Washing and screening of coarse and fine aggregates to remove fines, dirt or other deleterious materials shall be carried out by approved means as directed by the Engineer-in-charge.

The water cement ratio by weight shall be as given in IS 456 for severe exposure conditions including free moisture in the aggregates and slump should be suitable decided to provide good quality concrete work.

3.06.00 **Admixtures**

Admixtures may be permitted to be used in accordance with relevant IS codes to modify the rate of hardening or setting, to improve workability or as an aid to control concrete quality and protection to reinforcement bars against corrosion. The Owner reserves the right to direct the contractor to conduct laboratory tests or use test data, or other satisfactory reference before granting approval. The cost of all tests conducted shall be borne by the contractor. The admixture shall be used in strict accordance with the manufacturer's directions and/or as directed by the Owner. No extra payment will be made to the contractor on account of using admixtures.

Particular attention must be given to concrete placement because of the thin wall section and the presence of reinforcing steel. Consolidation of concrete shall be by vibration. Removal of air and water at the form surface shall be by vibration and rodding. Particular attention shall be paid to accurately shape the corners at all openings.

Point of discharge of the concrete in to the forms be 1500 mm max. above the concrete surface. Concrete shall be deposited in approximately level layers not greater than 400 mm deep unless permitted otherwise.

Concrete in the cooling tower shell in each lift shall be so laid that the no. of vertical or inclined construction joints are minimized to the extent possible. Horizontal construction joints shall be maintained at uniform spacing throughout the height of the cooling tower as per the directions of the Owner.

Special attention shall be paid to proper curing of vertical faces of the cooling tower shell so that these do not remain dry. All thin walled structural members shall be protected by means of curing agents. It is recommended to use a curing agent for the cooling tower shell providing additional protection like a single transparent cooling with a material based on vinyl mixed polymer. Inside face of the shell should be protected by a second pigmented coating of the same base material. Any other method of curing, if permitted by the Owner may be used.

Sampling and testing of concrete shall be carried out as stated in Technical Specification elsewhere and as per relevant Indian Standard Codes. However, following minimum tests shall be carried out, irrespective of whatever stated otherwise:

Test of compressive strength
Columns – 1 Set of 3 cubes per column

Shell-2 sets of 3 cubes per climbing section

3.07.00 **Cover to Reinforcement**

Unless indicated otherwise the clear concrete cover for reinforcement shall be as per IS Codes.

The correct cover shall be maintained by cement mortar spacers/cubes or other approved means, reinforcement for footing/pile caps, grade beam, and slabs on sub-grade shall be supported on pre-cast concrete cover block as approved by Engineer-in-charge. The use of pebbles or stones as cover blocks shall not be permitted.

The 28 days crushing strength of cement mortar cubes/pre-cast concrete cover blocks shall be at least equal to the specified strength of concrete in which the cubes / blocks are embedded.

The minimum clear distance between reinforcing bars shall be in accordance with IS:456 (latest edition) or as specified elsewhere in this specification.

All lapping of reinforcement bars in the cooling tower shell shall be by lapping as per relevant codal provisions. Prior approval of the Owner shall be taken for deciding the method of lapping the reinforcement bars in the shell.

3.08.00 **Checking of shell geometry**

The form work for shell shall be capable of adjusting to shell profile and thickness accurately, and rigidly braced to prevent deflection or movement during concreting.

The form work shall be rigid, shape preserving , tight fitting and easy to construct so as to ensure smooth concrete surfaces, no geometrical discontinuities and achieve a high degree of dimensional accuracy.

Check for absolute positions may be carried out from ground stations arranged at not more than 10 degree plan angle apart. Readings of horizontal radius shall be taken at every lift.

The shell shall be constructed within the dimensional tolerances as stipulated in clause 7.3 of IS: 11504. If the permissible dimensional tolerance are exceeded, the Owner will instruct the contractor, in writing, to stop construction of the shell. The Contractor shall then examine the situation and submit a report to the Owner who may require the contractor to demonstrate by calculations that the structural integrity of the shell will not be impaired as a result of the imperfections. The calculations shall be submitted to the Owner, for approval, before construction will be permitted to proceed.
If in the opinion of the Owner the calculations show that the integrity of the shell could be threatened, the Contractor will be required to submit to the Owner detailed arrangement and supporting calculations to set right the shell geometry for approval, before construction will be permitted to proceed.

The cost of carrying out the calculation, any remedial work required and idle time or any delays to the construction programme as a result of dimensional tolerances being exceeded will be borne by the contractor.

Adjustment to the tower shell line on the basis of the survey results shall be made gradually; limiting the maximum change of direction from the existing vertical shell profile to be not more than an angular change of 10 mm measured over 1m of height. Any such adjustment shall be made with full knowledge and consent of the Owner.

The contractor shall carry out an as-built-survey of each lift of the shell. The results of these checks will be recorded on a suitably developed drawing of the shell from which it will be possible to locate the survey check point. A copy of these results will be presented to the Owner prior to commencing the next shell pour.

The contractor’s shell construction procedures shall include for providing the Owner with the facilities and a reasonable time period as may be required to carry out an independent

check of the completed works.

Suitable communication system such as telephone, wireless equipments, etc. shall be provided by the contractor so that the communications are possible at different elevations of the tower from the ground during construction.

All piling work shall be carried out by specialist subcontractor approved by the Owner. Initial pile load test shall be carried out for at least 3 sets of piles for direct compression and lateral load.

Since the effective action of the piles will depend on the adopted method of construction, the contractor shall guarantee that the piles, as constructed by the sub-contractor, shall effectively transmit the maximum loads which can be imposed on the foundation soil and corresponding maximum deflections.

3.09.00 **General Requirements**

a) The basin slab shall be divided into two equal parts by a partition wall designed to withstand full hydrostatic pressure, with one side empty. The basin construction joints shall be made watertight by injection of chemical grout through nipples. The basin construction shall be tested for water tightness, in accordance with IS: 3370 (Part I) (Latest edition). The cost of the test and any rectification and re-test if required is deemed to be included in the contractor's quoted price. Any cost of filling and emptying of the basin and to rectify defects shall also be borne by the contractor.

b) PVC water stops shall be provided at all construction/ expansion joints of water retaining structures. 230 mm (min) wide and 10 mm (min) thick approved quality PVC water stop with central bulb shall be used where expansion joints are envisaged.

c) The basin floor of each compartment shall be provided with a slope of not less than 1 in 120 towards sump for dewatering. From sump, the water will be drained by C.I. drain pipe, embedded below the basin floor, into a drain chamber outside the tower basin or as per the arrangements described elsewhere in the tender document. Suitable sluice gates (rising spindle type) conforming to IS: 3042 or sluice valves shall be provided in the drain chamber or any other arrangement specified elsewhere in the tender document. Suitable operating platform with access ladders for operating the gates or valves and pipes, shall be provided in the drain box.

d) A 250 mm high sill shall separate the pond floor from the tower outlet.

e) Uniform surface on the top of basin floor shall be provided. In case undulated surface is observed, a top of layer of minimum 25 mm thick 1.3 mix mortar to be provided to achieve uniform surface.

f) Fill will be of film type supported on RCC beam. Film fill should be characterized by reduced air pressure losses, and shall not susceptible to clogging. Design and facing of the film fill shall be such as to expose high air/water surface with minimum air pressure

drop.

g) The sluice gates shall be structural steel with anti-corrosive coating specified elsewhere. Number of sluice gates and removable screen shall be two (2) per tower. Proper rubber seal shall be provided so as to avoid any leakage of water. The rubber seal provided for the sluice gates be tested in accordance with the relevant Indian Standard Code. Sluice gates shall be checked for water tightness and smooth operation in dry and wet conditions. Suitable facilities, as approved by the Owner, shall be provided for handling of sluice gates and screens.

h) Lean concrete below foundations, cold water basin, other liquid retaining structures and all underground structures, unless noted otherwise shall be at least 100 mm thick.

i) The R.C.C. structure of the Cooling Tower shall be painted on the exterior surface with two (2) coats of water proof cement paint of approved make and colour .

The interior surface of the Cooling Tower structure and the interior face of the Cooling Tower Basin, fill supporting beams, columns and bracings, raker columns etc. which are in contact with water / moisture shall be painted with one coat of primer and two coats water proof bituminous paint conforming to IS:3384 and IS:9862 respectively.

j) Unless noted otherwise all concrete surface which are in contact with the earth shall be applied with anticorrosive coat system.

k) Water proofing and plasticizer admixtures conforming to relevant IS codes may be added as per manufacturer's instruction to the concrete subject to approval of the Owner.

l) The tower shall be provided with two numbers external RC staircase, leading to a heavy duty door giving access to the distribution system. Staircase shall be minimum 1000 mm wide (clear), with landings of minimum width of 1000 mm at not more than 2500 mm height intervals unless approved otherwise. The stair shall have risers not exceeding 125 mm and treads 250 mm minimum. Anti-skid nosing at each step shall be provided.

m) Minimum size of all doors shall be 2100 mm high (clear) and 1200 mm wide (clear). The door shall be of steel with anti-corrosive coating of polyurethane as specified elsewhere. However, FRP material or equivalent may also be used subject to approval of the Owner. The door shall be air tight when closed.

n) The hand railing on both sides of the staircase shall be galvanized with three rails of 32 mm NB pipes conforming to medium class as per IS:1239, and posts conforming to medium class as per IS:1239 of 32 mm dia galvanized pipes spaced not more than 1.2 m centers. The top hand rail shall be at 1000 mm above the steps with an intermediate member at 550 mm height. The posts and runners shall be welded construction with round corners. Complete hand rail shall be applied with anticorrosive coating system as specified elsewhere. All galvanization works shall have 610 gm/sqm of deposit.

o) Approved walkways and platforms shall be provided inside the tower at distribution pipe level. These walkways and platforms shall provide safe and clear access to all sprayers and all distribution pipes. The clear width of walkway shall be 1.5m and clear head room shall not be less than 2 m. Radial gaps of 12 mm wide shall be provided at intervals in the walkways for discontinuity.

A reinforced concrete platform of 1500 mm clear width shall be provided around the tower valves. Other walkways shall be at least 600 mm wide with 50 mm (minimum) safety kerbs along each edge. Access ways shall be clear of all obstructions such as distribution pipe

support beams, drift eliminator support beams etc. The walkways shall be provided with transverse slots or other opening which will permit the free passage of air and water.
p) Hot double dip galvanized handrails as described above shall be provided on all sides where there is a risk of falling through the fill.

q) Reinforced concrete platforms 1.2 m clear width all around the tower circumference shall be provided on the tower for fixing of aviation warning light at levels specified elsewhere. 12 mm wide radial gaps shall be provided in the platform at suitable intervals for discontinuity. Adequate MS embedment shall be provided in each side of platform to facilitate maintenance of tower shell.

Two (2) diametrically opposite galvanized MS caged ladders, 600 mm wide, made out of 6 mm, x 10 mm flats for full height of the tower shall be provided as per IS: 3696.

r) MS rung ladders shall be hot dip galvanized ladder shall be 600 mm wide fabricated out of 60 mm x 10 mm flats with 20 mm dia. rungs at 300 mm centers. Stays shall be provided at every 2.25 m intervals connecting the ladder with the concrete shell. Upto throat level these ladders shall be on the exterior surface of the cooling tower and shall be continued along the inside surface of the tower up to the top of the tower.

Galvanised MS Safety cage shall be provided for all ladders and shall be fabricated out of 5 nos. verticals of 50 mm x 6 mm flats with 50 mm x 6 mm flat straps at 800mm centers.

A RCC landing of size not less than 750 mm x 1500 mm, with galvanized handrails and galvanized steel door to be provided at the throat for interchange. Intermediate landings of reinforced concrete of size not less than 750 mm x 1500 mm shall be provided at every 8 to 10 m height of the ladder.

Some of these landing levels shall be suitably adjusted to give access to aviation warning beacons for maintenance. Handrails as described above shall be provided on all platforms. The ladder leading to the top platform shall have approach from ground via the RCC staircase.

s) In order to provide approach for maintenance of shell (inside & outside faces), all platforms shall have 20 mm wide radial openings in the platform floor at locations approved by Owner. Adequate numbers of 75 mm internal diameter puddle flanged C.I. pipes shall be embedded in this platform for passing ropes during maintenance of tower shell.

t) All exposed structural steel work used in cooling towers shall be hot double dip galvanized unless it is coated with a separate anti-corrosive coating system. The minimum coating shall be 610 gm/sq.m and shall comply with relevant IS codes. Galvanizing shall be checked and tested in accordance with IS: 2629.Galvanization shall be followed by the application of an etching primer and anticorrosive hibuild epoxy coating system of DFT 260 microns. All welding shall be done before galvanizing. Any site joints required to be carried out after galvanizing shall be either flanged or screwed joints. Nails, nuts, bolts and all components coming in direct contact with water shall be of stainless steel of AISI 304 or equivalent.

u) Mix proportion in Cement-sand mortar for brick masonry work shall be 1:6 for 250 mm thick brickwork and cement-sand mortar (1:6) shall be used for 125 mm and 75 mm thick brickwork.Thickness of 1:6 cement-sand plaster on brick masonry shall be 18 mm for outside, 12 mm for inside and thickness of 1:4 cement-sand plaster shall be 6 mm for ceiling.

v) Materials for precast concrete components including joint fixing, lifting hooks and other exposed steel components shall conform to technical specification and other

points mention in the document.

3.10.00 **Grating**

Steel gratings, where required, shall be fabricated out of steel flats with minimum thickness of 6 mm. Thickness of fabricated grating shall be 32 mm with flats so arranged as to have a maximum opening of 25 mm or less. Treads for staircases, where needed, shall be of similar grating construction but provided with toe flats of 6 mm thick, and non-skid nosing in an approved manner extending up to 100 mm above the walkway surface. All steel gratings shall be galvanized and applied with anticorrosive coating specified elsewhere.

3.11.00 **Paving**

The finished ground level shall be paved for 3.0m width all round the outer edge of the cold water basin. The paving shall consist of 150 thick RCC slab of M-20 grade over soling. The minimum reinforcement shall be 10 mm dia spaced 150 mm center to center both ways top and bottom. The RCC slab shall be overlaid 100 mm thick M-10 PCC mat and 300 mm well compacted sand layer. All around peripheral RCC drain leading to drain chamber shall be suitably provided.

SECTION D1

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

STANDARD TECHNICAL SPECIFICATION FOR NDCT

DATASHEET A

DOCUMENT DISTRIBUTION SCHEDULE

STANDARD QUALITY PLANS

1.0 GENERAL:

1.1 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.

2.0 CODES AND STANDARD:

2.1 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.

a) Cooling Tower Institution of USA, Bulletin ATP-105: Acceptance Test Code for Industrial Water Cooling tower.

b) PTC-23: ASME Performance Test Code for Atmospheric Water Cooling equipment.

c) For Electrical, Civil Codes/ Standards refer respective Specification.

d) BS-4485 – Specification for Water Cooling Tower.

2.2 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.

3.0 DESIGN REQUIREMENTS:

3.1 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.

3.2 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.

3.3 The cooling tower shall be Natural Draft cross flow/ counter flow type as per enclosed Data Sheet-A.

3.4 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.

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

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.

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:**

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,

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.

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.

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.

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

10. Drawings, data and calculation on civil works :

l) 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.

1.0 GENERAL INFORMATION

	No. of Cooling Towers required	:	Four (04) nos.
	Location		Out door
	Duty		Continuous
	Type		Natural draft counter flow with PVC Splash , V Bar type
	Basin Sill level		EL (+) 0.8 M
	Finished ground level		EL (+) 0.5 M

2.0 DESIGN PERFORMANCE FOR EACH COOLING TOWER

2.1	Design Cooling water flow	:	38000 M^3/hr.
2.2	Design ambient wet bulb temp.	:	28.0 ^oC
2.3	Design inlet air wet bulb temperature.	:	28.0 ^oC
2.4	Approach w.r.t. design inlet air wet bulb temperature (viz. 28.0^oC)	:	5.0 ^oC
2.5	Cold water temperature	:	33 ^oC
2.6	Hot water inlet temperature	:	42 ^oC
2.7	Cooling Range	:	9 ^oC
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: • Static head w.r.t. FGL • Frictional losses within bidders T.P. with 10% margin • Velocity head	:	Not to exceed 15 MWC
2.10	Maximum permissible drift loss	:	Max. 0.005 %
2.11	Design pressure for hot water distribution system	:	5 kg/cm^2(g)
2.12	Maximum Basin Diameter	:	100 M
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.

2.14	Draft Margin	:	Min. 3% Margin
3.0	**SPECIAL FEATURES**		
3.1	Basin type		Sectionalized (two compartment) by partition wall. Each basin chamber shall have overflow arrangement and sludge pit end with necessary dewatering arrangement.
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 (+) 0.5 M
4.2	Maximum water level	:	EL (+) 0.5 M
4.3	Min. Water level	:	EL (-) 0.1 M
4.4	Storage capacity between Normal and minimum water levels.	:	6 minutes (Between Max. & Min. Water Level) of Cooling tower design Flow.
4.5	Invert level of CT Basin	:	EL (-) 0.6 M (at basin centre) & EL(-) 1.1M (at basin periphery)
4.6	Invert level of CW Channel near CT level	:	EL (-) 3.6 M
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 (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 5 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		4.1 M up to FGL (Ref Annexure-1)
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	:	0.6 M/Sec.

4.13	Maximum allowable effective velocity through gates at Min. Water Level	:	1.2 M/Sec.
4.14	Max. allowable effective velocity through screens at Min. Water Level	:	0.6 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 up to 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 each aviation lamp levels
5.5	Platform for access of BFV	:	Provided by Bidder.
6.0	**HOT WATER SUPPLY HEADER TERMINALS**	:	As per terminal point sketch –1 enclosed. CW return piping in BHEL scope 2500 Nb shall be terminated with centre line of pipe elevation as shown in sketch. Further Piping from T.P. with isolating Motorized B.F. Valves in each riser shall be in bidder's 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(motorised) 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	Stop Log gate with guides and sealing device for each cold water outlet sump/ channel.	:	Yes

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 and stop log gate 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 equipment supplied	**:**	Yes
7.12	Drift Eliminator	**:**	Yes
7.13	**Electrical**		
	As per electrical plant specification	**:**	Yes
7.14	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./ Hot Dip 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
8.8	Fills	:	PVC V Bar
8.9	Fill support col, beams & trusses	:	R.C.C
8.10	Louvers	:	R.C.C.
8.11	Drift eliminators	:	PVC UV Stabilised
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 **Below and 150 Nb** : Carbon steel as per IS 1239 (Heavy grade)