2950 as applicable. Continuous foundations shall be provided for cooling towers more than 75 m in height.	
9.2	<p>The foundation structure shall be designed for loads indicated in clause 8.0 of this specification and shall in addition consider the following:</p> <ol style="list-style-type: none"> Thermally induced local loading where supply culverts pass through the foundation structure without structural isolation. Cold water basin floor loading. Surcharge load of 20 kN per sqm at the ground / grade level. In case of subsoil with varying degrees of stiffness, non uniform settlements due to the varying stiffnesses have to be determined. The redistribution of stress resulting from interaction effects between the subsoil and the shell structure have to be taken into account. 	
9.3	For the load combination 0.9DL+1.5WL, for uplift of the foundation, sectoral participation of the soil adjacent to foundation shall not be considered.	
10.	BASIN AND COLD WATER OUTLET	
10.1	The basin shall be divided into two compartments to facilitate complete isolation of one half of the basin for the purpose of cleaning and maintenance, while the other half is in service.	
10.2	The basin floor of each compartment shall be sloped towards a collecting sump for effectively draining the water to permit desilting/desludging. To minimise obstructions to the flow of water, only the columns supporting the Fill structure shall be projected above the basin floor. Water shall be drained from the sump into a drain chamber outside the basin by CI drain pipe embedded below the basin floor. Suitable sluice gates of the rising spindle type conforming to IS:3042 or sluice valve conforming to IS:780 shall be provided in the drain chamber.	
10.3	A minimum of 300mm free board shall be provided for the basin over the maximum design water level. The basin wall shall project a minimum of 500 mm over the surrounding grade level.	
10.4	Each compartment of the basin shall be provided with a concrete channel for outlet of cold water. Cold water outlet channels shall be provided with the stoplogs and screens.	
10.5	Stoplogs shall be fabricated out of structural steel plate and rolled sections and provided with rubber seals to prevent leakage. Stoplogs shall be hot dip galvanised and provided with etch primer and bituminous paint.	

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS,UNIT-3 OF 700 MW		SECTION: D4.6 VOLUME - V
	TITLE PART G : COOLING TOWER	SHEET 8 OF 13	
11.2.2	A minimum factor of safety of five(5) against buckling shall be ensured at all levels.		
11.3	Design		
11.3.1	The tower shell shall be designed based on bending analysis and as per elastic theory for thin shells.		
11.3.2	Consideration shall also be given to the following effects of temperature and moisture variations that occur in the shell :		
	a) The strain resulting from a temperature gradient across the shell thickness.		
	b) The strain resulting from moisture content variations through the shell thickness, and		
	c) The strain resulting from variations of conditions (a) and (b) caused by rain and sunshine on one side of the tower or partial operation of the tower.		
11.3.3	The effect of stress concentration due to any fixtures shall be taken into account.		
11.4	Reinforcement and Cover		
11.4.1	Reinforcement shall be provided on each face of the shell in both directions.		
11.4.2	The shell reinforcement of high yield strength deformed bars, in either direction and on each face shall be not less than 0.15% of the concrete cross-sectional area. Further, the circumferential reinforcement on each face shall be not less than 0.20% of the concrete cross sectional area in the top one third height of the shell.		
11.4.3	The maximum spacing of reinforcement in either direction on each face shall be restricted to twice the thickness of the shell or 200 mm whichever is less. Further, not more than one third of the reinforcement at any level or section shall be lapped.		
11.4.4	Minimum lap lengths in shell shall be 1.3 times L_d where L_d is the development length as described in cl 26.2.1 of IS:456.		
11.4.5	Column reinforcing bars shall be carefully anchored in the shell and in the foundations. The minimum anchorage length in the shell shall be $2L_{d..}$		
11.4.6	Minimum size of deformed bars used shall be 8mm for circumferential reinforcement and 10mm for Meridional steel.		
11.4.7	The minimum clear cover to shell reinforcement shall be 30mm.		

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW		SECTION: D4.6
	TITLE	PART G : COOLING TOWER	VOLUME - V
			SHEET 9 OF 13

11.5 **Tolerances**

The shell should be constructed within the dimensional tolerances stipulated in clause 7.3 of IS:11504. Permissible allowances for survey inaccuracies while checking of shell geometry shall be as per clause 7.4 of IS:11504.

12.0 **FILL**

12.1 PVC film type fill shall be provided.

12.2 The fill shall be adequately supported to minimize sag, possibility of dislodgment and damage as a consequence of induced vibrations in the fill.

12.3 In case of film type of fill, the supporting hanger rods/tubes shall be of stainless steel conforming to ASTM 316L.

13.0 **FILL SUPPORTING STRUCTURE**

13.1 Fill supporting structure with its foundation shall be of reinforced concrete construction.

13.2 Fill supporting structure, where formed of precast concrete units, shall be made stable by the use of either bolted, cast-in-situ or glued joints. Members of precast concrete structure shall be either pre-stressed or reinforced concrete units. Where bolts are used for permanent connections, they shall be of a material highly resistant to corrosion or fully protected by embedment or coating.

13.3 The columns and beams supporting the Fill shall be adequately braced in all directions. The design of all members shall be checked for resistance to buckling.

13.4 The stability of the Fill support structure shall be checked for its capacity to resist a horizontal force of 2% of self-weight, the Fill and supporting structure, assumed to act horizontally in any direction. The structure shall also be checked for the appropriate earthquake loading as applicable.


13.5 During erection, care shall be taken to ensure the stability of the potentially unstable, partially completed structure.


13.6 The Fill support structure members shall be designed to cater for the likely loads to be imposed thereon, including:


 a) temporary loadings they are subjected to during handling, transportation and erection at normal design stresses.


 b) loading due to scaffolding for the erection crew if so envisaged to be supported.


100

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D4.6
	TITLE PART G : COOLING TOWER	VOLUME - V SHEET 10 OF 13
	<p>c) loading of personnel during maintenance of pipe work and sprinkler system. The appropriate parts of the pack support structure shall be designed to support a point load of 1.5 kN at any position.</p> <p>13.7 Reinforced concrete members shall be designed for self-weight and permanent loadings by working stress method with allowable stresses limited to 80% of those specified in IS:456.</p> <p>14.0 MAINTENANCE ACCESS FACILITIES</p> <p>All areas of the cooling tower requiring inspection, cleaning, repairs and/or adjustment shall be easily and safely accessible by suitable provision of stairs, platforms, etc., as per the requirement described herein below :</p> <p>14.1 Stairs</p> <p>14.1.1 The cooling tower shall be provided with two numbers external dog-legged reinforced concrete stairs. Stairs shall give access to the water distribution system through hot dip galvanised steel doors.</p> <p>14.1.2 All access doors shall be of size 800mm wide and 1800mm height, minimum.</p> <p>14.2 Platforms</p> <p>Reinforced concrete platform of 1.2m clear width shall be provided around the circumference at the top of the cooling tower on the outside for fixing aviation warning beacons.</p> <p>14.3 Walkways</p> <p>14.3.1 Walkways having a minimum clear width of 1.20m shall be provided around the circumference inside the cooling tower above the Fill to provide access for inspection and maintenance of all hot water distribution pipes/ducts and nozzles. Walkways shall be supported independent of the Fill structure.</p> <p>14.4 Ladders</p> <p>14.4.1 Four numbers of hot dip galvanised mild steel rung ladders with etch primer and bituminous painting shall be provided equally spaced around the circumference of the tower:</p> <p>14.4.2 Safety cage for the ladder shall be provided for the ladders located on the external surface of the tower upto the throat level.</p> <p>14.4.3 Ladders shall be continued along the inside surface of the tower upto the top of the tower and then on to the top platform. At the throat level a reinforced concrete landing of 1.2m minimum width shall be provided with a hot dip galvanised steel access door for the interchange.</p>	


KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW <hr/> TITLE PART G : COOLING TOWER	SECTION: D4.8 VOLUME - V SHEET 11 OF 13
	<p>14.4.4 Two of the ladders leading to the platform at the top of the tower shall have approach from the reinforced concrete stairs. Other two ladders shall be directly from the ground level itself.</p> <p>14.5 <u>Handrailing</u></p> <p>14.5.1 Handrailing shall be provided at the edges of platforms, landing slabs, sides of stairs, walkways and cold water outlet channel.</p> <p>14.5.2 Handrailing shall be of hot dip galvanised construction and shall be out of 32 mm NB pipes of medium class conforming to IS:1239 and provided with etch primer and bituminous painting.</p> <p>14.5.3 Handrailing shall be 1300 mm high with two intermediate rails at 450mm and 900 mm with the top rail at 1300 mm above the surface of slab/steps. Handrail posts shall be spaced at not more than 2 m centres.</p> <p>14.5.4 A toe plate of hot dip galvanised mild steel of size 65 mm x 8 mm shall be provided for all handrailing.</p> <p>• 15.0 PAINTING TO CONCRETE SURFACES</p> <p>15.1 Painting to the concrete surfaces specified herein below shall consist of one coat of primer and two finish coats of bituminous paint conforming to IS:3384 and IS:9862 respectively.</p> <ul style="list-style-type: none"> a) Basin floor. b) Internal and external surfaces of basin wall including the partition wall. c) Diagonal columns over complete height. d) Fill support columns and beams for the full height and length respectively. e) Internal and external surfaces of hot water duct. f) Internal and external surfaces of cold water channel upto the terminal point. g) Internal and external surfaces of the drain chamber. f) Complete internal surface of the shell for atleast 2 metres at the top and bottom and for at least 1 metre on the outside of the shell at top and bottom. <p>15.2 The preparation of concrete surface for painting shall conform to IS:2395 (Part-I). For new surface, it is preferable that the surface left unpainted for as long as possible to allow drying. Before painting, the surface shall be thoroughly brushed to remove all dirt and remains of loose or powdered materials.</p>	

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW		SECTION: D4.6
	TITLE	VOLUME - V	
	PART G : COOLING TOWER		SHEET 12 OF 13
15.3	Painting shall consist of one coat of primer conforming to IS:3384 and two coats of bituminous paint conforming to IS:3384. Rate of application of paint shall be so as to give a dry film thickness of 75 microns per coat and shall be to the satisfaction of OWNER. Manufacturer's instructions for application of paint shall be strictly followed.		
15.4	All other exposed concrete surfaces shall be given one coat of cement wash after the surfaces are rubbed down suitably and as approved by the OWNER.		
16.0	WATER DISTRIBUTION SYSTEM		
16.1	The arrangement of water distribution system shall permit a satisfactory distribution of water over the whole area of the tower at all reasonable loads.		
16.2	Hot water Inlet pipe shall conform to the requirements of Class I of IS:3589 and steel shall conform to IS:2062.		
16.3	The distribution troughs/pipes shall be independently supported from the structures and shall be easily removable. Provision shall also be made for easy flushing or cleaning of all troughs/pipes.		
17.0	LIGHTNING PROTECTION		
17.1	The cooling tower shall be protected against damage by lightning. The installation work shall conform to the requirements of IS:2309.		
17.2	CONTRACTOR's scope of work includes supply and installation of the complete system upto and including the earth electrodes.		
17.3	For detailed specification of lightning protection system refer electrical section of this document..		
17.4	During the construction of tower, temporary lightning protection shall be maintained by connecting the reinforcement bars to two grounding conductors of size 50 mm x 6 mm.		
18.0	AVIATION WARNING SYSTEM, LIGHTING AND POWER RECEPTACLES		
18.1	CONTRACTOR's scope of work includes supply and installation of the complete aviation warning system, lighting and power receptacles including the cabling between the main incoming 63A switch and aviation warning beacons and 30A receptacles.		
18.2	CONTRACTOR shall provide and fix aviation warning beacons with their supports at the top platform, at the throat level of the tower and at every 45m height or part thereof, between the ground level and the throat level.		

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D4.6
	TITLE PART G : COOLING TOWER	VOLUME - V SHEET 13 OF 13
	<p>The beacons shall conform to the requirement of the civil aviation department, Govt. of India. The beacons at the top of the tower should be atleast 2 metres below the top of the tower to prevent them from being obscured by vapour.</p> <p>18.3 For detailed specification refer to the electrical section of this document.</p> <p>18.4 Temporary warning lights shall be installed during construction suitably located above the top most point of obstruction and shall be shifted up as the construction progresses. These lights need be installed only after the level of obstruction is greater than 45 m above the grade level.</p> <p>19.0 PERFORMANCE TESTS</p> <p>19.1 After the cooling tower is completely erected and commissioned, tests on its performance shall be conducted. The method of testing shall generally conform to provisions of BS:4485 : Part 2</p> <p>19.2 CONTRACTOR shall submit the detailed test procedure, correction curves, etc. for performance testing for OWNER's approval.</p> <p>19.3 It shall be the responsibility of the CONTRACTOR to carryout all the tests as specified to the full satisfaction of the OWNER and the cost of such tests including supervision shall be borne by him entirely and is deemed to be included in the quoted lumpsum price. CONTRACTOR shall be fully responsible to make good any and every deficiency in the guaranteed performance of the cooling tower.</p> <p>19.4 All the instruments supplied and used shall be calibrated by a National laboratory or by an Independent laboratory approved by the OWNER. CONTRACTOR shall furnish necessary test certificates for the same to the OWNER.</p> <p>20.0 PERFORMANCE GUARANTEE</p> <p>20.1 The performance of the cooling tower shall be guaranteed over the following range as per CT. / code /BS 4485</p> <p>a) Cooling tower flow 90% to 110% of design flow.</p> <p>b) Wet bulb temperature (+) 1.7 deg C to (-) 3.9 deg C of design inlet wet bulb temperature.</p> <p>c) Cooling range 80% to 120% of design cooling range.</p> <p>d) Relative humidity 30% to 100%</p> <p>20.2 The results of the above tests shall govern the acceptance or otherwise of the cooling tower commissioned.</p> <p>20.3 The guarantee period shall be deemed to be 12 (twelve) calendar months from the date of taking over of the complete cooling tower by the OWNER OR the stabilisation of the unit, whichever is later.</p>	

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS,UNIT-3 OF 700 MW	SECTION: D4.8 VOLUME - V
	TITLE	SHEET 1 OF 19
	PART H : REINFORCED CONCRETE CHIMNEY	

1.0	SCOPE
1.1	This specification covers the general requirements for design and construction of a reinforced concrete chimney of circular cross section including foundations, RCC shell, brick flue, appurtenances, fixtures, fittings, conduit and other embedments, lift where specified, etc., complete.
2.0	APPLICABLE CODES, SPECIFICATIONS & REFERENCES
2.1	The following specifications, standards and codes are made a part of this specification. These shall be the latest edition including all applicable official amendments and revisions. In case of discrepancy between this specification and those referred to herein, the former shall govern :
IS: 6	Moderate heat duty fire clay refractories
IS:158	Ready mixed paint, brushing, bituminous, black, lead free; acid, alkali and heat resisting.
IS:456	Code of Practice for plain and reinforced concrete.
IS:800	Code of Practice for general construction in steel.
IS:875	Code of practice for design loads (other than earthquake) for buildings and structures: Part 3 – Wind Load.
IS:1239	Mild steel tubes, tubulars and other wrought steel fittings: Part-1 - mild steel tubes.
IS:1526	sizes and shapes for fire brick
IS:1893	Criteria for earthquake resistant design of structures.
IS:1904	Code of Practice for design and construction of foundations in soils: General requirements.
IS:2042	Insulating bricks.
IS:2062	Steel for general structural purposes.
IS:3043	Code of practice for earthing.
IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot-plate method)
IS:3677	Unbonded rock and slag wool for thermal insulation
IS:4860	Acid resistant bricks.
IS:4998	Criteria for design of reinforced concrete chimneys: Part 1 - Design criteria - 1975

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW <hr/> TITLE PART H : REINFORCED CONCRETE CHIMNEY	SECTION: D4.6 VOLUME - V <hr/> SHEET 2 OF 19
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IS:4998 Criteria for design of reinforced concrete: Part 1
Assessment of loads-1992

IS:8183 Bonded Mineral wool.

Annexure-14 International Standards and Recommended Practices
Aerodromes - International Civil Aviation Organisation.
Indian Electricity Rules

2.2 The following is the list of publications referred to in this specification.

Manohar, S.N "Tall Chimneys-Design and Construction", Tata
McGraw Hill Publishing Co.Ltd., New Delhi, 1985.

Pinfold, G.M "Reinforced Concrete Chimneys and Towers",
View Point Publication, Cement and Concrete
Association, U.K., 1975.

Vickery, B.J "Wind Induced Loads on Reinforced Concrete
Chimneys", Paper presented at National
Seminar on Tall Reinforced Concrete
Chimneys, 25-27 April 1985, New Delhi.

Vickery, B.J "The response of reinforced concrete chimneys to &
Basu. R. I. vortex shedding",

Journal of Eng. Struct., 1984, Volume 6

ACI 307 - 88 Standard Practice for the Design and Construction of
Cast-in-place reinforced concrete chimneys

2.3 SI units shall be adopted for all design and drawing work.


3.0 **DESIGN REQUIREMENTS**


3.1 The principal design parameters for this chimney are indicated in DATA
SHEET- A.


3.2 The design shall be based on working stress method.


3.3 The design and construction of the chimney and its foundation shall
conform to the requirements of all statutory rules and regulations of local
and national authorities. Where such requirements are less conservative
than the corresponding requirements of this specification, the latter shall
govern.


3.4 The chimney and its foundation shall be designed to resist stresses due
to the most critical combination of any of the following;


KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW		SECTION: D4.8 VOLUME - V
	TITLE PART H : REINFORCED CONCRETE CHIMNEY		SHEET 3 OF 19
	<p>(a) Weight of the chimney with or without lining, platforms, accessories and all other dead loads.</p> <p>(b) Wind loads (both along-wind and across wind) or earthquake forces whichever is governing.</p> <p>(c) Temperature gradient across the chimney shell.</p> <p>(d) Eccentric loads from corbels/platforms supporting the lining, soot hopper, etc.</p> <p>(e) Live loads on platforms. Also weight of equipment and materials and other live loads during construction. Live load of 500 kg / sq.m shall be assumed for platforms.</p> <p>(f) For the foundation and portion of the shell below grade level, appropriate earth pressures, hydro- static forces, surcharge etc., as applicable.</p> <p>(g) Local moments due to overloading.</p> <p>(h) Forces from the lift and operating equipment.</p> <p>(i) Loads from flue duct supports.</p> <p>(j) Construction loads such as those due to plant and equipment, stacked materials, live loads due to movement of plant, materials and personnel, etc.</p> <p>3.5 The total design stresses at a section shall include all secondary effects, viz. corbel effect, eccentric loading due to platforms, secondary moments due to p-Δ effect, etc. The total design stress in no case shall exceed the permissible stresses specified in clause 7.0 of IS:4998 (Part-1) 1975 and modified as below.</p> <p>3.5.1 Stress in concrete shall be restricted to 0.275 σ_{cu} under the combination of "Dead load + Wind load" against the value specified in Clause 7.11 (a) of IS:4998 Part II-1975.</p> <p>3.5.2 If the circumferential tensile stress in concrete due to wind induced ring moment exceeds the value specified in clause 7.1.1 (g) of IS:4998-Part I, additional reinforcement shall be provided in 2 layers limiting the stress in reinforcement steel to value specified in clause 7.1.2(g).</p> <p>3.6 The safety factor against over-turning under worst combination of loads, shall not be less than 1.5 in any direction during construction and 2.0 after construction is complete. For the purpose of calculating safety factor against overturning, during construction the weight of liner, liner supporting platform, insulation and accessories shall not be considered. Net safe allowable bearing capacity of soil specified in DATA SHEET- A can be increased by 25% under seismic conditions; but no such increase will be permitted due to wind loading. No tension shall be allowed in gross pressure under chimney working condition i.e., shell + lining complete.</p> <p>3.7 For estimating the deflections of the chimney in lined and unlined conditions, the modulus of elasticity of concrete shall be as per the mean value specified in clause A-3.1 of IS:4998 (Part-1)-1992.</p> <p>3.8 Stresses in the shell shall be shown to be within permissible limits at 10 metre intervals along the height of the shell or at every corbel level</p>		

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE PART H : REINFORCED CONCRETE CHIMNEY	SECTION: D4.6 VOLUME - V SHEET 4 OF 19
	<p>whichever distance is less and in addition at the critical locations across openings.</p> <p>3.9 Air inlets, sloped up towards inside, shall be provided near the base with proper GI wire mesh cover over the openings so as to prevent dirt or tiny creatures entering the air gap.</p> <p>3.10 Air outlets of minimum size 150 mm x 300 mm with proper Stainless steel(SST) wire mesh mounted on SST cover on the outside shall be provided at the top of the shell. These openings shall be suitably spaced and their total area shall not be less than that provided for air inlets.</p> <p>3.11 The maximum width of the openings shall normally be limited to an angle of not more than 60° subtended at the centre of the concrete shell.</p> <p>3.12 The bearing capacity and soil strata furnished with the bid are preliminary based on the findings of preliminary soil investigation conducted at the site. Actual design shall be based on SBC obtained from detailed geotechnical investigation carried out by the CONTRACTOR, duly approved by OWNER. No claim from the CONTRACTOR will be entertained by OWNER on the ground that final SBC is different from the value given in the bid.</p> <p>3.14 The analysis of the windshield for wind and earthquake forces shall be done as per the requirements of IS 4998 and IS 1893.</p> <p>3.15 The foundation shall be designed as a rigid member. The thickness of the foundation below the shell shall not be less than 0.40 times the overhang of the foundation beyond the shell. Foundation diameter to depth ratio shall not exceed 12.</p> <p>3.16 For the purposes of analysis/design, the following shall be assumed:</p> <p>a) Stiffness of shell shall not be considered for design of the foundation.</p> <p>b) Shell fixed to foundation for shell design.</p> <p>4.0 REQUIREMENTS IN RESPECT OF CONCRETE</p> <p>4.1 All concrete work shall be carried out strictly in accordance with the IS: 456 except as otherwise specified hereunder.</p> <p>4.2 When slip forming is adopted, the slump shall be between 75 mm and 100 mm at the point of placement. If necessary, approved admixtures such as retarders/ plasticizers to maintain the workability shall be used with the prior consent of the ENGINEER. Such admixtures shall be identified after preliminary tests to prove their satisfactory performance and compatibility with the particular type of cement envisaged to be used in the shell construction.</p>	

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D4.6 VOLUME - V
	TITLE PART H : REINFORCED CONCRETE CHIMNEY	SHEET 6 OF 19
	reinforcement shall be twice that arrived at as stated above due to design considerations.	
5.5	Circumferential reinforcement shall be placed around the exterior of the vertical bars and securely wired or welded to the vertical bars at an interval of not more than 600 mm.	
5.6	In addition to the reinforcement determined from structural considerations as well as to meet temperature and other stresses, extra reinforcement shall be provided around and at corners of openings, generally in line with clause E6 of IS:4998-1975.	
5.7	Foundation raft of the Chimney shall be provided with a layer of reinforcement at the top and the same shall not be less than 12 mm deformed bars at 250 mm centres placed orthogonally.	
6.0	LINER (FLUE)	
6.1	<u>BRICK LINING</u>	
6.1.1	The chimney shall be lined with fire/acid resistant bricks for the full height of the chimney above the hopper. The lining shall be supported on concrete platforms at intervals of not more than 10 metres unless otherwise shown in the DATA SHEET-A.	
6.1.2	Lining bricks shall be hard, uniformly well burnt, uniform in colour, of correct shape and size, homogenous in texture and free from cracks, voids and other flaws and shall be of material suitable to withstand the service conditions. No broken bricks shall be allowed to be used except for closing the course. Each brick shall be clearly marked with the MANUFACTURER's name and trade mark.	
6.1.3	The sizes and shapes of fire clay bricks shall conform to IS : 1526 and shall be of Group-A Type 1 conforming to IS:6. These bricks shall be laid in air setting mortar and cured as per MANUFACTURER's specification. The mortar shall meet the following specifications:	
	(i) Fineness grading	: 95% passing through 0.5 mm sieve
	(ii) Service Temperature	: 1000°C maximum
	(iii) Setting	: Air setting on drying
	(iv) Al ₂ O ₃	: 28% minimum
	(v) Fe ₂ O ₃	: 2.5% maximum
	(vi) Minimum Bond Strength when tested as per ASTM C 198 for flexure cured at 110°C for 18 hours	: 1.0 N/mm ²
	(vii) Refractoriness tested as per	

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW		SECTION: D4.8 VOLUME - V
	TITLE PART H : REINFORCED CONCRETE CHIMNEY		SHEET 7 OF 19
	<p data-bbox="604 513 1298 583">IS:1528 : Pyrometric cone ASTM No.28 (min)</p> <p data-bbox="497 594 1306 920">(b) Prior to despatch of mortar material from MANUFACTURER, at least five (5) samples of the lot to be despatched shall be tested for bond strength as specified above, and the test reports submitted to OWNER/CONSULTANT for approval and permission for despatch of material. Similarly, five (5) samples of the lot to be despatched shall also be tested for chemical resistance as per IS:4456 (Part-1) and loss in weight and loss in compressive strength of the test specimen shall not exceed 5 %. The test reports on chemical resistance shall be reported as per clauses 10.11.2 and 10.11.3 of IS: 4456 (Part-1).</p> <p data-bbox="340 931 1314 1187">6.1.4 The acid resistant bricks shall conform to Class I of IS:4860 and the mortar for this brickwork shall conform to IS:4832 (Part 1) - Silica type with potassium silicate liquid binder. The Contractor shall furnish test certificates confirming the coefficient of thermal conductivity of both fire clay bricks and acid resistant bricks from an approved laboratory for ENGINEER's approval before bringing them to site. Similarly, test certificates for acid resisting properties shall also be furnished for acid resisting bricks.</p> <p data-bbox="340 1199 1314 1338">6.1.5 In the case of Acid resistant Brick lining, the mortar joints shall be cured with 25% dilute HCl for a minimum period of 3 days and as per MANUFACTURER's specification after which exposed face shall be thoroughly cleaned with water.</p> <p data-bbox="340 1350 910 1396">6.1.6 Thermal Conductivity of Lining Bricks</p> <p data-bbox="340 1408 1314 1547">6.1.6.1 The value of the coefficient of thermal conductivity for fire clay and acid resistant lining bricks shall not exceed $K = 1.25 \text{ Kcal/m/hr}^\circ\text{C}$ and shall be considered as $K = 1.25 \text{ Kcal/m/hr}^\circ\text{C}$ for the purpose of design of shell for temperature effects.</p> <p data-bbox="340 1559 1314 1780">6.1.6.2 Prior to despatch of bricks from MANUFACTURER at least five (5) samples of the lot to be despatched shall be tested for K-value at an approved laboratory and test reports submitted to ENGINEER for approval and permission for despatch of material. While testing, the hot-face temperature of the bricks shall be 300°C. Similarly, test certificates for acid resisting properties shall also be furnished for acid resisting bricks.</p> <p data-bbox="340 1791 1314 1931">6.1.6.3 The acid resistant bricks shall conform to Class I of IS:4860 and the mortar for this brickwork shall conform to IS:4832 Part-I - Silica type with Potassium Silicate. Provision shall be made for differential vertical expansion at the lining support.</p> <p data-bbox="340 1942 1314 2082">6.1.6.4 The thickness of lining shall be as shown on the bid drawings. The radial joints shall be broken in each course. Lining shall be strapped with circumferential and vertical galvanised mild steel bands having a minimum dimension of 75x6 mm and 50x5 mm respectively, both</p>		

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW <hr/> TITLE PART H : REINFORCED CONCRETE CHIMNEY	SECTION: D4.6 VOLUME - V SHEET 8 OF 19
	<p>spaced at one metre centres, on the exterior of the brickwork throughout the full height of the lining.</p> <p>6.1.6.5 The vertical and horizontal bands shall be joined together by either (a) suitable spot welding and all weld joints painted with 2 coats of zinc rich aluminium paint over a coat of compatible primer as per the requirement of the MANUFACTURER, or (b) fixed by bolting arrangement, with counter sunk bolts and slotted holes as indicated in relevant bld drawings.</p> <p>6.1.6.6 Special care shall be taken to ensure proper laying of bricks to cover the RCC platforms so as to protect them from the action of gases. Glass/mineral wool insulation of 25 mm thick, shall be provided between the face of the platform and brick lining with a sealing by 2 Nos. 25 mm dia asbestos chords conforming to Grade 3 of IS:4687. Bricks shall be laid on corbels on 12 mm thick asbestos sheet.</p> <p>6.1.6.7 Mortar for lining shall be used within the initial setting time and no retempering shall be permitted. Joints shall be properly filled and at a given cross section, the thickness of the joint shall not be more than 2 mm along the inner periphery of the lining and not more than 12mm along the outer periphery. In the case where the inner diameter of the lining is less than 4500, shaped bricks shall be used to maintain the thickness of joints mentioned above.</p> <p>6.1.6.8 The lining, unless otherwise specified in DATA SHEET-A, shall be of acid resistant bricks laid in acid resistant mortar for the following portions :</p> <ul style="list-style-type: none"> a) Top most two lifts of the chimney shell (A lift shall mean distance between two successive corbels) but not less than 14 metres. b) Bottom first lift of the chimney shell immediately above the ring beam of the hopper extending a minimum 3 metres above the top of flue gas duct. c) Over the hopper and around the baffle wall. <p>6.1.6.9 However the lining shall be of acid resistant bricks laid in acid resistant mortar for the whole height if the provision of desulphurisation plant is indicated in Data Sheet A.</p> <p>6.2 Flue support arrangement</p> <p>6.2.1 Brick flue shall be supported from RC corbel / Platform.</p>	

<div>KPCL/BTPS/03/EPC</div> <div></div>	<div>KARNATAKA POWER CORPORATION LIMITED</div> <div>BELLARY TPS, UNIT-3 OF 700 MW</div>	<div>SECTION: D4.6</div> <div>VOLUME - V</div>
	<div>TITLE</div> <div>PART H : REINFORCED CONCRETE CHIMNEY</div>	<div>SHEET 9 OF 19</div>

7

INSULATION

7.1

Brick flue

7.2

All insulation and packing shall be of dimensions specified in DATA SHEET-A. The materials for insulation and packing shall be mineral/glass wool, asbestos rope, asbestos mill boards, insulation bricks, etc., of approved quality.

7.3

The mineral/glass wool shall be of resin bonded type conforming equivalent with a maximum coefficient of thermal conductivity of 0.060 Kcal/m/hr°C at a mean temperature of 150°C. The material shall have a minimum density of 0.80 kN/m³

7.4

The diameter of the asbestos rope conforming to Grade 3 of IS:4687 shall be 25 mm unless otherwise specified in DATA SHEET-A. The strands shall be long, well twisted and stranded and no torn fibre shall stick out. The rope of approved quality shall be firmly packed so as to prevent gas leakage at all locations where the lining overlaps.

7.5

Asbestos mill board shall be 12 mm thick, unless otherwise specified in DATA SHEET-A. It shall be plain, dense and have a homogenous texture, without cracks, flaws or any other manufacturing defect. It shall be laid directly over the concrete after removing all loose materials but without any mortar/plaster bedding.

7.6

The base for acid resistant brick lining in hopper portion shall be either cellular concrete or insulating bricks of Grade 'C' conforming to IS:2042 or equivalent unless otherwise specified in DATA SHEET-A.

7.7

22 gauge AC sheet covers shall be provided all around the insulation wrapping around the lining of flues and ducts. The sheeting shall be in three segments with all necessary fixing arrangements with rivets including overlapping and work shall be executed as per drawings and as directed by the ENGINEER.

8.0


Liner Test Ports


8.1


Gas sampling ports fabricated from SST with flanged ends shall be provided for each liner at platform levels where indicated including proper insulation, blank plates nuts, bolts, etc. The location, orientation and level of ports shall be as per the details indicated in the relevant sections of this specification document.


8.2

CONTRACTOR shall provide for the purposes of instrumentation other than the sampling ports mentioned above required number of 38 NB conduits including pull wires, junction boxes and pull boxes, all securely tacked / anchored to internal of shell and S 316 L plates below each pipe insert for fixing of measuring instruments.

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE PART H : REINFORCED CONCRETE CHIMNEY	SECTION: D4.6 VOLUME - V SHEET 10 OF 19
9. 9.1	<p>ACCESSORIES</p> <p>Ladder</p> <p>The chimney shall be provided with a hot dip galvanised steel ladder having access to intermediate resting platforms extending from bottom to top fabricated in 2.4, 3.6 or 4.8 m sections. Stringers shall be of flat 75x10 with a clear distance of 400 mm in-between; Rungs shall be of 20 mm dia mild steel rods spaced at 300 mm centres. The ladder and its connection shall be designed for a load of 175 kg at any location. The ladder shall be provided with a safety cage made up of hot dip galvanised steel flats. All inserts shall also be hot dipped galvanised. A ladder safety device shall be provided for the entire height of the chimney. Intermediate landing /resting platforms of length not less than 1500 mm and width 1000 mm shall be provided along the height of the ladder at intervals not exceeding 15 metres. The landing platforms shall be of reinforced cement concrete and designed for a live load of 500 Kg/sq.m</p> <p>Chimney roof cap</p> <p>To prevent gas-entrained matter from falling into the space between the liner and the shell and also to prevent the chimney top from chemical attack of flue gases, a sectional grey cast-iron cap of minimum 12 mm thickness over 25 mm thick asbestos shall be provided, unless otherwise specified on the drawing. The cap shall cover the concrete shell, brick lining and air space between them. The cap shall slope towards the inside of the chimney at approximately 30° to the horizontal. All sections of the cap shall be anchored in place with bronze bolts and bronze rag bolts respectively.</p> <p>Soot Hopper for Brick flue chimney</p> <p>This shall be of reinforced concrete and lined with acid resistant brickwork laid in acid resistant mortar. Only shaped acid resistant bricks shall be used in the hopper portion. The bricks, mortar and details of laying and joining shall conform to the requirements laid down for acid resistant brick lining.</p> <p>Between the reinforced concrete hopper and acid resistant brick lining, 75 mm thick (unless otherwise specified on the drawing) insulation bricks of Grade C conforming to IS:2042 or equivalent cellular concrete shall be provided. At the bottom of the hopper, CI flanged pipe with puddle flange of specified dia and length shall be embedded as shown on the drawing. Inside of this pipe sleeve shall be coated with sodium silicate.</p> <p>Strakes</p> <p>Strakes shall be provided if necessary from design point of view for controlling effect from vortex excited oscillation.</p>	

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D4.8 VOLUME - V
	TITLE PART H : REINFORCED CONCRETE CHIMNEY	SHEET 11 OF 19
10.3.2	The strakes shall be designed for a pressure of not less than four times the wind pressure computed at top of chimney.	
10.3.3	Strakes, if specified, shall be made up of mild steel plates and rolled sections of thickness not less than 6 mm. A corrosion allowance of 1.5 mm in the structural members shall be provided for, beyond the design values.	
10.3.4	Fixing arrangement of strakes to the chimney shell shall ensure full fixity for the design load. All strakes, embedded parts, bolts, nuts, washers, etc., shall be hot dip galvanised.	
10.4	Doors	
10.4.1	Clean out Doors	
10.4.1.1	Each flue shall be provided with clean out doors having clear dimension to 650 mm x 825 mm at appropriate location with proper access for operating the door. The edges of the doors shall be properly sealed to prevent escape of hot flue gases. The door shall be of hollow steel construction with inner plate of 8 mm and outer plate of 6 mm with suitable infill of stiffeners. The hollow space shall be filled up with insulation of the type used around flues. In addition around the door openings, removable type of insulation similar to the insulation provided around flue shall be provided. The door shall be of hinged type and provided with locking device in addition to Swivel studs with wing nuts on the remaining 3 edges. The door shall be openable both from inside and outside.	
10.4.2	Removable cladding / Access door Opening provided near the base of the wind shield for the purposes of flue can erection shall be closed using a removable type of colour coated galvanised aluminium sheet min 0.6 mm thick on structural steel framing which also can be dismantled if required. Within the cladding area, an access door of size 2100 x 1000 mm shall be provided with sill level at 300 mm from paved level. This door shall be similar to hollow steel doors provided in other buildings. The door shall be provided with a minimum two coats of acid and alkali resistant paint conforming to IS:158 type I to give a DFT of 75 microns. The outside surface shall be provided with 2 coats of zinc red oxide primer and two coats of synthetic enamel paint. The door shall be provided with suitable locking arrangement.	
10.5	Louvres Air inlet and outlet louvres shall be provided as per the requirement of this specification near the top. The louvre fins shall be of Z-shape in cross section and made from anodised aluminium plates of a minimum thickness of 4 mm. The frame work supporting the louvre fins shall be made from extruded aluminium sections of minimum thickness 6 mm. The louvres shall be mounted in the form of panels. The fins shall be closely spaced to cut off any driving rain entering the chimney wind	

KPCU/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW <hr/> TITLE PART H : REINFORCED CONCRETE CHIMNEY	SECTION: D4.6 VOLUME - V <hr/> SHEET 12 OF 19
<p>shield. All panels must be approved by the ENGINEER before installation. To outside face of louvers ST mesh on SST mesh frame work shall be provided.</p> <p>10.6 Maintenance Provisions</p> <p>10.6.1 The outer face of the chimney wind shield shall be provided with adequate number of stainless steel insert plates of grade 316 L at the top to enable fixing and supporting painter's trolleys and other accessories. The insert plates shall be provided with suitable number of threaded holes and nuts welded at the rear end to enable bolting of the assembly when desired.</p> <p>10.6.2 Similar arrangement shall be made at each platform level but to fix the painting trolley arrangement directly on the platforms for the purpose of painting the internals of the chimney.</p> <p>10.6.3 A lifting beam shall be provided at platform level to cater for lifting of materials during maintenance and painting. The size and capacity of the lifting beams shall be as indicated in relevant drawings.</p> <p>10.7 Electrical Requirements</p> <p>10.7.1 Electrical requirements are generally listed in Data sheet A. Detailed specification for various electrical components are covered in the Electrical section of this document. This shall essentially include Aviation Warning beacons, Lighting system, Lightning protection systems, embedment all GI conduits cabling and all Electrical installation work in the chimney from the Junction box provided near the base of chimney. Cabling for instruments are also included in the scope of the CONTRACTOR.</p> <p>10.7.2 The temporary lighting to meet the requirement of Civil Aviation Department and lightning protection and earthing required during the construction stage of the chimney shall also be provided by the CONTRACTOR.</p> <p>10.7.3 The installation of Electrical system shall be in strict accordance with the latest edition of Indian Standard Code of Practice and regulations existing in the locality where the system is installed. In particular the following standards shall apply.</p> <p> i) IS:3043 --- Code of Practice for Earthing</p> <p> ii) IS:2309 --- Code of practice for the protection of building and allied structures against lightning.</p> <p> iii) Indian Electricity Rules.</p> <p>10.8 INSTRUMENTATION REQUIREMENT</p> <p>10.8.1 Details of instrument to be installed are furnished in the Instrumentation section of this document. Generally the following instruments are mounted on the chimney.</p>		

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D4.6 VOLUME - V
	TITLE PART H : REINFORCED CONCRETE CHIMNEY	SHEET 13 OF 19

- i) Anemometer
- ii) Accelerometer
- iii) Flue gas analyser


10.8.2 Necessary embedment in stainless steel to install the above instruments (to be supplied by the owner as specified in data sheet) along with embedded conduits including JBs for running cables to these instruments from JB provided by OWNER outside the chimney are included in the scope of the CONTRACTOR.


10.9 External Platforms


10.9.1 Unless otherwise stated in Data Sheet-A, external platforms shall be provided, one at 2300 mm below the exit level of flue and others at intervals of 45 m along the chimney height, platforms shall be of reinforced concrete and be 1000 mm clear width between shell and 150 high kerb and with 32 mm dia hot dip galvanised pipe ceiling consisting of three rails, the two intermediate rails being about 450 mm and 900 mm above platform level and 32 mm NB pipe pots spaced not more than 1000 mm centres. Top handrail shall be 1300 mm above than 1000 mm centres. Top handrail shall be 1300 mm above platform level. All pipes for railings and posts shall conform to medium class as per IS: 1239 (Part-I). For the topmost platforms, access for passenger lift (if specified) shall be ensured by provision of a landing platform with steps/ladder if necessary.

10.9.2 Radial gaps of 12 mm wide shall be provided in the platform floor at 45° for shell diameter less than 7.5m, 30° for shell diameter between 7.50 m and 12.5 m, 22.50° for shell diameter between 12.5 m and 15.0 m and 15° for shell diameter between 12.5 m and 15.0 m and 22.0 m. At the centre of each circumferential segment of each platform and located 100 mm and 750 mm from the face of the chimney shell, 2 nos. of puddle flanged cast iron pipe sleeves of 75mm internal diameter shall be provided. In addition, One MS plate of size 400 x 150 x 16 mm located centrally between the CI pipe sleeves with 400 mm dimension radially shall be embedded in each of the external platforms for passing ropes during maintenance of the chimney. These embedded plates for pulley block shall be provided with 4 nos. tapped holes to receive 20 mm dia bolts in rectangular pattern of dimension 300 x 80 mm concentrically. One number of hot dip galvanised pulley block with a lifting capacity of 300 kg for a painters trolley with all fixtures shall be supplied by CONTRACTOR. A mild steel drain pipe of 100 mm internal dia flush with concrete shall be provided near the kerb for each segment of external platform. Care shall be taken to avoid radial joints in front of clean out doors.

10.9.3 External platforms shall be designed for a live load of 500 kg per sqm or for a live load of 150 kg per sqm and reaction from the mounting

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW <hr/> TITLE PART H : REINFORCED CONCRETE CHIMNEY	SECTION: D4.8 VOLUME - V <hr/> SHEET 14 OF 19
	<p>arrangement of pulley block/bracket, whichever is critical . They shall also be designed for dead load, wind forces, etc.</p> <p>10.9.4 All bolts, nuts, pipe railing posts, etc., shall be hot dip galvanised. The railings posts, beacon supports, etc., shall be fitted to the chimney platforms by GI nuts on to GI inserts left projecting from the concrete shell.</p> <p>10.9.5 Details of intermediate platforms are as specified under the requirements of ladder</p> <p>11.0 PAINTING</p> <p>11.1 Two coats of acid and heat resisting paint conforming to IS: 158 over a coat of compatible primer shall be given to the following surfaces as per MANUFACTURER's recommendations:</p> <p>i) Internally full height of the chimney shell including top of wind shield, including all faces of corbels before constructing the liner.</p> <p>ii). From the top to a distance of 1.5 times the diameter of the chimney shell at the top, externally.</p> <p>11.2 Painting the external surfaces of the chimney shell with two coats of synthetic enamel paint over 2 coats of primer as per MANUFACTURER's recommendations in alternate bands of Orange or Red and White shade, each band with a band width of H/7 metres for Chimneys less than 210m height or H/9 for chimneys more than 210m height or 30 metres whichever is smaller (H = Height of chimney in metres) and bands at the extremities being of Orange or Red shade. This shall be done after removing all loose and foreign matter to give a smooth and uniform finish.</p> <p>11.3 External painting shall commence immediately after the shell construction/platform is completed and the concrete is well cured. The painting shall preferably be started from the top. This is to ensure visibility of stack to low flying aircraft at day time even during the period of construction of the internals of the chimney.</p> <p>12.0 DESIGN AND DRAWINGS</p> <p>12.1 The CONTRACTOR shall submit his method of analysis, design parameters, allowable stresses, method and sequence of construction including staging, details of proposed site testing facilities, etc., strictly as per specifications for the OWNER's review and approval within 30 days from the date of Purchaser Order.</p> <p>12.2 The CONTRACTOR shall submit, based on the approved concept, detailed working drawings/design for the foundation (with dowels for the shell), complete and detailed general arrangement drawing for the ENGINEER's approval within 45 days from the date of purchase order.</p>	

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D4.6 VOLUME - V
	TITLE	SHEET 15 OF 19
	PART H : REINFORCED CONCRETE CHIMNEY	
<p>The remaining drawings shall be submitted in a progressive manner within six months from the date of award of contract.</p>		
12.3	In case the CONTRACTOR adopts computerised designs, only validated computer programs shall be used for the analysis and design. The computer output listing should include all input data covering the loads and load combinations.	
12.4	All modifications suggested by the OWNER to meet specification requirements and sound engineering practice, shall be incorporated by the CONTRACTOR at no extra cost to the OWNER.	
12.5	Any modifications/change in subsequent revisions of design/drawings shall be clearly marked and identified with a revision for the OWNER's review/approval.	
12.6	Construction of work shall commence only after the written approval of drawings by the OWNER. However, the OWNER's approval of the design/drawings shall not absolve the CONTRACTOR of his responsibility for correctness of design, accuracy of dimensions, loadings, details, etc., or safety and stability of the structure including foundations, accessories, appurtenances, etc.	
13.0	CONSTRUCTION	
13.1	Staging	
13.1.1	Design and erection of staging shall conform to the requirements of all relevant IS Codes and National safety standards/regulations.	
13.1.2	As the staging serves a dual purpose, viz., as an access tower and as a bearing structure to support construction loads, it shall be designed for all possible loads that could be imposed on it such as self-weight, weight of ladder and timber platforms at all levels, weight of men, weight of construction materials and equipment, wind loads, seismic loads, etc.	
13.1.3	Minimum live load on staging due to labour and personnel movement shall be considered at 300 kg/m ² . It may be taken as 150 kg/m ² when earthquake loads are also taken into account. No increase in stresses shall be considered for wind and seismic conditions.	
13.2	Shell Construction	
13.2.1	The CONTRACTOR shall prepare and submit a detailed quality assurance plan within one month of award of work. This plan shall include the following:	
a)	Design criteria	
	The CONTRACTOR shall give the criteria to be adopted for design of various temporary works and the slipform.	

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D4.8 VOLUME - V
	TITLE PART H : REINFORCED CONCRETE CHIMNEY	SHEET 16 OF 19

The CONTRACTOR's design calculations shall be based on normally accepted practice for the structural forms which the CONTRACTOR adopts for staging.

b) 'Construction Method'

This shall include atleast the following:

- i) Structural analysis proving adequacy of jacks, slipform, and their supports and staging.
- ii) Planned interruptions. Also the operations during planned interruptions such as retrieval of jack rods, resetting of form panels, etc., shall be stipulated.
- iii) Method of preparing, transporting, pouring, vibrating and finishing concrete.
- iv) Treatment at construction joints during unplanned interruptions..

c) Construction Equipment

The CONTRACTOR shall furnish a detailed description of the following:

- i) The type and number of equipment and facilities to be used for slipform such as jacks, working platforms at various levels, yokes, walers, etc. There shall be atleast a 50% standby capacity of jacks, jack rods, hydraulic pump, hose pipes, etc.
- ii) Provision, including standby, of concrete mixing units and pumps to cater to the planned rate of progress of slipping.
- iii) Material hoists and buckets for transport of concrete, reinforcement, scaffolding components, etc.
- iv) Curing arrangements consisting of pumps, pipelines, etc. There shall be atleast 50% standby pumps
- v) Provision of precision survey instruments including lasers for verticality check. The laser instrument shall emit a long range visible laser which has a self-levelling platform which electronically levels the instrument and has a fail-safe system that shuts off the beam when out of level. There shall be a standby.
- vi) Stipulation of power requirement for operation and the CONTRACTOR shall provide adequate standby



diesel generating sets. Details of night lighting shall also be specified.


- vii) Communication arrangements between ground and working deck.


13.2.2 Concreting

- a) Particular attention must be given to concrete placement because of the thin wall section and the presence of reinforcing steel. Compaction of concrete shall be by vibration.
- b) Under no circumstances shall the point of discharge of the concrete into the forms be more than 1.5 m above the concrete surface on which it is to be deposited. Also, not more than 2 metres height of chimney shall be concreted on any one day if permission is given to proceed with jump forms.
- c) The slipping rate of the forms shall be such that the concrete, when exposed has already achieved enough strength to support the vertical pressure from the concrete still in the forms as well as to withstand lateral pressure caused by wind, inclination of walls, etc. The slipping rate shall be limited to 200mm/hour.
- d) Small openings and pockets less than 600 x 300 mm can be formed by inserting blocks. Larger openings shall be formed using frames which shall be formed well in advance of the sliding.
- e) Horizontal bars should be fixed nearest to the face of the wall. These bars should be pre-bent.
- f) The interior and exterior surfaces of the shell shall be kept moist for 14 days after exposure from the forms as the chimney construction progresses upwards. For this purpose, circumferential perforated pipes shall be hung from immediately below the forms and raised along with them.
- g) If the ENGINEER so requires, the CONTRACTOR shall make immediate arrangements, through an approved agency, to undertake ultrasonic tests to prove the quality of concrete. The quality of concrete shall be considered as satisfactory if it meets specification requirements and the sonic velocity is atleast 4000 m/s. If the tests prove that the quality of concrete is not satisfactory, then all costs associated with the tests and any rectification shall be borne by the CONTRACTOR.

13.2.4 Physical Checks


Some of the mandatory physical checks to ensure that construction tolerances are met with shall be carried out by the CONTRACTOR, as under:

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE PART H : REINFORCED CONCRETE CHIMNEY	SECTION: D4.6 VOLUME - V SHEET 18 OF 19
<p>a) The twist or rotation of the slipform every 60 minutes.</p> <p>b) Level of top of jacks every thirty minutes.</p> <p>c) Verticality with the help of lasers atleast once in four hours.</p> <p>d) Inside and outside diameters/dimensions and wall thickness, once in each shift of 8 hours.</p> <p>e) Condition of jack rods for ovality, indentation, buckling, moving out of alignment, etc., before fixing each rod.</p> <p>f) Live load on working deck to avoid accidental overloads.</p> <p>g) Workability of concrete at mixer and at point of placement, once an hour.</p> <p>13.2.5 Construction Tolerance</p> <p>The following shall be the limiting construction tolerances to be strictly adhered to by the CONTRACTOR.</p> <p>a) Verticality : 1 in 1000 subject to a maximum of 75 mm. In addition, no two points 10 m apart vertically shall be more than 20 mm out of plumb wrt each other</p> <p>b) Wall thickness : ± 10 mm, - 0.</p> <p>c) Shell diameter : ± 10 mm for every 3m diameter without any abrupt changes but in no case more than ± 40 mm.</p> <p>d) Spiralling : Rate of spiralling of forms not greater than 10 mm circumferential rotation at the outer face of the concrete per metre of vertical travel.</p> <p>e) Openings, inserts, pocket : ± 12 mm</p> <p>f) Cover : + 5 mm, - 0.</p> <p>g) Level of any part of structure : ± 20 mm</p> <p>13.3 Construction Tools and Materials</p> <p>13.3.1 CONTRACTOR shall provide and maintain at the site necessary number and type of machinery and equipment including survey instruments in good working condition for proper setting out and timely completion of the</p>		

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D4.8 VOLUME - V
	TITLE PART H : REINFORCED CONCRETE CHIMNEY	SHEET 19 OF 19

works covered under this specification. All arrangements for transporting the equipment to and from the site shall be done by the CONTRACTOR at his own expense.


- 13.3.2 It shall be ensured by the CONTRACTOR that work shall proceed uninterrupted even in the event of power failures. As such, adequate number of diesel generator sets and diesel operated equipment
- 13.3.3 CONTRACTOR shall furnish MANUFACTURER's test certificate for the materials supplied by him.
- 13.3.4 Climbing or slip-forms shall be controlled by linked hydraulically operated jacks that are reversible, driven by an electrically operated pump and with provision for manual operation in the event of a break down.
- 13.4 Work Execution and Supervision
- 13.4.1 CONTRACTOR shall have at the site accredited and qualified engineers and foremen / supervisors with adequate number of years of experience in execution of similar works and operators of machinery and equipment, for satisfactory progress and timely completion of the works.
- 13.4.2 All temporary electrical installation shall be supervised by a qualified electrical supervisor of the CONTRACTOR.
- 13.4.3 One hoist for passengers / supervisory staff and one for transport of goods shall be provided by the CONTRACTOR. These hoists shall be operational not later than the time when construction first reaches 30 m and should be available throughout the construction period.
- 13.4.4 Quality of ingredients of concrete and the concrete produced and placed shall be controlled as per the relevant code provisions. For this purpose, samples shall be collected and tested as per relevant IS codes and quality ensured. The defects and inadequacies in the quality of concrete shall be rectified, as per standard practice.

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED		VOLUME C 1 - V
	BELLARY TPS, UNIT-3 OF 700 MW		SECTION: D4.6
	DATA SHEET - A REINFORCED CONCRETE CHIMNEY		SH 1 OF 5


REINFORCED CONCRETE CHIMNEY


(Note: Balance data to be furnished by Bidder)

1.0	GENERAL	:	
1.1	NO. OF CHIMNEY	:	ONE SINGLEFLUE
1.2	DISTANCE BETWEEN CHIMNEYS	:	NOT APPLICABLE
1.3	METHOD OF SHELL CONSTRUCTION	:	SLIPFORM ABOVE HOPPER RING BEAM AND SLIP / JUMP FORM BELOW THIS LEVEL
2.0	DIMENSIONS OF CHIMNEY	:	
2.1	CLEAR INSIDE DIA OF CHIMNEY AT EXIT ELEVATION	:	
2.2	CLEAR INSIDE DIA OF FLUE AT EXIT ELEVATION	:	
2.3	TOP ELEVATION OF CHIMNEY	:	HEIGHT OF CHIMNEY - 275 m
2.4	BATTERY OF EXTERNAL SURFACE FROM EL. TO EL.	:	
2.5	MAXIMUM EXTERNAL DIA OF SHELL AT CHIMNEY GRADE SLAB LEVEL	:	
2.6	SILL ELEVATION OF ACCESS DOOR	:	
2.7	SILL ELEVATION OF CLEAN OUT DOOR	:	
2.8	GRADE SLAB ELEVATION INSIDE CHIMNEY	:	
2.9	GRADE SLAB ELEVATION OUTSIDE CHIMNEY	:	
2.10	GRADED LEVEL OF GROUND	:	
2.11	MINIMUM FOUNDING LEVEL OF RAFT	:	
2.12	MINIMUM EARTH FILLING ON TOP OF FOUNDATION RAFT (REF. 2.10 ABOVE)	:	1000 mm
2.13	NUMBER OF FLUE OPENINGS AND THEIR ORIENTATION	:	ONE
2.14	CENTRE LINE ELEVATION OF FLUE OPENING	:	
2.15	INSIDE DIMENSION OF FLUE GAS DUCT (LXB)	:	
2.16	THICKNESS OF FLUE GAS DUCT	:	
2.17	THICKNESS OF MATING FLANGE	:	


KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED	VOLUME C 1 - V
	BELLARY TPS, UNIT-3 OF 700 MW	SECTION : D4.8
	DATA SHEET - A	
	REINFORCED CONCRETE CHIMNEY	SH 2 OF 5


2.18	DISTANCE FROM CL. OF CHIMNEY TO TERMINAL FLANGE OF FLUE DUCT SUPPLIED BY OTHERS	:	
3.0	FOUNDATION DATA	:	
3.1	ALLOWABLE SAFE BEARING CAPACITY OF SOIL AT FOUNDING LEVEL	:	
4.0	FLUE GAS DATA	:	
4.1	MAXIMUM QUANTITY OF FLUE GAS THROUGH EACH FLUE DUCT	:	
4.2	MAXIMUM FLUE GAS TEMPERATURE AT ENTRY TO CHIMNEY	:	
4.3	MINIMUM FLUE GAS TEMPERATURE AT ENTRY TO CHIMNEY DURING OPERATION	:	
4.4	SULPHUR CONTENT IN FUEL	:	
4.5	AVAILABILITY OF FLUE GAS DESULPHURISATION PLANT	:	
4.6	AVAILABILITY OF PREHEATING AFTER DESULPHURISATION	:	
5.0	DESIGN PARAMETERS	:	
5.1	TEMPERATURE	:	
5.1.1	OUTSIDE AMBIENT TEMPERATURE	:	
	MAXIMUM	:	45 DEG. C
	MINIMUM	:	14 DEG. C
5.1.2	THERMAL GRADIENT IN SHELL BELOW HOPPER RING BEAM	:	20 DEG. C
5.2	WIND FORCE (IS - 875)	:	
5.2.1	BASIC WIND SPEED	:	39 m/sec
5.2.2	TERRAIN CATEGORY	:	1
5.2.3	CLASS OF STRUCTURE(k1)	:	1.06
5.2.4	TOPOGRAPHY FACTOR (K3)	:	1.0
5.2.5	Cd = DRAG CO-EFFICIENT	:	
5.3	SEISMIC FORCES	:	
5.3.1	SEISMIC ZONE	:	ZONE - III AS PER IS:1893
5.3.2	SOIL FOUNDATION COEFFICIENT	:	
5.3.3	IMPORTANCE FACTOR	:	

	KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED	VOLUME C 1 - V
		BELLARY TPS,UNIT-3 OF 700 MW	SECTION : D4.6
		DATA SHEET - A	
		REINFORCED CONCRETE CHIMNEY	SH 3 OF 5
6.0	DESIGN DATA	:	:
6.1	MODULAR RATIO FOR STRESS COMPUTATION	:	$m = 280/3 \sigma_{cbc}$
	WHERE σ_{cbc} IS THE ALLOWABLE COMPRESSIVE STRESS IN CONCRETE IN BENDING		
6.2	(a) MAXIMUM GRADE OF CONCRETE IN CHIMNEY SHELL	:	
	(b) MINIMUM GRADE OF CONCRETE IN FOUNDATION	:	
6.3	INCREASE IN CONCRETE STRESS PERMISSIBLE DUE TO AGEING	:	NIL
6.4	DENSITY OF ASH IN HOPPER	:	1.12 T/M ³
6.5	MAXIMUM CO-EFFICIENT OF THERMAL CONDUCTIVITY OF GLASS / MINERAL WOOL INSULATION AT 150 DEG. C MEAN TEMPERATURE	:	0.06 KCAL/HR/DEG. C
6.6	FOR COMPUTATION OF TEMPERATURE STRESS THE MODULUS OF ELASTICITY OF CONCRETE	:	E_s/m - WHERE m IS THE MODULAR RATIO AS PER CLAUSE 6.1 ABOVE AND E_s IS TAKEN AS 210000 N/mm ²
6.7	CO-EFFICIENT OF LINEAR THERMAL EXPANSION OF CONCRETE AND REINFORCEMENT	:	11×10^{-6} / DEG. C
6.8 DD	DESIGN OF REINFORCEMENT IN SHELL AT LOCATION OF CORBEL AND PLATFORM: AS PER "REINFORCED	:	AS PER "REINFORCED CONCRETE CHIMNEYS AND TOWERS" BY PINFOLD GMD 6.90 PERMISSIBLE
6.9	PERMISSIBLE DEFLECTION	:	H/500 WHERE H IS THE HEIGHT OF CHIMNEY ABOVE THE TOP OF FOUNDATION
7.0	ACCESSORIES	:	
7.1	STRAKES	:	YES
7.2	CAGE LADDER	:	YES
7.3	PROVISION FOR SEPARATE HOISTS FOR MATERIALS AND PASSENGER DURING CONSTRUCTION	:	YES
7.4	PLATFORM - EXTERNAL - ELEVATIONS	:	
7.5	GASKET AND BOLTS FOR FLUE GAS DUCT	:	YES / NO
7.6	SUPPLY OF MATING FLANGE	:	YES / NO
7.7	ERECTION OF MATING FLANGE	:	YES / NO

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	VOLUME C 1 - V SECTION : D4.6
	DATA SHEET - A REINFORCED CONCRETE CHIMNEY	SH 4 OF 5

8.0	INSTRUMENTATION	: YES <input type="checkbox"/> 8.2 STUBS FOR
8.1 DP	PROVISIONS FOR INSTRUMENTATION; PROVISIONS SHALL INCLUDE EMBEDMENT PLATES, CONDUITS, JUNCTION BOXES, ETC., COMPLETE AS PER SPECIFICATION <input type="checkbox"/> YES	
8.2	STUBS FOR ANEMOMETER	: YES
8.3	STUBS FOR ACCELEROMETER	: YES
8.4	PROBES	: YES
8.5	SPECIAL CABLES FOR INSTRUMENTS, ANEMOMETERS / ACCELEROMETERS SUPPLIED BY OWNERS	: CHIMNEY VENDOR SHALL INSTALL THESE CABLES FROM JUNCTION BOX AT EL 1.000 TO EL _____ UNDER THE SUPERVISION OF INSTRUMENTATION VENDOR
9.0	LIFT	
	PERMANENT RACK AND PINION TYPE LIFT COMPLETE FOR PERSONNEL INCLUDING CONDUIT RISERS AND NECESSARY CABLES REQUIRED	: YES
	LANDING LEVELS :	
	ESSENTIAL FEATURES	: (a) CAGE WITH FRAME, GUIDE ROLLERS AND MECHANICAL SAFETY HOOKS. (b) CAGE OF WELDED STEEL STRUCTURE WITH WIRE MESH COVERED WALLS, WITH ONE DOOR ELECTRICALLY AND MECHANICALLY INTERLOCKED. (c) ELECTRICALLY AND MECHANICALLY INTERLOCKED TRAPPED DOOR IN CAGE ROOF, SAFETY RAILING ON TOP OF CAGE AND LADDER INSIDE CAGE. (d) SEMI-AUTOMATIC CONTROL SYSTEM FOR OPERATION OF LIFT FROM INSIDE THE CAGE AS WELL AS ON LANDING WITH AUTOMATIC STOP EQUIPMENT "STOP NEXT LANDING". (e) OVERSPEED GOVERNOR FOR CONTROLLING EXCESSIVE DESCENDING SPEED. (f) AN EXTERNAL BRAKE RELEASE MECHANISM LOCATED INSIDE THE CAGE FOR DESCENDING CAGE IN CASE OF POWER FAILURE

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	VOLUME C 1 - V SECTION : D4.6
	DATA SHEET - A REINFORCED CONCRETE CHIMNEY	SH 5 OF 5
<div style="text-align: right;"> <p>(g) PROGRESSIVE TYPE POSITIVE ACTION SAFETY DEVICE DRIVEN BY A SEPARATE PINION ENGAGED IN THE ROCK (ALIMAK PATENTED OR EQUIVALENT)</p> <p>(h) EMERGENCY ALARM SYSTEM</p> </div>		

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D4.6 VOLUME - V
	TITLE PART I : CODES, STANDARDS & REFERENCES	SHEET 1 OF 4

1. IS CODES & REFERENCES

1.1 All the Indian Standards referred to shall be the latest revision (including all amendments issued thereto) at the time of execution.

1.2 Reference to only some of the codes in this document and various clauses of design criteria shall not limit or restrict the scope or applicability of other relevant codes. It shall be ensured that all other codes relevant to a specific job, in addition to those already mentioned, are followed wherever applicable.

1.3 Where British / American / DIN or other codes and standards are referred to in this document, equivalent Indian Standards may be substituted if available.

1.4 In case of any deviation / conflict between provisions of IS codes and the design criteria, the provisions that are more stringent shall followed unless specifically directed otherwise.

1.5 The Codes and Standards listed below are applicable for the design and construction of structures and buildings in general. Codes and Standards applicable for specific design and construction are listed elsewhere in reference sections.

1.6 Specifications for materials supplied from India follow the Indian Standard Specifications.

1.7 Field and laboratory testing procedures for materials follow Indian Standard Specifications.


1.8 Working stress design can be used as alternative but the approval of OWNER is a prerequisite.


2. LOADS


IS:875	Code of Practice for design loads (other than earthquake) for Buildings and structure (All parts)
IS:1911	Schedule of unit weights of building materials
IS:1893	Criteria for earthquake resistant design of structure

3. FOUNDATIONS

IS:1080	Code of Practice for design and construction of shallow foundations on soils (other than raft, ring and shell)
IS:1904 foundations in soils	Code of Practice for design and construction of general requirement
IS:2911	Code of Practice for design and construction of pile foundations: (All parts)
IS:2950	Code of Practice for design and construction of raft foundations

KPCL/BTPS/03/EPC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS,UNIT-3 OF 700 MW		SECTION: D4.6 VOLUME - V
	TITLE	PART I : CODES, STANDARDS & REFERENCES	SHEET 2 OF 4
	IS:2974	Code of Practice for design and construction of machine foundations (all parts)	
	IS:4091	Code of Practice for design and construction of foundations for transmission line towers and poles	
	IS:8009	Code of Practice for calculation of settlement of foundations: (All parts)	
	IS:9556	Code of Practice for design and construction of diaphragm walls	
	IS:11089	Code of Practice for design and construction of ring foundation	
	IS:13301	Guidelines for vibration isolation for machine foundations	
4.	RCC		
	IS:456	Code of Practice for plain and reinforced concrete	
	IS:458	Specification for precast concrete pipes	
	IS:3370	Code of Practice for concrete structures for the storage of liquids: (All parts)	
	IS:3414	Code of Practice for design and installation of joints in buildings	
	IS:3935	Code of Practice for composite construction	
	IS:4326	Code of Practice for earthquake resistant design and construction of buildings	
	IS:4995	Criteria for design of reinforced concrete bins for storage of granular (all parts) and powdery materials	
	IS:4998	Criteria for design of reinforced concrete chimneys: (All parts)	
	IS:5525	Recommendation for detailing of reinforced concrete works	
	IS:1786	Specification for high strength deformed steel bars and wires for concrete reinforcement	
	IS:10262	Recommended guidelines for concrete mix design	
	IS:11384	Code of Practice for composite construction in structural steel and concrete	
	IS:11504	Criteria for structural design of Reinforced concrete Natural Draft Cooling Tower	
	IS:11682	Criteria for design of RCC staging for overhead water tanks	

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D4.6 VOLUME - V
	TITLE PART I : CODES, STANDARDS & REFERENCES	SHEET 3 OF 4
<p>IS:13920</p> <p>5. STRUCTURAL STEEL</p> <p>IS:800</p> <p>IS:802</p> <p>IS:806</p> <p>IS:808</p> <p>IS:813</p> <p>IS:816</p> <p>IS:1024</p> <p>IS:1161</p> <p>IS:2062</p> <p>IS:4000 Practice</p> <p>IS:7215</p> <p>IS:8640</p> <p>IS:9178</p> <p>IS:9595</p> <p>IS:12843</p>	<p>Code of Practice for ductile detailing of reinforced concrete structures subjected to seismic forces.</p> <p>Code of Practice for general construction in steel</p> <p>Code of Practice for use of structural steel in overhead transmission line towers: (All parts)</p> <p>Code of Practice for use of steel tubes in general building construction</p> <p>Dimensions for hot rolled steel beam, column channel and angle section</p> <p>Scheme of symbols for welding</p> <p>Code of Practice for use of metal arc welding for general construction in mild steel</p> <p>Code of Practice for use of welding in bridges and structures subjected to dynamic loading</p> <p>Steel tubes for structural purposes</p> <p>Structural steel (fusion welding quality)</p> <p>High Strength bolts in steel structures – Code of</p> <p>Tolerances for fabrication of steel structures</p> <p>Recommendations for dimensional parameters for Industrial building</p> <p>Criteria for design of steel bins for storage of bulk material (all parts)</p> <p>Recommendation for Metal arc welding of carbon and carbon manganese steel</p> <p>Tolerances for erection of steel structures</p>	
<p>6. MISCELLANEOUS</p> <p>IS:1038</p> <p>IS:1172</p> <p>IS:1346</p> <p>IS:1742</p>	<p>Specification for steel doors, windows and ventilators</p> <p>Code of basic requirements for water supply, drainage and sanitation</p> <p>Code of Practice for water proofing of roofs with bitumen felts</p> <p>Code of Practice for building drainage</p>	

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW		SECTION: D4.6 VOLUME - V
	TITLE PART I : CODES, STANDARDS & REFERENCES		SHEET 4 OF 4

IS:1905	Code of Practice for structural use of unreinforced masonry
IS:2210	Criteria for design of reinforced concrete shell structures and folded plates
IS:2470	Code of Practice for installation of septic tank: (part 1) Design criteria and construction (part 2) Secondary treatment and disposal of septic tank effluent
IS:3067	Code of Practice for general design details and preparatory works for damp proofing and water proofing of buildings
IS:10440	Code of Practice for construction of reinforced brick and reinforced brick concrete floors and roofs SP:6 Handbook for structural engineers (all parts)
SP:7	National Building Code of India
SP:16	Design Aids for reinforced concrete to IS:456-1978
SP:20	Handbook on masonry design and construction
SP:22	Explanatory handbook on codes for earthquake engineering (IS:1982-1975 and IS:4326-1976)
SP:24	Explanatory handbook on Indian Standard code of Practice for plain and reinforced concrete
SP:25	Handbook on causes and prevention of cracks in buildings
SP:32	Handbook on functional requirements of industrial buildings
SP:34	Handbook of concrete reinforcement and detailing (SCIP)
IRC:37	Guidelines for design of flexible pavements
IRC:73	Geometric design of roads Bridge rules of Government of India, Ministry of Railways (Railway Board)
BS:4485	Structural design of Cooling Towers (part 4)



TITLE:

**TECHNICAL SPECIFICATION
COOLING TOWER**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: PE-TS-367-165-N001

VOLUME: IIB

SECTION: D

REV. NO. 0 DATE 09.05.11

SHEET 1 OF 1

SECTION - D

STANDARD TECHNICAL REQUIREMENTS

SECTION D1 - Standard Technical Requirements (Mech.) including Datasheet - A
SECTION D2 - Standard Technical Requirements (Electrical)



TITLE:
TECHNICAL SPECIFICATION
COOLING TOWER
STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: PE-TS-367-165-N001
VOLUME: IIB
SECTION: D
REV. NO. 0 **DATE :** 09.05.11
SHEET 1 **OF** 1

SECTION D1

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

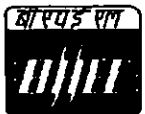
STANDARD TECHNICAL SPECIFICATION FOR NDCT


DATASHEET A

DOCUMENT DISTRIBUTION SCHEDULE FOR BELLARY PROJECT

STANDARD QUALITY PLANS

DATASHEET B

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR NATURAL DRAFT COOLING TOWERS	SPECIFICATION NO. PE-TS-999-165-N004	
		VOLUME : II B	
		SECTION : D Part-A	
		REV. NO. 0	DATE : 22.03.2003
		SHEET 1 of 9	
<p>1.0 GENERAL:</p>			
1.1	<p>This standard specification covers the design, manufacture and assembly, inspection and testing at the Vendor's and/or his sub-vendor's works, suitable painting and packing requirements for transportation, erection, commissioning and testing at site of all materials and equipments inclusive of complete electrical and civil works for the Natural Draft Cooling Tower complete with all accessories as specified hereinafter.</p>		
2.0	<p>CODES AND STANDARD:</p>		
2.1	<p>The design, manufacture, inspection and testing, and performance of the Cooling Tower as specified hereinafter shall comply with the requirements of all applicable latest Indian/British/American Standards and Codes of practice. The latest editions of the following standards and publications shall be followed in particular.</p>		
	<p>a) Cooling Tower Institution of USA, Bulletin ATP-105: Acceptance Test Code for Industrial Water Cooling tower.</p>		
	<p>b) PTC-23: ASME Performance Test Code for Atmospheric Water Cooling equipment.</p>		
	<p>c) For Electrical, Civil Codes/ Standards refer respective Specification.</p>		
	<p>d) BS-4485 – Specification for Water Cooling Tower.</p>		
2.2	<p>In case of any conflict between the above codes/ standards and this specification, the later shall prevail and in case any further conflict in the matter, the interpretation of the specification by the Engineer shall be final and binding.</p>		
3.0	<p>DESIGN REQUIREMENTS:</p>		
3.1	<p>The Cooling Tower shall be designed for continuous operation to cool not less than the design flow of water from specified inlet temperature to outlet temperature at a design ambient wet bulb temperature as indicated under Data Sheet-A enclosed to this specification.</p>		
3.2	<p>All the components shall be capable of safe, proper and continuous operation at all cooling water flows up to and including those specified under Data Sheet-A and shall be designed with regard to ease of maintenance, repair, cleaning and inspection.</p>		
3.3	<p>The cooling tower shall be Natural Draft cross flow/ counter flow type as per enclosed Data Sheet-A.</p>		
3.4	<p>The vendor under this specification shall assume full responsibility in proper design and operation of each and every component of the cooling tower as well as the cooling tower as a whole unit.</p>		

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR NATURAL DRAFT COOLING TOWERS	SPECIFICATION NO. PE-TS-999-165-N004	
		VOLUME : II B	
		SECTION : D	Part-A
		REV. NO. 0	DATE : 22.03.2003
		SHEET 2 of 9	

3.5

The Cooling tower shall be suitable for handling the fluid as per Data Sheet-A. and also for achieving the specified parameters in Data Sheet-A.

3.6

The Cooling tower shall be designed such that the drift losses and the evaporation losses are limited to the values as specified in Data Sheet-A.

3.7

The Cooling Tower structure shall be of adequate strength to withstand the wind load and the effect of earthquake on the structure. Design wind pressure and horizontal/vertical seismic coefficient shall be taken as mentioned in the specification for civil works enclosed to this specification.

4.0

CONSTRUCTIONAL FEATURES:

4.1

Casing and Louver (If required):

4.1.1

The Louvers shall be designed for air entry to the tower with low velocity for minimum pressure drop and less chance of recirculation of moist air. To eliminate splash out, louvers shall slope to shed water inwards.

4.1.2

The louvers and casing shall be made of material as specified in the Data Sheet-A.

4.2

Partitions:

4.2.1

Partitions shall be provided so that one section can be taken out of service without affecting the operation of capacity of other section.

4.3

Fill:

4.3.1

Cooling tower fills type and material shall be as specified in Data Sheet-A.

4.3.2

Design and arrangement of the fills shall be so as to expose high air/ water surface with minimum air pressure drop.

4.4

Fill Supports:

4.4.1

Fills shall be supported at frequent intervals, which shall minimise sag. Possibility of dislodgement and damage to fill materials as a consequence of induced vibration in the fill.

4.5


Drift Eliminations:

4.5.1

Multipass drift eliminators with minimum two-pass zig zag path type shall be provided so as to limit the drift loss to that specified in Data Sheet-A.

4.5.2

The eliminator frame shall be of rugged construction and shall be firmly secured to the structural

	TITLE :	SPECIFICATION NO.	PE-TS-999-165-N004
	STANDARD TECHNICAL SPECIFICATION	VOLUME :	II B
	FOR	SECTION :	D Part-A
	NATURAL DRAFT COOLING TOWERS	REV. NO.	0 DATE : 22.03.2003
		SHEET	3 of 9

frame to arrest vibration. Suitable access to the eliminator frame work from the basin should be provided for any maintenance or physical replacement of eliminator blades etc., when the particular cell is taken out for maintenance.

4.6 Hot Water Distribution System:

4.6.1 Motorised/Manual valves (as indicated in Data sheet A) shall be provided in the hot water distribution piping such that each section can be isolated without affecting the operation of other section.

4.6.2 The pipes and valves in hot water distribution system shall be designed to take care of the possible thermal stresses due to temperature variation. This could be achieved by providing sliding supports for supporting all the pipes fabricated from carbon steel.

4.6.3 The hot water distribution piping and valves shall be designed for the design pressure as indicated in the Data Sheet-A.

4.7 Cold Water Basin:

4.7.1 The cooling tower basin shall be constructed in RCC (unless otherwise specified in Data Sheet-A). The capacity of the cooling tower basin shall be as indicated in Data Sheet-A.

4.7.2 The cold water basin shall be partitioned into two chambers or as specified in Data Sheet-A. The two sections of the Cooling Tower basin should be separate water tight compartments, which can be isolated one at a time for cleaning/maintenance purposes.


4.7.3 Sludge pits with isolating valves and spool pipe having flanged ends shall be provided for individual basin chamber for connection to drainage pipe.

4.7.4 For each basin chamber, there shall be a cold-water outlet channel. In the connection between basin chamber and cold water outlet channel there shall be a stationary coarse bar screen and gate in the absence of any specific preference under Data Sheet-A.

4.7.5 Each basin chamber shall have an overflow arrangement and scouring arrangement.

4.8 Submersible sludge Pumps:

4.8.1 The submersible type sludge pumps complete with electric motors, discharge side valves, piping, supports, hangers and clamps etc. shall be supplied at the option of the purchaser for each cooling tower for basin draining/ desludging. The quantity, design parameters and the materials of construction of the vertical sludge pumps shall be as per Data Sheet-A. Each pump shall be non-clog type, self water lubricated. The vertical sludge pumps shall be treated as an optional item and are to be offered if asked for in the Data Sheet-A enclosed to this specification.

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR NATURAL DRAFT COOLING TOWERS	SPECIFICATION NO. PE-TS-999-165-N004	
		VOLUME : II B	
		SECTION : D	Part-A
		REV. NO. 0	DATE : 22.03.2003
		SHEET 4 of 9	

4.9.0 **Screens & Gates in Cold Water outlet Chamber:**

4.9.1 The screens shall be vertical stationary type; the opening size and the mesh aperture shall be as per Data Sheet-A. The guides for the screens to be embedded in the concrete shall be of material as per Data Sheet-A.

Lifting lugs or eye bolts shall be provided on top of the screen frame for ease of handling.

4.9.2 For handling screens, one set of monorail with supporting structure and chain pulley hoist complete with lifting chain and trolley for mounting the hoist shall be furnished. The chain pulley hoist shall be manually operated and shall conform to IS-3832 class-II.

4.9.3 The gates fixed in vertical sections in cold water outlet chamber shall be as per standard practice and quality, material and type shall be as given in Data Sheet-A.

4.9.4 The isolating valves on the scour lines within the sludge pits shall conform to class I of IS-780 and shall be of reputed make.

4.10 **Hardware:**

4.10.1 All nails and fastening bolts, nuts and washers etc used in the cooling tower which are coming in direct contact with water or humid air shall be made of stainless steel 304, all others nuts & bolts etc. shall be made of HDG steel.

4.11.0 **Access:**

4.11.1 Two R.C.C. staircases for approach to the hot water distribution level

4.11.2 Doors for entrance into Cooling Tower Distribution level shall be provided as specified in Data Sheet -A.

4.11.3 Two external ladders for approach to top of cooling tower from water distribution level.

4.11.4 Access/platforms for inspection and maintenance of hot water distribution system along with spray nozzles.

4.11.5 Suitable arrangement for supporting walkways inside the cooling tower shall be made and loading of such arrangement shall be independent of the fill material.

4.11.6 Whether specifically mentioned in the data sheet or not, steel components and fittings used in walkways, handrails and access doors shall be hot dip galvanised after fabrication.

5.0 **INSPECTION AND TESTING:**



TITLE :
STANDARD TECHNICAL SPECIFICATION
FOR
NATURAL DRAFT COOLING TOWERS

SPECIFICATION NO. PE-TS-999-165-N004

VOLUME : II B

SECTION : D Part-A

REV. NO. 0 **DATE :** 22.03.2003

SHEET 5 of 9

5.1 The inspection/ testing of cooling tower and its various components shall be as per the approved Quality Plans.

5.2 Hydrostatic test for the hot water distribution piping shall be conducted at site after complete erection. The test pressure and duration shall be as per Data Sheet-A.

6.0 TEST AT SITE:

6.1 The Cooling Tower as a whole shall be tested at site to check and ascertain that the performance meets the requirements of the specification. It is the responsibility of the vendor to conduct the performance test of the cooling tower and prove the specified parameters to the satisfaction of the purchaser. The test shall be witnessed by the purchaser/ customer's representative or both, for which 15 days clear notice will be given to purchaser by the vendor.

6.2 The performance test of the cooling tower shall be carried out in accordance with cooling tower Institute Bulletin No. ATP 105 Acceptance test for Industrial Cooling Tower.

The details of the proposed test procedure shall be submitted by the vendor sufficiently in advance of the commencement of test for the review and approval of the purchaser.

6.3 Necessary correction curves required for correcting the test results for any difference in test and guaranteed design condition shall be furnished by the supplier for approval along with the proposed test procedure.

6.4 All testing and calibrating instruments required for the site performance test shall be arranged by the cooling tower supplier without any extra cost. All instruments used by the supplier shall be duly calibrated from a recognised Institution and the same is to be arranged by the supplier.

7.0 PERFORMACNE GUARANGTEE, TOLERANCE & PENALTIES:

7.1 Each equipment shall be guaranteed to meet the performance requirement as specified.

7.2 The tests shall be conducted at the manufacturer's works/ site in accordance with this specification and rectification of all defects shall be satisfactory done without charging any extra amount to purchaser.

7.3 The performance test shall be carried out at site as specified and all defects shall be satisfactorily rectified within a time period decided by purchaser. No extra amount shall be charged to purchaser for such rectification. After rectification, retesting will be done by purchaser/ customer's representative without any extra cost to purchaser till satisfactory performance is achieved.

7.4 The vendor shall submit performance curves for the cooling tower showing variation in performance from the design duty point with change in approach to wet bulb temperature,



TITLE :
STANDARD TECHNICAL SPECIFICATION
FOR
NATURAL DRAFT COOLING TOWERS

SPECIFICATION NO. PE-TS-999-165-N004

VOLUME : II B

SECTION : D **Part-A**

REV. NO. 0 **DATE :** 22.03.2003

SHEET 6 of 9

cooling range, water loading of the tower.

7.5 The vendor shall guarantee the performance of the whole cooling tower plant to meet the specifications when tested in accordance with cooling tower institute acceptance test code ATP-105, performance curves as per ATP-105 shall be furnished by the vendor.

7.6 If any defects are observed, the bidder shall rectify the same without extra cost to the purchaser. Even after rectification if the guaranteed performance is not achieved, then for every increase of 0.5 degree C or part thereof in the cold water temperature over design conditions, a sum as specified in data Sheet-A shall be paid by vendor to the purchaser for shortfall of guarantee, for the cooling tower.

7.6.1 In case the cold water temperature exceeds the acceptable limits of purchaser, the whole plant will be rejected and the vendor shall refund the entire money paid to him together with any penalty levied otherwise.

8.0 SPECIAL CLEANING PROTECTION & PAINTING:

8.1 All equipment shall be neatly finished. All exposed metal/ concrete/ wooden surface shall be smooth and free from burrs/ projections.

The metal surfaces to be painted should be accessible, suitable for priming and affording maximum protection throughout the life of the plant. The surface preparation shall be done either mechanically or chemically by one or more of the methods as given in IS-1477 (Part-I) and shall include the following:

- a) Removal of oil, grease, dirt and swarf etc., as per Section 6.1 of IS-1477 (Part-I).
- b) Removal of rust and scale etc., as per Section 6.2 of IS-1477 (Part-I).
- c) Sand blasting/ shot blasting as per Section 6.2.4 of IS-1477 (Part-I) or wire brushing and picking as specified in Data Sheet-A.

8.2 INSIDE SURFACE OF PIPING & VALVES IN HOT WATER RISERS:

8.2.1 The inside surfaces of the piping and the valves which are in contact with water and which are not made of stainless steel or other corrosion resistant materials shall be painted with coal tar based epoxy paint of approved make and quality over a coat of Zinc Chromate Primer. The thickness of cured coating shall be as specified in Data Sheet-A.

8.3 Outside Surface of Piping (Buried):

8.3.1 Surface treatment as specified in Data Sheet-A.



TITLE :
STANDARD TECHNICAL SPECIFICATION
FOR
NATURAL DRAFT COOLING TOWERS

SPECIFICATION NO. PE-TS-999-165-N004

VOLUME : II B

SECTION : D **Part-A**

REV. NO. 0 **DATE :** 22.03.2003

SHEET 7 of 9

8.3.2 Coating/ wrapping/ concrete lining as specified in Data Sheet-A.

8.4 **Outside Surface or Piping (Exposed):**

8.4.1 Surface treatment as specified in Data Sheet-A.

8.4.2 One coat of red oxide primer.

8.4.3 Synthetic enamel paint of approved shade, make and quality. The thickness of cured coating shall be as specified in Data Sheet-A.

8.5 All steel parts used for cooling tower construction shall be hot dip galvanised as per IS-4736 after shop fabrication. The external surfaces of the flow regulating valves access platform, access door and also the hoisting derrick subjected to hot water fumes shall also be thoroughly cleaned and treated and shall be coated with rust preventing paints.

8.6 All parts shall be properly boxed, crated or otherwise protected for transportation. Exposed metal finished surfaces shall be thoroughly greased before transportation.

8.7 The external and internal surfaces of the tower shall also be painted.

9.0 **DRAWING AND DATA AFTER AWARD OF CONTRACT:**

The vendor shall furnish drawings and other technical documents as given in Data Sheet-C, enclosed with the specification.

10.0 **SPECIAL TOOLS & TACKLES:**

Special tools & tackles, if any, shall be included in scope of supply by the vendor. A list giving description of such tools & tackles shall be furnished by vendor.



TITLE :

**DATA SHEET - C
FOR
NATURAL DRAFT COOLING TOWERS**

SPECIFICATION NO. PE-TS-999-165-N004

VOLUME : II B

SECTION : D **Part-A**

REV. NO. 0 **DATE :** 22.03.2003

SHEET 8 of 9

DATA / DOCUMENTS TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

1. General Arrangement drawing of complete cooling tower (showing plan, front elevation and side elevation) incorporating principal dimensions limits of scope of supply of piping, limits of civil works included, showing extent of platforms, walk ways, handrails, access doors staircase, end wall derrick etc. and the limits of scope of supply of electrical works.
2. General Arrangement drawing of Cooling Tower basin indicating overflow and desludging arrangement.
3. General Arrangement and Sectional Assembly drawings pertaining to the following components of the Cooling Tower.
 - a) Tower fill with supporting arrangement.
 - b) Drift eliminator installation and details.
 - c) Complete hot water distribution system including flow regulating valves, distribution basin/ pipes and nozzles etc.
4. Arrangement drawing of the cold water outlet chambers and sludge pits incorporating also the arrangement of screens, gates, valves and piping terminal details.
5. Cooling tower performance curves showing wet bulb temperature V/s. cold water temperature for design cooling range, 90% cooling range and 110% cooling range at 90% ,100% and 110% of design flow.
6. Detailed GA and sectional assembly drawing of BF valves in hot water risers indicating materials of construction of various components.
7. General Arrangement and cross-sectional assembly drawings of sludge pumps and motor drives along with their performance curves.
8. Electrical drawings and data.
 - i) Cable Schedule
 - ii) Cable tray and trench layout.
 - iii) Drawing on illumination system of cooling tower structure including wiring diagram showing conductor and conduct sizes and design calculation.
 - iv) Drawing on Aviation Obstruction Lighting System.
 - v) Drawing on grounding system inclusive of lighting protection system.



TIT F

DATA SHEET - C
FOR
NATURAL DRAFT COOLING TOWERS

SPECIFICATION NO. PE-TS-999-165-N004

VOLUME: II B

SECTION: D **Part-A**

REV. NO. 0 **DATE:** 22.03.2003

SHEET 9 of 9

vi) Drawing of lighting sub-distribution board & junction boxes.

10. Drawings, data and calculation on civil works :

- i) Design calculations for strength and suitability showing justification for size of members chosen for all structural components of cooling towers inclusive of prestressed concrete fill where applicable. All civil and structural design calculations shall be furnished by the supplier for approval of the purchaser.
- ii) Load drawings setting out clearly and concisely the various loads taken into consideration for design.
- iii) Civil drawings for cold water basin, sludge sumps, connecting channels, partitions, louvers, end walls, longitudinal beams, hot water distribution basin, its covering, staircase, platforms, cable trenches, etc. all complete.
- iv) Bar bending details for all reinforced concrete structures.
- v) Insert details, anchor bolt details.
- vi) Final painting schedule.
- vii) Other drawings & data as necessary.

11. Test procedure along with details of tests to be conducted for the offered cooling tower.

12. Quality Plan along with complete details of the testing and inspection requirements of mechanical and electrical items of the cooling tower in BHEL format.

13. Operation and Maintenance Manuals

14. Field Quality Plan for site activities – viz. Civil works & Erection.

15. Cooling tower performance test procedure.



TITLE:
TECHNICAL SPECIFICATION
COOLING TOWER
BELLARY TPS UNIT-III, (1 X 700 MW)
DATASHEET - A

SPEC. NO.: PE-TS-367-165-N001
VOLUME: II B
SECTION: D1
REV. NO. 0 DATE 09.05.11
SHEET 1 OF 6

1.0 GENERAL INFORMATION

No. of Cooling Towers required : One (01) no
Location : Out door
Duty : Continuous
Type : Natural draft counter flow with PVC Film fills
Basin Sill level : EL (+)0.5 M (RL 478.5 M)
Finished ground level : EL (+)0.0 M (RL 478.0 M)

2.0 DESIGN PERFORMANCE FOR EACH COOLING TOWER

- 2.1 Design Cooling water flow : 81000 M³/hr.
- 2.2 Design ambient wet bulb temp. : 27.0 °C
- 2.3 Design inlet air wet bulb temperature. : 27.0 °C
- 2.4 Approach w.r.t. design inlet air wet bulb temperature (viz. 27.0°C) : 5.0 °C
- 2.5 Cold water temperature : 32 °C
- 2.6 Hot water inlet temperature : 41.8 °C
- 2.7 Cooling Range : 9.8 °C
- 2.8 Design ambient Relative Humidity : 45 %
- 2.9 Liquid Handled : Clarified water (refer details of cooling water analysis)
- a) Total CW Pumping head permissible viz. static head plus frictional losses as below: : Not to exceed 13 MWC
- Static head w.r.t. FGL
 - Frictional losses within bidders T.P. with 10% margin
 - Velocity head
- 2.10 Maximum permissible drift loss : Max. 0.05 %
- 2.11 Design pressure for hot water distribution system : 5 kg/cm²(g)
- 2.12 Max permissible Cooling Tower Plan dimensions at 'FGL' : Basin Diameter should not exceed 120 meter.
- 2.13 Maximum Cooling tower flow capacity to be considered for design of hot water distribution and cold water channel : Min 120% of design CW flow.



TITLE:

**TECHNICAL SPECIFICATION
COOLING TOWER
BELLARY TPS UNIT-III, (1 X 700 MW)
DATASHEET - A**

SPEC. NO.: PE-TS-367-165-N001

VOLUME: II B

SECTION: D1

REV. NO. 0 DATE 09.05.11

SHEET 2 OF 6

3.0 SPECIAL FEATURES


- 3.1 Basin type** : Sectionalized (two compartment) by partition wall
- 3.2 Whether fills are removable** : Yes
- 3.3 Fills supporting by nailing acceptable** : NO
- 4.0 Cold Water Basin Details**
- 4.1 Finished ground level** : EL 0.00M (RL 478.0 M)
- 4.2 Maximum water level** : EL 0.00M (RL 478.0 M)
- 4.3 Min. Water level** : EL (-) 1.0M (RL 477.0 M)
- 4.4 Storage capacity between Normal and minimum water levels.** : Shall be suitable to provide a minimum storage of Six (6) minutes between Maximum and minimum water levels.
- 4.5 Invert level of CT Basin** : EL (-) 1.6M (RL 476.4 M)
- 4.6 Invert level of CW duct near CT level** : EL (-) 5.0M
- 4.7 a) Depth of Sludge pit** : Suitable for complete dewatering. To include sludge pump submergence & clearance depth below basin/ channel invert level
- b) Submersible type sludge pumps** : 1 working + 1 standby (of Min capacity of 200 cub M / hr
- 4.8 Number of sludge pits** : Common sludge pit with inter connection with both compartments of CW basin.
- 4.9 Number of cold water outlet channels** : One for each compartment of CW basin. Cold water outlet shall be 10 M wide (clear width – excluding wall thickness) at CT basin outlet for each compartment. At T.P Bidder to match same as per T.P. Drawing.
- 4.10 Depth of CW channel** : 3.5 M (Ref Annexure-2)
- 4.11 Number of screens and gates in common outlet channel** : One for each compartment of CW basin
- 4.12 Maximum allowable effective velocity through Cold water channel at Min. Water Level** : 1.2 M/Sec.
- 4.13 Maximum allowable effective velocity through gates at Min. Water Level** : 1.2 M/Sec.



TITLE:
TECHNICAL SPECIFICATION
COOLING TOWER
BELLARY TPS UNIT-III, (1 X 700 MW)
DATASHEET - A

SPEC. NO.: PE-TS-367-165-N001
VOLUME: II B
SECTION: D1
REV. NO. 0 DATE 09.05.11
SHEET 3 OF 6

- 4.14 Max. allowable effective velocity through screens at Min. Water Level : 1.2 M/Sec.
- 4.15 Length of outlet channel including expansion joint in bidder's scope : As per terminal point details in Section C1 and details as shown in the enclosed sketch 1.
- 5.0 COOLING TOWER ACCESS DETAILS**
- 5.1 Required number of stair cases from ground level upto hot water inlet trough cooling tower roof : Two (2) Nos.
- 5.2 Number of cage ladders from ground floor to cooling tower top : Total Four (4) Nos.: Two from reinforced concrete stairs to platform at the top of the tower and other two shall be from ground level itself.
- 5.3 Internal walkway of platform with hand rails : Peripheral walkway above fill level inside of the cooling tower
- 5.4 External walkway platform : 1.2 M width around the circumference at top and at aviation lamp level
- 6.0 HOT WATER SUPPLY HEADER TERMINALS** : As per terminal point sketch -1 enclosed.
CW return piping in BHEL scope 3350 Nb shall be terminated with centre line of pipe elevation as shown in sketch. Further Piping from T.P. with isolating B.F. Valves in each riser shall be in bidders scope.
- 7.0 SCOPE OF SUPPLY :**
- 7.1 Cooling tower basin outlet channels/ sump and sludge pits : Yes
- 7.2 Hot water piping to distribution Duct : Yes
- 7.3 Hot water header isolation valves(manual) on risers : Yes
- 7.4 Flanges/counter flanges for all flanged connections with bolts, nuts & gaskets etc. : Yes
- 7.5 Screen & guide for each cold water outlet sump/ channel : Yes
- 7.6 Sluice gate with guides and sealing device for each cold water outlet sump/ channel. : Yes
The sluice gates shall be complete with head stock for manual operation. The head stock shall have pillar, base plate and hand wheel made up of cast iron

	TITLE: TECHNICAL SPECIFICATION COOLING TOWER BELLARY TPS UNIT-III, (1 X 700 MW) DATASHEET - A		SPEC. NO.: PE-TS-367-165-N001	
			VOLUME: II B	
			SECTION: D1	
			REV. NO. 0	DATE 09.05.11
			SHEET 4	OF 6
7.7	Isolation valves in sludge pit	:	Yes	
7.8	Drain Piping from sludge pit to terminal point	:	Yes	
7.9	Pulley block for lifting each screen in cold water outlet sump/ channel	:	Yes	
7.10	All necessary supports, hangers	:	Yes	
7.11	Base plates, foundation plates, anchor bolts, sleeves, inserts, bolts, nuts for all equipments supplied	:	Yes	
7.12	Electrical			
	As per electrical plant specification	:	Yes	
7.13	All related Civil works included	:	Yes	
8.0	MATERIAL OF CONSTRUCTION			
8.1	Cold water basin, outlet channel/ sump & sludge pit.		R.C.C.	
8.2	shell	:	R.C.C	
8.3	Basin partition wells	:	R.C.C	
8.4	Internal walk way	:	R.C.C./ Galvanized steel	
	External walkway platform		R.C.C	
8.5	Staircase	:	R.C.C.	
	Hand rail		Hot dip galvanized steel	
8.6	Supporting structures	:	R.C.C.	
	Hot water distribution basin		R.C.C	
8.7	Hot water distribution nozzles	:	Polypropylene/PVC	
8.8	Fills	:	VIRGIN PVC	
8.9	Fill support col,beams & trussess	:	R.C.C	
8.10	Louvers	:	R.C.C.	
8.11	Drift eliminators	:	PVC- UV Stabilized	
8.12	Fasteners/wetted parts	:	SS-316	
8.13	Piping		Above 150 Nb : Carbon steel plates to IS 2062, rolled and welded as per IS 3589 with PU coating (polyurethane) internally with minimum 2 mm DFT as per AWWA-C-222. From 65 Nb Upto 150 Nb : SS conforming to ASTM A-312- Gr.316 Sch 10S Upto 50 Nb : SS conforming to ASTM A-312-	



TITLE:
TECHNICAL SPECIFICATION
COOLING TOWER
BELLARY TPS UNIT-III, (1 X 700 MW)
DATASHEET - A

SPEC. NO.: PE-TS-367-165-N001
VOLUME: II B
SECTION: D1
REV. NO. 0 **DATE 09.05.11**
SHEET 5 **OF 6**

Gr.316 Sch 40S

8.14 Hot water line valves

a) BF Valves

400 Nb & above & upto 1200 Nb
Body & disc : CI, IS210 FG260, Rubber lined
Shaft: SS-316L.

Above 1200 Nb
Body & disc : Fabricated as per IS:2062, Rubber lined
Shaft: SS-316L

Test pressure & duration shall comply with AWWA C504

b) Other valves

- Body : ASTM A 182 F 316L(Forged SS)/ASTM A743 Gr. CF8M (cast SS)
- Spindle & Trim : SS316L

8.15 Sludge pit isolation valves

- Body : ASTM A 743 Gr. CF8M
- Spindle & Trim : SS316L

8.16 Sludge outlet pipe : As per the material specified above in 8.13

8.17 Sluice gates in cold water outlet channel : CI to IS 2062- Hot dip galvanised

8.18 Guide for sluice gates : SS-316L

8.19 Screen : SS 316L with 10X10 Mesh with Heavily Galvanised (as per IS: 2629) carbon steel frame and supports

8.20 Guide for Screen : SS- 316L

8.21 Bolts, buts & other hardware : SS-316L or equivalent

Note:

- (a) Carbon /Mild steel parts or structures used in Cooling Tower or its vicinity shall be Heavily Galvanised.
(b) Material of construction for items not specified shall be subject to purchaser's approval during detailed engineering stage, in the event of order.

9.0 Pipe work Painting / Protection of Pipes:

9.1 Internal surface (for pipe dia above 200 mm) Surface preparation : Sand blast to SA 2.5
Final Paint: PU coated (Minimum 2mm DFT)

9.2 External surface – overground piping :

a. Surface cleaning by Sand/shot blasting to SA2.5. Yes

b. Application of two coat of red oxide Zinc Chromate primer (conforming to IS 2074) with minimum DFT of Yes



TITLE:
TECHNICAL SPECIFICATION
COOLING TOWER
BELLARY TPS UNIT-III, (1 X 700 MW)
DATASHEET - A

SPEC. NO.: PE-TS-367-165-N001
VOLUME: II B
SECTION: D1
REV. NO. 0 **DATE 09.05.11**
SHEET 6 OF 6

25 microns per coat.

- c. Three coats of finish paint 25 microns per coat using enamel paint to give minimum total DFT of 125 microns(including (b) above). Yes

9.3 External surface – Buried piping :

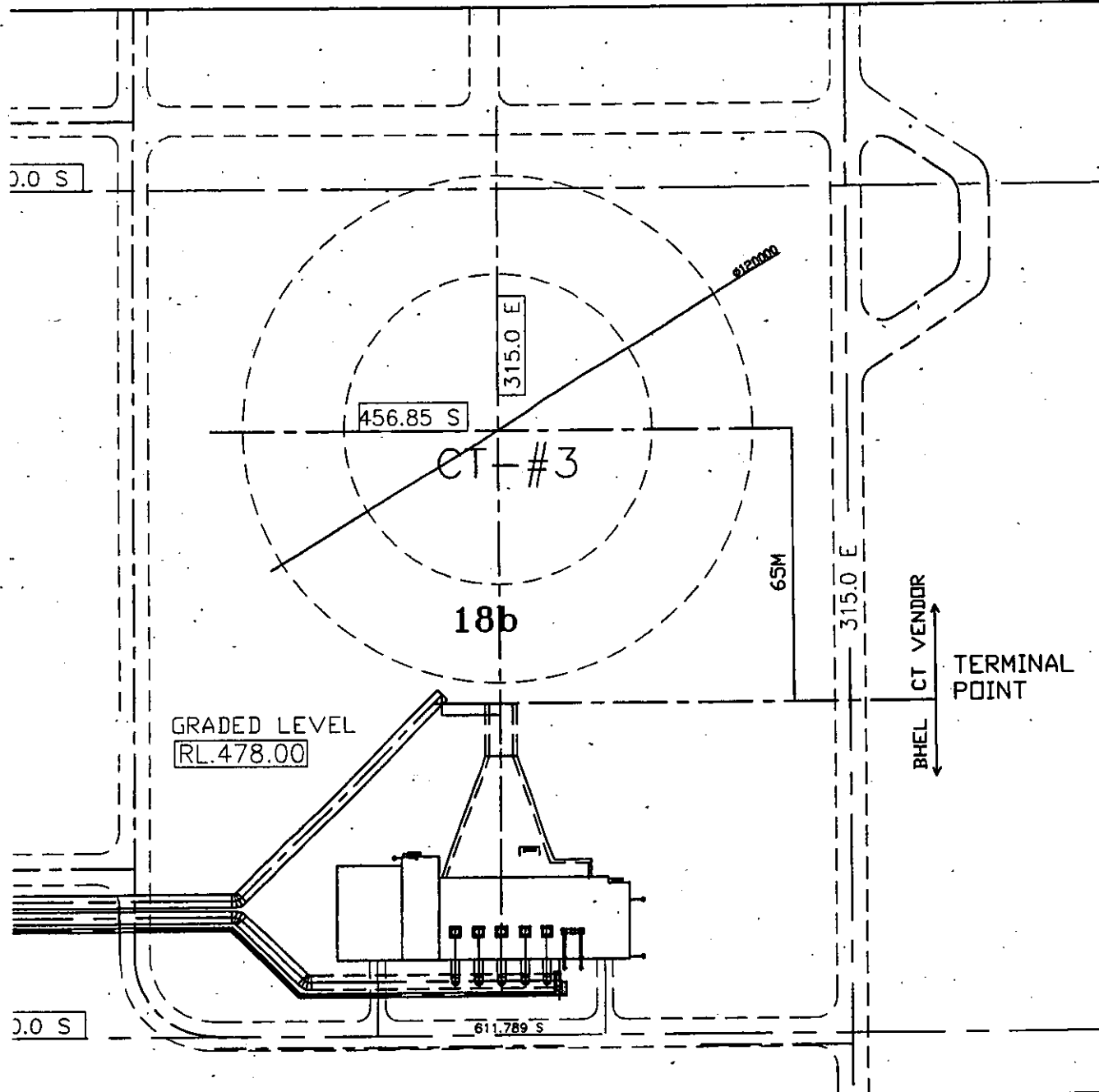
- a. Surface cleaning by Sand/Shot blasting to SA2.5. Yes
- b. Application of one coat of coaltar/primer/enamel conforming to AWWA C 203/ IS 10221 Yes
- c. Application of one layer of tape comprising of coal tar. Application of tape shall confirm to AWWA C 203/ IS 10221 (appendix – B) with thickness of tape as 4.5 mm Yes

10.0 INSPECTION AND TESTING

- 10.1 Quality Surveillance by : Manufacturer, purchaser and customer
- 10.2 Material testing and identification : Required
- 10.3 Stage inspection to be witnessed by Purchaser and customer : Yes
- 10.4 Hydrostatic test for piping & valves required : Yes
- 10.5 Hydrostatic test to be witnessed by Purchaser and customer : Yes
- 10.6 Field performance test of individual items and the cooling tower as a whole required : Yes
- 10.7 Field performance test to be done by : Approved CTI agency
- 10.8 All testing instruments by supplier : Yes
- 10.9 Commissioning at site by : Bidder
- 11.0 Mandatory spare : NIL

Attachments :

- a) Plot plan
- b) Sketch showing T.P details for hot water riser and discharge channel



ANNEXURE-1

NOTES:

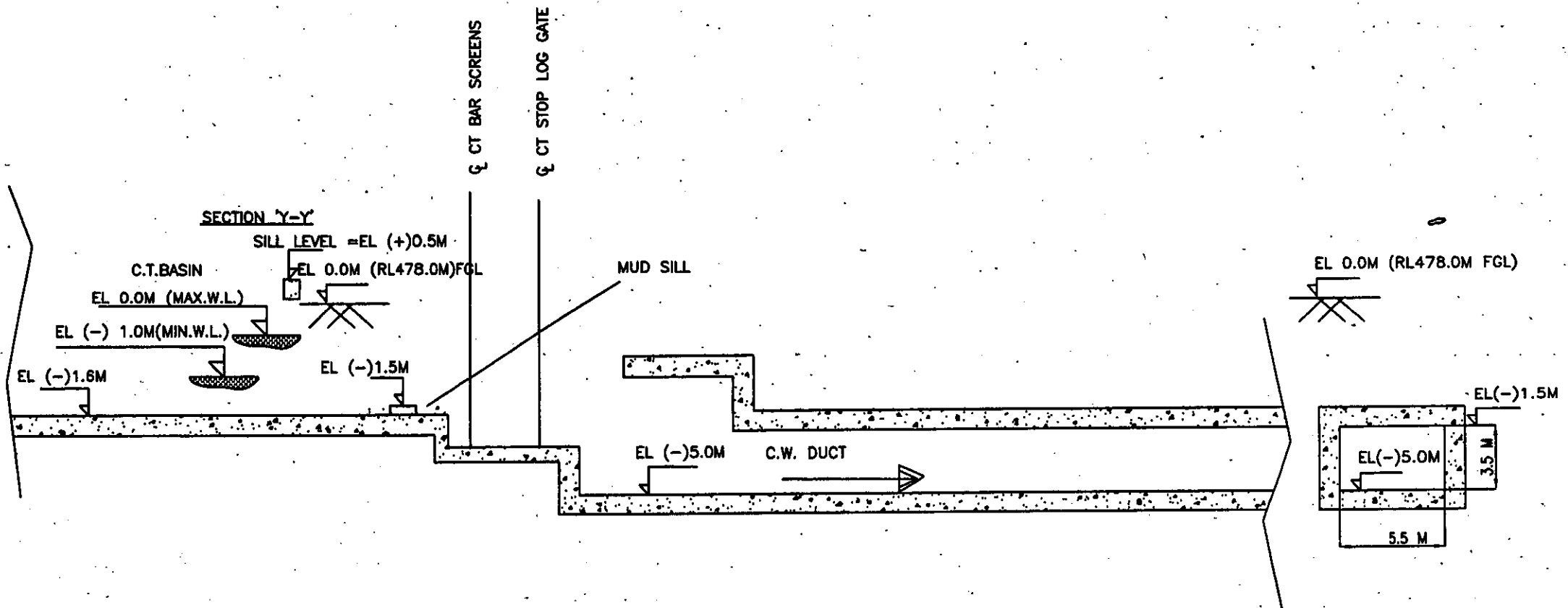
- 1) THE ISOLATION VALVES FOR HOT WATER RISER SHALL BE IN VENDOR SCOPE WITH RISERS TAPPED FROM WITHIN BIDDERS SCOPE OF HW HEADER.
- 2) CENTRELINE ELEVATION FOR COMMON HEADER IS EL(-)3.0M.

SKETCH 1

PART DRAWING OF PLOT PLAN (DRG. NO-PE-DG-367-100-M001/RD) FOR LOCATION OF TP CW PIPING /CHANNEL

REV-0

ANNEXURE - 2



PROJECT: 1X700 MW BELLARY TPS. UNIT-III

COOLING TOWER SPECIFICATIONS

COOLING TOWER COLD WATER OUTLET

WITH CT BASIN WATER LEVELS

1X700 MW BELLARY TPS, UNIT-III

DRAWING/ DOCUMENTS DISTRIBUTION SCHEDULE

Sl. No.	Type of Document	Number of Copies	
		For Approval	Final
1	Drawings/Documents/Quality Plans etc.	3 Nos	13 Prints
2	Datasheets	3 Nos	13 Prints
3	Test Certificates & Reports	3 Nos	13 Prints
4	Erection/ Installation/ O&M Manuals	3 Nos	13 Prints
5	As Built Drawings/ Documents	3 Nos	13 Prints

NO.	DESCRIPTION OF ITEM	DATE	TYPE/METHOD OF CHECK	TEST/EXT. OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE CRITERIA	FORMAT OF RECORD	AGENCY	REMARKS
		(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1	INTERNAL AND BRIGHT DENT CONTROL								
2	FAK PLATE (METALLIC)								
3	1. RESIN								
4	FAK PLATE (METALLIC)								
5	FAK HUB (CENTRE PORTION), SPOKES BRIDGES ETC.								
6	DRIVE SHAFT & COUPLER								
7	REDUCTION BEAR UNIT - HUB SHAFT, GEAR, PLENDER, BEVEL GEAR, CASTING								
8	1. SHAFT & GEAR BLANKS								

P. NO.	1005/SP/12	SIGNATURE	DATE	DATE	DATE
V. NO.	001-11-85	NAME			
AGE NO.	1006	PART	CUSTOMER/CONSULTANT	BREL	VENDOR

198



PROJECT
VENDOR

DATE QUALITY ASSURANCE

STANDARD QUALITY PLAN

SYSTEM
ITEM 1 COOLING TOWER



ITEM NO.	COMPONENT/LOCATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE CRITERIA	FORMAT OF RECORD	AGENCY	REMARKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
2. VIBES - PSE COM	(11) APPLICABLE	SURFACE DEFECTS, PIX HOLES	CR	VISUAL EXAM., SPARK TEST	100%	11S-4682 PL. IV	11S-4682 PL. IV	11R	3/2 12,1	-
3. VIBES MESH		MESH, STEEL, SURFACE DEFECTS	KI	MEAS., VISUAL EXAM.	RANDOM	INFG. DRG.	INFG. DRG.	14R	3/2	12,1
4. VIBES NOZZLES, FITTINGS, SUPPORTS, SPLASH BARS, AND OTHER ACCESSORIES		DIMENSIONS, WORKMANSHIP AND FINISH	KI	-DO-	RANDOM	INFG. DRG./APPD. DATA SHEET	INFG. DRG./APPD. DATA SHEET	11R	3/2	12,1
5. VIBES VIBRATION SWITCH		1. CONTACT RESISTANCE 2. CONTACT RATING 3. INSULATION RES. 4. DI-ELECTRIC STRENGTH 5. OPTIC 6. DEGREE OF PROTECTION & VIBRATION TEST	MA	ELEC. TESTS	100%	1APPD. DATA SHEET/1APPD. DATA SHEET/11R 1DRG.	1APPD. DATA SHEET/1APPD. DATA SHEET/11R 1DRG.	11R	3/2 12,1	-
6. VIBES LIGHTING FIXTURE			MA	ELEC. TEST	11/TYPE/ 1SITE	-DO-	-DO-	LAB. REPORT	3/2	12,1
7. VIBES PIPES, FITTINGS & PIPE WORK										
8. VIBES VALVES (ALL TYPES)										
9. VIBES PUMPS										
10. VIBES LIGHTING FIXTURE										

2. P. NO.	11S-4682	SIGNATURE	DATE	DATE	DATE
REV. NO. / DATE	11-85 / 01 JULY 88	NAME			
PAGE NO.	13 OF 14	PARTY	CU TOWER/CONSTRUCTION	DATE	

QTY.	COMPONENT/OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/METHOD OF CHECK	PERCENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE CRITERIA	FORMAT OF RECORD	AGENCY	REMARKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
15	CABLES	1. TYPE TESTS INCLUDING FRLS TESTS	NA	VERIF. OF TYPE TEST CERT.	100%	1. H. SPECK., 1. APPD. DATA SHEET	1. TECH. SPECK., 1. APPD. DATA SHEET	1. TYPE TC	3	12, 11
		2. ROUTINE TESTS	NA	ELECT. TESTS	-00-	-00- 15:1551	-00- 15:1551	ROUTINE TC	3	12, 11
		3. ACCEPTANCE TESTS	NA	-00-	-00-	-00-	-00-	ACCEPT. TC	3	12, 11
10	1X-PROCESS CONTROL									
1	1X-PROCESS CONTROL	1. HARDNESS	NA	PHYS. TEST	100%	1. APPD. DATA SHEET	1. APPD. DATA SHEET	1. LOG BOOK/IR	3/2	12, 11
		2. PROFILE	CR	1. TEMPLATE/MEAS.	100%	1. INF. STD., 15:1066	1. INF. STD., 15:1066	1. IR	3/2	12, 11
		3. DIMENSIONS	NA	1. MEASUREMENT	100%	1. -00-	1. -00-	1. IR	3/2	12, 11
		4. DEFLECTION/PROOF LOAD CAPACITY	CR	1. DEFLECTION TEST/1	100%	1. -00-	1. 1X0 PERI. DEFCTN. 7	1. IR	3/2	12, 11
		5. WORKMANSHIP AND FINISH	NA	1. VISUAL EXAM.	100%	1. -00-	1. -00-	1. IR	3/2	12, 11
		6. SURFACE DEFECTS OF HUB ENDS	NA	1. PT	100%	1. 1. SINE 165	1. 1X0 SURFACE DEFECT	1. IR	3/2	12, 11
										1. 1X0 METALLIC BLADES ONLY
2.2	HUBS DRIVE SHAFT & COUPLING (BEFORE GALVANIZING)	1. DIMENSIONS	NA	1. MEASUREMENT	100%	1. INF. DRG./STD.	1. INF. DRG./STD.	1. IR	3/2	12, 11
		2. WORKMANSHIP AND FINISH	NA	1. VISUAL EXAM.	100%	1. -00-	1. -00-	1. IR	3/2	12, 11
		3. SURFACE DEFECTS	NA	1. PT	100%	1. 1. SINE 165	1. 1X0 SURFACE DEFECT	1. IR	3/2	12, 11
		4. STATIC, DYNAMIC RESIDUAL UNBALANCE	CR	1. STATIC, DYNAMIC BALANCING	100%	1. 1. ISO 1940	1. 1. ISO 1940	1. IR	3/2	12, 11
							1. 1. 6.3			
2.2.11	HUB, DRIVE SHAFT & COUPLING (AFTER GALVANIZING)	1. UNIFORMITY, WT. ADHESION	CR	1. DIP, STRIP, ADHESION TESTS	100%	1. 1. BATCH 15:2633	1. 1. APPD. DATA SHEET	1. IR	3/2	12, 11
		2. SURFACE DEFECTS OF ZINC COATING	NA	1. VISUAL EXAM.	100%	1. 1. 15:2633	1. 1. 15:2633			

Q.P. NO. 1007/SOP/12 SIGNATURE DATE DATE DATE DATE

REVISED BY 10/1-11-85 10/17 JULY, 85 NAME

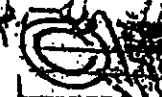
DATE NO. 1007-1 PART CUSTOMER/CONSULTANT DIEEL VENDOR



PROJECT:
PERIOD:

STANDARD QUALITY PLAN

ITEM: COOLING TOWER



S. NO.	COMPONENT & DETAIL	CHARACTERISTICS CHECKED (1)	CATE-1 SORT (2)	TYPE/METHOD OF CHECK (3)	EXTENT OF CHECK (4)	REFERENCE DOCUMENTS (7)	ACCEPTANCE CRITERIA (8)	FORMAT OF RECORD (9)	AGENCY			REMARKS (11)
									P	V	V	
7.1	REDUCTION GEAR UNIT - ALL COMPONENTS	1. WORKMANSHIP AND FINISH, DIMENSIONS	MA	1. VISUAL EXAM. 1. MEAS.	100%	INFG. DRG.	INFG. DRG.	LOG BOOK/IR	3/2	1	12, 1	
7.1.1	GEARS, SHAFTS	1. DIAL INDICATOR CYCLE, HARDNESS, CASE DEPTH	MA	1. VERT. OF 111 CHART 1. MEAS.	100%	INFR. SPECN. / APPD. DATA SHEET	INFR. SPECN. / APPD. DATA SHEET	111 CHART, LOG BOOK	3/2	1	12, 1	
7.1.2	GEARS	1. UNIFORMITY OF CONTACT	MA	1. BLUE-MATCHING	100%	INFR. SPECN.	INFR. SPECN.	LOG BOOK	3/2	1	12, 1	
7.1.3	SHAFT AND GEAR	1. SURFACE DEFECTS	MA	1. SPI	100%	INSPE 165	INSPE SURFACE DEFECTS	IR	3/2	12, 1		
7.6	ASSEMBLY COXII FINAL TESTS											
7.7	FIN ASSEMBLY DES WITH 11111	1. STATIC RESIDUAL UNBALANCE	CR	1. STATIC BALANCING	100%	INFR. SPECN.	INFR. RESIDUAL UNBALANCE	IR	2	1		
7.7	COMPLETE GEAR UNIT	1. GEAR RATIO, ORIENTATION, NOISE, TEMP. RISE, LEAKAGES	MA	1. VISUAL EXAM. NO. 1 1. LOAD RUNNING FOR 111 IR.	100%	INFG. STD. APPD. DATA SHEET	INFG. STD. APPD. DATA SHEET, INFR. LEAKAGES	IR	3/2	12, 1		
7.8	COMPLETE FIN ASSEMBLY	1. AIR DELIVERY 2. POWER CONSUMED 3. FIN EFFICIENCY 4. NOISE, VIBRATION	CR	1. PERFORMANCE TESTS 1. TYPE /	100%	105 Q10 PT 1, 2 1. TYPE-C/BULLETIN 1. APP 105-COOLING 1. TOWER INST. OF 1. USA	1. APPD. DATA SHEET 1. 105 Q10 PT 1, 2 1. TYPE-C/BULLETIN 1. APP 105-COOLING 1. TOWER INST. OF 1. USA	1. TYPE TEST 1. REPORT	2	1	1	1. IN ARSEP 1. TYPE TEST 1. REPORT 1. WITNESS 1. LABEL

NO. 100	REQ	DATE	SIGNATURE	DATE	DATE
NO. 100	1-85	01/JULY, 88	NAME		
			CUSTOMER CONSULTANT	BUEL	VENDOR

[illegible]

COMPONENT EVALUATION	CHARACTERISTICS	SCALE 1-5	TYPE/REMARKS	REFERENCE	DOCUMENTS	RECORDS	FORMAL OF AGENCY	REMARKS
1.0	COPIES COPIED	1	1	1	1	1	1	1
2.0	COPIES COPIED	1	1	1	1	1	1	1
3.0	COPIES COPIED	1	1	1	1	1	1	1
4.0	COPIES COPIED	1	1	1	1	1	1	1
5.0	COPIES COPIED	1	1	1	1	1	1	1




QUALITY PLAN					PROJECT :		SPEC. NO				
SHEET 1 OF 3					CUSTOMER :		VOLUME: II-B				
BIDDER/VENDOR					REV.00 DT. 31.03.99		SECTION D				
SYSTEM:					ITEM: PIPES & FITTINGS		AGENCY				
S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATE GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	P W V	REMARKS	
1.0.0	MATERIAL CONTROL										
1.1.0	PIPES (MILL MADE)	1. PHY., CHEM. PROPS, DIMENSIONS, SURFACE FINISH, HEAT TREATMENT (IF APPLICABLE), LEAK TIGHTNESS	MA	PHY. CHEM. TESTS MEASUREMENTS, VISUAL EXAM, VERI. OF HT CHART HYDRO TEST	TECH. SPEC., IS:4711	APPD. DATA SHEET/ TECH. SPEC.	APPD. DATA SHEET/ TECH. SPEC.	MFR.TC/ LAB REPORT	3 -	2,1	SAMPLE IDENTIFICATION BY BHEL
1.2.0	FITTINGS	1. PHY. CHEM. PROP.,	MA	PHY., CHEM. TESTS MEASUREMENTS, VISUAL EXAM, VERI. OF HT CHART	1/HEAT	-DO-	-DO-	-DO-	3/2 -	2,1	-DO-
		2. DIMNS., SURFACE FINISH, HEAT TREATMENT (IF APPLICABLE)	MA		100%	-DO-	-DO-	-DO-	3/2 -	2,1	
1.3.0	PLATE FOR FLANGES, FABRICATED PIPING AND FORGINGS FOR FLANGES	1. PHY. CHEM. PROP.,	MA	PHY., CHEM. TESTS MEASUREMENTS, VISUAL EXAM, VERI. OF HT CHART	1/CAST	-DO-	-DO-	-DO-	3 -	2,1	-DO-
		2. DIMNS., SURFACE FINISH, HEAT TREATMENT (IF APPLICABLE)	MA		100%	-DO-	-DO-	-DO-	3 -	2,1	
2.0.0	IN PROCESS CONTROL										
2.1.0	PIPES, FITTINGS, FLANGES - MACHINING, BENDING	1. DIMNS. INCLUDING THINNING, OVALITY, FINISH, WRINKLES ETC.	MA	MEASUREMENTS, VISUAL EXAM.	100%	MANUFAC-TURING DRG.	MANUFAC-TURING DRG.	I. R	3/2 -	2,1	
2.2.0	WELDING PROCEDURE SPECIFICATION	1. CORRECTNESS	MA	EXAM	100%	IS:7307/ ASME - IX	IS:7307/ ASME - IX	FORMAT OF IS:7307/ ASME - IX	3/2 -	2,1	
2.3.0	PROCEDURE QUALIFICATION AND WELDER'S QUALIFICATION	1. WELD SOUNDNESS	MA	PHY. TESTS	ASME IX IS:7310 IS:7307	IS:7310/ ASME - IX	IS:7310/ ASME - IX	FORMAT OF IS:7310/ ASME - IX	3/2 2,1	-	
2.4.0	WELD FIT-UPS	1. DIMNS.,	MA	MEASUREMENT,	100 %	W.P.S,	W.P.S,	I.R	3/2 2	1	

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

QUALITY PLAN SHEET 2 OF 3			CUSTOMER: BIDDER/VENDOR			PROJECT: QP NO. PE-QP-999-100-MO41			SPEC. NO.			
SYSTEM:			REV.00 DT. 31.03.99			VOLUME: II-B			SECTION D			
S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATE GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P W V			REMARKS
2.5.0	WELDS	ALIGNMENT, ORIENTATION		VISUAL		APPD. DRGS.	APPD. DRGS.					
	A) BUTT WELDS WITH JOINT EFFICIENCY OF 1.0 & 0.9											
	i) ROOT RUN	i) WELD DEFECTS	MA	PENETRANT TEST	100%	IS:3858/ ASTM E 185	ASME VIII DIV.I ASME B 31.1	INSPN. REPORT	3/2	2	1	
	ii) FINAL RUN	i) WELD DEFECTS	MA	-DO- RADIOGRAPHY TEST	100% 100% FOR JT. EFF. 1.0 & 10% FOR JT. EFF. 0.9	-DO- ASME B 31.1	-DO- ASME B 31.1	-DO- -DO-	3/2 3/2	2/1 -	- 2/1	FILMS TO BE SHOWN TO BHEL FOR APPROVAL
	B) OTHER BUTT WELDS WITH JOINT EFF. LESS THAN 0.9	1. WELD DEFECTS (FOR ROOT RUN & FINAL RUN)	MA	PENETRANT TEST	100%	IS:3858/ ASTM E 185	ASME B 31.1	INSPN. REPORT	3/2	2,1	-	
3.0.0	COMPLETE PIPE WORK & PIPES INCLUDING GALVANIZED/ RUBBER LINED PIPING (BEFORE GALVANIZING/ RUBBER LINING)	1. WORKMANSHIP AND FINISH, DIMNS., ORIENTATION, LEAK TIGHTNESS	CR	MEAS. VISUAL, HYDRO TEST AT 1.5 X DESIGN PRESS.	100%	APPD. DRGS.	APPD. DRGS., NO LEAKAGE	I.R.	3/2	2,1	-	
3.1.0	COMPLETE PIPE WORK (DULY GALVANIZED AS APPLICABLE)	1. FREEDOM FROM SURFACE DEFECTS	MA	VISUAL	100%	IS:4738/ IS 2829 & TECH. SPECN.	IS:4738/ IS 2829 & TECH. SPECN.	INSPN. REPORT	3/2	2,1	-	
		2. UNIFORMITY OF COATING	MA	DIP TEST	SAMPLING AS PER IS	IS 2833 & TECH. SPECN.	IS 2833 & TECH.	-DO-	3/2	2,1	-	

BHEL		PARTICULARS	BIDDER/VENDOR
		NAME	
		SIGNATURE	
		DATE	
BIDDER'S/VENDOR'S COMPANY S/A			

 QUALITY PLAN SHEET 3 OF 3		CUSTOMER :			PROJECT :			SPEC. NO				
		BIDDER/VENDOR			QP NO. PE-QP-899-100-MO41 REV.00 DT. 31.03.99			VOLUME: II-B				
		SYSTEM:			ITEM: PIPES & FITTINGS			SECTION D				
S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATE GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
3.2.0	COMPLETE PIPE WORK (RUBBER LINING AS APPLICABLE)	3. MASS OF ZINC COATING	MA	STRIP TEST	-DO-	IS 4738/ IS 6745 & TECH. SPECN.	IS 4738 & TECH. SPECN.	-DO-	3/2	2,1	-	
		5. ADHESION	MA	ADHESION TEST	-DO-	IS-2629/ IS 4736 & TECH. SPECN.	IS-2629/ IS 4736 & TECH. SPECN.	-DO-	3/2	2,1	-	
----- AS PER QUALITY PLAN FOR RUBBER LINING -----												
4.0.0	PAINTING AND PACKING	1. SURFACE PREPARATION, DFT, NO. OF COATS, SOUNDNESS OF PACKING, MARKING ETC.	MA	VISUAL EXAM, MEASUREMENT	100%	APPD. PROCEDURE	APPD. PROCEDURE	I.R. MFRS CHECK LIST	3/2	-	2,1	

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

STANDARD QUALITY PLAN

PROJECT:
VENDOR:

SYSTEM:
ITEM: BUTTERFLY VALVES

S N	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CAT. EGRY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10	11	12	
1	RAW MATERIAL BOUGHT-OUT CONTROL											
11	3 SHAFT SEAT RING	1. CHEM. COMPOSITION & PHYS. PROPS 2. INTERNAL DEFECTS OF SHAFT DIA 250MM	MA CR	CHEM. & PHYS TESTS UT	ONE HEAT BATCH 100%	TECH SPEC APPD DRG ASTM A388 6 AE 100%	TECH SPEC (APPD DRG)	LAB REPORT INSPN REPORT INSPN REPORT	3/2 3/2	2.1 2.1		CORRELATION NOT REQUIRED FOR GREY CI FOR OTHER POURING WITNESS BY BH: MATERIAL IDENTIFICATION OF SHAFTS BY BHEL NOTE: COMPLIANCE TO FMS & GJ CORRELATION & IDENTIFICATION FOR SS
12	DISC & SHAFT SEAL	3. CASTING DEFECTS / FORGING DEFECT 1. VISUAL INSPECTION 2. DIMENSIONS 3. HARDNESS 4. OZONE RESISTANCE 5. AGEING TEST	MA MA MA MA MA	1. VISUAL 2. MPI VISUAL MEAS MEAS TESTING TESTING	100% 100% 100% 1/BATCH 100%	MSSSP65 TECH SPEC APPD DATA SHEET TECH SPEC -DO- -DO- -DO- ASTM D 1148 IS 3400	MSSSP65 TECH SPEC (APPD DATA SHEET) TECH. SPEC -DO- -DO- -DO- RELV. STD. -DO-	-DO- LOG BOOK -DO- TEST CERT. -DO- -DO-	3/2 3/2 3/2 3/2 3/2	2.1		COMPLIANCE TO
13	COUNTER FLANGES	1. CHEM. PHYS. PROPERTIES	MA	CHEM. PHYS. TEST	1/HEAT	APPD. DRG. / DATA SHEET	APPD. DRG. / DATA SHEET	LAB. REPORT, INSPN. REPORT	3/2			COMPLIANCE TO FOR MATERIAL IDENTIFICATION BY BHEL
O.P. NO.		PEMMSE/SQP/03		PREPARED BY		REVIEWED BY		APPROVED BY		ACCEPTED BY		
REV. NO/DATE		00/8-10-97		PEM J		CQS & PEM		PEM		VENDOR		
PAGE NO.		1 OF 7		NAME		NAME		SIGN		DATE		
				SIGNATURE		SIGNATURE		DATE				
				DATE		DATE						



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

STANDARD QUALITY PLAN

PROJECT:
VENDOR:

SYSTEM:
ITEM: BUTERFLY VALVES

S. NO	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CAT. EGO. RV	TYPE / METHOD OF CHECK	EXTEN. OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10	11	12	
4	FASTENERS (APPD MAKE)	2 DIMENSION	MA	MEASURE- MENT	100%	-DO-	-DO-	INSPN. REPORT	3/2	2	1	
		3. INTERNAL DEFECTS FOR THICKNESS 30MM AND ABOVE	CR	UT	100%	ASTM A435	ASTM A435	INSPN. REPORT	3/2	2	1	
		4 HEAT TREATMENT		SRM.T. CHART	100%	STANDARD PRACTICE	STANDARD PRACTICE	CORRELATED SRM.T. CHART	3/2			
5	OPERATING (GEAR BOX GEAR)	1 VERIFICATION OF MAKE GRADE	MA	VISUAL	100%	TECH. SPEC. DATA SHEET	TECH. SPEC. DATA SHEET	INSPN. REPORT	3/2	2	1	
5	OPERATING (GEAR BOX GEAR)	COMPOSITION	MA	CHEM. ANALYSIS	ONE/BATCH	AS PER MATERIAL SPEC	AS PER MATERIAL SPEC	TC 'C'	3	3	2/1	
5.1	GEAR WORM SHAFT	HARDNESS	MA	MEAS.	SAMPLING	AS PER APPD. ORG. MATL. SPEC	AS PER APPD. ORG. MATL. SPEC	TC 'C'	3	3	2/1	
		DIMENSION	MA	-DO-	-DO-	-DO-	-DO-	REPORT	3	3	2/1	UT ON GEAR BLANKS
		NOT	MA	UT/MPH	100%	-DO-	-DO-	TC 'C'	3	3/2	2/1	UT ON SHAFTS & SC. 'M' DIA
5.2	TORQUE TEST OF GEAR BOX AT 2. RATED TORQUE	TORQUE TRANSMITTING	MA	TESTING	ONE/TY	AWWA C504 STD 87	AWWA C504 STD 87	TC 'C' CMP	3	3/2	2/1	MPI OR LPI ON GEAR & SHAFT AFTER MACHINING "NO DAMAGE TO T. & FACE OF GEAR"
5.3	ELECTRICAL ACTUATORS	1 TORQUE TESTING & SETTING OF TORQUE SWITCH	MA	MECH. ELEC. TESTS	100%	TECH. SPEC. (APPD. ORG. DATA SHEET) IS 9334	APPD. ORG. DATA SHEET IS 9334	INSPN. REPORT	3	2	1	QHEL TO WITNESS - PER TYPE IF QTY IS MORE THAN 10/TY
Q.P. NO		PEM/MSE/SQP/03		PREPARED BY:		REVIEWED BY:		APPROVED BY:		ACCEPTED BY:		
				PEM		COS & PEM		PEM		VENDOR		
REV NO/DATE		00/8-10-97		NAME						NAME		
				SIGNATURE						SIGN.		
PAGE NO.		2 OF 7		DATE						DATE		

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

STANDARD QUALITY PLAN

PROJECT
VENDOR :

SYSTEM :
ITEM : BUTERFLY VALVES

S. NO	ITEM / OPERATION	CHARACTERISTICS CHECKED	CAT. EGO. RY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									R	W	U	
1	2	3	4	5	6	7	8	9	10			
16	HYD. NLEA BIP. 10	2 TRAVEL / STROKE	MA	WATER DUST TEST	1/TYPE	-DO-	-DO-	3rd PARTY TEST CERT	3	2.1		
		3 TRAVEL TIME	MA									
		4 OPERATION OF LIMIT SWITCH	MA									
		5 MANUAL OPERATION THROUGH HAND WHEEL	MA									
		6 OPERATION TEST WITH POWER SUPPLY VARIATION, ENERGISE TO OPEN/CLOSE, CURRENT, DRAWN	MA									
		7 IR, HV, IR	MA									
		8 DEGREE OF PROTECTION	MA									
		1 CHEM & PHYS. PROPS	MA									CHEM. PHYS. TESTS
2 HARDNESS	MA	MEAS	100%	-DO-	-DO-	-DO-	3/2	2.1				
3 DIMENSIONS	MA	MEAS	100%	MFG. DRG	MFG. DRG.	LOG BOOK	3/2					
4. LEAK TIGHTNESS	MA	HYDRO TEST	100%	APPD. DATA SHEET	NO LEAKAGE	INSPN. REPORT	3/2	2.1				
1. CHEM. PHYS. PROPS	MA	CHEM. PHYS. TESTS	1/HEAT	APPD. DATA SHEET	APPD. DATA SHEET	TEST CERT	3/2	2	1.1			
2. DIMENSION	MA	MEASUREMENT	100%	MFG. DRG.	MFG. DRG.	LOG SHEET	3/2					

Q.P. NO	PEMMSE/SQP/03	PREPARED BY		REVIEWED BY	APPROVED BY	ACCEPTED BY	
		REM		CQS & PEM	PEM	VENDOR	
		NAME				NAME	
		SIGNATURE				SIGN	
REV. NO DATE	00/8-10-97	DATE				DATE	
PAGE NO	3 OF 7						



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

PROJECT:
VENDOR:

STANDARD QUALITY PLAN

SYSTEM:
ITEM: BUTTERFLY VALVES

S NO	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CAT. EGO-RY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMA OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10	11	12	
2.0	2.0 PISTON ROD	1. CHEM PHYS PROPS 2. DIMENSIONS 3. HARDNESS	MA MA MA	CHEM PHYS TESTS MEAS. MEAS	VBATCH 100% 100%	MATL SPEC / APPD ORG. MFG DRG. -OO-	MATL SPEC / APPD ORG. MFG ORG -OO-	LOG BOOK TEST CERT	3/2 3/2 3/2	2 2 2	1 1 1	
2.1	2.1 IN-PROCESS CONTROL											
2.1	2.1 BODY & DISC	1. SURFACE DEFECTS 2. DIMENSIONS 3. LEAK TIGHTNESS OF BC	MA MA MA	PT MEAS HYDRO TEST	100% 100% 100%	ASTME-165 MFG DRG TECH. SPEC / APPD ORG / DATA SHEET	NO DEFECTS APPD ORG NO LEAKAGE	INSPN REPORT LOG BOOK INSPN REPORT	3/2 3/2 3/2	2 2 2	1 1 2.1	
2.2	2.2 SHAFT	1. DIMENSIONS 2. SURFACE DEFECTS 3. TENSILE	MA MA MA	MEAS PT PT	100% 100% 100%	MFG DRG ASTME-165 MFG DRG	APPD ORG NO SURFACE DEFECTS APPD ORG	LOG BOOK INSPN REPORT LOG BOOK	3/2 3/2 3/2	2 2 2	1 1 2.1	
2.3	2.3 SEAT RING	1. DIMENSIONS 2. BOND STRENGTH IN CASE OF RUBBER SEAT 3. HARDNESS	MA MA MA	MEAS PEEL STRENGTH MEAS	100% ONE/BATCH 100%	MFG DRG ASTMD 429 MFG DRG	APPD ORG ASTMD 429 MFG DRG	LOG BOOK TEST CERT -OO-	3/2 3/2 3/2	2 2 2	1 1 1	
Q.P. NO.		PEM/MSE/SOP/00		PREPARED BY		REVIEWED BY		APPROVED BY		ACCEPTED BY		
REV NO/DATE		00/8-10-97		PEM		COS & PEM		PEM		VENDOR		
PAGE NO.		4 OF 7		NAME						NAME		
				SIGNATURE						SIGN.		
				DATE						DATE		

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

STANDARD QUALITY PLAN

PROJECT
VENDOR

SYSTEM :
ITEM : BUTERFLY VALVES

S NO	COMPONENT OPERATION	CHARACTERISTICS CHECKED	CAT- EGO- RY	TYPE & METHOD OF CHECK	EXTENT C CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
	2	3	4	5	6	7	8	9	10	11	12	13
2.4	WELDED FLANGES/COUNTER FLANGES	1 SURFACE DEFECTS	MA	RT	100%	ASTME 165	NO SURFACE DEFECTS	-DO-	3/2	2	1	FOR FABRICATED FLANGES ONLY FILMS TO BE SOWN TO SHEL
			MA	PHYS TESTS	100%	ASME IX	ASME IX	FORMATS OF ASME IX	3/2	2.1	1	
		1 FIT UP	MA	MEAS. TEMPLATE, VISUAL	100%	MFG DRG	MFG DRG	LOG BOOK	3/2		2.1	
		2 INTERNAL DEFECTS OF WELDMENTS	CR	RT/AUT	100%	ASME VIII DIV. I	ASME VIII DIV. I	RADIO GRAPH REPORT FILMS	3		2.1	
2.4.1	WELDING PROCEDURE SPECIFICATION	CORRECTNESS	MA	EXAM	100%	ASME SEC IX	ASME SEC IX	QW482 OF ASME SEC IX	3/2		2.1	WELDING PROCEDURE APPROVAL BY EHE, AS WELL AS 3RD PARTY (LY JDS, BVQI OR EQ.)
2.4.2	WELDING PROCEDURE QUALIFICATION	WELD SOUNDNESS	MA	VISUAL, PHYS. TESTS RT (AS APPLICABLE)	100%	ASME SEC IX	ASME SEC IX	QW483 OF ASME IX	3/2	2.1		
2.4.3	WELDER PERFORMANCE QUALIFICATION	WELD SOUNDNESS	MA	-DO-	100%	ASME SEC. IX	ASME SEC. IX	QW484 OF ASME	3/2	2.1		
Q.P. NO.		PEM/MSE/SQP/03		PREPARED BY		REVIEWED BY		APPROVED BY		ACCEPTED BY		
				PEM		COS & PEM		PEM		VENDOR		
REV. NO/DATE		00/8-10-97		NAME						NAME		
PAGE NO.		5 OF 7		SIGNATURE						SIGN		
				DATE						DATE		



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

STANDARD QUALITY PLAN

PROJECT:
VENDOR:

SYSTEM:
ITEM: BUTTERFLY VALVES

S NO	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CAT. CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
2.4.4	WELD FIT-UPS	1. DIMENSION ALIGNMENT	MA	MEAS. VISUAL EXAM	100%	WPS, MFG. DRAWING	WPS, MFG. DRAWING	IR LOG BOOK	3/2	-	-	WITNESSING OF U T
2.4.5	ROOT RUNS	1. SURFACE DEFECTS	MA	PENETRANT TEST	100%	ASTME 185	NO SURFACE DEFECT	-OO-	3/2	-	2	
2.4.6	WELDMENTS	1. SURFACE DEFECTS	MA	-OO-	100%	ASTME 185	ASME-VIII, DIV. I	INSPN REPORT	3/2	2.1	-	
2.4.7	BUTT WELDS	INTERNAL DEFECT	MA	UT/RT	100%			IR	3/2	-	2.1	
2.4.8	S/R WELDING	S/R	-	SR	100%	ASME SEC. V	ASME SEC. VIII, DIV. I	IR	3/2	-	2.1	
3.1	FINAL ASSEMBLY	VERIFICATION OF RECORDS	MA	-OO-	100%	TECH. SPEC.	TECH. SPEC		2	-	1	
3.2	TESTS (HYDRAULIC)	1. BODY TEST 2. DISC STRENGTH 3. SEAT LEAKAGE 4. PERFORMANCE TEST	MA MA MA MA	HYDRO TEST HYDRO TEST -OO- PERFORMANCE	100% 1/TYPE 100% 3 TIMES UNDER NO LOAD/FLOW COND. BOTH MANUAL & THROUGH OPERATORS	TECH. SPEC / REL. STD -OO- -OO- -OO-	TECH. SPEC / REL. STD -OO- -OO- -OO-	TEST CERT -OO- -OO- -OO-	3/2 3/2 3/2 3/2	2.1 2.1 2.1 2.1	-	
Q.P. NO.		PEM/MSE/SQP/03		PREPARED BY PEM		REVIEWED BY CQS & PEM		APPROVED BY PEM		ACCEPTED BY VENDOR		
REV. NO. / DATE		00/8-10-97		NAME						NAME		
PAGE NO.		6 OF 7		SIGNATURE						SIGN.		
				DATE		211				DATE		

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT


STANDARD QUALITY PLAN


PROJECT
VENDOR


SYSTEM
ITEM BUTERFLY VALVES


COMPONENT	CHARACTERISTICS CHECKED	CAT. EGO. RY	TYPE & METHOD OF CHECK	EXTEN OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								P	W	V	
2	3	4	5	6	7	8	9				11
SHIPPING RELEASE FINAL INSPECTION	5. TESTING OF ACCESSORIES	MA	TESTING	100%	TECH SPEC REL STD	TECH SPEC REL STD	TC	12	2		NOTE: IF CYCLE LIFE TEST ALREADY CONDUCTED ON SIMILAR SIZE RANGE & VALVE REPORT SHALL BE SUBMITTED
	6. PROOF OF DESIGN TEST	MA	TESTING	100%	DO	DO	TC	12	2		
	1. OVERALL DIMENSIONAL	MA	MEASUREMENT	100%	APPD DRG	APPD DRG		12	2		
	2. DOCUMENTATION VIEW	MA	REVIEW	100%	TECH SPEC APPD DRG	TECH SPEC APPD DRG		12	2		
	3. CLEANLINESS	MA	VISUAL	100%	DO	DO		12	2		
	4. NAME PLATE DETAILS	MA	VISUAL	100%	DO	DO		12	2		
PAINTING	5. STAMPING	MA	STAMPING	100%	DO	DO		12	2		
	1. SURFACE PREP	MA	VISUAL MEAS.	100%	TECH SPEC	TECH SPEC	INSPN REPORT	12	2	1	
	2. UNIFORMITY & THICKNESS	MA	DO	100%	DO	DO	DO	12	2	1	

O.P. NO.	PEM/MSE/SQP/03	PREPARED BY		REVIEWED BY		APPROVED BY		ACCEPTED BY	
		PEM		COS & PEM		PEM		VENDOR	
		NAME						NAME	
		SIGNATURE						SIGN	
REV NO/DATE	0018-10-97	DATE						DATE	
PAGE NO	7 OF 7								

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT PACKAGE					
		(AS PER BHEL APPROVED VENDOR LIST)		ITEM: Chain Pulley Block With Trolley		QP NO REV 0 DATE 20.02.2001 PAGE 1 of 3		PROJECT No CONTRACTOR					
Sl. No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
RAW MATERIAL & B/OUT ITEMS:													
1	HOOKS	DIMENSIONS CHEMICAL COMPOSITION IDENTIFICATION & CORRELATION WITH TC	MA MI MA	MEASUREMENT LAB ANALYSER VERIFICATION		IS 8610 GR M/ DRAWING	IS 8610 GR M/P DRAWING & SPECIFICATION	T.C.		P			
1	LOAD CHAIN	DIMENSIONS BREAKING STRENGTH		MEASUREMENT TENSILE TEST	100%	IS 6216	IS 6216	MPR'S TC		P			
1	RAW MATL FOR GEAR/RATCHET PAWL/RATCHET WHEEL	CHEMICAL COMPOSITION	MA	LAB ANALYSIS	ONE SAMPLE PER LOT	SPECS AS PER APPD. DRG.	RELEVANT STANDARD	TC		P			
1	LOAD CHAIN WHEELS	TENSILE STRENGTH	MA	TENSILE TEST	ONE SAMPLE PER LOT	SPECS AS PER APPD. DRG.	RELEVANT STANDARD	TC		P			
				LEONDS * RECORDS IDENTIFIED WITH 'TICK' () SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION ** M: MANUFACTURER/SUBCONTRACTOR C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL) N: CUSTOMER INDICATE 'P' PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE "CHP" CUSTOMER SHALL IDENTIFY IN COLUMN "N"									
MANUFACTURER/ SUB CONTRACTOR		CONTRACTOR						REVIEWED BY					
SIGNATURE								NAME & SIGN OF APPROVING AUTHORITY & SEAL					


		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT			
		(AS PER BHEL APPROVED VENDOR LIST)		ITEM:		QP NO		PACKAGE			
				Chain Pulley Block With Trolley		REV 0		PROJECT No			
						DATE 20.02.2001		CONTRACTOR			
						PAGE 2 of 3					
Sl. No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	D* M C N ** 10	11	
2	PROCESS										
2	HOOKS	PROOF LOAD	MA	LOAD TEST	100%	IS 8610	IS 8610	IR	P	W	
		DPT AFTER PROOF LOAD	MA		100%	ASTM 709	ASTM 709	IR	P	W	
2	RACHET PAWL/RACHET WHEEL	HARDNESS	MA	HARDNESS TESTER	100%	IS : 1832	IS : 3832	IR	P	W	
		SURFACE CRACKS	MA	DPT	100%	ASTM E			P	W	
2	LOAD CHAINS	PROOF - LOAD	MA	LOAD TEST	100%	IS : 6216	IS:6216	MPR'S	P		
3	FINAL INSPECTION										
3	COMPLETE ASSEMBLY	PROOF LOAD TEST	CR	LOAD TEST	100%	IS: 3832	IS: 3832	IR	P	W	
		OPERATIONAL EFFORT	MA	LOAD TEST	RANDOM	IS: 3832	IS: 3832	IR	P	W	
		HEIGHT OF LIFT	MA	MEASUREMENT	100%	IS: 3832	IS: 3832	IR	P	W	
		SWIVELLING OF HOOK	MA	VISUAL	100%	IS: 3832	IS: 3832	IR	P	W	
			LEGENDS								
			* RECORDS IDENTIFIED WITH 'TICK' () SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION ** M: MANUFACTURER/SUBCONTRACTOR C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL) N: CUSTOMER INDICATE 'P' PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE * CHP* CUSTOMER SHALL IDENTIFY IN COLUMN "N"								
MANUFACTURER/ SUB CONTRACTOR			CONTRACTOR		REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY & SEAL				
SIGNATURE											

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT PACKAGE				
		(AS PER BHEL APPROVED VENDOR LIST)		ITEM:		QP NO		PROJECT No				
				Chain Pulley Block With Trolley		REV 0		CONTRACTOR				
						DATE 20.02.2001						
						PAGE 3 of 3						
Sl. No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	D*	M	C	N
										**	10	11
3	PAINTING	CLEANED SHADE OF PAINT GOLDEN YELLOW	MA	VISUAL	AT RANDOM	SPEC. AT RANDOM	PE	IR		P	-	W
3	NAME PLATE	VERIFICATION	MI	VISUAL	100%	PR	PR	IR		P	W	-
3	PACKING	VERIFICATION	MI	VISUAL	100%	PR	PR	IR		P	W	-
				LEONDS * RECORDS IDENTIFIED WITH 'TICK' () SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION ** M: MANUFACTURER/SUBCONTRACTOR C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL) INDICATE 'P' PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE "CHP" NTPC SHALL IDENTIFY IN COLUMN "								
MANUFACTURER/ SUB CONTRACTOR		CONTRACTOR										
SIGNATURE						REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY & SEAL				

	QUALITY PLAN		CUSTOMER:			PROJECT:			SPEC. NO.:					
			BIDDER/VENDOR			QP NO. PE-QP-999-100-M004			REV. 00 DT. 31.03.99			SPEC. TITLE		
	SHEET 1 OF 3		SYSTEM POWER CYCLE/ LP VALVES			ITEM: GATE/ GLOBE VALVE			SECTION			VOLUME		
S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATE- GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P W V			REMARKS		


1.0	MATERIALS											
1.1	BODY,BONNET, YOKE,WEDGE/DISC, SPINDLE, BODY SEAT, BACK SEAT, THRUST PLATE	1. PHYS,CHEM,PROPS	MA	PHYS.CHEM. TESTS	ONE/HEAT	APPD. DRG./ TECH.SPEC.	APPD. DRG./ TECH.SPEC.	TEST CERT.	3/2	2	1	CORRELATION REQD. FOR BODY BONNET, SPINDLE - FOR GREY C.I. ONLY PHYS. TEST.
		2. HEAT TREATMENT	MA	REVIEW OF H.T. CHART	100%	-DO-	-DO-	H.T. CHART	3/2	2	1	
		3. SURFACE DEFECTS	MA	VISUAL	100%	MSS-SP-55	MSS-SP-55	INSPN. REPORT	3/2	2	1	
1.2	BODY & BONNET FOR RATING 900 & ABOVE (ALSO FOR LOWER RATING IF REQUIRED IN SPEC.)	1. SURFACE DEFECTS	CR	PT/MT	100%	ANSI B16.34 AND TECH. SPEC.	ANSI B16.34 AND TECH. SPEC.	-DO-	3/2	2,1	-	FILM REVIEW BY BHEL
		2. SUB-SURFACE DEFECTS	CR	RT/UT	100%	ANSI B16.34 AND TECH. SPEC.	ANSI B16.34 AND TECH. SPEC.	-DO-	3/2	-	2,1	
1.3	ACTUATORS 1. ELECTRIC ACTUATORS	1. TORQUE TESTING & SETTING OF TORQUE SWITCH	MA	MECH., ELEC. TESTS	100%	TECH. SPEC./ APPD. DRG./ DATA SHEET/ IS:9334	APPD. DRG./ DATA SHEET/ IS:9334	INSPN. REPORT	3	2,1	1*	*BHEL TO WITNESS IF QTY. MORE THAN 10/TYPER
		2. TRAVEL/STROKE	MA									
		3. TRAVEL TIME	MA									
		4. OPERATION OF LIMIT SWITCH	MA									
		5. MANUAL OPERATION THROUGH HAND WHEEL	MA									
		6. OPERATION TEST WITH POWER SUPPLY VARIATION ENERGISES TO OPEN/CLOSE	MA									
		7. IR,HV,IR	MA									
		8.DEGREE OF PROTECTION	MA	WATER, DUST TEST	1/TYPER	TECH. SPEC./ APPD. DRG./ DATA SHEET/ IS:9334	APPD. DRG./ DATA SHEET/ IS:9334	3RD PARTY TEST CERT.	3	-	2,1	

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

	QUALITY PLAN			CUSTOMER:		PROJECT:			SPEC. NO :			
	SHEET 2 OF 3			BIDDER/VENDOR		QP NO. PE-QP-999-100-M004			REV. 00 DT. 31.03.99			SPEC. TITLE
	SYSTEM POWER CYCLE/ LP VALVES			ITEM: GATE/ GLOBE VALVE			SECTION			VOLUME		
S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATE- GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	

2.0	SS/STELLITE DEPOSIT ON DISC / BODY SEAT/BACK SEAT	1. LEAK TIGHTNESS	CR	PNEUMATIC TEST AT 1.2 X DESIGN	100%	APPD. DATA SHEET/MFG. STD.	NO LEAKAGE	INSPN. REPORT.	3	2,1	1*	*BHEL TO WITNESS IF QTY. MORE THAN 10/ TYPE
		2. ACCURACY	CR	CALIBRATION	100%	-DO-	APPD. DATA SHEET/MFG. STD.	CALIBRATION REPORT	3	2,1	1*	
		3. SIMULATION (OPERATION, AIR TO OPEN/CLOSE)	CR	OPERATION AT RATED PRESSURE P.T	100%	-DO-	-DO-	INSPN. REPORT	3	2,1	1*	
		1. SURFACE DEFECTS	CR		100%	ASTME:165 & TECH.SPEC.	ANSI B16.34 & TECH.SPEC.	-DO-	3/2	2,1	2,1	
		1. DIMENSIONS, WORKMANSHIP AND FINISH	MA	MEAS. VISUAL	100%	MFG.DRG.	MFG.DRG.	LOG BOOK	3/2	-	-	
		1. HARDNESS	MA	TESTING	100%	APP.DRG.	APP. DRG./ ANSI B16.34	TEST CERT.	3/2	-	2,1	
		1. SURFACE DEFECTS	CR	P.T.	100%	ANSI B16.34 AND TECH. SPEC./	ANSI B16.34 AND TECH. SPEC.	-DO-	3/2	-	2,1	
		1. LAPPING	CR	BLUE MATCHING	100%	UNIFORM METAL TO METAL CONTACT		INSPN. REPORT	3/2	-	2,1	
		1. DIMENSIONS	MA	MEAS.	100%	APPD.DRG.	APPD.DRG.	-DO-	3/2	2,1	-	
		2. WEAR TRAVEL	MA	MEAS.	100%	-DO-	-DO-	-DO-	3/2	2,1	-	
3.0	IN-PROCESS INSPECTION											FOR 900 CLASS & ABOVE TO BE WITNESSED BY BHEL
3.1	MACHINING OF ALL COMPONENTS											
3.2	WEDGE/DISC, BODY SEAT RING, BACK SEAT, SPINDLE, THRUST PLATE											
3.3	SPINDLE, BODY SEAT RING, WEDGE/DISC, BACK SEAT											
3.4	WEDGE/DISC & SEAT RING, SPINDLE AND BACK SEAT											
4.0	ASSEMBLY											
5.0	TESTING											
5.1	BODY, SEAT, BACK SEAT											
												FOR GATE VALVES ONLY

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

	QUALITY PLAN		CUSTOMER:			PROJECT:			SPEC. NO.:					
			BIDDER/VENDOR			QP NO. PE-QP-999-100-M004			REV. 00 DT. 31.03.99			SPEC. TITLE		
	SHEET 3 OF 3		SYSTEM POWER CYCLE/ LP VALVES			ITEM: GATE/ GLOBE VALVE			SECTION			VOLUME		
S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATE- GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS		
									P	W	V			

5.2	SEAT & BACK SEAT FOR MOTORISED/ PNEU. VALVES WITH ACTUATOR	1. LEAK TIGHTNESS OF SEAT	CR	HYDRUALIC TEST	100%	APPD. DRG/ TECH. SPEC.	NO LEAKAGE	I.R./ IBRTC (IF REQD)	3/2	2.1	-	
5.3	OPERATION AL TESTING											
	1. MANUALLY OPERATED VALVES	1. SMOOTH & FULL OPENING AND CLOSING	CR	MANUAL	100%	TECH. SPEC.	SMOOTH OPERATION OF VALVES & CLEAR BORE	INSPN. REPORT	3/2	2.1	-	
	2. MOTOR /PNEU OPERATED VALVES	1. ASCENDING& DESCENDING LIFT CHARACTERISTIC	CR	ELEC.	100%	APP. DRG./ TECH. SPEC./ IS:9334	APP. DRG./ TECH. SPEC./ IS:9334	INSPN. REPORT	3/2	2.1	-	
		2. LIMIT/TORQUE SWITCH SETTING FOR OPENING AND CLOSING TIME	CR	ELEC.	100%	APP. DRG./ TECH. SPEC./ IS:9334	TECH. SPEC./ APPD.DRG	INSP. REPORT	3/2	2.1	-	
6.0	COMPLETE VALVES	1. OVERALL DIMENSION	MA	MEAS	SAMPLE	APPD.DRG	APP.DRG.	-DO-	3/2	2.1	-	
7.0	END CONNECTION DETAILS	1. DIMENSIONS	MA	MEAS.	100%	APPD. DRG. / RELV.STD	APPD. DRG. / RELV.STD	-DO-	3/2	2.1	-	
		2. SURFACE DEFECTS FOR B.W. ENDS	CR	PT	100%	ASTME:185	NO DEFECTS	TEST CERT.	3/2	2	1	
8.0	FINAL INSPECTION	1. CLEANLINESS & COMPLETENESS	MA	VISUAL	100%	APPD. DRG./ TECH. SPEC.	APPD. DRG./ TECH. SPEC	INSPN. REPORT	3/2	-	2.1	
9.0	PAINTING	1. SURFACE PREPARATION	MI	VISUAL	100%	TECH. SPEC.	TECH. SPEC.	INSPN. REPORT	3/2	-	2.1	
		2. UNIFORMITY & THICKNESS	MI	MEASUREMENT	100%	-DO-	-DO-	-DO-	3/2	2	1	
10.0	PACKING	AS PER BHEL TECH. SPEC	MA	VISUAL	100%	AS PER BHEL TECH. SPEC.	AS PER BHEL TECH. SPEC	-DO-	3/2	-	2.1	

ABBREVIATIONS

CR = CRITICAL CHARACTERISTIC
MA = MAJOR CHARACTERISTIC
MI = MINOR CHARACTERISTIC

P = PERFORMED BY
1 = PURCHASER (BHEL)2

W = WITNESSED BY
= VENDOR

V = VERIFIED BY
3 = SUB VENDOR OF THE VENDOR

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

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

STANDARD QUALITY PLAN

SYSTEM
ITEM SUBMERSIBLE PUMP SET

PROJECT
VENDOR

S NO	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CA EG RY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGEN. V			REMARKS
									P	W	V	
1	RAW MATERIAL AND BOUGHT OUT CONTROL	1. PHYSICAL CHEM PROPS	CP	PHYS. CHEM ANAL	IN-ENTRY BATCH	APPO. DRG/APPO. DATA SHEET	APPO. DRG/APPO. DATA SHEET	LAB REPORT	3/2		2.1	COMPLIANCE TC FOR CI & MS AND TC FOR OTHERS
2	PUMP, BOOMS, DISCHARGE CASING, SUCTION CASING, MOTOR STATOR, BRG HOUSINGS	-DO-	CP	DC	DO	DO	DO	-DO-	3/2		2.1	COMPLIANCE TC
3	IMPELLER	-DO-	CP	DC	DO	DO	DO	-DO-	3/2		2.1	
4	BEARING SLEEVE, WEARING RINGS, COUPLING, BEARING BUSHES	-DO-	MA	DC	DO	DO	DO	-DO-	3/2		2.1	
5	HEAT TREATMENT OF CASTINGS IF APPLICABLE (AL. CASTINGS TO BE NORMALISED)	1. HEAT CYCLE	MA	VERIF OF SR - 1 CHARTS	ALL BATCHES	DO	DO	CORRELATED SR/MT CHARTS	3/2		2.1	
6	BAR/FORGINGS FOR PUMP AND MOTOR SHAFTS	1. PHYSICAL CHEM PROPS	CP	PHYS. CHEM ANAL	1/CAST OR 1/BSR	DO	DO	MILL TS OR LAB REPORT	3/2		2.1	IDENTIFICATION BY BHEL FOR 25 DIA
		2. DIMENSIONS	MA	VE-5	100%	MFR. CPG	MFR. CPG	IR	3/2		2.1	
		3. INTERNAL DEFECT FOR SQMM AND ABOVE DIA SHAFT	GO	T	100%			IR	3/2		2.1	
7	CABLE	1. DIMENSIONS	MA	DC	DO	MFR. CPG	MFR. DRG	MFR. TC	3/2			CABLES TO BE OF APPROVED MAKES ONLY
O.P. NO.		REM/MSE/SOP/05		PREPARED BY		REVIEWED BY		APPROVED BY		ACCEPTED BY		
				PEM		COS & PEM		PEM		VENDOR		
REV. NO/DATE		00/8.10.97		NAME						NAME		
				SIGNATURE						SIGN		
PAGE NO.		1 OF 4		DATE						DATE		

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

STANDARD QUALITY PLAN

SYSTEM: **SUBMERSIBLE PUMP SET**

PROJECT
VENDOR:

ITEM NO.	DESCRIPTION	CHARACTERISTICS CHECKED	DAY EQUIPMENT	TYPE/ METHOD CHECK	PERCENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE CRITERIA	FORMAT OF RECORD	AGENT		REMARKS
									1	2	
1.0	PROCESS CONTROL	1. SHAFT BEARING SURFACE FINISH	MA	SUAL E	100%	MFR DRG	MFR DRG	MFR TC	3		APPROPRIATE
2.0	SUB-ASSEMBLY: ASSEMBLY CONTROL	2.1. SUAL DEFECTS	MA	SUAL	100%	DO	NO HARMFUL DEFECT	LOGBOOK	3.1		
		2.2. DIMENSIONS	MA	MEAS	100%	DO	MFG DRG	DO	3.2		TEST PR 2 & 3.1 & 3.2 PR OR SHUT-OFF ANCHOR 5 - 3-ER
		2.3. LEAK TIGHTNESS	CH	HYDRO 1. IT DYNAMIC 10 MINIS MIN)	100%	TECH SPEC D-1 SHEET	NO LEAKAGE	IR	3.3		
		2.4. SURFACE DEFECT	OP	1"	100%	ASTM E185	NO SURFACE DEFECTS	IR	3.4		FINISHING ON 1" FOR SIZE 1" 30% 5 MM PA 1.5
		2.5. STATIC DYNAMIC RESIDUAL UNBALANCE	CH	STATIC DYNAMIC BALANCE	100%	ISO 1940	ISO 1940 G 2.5	IR	3.5		
3.0	IMP MOTOR ROTORS	3.1. SURFACE DEFECT	CH	RT	100%	ASTM E185	NO SURFACE DEFECTS	IR	3.6		
		3.2. ECCENTRICITY	MA	MEAS	100%	MFG DRG	MFG DRG	LOGBOOK	3.7		
O.P. NO.		REM/ASE/SGP/05		PREPARED BY		REVIEWED BY		APPROVED BY		ACCEPTED BY	
REV NO/DATE		008-10-97		PBM		COS & PBM		PBM		VENDOR	
PA NO		2 OF 4		NAME		SIGNATURE		DATE		NAME	
										SIGN	
										DATE	

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

STANDARD QUALITY PLAN

PROJECT
VENDOR

SYSTEM
ITEM SUBMERSIBLE PUMP SET

S NO	COMPONENT OPERATION	CHARACTERISTICS CHECKED	QAT EGO RV	TYPE METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE WORKS	DATE OF ORD	AGEN	REMARKS
1	2	3	4	5	6	7	8	9	10	11
4.3	STRIPDOWN AFTER PERFORMANCE TEST	1. UNIFORM WEAR TEAR & BREAKAGE	CR	VISUAL EXAM AFTER STRIPPING	TYPE & SIZE	TECH SPEC	NO UNIFORM WEAR TEAR & BREAKAGE		32	
4.4	COMPLETE PUMP SET UNIT	1. COMPLETENESS CORRECTNESS WORKMANSHIP AND FINISH OVERALL DIMENSIONS	MA	VISUAL EXAM MEAS	100%	APPD. GA. DRG	APPD. GA. DRG		32	
4.5	COMPLETION OF ALL STAGES	1. COMPLETION	MA	VERIFICATION OF FRS	100%	TECH SPEC APPD. DRGS APPD. DATA SHEETS	TECH SPEC APPD. DRGS APPD. DATA SHEETS		32	
4.6	PAINING	1. SURFACE PREP		VISUAL MEAS	100%	DO	DO		32	
		2. UNIFORMITY & THICKNESS		DO	100%	DO	DO		32	
4.7	PACKING	SOUNDNESS AESTHETIC		VISUAL	100%	MFR STAND	MFR STD		32	

O.P. NO.	REV. NO/DATE	PAGE NO.	PERMMSE/SQP/05	00/8-10/97	4 OF 4	PREPARED BY			REVIEWED BY			APPROVED BY			ACCEPTED BY		
						PEN			COS & PEN			PEN			VENDOR		
						NAME											
						SIGNATURE											
						DATE						NAME					
												SIGN					
												DATE					

PROJECT
VENDOR

[illegible]



TITLE:
TECHNICAL SPECIFICATION
COOLING TOWER
STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: PE-TS-367-165-N001
VOLUME: IIB
SECTION: D2
REV. NO. 0 DATE
SHEET 1 OF 1

SECTION – D2

STANDARD TECHNICAL REQUIREMENTS (ELECTRICAL)

BELLARY TPS UNIT-III, (1 X 700 MW)



LIGHTING NOTES & DETAILS

DRG. No. PR-DG-281-008-000
REV. No. 0
SHEET -1 OF 18

These lighting notes and details shall be read and construed in conjunction with the illumination layout and drawings.

Except specifically approved by site office, installation of exposed conductors, mounting of lighting fixtures etc. shall be taken up only after all other services such as piping, air ducting, cable tray/bundling hanger, structural bracings etc. in a particular area have been installed.

The Contractor shall develop final conduct/cable routing based on fixture location and other site conditions.

Unless otherwise shown, the mounting heights of lighting fixtures and accessories shall be generally as follows:

- 1) Low-Bay Lighting fixtures in general indoor areas of industrial plants.
 - 3500 mm from bottom to finished floor
 - 3500 to less than 4000 mm from bottom to finished floor
 - 4000 mm from bottom to finished floor
 - 4000 mm and above to finished floor

- 2) Medium Bay Type fixtures.
 - 3500 mm from bottom to finished floor
 - 3500 to less than 4000 mm from bottom to finished floor
 - 4000 mm from bottom to finished floor
 - 4000 mm and above to finished floor

- 3) High Bay Type fixtures.
 - 3500 mm from bottom to finished floor
 - 3500 to less than 4000 mm from bottom to finished floor
 - 4000 mm from bottom to finished floor
 - 4000 mm and above to finished floor

- 4) Bracket lights over door openings.
 - 300 mm bottom of fixture above top of opening
 - Pendant below roller platforms or with brackets from hand-rail platform.
 - 3000mm above platform.

- 5) Local switches.
 - 450 mm from finished floor to centre
 - 900 mm from finished floor to centre
 - 1500 mm from finished floor to centre
 - 1800 mm from finished floor to top

- 6) Lighting Panels.
 - Unless otherwise noted, all lighting fixtures shall be fed from respective lighting panels. Normal AC lighting panels will be fed from main lighting distribution boards (LDB). Emergency AC lighting panels will be fed from Emergency Main Lighting distribution boards (ELDB). DC Emergency lighting distribution boards (DCELDB) will be fed from MLD and Main DC distribution boards.

All outdoor lighting fixtures, unless it is fed from time switch controlled lighting panel shall be provided with outdoor type local switches.

7. Separate neutral wire shall be provided for each circuit. Wiring throughout the installation shall be such that there is no break in the neutral wire in the form of switch or fuse.
8. All exposed conduit runs in battery room, chemical feed station area, water treatment building etc. shall be suitably painted with acid/alkali proof paints.
9. The entire metallic conduit system whether embedded or exposed, shall be electrically continuous and thoroughly grounded.
10. Lighting fixtures shall not be suspended directly from junction box in the main conduit run.
11. Separate conduits shall be used for wiring lighting circuits of different lighting distribution system such as normal AC lighting/emergency AC lighting/emergency DC lighting/low voltage lighting.
12. A.C. and D.C. circuits shall not be run in the same conduit and junction boxes. Circuits fed from different transformers and different batteries (D.C. Source) shall not be run through same conduit and junction boxes.
13. Receptacle circuits shall be kept separate and distinct from lighting and fan circuits.
14. Wires/cables shall be spliced only at junction boxes with ring-tongue lugs of approved equal.
15. For cable/wire numbering, PVC sleeve with cable/wire tag number of different colour code shall be used.
16. For roads/outdoor areas, main runs from street/area lighting panels shall be by means of AYW cables, directly buried in ground with proper protection as per details shown or through duct bank.
17. When buried cables cross road/railway track, additional protection to be provided in form of Humei G.I. Pipe.
18. Flame proof installations shall be carried out with Flame proof conduits, flame proof accessories and junction boxes.
19. Unless otherwise noted, the minimum size of cables, wires, conduits, junction boxes shall be as below

A) CABLES

- i) From main lighting distribution Boards to 400 V normal AC lighting panels

1x3-1/2C, 25 Sq. mm AL PVC

- ii) From emergency lighting Dist. Boards (EMLD) to 400 V emergency AC lighting Panels

1x3-1/2C, 35 Sq. mm AL PVC



LIGHTING NOTES & DETAILS

DRG. No.	PE-DG-281/558-001
REV. No.	0
SHEET	2 OF 18

(32)

iii) From main lighting Dist. Boards (MLDB) TO 400V AC/ 220V DC emergency lighting distribution board (DCELDDB)

: 1x3-1/2C, 95 Sq.mm AL PVC

iv) From 220V main DC dist. Boards to 400V AC/220V DC emergency lighting distribution board (DCELDDB)

: 2 x 4C, 35 Sq.mm AL PVC

v) From PCCC/MCC/DDB to 100A, 3 Phase Receptacles

: 1 x 3-1/2C, 95 Sq.mm AL PVC

vi) From 400 normal AC street/ Area lighting panels to street lighting pole Junction Box

: 1x4C, 35 Sq.mm AL PVC

vii) From PCCC/MCC/DDB to 63A, 3 Phase Receptacles

: 1 x 4C, 35 Sq.mm AL PVC

B. WIRES.

Wires shall be PVC insulated, 650V grade and of following sizes :

i) From lighting panels to Junction Boxes

: 1C, 10 Sq.mm AL (Stranded)

ii) From Junction Boxes to lighting Fixtures

: 1C, 2.5 Sq.mm Cu.

iii) From Junction Boxes to Flood Light Fixtures

: 2 x 2.5 Sq.mm, 1C, Cu

iv) From lighting Panels to 230V AC 5/15A, 1 Phase Receptacles & 24V AC supply Modules type M

: 1C, 10 Sq.mm AL (Stranded)

v) From 24V A.C. supply Modules to 230 V A.C. 5A Receptacles

: 1C, 10 Sq.mm AL (Stranded)

C. CONDUITS

All conduits shall be of galvanized steel of following minimum sizes :

CABLE SIZE

CONDUIT SIZE

20MM 25MM 32MM 40MM 50MM

i) 10 Sq.mm AL

2

3

7

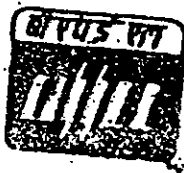
ii) 2.5 Sq.mm CU

3

5

9

8) Maximum No. of Conductors Admissible for Conduit



LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-281-558-01

REV. No.

0

SHEET 3 of 18

0. JUNCTION BOXES

CONDUIT SIZE

JUNCTION BOX SIZE (MM)

(MM)	4-WAY	3-WAY	STRAIGHT THROUGH	90°
i) 20 / 25	150x150x100	150x100x100	88 #	88 #
ii) 32 / 40	254x200x127	254x200x127	150x150x100	
iii) 50	254x200x127	254x200x127	254x200x127	

20. All lighting panels/distribution boards, junction boxes, receptacles, fixtures, conduits, etc. shall be grounded in compliance with the provision of I.E. rule and as detailed below:

- i) Lighting Panels 35 x 6 MM G.S. Flat
- ii) Distribution Boards 50 x 6 MM G.S. Flat
- iii) Power Receptacles, Junction Boxes etc. 12 SWG G.I. wire
- iv) Lighting fixtures, switches, conduits etc. 16 SWG G.I. wire
- v) Street Light Poles and Towers for Floodlighting 25 x 3 MM G.S. Flat

21. A continuous ground conductor of 16 SWG G.I. wire shall run along each conduit run and bonded to it every 600 mm.

22. The electrical installation work shall meet the requirements of Indian Electricity Rules, relevant IS codes of practice and safety codes. All the standards upto date. In addition, other rules or regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

23. Typical details of lighting fixtures, other lighting system components and their mounting arrangement as shown herein are for general guidance only. The type no. of some make has been referred in the various drawings. Only to indicate desired appearance, construction features and performance of the fixture. The contractor has to design the same fulfilling the requirement of the specification.



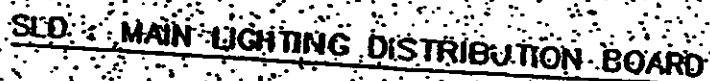
LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-291-568-000

REV. No.

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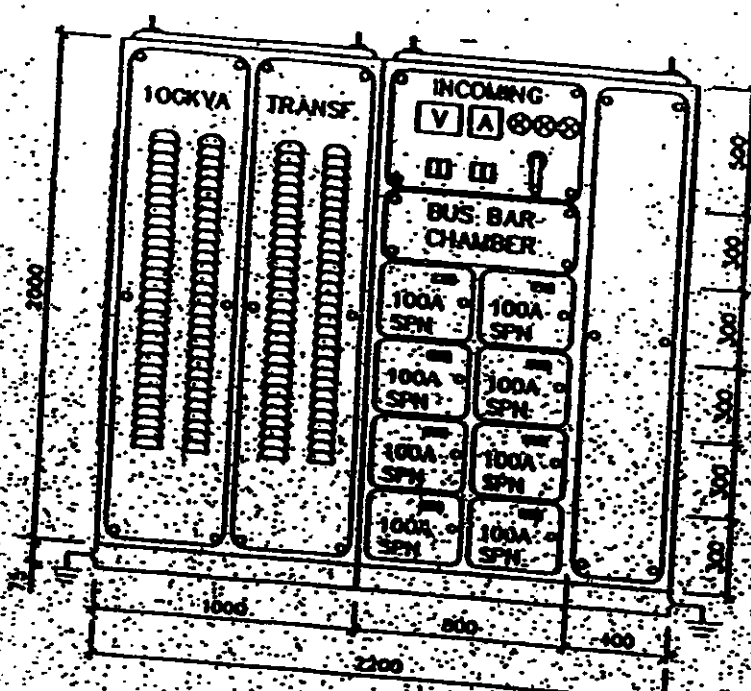
SHEET 4 OF 18



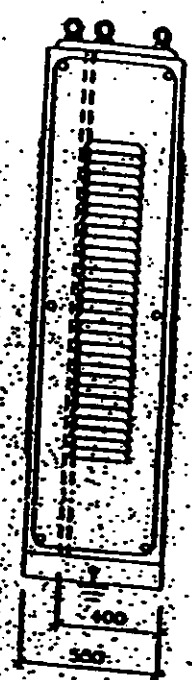
- ALL OUTGOING SW/FUSE RATINGS SHALL BE SAME
- TRANSFORMER RATING AND JZ SHALL BE SO SELECTED THAT THE FAULT LEVEL SHALL BE WITHIN AVAILABLE MCB.



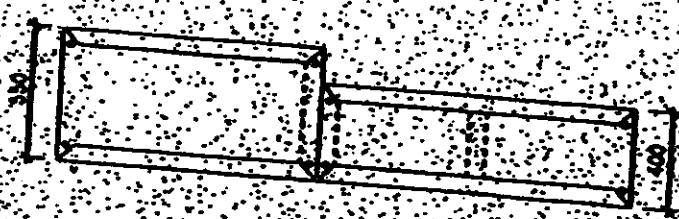
SHEET 5 OF 18



FRONT VIEW



SIDE VIEW



FOUNDATION PLAN

GENERAL ARRANGEMENT MAIN LIGHTING DISTRIBUTION BOARD

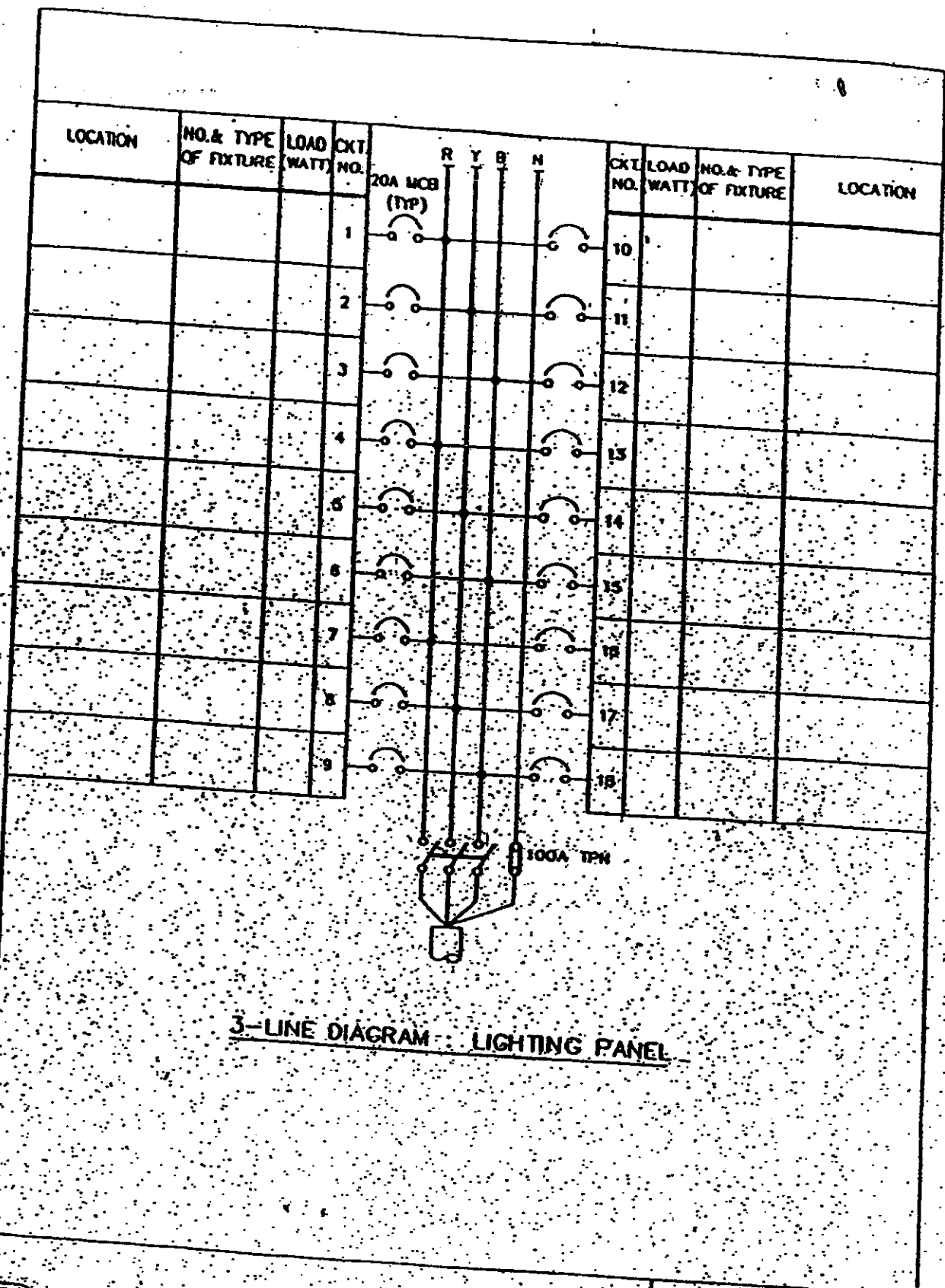


LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-281-558-0001

REV. No.
0

SHEET 6 OF 18



LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-231-558-0001

REV. No.
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SHEET 7 OF 18

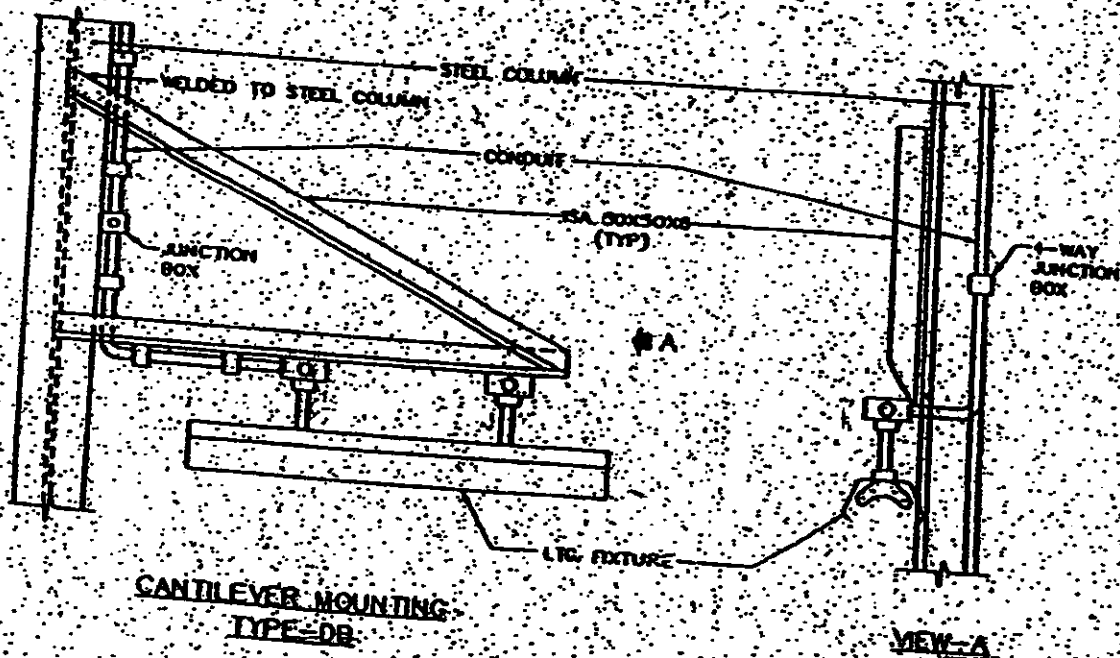
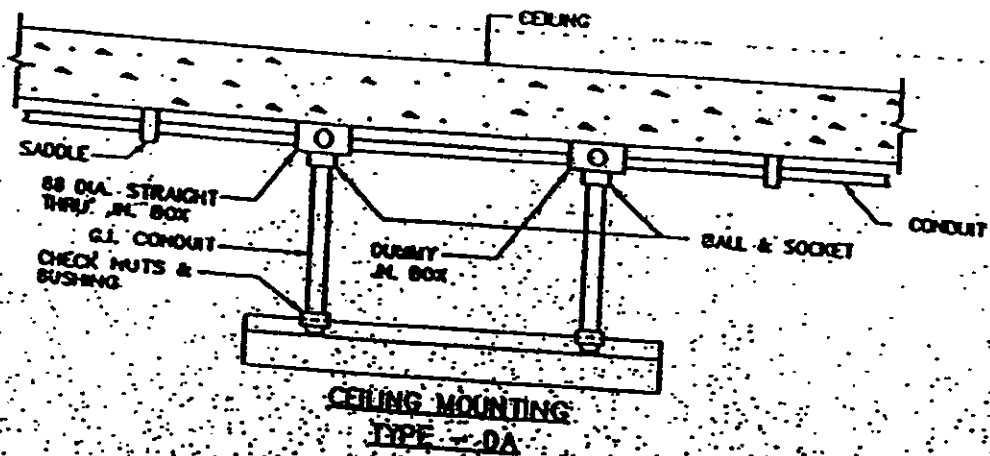


FIGURE SIMILAR TO PHILIPS MC-24/236 OR EQUIV.
WITH 2X36W FLUORESCENT LAMP SUITABLE FOR 230V. A.C.

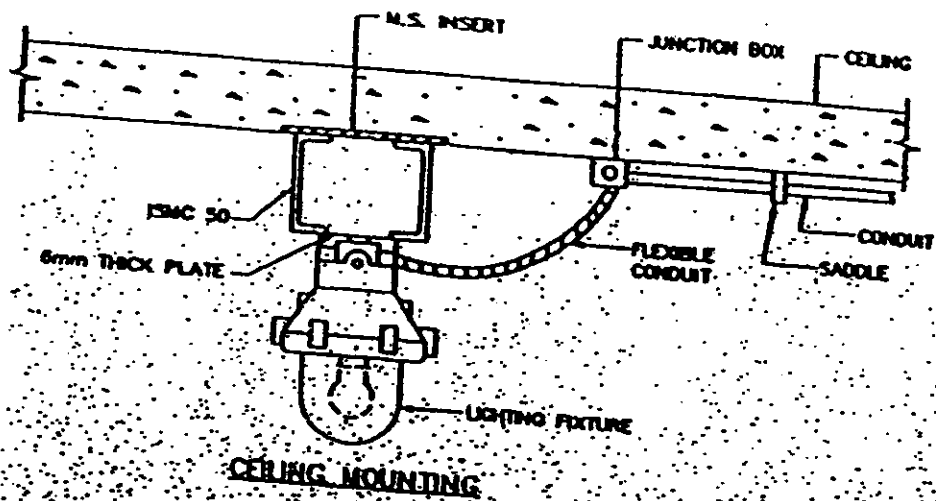


LIGHTING NOTES & DETAILS

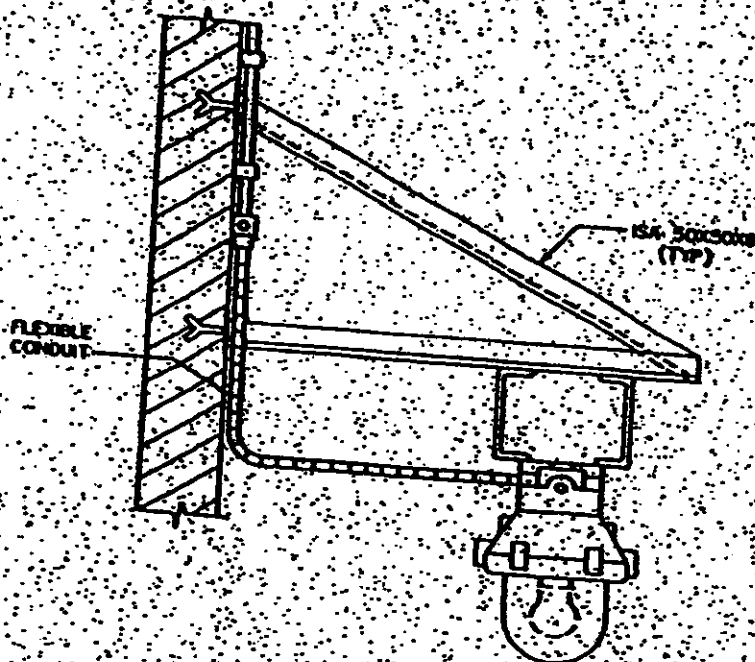
DRG. No.
PE-DG-281-568-0001

REV. No.
0

SHEET 9 OF 18



CEILING MOUNTING



WALL MOUNTING

FIXTURE SIMILAR TO GENELEC 65007 OR EQUIVALENT WITH 12X125W HPV LAMP SUITABLE FOR 250V A.C. SUPPLY.

NOTE:

WHEN USED WITH HV LAMPS THE CONTROL GEAR MUST BE HOUSED IN AN APPROVED FLAME PROOF ENCLOSURE OR ALTERNATELY LOCATED OUTSIDE THE DEFINED HAZARDOUS AREA.



LIGHTING NOTES & DETAILS

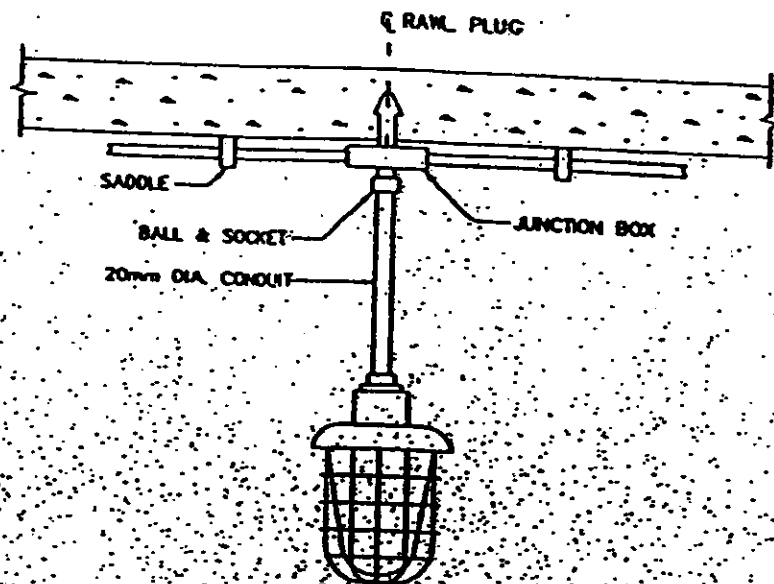
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PE-DG-281-558-0001

REV. No.

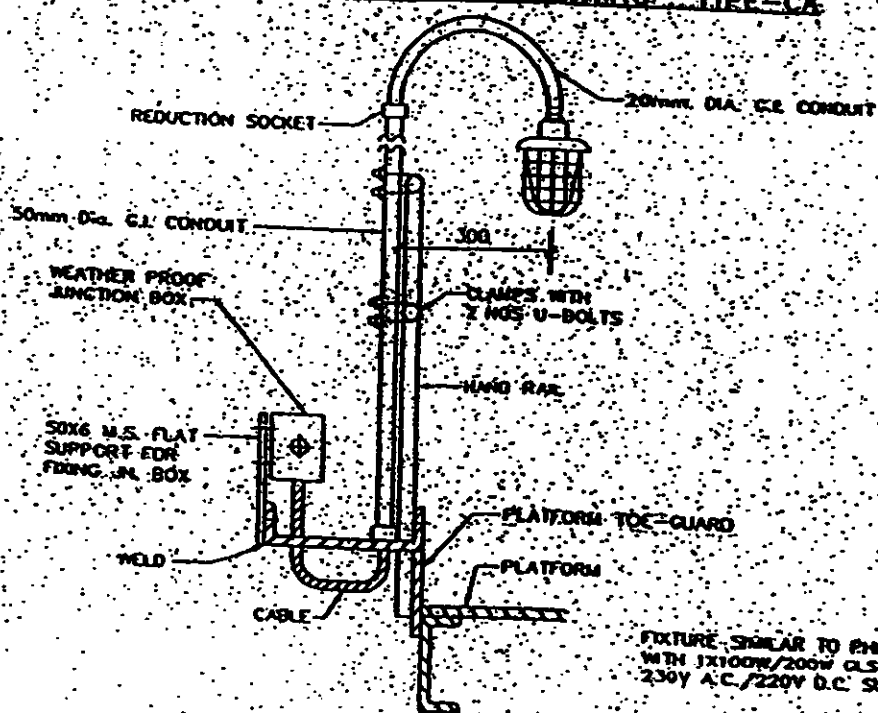
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SHEET 10 OF 18

90



PENDANT CEILING MOUNTING - TYPE-CA



PLATFORM MOUNTING - TYPE-CB

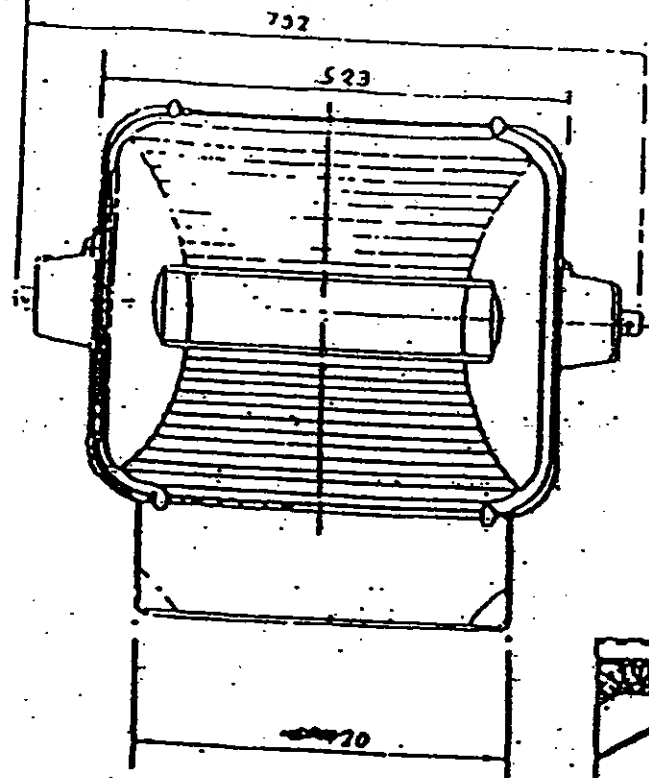


LIGHTING NOTES & DETAILS

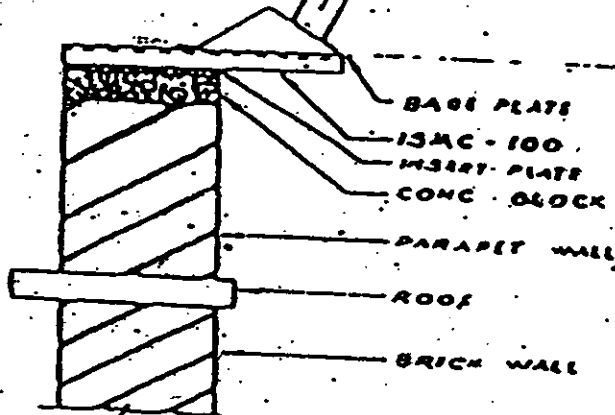
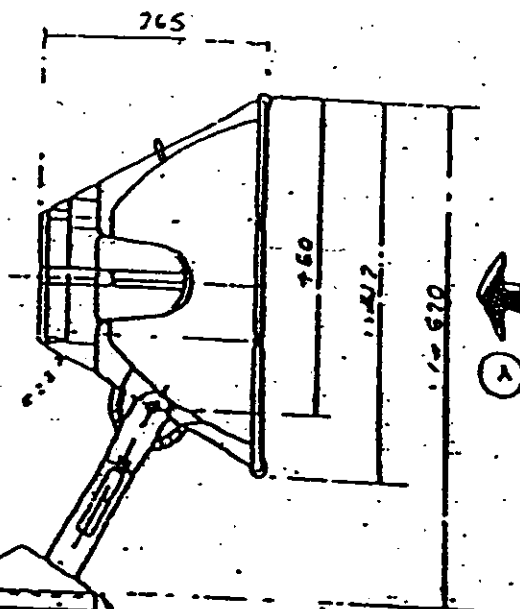
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REV. No. 0

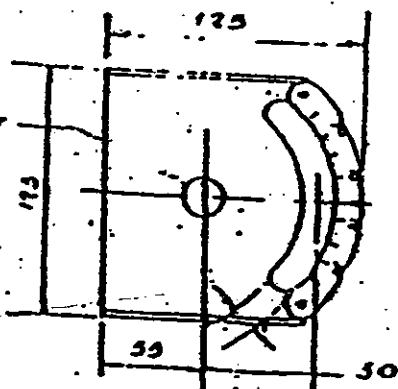
SHEET 11 OF 18



VIEW - A



TYPICAL MOUNTING ARRANGEMENT OF
FLOOD LIGHT FIXTURE ON THE ROOF



BASE PLATE



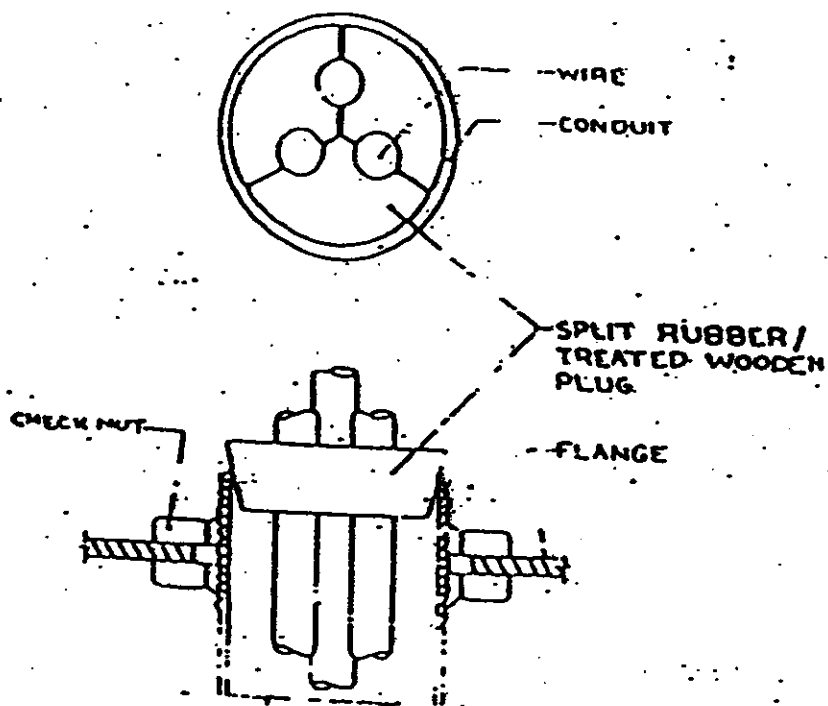
LIGHTING NOTES & DETAILS

MOUNTING OF FLOOD LIGHT
FIXTURE

DRG. No.
PE-DG-281-558-0001

REV. No.
0

SHEET 13 OF 18



CLAMPING OF WIRES
IN CONDUIT VERTICAL RUN

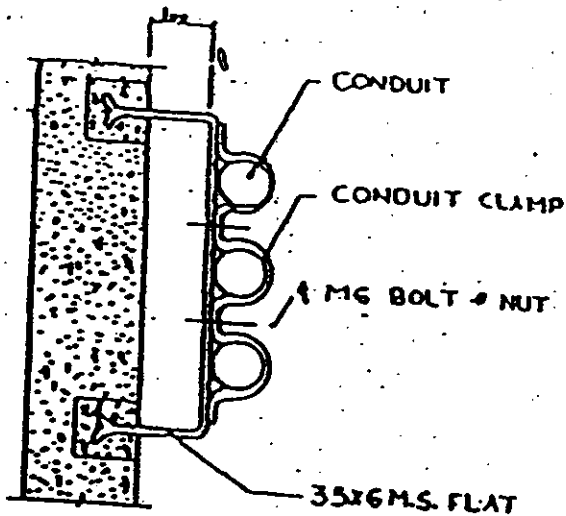


LIGHTING NOTES & DETAILS

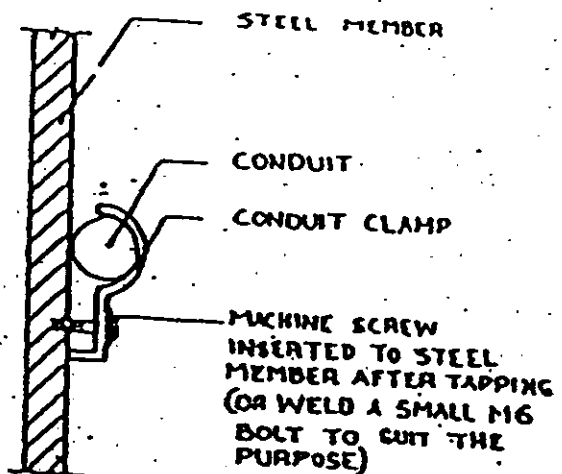
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PE-DG-281-558-0001

REV. No.
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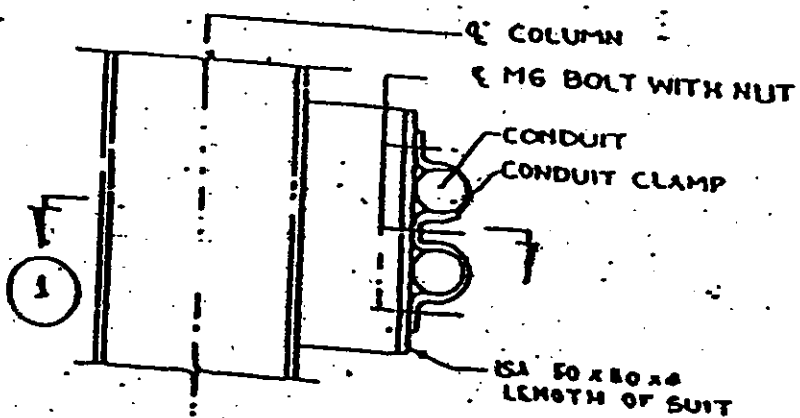
SHEET 13 OF 18



GROUP OF CONDUITS RUN ON CONCRETE SURFACE

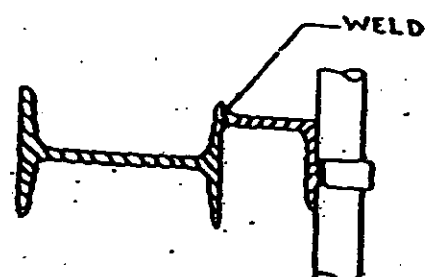


SINGLE CONDUIT RUN ON STEEL MEMBER



ELEVATION

GROUP OF CONDUIT RUN ON STEEL MEMBER ARRANGEMENT-A



SECTION — 1



LIGHTING NOTES & DETAILS

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PE-DG-281-558-0001

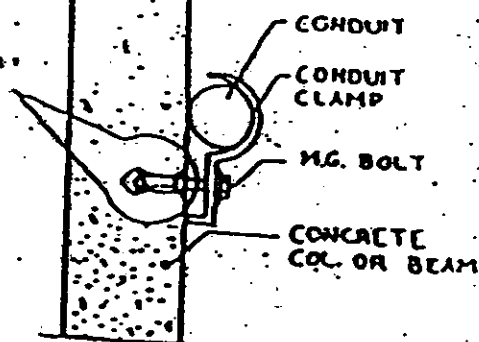
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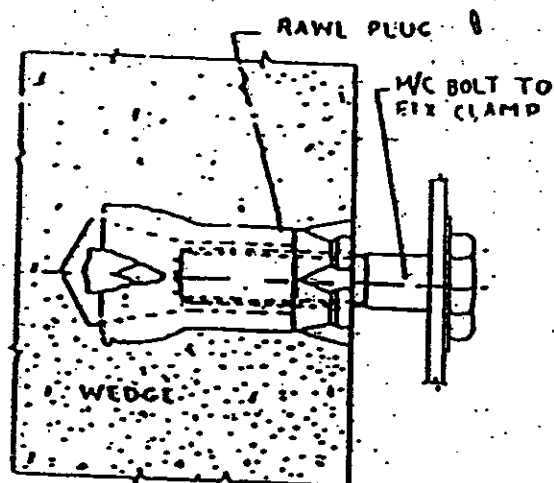
SHEET 14 OF 18

353

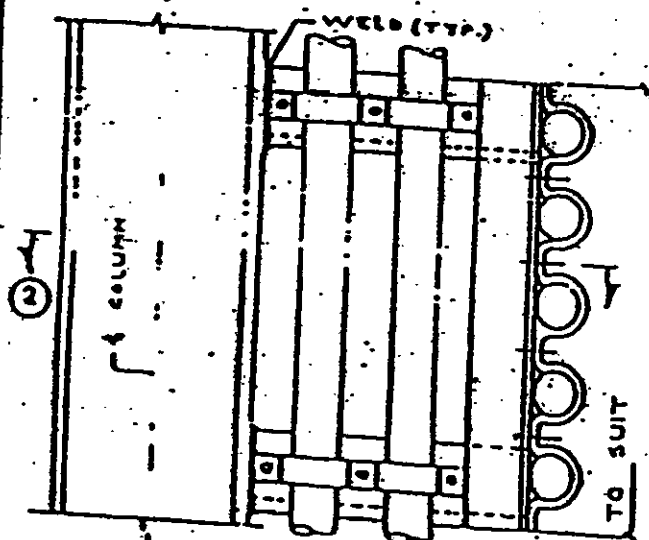
SEE
DETAIL-A



SINGLE CONDUIT RUN
ON CONCRETE SURFACE

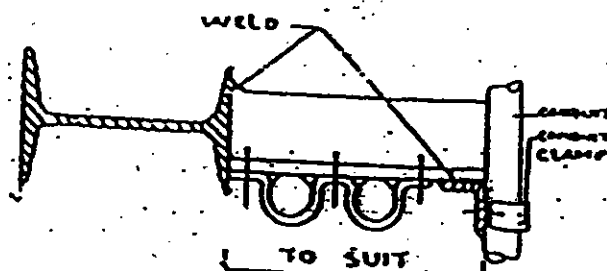


DETAIL-A



ELEVATION

GROUP OF CONDUIT RUN ON
STEEL MEMBER ARRANGEMENT-B



SECTION-2



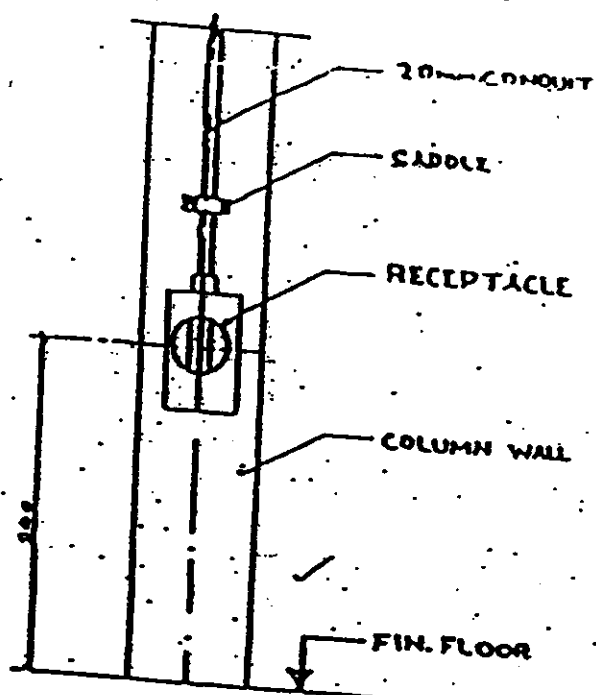
LIGHTING NOTES & DETAILS

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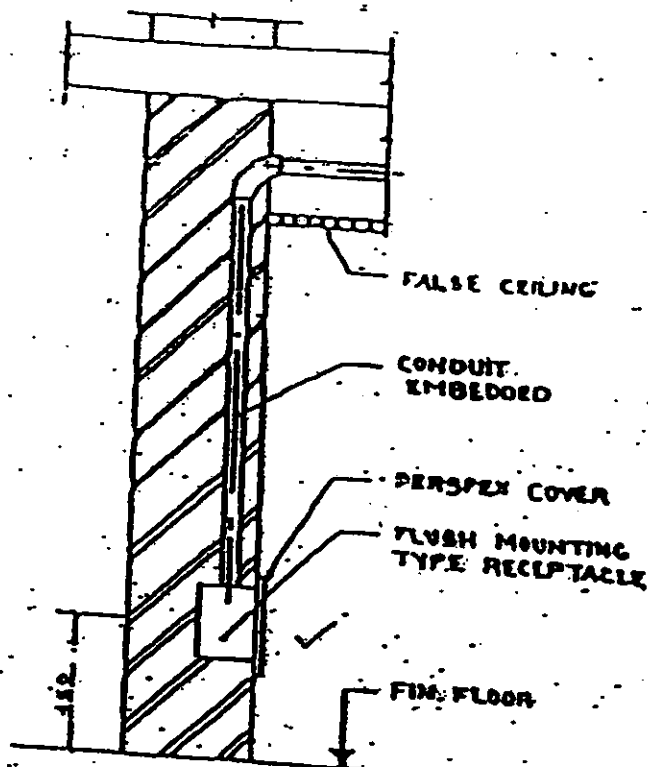
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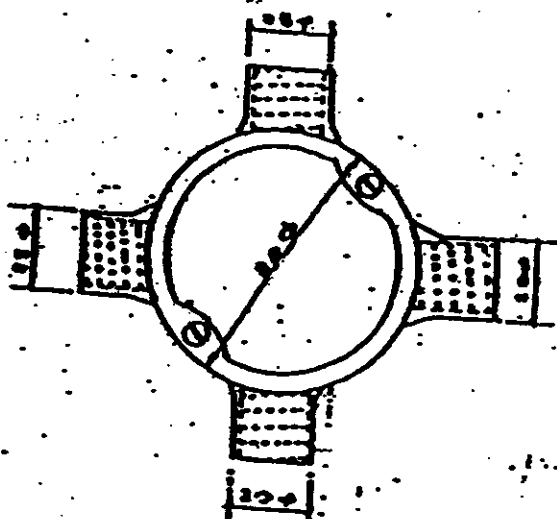
SHEET 15 OF 18



RECEPTACLE - TYPE 'Rb'
(STRUCTURE MOUNTING)



RECEPTACLE - TYPE 'Ra'
(WALL MOUNTING)



JUNCTION BOX ROUND (TYP.)



LIGHTING NOTES & DETAILS

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PE-DG-281-558-0001

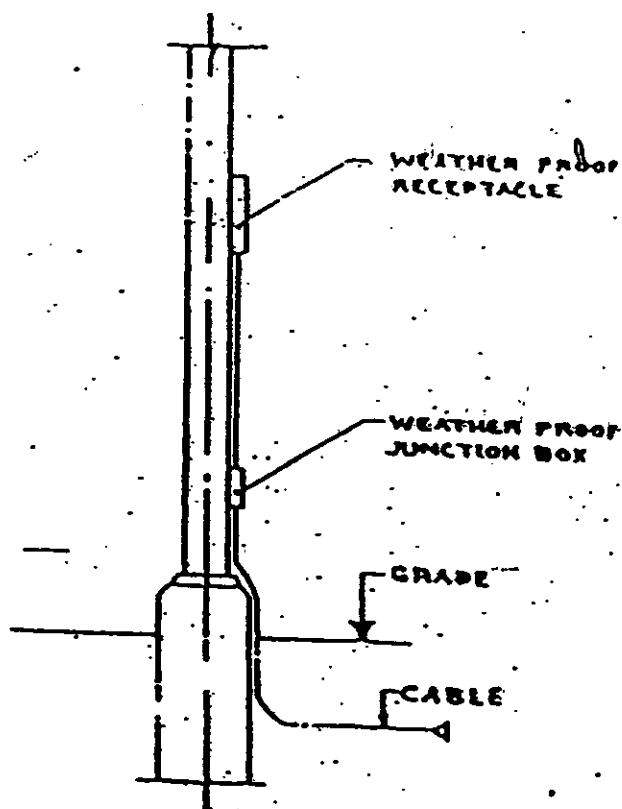
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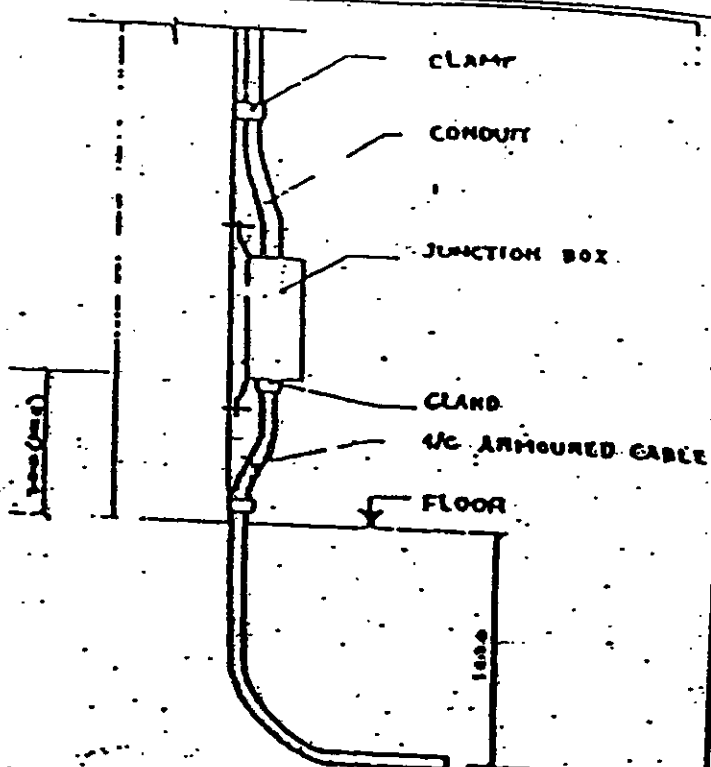
SHEET: 16 OF 18

355

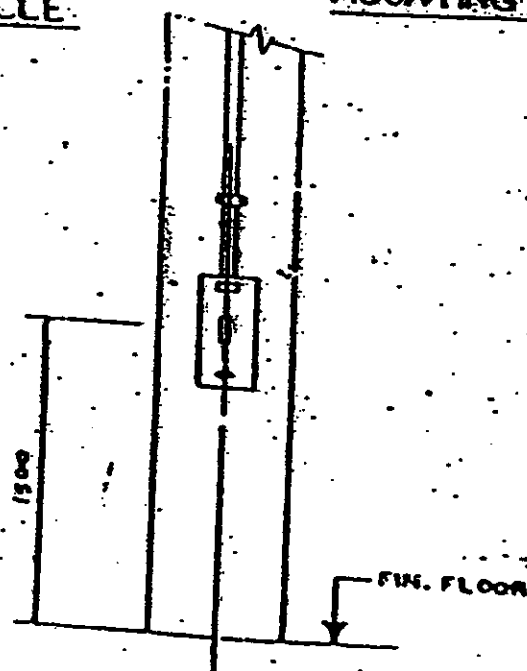
46



OUTDOOR RECEPTACLE



JUNCTION BOX MOUNTING (TYP)



SWITCH ON COLUMN



LIGHTING NOTES & DETAILS

DRG. No.

~~224-558-0001~~

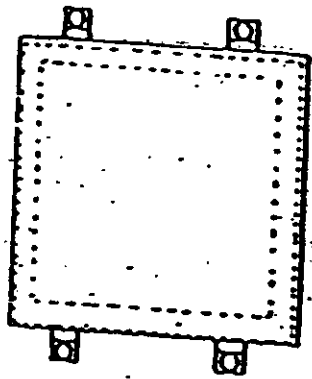
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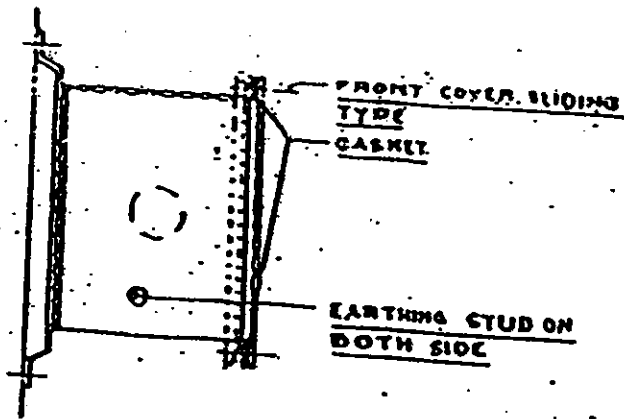
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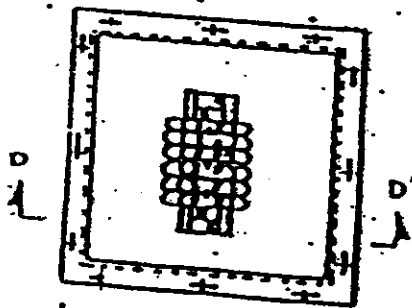
SHEET 17 OF 18



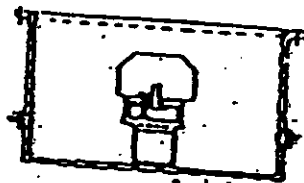
TYP. FIXING DETAIL
OF JUNCTION BOX



SECTION: C-C'



JUNCTION BOX (TYP)
FRONT VIEW



SECTION: D-D'



LIGHTING NOTES & DETAILS

DRG. No.	PE-DG-234-558-0001
REV. No.	0
SHEET	18 OF 18

357

(48)



**LIGHTING
FOR
COOLING TOWER**

SPECIFICATION NO: PES-558-02

VOLUME NO: II

SECTION: D

REV. NO: 00 DATE :

SHEET : OF 10

COOLING TOWER AREA LIGHTING

SECIFICATION NO: PES-558-02



**LIGHTING
FOR
COOLING TOWER**

SPECIFICATION NO: PES-558-02

VOLUME NO: II

SECTION: D

REV. NO: 00 DATE :

SHEET : OF 10

CONTENTS

1 General

2 Codes & standards

3 Design requirements

4 Painting

5 Testing & inspection

6 Spare parts

7 Guaranteed performance requirements

8 Drawing & data

9 Operation and maintenance manual



LIGHTING FOR COOLING TOWER

SPECIFICATION NO: PES-558-02

VOLUME NO: II

SECTION: D

REV. NO: 00 DATE :

SHEET : OF 10

1.0 General

1.1 This specification covers the following:

- Engineering of lighting system including the associated distribution system for cooling tower areas.
- Design manufacture, supply, storage at site, testing of all necessary equipment such as lighting Panel, lighting luminaries, lamps, sockets, wiring accessories and any other equipment and material as would be found necessary for the satisfactory execution/completion of the job.
- Erection, testing and commissioning of the lighting system for cooling towers.

2.0 Codes & standards

2.1 Unless otherwise specified the following codes standards are applicable. In all cases latest revision Of codes shall be referred to.

Indian standard

Title

- | | |
|----------|--|
| IS: 3645 | : Code of practice for interior illumination. |
| IS: 1913 | : General safety requirement for electric lighting fitting. |
| IS: 3528 | : Water proof electric lighting fitting. |
| IS: 732 | : Code of practice for electric wiring installation (system voltage not exceeding 650 V) |
| IS: 1947 | : Specification for flood lights. |
| IS: 2183 | : High pressure mercury vapor lamp. |
| IS: 418 | : Tungsten filament general service electric lamp. |
| IS: 1253 | : 3 pin plugs and socket outlets. |

3.0 Design requirements

3.1 General

Lighting equipment and accessories shall be designed to operate satisfactorily under conditions Specified in data sheet -A The designed ambient temperature shall be as indicated in data sheet-A.

3.2 Supply voltage & frequency

Details of the supply system shall be as specified in data sheet - A.

3.3 Illumination levels

The following are the minimum illumination levels to be achieved with the type of lighting fixture Specified against each area.

<u>Area</u>	<u>Illumination level – lux</u>	<u>Type of fixtures</u>
Cooling tower Platform	100	well glass weather proof lighting fixture with galvanized wire guard and equipped with 1x 125 W HPSV lamp Mounted on suitable G.I. pipe bracket with adequate



LIGHTING FOR COOLING TOWER

SPECIFICATION NO: PES-558-02

VOLUME NO: II

SECTION: D

REV. NO: 00 DATE :

SHEET : OF 10

Fixing arrangement.

Stairs	70	Weather proof will glass fixture with galvanized wire guard and 1x70 W HPSV lamp.
Cooling tower Surrounding	30	Flood lighting fixture with 1x250 W HPSV lamp complete with all accessories including wall/ structure mounting bracket.

Bidder shall calculate number of fitting and furnish calculation for approval maintenance factor shall be taken as 0.7.

3.4 Lighting panel

Lighting panel (L.P) shall be totally enclosed sheet steel indoor outdoor vermin proof type. Sheet Steel use shall be 2.0 mm thick and be smooth and flawless. Hinged door with gaskets shall be provided for access to the switches etc. The hinged door shall be interlocked with main switch.

The lighting panel shall be complete with aluminum bus bars and shall incorporate TPN switch on the Incoming side and single pole and neutral miniature circuit breaks having thermal and magnetic element for over load and short circuit protection on the outgoing. Suitable number of outgoing feeder with 20% spare circuit shall be provided.

The current rating of the bus bars in lighting panel not less than the sum of maximum current rating of all outgoing circuits the three phase & neutral panel shall be fitted with neutral busbar having facility for terminating as many neutral cables as single phase ways in the panel. Lighting panel shall be fitted with G.I. earth stud located in an accessible position on the outside of the board. All metal parts of the panel except current carrying parts shall be bonded to the earth busbar. Lighting panel shall be fitted with phase barriers of fire proof insulating material fitted in such a manner that it is not readily possible for personnel to touch the phase busbar. Preferably insulation barriers shall be fitted/around MCBS so that only surface and toggle of the breakers are available on the front. Panel shall be fitted with a card index of circuits on the inside of front cover.

The tenderer shall be supply, erect and interconnect the lighting panel to the lighting distribution Board (LDB) located in the nearby pump house/building. The tenderer shall indicated the rating of incoming feeder from I DB lighting panel and provide the same. However LDB shall be supplied and erected by the purchaser.

15 A, 240V, socket outlets



**LIGHTING
FOR
COOLING TOWER**

SPECIFICATION NO: PES-558-02

VOLUME NO: II

SECTION: D

REV. NO: 00 DATE:

SHEET : OF 10

15 A switched socket outlets (weather proof type) at every 5.0 m interval be provide

3.6 Junction and socket boxes

These boxes to be provided in the cooling tower area shall be weather proof made from 2.0 mm thick galvanized sheet steel and shall incorporate terminal blocks for termination of incoming and outgoing cables.

3.7 Method of wiring

From lighting distribution board to lighting panel and from lighting panel to junction boxes in the cooling tower area a 650/1100V grade PVC insulation armored and PVC sheathed cable shall be laid under ground as per relevant Indian standard. From junction boxes in the cooling tower area to the lighting fittings/socket outlet PVC insulated and overall PVC sheathed cable shall be drawn in G.I. conduits.

The minimum conductor size for 15A socket outlets shall be 4.0 mm² single core cable depending upon voltage drop consideration. The minimum acceptable conductor size for connecting lighting fittings to be provided on the platforms/stairs shall be 2.5 mm² single core/cable or depending upon voltage drop consideration.

The minimum acceptable conductor size for connecting flood lighting for illuminating surrounding shall be single core cable 6 mm² or more depending upon voltage drop consideration.

3.8 Refer enclosed lighting notes & details (15 sheets) for wiring & installation cable, lighting panel etc. In case of conflicts between above clauses and section-C, section-C shall be prevailed.

4. Painting


Unless otherwise specified the colour of finish shall be battles grey to shade No.632 as per IS: 5. The paint shall be epoxy based and shall be suitable for with standing specified site conditions.

5. Testing and inspection

5.1 Lighting panel, lighting fitting, lamps, socket outlet etc. and all accessories shall be subject to routing and type test in accordance with the requirement of appropriate Indian standard in the presence of purchaser's representative.

5.2 Tests at site

On completion of erection work the lighting installation shall then be tested and commissioned as per the requirement of appropriate Indian standard in the presence of purchaser or purchaser's representatives. The test shall be made to ensure the guaranteed illumination level and level after 100 burning hours.

	LIGHTING FOR COOLING TOWER	SPECIFICATION NO: PES-558-02
		VOLUME NO: II
		SECTION: D
		REV. NO: 00 DATE :
		SHEET : OF 10

The tenderer shall furnish all required testing meters instruments and equipment for testing all equipment specified.

6.0 Spare parts

Recommended list of spares for commissioning and for operation and maintenance of the lighting system for a period specified in data sheet -A be furnished. The tenderer shall furnish separate price and list of the same. Unit rates shall also be furnished in addition to total price.

7.0 Guaranteed performance requirements

The vender shall guarantee satisfactory performance of equipment supplied under all conditions & requirement as laid down in the specification.

8.1 Drawings & data

General arrangement drawing of lighting panel

-Single line distribution diagram

- Detailed specification of the luminaries

offered with dimensional and mounting details supported by illustrative of leaflets.

Complete technical literature of equipment.

8.2 Drawing & data to be furnished after award of contract

Complete design calculation sheet/arriving at the number and type of luminaries.

Deign and calculation sheet for the selection of cables MCBS, busbars.

Single line distribution diagram. General arrangement drawing of lighting panel.

Fixing and mounting detail of luminaries.

Test certificates for all equipment.

Lighting layout plan showing luminaries, sockets, conduit routing, conduit size, cable size, lighting Panel etc.

9. Manufacturers catalogues/literature for all equipment. Polar curves, zonal flux diagram & C.O. charts of luminaries.

Operation and maintenance manual

Operation and maintenance manual of lighting shall contain the following:

- Application of lighting luminaries with lamp.
- Technical data & salient constructional feature of lighting equipment.
- Instruction for maintenance of various lighting equipment.



**LIGHTING
FOR
COOLING TOWER**

SPECIFICATION NO: PES-558-02

VOLUME NO: II

SECTION: D

REV. NO: 00 DATE:

SHEET : OF 10

DATA SHEET-A

1 Details for supply system

- a) Rated voltage = 415 V \pm 10%
- b) Rated frequency = 50Hz \pm 5%
- c) Combined voltages frequency variation = 10% (Absolute)
- d) System fault level at rated voltage = 50 KA.(RMS)
- e) LV system grounding = solidly
- f) Design ambient = 50 deg C

2. Lighting panel

- a) Enclosure = CRCA sheet steel
- b) Thickness = 2.0mm
- c) Type = outdoor
- d) Busbar material = Al
- e) Degree of protection = IP 55 with Canopy
- f) Paint finish
 - i) Exterior = 631 of IS -5
 - ii) Interior = White

3. Cable

- Conductor material = HRPVC
- Voltage grade = 1.1KV

**4) Operation & maintenance
Spares required for**

= 3 year

5) Junction box

- a) Enclosure = sheet steel
- b) Thickness = 16 SWG
- c) Type = outdoor
- d) Degree of protection = IP-55

6) Type of conduit

= heavy gauge, rigid steel, hot dip galvanized
as per IS: 9537



**LIGHTING
FOR
COOLING TOWER**

SPECIFICATION NO: PES-558-02

VOLUME NO: II

SECTION: D

REV. NO: 00 DATE :

SHEET : OF 10

DATA SHEET-C

1.0 Lighting panel

- a) make
- b) Type
- c) Enclosure
 - i) Sheet steel thickness (mm)
 - ii) Degree of protection
- d) Busbar
 - i) Material
 - ii) Size
 - iii) Maximum continuous current rating
 - iv) Short time rating (for-sec) KA
- e) Finish
 - i) Colour
 - ii) Shade as per IS
- f) Earthing busbar
 - i) Material
 - ii) Size
- g) Switch
 - i) Make
 - ii) Type
 - iii) Rating
 - iv) Switch conforms to
- h) Miniature circuit interrupting capacity.
 - i) Make
 - ii) Type
 - iii) No. of poles
 - iv) Rated voltage
 - v) Current rating at design ambient
 - vi) Short circuit interrupting capacity
 - vii) Type of blow-out device
 - viii) Type of over load thermal/magnetic
 - ix) Miniature breaker conforms to
- i) Earthing terminal provided
- j) Lighting panel outgoing feeder (NOS)
- k) Dimensions (length X depth X height) (in mm)
- l) Weight (kg)
- m) Whether lighting panel supplied will be complete with terminal blocks, neutral link, danger notice plate, designation plate, gland plate with rubber gasket, circuit directory, cable glands



LIGHTING FOR COOLING TOWER

SPECIFICATION NO: PES-558-02

VOLUME NO: II

SECTION: D

REV. NO: 00 DATE:

SHEET : OF 10

& lug etc.

2.0 Conduit

- a) Make
- b) Type
- c) Size
- d) Applicable standard

3.0 Junction box

- a) Make
- b) Material
- c) Size
- d) Applicable standard

4.0 Socket outlet

- a) Make
- b) Type
- c) Rating (A)
- d) Voltage (V)
- e) Applicable standard

5.0 Cable

- a) Make
- b) Type
- c) Voltage grade
- d) Applicable standard
- e) Conductor
 - Material
 - Size
 - Insulation
- g) Material
- h) Armouring
 - Diameter
 - Insulation
 - Material
- i) Continuous current rating at designed ambient
- j) Approximate overall Dia.

6.0 Luminaires

- a) Make



**LIGHTING
FOR
COOLING TOWER**

SPECIFICATION NO: PES-558-02

VOLUME NO: II

SECTION: D

REV. NO: 00 **DATE:**

SHEET : OF 10

- b) Type
- c) Type of mounting
- d) Material of luminaire
- e) material of support/bracket
- f) Type of lamp holder
- g) Power factor
- h) ballast losses in watts
- i) capacitor rating
- j) weight of luminaire
- k) applicable standard


7.0 Lamps

- a) Make
- b) Type
- c) Wattage
- d) Nominal lamp voltage
- e) Light output (Lumens)
- f) Life of lamp
- g) Weight
- h) Applicable standard.

QUALITY PLAN				CUSTOMER		PROJECT TITLE		SPECIFICATION NUMBER				
SHEET 1 OF 3				BIDDER/VENDER		QUALITY PLAN NUMBER PED-558-00-Q-001/D1		SPECIFICATION TITLE				
SYSTEM				ITEM		ILLUMINATION		SECTION				
S.NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	CABLE & WIRES	1. SURFACE DEFECTS	MA	VISUAL	SAMPLE	BHEL SPEC. IS:694,IS:1554	BHEL SPEC. IS:694,IS:1554	INSPT. REPORT & TESTS REPORT FROM MANUFACTURER	3/2	2	1	TO BE PROCURE FROM APPROVE SOURCE
		2. DIMENSIONS	MA	MEASUREMENT	SAMPLE	DO-	DO-	DO-	3/2	2	1	
		3. TYPE TESTS	CR	ELEC. TESTS	ONE/TYPE & SIZE	BHEL SPEC. IS:694,IS:1554	BHEL SPEC. IS:694,IS:1554	TEST CERT	3	2	1	
		4. ACCEPTANCE TESTS	MA	DO-	SAMPLING	DO-	DO-	DO-	3	2	1	
		5. ROUTINE TESTS	MA	DO-	100%	DO-	DO-	DO-	3	-	2,1	
		6. FRLS PROPS.	CR	FRLS PROPS.	SAMPLES	BHEL SPEC.	BHEL SPEC.	DO-	3	2	1	
2.0	JUNCTION BOXES, LIGHTING PANELS AND DISTRIBUTION BOARDS											
2.1	JUNCTION BOXES	1. DIMENSIONS	MA	MEASUREMENT	100%	BHEL DRG	BHEL DRG	INSPT. REPORT	3	-	2	COMPONENT TO B APPROVED MAKE
		2. PAINT SHADE/ THICKNESS	MA	VISUAL/MEAS	SAMPLES	BHEL SPEC/DRG.	BHEL SPEC/DRG.	DO-	3	-	2	
		3. HV/IR/HV	MA	ELEC. TESTS	100%	2KV AC FOR 1 MINUTE	2KV AC FOR 1 MINUTE	DO-	3	-	2	
		4. DEGREE OF PROTECTION	MA	TESTS	1/SIZE	IS:2147	IS:2147	TEST CERT	-	-	2,1	
		5. SPECIAL TESTS, IF ANY, EXPLOSION PROOF ETC.	MA	DO-	DO-	IS:2148	IS:2148	DO-	-	-	2,1	
2.2	LIGHTING PANELS AND LIGHTING DISTRIBUTION BOARDS	1. DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DRG	BHEL DRG	INSPT. REPORT	3	2,1	-	COMPONENT TO BE APPROVED MAKE
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

QUALITY PLAN				CUSTOMER			PROJECT TITLE		SPECIFICATION NUMBER			
SHEET 2 OF 3				BIDDER/VENDER			QUALITY PLAN		SPECIFICATION TITLE			
				SYSTEM			ITEM		ILLUMINATION		SECTION	
S.NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		2. PAINT SHADE/THICKNESS	MA	VISUAL/MEAS.	DO-	BHEL SPEC/DRG.	BHEL SPEC/DRG.	INSPT. REPORT	3	2,1	-	BHEL SHALL WITNESS ON RANDOM ONE SAMPLE, THROUGH EACH ITEM SHALL BE CHECKED BY THE MANUFACTURER. DO-
		3. DEGREE OF PROTECTION(INCLUDING EXPLOSION PROOF, IF ANY)	MA	TESTS	1/SIZE	BHEL SPEC/RELEVANT IS	BHEL SPEC/RELEVANT IS	TEST CERTF.	-	-	2,1	
		4. PERFORMANCE TEST	MA	ELEC.	100%	BHEL SPEC	BHEL SPEC	INSPT. REPORT	3	2,1	-	
		5. HV/IR/HV	MA	ELEC.	100%	2.5 KV AC FOR 1 MINUTE	2.5 KV AC FOR 1 MINUTE	DO-	3	2,1	-	
		6. TEMP. RISE TEST (FOR COMPLETE ASSEMBLED LDB)	MA	ELEC.	1/RATING	BHEL SPEC	BHEL SPEC	DO-	3	2	1	
		1. ACCEPTANCE TESTS	MA	TESTS	SAMPLES	BHEL SPEC/RELEVANT IS	BHEL SPEC/RELEVANT IS	TEST CERTF.	3,2	-	1	
3	TUNGSTEN FILAMENT LAMPS, TUBULAR FLUORESCENT LAMPS, H.P. MERCURY VAPOUR LAMPS, SODIUM VAPOUR LAMPS, BALLASTS, LUMINAIRES											
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

252

		QUALITY PLAN		CUSTOMER			PROJECT TITLE		SPECIFICATION NUMBER			
SHEET 3 OF 3		BIDDER/VENDER			QUALITY PLAN		NUMBER PED-558-00-Q-001/01		SPECIFICATION TITLE			
		SYSTEM			ITEM		ILLUMINATION		SECTION		VOLUM III	
S.NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	W	V	11
4.0	CONDUITS	1. MATERIAL	MA	VISUAL, MECH AND CHEMICAL	AS PER SPEC./ IS 9537	IS: 9537	IS: 9537	INSPT. REPORT	3	2	1	
		2. DIMENSIONS	MA	MEASUREMENT	AS PER SPEC./ IS 9537	IS: 9537	IS: 9537	DO-	3	2	1	
		3. OTHER TESTS	MA	TESTS	AS PER SPEC./ IS 9537	AS PER SPEC./ IS 9537	IS: 9537	DO-	3	2	1	
5.0	ELECTRIC POLES											
5.1	MATERIALS	1. CHEMICAL COMP.	MA	CHEM. ANALYSIS	SAMPE	IS: 2713, IS: 228 & IS: 1894	IS: 2713, IS: 228 & IS: 1894	DO-	3/2	-	2,1	
		2. PHYSICAL PROPERTIES	MA	PHYS. TESTS	DO-	DO-	DO-	DO-	3/2	-	2,1	
5.2	FINAL INSPECTION	1. WORK-MANSHIP & FINISH	MA	VISUAL/MEAS	SAMPLES	BHEL DRG /IS: 2713	BHEL DRG /IS: 2713	DO-	3/2	2,1	-	
		2. DIMENSIONS	MA	DO-	DO-	DO-	DO-	DO-	3/2	2,1	-	
		3. WEIGHT	MA	DO-	DO-	DO-	DO-	DO-	3/2	2,1	-	
		4. TESTS AS PER IS: 2713	MA	DO-	DO-	IS:2713	IS:2713	DO-	3/2	2,1	-	
NOTE : IN CASE TYPE TEST CERTIFICATE FOR DEGREE OF PROTECTION/EXPLOSION PROOFNESS FROM INDEPENDENT LAB IS NOT AVAILABLE, THE ITEM SHALL BE TESTED AT AN INDEPENDENT LAB												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

DCPL-K6A03

VOLUME : II-F/2

SECTION-IX

**TECHNICAL SPECIFICATION
FOR
ERECTION CABLING, GROUNDING AND
LIGHTNING PROTECTION SYSTEM**

(PCA.989.E276EL13.doc)

CONTENT

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	SCOPE OF WORK	V.IIF-2/S-IX : 1
2.00.00	SCOPE OF SUPPLY	V.IIF-2/S-IX : 1
3.00.00	GENERAL REQUIREMENTS	V.IIF-2/S-IX : 4
4.00.00	DESIGN CRITERIA	V.IIF-2/S-IX : 4
5.00.00	SPECIFIC REQUIREMENTS - SUPPLY	V.IIF-2/S-IX : 8
6.00.00	METHODS AND WORKMANSHIP	V.IIF-2/S-IX : 13
7.00.00	INSTALLATION	V.IIF-2/S-IX : 13
8.00.00	TESTS	V.IIF-2/S-IX : 23
9.00.00	DRAWINGS, DATA & MANUALS	V.IIF-2/S-IX : 24
ATTACHMENTS		
ANNEXURE-A	NOTES AND DETAILS FOR CABLING SYSTEM	V.II-F2/S-IX : 25
ANNEXURE-B	NOTES AND DETAILS FOR GROUNDING AND LIGHTING PROTECTION SYSTEM	V.IIF-2/S-IX : 30

VOLUME : II-F/2**SECTION-IX****TECHNICAL SPECIFICATION
FOR
ERECTION CABLING, GROUNDING AND
LIGHTNING PROTECTION SYSTEM****1.00.00 SCOPE OF WORK**

1.01.00 The scope of work covers complete and efficient erection, testing and commissioning of lightning protection system, all cabling and electrical grounding works. The scope shall broadly cover, but not be limited to :

1. Main Power House Building
2. Boiler area, ESP stack
3. Transformer yard
4. All auxiliary buildings (including electrical rooms of respective buildings) and structures like C.W. Pump house, cooling Tower, ESP control cum fly ash equipment building, Fly ash conveying compressor building, surge tank area, Ash water and Ash slurry complex, Ash Silo, DG Building etc. as details in the Lead Specification.
5. Overhead interplant cable trestle and pipe cum cable trestle.
6. All electrical equipment as described in Volumes II-F/1 & II-F/2.

1.02.00 The scope of work shall also include all civil and structural works necessary for successful installation and commercial operation of all electrical equipment to be erected under this specification.

2.00.00 SCOPE OF SUPPLY

2.01.00 The scope of supply shall include but not be limited to the followings

2.01.01 Timely procurement and transportation to site in properly packed condition of all materials and miscellaneous items required to complete the erection work under this specification.

These materials and miscellaneous items shall include but not be limited to the following :

- a) Galvanised steel pre-fabricated cable trays, coupler plates, nuts, bolts & washers, reducers, covers, wall brackets, hanger clamps, straight run, elbows, bends etc.
- b) Galvanised steel rigid/flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanised sheet steel junction boxes, cable fixing clamps, nuts & bolts etc. as required.
- c) Cable termination and jointing kits as necessary.
- d) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.
- e) Mild steel rods, galvanised steel flats, galvanised steel rods, lead coated copper tube suitably brazed with galvanised steel Bend ring galvanised steel wires etc. required for grounding and lightning protection system shall be supplied in standard lengths.
- f) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved shall be deemed to be included in the scope of this specification and shall be furnished by the contractor without any extra charge to the Purchaser.

2.01.02

a) **Main Ground Mat**

Laying underground conductors and arc welding the conductors at each crossing and straight run (lap joint). The conductors at the periphery of the mat shall be 1 no. 40 mm diameter M.S. rod and the internal cross conductors of the mat shall be 1 No. 40 mm diameter M.S. rod. Suitable pigtailed shall be provided and shown in the layout drawing for connection with existing plant ground grid.

b) **Grounding Electrode**

Fabrication and driving into ground 40 mm. diameter 3000 mm long M.S. rod and connecting them to the grounding mat by arc welding.

c) **Column Grounding**

i) **Concrete Columns**

Erection of 1 no. 40 mm. dia. M.S. rod from grounding mat to all concrete columns including necessary fixing, welding of one end of the rod with ground mat and the other end with the column above ground by welding with a short GS flat to edge angles.

ii) **Steel Columns**

Erection and connection of 1 No. 40 mm diameter M.S. rod from grounding mat to all steel columns including necessary fixing welding with ground mat and the other end with the column above ground with a short GS flat.

d) **Risers**

Erection and connection of all risers from underground mat to above ground levels where the ends will be left free for connecting to the equipment. Each riser will be 1 No. 40 mm dia. M.S. rod and Minimum 300 mm above grade level/concrete floor level.

e) All other ancillary works in connection with the items of work described above which are not specifically mentioned but are necessary to complete the work, shall be under the scope of this specification.

2.02.00 All materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

2.03.00 Necessary drawings, data sheets and Technical leaflets on each piece of material.

2.04.00 **Scope of Services**

The scope includes but is not limited to the followings;

2.04.01 Furnishing of all erection tools and tackles, testing equipment, implements, supplies, hardware and transport for timely and efficient execution of the erection work.

2.04.02 The items of erection work shall be performed with respect to the following equipment/materials :

a) **Power Cables**

b) Cables laid directly buried in ground

c) Control, instrument and special cables

d) Entire cable tray and cable shaft arrangements inside Power House & other buildings under Main Plant package as well as outdoor cable bridges and all associated civil and structural works including foundation and cable trenches.

e) Supply and Erection of Grounding system.

f) Supply and erection of lightning Protection system.

3.00.00 **GENERAL REQUIREMENTS**

3.01.00 **Codes and Standards**

3.01.01 All cable and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

3.01.02 Cable and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

3.01.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.02.00 Erection Schedule

3.02.01 The entire erection work shall be carried out in a phased manner. A schedule of the work showing the sequence of erection shall be submitted by the tenderer for this purpose.

3.02.02 The erection schedule, as approved by the Owner's Engineer shall be strictly followed by the contractor. If, for any reason beyond the control of the Contractor, the work is held-up then the Contractor shall bring it to the notice of the Owner's Engineer without any delay.

4.00.00 DESIGN CRITERIA

4.01.00 Grounding System

4.01.01 The main objectives of grounding system are to :

- a) Provide safety to personnel from contact of dangerous potential caused by ground fault.
- b) Ensure sufficient grounding current for effective relaying.
- c) Stabilize circuit potential with respect to ground.

4.01.02 In order to meet the above objectives, ground grid mesh will be provided for the main plant complex. viz. switchyard, transformer yard adjacent to power house building, power house building and boiler area up to stack, auxiliary buildings etc.

All electrical equipment, non current carrying metal parts, structures, building steel, lightning protection system, generator/transformer neutrals will be connected to this station ground grid.

The major aspects to be considered for grounding system design are given below :

4.01.03 Ground Grid Conductor

- a) Ground grid conductor of mild steel rod shall be used.
- b) The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm per year over the design life of 30 years.

4.01.04 Underground Grid

- a) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80.
- b) The ground grid conductors will be buried in earth at a minimum depth of 1000 mm. The length of ground conductors below earth will be sufficient to ensure a ground resistance less than one (1) ohm.
- c) The ground grid conductor will be so laid as to provide short and direct connection to building steel and major electrical equipment.
- d) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.
- e) All ground grid conductor connections will be welded type.
- f) New ground grid shall be connected with the existing ground grid at least at two (2) points.

4.01.05 Above Ground Connections

- a) Galvanised steel flats shall be used for all connections above earth.
- b) Inside building, ground conductors will be run for each floor supported on building steel and/or cable trays. These ground conductors in turn will be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.
- c) Two separate and distinct ground connections will be provided for each electrical equipment in compliance with I.E. Rules.
- d) All connections above ground will be welded type except connection to equipment/structures which shall be bolted type.

4.01.06 Equipment Ground Lead

Equipment ground connections will be sized to carry the available ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes.

4.01.07 The minimum ground conductor sizes for various equipment and structures are given in Annexure-B.

- 4.01.08 Entire erection of grounding work shall be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage/deformation.
- 4.02.00 **Lightning Protection System**
- 4.02.01 The main purposes of lightning protection system are to :
- Provide protection to structures from lightning strokes.
 - Provide a low resistance-conducting path to lightning discharge.
- 4.02.02 Lightning protection shall be provided for Power House building, auxiliary building chimney, cooling tower and other structures.
- 4.02.03 Lightning protection will also be provided for building/ structures where the overall rise factor exceeds 10^{-6} as per IS:2309..
- 4.02.04 For metal structures which are electrically continuous down to the ground level, no lightning protection is required except adequate grounding connections.
- 4.02.05 **System Design**
- Air termination network with down conductors and earthing electrodes will be provided on the basis of IS Code of Practice.
 - Horizontal air termination shall be so laid out that no part of the roof will be more than 9 meters from the nearest conductor.
 - Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.
 - Down conductors will run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground.
 - An earth electrode will be provided at the connection point of the down conductor with the station ground.
 - Galvanised steel rods and flats will be generally used for air termination and connections. All connections will be welded type.
 - For air terminals of chimney, lead coated copper tube suitably brazed with G.S. Band ring shall be provided.
- 4.03.00 **Cabling System**
- 4.03.01 Erection of cabling work shall be carried out in such a way as to provide a reliable and assured electric power supply system to all station auxiliaries.

- 4.03.02 Cable routing will be done on unit basis as far as possible.
- 4.03.03 Cables will generally be laid on cable trays either in concrete trenches or overhead supported from building steel/structures. Cables shall be run in concrete trenches in those electrical rooms at ground level, which are without any spreader room below.
- In indoor pumps, mechanical equipment areas overhead cable trays shall generally be used local concrete trenches shall be used outdoor in transformer yard adjacent to Power House Row 'A' and within switchyard bays for cable routing.
- 4.03.04 For inter plant connections, the cables shall be routed through an overhead cable bridge pipe cum cable bridge. For isolated but long outdoor cable route with very few cables of 3/4 nos., the cables may be directly buried.
- 4.03.05 For underground crossing of railways, road etc. additional protection shall be provided in form of hume pipe or concrete encased rigid steel conduits (duct bank).
- 4.03.06 A.C. and D.C. circuit will not be run in same cable. Further, separately fused circuit will run in separate cables.
- 4.03.07 Cables for redundant equipment system shall be run in separate trays, as far as possible.
- 4.03.08 Erection of cabling work shall be executed keeping in view all necessities and requirements of fire fighting codes for Generating Stations having an adverse industrial environment.
- 4.03.09 Suitable embedded steel inserts shall be provided on wall/floor/ ceiling surfaces for welding of cable tray bracket in order to make the cable tray system withstand horizontal/vertical accelerations due to seismic forces for indoor trays and also wind load for outdoor trays such as on Boiler platforms in addition to normal tray cable loadings.
- 4.04.00 All erection work to be carried out under this specification shall conform to the notes and details given in Annexure-A to this specification.
- 5.00.00 **SPECIFIC REQUIREMENTS - SUPPLY**
- 5.01.00 **Equipment and Material**
- 5.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.
- 5.01.02 Equipment and materials furnished shall be complete and operative in all details.
- 5.01.03 All accessories, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

- 5.01.04 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.
- 5.02.00 **Pre-fabricated Cable Trays**
- 5.02.01 Cable trays shall be pre-fabricated ladder type sheet steel with hot dip galvanising furnished in standard length of 2.5 metres.
- 5.02.02 Cable trays shall be of standard width specified in Annexure-A and drawings.
- 5.02.03 Cable trays shall be complete with all necessary hot dip galvanised sheet steel accessories such as coupler plates, ground continuity connections, nuts, bolts, washers, hangers, clamps etc. Also horizontal/vertical bends, horizontal/vertical Tee, Reducers, Horizontal cross-pieces, protective covers shall be supplied along with straight runs in order to take care of cable tray alignments in different routes.
- 5.02.04 All fittings like horizontal/vertical elbow, horizontal crosspiece, reducer, horizontal tee etc. should be prefabricated.
- 5.02.05 Cable trays, fittings & accessories as well as elbows, reducers, tees, crosses etc. shall be fabricated out of 14 gauge (2 mm thick) hot rolled mild steel sheets.
- 5.02.06 Contractor shall supply 14 gauge (2 mm thick) perforated type hot rolled mild steel sheet covers for vertical cable shafts up to a height of 2.5 metres from floor level. The perforated covers used for the vertical raceways may be of one or more pieces along the width of the raceway, depending on the width of the raceway and shall be bolted to the structural framework of the raceway.
- 5.02.07 The cable trays, fittings and accessories including all bolts, nuts, screws, washers etc. shall be hot dip galvanised after fabrication as per IS:2629. Galvanising shall be uniform, clear, smooth and free from acid spots. Should the galvanising of the samples be found defective, the entire batch of steel will have to be regalanised at Contractor's cost.
- The amount of zinc deposited shall not be less than 610 gms per square metre of surface area and in addition the thickness of the zinc deposit at any spot whatsoever, shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by Elcometer or any other instrument and reject any component, which shows thickness of zinc at any location to be less than 75 microns.
- 5.02.08 Each 2.5M long section of all types of cable trays & each fittings like elbow, tees, crosses etc. shall be provided with two nos. hot dip galvanised side coupler plates & associated bolts, nuts and washers on each side.
- 5.02.09 The Contractor shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and that such tests are

adequate to demonstrate that the equipment will comply with the requirement of this specification.

The tolerance on dimensions shall be in accordance with appropriate Indian Standards. The extent of the tests to be performed by the contractor shall include but not be limited to the following:

Deflection Test

A 2.5 metre straight section of each type of cable trays shall be simply supported at the two ends. A uniformly distributed load of 100 Kg per metre will be applied along the length of the tray. The maximum deflection at mid span shall not exceed 7 mm.

- 5.02.10 For other details refer CABLING NOTES AND DETAILS annexed to this specification.
- 5.03.00 **Conduits and Accessories**
- 5.03.01 Conduits shall be of rigid steel, hot-dip galvanised, furnished in standard length of 5 metres, threaded at both ends.
- 5.03.02 Conduits diameter upto and including 25mm size shall be of 16 SWG and conduits above 25 mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 20 mm.
- 5.03.03 Each piece of conduit shall be straight, free from blister and other defects, internal surface shall be of smooth finish and covered with capped bushings at both ends.
- 5.03.04 The contractor shall provide and install all rigid steel conduits, mild steel pipes, flexible conduits rigid PVC pipes etc. complete with accessories such as tees, bends, adopters, locknuts, pull boxes, conduit plugs, caps etc as required for the cabling work.
- 5.03.05 Steel conduits with interior coating of silicon epoxy ester for ease of wire/cable pulling shall be seamed by welding and fio-coat metal conduit/hot-dip galvanised. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS:9537. In chemical handling areas, Battery Room etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion. Conduits, fittings & accessories shall have ISI mark.
- 5.03.06 For sizes above 63 mm mild steel pipes with necessary fittings & accessories shall be provided and installed by the contractor. Pipes shall be manufactured by electric welding process. These pipes shall be of heavy duty class as per IS:1239 and shall have ISI mark. Pipes shall be supplied in lengths of approximately 5 metres. Pipes, fittings & accessories shall be hot dip galvanised both on inside and outside.

- 5.03.07 Flexible conduits shall comply with IS:3480. They shall be made with bright, cold-rolled, annealed and electro-galvanised mild steel strips. Flexible conduits shall be used between embedded conduits/pipes and the motor terminals. Flexible conduits shall also be used between fixed conduit and any equipment terminal boxes where vibration is anticipated or equipment that require regular removal.
- 5.03.08 Rigid PVC conduits conforming to IS:4985 shall generally be used for control & instrumentation cables in some areas where cable trays do not exist and where the runs are straight ones generally the PVC pipes with special Bell Mouthing shall be of 110 mm, 160 mm & 200 mm outside diameter and shall be suitable for working pressure of 6 kg/sq. cm. The length of each pipe shall be 5 to 6 metres. Necessary fittings & accessories as may be required for the installation shall also be provided.
- 5.04.00 **Junction Boxes**
- 5.04.01 Junction boxes shall be of 16 SWG sheet steel hot-dip galvanised, out-door type, dust vermin and damp proof, generally conforming to IP 55.
- 5.04.02 Junction boxes shall be complete with neoprene gasketed inspection cover, conduit knock out, terminal blocks and painted with one coat of red oxide primer and two finishing coats of light grey (shade 631 of IS-5) synthetic enamel paint.
- 5.04.03 Junction boxes for outdoor use shall be weather proof IPW-55 and those for hazardous location shall be flame-proof type. Outdoor junction boxes shall be epoxy painted.
- 5.04.04 Junction boxes shall be of two types viz one suitable for control wiring and the other with terminals for power cable terminations. Junction boxes for power cable terminations shall have minimum nine (9) nos. of terminals. Size of terminals shall be suitable to accommodate cables of sizes as required.
- 5.04.05 **The junction boxes shall have the following indelible markings :**
- Circuit nos. on top by white-stenciled paint at site.
 - Circuit nos. with ferrules (inside) as per approved drawing.
 - Danger sign in case of 415 V circuit.
- 5.04.06 Junction boxes shall be provided with tow nos (2) earthing terminals complete with nuts and washers suitable for connection to 8 SWG G.I. wire.
- 5.05.00 **Terminals**
- 5.05.01 Multiway terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.

- 5.05.02 Each control cable terminal shall be suitable for connection of 2 nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.
- 5.06.00 **Cable Termination & Jointing Kits**
- 5.06.01 The Bidder shall supply cable termination and jointing kits in requisite quantity for H.T. Power Cables, L.T. Power, Control Cables, Instrumentation Cables etc. along with all accessories & consumables required for making termination and joints complete. All the materials and components of the termination/joints shall be suitable and compatible with the type of cables for which the terminals/joints are intended.
- 5.06.02 The straight through joints of H.T. and L.T. cables shall be of Tapex/Paracast/Parawrap type. The end termination kits for H.T. cables shall be of Raychem/3M/Elastimold type. Cable joint or end terminations on Electrical equipment shall be suitable for Indoor & Outdoor use, as the case may be.
- 5.06.03 Glands and lugs required for termination of H.T., L.T. and instrumentation cables shall be supplied by the Contractor in required quantity.
- 5.07.00 **Cable Glands**
- Cable glands shall be tinned brass gland, double compression type complete with necessary armour clamp and tapered washer etc. Cable glands shall match with the sizes of different HT/LT/Control cables.
- 5.08.00 **Cable Lugs**
- Cable lugs shall be suitable for termination of different cross-sections of H.T./L.T./Control/Instrumentation cables and shall be of following types :
- i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.
 - ii) Copper tubular terminal end for solderless crimping to copper conductors.
- Solderless crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.
- iii) Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ring type/U type to suit the terminals provided in the panels.
- 5.09.00 **Consumables and Hardware**
- 5.09.01 The Contractor shall furnish all erection materials, hardware and consumables required to complete the installation.

5.09.02 The materials shall include but not be limited to the following :

Consumables : Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc.

Hardware : Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.
5.09.03 Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Contractor.

5.10.00 Testing Equipment

5.10.01 The major testing equipment that are required to be provided by the Contractor are listed below :

a) Insulation Tests

i) Power operated Meggar - 1 KV and 10 KV grade

ii) Hand operated Meggar - 1 KV grade

b) Hand driven earth Resistance Meggar, range 0-1/3/30 ohms.

c) High potential testing set - roller mounted type

d) Tong testers of suitable ranges.

e) Contact resistance measuring set for micro-ohms.

f) Torque wrench of various sizes.

g) Multimeters, test lamp, field telephone with buzzer set, different gauges etc.

5.10.02 The list of equipment is indicative only. Any other test equipments required will be arranged by the Contractor.

6.00.00 METHODS AND WORKMANSHIP

6.01.00 All work shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.

6.02.00 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

6.03.00 All details on installation shall be electrically and mechanically correct.

- 6.04.00 The installation shall be carried out in such a manner as to preserve access to other equipment installed.
- 7.00.00 **INSTALLATION**
- 7.01.01 Installation work shall be carried out in accordance with good engineering practices and also as per manufacturer's instructions/ recommendations where the same are available.
- 7.01.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.
- 7.01.03 Cable installation work shall mean erection of cable trays/racks, supports, hangers, junction boxes, conduits, laying of cables either in ground or on trays inside trenches tunnels/overhead trays in conduits etc. dressing and clamping, jointing and termination inclusive of supply of necessary jointing/termination kits, lugs, glands, ferrules, tapes etc. and other accessories, grounding of cable armour. In case of direct laying in ground, all excavation work, necessary back-filling, supply of bricks and protective concrete slabs, removal of excess earth shall be part of the installation work.
- 7.01.04 Grounding installation work shall mean erection, jointing/ brazing/welding, connection and painting, testing of ground conductors including supply of necessary steel/copper.
- 7.01.05 Lightning protection system installation work shall mean erection, jointing, welding, connection and painting, testing of air termination network, down conductors, shielding masts, connection to ground grid, electrodes, risers, horizontal conductors etc. of lightning protection system.
- 7.02.00 **Cable Trays**
- 7.02.01 Pre-fabricated cable trays and accessories shall be assembled & erected at site. Adequate spaces will be provided to facilitate installation of cable system and to allow routine inspection and modification after installation.
- 7.02.02 Cable trays either inside concrete trenches or inside buildings and racks inside cable shafts shall be aligned and leveled properly. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings.
- 7.02.03 As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.
- 7.02.04 The cable trays shall be supported in general at a span of exceeding 1.25 metres horizontally and 1.0 metre vertically.
- 7.02.05 Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access, for installing and maintaining the cables.

- 7.02.06 Complete cable tray support structure after installation shall be inspected/tested for welding strength, straightness, accuracy, use of proper sizes and compliance to drawings.
- 7.02.07 Complete cable tray and accessory installation work shall be inspected/tested for proper alignment, leveling, use of proper accessories, high quality workmanship etc.
- 7.02.08 The Contractor shall remove the RCC/steel trench covers whenever required and shall again place the same in their positions after the erection work in the particular area is completed or when further work is not likely to be taken up for some time.
- 7.02.09 Whenever any pipe/conduit/cable tray emerges out or enters into a building care should be taken to ensure that no water enters into the building.
- 7.02.10 Cable trays in areas subject to excessive coal dust, oil spillage, mechanical damage or accessible to personal contact shall be provided with raised sheet metal tray covers, installed on upper tray in horizontal run and front in vertical run.
- 7.02.11 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way.
- 7.02.12 Cable tray/conduit system will be so designed as to accommodate maximum pulling tension and minimum bending radius of cable.
- 7.02.13 Cable tray/conduit system will be constructed to prevent drainage of water into equipment or building.
- 7.02.14 Cable tray/conduit system shall be electrically continuous and grounded.
- 7.02.15 Different voltage grade cables will be laid in separate trays when trays are run in tier formation. Power cables will normally be on top trays and control/instrumentation cable on bottom trays.
- 7.03.00 **Cable and Conduits**
- 7.03.01 The Contractor shall install, terminate and connect up all cable and conduits as per drawings and cable schedules.
- 7.03.02 The drawings shall be strictly followed except where obvious interference occurs. In such cases, the routing shall be changed as directed and/or approved by the Engineer.
- 7.03.03 Approximate lengths of cable and conduit runs will be shown by the contractor in the cable schedule for guidance only. Before commencement of work the Contractor shall take actual measurements and prepare his own cable-cutting schedule to reduce wastage to a minimum.

- 7.03.04 The Contractor shall also maintain and submit when requested, a record of cable insulation value when drawn from store, after laying, before and after termination/jointing.
- 7.03.05 Where direct heat radiation exists, heat isolating barriers, shall be adopted for cabling system.
- 7.03.06 Cabling/wiring in offices, laboratories, control rooms etc. shall be taken through concealed G.I. or rigid PVC pipes as directed by the owner's Engineer.
- 7.03.07 At certain places where hazardous fumes/gasses may cause fire to the cables, cable trenches after installation of cables shall be sand filled.
- 7.04.00 **Conduit and Accessories**
- 7.04.01 Conduit/pipes shall be used only in short lengths in certain areas where required and/or as directed by the Engineer.
- 7.04.02 The Contractor shall furnish all conduits complete with accessories as required.
- 7.04.03 Conduits shall be flexible type in general. However, rigid type steel conduit if required shall also be supplied by the Contractor.
- 7.04.04 Except for inside an enclosure wherever the cable enters or leaves the conduit, the conduit end shall be sealed by suitable sealing compound, having fire withstand capability.
- 7.04.05 The entire metallic conduit system, when embedded or exposed shall be electrically continuous and grounded.
- 7.04.06 Where it is possible for water or other liquids to enter conduits, sloping of conduit runs and drainage of flow points shall be considered.
- 7.04.07 Pull boxes will be installed between termination points where required to facilitate cable pulling, but at a maximum interval of 30 meters.
- 7.04.08 Conduits shall be firmly fastened within 900 mm of each junction box/pull box/cabinet/fitting etc. Conduits shall be supported at least every 2000 mm.
- 7.05.00 **Cables : Storage and Handling**
- 7.05.01 Cable drums shall be stored on hard and well-drained surface so that they may not sink. In no case shall the drum be stored on the flat, i.e., with flange horizontal.
- 7.05.02 Rolling of drums shall be avoided as far as practicable, for short distance, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum.
- 7.05.03 In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cable.



QUALITY PLAN

CUST. NO. :

PROJECT

SPECIFICATION :

BIDDER/
VENDOR
SYSTEM

TITLE

NUMBER :

SHEET 1 OF 2

QUALITY PLAN
NUMBER PED-507-00-Q-005/02SPECIFICATION
TITLE

ITEM : CABLE TRAYS & ACCESSORIES

SECTION

VOLUME III

SL NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW-MATERIAL											
1.1	ROLLED SHEET	1.SURFACE FINISH	MA	VISUAL	100%	IS-1057/ TECH. SPEC.	IS-1057/ TECH. SPEC.	QC RECORD	2			
		2.DIMENSIONS	MA	MEASUREMENT	100%	-DO-/IS-1730	-DO-/IS-1730	-DO-	2			
		3.CHEM.& PHY PROPERTY	MA	VERIFICATION OF TC	100%	IS1079/TECH SPEC	IS1079/TECH SPEC	MILL TC	3/2			
1.2	ZINC	CHEM.COMP.		CHEM TEST	EACH HEAT	IS-209	IS-209	TC	3/2		1/2	
2.0	IN-PROCESS											
2.1	FABRICATION	1.DIMENSIONS & DISTORTION	MA	MEASUREMENT	100%	APPD.DRG.	APPD.DRG.	QC RECORD	2			
		2.SURFACE FINISH	MA	VISUAL	100%		FREE FROM BURRS	-DO-	2			
		3.WELDING QUALITY	MA	VISUAL	100%	GOOD WELDING PRACTICE	FREE FROM DEFECTS & SLAG	-DO-	2			
		4.RIGIDITY (CABLE TRAYS)	MA	DEFLECTION TEST	2 OF EACH SIZE	BHEL SPEC.	BHEL SPEC	-DO-	2			
2.2	SURFACE PREPARATION	1.CLEANING PICKLING & RINSING, BATH STRENGTH/ PURITY & TEMPERATURE	MA	CHEM. & MEASUREMENT	PERIODIC IN EACH SHIFT	IS:2629	IS:2629	QC RECORD	2			
		2. SURFACE QUALITY	MA	VISUAL	100%	-DO-	-DO-	-DO-	2			

BHEL

PARTICULARS

BIDDER/VENDOR

NAME

SIGNATURE

DATE

BIDDER'S/VENDORS COMPANY SEAL



QUALITY PLAN			CUSTOMER :			PROJECT			SPECIFICATION :		
SHEET 2 OF 2			BIDDER/ VENDOR SYSTEM			TITLE			NUMBER :		
SL. NO	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III	REMARKS
1	2	3	4	5	6	7	8	9	P	W	V
2.3	GALVANISING	1.TEMPERATURE OF ZINC BATH 2.DURATION OF DIP 3.SURFACE QUALITY	MA MA MA	TEMPERATURE INDICATOR VISUAL VISUAL	CONTINUOUS -DO- 100%	IS-2629 MANUFS.PRACT -DO-	IS-2629 MANUFS.PRACT FREE FROM BURRS, ROUGHNESS, SLAG FLUX, STAIN, ETC.	-DO- -DO- -DO-	2 2 2		
3.0	FINISHED ITEMS	4.GROSS QUANTITY & AGITATION	MA	TEST	PERIODIC	RELEVANT:IS	RELEVANT:IS	-DO-	2		
3.1	(CABLE TRAY, ACCESSORIES & HARDWARES)	1.DIMENSIONS DISTORTION 2.SURFACE FINISH	MA MA	MEASUREMENT VISUAL	IS-2500 (1) LEVEL IV -DO-	APPD. DRG APPD. DRG	APPD. DRG FREE FROM BURRS, SLAG, ROUGHNESS, FLUX, STAIN, ETC.	INSP.REPORT -DO-	2 2	1 1	
		3.RIGIDITY (FOR TRAYS) 4.WEIGHT OF ZINC COATING 5.UNIFORMITY OF ZINC COATING 6.THICKNESS OF ZINC COATING 7.ADHESION	MA MA MA MA MA	DEFLECTION TEST CHEM. TEST -DO- ELCOMETER MECH.TEST	1 OF EACH SIZE IS-4759 -DO- -DO- IS-4759	BHEL SPEC. IS-6746 IS-2633 BHEL SPEC.	BHEL SPEC. BHEL SPEC. IS-2633 BHEL SPEC.	-DO- -DO- -DO- -DO-	2 2 2 2 2	1 1 1 1 1	BOLT AND NUTS SHALL BE OF REPUTED & APPROVED MAKE
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								

(74)



QUALITY PLAN

CUSTOMER :

PROJECT

SPECIFICATION :

NUMBER :

BIDDER/
VENDOR
SYSTEM

QUALITY PLAN

NUMBER PED-607-00-Q-008/02

SPECIFICATION :

TITLE

ITEM : CABLE TRAYS & ACCESSORIES

SHEET 1 OF 2

SL NO	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL											
1.1	ROLLED SHEET	1.SURFACE FINISH	MA	VISUAL	100%	IS-1057/TECH. SPEC.	IS-1057/TECH. SPEC.	QC RECORD	2			
		2.DIMENSIONS	MA	MEASUREMENT	100%	-DO-/IS-1730	-DO-/IS-1730	-DO-	2			
		3.CHEM.& PHY. PROPERTY	MA	VERIFICATION OF TC	100%	IS1079/TECH SPEC	IS1079/TECH SPEC	MILL TC	3/2			
1.2	ZINC	CHEM.COMP.		CHEM TEST	EACH HEAT	IS-209	IS-209	TC	3/2		1/2	
2.0	IN-PROCESS											
2.1	FABRICATION	1.DIMENSIONS & DISTORTION	MA	MEASUREMENT	100%	APPD.ORG.	APPD.ORG.	QC RECORD	2			
		2.SURFACE FINISH	MA	VISUAL	100%		FREE FROM BURRS	-DO-	2			
		3.WELDING QUALITY	MA	VISUAL	100%	GOOD WELDING PRACTICE	FREE FROM DEFECTS & SLAG	-DO-	2			
		4.RIGIDITY (CABLE TRAYS)	MA	DEFLECTION TEST	2 OF EACH SIZE	BHEL SPEC.	BHEL SPEC	-DO-	2			
2.2	SURFACE PREPARATION	1.CLEANING PICKLING & RINSING. BATH STRENGTH/ PURITY & TEMPERATURE	MA	CHEM. & MEASUREMENT	PERIODIC IN EACH SHIFT	IS:2629	IS:2629	QC RECORD	2			
		2. SURFACE QUALITY	MA	VISUAL	100%	-DO-	-DO-	-DO-	2			
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
BIDDER'S/VENDORS COMPANY SEAL												

QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :				
SHEET 2 OF 3		BIDDER/ VENDOR SYSTEM		QUALITY PLAN NUMBER PED-507-00-Q-00502			SPECIFICATION : TITLE				
SL NO	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS	
1	2	3	4	5	6	7	8	9	P W V	11	
2.3	GALVANISING	1.TEMPERATURE OF ZINC BATH	MA	TEMPERATURE INDICATOR	CONTINUOUS	IS-2629	IS-2629	-DO-	2	.	.
		2.DURATION OF DIP	MA	VISUAL	-DO-	MANUFS.PRACT	MANUFS.PRACT		2	.	.
		3.SURFACE QUALITY	MA	VISUAL	100%	-DO-	FREE FROM BURRS ROUGHNESS, SLAG FLUX, STAIN, ETC.	-DO-	2	.	.
		4.GROSS QUANTITY & AGITATION	MA	TEST	PERIODIC	RELEVANT:IS	RELEVANT:IS	-DO-	2	.	.
3.0	FINISHED ITEMS	1.DIMENSIONS DISTORTION	MA	MEASUREMENT	IS-2500 (1) LEVEL IV	APPD. DRG	APPD. DRG	INSP.REPORT	2	1	.
3.1	(CABLE TRAY, ACCESSORIES & HARDWARES)	2.SURFACE FINISH	MA	VISUAL	-DO-		FREE FROM BURRS, SLAG, ROUGHNESS, FLUX STAIN, ETC.	-DO-	2	1	.
		3.RIGIDITY (FOR TRAYS)	MA	DEFLECTION TEST	1 OF EACH SIZE	BHEL SPEC.	BHEL SPEC.	-DO-	2	1	.
		4.WEIGHT OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-6745	BHEL SPEC.	-DO-	2	1	.
		5.UNIFORMITY OF ZINC COATING	MA	-DO-	-DO-	IS-2633	IS-2633	-DO-	2	1	.
		6.THICKNESS OF ZINC COATING	MA	ELCOMETER	-DO-	BHEL SPEC.	BHEL SPEC.	-DO-	2	1	.
		7.ADHESION	MA	MECH.TEST	IS-4759	IS-2629	IS-2629	-DO-	2	1	.
BHEL			PARTICULARS NAME		BIDDER/VENDOR						
			SIGNATURE								

QUALITY PLAN		CUSTOMER			PROJECT			SPECIFICATION		
SHEET 1 OF 6		BIDDER/VENDOR			TITLE			NUMBER		
SYSTEM		CAT.			REFERENCE DOCUMENT			ACCEPTANCE NORM		
SL. NO.	DESCRIPTION/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION	VOLUME III
1	2	3	4	5	6	7	8	9	P	W
1.0	RAW MATERIAL & BOUGHT OUT CONTROL									
1.1	SHEET STEEL/CHANNELS	1. DUCTILITY	CR	BEND TEST	SAMPLE	IS-1079/IS-513/IS-226	IS-1079/IS-513/IS-226	LOG BOOK	3/2	2
		2. SURFACE FINISH DEFECTS	MA	VISUAL	100%	FACTORY STD	NO RUSTING	-DO-	3/2	
		3. THICKNESS	MA	MEASUREMENT	100%	BHEL SPEC./IS-1730	BHEL SPEC./IS-1730	-DO-	3/2	2
1.2	WIRES	1. SURFACE DEFECTS.	MA	VISUAL	100%	BHEL SPEC./IS-1554/IS-694/RELEVANT. IS	BHEL SPEC./IS-1554/IS-694/RELEVANT. IS	-DO-	3/2	
		2. IR, HV, IR	MA	ELECTRICAL	SAMPLE	-DO-	-DO-	-DO-	3/2	
		3. TYPE / ROUTINE TESTS	MA	VERIFICATION OF TYPE / ROUTINE TEST CERTIFICATE	100%	-DO-	-DO-	MFR'S TEST CERT.	3	1.2
1.3	ZINC INGOT FOR GALVANISING	CHEM. COMP.	MA	CHEM. TEST	EACH	IS-209	IS-209	TEST CERT	3/2	1.2
BHEL			PARTICULARS			BIDDER/VENDOR				
			NAME							
			SIGNATURE							
			DATE							
BIDDER'S/VENDOR'S COMPANY SEAL										

QUALITY PLAN		CUSTOMER		PROJECT		SPECIFICATION						
SHEET 3 OF 6		BIDDER/VENDOR		TITLE		NUMBER						
SYSTEM		QUALITY PLAN		NUMBER PED-508-00-Q-005/01		SPECIFICATION						
ITEM : LCC'S / M. BOXES / JN. BOXES		SECTION		VOLUME III		REMARKS						
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	GENCY	P	W	V
1	2	3	4	5	6	7	8	9	10	11		
2.3	SURFACE PREPARATION AND PRE-TREATMENT (7 OR 8 TANK PROCESS)	1. PROCESS PARAMETERS LIKE BATH TEMP, CONCENTRATION, DIPPING/ REMOVAL TIME	MA	PROCESS CHECK	PERIODIC	BHEL SPEC., MFR. SPEC., IS-6005	BHEL SPEC., MFR. SPEC., IS-6005	LOG BOOK	3/2	.	.	IF SAND/SHOT BLASTING, ACID PICKLINGS IS NOT REQUIRED.
		2. SURFACE QUALITY AFTER EVERY DIP	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	.	.	
2.4	PRIMER APPLICATION & PAINTING	1. SURFACE FINISH & COVERAGE	MA	VISUAL	100%	MFR. SPEC., IS-6005	MFR. SPEC., IS-6005	LOG BOOK	3/2	.	.	
		2. FILM THICKNESS	MA	MEASUREMENT	100%	-DO-	-DO-	-DO-	3/2	.	2	
		3. SHADE	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	.	2	
		4. ADHESION	MA	SCRATCH TEST / CROSS CUT TAPE	TEMPLATE	-DO-	-DO-	-DO-	3/2	.	2	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
BIDDER'S/VENDOR'S COMPANY SEAL												

QUALITY PLAN		CUSTOMER		PROJECT			SPECIFICATION				
SHEET 4 OF 6		BIDDER/VENDOR SYSTEM		QUALITY PLAN NUMBER PEM-6041-0-005/01			SPECIFICATION NUMBER				
SL. NO.	EVENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION GENCY VOLUME III		
1	2	3	4	5	6	7	8	9	P	W	V
2.5	WIRING, GASKET, NAME PLATE, COMPONENT MOUNTING ETC.	1. WIRING LAYOUT	MA	VISUAL	100%	APPD. DRGS & SPEC.	APPD. DRGS & SPEC.	LOG BOOK	3/2	.	.
		2. WORKMANSHIP AND FINISH CORRECTNESS COMPLETENESS	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	.	.
2.6	GALVANISATION PROCESS	1. TEMP OF ZINC BATH	MA	TEMP. INDICATOR	CONTINUOUS	IS-2629	IS-2629	QC RECORD	2	.	.
		2. DURATION OF DIP	MA	VISUAL	-DO-	MANUFACTURER PRACTICE.	MANUFACTURER PRACTICE.	-DO-	2	.	.
		3. SURFACE QUALITY	MA	VISUAL	100%	-DO-	FREE FROM ROUGHNESS, FLUX, STAIN ETC.	-DO-	2	.	.
		4. GROSS QUANTITY & AGITATION	MA	TESTS	PERIODIC	RELEVANT. IS	RELEVANT. IS	-DO-	2	.	.
3	FINAL INSPECTION										
3.1	COMPLETE JUNCTION BOX/LCC'S MARSHALLING BOXES	1. WORKMANSHIP & FINISH, PAINT SHADE/GALV. THICKNESS & ADHESION	MA	VISUAL	100%	BHEL SPEC. APPD. DRG RELEVANT. IS	BHEL SPEC. APPD. DRG RELEVANT. IS	INSPN REPORT	3/2	2.1	.
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE								
BIDDER'S/VENDOR'S COMPANY SEAL											

QUALITY PLAN		CUSTOMER		PROJECT		SPECIFICATION						
SHEET 5 OF 6		BIDDER/VENDOR		TITLE		NUMBER						
SYSTEM		ITEM : LOC'S / M. BOXES / JN. BOXES		SPECIFICATION		TITLE						
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III	REMARKS	
1	2	3	4	5	6	7	8	9	10	11		
		2. UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	IS-8368	IS-2633	IS-2633	INSPN REPORT	2	1		
		3. THICKNESS OF ZINC COATING	MA	ELCOMETER	-DO-	BHEL SPEC.	BHEL SPEC.	-DO-	2	1		
		4. WIRING LAYOUT	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	2,1		
		5. COMPONENT LAYOUT & FIXING, ACCESSIBILITY AND SAFETY	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	2,1		
		6. COMPONENT IDENTIFICATION (MARKING/ NAME PLATES)	MA	VISUAL	100%	APPD. DRG.	APPD. DRG.	-DO-	3/2	2,1		
		7. PROPER WIRE TERMINATION	MA	PULLING	SAMPLE	-DO-	NO LOOSE CONNECTIONS. ALL TERMINATION TO BE LUGGED	-DO-	3/2	2,1		
		8. DOOR LOCK FUNCTIONING	MA	OPERATON	100%	APPD. DRG	NO MISMATCH	-DO-	3/2	2,1		
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
BIDDER'S/VENDOR'S COMPANY SEAL												



QUALITY PLAN

CUSTOMER

PROJECT

FORM NO. PEM-8041-0

SPECIFICATION

NUMBER

SPECIFICATION

TITLE

SECTION

VOLUME III

AGENCY

REMARKS

P

W

V

SL. NO

COMPONENT/OPERATION

CHARACTERISTICS CHECK

CAT.

TYPE/
METHOD OF
CHECKEXTENT OF
CHECKREFERENCE
DOCUMENTACCEPTANCE
NORMFORMAT
OF RECORD

P

W

V

REMARKS

1

2

3

4

5

6

7

8

9

10

11

9. OVERALL
DIMENSIONS

MA

MEASUREMENT

100%

APPD. DRG.

APPD. DRG.

INSPN.
REPORT

3/2

2.1

10. CONTINUITY

CR

ELECTRICAL

100%

APPD. DRG.,
BHEL SPEC.,
& RELEVANT ISAPPD. DRG.,
BHEL SPEC.,
& RELEVANT IS

-DO-

3/2

2.1

11. IR-HV-IR

CR

ELECTRICAL

100%

-DO-

-DO-

-DO-

3/2

2.1

12. OPERATION
INTERLOCKS
ETC

CR

ELECTRICAL
OPERATION
AND FUNCTION
IN ENERGISED
CONDITION.

100%

-DO-

-DO-

-DO-

3/2

2.1

13. TEMP RISE
(IF APPLICABLE)

CR

ELECTRICAL

ONE/ TYPE/
SIZEBHEL SPEC.
RELEVANT ISBHEL SPEC.
RELEVANT IS

-DO-

3/2

2.1

14. DEGREE OF
PROTECTION &
FLAME/
EXPLOSION
PROOF

CR

WATER AND
DUST TESTS,
FLAME/
EXPLOSION
TESTS

ONE/ TYPE

-DO-

-DO-

-DO-

3/2

2

IR-HV-IR
TEST TO BE DONE
BEFORE OPERATIONAL TESTS

FLAME/EXPLOSION PROOF
TEST, IF SPECIFIED IN
BHEL SPEC.

NOTE:

IF TC'S FOR DEGREE OF PROTECTION/EXPLOSION PROOFNESS IS AVAILABLE FROM AN INDEPENDENT LABORATORY FOR IDENTICAL DESIGN (SIZE SHALL BE SMALLER THAN THAT INDICATED IN THE TO) THESE TESTS NEED NOT BE REPEATED.

BHEL

PARTICULARS


NAME

SIGNATURE

DATE

BIDDER/VENDOR


BIDDER'S/VENDOR'S COMPANY SEAL


		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
SHEET 1 OF 9		BIDDER/ VENDOR SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE				
					ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	RAW MATERIAL & BROUGHT 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-	INSPER. REPORT	3	-	-	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	-	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	-	
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	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			


SL. NO.		COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY			VOLUME III 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	-	-		
		4. INTERNAL FLOWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	-		
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO BREAKAGE ON OTHER PHY. DESIGN	-DO-	3	-	-		
		3. DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. / SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	-		
		4. PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	-		
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				


SL. NO.		COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1		2	3	4	5	6	7	8	9	P	W	V	11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	-	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		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	MANUF'S DRG.	MANUF'S DRG.	-DO-	3	-	2		
		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. 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	-	2		


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


			QUALITY PLAN SHEET 4 OF 8			CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
						BIDDER/ VENDOR SYSTEM			QUALITY PLAN NUMBER PED-508-00-Q-007/2 ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SPECIFICATION : TITLE		
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		
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	-			
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG.	MANFR'S DRG.	-DO-	3	-	-			
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	-			
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-			
1.11	SLIP RING	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.	MANUF'S SPEC.	-DO-	3	-	-			
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	-			
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 :		
SHEET 5 OF 9		BIDDER/ VENDOR SYSTEM			QUALITY PLAN NUMBER PED-508-00-Q-007/2			SPECIFICATION : TITLE				
					ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC/ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	3	-	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	3	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	3	-	2	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	3	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			


		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
SHEET 6 OF 9		BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-508-00-Q-007/2			SPECIFICATION : TITLE					
SYSTEM		ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION		VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11		
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	3	-	-	(FOR MOTORS OF 2MW AND ABOVE)
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	3	-	-	
		3.CORE LOSS & HOTOPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	3	-	2	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	3	-	-	FOR MV MOTOR
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	2	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	2	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	2	1	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	3	-	-	THREE DIPS TO BE GIVEN
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	3	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE						BIDDERS/VENDORS COMPANY SEAL			
			DATE									

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
		SHEET 7 OF 8		BIDDER/ VENDOR SYSTEM		QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
						ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	2	VERIFICATION FOR MV MOTOR ONLY
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	3	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	-	
		2.SOUNDNESS	CR	MALLET TEST & MV TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	3	2	1	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	3	2	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	3	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	3	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	3	-	2	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG/ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	3	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	3	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN SHEET 8 OF 9		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-508-00-Q-007/2			SPECIFICATION : TITLE		
				SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
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	3	1	1,2	NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	3	1,2	1,2	NOTE - 2
		3.VIBRATION	MA	-DO-	100%	IS-12075	IS-12075	-DO-	3	1,2	-	
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	3	2,1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	3	-	2,1	TC FROM AN INDEPENDENT LABORATORY NOTE-3
		6.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	3	2,1	-	
		7.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	3	-	2,1	NOTE-3
		8.PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	3	2,1	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN SHEET 9 OF 9		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-508-00-Q-007/2			SPECIFICATION : TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION VOLUME III		
									AGENCY		
1	2	3	4	5	6	7	8	9	10	11	
<p>NOTES:</p> <p>1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.</p> <p>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.</p> <p>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.</p> <p>4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION WITH THE CUSTOMERS, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p>											
BHEL			PARTICULARS		BIDDER/VENDOR			BIDDER'S/VENDORS COMPANY SEAL			
			NAME								
			SIGNATURE								
			DATE								

		QUALITY PLAN SHEET 1 OF 2		CUSTOMER :			PROJECT			SPECIFICATION :		
				BIDDER/			TITLE			NUMBER :		
				VENDOR			QUALITY PLAN			SPECIFICATION		
				SYSTEM			NUMBER PED-508-00-Q-008/0			TITLE		
					ITEM AC ELECT. MOTORS BELOW 75KW (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	P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	3	-	-	NOTE -1
2.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	3	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	3	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	3	-	-	
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	3	2.1	2.1	
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION :		
				BIDDER/ VENDOR			QUALITY PLAN			NUMBER :		
SHEET 2 OF 2		SYSTEM			NUMBER PED-506-00-Q-006/0			SPECIFICATION :			TITLE :	
					ITEM AC ELECT. MOTORS BELOW 75KW (LV)			SECTION			VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	3	1		
<p>NOTES:</p> <p>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</p> <p>2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p>3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW, ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.</p>												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

