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| <p>are not constrained and there is no appreciable shift in centreline of pipe or the elevation of the supporting point on pipe due to sway. The design shall have provisions for adjusting the length to take up any slack and securely locking in position permanently once adjustment is done.</p> <p>7.4.27 Snubbers &amp; dampers shall be designed to take seismic/dynamic loads, thrust due to safety valve discharge. Effort shall be made to limit its use by judicious placement of rigid hangers.</p> <p>7.4.28 Bottom support spring hangers to be avoided as far as possible.</p> <p><b>Note:</b> In case, turbine steam stop valve is not anchored, steam hammer analysis of the main steam &amp; HP/LP By-pass pipe line on stop valve closing shall be carried out.</p> <p>7.5 <u>VALVES AND ACCESSORIES</u></p> <p>7.5.1 General Requirements</p> <p>7.5.1.1 All the control station configuration shall be as follows.</p> <p>(a) For Continuous Service requirement:</p> <ul style="list-style-type: none"> <li>(i) One (1) pneumatically/hydraulically operated control valve.</li> <li>(ii) One (1) motor operated isolation valve at the upstream side of control valve.</li> <li>(iii) One (1) manual operated isolation valve at the downstream side of the control valve.</li> <li>(iv) One (1) pneumatically/hydraulically operated bypass control valve.</li> <li>(v) One (1) motor operated isolation valve at the upstream side of the bypass control valve.</li> <li>(vi) One (1) manual operated isolation valve at the downstream side of the bypass control valve.</li> </ul> |                                                    |                |

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| <p>(vii) Non return valve in the common downstream line, for spray piping.</p> <p>(viii) Drain valves at upstream and downstream of the control valves.</p> <p>(b) For Intermittent Service requirement:</p> <p>(i) One (1) pneumatically/hydraulically operated control valve.</p> <p>(ii) One (1) motor operated isolation valve at the upstream side of control valve.</p> <p>(iii) One (1) manual operated isolation valve at the downstream side of the control valve.</p> <p>(iv) One (1) motor operated inching type regulating bypass valve.</p> <p>(v) One (1) motor operated isolation valve at the upstream side of the bypass valve.</p> <p>(vi) One (1) manual operated isolation valve at the downstream side of the bypass valve.</p> <p>(vii) Non return valve in the common downstream line, for spray piping.</p> <p>(viii) Drain valves at upstream and downstream of the control valves.</p> <p>7.5.1.2 All valves shall have cast/forged steel bodies with covers and glands of approved construction. The valves shall be provided with electric motors/solenoids and actuators as required.</p> <p>7.5.1.3 Locating the valves on vertical runs shall be avoided as far as possible</p> <p>7.5.1.4 All valves shall, unless otherwise approved, have ends prepared for butt-welding and the internal diameter shall be the same as the internal diameter of the pipes to be joined.</p> |                                             |                |

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| 7.5.1.5                                                                                                                                              | All valves shall receive tests at Manufacturer's or Contractor's works in accordance with the specific requirements of the approved Codes of Practice so that the same is acceptable to IBR where applicable. Valves shall be rising stem or otherwise as approved by the Owner.                                      |                |
| 7.5.1.6                                                                                                                                              | All valves shall function smoothly without sticking, rubbing or vibration on opening or closing.                                                                                                                                                                                                                      |                |
| 7.5.1.7                                                                                                                                              | Material, design, manufacture, testing etc. for all valves and specialties along with the accessories shall conform to the codes as specified or approved equivalent and acceptable to IBR.                                                                                                                           |                |
| 7.5.1.8                                                                                                                                              | By-pass valves shall be provided for high pressure and larger size valves (including control valves) as per standards followed and as felt necessary for smooth and easy operation, even though not specifically mentioned in the specification.                                                                      |                |
| 7.5.1.9                                                                                                                                              | Valves subjected to vacuum shall have sufficient long deep-seated packing. Valves in general shall preferably be of such design as to permit repacking while in service by providing back seating arrangement duly tested during manufacture.                                                                         |                |
| 7.5.1.10                                                                                                                                             | All valves shall have outside screwed spindles and screwed thread of spindle shall not pass through or into the stuffing box. Where valves are exposed to the weather, protective covers shall be provided for the spindles, which shall be subject to approval.                                                      |                |
| 7.5.1.11                                                                                                                                             | Valves requiring sealing water shall be adequately deep and shall be equipped with lantern ring to admit pressurised water for gland-sealing. Gland sealing water shall be tapped from one tapping point on the condensate extraction pumps discharge header and shall be reduced in pressure as per the requirement. |                |
| 7.5.1.12                                                                                                                                             | The stops which limit the travel of any valve in the "Open" or "Shut" position shall be arranged exterior to the valve body.                                                                                                                                                                                          |                |
| 7.5.1.13                                                                                                                                             | All regulating valves shall be designed to prevent erosion of the valve plugs and seats when the valves are operated partially opened. The valves shall have contoured plug.                                                                                                                                          |                |

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| <p>7.5.1.14 Approved access arrangements shall be provided for all valves and particular attention shall be given to those valves fitted with gearing, which require lubrication of the valve itself.</p> <p>7.5.1.15 Valves which cannot be operated from the floor or walkways shall be provided with suitable extension rods and linkages. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also. The extension shall be such that the hand wheel is at a height of approximately one metre above the level of the floor or platform from which the valve is to be operated. Where required, valves shall be provided with head-stocks and pedestals of rigid construction and where gears or level wheels are used, these shall be of cast steel or suitable quality cast iron with machine cut teeth. Where extension spindles are fitted, all thrust when opening or closing the valves shall be taken directly on the valve body. The extension linkage shall be so designed to take care of the thermal movements of the valve body with the pipe on which the valve is installed. The connection of the extension spindle to the valve stem shall be through a flexible coupling.</p> <p>The extension spindle shall be of the same material as that of the valve stem. The floor stands shall have column, not less than Group-B of ASTM-126. Necessary nuts and bolts for mounting the floor stands on foundation shall have to be provided. Adequate means of easy lubrication shall have to be provided for valves and operating extension components.</p> <p>7.5.1.16 Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position.</p> <p>7.5.1.17 Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Contractor shall supply the first fill of oil or grease for these parts. The Contractor shall supply a suitable manually operated grease gun for the standard type of nipple provided.</p> |                                                    |                |

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| 7.5.1.18                                                                                                                                             | The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction.                                                                                                                                                                      |                |
| 7.5.1.19                                                                                                                                             | All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.                                     |                |
| 7.5.1.20                                                                                                                                             | Plastic or bakelite valve hand wheels are not permitted.                                                                                                                                                                                                                                          |                |
| 7.5.1.21                                                                                                                                             | All valves shall be closed by rotating the hand wheel in a clockwise direction when looking at the faces of the hand wheel. The face of each hand wheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers. |                |
| 7.5.1.22                                                                                                                                             | Each valve hand wheel shall be fitted with a circular nameplate of approved material indicating the valve tag number, duty or service intended and the function of the valve. The nameplates shall incorporate the colour code corresponding to the service of the piping.                        |                |
| 7.5.1.23                                                                                                                                             | Wherever practicable, heavy valves of total weight including actuator, drive motor, integral by-pass etc equal to or greater than 500 kg shall be provided with suitable lugs to permit direct suspension by hanger rods or direct resting on bottom support, as applicable.                      |                |
| 7.5.1.24                                                                                                                                             | Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.                                                                                                                        |                |
| 7.5.1.25                                                                                                                                             | Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves.                                                                                                                                                                                                |                |
| 7.5.1.26                                                                                                                                             | The Bidder shall supply during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure /temperatures. They should include a parts list referring to the various materials used in the valve construction.                             |                |
| 7.5.1.27                                                                                                                                             | Gate valves below 100 NB shall be solid wedge/Flexible wedge type. Valves of 150/300 and size 100 NB and above shall be flexible wedge type.                                                                                                                                                      |                |

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| <p>However, for sizes 100 NB and above for temperature 300°C above, parallel slide gate valves shall be used.</p> <p>7.5.1.28 All sampling and root valves shall be of integral body bonnet type.</p> <p>7.5.1.29 For butterfly valves, Contractor shall guarantee that in the closed position and with a disc differential pressure as specified, the valves shall be water tight.</p> <p>7.5.1.30 Contractor shall guarantee that the operating mechanism shall open and close the valve under the specified maximum differential pressure within the time specified.</p> <p>7.5.2 Design Requirements</p> <p>7.5.2.1 Design working pressure and temperature as well as pressure rating of all valves and specialties has been listed in Annexure-II of this Section. Valves and Specialties are to be supplied conforming to specified pressure rating.</p> <p>7.5.2.2 Steel body gate valves shall preferably be in accordance with API-600 or other approved international standards.</p> <p>7.5.2.3 Carbon steel gate valves in size 40 NB and below shall be in accordance with API-602 or any other approved international standards.</p> <p>7.5.2.4 Globe valves shall generally conform to BS-1873 or approved international standards, subject to other requirement specified in the specification.</p> <p>7.5.2.5 Check valves shall conform to BS-1868 or approved international standards and shall be of swing check type for low pressure line and lift type NRV for high pressure line.</p> <p>The body seat for swing check valves shall be inclined at such an angle as to minimise chatter.</p> <p>To enable the internal parts to be examined or renewed without removing the valves from the pipe line, the flanged cover should be used. The body shall be stamped with an arrow to indicate the correct flow direction.</p> |                                             |                |

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| <p><b>7.5.2.6 Butterfly valves</b></p> <p>Butterfly valves shall conform to AWWA C –504 or BS: EN: 593 or equivalent Standard of required class/rating. Irrespective of design standard adopted (either AWWA C-504 or BS: EN: 593), the butterfly valves shall be POD (proof of design) tested as per AWWA C- 504. In case POD test has been conducted in the past, required certified documents, such as GA drawing, cross sectional drawing and test certificate shall be submitted to Employer for approval. In case such test was not conducted in the past, the same shall be conducted for this project as per AWWA C-504 for each design/rating being offered and furnish the documents for approval. Valves used for POD testing valves shall not be supplied.</p> <p>Butterfly valves shall be double flanged type for sizes above 300 NB. For sizes 300 NB and below valve shall be double flanged or lugged wafer type. Fabricated butterfly valves (POD tested) instead of cast body valves are acceptable for larger size (600 NB and above) provided testing features and face to face dimension of the valve are as per the relevant design standard (AWWA C 504 or BS: EN: 593 as the case may be). In such a case, the valve supplier shall submit the design calculations for selection of major dimensions such as body, shaft diameter, disc thickness etc.</p> <p>The Geometry, overall dimensions, laying length, body shell thickness, shaft diameter, and shaft torque value shall be as per design standard adopted and of applicable design class. For valves of sizes not covered in AWWA C-504 (which are designed as per AWWA C-504), the same shall be extrapolated.</p> <p>For valves designed as per AWWA C-504, valve flanges shall conform to ANSI B16.1 Class 125 for Cast Iron Valves and AWWA C 207 Class E for fabricated type. The counter flanges shall conform to AWWA C-207 Class E. For Valves designed as per BS: EN: 593, the flanges shall conform to relevant standard.</p> <p>For Condensate polishing plant all butterfly valves shall be of stainless steel construction, SS-316 (for body, disc and shaft). Seat/seat rings shall be of Teflon/titanium back up rings. Seal shall also be of Teflon only.</p> |                                                    |                |

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| <p><b>7.5.2.7 Safety Valve</b></p> <p>The safety relief valves shall be direct spring loaded type and shall be provided with casing levers. The valves shall be of rugged construction suitable for long periods of uninterrupted service. The safety relief valves shall conform to the requirements of ASME Boiler and pressure vessel code, Section-VIII and IBR as applicable and shall be installed as per recommended rules for the design of safety valve installations in ANSI B31.1.</p> <p><b>7.5.2.8 Motor Operated Valves</b></p> <p>(a) Motor operated valves shall be fitted with both hand and motor operating gears and where a by-pass valve is provided, this also shall be provided with both hand and motor operated gear and interlock to ensure that the by-pass valve is opened before the main valve. Each valve shall be complete with a device for automatically stopping the motor when the valve gate has reached the "full open" or "full close" position (with a minimum increase in the torque). The motor shall be placed in such a position relative to the valve that there is no possibility of leakage of liquid, steam or corrosive gas from valve joints on the motor or control equipment.</p> <p>(b) The hand operating and motor operating mechanism shall be so interlocked that the hand operating mechanism is disconnected before the motor is started. Valves shall be provided with seating control and except where specifically approved by the engineer for small valves, a slipping clutch or other torque-limiting device shall be incorporated in the motor drive. The opening or closing of the valve shall be controlled by means of push buttons labelled respectively "open" and "stop". The control shall be so arranged that the motor can be stopped with the valve in any position by means of "stop" push button and after having been stopped, can be re-started in either direction by the "open" or "close" push buttons. Hand operating mechanism shall be placed in an accessible position from the floor.</p> <p>(c) Necessary output signal (4-20 mA) shall be given for provision of positioning indicator in UCB.</p> |                                                    |                |

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| <p>7.5.2.9 For reheater isolation, for hydraulic testing as well as wet layup, reheater isolating devices shall be provided on cold reheat and hot reheat lines, at boiler outlet. Isolating device shall consist of a robust cast steel body with carbon steel (ASTM A216 GR WCB) material for cold reheat application and alloy steel (ASTM A217 GR WC 12) for hot reheat application suitable for pressure and temperature condition which device will be subjected. These shall be of welded type construction and shall form part of the pipeline during normal operation without any leakage. Before hydrostatic test, top cover and bonnets are removed and a separate test closure assembly with sealing rings are inserted to close the flow patch. The test closure assembly shall be of disc type construction with appropriate seal and a preloading lever to form a complete tight assembly for effective closure during hydraulic testing. Drains shall be provided on both side of the device to detect leakage.</p> <p>7.5.2.10 Drain Valves, Steam Traps and Strainers</p> <p>(a) Drain Valves</p> <p>All drain valves shall have cast or forged steel bodies with covers and glands of approved construction. Spindles shall be of stainless steel and the materials of internal parts shall be suitable for operation at the maximum working pressure and temperature of the piping to which they are connected. Valves shall be full-way type, unless otherwise specified and in full open position the bore of the valve shall not be obstructed by any part of the gate. The internal diameter of all valves at the bore and at the ends adjacent to the pipe work shall be similar to the internal diameter of the connecting pipe work. Valves shall be designed for continuous operation in partially open condition without erosion of the valve seats or faces. Where valve seats are shrouded, the design of the shroud shall be such as to prevent foreign matter lodging in the valve seat.</p> <p>All drain traps shall be complete with air cock and casing mechanism. All internal parts shall be constructed from approved material and shall be renewable. Trap bodies and covers shall be of cast or forged steel and shall be suitable for operation at the maximum working pressure and temperature of the steam piping to which they are connected.</p> |                                                    |                |

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| <div style="margin-left: 40px;"> <p>(b) Steam Traps and Strainers</p> <ul style="list-style-type: none"> <li>(i) The steam traps shall be thermo-dynamic type complete with integral or separate strainers.</li> <li>(ii) The internal components of traps shall be of AISI-316 stainless steel construction.</li> <li>(iii) All Y-type strainers, wherever provided with steam traps or otherwise, shall have AISI-316 stainless steel screen of not more than 20 mesh size. Screen open area shall be at least three (3) times the pipe internal cross-sectional area. The strainer shall have a screwed blow-off connection with a removable plug. Material of construction of the body shall be selected by the bidder based on the duty conditions specified.</li> <li>(iv) All traps and strainers shall have socket weld ends as per ANSI B16.11 for size 40 NB and smaller and butt weld ends as per B 16.25 for size 50 NB and above.</li> <li>(v) Steam drain traps shall be provided with strainers, inlet and discharge valves and by-passes and test cocks. Materials and other details of these valves shall meet the specified requirement.</li> </ul> </div> <div style="margin-top: 20px;"> <p><b>7.5.2.11 Pump Suction Strainer</b></p> <p>The strainer at condensate transfer pump should be removable type conical strainer assembly. The spool pipe shall have flanged ends suitable for direct mounting on condensate transfer pump suction flange. The material of construction of spool pipe shall be the same as that of pumps suction piping. The strainer element shall be of perforated sheet with aperture size of 6 mm and wrapped with AISI-316 stainless steel wire mesh of 500 micron nominal aperture. The clear opening area of the strainer shall be at least 5 times the pipe area.</p> </div> |                                                    |                |

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| <p><b>7.5.2.12 Non-return Valves</b></p> <ul style="list-style-type: none"> <li>(a) Non- return valves for steam services and on pump discharge sides shall be provided with dash pots, where required.</li> <li>(b) The body seat for swing check valves shall be inclined at such an angle as to minimise chatter.</li> <li>(c) To enable the internal parts to be examined or removed without removing the valves from the pipeline, the flanged cover should be used. The bodies shall be stamped with an arrow to indicate the correct flow direction.</li> <li>(d) Provision shall be made to drain both sides of a horizontal non-return valve where such a valve adjoins an isolating valve. For non-return valves mounted on vertical pipe, integral by-pass shall be used to facilitate draining as stated earlier.</li> </ul> <p><b>7.5.2.13 De-super heaters</b></p> <p>De-super heaters along with spray water supply and control system shall be provided on the auxiliary steam lines etc, as required. A de-superheater shall be designed for the design conditions of the piping on its upstream side and shall take care of its severe condition of working. The orientation of the unit must be such that the nozzles point downstream in the same direction as the steam flow. The unit can be installed in a vertical or horizontal pipe, with the best installation being in a vertical line with the flow upwards.</p> <p><b>8.0 <u>INSTALLATION AND CLEANING</u></b></p> <p><b>8.1 <u>INSTALLATION</u></b></p> <p><b>8.1.1</b> For all steam blown lines, temporary strainers shall be installed at the equipment terminals so as to prevent any inflow of particles where that may cause any damage or harmful effect. The temporary strainers shall be kept on line for sometime after the plant starts normal operation, as per the discretion of the Engineer. Where flow meters are to be installed in pipes requiring steam blowing, initially the pipes shall be erected with the flow</p> |                                                    |                |

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| <p>meter branch pipes replaced by temporary spool pieces. After the end of steam blowing operation, the temporary spool pieces shall be removed and the flow meter branch pieces shall be erected in position. In case such a pipe has also to be subject to cold pull- up, temporary anchoring of the main pipe on either ends of the temporary spool piece shall be done before replacing it by the flow-meter branch pipe.</p> <p>8.1.2 All piping shall be installed in a manner such that expansion will take place in the direction desired and so that vibrations will be minimised. Expansion provisions and flexibility of all field run piping shall be ensured. No piping shall be cold-sprung or cold-pulled unless there remains absolutely no other means to bring down the hot stress or terminal forces/moments within acceptable limit. All such cold pull up shall be shown in the piping drawings, along with a write-up describing clearly the method adopted for cold-pulling. All necessary attachments for cold-pulling, along with temporary anchors, as and wherever required, shall be provided.</p> <p>8.1.3 The forces and moments on the temporary anchors and attachments shall be submitted. The cold pull-ups and all the above-mentioned documents shall be subject to the approval of the Owner.</p> <p>8.1.4 All expansion bellows shall be installed with a minimum of two tie rods or bolts across each bellows to prevent the bellows from opening under pressure. The connection of the tie rods or bolts to the pipe shall make adequate provision for angular movement of the pipe and bellows.</p> <p>8.1.5 Pump suction pipes shall be installed in such a manner that no air can be trapped in the suction piping. Suction pipes shall be supported in such a manner that there will be no high spots where air can be trapped.</p> <p>8.1.6 Standard "Factory Made" fittings shall be used in all piping. Shop or site fabricated mitred fittings shall not be used.</p> <p>8.1.7 During erection, no weights must be lifted by means of tackle fastened to the beams or slabs of the floor or roof except where provision has been specifically made for this purpose.</p> <p>8.1.8 Supporting straps around flanges of pipes or valves or around welded joints will not be accepted. Anchors shall be attached to pipe by approved</p> |                                                    |                |

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| <p>means. All supports shall be shop fabricated and shall be positioned before erection of the piping takes place and near to joints and valves wherever possible.</p> <p>8.1.9 All the necessary wall boxes and collars where pipes pass through walls, floors and roofs along with necessary supports for any trenched pipes shall be provided. Roof collars shall be fitted with a high sealing to prevent water falling through the holes.</p> <p>The wall boxes and floor collars shall be constructed so that they can, if necessary, be erected after the pipes are in position. Pipes passing through roof collars shall be provided with an approved pipe sleeves, weather hood and cowl which shall be fixed by the Bidder. Floor collars shall extend to an approved height above the floor level and the pipes shall be fitted with hoods where required.</p> <p>8.1.10 Drain Pipe work</p> <p>High pressure drains (above 40 kg/cm<sup>2</sup>) shall have two valves in series and that near the condenser or flash box shall be motor operated and arranged to open and close to ensure minimum wear on one valve.</p> <p>High-pressure drains shall have a screw-down non-return valve at the point of discharge near the manifold of the Flash tank to prevent backflow of flashed steam.</p> <p>Low-pressure drains shall have steam traps of an approved design complete with strainers, isolating valves and by-pass valves.</p> <p>Low-pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained or as near as possible for convenient operation.</p> <p>Pipe wall thickness shall be as per international standard approved by Owner/Engineer during detailed engineering.</p> <p>Drain pockets of an approved size and construction shall be provided for all steam lines.</p> |                                                    |                |

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| <p>8.2</p>                                                                                                                                           | <p>Arrangement of valves in the drain line shall be as shown in the Bidder's P &amp; I Diagram.</p> <p><u><b>PRE-COMMISSIONING CLEANING WORK</b></u></p> <p>Chemical Cleaning of Piping Systems and Equipments</p> <p>8.2.1 It is intended to chemically clean the following piping system:</p> <ul style="list-style-type: none"> <li>(a) Boiler feed discharge piping</li> <li>(b) Heater drains piping</li> <li>(c) Main condensate piping</li> <li>(d) Extraction steam piping</li> </ul> <p>8.2.2 Before introducing chemicals, all the piping systems and equipment listed above shall be water flushed. Water flushing shall be followed by alkaline cleaning, acid cleaning and passivation or by EDTA (Ethylene Diamene Tetra Acid) and passivation.</p> <p>8.2.3 However, usual procedures and practices for chemical cleaning of the piping and equipment specified shall be submitted. All schematics, write up, details of chemicals to be used etc and detailed procedures to be followed shall be submitted. These schematics and procedures shall be subject to the approval of the Owner.</p> <p>8.2.4 Pre- cleaning procedure:</p> <p>Prior to starting any phase of cleaning operation, the following procedures shall be ensured:</p> <ul style="list-style-type: none"> <li>(a) Installation of all temporary piping, valves, pumps and equipments as required for the flushing and chemical cleaning operations. Temporary piping shall be routed at floor level as far as possible and secured in place to prevent movement/ vibration beyond acceptable limits.</li> </ul> |                |

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| <p>(b) Installation of the instruments as required to ensure satisfactory monitoring and control of the cleaning process. Locations for sampling of the cleaning solution during cleaning shall be determined and arranged.</p> <p>(c) Bypassing all regulation/control valves coming in the cleaning circuit or installation of temporary spool pieces.</p> <p>(d) Installation of special end covers and temporary suction strainers, for boiler feed pumps and condensate pumps. Pump internals shall not be installed.</p> <p>(e) Installation of plastic seal in the condenser neck to protect the turbine from alkaline fumes.</p> <p>(f) Blocking and securing of all spring hangers in the steam lines which may be flooded during the cleaning operation.</p> <p>(g) Hand cleaning of the interiors of all vessels which are included in the cleaning operation.</p> <p>8.2.5 Steam Blowing of Piping Systems</p> <p>(a) Steam blowing shall include engineering, supply and installation of all temporary piping, valves, fittings including quick actuating valves (for puffing purposes), supports, blanking plates, spools, target plates, instruments, controls and all other accessories and services required to complete the cleaning process as specified herein. The detailed schemes and procedure for steam blowing operations shall be prepared and furnished and discussed and finalized during the detailed engineering stage.</p> <p>(b) Steam blowing shall also include reinstatement of cleaned piping systems and dismantling/removal of all temporary piping, equipment and materials from site. All temporary piping, valves, equipment and materials shall be taken back upon satisfactory completion of cleaning and shall be removed from the Owner's premises.</p> |                                             |                |

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| <p>(c) Engineering involved regarding temporary piping shall include the following:</p> <ul style="list-style-type: none"> <li>(i) Selection of temporary piping including disturbance factor calculation.</li> <li>(ii) Preparation of layout for temporary piping and performing stress analysis as per ANSI B 31.1.</li> <li>(iii) Selection of temporary hangers and supports as required.</li> </ul> <p>(d) The following piping systems shall be cleaned through steam blowing operation.</p> <ul style="list-style-type: none"> <li>(i) Main steam, HRH, CRH, HP bypass &amp; LP bypass piping</li> <li>(ii) Auxiliary steam piping including TG gland sealing lines.</li> <li>(iii) Steam lines feeding turbines of boiler feed pumps.</li> </ul> <p>Steam blowing shall be carried out for removal of particles (rust, scales, weld splatter etc.) from various piping systems to avoid damage to turbine blades.</p> <p>Cleanliness of system shall be checked by means of test plates made of steel, which will be installed in the centre line of the piping system.</p> <p>(e) Cleaning shall be achieved by steam purging i.e. by blowing of steam through the piping such that the momentum of flow is greater than that of steam flow during normal operation of unit (at TMCR). The disturbance factor during steam blowing (ratio of momentum of flow during purge to that during TMCR) shall be more than 1.4.</p> <p>(f) The blow off shall be done with steam which is exhausted through adequately sized, open-ended temporary piping. Temporary piping and motor operated valves shall be installed for steam blowing operation. Pressure shall be built up in the boiler and the piping warmed before release of steam by quick opening of motor operated</p> |                                                    |                |

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| <p>valve located on temporary piping. The cycle shall be repeated until steam from the blow out pipe is determined to be clean.</p> <p>(g) If the flow nozzles and control valves etc have already been erected, these shall be removed and replaced by spool pieces before steam blowing. The removed flow nozzle and control valves etc shall be put back after steam blowing. The motor operated valves used for steam blowing shall have special characteristics like minimum loss of pressure, resistance to wear during severe working conditions (high velocity and carry over of water and solid particles), quick opening time, minimum effort on electric actuator etc.</p> <p>(h) The steam blowing termination criteria shall be as under:</p> <p>(i) Acceptable target plate condition</p> <p>(ii) Measured disturbance factor (DF) more than 1.4</p> <p>The required values to calculate actual DF shall be measured at site. The criteria for acceptable target plate condition shall be finalised during detailed engineering.</p> <p><b>9.0 <u>DRAWINGS, DATA, INFORMATION &amp; MANUALS</u></b></p> <p>9.1 For Drawing, Data and Information required along with BID refer <b>Volume VIII.</b></p> |                                                    |                |

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### ANNEXURE – I

#### LIST OF POWER CYCLE PIPING

The following list of power cycle piping is an indicative one and is provided for the guidance of the Bidder only. Items not mentioned but deemed necessary for making the system complete shall also be included.

| SR. NO. | NAME                                    |   | DESCRIPTION                                                                    |
|---------|-----------------------------------------|---|--------------------------------------------------------------------------------|
| 1.0     | Main Steam lines                        | : | From SH outlet to inlet of turbine                                             |
| 2.0     | Main Steam Equalising line              | : | Between RHS and LHS Main Steam lines                                           |
| 3.0     | HP By-pass line                         | : | Between Main Steam line and CRH line                                           |
| 4.0     | Cold Reheat line                        | : | Between HP turbine outlet and Reheater                                         |
| 5.0     | Extraction line from CRH                | : | Between CRH and Deaerator                                                      |
| 6.0     | Extraction line from CRH                | : | Between CRH and H.P. heater                                                    |
| 7.0     | Extraction line from MS equalising line | : | From MS equalising line to auxiliary steam header                              |
| 8.0     | Steam supply to BFP Turbine             | : | From the main and alternative source point to BFP Turbine Inlet                |
| 9.0     | Extraction from BFP discharge           | : | 1. Between BFP discharge and H.P. By-pass<br>2. Between BFP discharge and PRDS |
| 10.0    | Warm up line for HP By-pass             | : | Between MS line and H.P. By-pass line                                          |
| 11.0    | Hot Reheat lines                        | : | Between Reheater and I.P. turbine                                              |
| 12.0    | HRH equalising line                     | : | Between LHS and RHS Hot Reheat lines                                           |
| 13.0    | LP By-pass line                         | : | Between HR line and condenser                                                  |
| 14.0    | Warm up line for LP By-pass             | : | Between LP By-pass line and HR line                                            |

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| 15.0                                                                                                                                                 | CEP Suction line                                   | : | Between condenser hot well and CEP.                                                         |
| 16.0                                                                                                                                                 | Main condensate line                               | : | Between CEP outlet and Deaerator through GSC, CPU, Drain Cooler, L.P. heaters.              |
| 17.0                                                                                                                                                 | CEP Minimum Recirculation line                     | : | Between main condensate line after CEP to condenser.                                        |
| 18.0                                                                                                                                                 | GSC Minimum Recirculation line                     | : | Between main condensate line after GSC to condenser.                                        |
| 19.0                                                                                                                                                 | Deaerator filling line                             | : | Between Condensate Transfer pump discharge and deaerator                                    |
| 20.0                                                                                                                                                 | Boiler filling line                                | : | Between Condensate Transfer pump discharge and Boiler bottom ring header /economiser inlet. |
| 21.0                                                                                                                                                 | Fill up and Emergency                              | : | From Condensate Transfer pump discharge to make-up to condenser.                            |
| 22.0                                                                                                                                                 | DMCW make-up tank                                  | : | From Cycle make-up pump discharge to DMCW make-up tank.                                     |
| 23.0                                                                                                                                                 | Gravity Make-up to condenser                       | : | From condensate storage tank to condenser.                                                  |
| 24.0                                                                                                                                                 | Condensate Dump Line                               | : | Between M.C. line after GSC and condensate storage tank.                                    |
| 25.0                                                                                                                                                 | Cycle make-up Pump Recirculation                   | : | Between Cycle make-up pump discharge header and Condensate Storage Tank.                    |
|                                                                                                                                                      |                                                    |   |                                                                                             |

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| 26.0                                                                                                                                                 | Cycle make-up Pump Suction Line                            | : | From condensate storage tanks to Cycle make-up pump suction header. |
| 27.0                                                                                                                                                 | By-pass line                                               | : | For all control valves                                              |
| 28.0                                                                                                                                                 | By-pass lines for heaters (group bypass/individual bypass) | : | GSC, LP Heaters and HP Heaters.                                     |
| 29.0                                                                                                                                                 | CEP sealing line                                           | : | Bidder's choice.                                                    |
| 30.0                                                                                                                                                 | All extractions from main condensate line                  | : | For                                                                 |
|                                                                                                                                                      |                                                            |   | (a) Exhaust Hood spray                                              |
|                                                                                                                                                      |                                                            |   | (b) Turbine Flash Tank spray                                        |
|                                                                                                                                                      |                                                            |   | (c) L.P. By-pass spray                                              |
|                                                                                                                                                      |                                                            |   | (d) Water sealing of valves                                         |
|                                                                                                                                                      |                                                            |   | (e) Vacuum breaker line sealing                                     |
|                                                                                                                                                      |                                                            |   | (f) CEP sealing                                                     |
|                                                                                                                                                      |                                                            |   | (g) Analytical measurements                                         |
|                                                                                                                                                      |                                                            |   | (h) Alkali flushing                                                 |
|                                                                                                                                                      |                                                            |   | (i) Spray water to GSC desuperheater                                |
|                                                                                                                                                      |                                                            |   | (j) Sampling                                                        |
|                                                                                                                                                      |                                                            |   | (k) Instrument seal pot                                             |
|                                                                                                                                                      |                                                            |   | (l) Water sealing of valves & water washing of BFP Turbine          |
|                                                                                                                                                      |                                                            |   | (m) Spares                                                          |

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| 31.0                                                                              | Turbine flash tank drain and vent line             | : | From turbine Flash Tank drains to condenser hot well<br><br>From flash vessels vent to condenser steam space |
| 32.0                                                                              | BFP Suction lines                                  | : | Between Deaerator and individual BFP suction                                                                 |
| 33.0                                                                              | Main Feed Water Line                               | : | From BFP discharge through HP heaters, control station up to economiser inlet header                         |
| 34.0                                                                              | Steam turbine drive for BFP                        | : | Associated piping                                                                                            |
| 35.0                                                                              | Inlet line to attemperation water header           | : | From main feed water line to attemperation water header                                                      |
| 36.0                                                                              | Extraction from BFP                                | : | From BFP suction to sample cooler suction, BFP warm-up & Balance Leak-off line.                              |
| 37.0                                                                              | All extraction from Main Feed Water line           | : | (a) To Auxiliary Steam pressure reducing de-superheating station                                             |
|                                                                                   |                                                    |   | (b) Stub for alkali flushing                                                                                 |
|                                                                                   |                                                    |   | (c) HP By-pass spray                                                                                         |
|                                                                                   |                                                    |   | (d) Blind Stub                                                                                               |
|                                                                                   |                                                    |   | (e) Minimum re-circulation lines                                                                             |
| 38.0                                                                              | Extraction lines                                   | : | From various stage of turbine/CRH to L.P. Heaters, H.P. heaters, Deaerator and BFP Turbines.                 |
|                                                                                   |                                                    |   |                                                                                                              |

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| 39.0                                                                                                                                                 | All vents of H.P and L.P. heaters            | :                                                  | (a)                                              | L.P. Heater vents to Condenser                                         |
|                                                                                                                                                      |                                              |                                                    | (b)                                              | H.P. Heater vents to Condenser                                         |
| 40.0                                                                                                                                                 | All cascade drain connection between heaters |                                                    | (a)                                              | From each HP Heater to next lower pressure HP Heater                   |
|                                                                                                                                                      |                                              |                                                    | (b)                                              | From the lowest pressure H.P. heater to Dearator                       |
|                                                                                                                                                      |                                              |                                                    | (c)                                              | From each L.P. Heater to next lower pressure L.P. heater               |
|                                                                                                                                                      |                                              |                                                    | (d)                                              | From lowest pressure L.P. heater to flash vessel through drain cooler. |
| 41.0                                                                                                                                                 | All Drip connections to Flash Tanks          | :                                                  | (a)                                              | From H.P. Heaters                                                      |
|                                                                                                                                                      |                                              |                                                    | (b)                                              | From L.P. Heaters (except the lowest pressure L.P. heater)             |
|                                                                                                                                                      |                                              |                                                    | (c)                                              | From Gland Steam condenser                                             |
| 42.0                                                                                                                                                 | Air Steam mixture line from Turbine Glands   | :                                                  | (a)                                              | To GSC                                                                 |
|                                                                                                                                                      |                                              |                                                    | (b)                                              | To Atmosphere                                                          |
| 43.0                                                                                                                                                 | Vapour extraction line for GSC               | :                                                  | From GSC through vapour extractors to atmosphere |                                                                        |
| 44.0                                                                                                                                                 | By pass Line to GSC                          | :                                                  | Through desuperheater to atmosphere              |                                                                        |
| 45.0                                                                                                                                                 | Air steam mixture line from condenser        | :                                                  | To vacuum pumps                                  |                                                                        |
| 46.0                                                                                                                                                 | Drip connections to Deaerator                | :                                                  | From H.P. Heaters                                |                                                                        |

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| 47.0                                                                                                                                                 | Connections for air outlet from vacuum pump        | : | From vacuum pumps to atmosphere         |
| 48.0                                                                                                                                                 | Steam connection to Auxiliary steam header         | : | From final superheater outlet           |
| 49.0                                                                                                                                                 | High Temperature Auxiliary Steam Header            | : | One with interconnection                |
| 50.0                                                                                                                                                 | Auxiliary Steam from High Temperature Header       | : | (a) To Gland Sealing unit               |
|                                                                                                                                                      |                                                    |   | (b) For mill inerting (if required)     |
|                                                                                                                                                      |                                                    |   | (c) For soot blowing                    |
| 51.0                                                                                                                                                 | Low Temperature Auxiliary Steam Header             | : | One with interconnection                |
| 52.0                                                                                                                                                 | Auxiliary Steam from Low Temperature Header        | : | (a) For Deaerator pegging               |
|                                                                                                                                                      |                                                    |   | (b) For atomising                       |
|                                                                                                                                                      |                                                    |   | (c) For F.O. Heating                    |
| 53.0                                                                                                                                                 | Extraction line from CRH line                      | : | From CRH line to auxiliary steam header |
|                                                                                                                                                      |                                                    |   |                                         |

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| <p style="text-align: center;"><b><u>ANNEXURE – II</u></b></p> <p style="text-align: center;"><b><u>MATERIALS OF CONSTRUCTION FOR PIPING &amp; FITTINGS &amp; VALVES</u></b></p> |                                                                               |                                                                                                       |
| 1.0                                                                                                                                                                              | <b><u>THE STEAM PIPING, FITTING AND VALVES SHALL BE AS BELOW:</u></b>         |                                                                                                       |
| 1.1                                                                                                                                                                              | <b><u>MAIN STEAM, HP BYPASS &amp; LP BYPASS UPSTREAM, HRH ( ≥ 550 °C)</u></b> |                                                                                                       |
| 1.1.1                                                                                                                                                                            | Pipes                                                                         | ASTM A 335 GR P91, SMLS                                                                               |
| 1.1.2                                                                                                                                                                            | Elbows / Reducer / Tees / Caps                                                | For Size ≤ 40 NB, ASTM A 182 GR. F91, SW (beyond 100Sch thick pipe-Equivalent class rating is 6000#). |
|                                                                                                                                                                                  |                                                                               | For Size ≥ 50 NB, ASTM A 234 GR WP91, SMLS, BW                                                        |
| 1.1.3                                                                                                                                                                            | Flanges                                                                       | For Size ≤ 40 NB, ASTM A 182 GR. F91, SW RTJ                                                          |
|                                                                                                                                                                                  |                                                                               | For Size ≥ 50 NB, ASTM A 182 GR. F91, WN RTJ                                                          |
| 1.1.4                                                                                                                                                                            | Valves (Body)                                                                 | Gate / Globe / Check                                                                                  |
|                                                                                                                                                                                  |                                                                               | For Size ≤ 40 NB ASTM A 182 GR. F91, SW                                                               |
|                                                                                                                                                                                  |                                                                               | For Size ≥ 50 NB ASTM A 217 WC 12, BW                                                                 |
| 1.1.5                                                                                                                                                                            | Steam Traps                                                                   | ASTM A 182 GR. F91, SW, MFR'S Std, Thermodynamic for line drains.                                     |
| 1.2                                                                                                                                                                              | <b><u>STEAM PIPES (510 °C to 549 °C)</u></b>                                  |                                                                                                       |
| 1.2.1                                                                                                                                                                            | Pipes                                                                         | ASTM A 335 GR P22, SMLS                                                                               |
| 1.2.2                                                                                                                                                                            | Elbows / Reducer / Tees / Caps                                                | For Size ≤ 40 NB, ASTM A 182 GR. F 22, 3000#, SW                                                      |

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|                                                                                                                                         |                                                                        | For Size $\geq$ 50 NB, ASTM A 234 GR WP 22, SMLS, BW              |
| 1.2.3                                                                                                                                   | Flanges                                                                | For Size $\leq$ 40 NB, ASTM A 182 GR. F22, SW RTJ                 |
|                                                                                                                                         |                                                                        | For Size $\geq$ 50 NB, ASTM A 182 GR. F22, WN RTJ                 |
| 1.2.4                                                                                                                                   | Valves                                                                 | Gate / Globe / Check                                              |
|                                                                                                                                         |                                                                        | For Size $\leq$ 40 NB ASTM A 182 GR. F22, SW                      |
|                                                                                                                                         |                                                                        | For Size $\geq$ 50 NB ASTM A 217 WC 9, BW                         |
| 1.2.5                                                                                                                                   | Steam Traps                                                            | ASTM A 182 GR. F22, SW, MFR'S Std, Thermodynamic for line drains. |
| 1.3                                                                                                                                     | <u>STEAM PIPES WHERE TEMPERATURE IS (400 °C to 509 °C)</u>             |                                                                   |
| 1.3.1                                                                                                                                   | Pipes                                                                  | ASTM A 335 GR P11, SMLS                                           |
| 1.3.2                                                                                                                                   | Elbows/Reducer/Tees/Caps                                               | For Size $\leq$ 40 NB, ASTM A 182 GR. F11, 3000#, SW              |
| 1.3.3                                                                                                                                   | Flanges                                                                | For Size $\leq$ 40NB, ASTM A182GR.F22,SW RTJ                      |
|                                                                                                                                         |                                                                        | For Size $\geq$ 50NB,ASTMA182GR.F22, WN RTJ                       |
| 1.3.4                                                                                                                                   | Valves                                                                 | Gate / Globe / Check                                              |
|                                                                                                                                         |                                                                        | For Size $\leq$ 40 NB ASTM A 182 GR. F11, SW                      |
|                                                                                                                                         |                                                                        | For Size $\geq$ 50 NB ASTM A 217 WC6, BW                          |
| 1.3.5                                                                                                                                   | Steam Traps                                                            | ASTM A 182 GR. F22, SW, MFR'S Std, Thermodynamic for line drains. |
| 2.0                                                                                                                                     | <b><u>THE FEED PUMP DISCHARGE WATER PIPING SHALL BE AS BELOW :</u></b> |                                                                   |
| 2.1                                                                                                                                     | Pipes                                                                  | ASTM A106GR.B/GR.C                                                |

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| 2.2                                                                                                                                                                 | Elbows/Reducer/Tees/Caps                                                                                              | For Size $\leq$ 40 NB, ASTM A 105, 3000#, SW          |                |
|                                                                                                                                                                     |                                                                                                                       | For Size $\geq$ 50NB, ASTM A234GRWPB/WPC, SMLS, BW    |                |
| 2.3                                                                                                                                                                 | Flanges                                                                                                               | For Size $\leq$ 40 NB, ASTM A 105 ,900 #, SW RTJ      |                |
|                                                                                                                                                                     |                                                                                                                       | For Size $\geq$ 50NB, ASTM A105, 900 #, WN RTJ        |                |
| 2.4                                                                                                                                                                 | Valves                                                                                                                | Gate / Globe / Check                                  |                |
|                                                                                                                                                                     |                                                                                                                       | For Size $\leq$ 40 NB ASTM A 105, SW                  |                |
|                                                                                                                                                                     |                                                                                                                       | For Size $\geq$ 50 NB ASTM A 216 WCB , BW             |                |
| 3.0                                                                                                                                                                 | <b><u>HEATERS DRAINS, VENTS, CONDENSATE PIPING &amp; DESUPERHEATER DOWNSTREAM (TEMP <math>\leq</math> 400 °C)</u></b> |                                                       |                |
| 3.1                                                                                                                                                                 | Pipes                                                                                                                 | ASTM A106GR.B                                         |                |
| 3.2                                                                                                                                                                 | Elbows / Reducer / Tees / Caps                                                                                        | For Size $\leq$ 40 NB, ASTM A 105, 3000#, SW          |                |
|                                                                                                                                                                     |                                                                                                                       | For Size $\geq$ 50NB, ASTM A234GRWPB, SMLS, BW        |                |
| 3.3                                                                                                                                                                 | Flanges                                                                                                               | For Size $\leq$ 40 NB, ASTM A 105 ,150 #, RF          |                |
| 3.4                                                                                                                                                                 | Valves                                                                                                                | For Size $\geq$ 50 NB, ASTM A 216 GR WCB, 150 #, SORF |                |
|                                                                                                                                                                     |                                                                                                                       | Gate/Globe/Check                                      |                |
|                                                                                                                                                                     |                                                                                                                       | For Size $\leq$ 40 NB ASTM A 105, SW                  |                |
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| <p><b>1.0      <u>GENERAL INFORMATION</u></b></p> <p>This section covers all the low-pressure piping up to 400 NB size, associated valves and specialties that include as a minimum:</p> <p>1.1      The Raw Water Piping supplying raw water to raw water reservoir (from proposed raw water gravity line from Ozerkheda reservoir to existing 2 x 500 MW units.)</p> <p>1.2      Raw water piping from discharge of raw water pumps up to Cascade Aerator in Pre treatment plant.</p> <p>1.3      Service Air System</p> <p>1.4      Instrument Air System</p> <p>1.5      Demineralised Water Supply system</p> <p>1.6      Plant Potable Water System - (filtered &amp; Ozonised water)</p> <p>1.7      Service Water System</p> <p>1.8      Air heater washing system</p> <p>1.9      Clear water supply line for Coal handling plant dust suppression/dust extraction from discharge of CHP DS/DE supply pumps located at Clear water pump house in ETP area.</p> <p>1.10     Fuel oil system piping supply and Fuel Oil return from boiler and Steam tracing to HFO tank.</p> <p>1.11     Any other low pressure piping as found necessary during detail engineering shall also be included.</p> <p><b>2.0      <u>CODES AND STANDARDS</u></b></p> <p>2.1      In addition to the requirements spelt out in Volume II, the design, manufacture, inspection and testing of the piping, fittings, valves and</p> |                                                    |                |

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| specialties covered under this specification shall conform, in general, to the standards and codes mentioned below:                                  |                                                    |                                                                                                      |                |
| 2.1.1                                                                                                                                                | IS-1239<br>[Part-I & II]                           | : Mild steel tubes, tubular and other wrought steel fittings.                                        |                |
| 2.1.2                                                                                                                                                | IS-3589                                            | : Electrically welded steel pipes for water, gas and sewage (200 to 2000 NB)                         |                |
| 2.1.3                                                                                                                                                | IS-554                                             | : Dimensions for pipe threads where pressure tight joints are required on the threads.               |                |
| 2.1.4                                                                                                                                                | IS-1363<br>[Part-I & II]                           | : Hexagonal head bolts, screws and nuts (size range M5 to M36)                                       |                |
| 2.1.5                                                                                                                                                | IS-1364                                            | : Precision and Semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm) |                |
| 2.1.6                                                                                                                                                | IS-3138                                            | : Hexagon bolts & nuts (M42 to M150)                                                                 |                |
| 2.1.7                                                                                                                                                | IS-4736                                            | : Hot dip zinc coating on mild steel tubes.                                                          |                |
| 2.1.8                                                                                                                                                | IS 14846                                           | : Sluice Valves for water works purposes.                                                            |                |
| 2.1.9                                                                                                                                                | IS-2685                                            | : Code of practice for selection, installation and maintenance of sluice valve.                      |                |
| 2.1.10                                                                                                                                               | IS-5312                                            | : Swing check type reflux (non-return) valves.                                                       |                |
| 2.1.11                                                                                                                                               | IS-2379                                            | : Colour code for the identification of pipelines.                                                   |                |
| 2.1.12                                                                                                                                               | IS-2016                                            | : Plain washers                                                                                      |                |
| 2.1.13                                                                                                                                               | IS-2712                                            | : Compressed asbestos fibre jointing                                                                 |                |
| 2.1.14                                                                                                                                               | ANSI B-16.5                                        | : Steel pipe flanges and flanged fittings                                                            |                |
| 2.1.15                                                                                                                                               | ANSI B-16.9                                        | : Wrought steel Butt welding flanged                                                                 |                |
| 2.1.16                                                                                                                                               | ANSI B-16.11                                       | : Forged steel fittings, Socket-welding and Threaded.                                                |                |

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| <p>2.1.17    ANSI B-36.10    :    Steel pipes thickness</p> <p>2.1.18    API-600         :    Steel gate valves</p> <p>2.1.19    BS-2633         :    Class I Arc welding of ferrite steel pipe work for carrying fluids.</p> <p>2.1.20    BS-534            :    Specification for steel pipes and specials for water and sewage.</p> <p>2.1.21    BS-5351            :    Specification for Ball valves.</p> <p>2.1.22    BS EN ISO         :    Specification for Ball valves.<br/>17292 : 2004</p> <p>2.1.23    AWWA-C-504    :    Specification for Butterfly valves.</p> <p>2.1.24    AWWA-C-208    :    Dimension for fabricated steel water pipe fittings.</p> <p>2.2        Other international codes and standards may also be offered by bidder. However, same may be subject to acceptance by the Owner.</p> <p><b>3.0        <u>SCOPE OF WORK</u></b></p> <p>3.1        The equipment and materials to be supplied shall include as a minimum, the following :</p> <p>(a)        Supply of all low pressure piping including bends, elbows, tees, branches, laterals, crosses, reducing union, couplings, caps, saddles, shoes, flanges, blank flanges, Y-pieces etc as required for the piping system.</p> <p>(b)        Matching pipes, matching pieces like reducers/expanders etc, counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc.</p> <p>(c)        Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifices/nozzles with the main pipe work.</p> |                                                    |                |

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| <p>(d) All isolating and regulating valves, non-return valves, steam/air traps, relief/safety valves (wherever applicable), strainers, pressure reducing orifices etc complete with the counter flanges and matching connecting pieces as required for entire low pressure piping system.</p> <p>(e) Anchors, hangers and supports etc as required. Any platform necessary for maintenance and operation of valve and equipment located 1.5 m above any permanent floor or platform including access ladders, supporting structures etc.</p> <p>(f) All secondary structural steel members required for pipe supports from building steel structures and from embedded steel wherever provided including pipe supports in trenches. However, trench piping shall be avoided to the extent possible.</p> <p>(g) Funnels, tundishes for drips and drains including all miscellaneous drain piping and drain piping from tundish outlet up to drain points. All drain and vent lines shall be conveniently terminated to floor drain points/permanent drain trenches of the Power Station.</p> <p>(h) Pipe rack required between WTP, Oil storage area to TG Hall and boiler area is under bidders cost of design and construction including the civil foundation for pipe rack and any other piping support foundations wherever required.</p> <p>(i) Flanges, counter flanges, blank flanges, bolts, nuts, washers, temporary and permanent gaskets, fasteners caps etc as required for interconnecting piping, valves &amp; fittings.</p> <p>(j) Cleaning and Painting of all piping, valves &amp; specialties at manufacturer's shop.</p> <p>3.2 Following general requirements shall however be provided</p> <p>(a) Instrument connections including instruments, root valves, sensing lines etc.</p> <p>(b) Pipe stubs and blanking plates etc required for chemical cleaning and hydro testing.</p> |                                                    |                |

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For conducting acceptance test, the required pressure, temperature, flow measurement points shall be provided.

3.3 The Flow Diagrams forming a part of the specification are mainly intended to give general guidelines to the Bidder regarding extent of piping, valves, and specialties to be supplied under this section.

4.0 **GENERAL DESIGN AND CONSTRUCTION**

4.1 **GENERAL CONSIDERATIONS**

4.1.1 Line Sizing

Sizes of piping shall be selected such that the velocity of fluid in pipes does not exceed the following limits under conditions of maximum possible volumetric flow.

|     |          |                                     |                  |                 |                  |
|-----|----------|-------------------------------------|------------------|-----------------|------------------|
| (a) | Water    |                                     |                  |                 |                  |
|     | (i)      | Condenser CW                        | Below<br>1000 NB | 1000-2000<br>NB | Above<br>2000 NB |
|     |          | a. Pump suction                     | 1.0              | 1.3             | 1.5              |
|     |          | b. Pump discharge /<br>distribution | 2.4              | 2.8             | 3.0              |
|     | (ii)     | Water- General                      | Below<br>200 NB  | 200-400<br>NB   | 400-700<br>NB    |
|     |          | a. Pump suction                     | 1.0              |                 |                  |
|     |          | b. Pump discharge /<br>distribution | 1.8              | 2.2             | 2.5              |
| (b) | Fuel oil |                                     |                  |                 |                  |
|     |          | Heavy oil (Heated)                  |                  |                 |                  |
|     |          | a. Pump suction                     | 1.0              |                 |                  |

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| <table border="1"><tr><td></td><td></td><td>b. Pump discharge / distribution</td><td>1.5-2.0</td></tr><tr><td>(c)</td><td colspan="3">Gases</td></tr><tr><td></td><td></td><td>a. Compressed air</td><td>15-25</td></tr></table> |                                                                                                                                                                                                   |                                  |                |  |  | b. Pump discharge / distribution | 1.5-2.0 | (c) | Gases |  |  |  |  | a. Compressed air | 15-25 |
|                                                                                                                                                                                                                                  |                                                                                                                                                                                                   | b. Pump discharge / distribution | 1.5-2.0        |  |  |                                  |         |     |       |  |  |  |  |                   |       |
| (c)                                                                                                                                                                                                                              | Gases                                                                                                                                                                                             |                                  |                |  |  |                                  |         |     |       |  |  |  |  |                   |       |
|                                                                                                                                                                                                                                  |                                                                                                                                                                                                   | a. Compressed air                | 15-25          |  |  |                                  |         |     |       |  |  |  |  |                   |       |
| 4.1.2                                                                                                                                                                                                                            | The piping systems included in this section shall be designed to operate continuously without replacement during the plant service life of 30 years.                                              |                                  |                |  |  |                                  |         |     |       |  |  |  |  |                   |       |
| 4.1.3                                                                                                                                                                                                                            | The piping system shall be complete in every detail and in accordance with the highest standard of workmanship. Against any doubt, Owner shall be referred for clarification.                     |                                  |                |  |  |                                  |         |     |       |  |  |  |  |                   |       |
| 4.1.4                                                                                                                                                                                                                            | All design and fabrication shall be in accordance with codes/standards specified.                                                                                                                 |                                  |                |  |  |                                  |         |     |       |  |  |  |  |                   |       |
| 4.1.5                                                                                                                                                                                                                            | No pipe work shall run in trenches carrying electrical cables.                                                                                                                                    |                                  |                |  |  |                                  |         |     |       |  |  |  |  |                   |       |
| 4.1.6                                                                                                                                                                                                                            | Pipe size above 50 NB shall be shop fabricated and of size 50 NB and below shall be field run.                                                                                                    |                                  |                |  |  |                                  |         |     |       |  |  |  |  |                   |       |
| 4.1.7                                                                                                                                                                                                                            | All piping shall be identified by means of colour strips, by adequate lettering, conveniently spaced and located. Identification colours and lettering shall be as approved.                      |                                  |                |  |  |                                  |         |     |       |  |  |  |  |                   |       |
| 4.1.8                                                                                                                                                                                                                            | Air release and drain branches shall be provided, wherever necessary, depending upon the layout and arrangement so that the drains and air release valves are located for easy operation.         |                                  |                |  |  |                                  |         |     |       |  |  |  |  |                   |       |
| 4.1.9                                                                                                                                                                                                                            | Unless otherwise specified, all pipe work shall be suitable for a minimum pressure of 10.0 kg/cm <sup>2</sup> (g) at 80°C or as required by the design of the different piping system, if higher. |                                  |                |  |  |                                  |         |     |       |  |  |  |  |                   |       |
| 4.1.10                                                                                                                                                                                                                           | Drain Pipe work                                                                                                                                                                                   |                                  |                |  |  |                                  |         |     |       |  |  |  |  |                   |       |
|                                                                                                                                                                                                                                  | (a) Low pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained, or as near as possible for conventional operation.                          |                                  |                |  |  |                                  |         |     |       |  |  |  |  |                   |       |

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(b) Unless otherwise stated, all drain piping shall be of 25 NB minimum and all vent piping shall be of 15 NB minimum. For pipes up to 40 NB, pipe wall thickness shall be as per schedule 80 of ANSI B36.10.

(c) Unless otherwise stated, wherever a main or branch of any pipeline is terminated with a valve, such terminal valve shall be provided with a blank flange/blanking cap at the free end.

4.1.11 Specification of pipes used in different services included in the L.P. piping section has been detailed in Annexure-I.

4.1.12 Following types of valves shall be used for the system/ service marked as y

|                   | Types of Valves |      |       |       |      |
|-------------------|-----------------|------|-------|-------|------|
|                   | Butterfly       | Gate | Globe | Check | Ball |
| (a) Water         | y               | y    | y     | y     | y    |
| (b) Drains & Vent |                 | y    | y     | y     |      |
| (c) Fuel oil      |                 | y    | y     | y     | y    |
| (d) Air           |                 | y    | y     | y     | y    |

4.1.13 HFO oil line shall be traced by steam tracers.

4.2 MATERIAL SPECIFICATION

4.2.1 Materials for pipes and fittings shall be as stipulated in Annexure-I. In case bidder wants to offer alternative piping material, same may be accepted by the Owner depending on the merits of alternative material.

4.2.2 Pipe attachments for supports, anchors and restraints, which are coming in direct contact with pipes, shall have similar materials as the piping concerned. All other materials of supports, anchors and restraints shall be of tested quality and as per manufacturer's standards.

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| <p>4.3      <u>FABRICATION</u></p> <p>For Detailed Fabrication requirement of LP piping, Refer clause no- 6.5 of Section –I of this specification.</p> <p>4.4      <u>HANGERS, SUPPORTS, ANCHORS</u></p> <p>Normally pipe supports and anchors shall be selected at those points in the buildings where provision has been made for the loads imposed. The cutting of floor/roof beams or the reinforcement in slabs will not be permitted. Piping attached to a plant item, shall be supported in such a way that the plant item does not take the weight of the piping.</p> <p>4.4.1      Support spacing shall be as per good engineering practice. However, in no case it shall be less than support spacing stipulated in ANSI B31.1.</p> <p>4.4.2      Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection.</p> <p>4.4.3      All large pipes and all long pipes shall have at least two supports each arranged so that any length of pipe or valve may be removed without any additional supports being required.</p> <p>4.4.4      Support steel shall be of structural quality. Perforated strap, wire or chain shall not be used. Support components shall be connected to support steel by welding, by bolting or by beam clamps. Boltholes shall be drilled, not burned. Support components may be bolted to concrete using approved concrete anchors.</p> <p>4.5      <u>VALVES AND ACCESSORIES</u></p> <p>4.5.1      Valves</p> <p>(a)      All valves shall be of approved make and type and shall have cast/ forged bodies with covers and glands of approved construction and materials as specified in Annexure-II &amp; III.</p> |                                                    |                |

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| <p>(b) Valves and specialties to be supplied under this specification will be used for various air and water services and will be located indoor/ outdoor and on horizontal/vertical runs of the pipelines. However, mounting of valves in vertical pipe runs shall be avoided as far as possible.</p> <p>(c) All valves shall, unless otherwise stated, have the internal diameter same as the internal diameter of the pipes to be joined.</p> <p>(d) All valves shall receive tests at manufacturer's or contractor's works in accordance with the specific requirements of the approved Codes of Practice. Valves shall be rising stem or otherwise as approved by the Owner.</p> <p>(e) All valves shall function smoothly without sticking, rubbing or vibration on opening or closing and shall be suitable for most stringent service conditions i.e. flow, temperature and pressure under which they may be required to operate.</p> <p>(f) Where valves are of similar size and type they shall be interchangeable with one another. Valves shall have welded or flanged connections subject to the Owner's approval.</p> <p>(g) Gate, Globe and Ball valves shall be provided with the following accessories in addition to other standard items:</p> <ul style="list-style-type: none"> <li>(i) Hand wheel with embossed open and shut directions.</li> <li>(ii) Local position indicator.</li> <li>(iii) Motorised operation as specified by Engineer.</li> </ul> <p>(h) Gate valves, in addition shall be provided with following extra features</p> <ul style="list-style-type: none"> <li>(i) Bypass valve for larger valves</li> <li>(ii) Draining arrangement</li> </ul> |                                                    |                |

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| <p>(iii) Enclosed Gear operators for valves 300 NB and above for ease in operation.</p> <p>(iv) Motorised operation as specified by Engineer.</p> <p>(i) All gate and globe valves shall be rising stem type.</p> <p>(j) All valves shall be provided with hand-wheels, chain, operator, extended spindle and floor stand wherever required so that they can be operated manually by a single operator from the nearest operating floor either at a lower or higher elevation as the case may be. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also.</p> <p>(k) All valves and specialties shall be provided with brass Tag Discs indicating Tag numbers and nomenclature of the valve including duty or service intended and the function of the valves specialties.</p> <p>(l) Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position.</p> <p>(m) Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Bidder shall supply the first fill of oil or grease for these parts. The Bidder shall supply a suitable manually operated grease gun for the standard type of nipple provided.</p> <p>(n) The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction.</p> <p>(o) All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.</p> |                                                    |                |

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| <p>(p) Plastic or bakelite valve hand wheels will not be accepted.</p> <p>(q) All valves shall be closed by rotating the hand wheel in a clockwise direction when looking at the faces of the hand wheel. The face of each hand wheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers.</p> <p>(r) Wherever practicable, heavy valves of total weight including actuator, drive motor, integral by-pass etc., equal to or greater than 500kg shall be provided with suitable lugs to permit direct suspension by hanger rod or direct resting on bottom support, as applicable.</p> <p>(s) Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.</p> <p>(t) Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves.</p> <p>(u) The Bidder shall supply with his bid and in addition during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure/temperatures. They should include a parts list referring to the various materials used in the valve construction.</p> <p>(v) All sampling and root valves shall be of integral body bonnet type.</p> <p>(w) Gate and globe valves used for fuel oil system shall be of such design as to permit re-packing while in service.</p> <p>For Design Requirements for different valves, refer Annexure-II &amp; III.</p> <p>4.5.2 Strainer for fuel oil system</p> <p>(a) There shall be Duplex strainers on the Fuel Oil Line.</p> |                                                    |                |

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| <p>(b) The strainer shall have basket type straining elements permitting easy removal and replacement.</p> <p>(c) The open area ratio (i.e. straining area to the inlet area ratio) shall be at least 6:1.</p> <p>(d) The strainer shall have screen of stainless steel (AISI-316) construction with wire diameter of about 0.01 inch and open area of about 50%.</p> <p>(e) Strainer body shall be made of Mild steel. No Cast Iron component shall be used in F.O. system.</p> <p>(f) All strainers shall also be provided with oil drip plates beneath them for collection of oil.</p> <p>(g) Bolts and nuts shall be as per IS-1363. Gaskets shall be minimum 3 mm thick and made of compressed asbestos fibre as per IS-2712.</p> <p>4.5.3 Steam Traps</p> <p>(a) The steam traps shall be inverted bucket or thermodynamic type complete with integral or separate strainers.</p> <p>(b) Traps shall have carbon steel body with stainless steel internals to AISI 316.</p> <p>(c) Y-type strainers whether integral with steam traps or otherwise shall have body of Cast Steel Class 150 material and perforated metal screen of type AISI-316 stainless steel with about 0.8 mm perforation. The strainer shall have screwed blow off connections fitted with removable plug. The free hole area shall be at least three (3) times the internal pipe area.</p> <p>(d) Numbers and location of steam traps shall be selected by the Bidder.</p> <p>4.6 <u>SAFETY/RELIEF VALVES</u></p> <p>4.6.1 Safety/Relief valves shall be of direct spring loaded type and shall have a tight, positive and precision closing.</p> |                                                    |                |

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| <p>4.6.2 All safety valves shall be provided with manual lifting lever.</p> <p>4.6.3 Valves used for air and any other compressive fluid shall be of pop type.</p> <p>4.6.4 Safety/Relief valves shall be constructed and adjusted to permit the fluid to escape without increasing the pressure beyond 10% above the set blow off pressure. Valve shall reset at a pressure not less than 2.5% and more than 5% of the set pressure.</p> <p>4.6.5 Releasing capacity of the safety/relief valves shall be as per the applicable codes and standards and shall be subject to the approval of the Engineer.</p> <p>4.6.6 The seat and disk of safety valves shall be of suitable material to resist erosion. The seat of valve shall be fastened to the body of the valve in such a way that there is no possibility of the seat lifting.</p> <p>4.7 <u>HOSE PIPE AND ACCESSORIES</u></p> <p>4.7.1 Hose valves for service water system shall be Gate valves and service air system shall be Globe valves.</p> <p>4.7.2 Hose pipes with fittings for Service Water System:</p> <p>(a) The water hose shall be as per IS-444 (Type-3).</p> <p>(b) Length of each hose shall be 15 metres.</p> <p>(c) For each hose, one end shall be fitted with M.S. female coupling with swivelling nuts and soft seating ring suitable for connection to male end of hose valve and other end shall be made threaded for joining with the swivelling nut of a second hose whereby two hose lengths may be joined.</p> <p>4.7.3 Hose pipes with fittings for Compressed air System</p> <p>(a) The compressed air hose shall be as per IS-911 (Type 2).</p> <p>(b) The length and type of each end shall be similar to as specified in above clause no. 4.7.2 (b) (c) above.</p> |                                            |                |

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| <b>5.0</b>                                                                                                                                           | <b><u>BROAD GUIDELINES FOR ERECTION AND INSTALLATION OF LP PIPING</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                   |                |
| 5.1                                                                                                                                                  | All fittings like "T" pieces, flanges, reducers etc shall be suitably matched with pipes for welding. The valves shall be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning and during commissioning.                                                                                                                                                                                                                                              |                |
| 5.2                                                                                                                                                  | Adjustments like removal of oval ties in pipes and opening or closing the fabricated bends of high pressure piping to suit the layout shall be considered part of work and such work shall be carried out as per instructions, which shall include specified heat-treatment procedures etc also, wherever required.                                                                                                                                                                         |                |
| 5.3                                                                                                                                                  | Certain adjustments in length may be necessary while erecting low pressure pipelines and the extra lengths shall be removed to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures.                                                                                                                                                                                                                                                         |                |
| 5.4                                                                                                                                                  | Suspension for piping, pressure parts etc shall be supplied in running lengths, which shall be cut to suitable sizes and adjusted as required.                                                                                                                                                                                                                                                                                                                                              |                |
| 5.5                                                                                                                                                  | All the valves, lifting equipments, actuators, power cylinders etc shall be serviced and lubricated to the satisfaction of Engineer before erecting the same and during pre-commissioning. Even after commissioning, the equipments, if there are problems in the operation, shall be attended to by the Bidder during the tenure of the contract. Welding or jointing of extension spindle for valves to suit the site conditions and operational facility shall be part of erection work. |                |
| 5.6                                                                                                                                                  | All tubes and pipes shall be cleaned and blown with compressed air and shown to the engineer before lifting. Bigger size pipes should be cleaned with flexible wire brush, wherever necessary. After cleaning is over, the end caps shall be put back in tube openings till such time they are welded to other tubes.                                                                                                                                                                       |                |
| 5.7                                                                                                                                                  | Fine fittings, drain piping, oil systems & other small bore piping have to be routed according to site conditions and hence shall be done only in position. As such, layout of small-bore piping shall be done as per site requirement. There is a possibility of slight change in routing the above pipelines even                                                                                                                                                                         |                |

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| <p>after completion of erection, which shall be carried out by the Bidder without any extra cost to the Owner. Work shall also include fabrication of small bends at site from straight lengths to suit the site conditions.</p> <p>5.8 No temporary supports shall be welded on the pressure parts. Welding of temporary supports, cleats etc on the building columns shall also be avoided. In case of absolute necessity, prior approval from Engineer shall be taken. Further, any cutting or alteration of member of the structure or platform or other equipments shall not be done without specific prior approval of Engineer.</p> <p>5.9 Wherever piping is connected to other piping or equipment, the joint at the connecting point shall be considered under this specification.</p> <p>(a) All piping shall be grouped wherever practicable and shall be routed to present a neat appearance.</p> <p>(b) The piping shall be arranged to provide clearance for the removal of equipment for maintenance and for easy access to valves, instruments and other piping accessories required for operational maintenance.</p> <p>(c) Piping shall be routed above ground unless otherwise specifically indicated/approved by the Engineer. In such special case, the piping may be arranged in trenches or buried and properly protected as per AWWA Standards.</p> <p>(d) Overhead piping shall have a minimum overhead clearance of 4 meters above walkways and working areas and 6 meters above roadways unless otherwise approved by the Engineer. Inside TG hall, headroom clearance for piping should be minimum 2 metres.</p> <p>(e) Drains shall be provided at all low points and vents at high points as per actual layout regardless of whether some have been shown in respective drawings or not. The pipelines shall be sloped towards the drain points.</p> |                                                    |                |

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| <p>(f) All drips and drains for piping and equipment whether shown in the drawings or not shall terminate on the ground floor up to station drain unless otherwise specified.</p> <p>5.10 Painting</p> <p>(a) All uninsulated piping systems, hangers and supports shall have two coats of red oxide Zinc Chromate primer (conforming to IS 2074) with minimum dry film thickness (DFT) of 25 microns per coat and two coats of finish paints using enamel paint to give a minimum total DFT of 100 microns (after two coats of primer and two coats of finish paint). Shades shall be as per IS 5 or as indicated by Owner/ Engineer. Service of the pipe/line designations shall be painted on all pipes at visible locations.</p> <p>(b) Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot, grease, rust etc.</p> <p>(c) All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint.</p> <p><b>6.0 <u>DRAWINGS, DATA, INFORMATION &amp; MANUALS</u></b></p> <p>6.1 For Drawing, Data and Information required along with BID refer, <b>Volume VIII.</b></p> |                                                    |                |

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### ANNEXURE – I

#### (SPECIFICATION OF PIPES FOR DIFFERENT SERVICES)

|                      | A                                                                                                                           | B                                                                                                                                            | C                                                                                    | D                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 1.0 Services         | (a) Raw Water Piping<br>(b) Clarified Water piping,<br>(c) Filtered Water to DM Plant                                       | Drinking (Potable) Water Supply piping (filtered water, ozonised)                                                                            | Demineralised Water, Service and Instrument air piping less than and equal to 40 NB  | Demineralised Water, Service and Instrument air piping for sizes equal to or greater than 50 NB |
| 2.0 Material of Pipe | Carbon Steel IS-1239 Part I Heavy Grade upto 150 NB and IS-3589 for sizes above 150 NB with minimum pipe thickness of 6 mm. | Carbon Steel as per IS-1239 Part I Heavy Grade upto 150 NB and IS-3589 for sizes above 150 NB. The pipes shall be galvanized as per IS-4736. | Stainless Steel as per ASTM A-312 Gr 304. Thickness schedule 40S as per ANSI-B 36.19 | Stainless steel as per ASTM A-312 Gr 304. Size up to 250 NB as per schedule 10S, ANSI B 36.19   |
| 3.0 Construction     | ERW/Seamless                                                                                                                | ERW/Seamless                                                                                                                                 | Seamless                                                                             | ERW/Seamless                                                                                    |
| 4.0 End connections  | Flange and butt weld for size 50 NB and above and Socket weld joint for size 40 NB and below.                               | Screwed flange for sizes 50 NB and above and screwed socket for size 40 NB and below.                                                        | Socket welded for DM water lines. Screwed end connection for airlines.               | SORF and butt weld joint for DM application. Screwed end connection for air                     |

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|                                                                                   | A                                                                                   |                                                                                                                    | B                        |                                                        | C             | D                                                        |
|                                                                                   |                                                                                     |                                                                                                                    |                          |                                                        |               | lines upto 80 NB. Beyond 80 NB, it shall be butt-welded. |
| 5.0 Fittings                                                                      | Pipe size<br>≥ 50 NB                                                                | Pipe Size<br>≤ 40 NB                                                                                               | Pipe size<br>≥ 50 NB     | Pipe Size<br>≤ 40 NB                                   |               |                                                          |
| 5.1 Materials                                                                     | A 234 Gr WPB/<br>IS 3589                                                            | A105 or As<br>compatible with<br>IS-1239                                                                           | A 234 Gr WPB<br>/IS 3589 | A105 or as<br>compatible with IS<br>-1239              | A 182 F304    | A 351 CF8                                                |
| 5.2 Construction                                                                  | Welded/<br>Seamless                                                                 | Forged                                                                                                             | Welded/<br>Seamless      | Forged                                                 | Forged        | Welded/Seamless                                          |
| 5.3 Standard                                                                      | ANSI-B16.9 /<br>fabricated<br>fitting as per<br>AWWA-C-208<br>is also<br>acceptable | ANSI-B 16.11/<br>IS-1239 (Part-II)<br>cold Bends from<br>pipes having<br>bend radius<br>R=3D is also<br>acceptable | ANSI B16.9               | ANSI B16.11/IS-<br>1239 (Part- II)                     | ANSI-B16.11   | ANSI B16.9                                               |
| 5.4 End Details                                                                   | Butt welded<br>As per ANSI<br>B16.25                                                | Socket welded as<br>per<br>ANSI-B-16.11                                                                            | Screwed/<br>Flanged      | Screwed/<br>Socket as per<br>ANSI B16.11/or<br>IS-1239 | Socket Welded | Butt welded for<br>pipe &<br>fittings and<br>flanged for |

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|             | A                                                                                            | B                                                                                                                   | C                                                                                                     | D                                                                                                           |
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|             |                                                                                              | (Part-II)                                                                                                           |                                                                                                       | valves/equipment                                                                                            |
|             |                                                                                              | All fittings shall be galvanized                                                                                    |                                                                                                       |                                                                                                             |
| 6.0 Flanges | 150 class as per ANSI B16.5 complete with nuts, bolts and gaskets. FF flanges for CI valves. | As per ANSI B16.5 pressure class 150 - galvanised- complete with nuts, bolts and gaskets. FF flanges for CI valves. | As per ANSI B16.5 pressure class 150 complete with nuts, bolts and gaskets. Use slip on flanges here. | 150 class, flat face, as per ANSI-B-16.5 complete with nuts, bolts and gaskets. Use Lap Joint flanges here. |

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| 1.0 | Services         | Fuel Oil System              |
| 2.0 | Material of Pipe | API 5L Gr B or ASTM 106 Gr B |
| 3.0 | Construction     | Seamless                     |
| 4.0 | End connections  | ≤ 40NB SW, ≥ 50NB – BW       |
| 4.1 | Fittings         | ASTM A234 Gr WPB/A 105       |
| 5.0 | Valve end        | Flanged end is preferred     |
| 6.0 | connection       |                              |

**NOTE:**

1. Refer Annexure –III for Valve material specification.
2. Pipes which fall under IS: 1239 shall be hydrostatically tested according to the said code, for others refer Section-V, Volume II.

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| <div><div><b><u>ANNEXURE – II</u></b></div><div><b><u>SERVICES OF VARIOUS CATEGORIES OF VALVES</u></b></div></div>                      |                                                                 |                                                   |                                                                                      |
| SR. NO.                                                                                                                                 | VALVE CLASSIFICATION                                            | SERVICE                                           |                                                                                      |
| 1.0                                                                                                                                     | Cast iron body Gate/ Globe/Check Valve                          | (a) Service Water (Clarified)                     | For sizes 50 NB and above                                                            |
|                                                                                                                                         |                                                                 | (b) Filtered Water                                |                                                                                      |
|                                                                                                                                         |                                                                 | (c) Drinking Water                                |                                                                                      |
|                                                                                                                                         |                                                                 | (d) Inhibited Demineralised Water                 |                                                                                      |
| 2.0                                                                                                                                     | Stainless steel & Bronze body Gate / Globe / Check / Ball Valve | (a) For Demineralised water                       | For all sizes                                                                        |
|                                                                                                                                         |                                                                 | (b) Drinking Water                                | For sizes less than and equal to 40 NB                                               |
|                                                                                                                                         |                                                                 | (c) Service and Instrument Air                    | For all sizes. Ball valves to be used in air line.                                   |
| 3.0                                                                                                                                     | Steel Body valves                                               | (a) Clarified Water                               | For sizes less than and equal to 40 NB                                               |
|                                                                                                                                         |                                                                 | (b) Inhibited Demineralised Water for DMCW system |                                                                                      |
|                                                                                                                                         |                                                                 | (c) Fuel oil system                               | For all sizes                                                                        |
| 4.0                                                                                                                                     | Cast Iron body butterfly valve & Check valve                    | (a) For Demineralised Water                       | For sizes 50 NB and above. Rubber lining shall be provided for DM water application. |
|                                                                                                                                         |                                                                 | (b) Raw water                                     |                                                                                      |
|                                                                                                                                         |                                                                 | (c) Clarified Water                               |                                                                                      |
|                                                                                                                                         |                                                                 | (d) Filtered Water                                |                                                                                      |
|                                                                                                                                         |                                                                 | (e) Inhibited Demineralised Water for DMCW system |                                                                                      |

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### ANNEXURE-III

#### SPECIFICATION OF VALVES

|                                     | (A)<br>Cast Iron Body Gate/<br>Globe/Check Valve            | (B)<br>Stainless Steel Body Gate/ Globe<br>/Check/Ball Valve | (C)<br>Steel Body Gate / Globe / Check<br>Valves |
|-------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------|
| <b>1.0 <u>BASIC DESIGN CODE</u></b> |                                                             |                                                              |                                                  |
| (a) Gate                            | (a)                                                         | (a)                                                          | (a)                                              |
|                                     | (i) IS-780 for 50 – 300 NB                                  | (i) API 600 for 50 NB and above / ANSI-B-16.34               | (i) API 600 for 50 NB and above/ ANSI-B-16.34    |
|                                     | (ii) IS-2906 for 350 NB & above or as per MSS-SP-70         | (ii) API 602 for size below 50 NB / ANSI-B-16.34             | (ii) API 602 for size below 50 NB/ANSI-B-16.34   |
| (b) Globe                           | (b) MSS-SP-85                                               | (b) BS 1873/ANSI-B-16.34                                     | (b) BS 1873/ANSI-B-16.34                         |
| (c) Check                           | (c) IS-5312/MSS-SP-71                                       | (c) BS 1868/ANSI-B-16.34                                     | (c) BS 1868/ANSI-B-16.34                         |
| (d) Ball                            |                                                             | (d) BS 5351                                                  | (d) BS 5351                                      |
| <b>2.0 <u>PRESSURE CLASS</u></b>    | To be suitably chosen considering the pressure requirement. |                                                              |                                                  |
| <b>3.0 <u>CONSTRUCTION</u></b>      | Cast body and bonnet/cover                                  | Forged body up to 50 NB and Cast body above that size        | Same as Group B                                  |
| <b>4.0 <u>MATERIAL</u></b>          |                                                             |                                                              |                                                  |

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|                                                                                                                                                     | (A)<br>Cast Iron Body Gate/<br>Globe/Check Valve                                                      | (B)<br>Stainless Steel Body Gate/ Globe<br>/Check/Ball Valve                                      | (C)<br>Steel Body Gate / Globe / Check<br>Valves                                                                                                  |                |
| 4.1 Body & Bonnet Cover                                                                                                                             | IS 210 Gr. FG 260                                                                                     | A 351 CF8 for cast Body and<br>A 182 F304 for forged Body                                         | A 216 Gr. WCB for Cast Body and<br>A 105 for Forged body                                                                                          |                |
| 4.2 Trim/Disc                                                                                                                                       | IS 210 Gr. FG 260                                                                                     | A 182 F304 for 13% Cr. Steel as<br>per Gate, Globe, Check valves and<br>A 351 CF8 for Ball Valves | A 182 Gr.F6 heat treated and<br>hardened (min. 250 BHN) for cast<br>body and A 105 Hard faced with<br>Stellited (min. 350 HB) for forged<br>body. |                |
| 4.3 Seating surface                                                                                                                                 | 13% Cr. Steel as per IS-1570                                                                          | For Ball valves PTFE seats and<br>seals                                                           | 13% Cr. Steel as per A 182 Gr. F6.                                                                                                                |                |
| 5.0 <u>END PREPARATION</u>                                                                                                                          | Socket welded for size equal to and below 40 NB and flanged with counter flanges for 50 NB and above. |                                                                                                   |                                                                                                                                                   |                |
| 6.0 <u>TESTING</u>                                                                                                                                  |                                                                                                       |                                                                                                   |                                                                                                                                                   |                |
| (a) Gate                                                                                                                                            | (i) IS-780 for 50 – 300 NB                                                                            | ANSI B-16.34/ API-598/MSS-SP-61/<br>EN 12266-1                                                    | ANSI B-16.34/ API-598/MSS-SP-61/<br>EN 12266-1                                                                                                    |                |
|                                                                                                                                                     | (ii) IS-2906 for sizes equal<br>to and above 350 NB                                                   |                                                                                                   |                                                                                                                                                   |                |
| (b) Globe                                                                                                                                           | MSS-SP-85                                                                                             |                                                                                                   |                                                                                                                                                   |                |
| (c) Check                                                                                                                                           | IS 5312/MSS-SP-71                                                                                     |                                                                                                   |                                                                                                                                                   |                |
| (d) Ball                                                                                                                                            |                                                                                                       |                                                                                                   |                                                                                                                                                   |                |
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| <p style="text-align: center;"> <b>VOLUME III-F</b><br/><br/> <b>SECTION-3</b><br/><br/> <b>LARGE DIAMETER LOW PRESSURE PIPING</b> </p>                             |                                                    |                |

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| 2.8                                                                                                                                                                                                                                                                                                                                                            | AWWA MANUAL M11                                                                                                                                                                                                                                                                                       | : Steel Pipe - A Guide for design and installation.                                     |                |
| 2.9                                                                                                                                                                                                                                                                                                                                                            | IS-2062                                                                                                                                                                                                                                                                                               | : Steel for General Structural purposes                                                 |                |
| 2.10                                                                                                                                                                                                                                                                                                                                                           | IS-816                                                                                                                                                                                                                                                                                                | : Code of practice for use of metal arc welding for general construction in mild steel. |                |
| 2.11                                                                                                                                                                                                                                                                                                                                                           | IS-817                                                                                                                                                                                                                                                                                                | : Code of practice for Training & Testing of metal arc welders                          |                |
| 2.12                                                                                                                                                                                                                                                                                                                                                           | IS-822                                                                                                                                                                                                                                                                                                | : Code of procedure for inspection of welds                                             |                |
| 2.13                                                                                                                                                                                                                                                                                                                                                           | IS-9595                                                                                                                                                                                                                                                                                               | : Code of procedure for manual metal arc welding of mild steel                          |                |
| 2.14                                                                                                                                                                                                                                                                                                                                                           | IS-1570                                                                                                                                                                                                                                                                                               | : Schedule for wrought steel                                                            |                |
| 2.15                                                                                                                                                                                                                                                                                                                                                           | Expansion Joints Manufacturers Association (EJMA), USA                                                                                                                                                                                                                                                |                                                                                         |                |
| 2.16                                                                                                                                                                                                                                                                                                                                                           | Fluid Sealing Association, U.S.A.: Technical Handbook-Rubber Expansion Joints and Flexible pipe connectors                                                                                                                                                                                            |                                                                                         |                |
| <p>The technical requirements of the various equipments shall be guided by the design criteria and the Data specification sheets. In case of any contradiction between the aforesaid standards and stipulations of the design criteria and data specification sheets, the stipulations of design criteria and the data specification sheets shall prevail.</p> |                                                                                                                                                                                                                                                                                                       |                                                                                         |                |
| 3.0                                                                                                                                                                                                                                                                                                                                                            | <b><u>SYSTEM DESCRIPTION &amp; SPECIFIC REQUIREMENTS</u></b>                                                                                                                                                                                                                                          |                                                                                         |                |
| 3.1                                                                                                                                                                                                                                                                                                                                                            | <b><u>LARGE DIAMETER PIPING</u></b>                                                                                                                                                                                                                                                                   |                                                                                         |                |
| 3.1.1                                                                                                                                                                                                                                                                                                                                                          | The Circulating Water Piping will be used for supplying water (Clarified Quality) for condenser cooling from the CW pump house sump by C.W. Pumps to the condenser and also for taking out the hot water from the outlet of condenser to the inlet of hot water distribution system of cooling tower. |                                                                                         |                |

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| 3.1.2                                                                                                                                                | Auxiliary cooling water (Clarified Quality) piping will be used for supplying cooling water from the sump of C.W. pump house by Auxiliary C.W. pumps for cooling the closed cycle cooling DM water through Plate Heat Exchangers. ACW piping shall also be used for taking out the hot water from these coolers to the cooling tower.                                |                |
| 3.1.3                                                                                                                                                | Cooling Tower Make up (CTMU) water piping (1 no) shall be laid underground and used for supplying make-up water to the C.W. system from filtered water storage tank for non DM.                                                                                                                                                                                      |                |
| 3.1.4                                                                                                                                                | Ash water piping shall be used for supplying clear water to the Ash water sump from the clear water storage tank by means of Ash water make-up pumps located in ETP area.                                                                                                                                                                                            |                |
| 3.1.5                                                                                                                                                | Ash water piping shall be used for supplying raw water to the Ash water sump from the raw water storage tank by means of Ash water make-up pumps located in raw water pump house.                                                                                                                                                                                    |                |
| 3.2                                                                                                                                                  | <u>RUBBER EXPANSION JOINTS</u>                                                                                                                                                                                                                                                                                                                                       |                |
| 3.2.1                                                                                                                                                | The expansion joints will be used on C.W. Pipes at inlet and outlet of condenser and at CW pump suction to absorb relative movement between C.W. Pipes and respective equipment.                                                                                                                                                                                     |                |
| 3.2.2                                                                                                                                                | The expansion joints shall be designed for the maximum pressure that may appear in the C.W. and ACW system considering shut-off, water hammer, backwash and other operating conditions. The condenser shall be designed to withstand the maximum axial thrust from the inlet and outlet nozzles and if necessary pressure compensation type bellows may be provided. |                |
| 3.3                                                                                                                                                  | <u>BUTTERFLY VALVE</u>                                                                                                                                                                                                                                                                                                                                               |                |
| 3.3.1                                                                                                                                                | Valve (s) to be used for continuous flow control shall be provided with suitable actuator to continuously position the disc as per the system flow requirement.                                                                                                                                                                                                      |                |
| 3.3.2                                                                                                                                                | During manual operation of the valve, the maximum manual effort to be applied at the lever shall be limited within twenty (20) kg.                                                                                                                                                                                                                                   |                |

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| 3.3.3                                                                                                                                                | Valves fitted with power pack unit shall automatically close in the event of an interruption of power supply to the CCW system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |
| 3.4                                                                                                                                                  | Spring supports if required shall be provided for supporting M.S. fabricated C.W pipes at inlet to and outlet from the condenser.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |
| <b>4.0</b>                                                                                                                                           | <b><u>SCOPE OF WORK</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |
|                                                                                                                                                      | The scope of supply and scope of services under this section shall be as below. Items not specifically mentioned but deemed necessary for making large diameter piping systems completely reliable and efficient shall also be included.                                                                                                                                                                                                                                                                                                                                                                                       |                |
| <b>4.1</b>                                                                                                                                           | <b><u>LARGE DIAMETER PIPING</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |
| 4.1.1                                                                                                                                                | Supply and Installation of all piping system as shown in relevant drawings complete with all interconnections including connections with pump flanges and condenser/equipment flanges wherever required, bends, reducers, tees, distant pieces etc of all sizes and shapes as required for complete installation of the piping system. The nominal size of various pipes in different sections to be fabricated from steel plates are 450 NB and above.                                                                                                                                                                        |                |
| 4.1.2                                                                                                                                                | Erection of all vents, drains, instrument tapping points with stubs up to root valves and thermometer well etc connected with the above pipelines may be erected from straight length of piping. All bends, reducers, distant pieces, tees, etc of all shapes and sizes shall, however, have to be fabricated as necessary. All materials required for the same shall be supplied at no extra cost.                                                                                                                                                                                                                            |                |
| 4.1.3                                                                                                                                                | Valves, Flanged butterfly valves, strainers, flanges, root-valves other accessories shall be provided. Butterfly valves at condenser inlet and outlet shall be provided with Power actuators. Over and above, those specified above, the Bidder shall provide additional valves/strainers etc if required for safe and trouble-free operation of the systems. All the slip-on type counter flanges, Flat face flanges, blank flanges, caps etc necessary for the piping shall be fabricated and installed to make the installation complete in all respect. All materials for the same shall be supplied at no extra cost. All |                |

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| <p>necessary bolts, nuts &amp; gaskets required for installation of the system shall also be supplied.</p> <p>4.1.4 All flanged manhole and manhole covers, flanged tees with blank flanges appearing on above piping are included in the scope of work. Also, all flanged tees and blank flanges for tapping water supply from these pipelines to meet the necessity of Owner's other equipment are included. All materials required for the same shall be supplied.</p> <p>4.1.5 Steel hanger, supports, saddles, clamps etc required for all the pipes at locations and as required shall be designed, fabricated and erected after approval of the relevant drawings. Supports, clamps etc for pipeline in pipe trenches, if any and other places are also to be designed and fabricated and erected after approval of relevant fabrication drawings. All materials required for the same shall be provided at no extra cost.</p> <p>4.1.6 The scope of work under this specification shall include excavation and backfilling work required for installation of pipes running underground.</p> <p>4.1.7 Minor concrete works like pipe supports, thrust blocks etc as required shall be supplied and erected at no extra cost. Necessary steel work at supports shall also be supplied, fabricated and erected.</p> <p>4.1.8 The final fixing grout over the concrete support or through the opening left in the concrete work shall be done by the Contractor.</p> <p>4.1.9 All angle rings and annular rings that are to be welded in the piping for grouting in the wall openings are included. All necessary seating plates for all pipe supports with anchoring arrangement including steel straps, wearing plates to be welded to the piping system etc are included. The concrete pedestal, thrust blocks etc where required, shall have to be provided by the Contractor. The seating plate shall also be grouted by the Contractor. Necessary anchor bolts, nuts, sleeves etc shall be supplied by the Contractor.</p> <p>4.1.10 Coating and wrapping for buried pipes, painting for other pipes etc.</p> |                                                    |                 |

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4.2

RUBBER EXPANSION JOINTS

The scope of supply under this specification shall be as below. Items not mentioned but deemed necessary by the Bidder for making the system completely reliable and efficient shall also be included.

4.2.1

Expansion joints with retaining rings and requisite numbers of fixing bolts, nuts, washers gaskets connection, bellow with the companion/equipment flange.

4.2.2

Various accessories like companion flanges, control rod/unit assembly including stretcher plates, limit rods, washers, nuts, bolts etc.

4.3

BUTTERFLY VALVE

4.3.1

Butterfly Valves (Electro Hydraulic Actuator Operated) at the discharge side of Concrete Volute Casing Type pumps and Butterfly Valves (Electrical Actuator Operated) at the discharge side of ACW pumps shall be considered.

4.3.2

Electrically Operated Butterfly valves shall be provided at Condenser CW inlet/outlet.

Matching flanges with necessary bolts, nuts, gaskets etc. for all flanged connections shall also be provided.

4.4

Required number of spring supports as detailed shall be supplied.

5.0

DESIGN AND CONSTRUCTION

5.1

LARGE DIAMETER PIPING

5.1.1

The pipe sizing of CW and ACW lines shall be carried out based on velocity limits as follows:

(a)

Suction for CW and ACW

:

1.5 m/s

(b)

Condenser CW Discharge

:

3.0 m/s

(c)

ACW pump discharge &

:

2.5 m/s

|                                      |
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| <br><b>MAHAGENCO</b><br>Maharashtra State Power Generation Co. Ltd.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>MAHARASHTRA STATE POWER GENERATION CO. LTD.</b> | Volume: III-F   |                             |                        |                  |         |                      |         |                    |         |                     |         |                     |         |              |         |
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| <p>headers</p> <p>(d) ACW Branch lines : 2.0 m/s</p> <p>5.1.2 Pipe thickness shall be calculated based on AWWA standard (AWWA -M 11, chapter – 4) for internal pressure, external pressure, deflection and buckling criteria considering water filled pipe as well as vacuum condition that may prevail, transient/surge conditions, truck load, rail load and weight density for compacted soil etc. as applicable in line with relevant code. Contractor shall furnish pipe thickness calculations justifying the thickness selected.</p> <p>5.1.3 All piping to be fabricated under this section shall be made of tested quality mild steel plates having thickness not less than that stated below :</p> <table><tr><td><b>Pipe Diameter (O.D.)</b></td><td><b>Plate Thickness</b></td></tr><tr><td>(a) 500 – 800 NB</td><td>: 10 mm</td></tr><tr><td>(b) Above 800-950 NB</td><td>: 12 mm</td></tr><tr><td>(c) 950 NB-1200 NB</td><td>: 14 mm</td></tr><tr><td>(d) 1200 NB-1800 NB</td><td>: 16 mm</td></tr><tr><td>(e) 1800 NB-2500 NB</td><td>: 18 mm</td></tr><tr><td>(f) &gt;2500 NB</td><td>: 20 mm</td></tr></table> <p>5.1.4 All plates used shall be of mild steel quality conforming to IS-2062 or equivalent.</p> <p>5.1.5 Flanges shall be machined on both faces. Fabrication of flanges from segment plates shall be avoided. However, if under special circumstances flanges from segment plates are to be provided, on specific instructions of the Owner/Engineer, such flanges should be completely stress relieved after welding and all welds shall be subject to dye penetration test. These flanges should also be machined. Flanges at CI valve connections shall be Flat face flanges and gasket shall be as per that.</p> |                                                    |                 | <b>Pipe Diameter (O.D.)</b> | <b>Plate Thickness</b> | (a) 500 – 800 NB | : 10 mm | (b) Above 800-950 NB | : 12 mm | (c) 950 NB-1200 NB | : 14 mm | (d) 1200 NB-1800 NB | : 16 mm | (e) 1800 NB-2500 NB | : 18 mm | (f) >2500 NB | : 20 mm |
| <b>Pipe Diameter (O.D.)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Plate Thickness</b>                             |                 |                             |                        |                  |         |                      |         |                    |         |                     |         |                     |         |              |         |
| (a) 500 – 800 NB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | : 10 mm                                            |                 |                             |                        |                  |         |                      |         |                    |         |                     |         |                     |         |              |         |
| (b) Above 800-950 NB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | : 12 mm                                            |                 |                             |                        |                  |         |                      |         |                    |         |                     |         |                     |         |              |         |
| (c) 950 NB-1200 NB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | : 14 mm                                            |                 |                             |                        |                  |         |                      |         |                    |         |                     |         |                     |         |              |         |
| (d) 1200 NB-1800 NB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | : 16 mm                                            |                 |                             |                        |                  |         |                      |         |                    |         |                     |         |                     |         |              |         |
| (e) 1800 NB-2500 NB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | : 18 mm                                            |                 |                             |                        |                  |         |                      |         |                    |         |                     |         |                     |         |              |         |
| (f) >2500 NB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | : 20 mm                                            |                 |                             |                        |                  |         |                      |         |                    |         |                     |         |                     |         |              |         |

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| 5.1.6                                                                                                                                                | All welds are to be continuous single V butt with finished head of size equal to thickness of plate. All welding shall be as per provisions laid in IS-816/ equivalent standard. Welding shall be done by experienced and good welders who have been qualified by tests as specified in IS-817/ equivalent standard.                                                                                                                                                    |                 |
| 5.1.7                                                                                                                                                | The pipe circumferential weld shall be done in such a way that the longitudinal welds become staggered in any two consecutive sections.                                                                                                                                                                                                                                                                                                                                 |                 |
| 5.1.8                                                                                                                                                | Underground pipes at rail/road crossing shall be taken through RCC box/ pipe culverts. Box culverts shall be designed and constructed in accordance with civil specification.                                                                                                                                                                                                                                                                                           |                 |
| 5.1.9                                                                                                                                                | Pipe sections in straight lengths delivered at erection site shall be of suitable length to minimise field joints as far as possible. End preparations shall be done at the fabrication yard to facilitate site welding.                                                                                                                                                                                                                                                |                 |
| 5.1.10                                                                                                                                               | The piping shall be prepared cold rolled to true cylindrical shapes in a number of passes in a plate bending machine so that no undue stresses are developed.                                                                                                                                                                                                                                                                                                           |                 |
| 5.1.11                                                                                                                                               | The C.W. pipe running underground below rail/road crossings, shall be stiffened by longitudinal ribs and annular rings. The above stiffening shall be provided to make the piping adequately strong so that the same will retain its true circular shape under the external loading.                                                                                                                                                                                    |                 |
| 5.1.12                                                                                                                                               | Manholes shall be provided wherever required and the sizes shall conform to the requirement. All manholes shall be provided with flanged covers with handle, gasket, bolts, nuts etc. Manhole pits shall be provided for buried piping at regular intervals of 100 m. Valve pit, if required shall be provided for buried piping system for accessibility and maintenance of the valves. The design of the valve pit shall be approved at the detail Engineering Stage. |                 |
| 5.1.13                                                                                                                                               | Gaskets shall be 3 mm thick full-face rubber.                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |
| 5.1.14                                                                                                                                               | Bolts and nuts shall be hexagonal head conforming to IS-1367.                                                                                                                                                                                                                                                                                                                                                                                                           |                 |
| 5.1.15                                                                                                                                               | The pipe sections shall be carefully placed on the sand bed prepared as specified before and then welded. The method of holding the pipe sections                                                                                                                                                                                                                                                                                                                       |                 |

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| <p>in position for welding during erection shall be approved by the engineer. All joints before welding shall be thoroughly cleaned and requisite welding gap maintained.</p> <p>5.1.16 Welding shall be carried out as per provisions laid down in IS-816. Welding shall be done by experienced and good operators who have been qualified by tests as specified in IS-817. Welded and flanged joints shall as far as possible be located at one third span from supports.</p> <p>5.1.17 Welding sequence shall be done in such a way so as to minimise the distortion due to welding shrinkage. Any distortion shall be duly rectified by the Contractor.</p> <p>5.1.18 Welding shall not be carried out when the surface of the parts to be welded are wet for any cause and during periods of rain and strong winds unless the welder and work are properly shielded.</p> <p>5.1.19 The unpainted ends of pipe surface shall be painted after completion of jointing. Precaution shall be taken to prevent any crack or damage in the external coating during installation. Pipes shall be laid in trenches excavated along the route and the over ground portion shall be installed as per final layout drawings furnished to the Contractor.</p> <p>5.1.20 On completion of all welding in the pipe lines, the same shall be tested hydrostatically and after successful testing, shall be covered by sand wrapping and backfilling with earth as specified elsewhere in this specification.</p> <p>5.1.21 Installed pipe shall be closed up at both ends at the end of each day by watertight plug or other means approved by the Owner to prevent debris/ animals/human beings from entering the pipe.</p> <p>5.1.22 Header end connections shall be closed with end plates.</p> <p>5.2 <u>RUBBER EXPANSION JOINTS</u></p> <p>Design of the Expansion Joint shall take care of the axial, angular or rotational movement of the bellow and/or the equipment vibration. Axial compression or elongation of Rubber Expansion joint under design pressure</p> |                                                    |                 |

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| <p>from free condition shall be 10 mm (maximum). Lateral deflection of Rubber Expansion joint under design pressure from free condition shall be 10 mm. Lateral deflections with simultaneous axial elongation and compression shall be 10 mm. These figures shall be confirmed based on the final details of condenser and C.W. pumps.</p> <p>The general design and constructional features of various components of the Expansion Joints shall be as follows:</p> <p><b>5.2.1 Body</b></p> <p>(a) Expansion bellow shall be manufactured from abrasion resistant natural or synthetic rubber.</p> <p>(b) The Expansion Joints shall have integral flanges at both ends complete with split retaining rings. The flanges shall be made of tough non-compressible duck to resist stresses set up when the flange bolts are tightened. The flange compound shall be designed to resist flow under bolting pressure. The boltholes drilled on the flanges shall be thoroughly coated with self- vulcanizing rubber so that edges of the plies are not exposed.</p> <p>(c) Two (2) sets of split retaining rings shall be installed on each Expansion Joint to increase resistance to pressure. The rings shall be made of rolled steel IS-2062, split, bevelled and galvanized. The rings shall be placed directly against the flange of the Expansion Joint and bolted through it to the metal flange of the pipe. Steel washers shall be used at the points where the rings are split.</p> <p><b>5.2.2 Carcass</b></p> <p>Fabrics of high strength synthetic fibres (High quantity canvas duck and polyester chord, reinforced) shall be used in suitable number of plies to hold the shape of the bellow at the working condition. All fabric plies shall be impregnated with rubber or synthetic components to permit flexibility between them.</p> <p>Copper coated steel wire or solid endless rings embedded in the carcass shall be used for reinforcement of the expansion bellow.</p> |                                                    |                 |

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| <p>5.2.3      Cover</p> <p>The exterior and interior surfaces of the bellow shall be of Neoprene 3 mm thick Type A shore hardness <math>65 \pm 5</math> durometer. Protective hypalon coatings shall be applied at the exterior.</p> <p>5.2.4      Control rod assembly</p> <p>Expansion Joint shall be supplied with control rod assembly to prevent excessive elongation or contraction of the bellow. Control rod assembly shall consist of long bolt, nuts &amp; lock nuts, washers/spherical washers, connecting plates (gusset plate) for fixing the assembly with companion flanges.</p> <p>Control rod assembly shall allow transverse and rotational movements under limiting axial conditions of the expansion joints. Design of the control rod assembly shall take care of the maximum axial thrust across the bellow calculated on the basis of maximum fluid internal pressure and the internal diameter of the arch.</p> <p>5.2.5      Joints shall be provided with companion flanges. Companion flanges shall be flat faced, slip-on and shall be fabricated from steel plates or forged.</p> <p>5.3        <u>BUTTERFLY VALVE</u></p> <p>5.3.1      General</p> <p>The design of the valve shall take into consideration the water hammer effect in case of accidental closure of the valve disc.</p> <p>5.3.2      Valve body</p> <p>Valve body shall be of cast iron/fabricated steel with flanged ends. Hubs for housing the disc shaft bearings shall be integrally cast/ fabricated with the body.</p> <p>Body thickness of metal seated valves shall be suitable for the service application and that for the rubber seated valves shall comply with AWWA standard.</p> |                                                    |                 |

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| <p>Valve body shall be lined with resilient material, if asked for in data sheets.</p> <p>Valve shaft may be of single piece extending completely through the valve disc or in two pieces, stubbed into the disc hubs. The shaft diameter shall take into consideration the maximum torque required for the valve operation, the maximum differential pressure across the valve disc when the valve is closed and the shock load due to accidental closure of the valve disc.</p> <p>5.3.3 Valve disc</p> <p>Valve Disc may be of cast or fabricated design, with no external ribs transverse to the direction of flow. The disc shall be designed for maximum differential pressure across the valve as well as the shock load due to accidental closure of the valve.</p> <p>5.3.4 Valve seat</p> <p>Rubber seats shall preferably be applied on the disc. Valve seat shall be designed to provide bubble tight shut-off at all operating conditions. Valve seats shall be of a design that permits removal and replacement at site and shall be securely clamped on the body or disc of the valve.</p> <p>Seat material shall be suitable for the operating conditions and handling fluid and may be suitably reinforced, if required.</p> <p>5.3.5 Valve bearings</p> <p>The valve shall be fitted with two (2) sleeve type shaft bearings, contained in the hubs of the valve body. Bearings shall be of 'self lubricated' and shall not have any harmful effect due to handling fluid.</p> <p>Adjustable thrust bearing(s) shall be provided to hold the valve disc securely in the centre of the valve seat, when asked for in the data sheets.</p> |                                                    |                 |

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| 5.3.6                                                                                                                                                | <b>Shaft seals</b><br><br>Shaft seals shall be provided both at drive and non-drive end of the shaft to prevent fluid flow to valve bearings. Shaft seals shall be of replaceable type and shall allow easy replacement with minimum dismantling of the valve components.                                                                                                                                                                                                                                                             |                 |
| 5.3.7                                                                                                                                                | <b>Valve Operators</b><br><br>Butterfly valve and its operator shall be of heavy duty construction and shall be designed to withstand all working conditions i.e. shall be able to open/close or hold from/at any intermediate disc position, as required, without any difficulty under different combinations of flow and pressure. Some of the butterfly valves, as shown in the relevant Tender drawing, will be operating under bi-directional flow and therefore designed accordingly considering safe & trouble free operation. |                 |
| 5.3.8                                                                                                                                                | Design of the gear reducers for butterfly valves shall conform to AWWA standard.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |
| 5.3.9                                                                                                                                                | Butterfly valves to be used for flow regulation/control shall be designed to accommodate extra velocity through the valve passage to ensure normal service life.                                                                                                                                                                                                                                                                                                                                                                      |                 |
| 5.3.10                                                                                                                                               | The design shall take care of the pressure drop across the valve disc due to control of fluid flow and shall take care of the erosion and cavitation effect on the body and the disc due to such operation.                                                                                                                                                                                                                                                                                                                           |                 |
| 5.4                                                                                                                                                  | <b><u>SPRING SUPPORTS</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |
| 5.4.1                                                                                                                                                | The spring rate for the springs to be adopted shall be around 40 Kg/mm. The number of springs and their initial compression for each type of support shall be selected accordingly. The above details shall be furnished along with the offer.                                                                                                                                                                                                                                                                                        |                 |
| 5.4.2                                                                                                                                                | Each spring selected shall not be loaded more than 60% of its maximum rated load while carrying the load.                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |

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| 5.4.3                                                                                                                                                | The spring supports shall be taken from the ground floor and the method of attachment shall be detailed by the Bidder.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |
| 5.4.4                                                                                                                                                | The material of construction of component parts shall be equal to or superior than the following : <ul style="list-style-type: none"> <li>(a) Spring : Spring steel conforming to IS-1570 Gr.50 Cr.1</li> <li>(b) Spring housing : Carbon Steel to IS-2062</li> <li>(c) Base plate, anchor : Carbon Steel Hot dip galvanised bolts, nuts etc.</li> <li>(d) Saddle : Carbon Steel to IS-2062</li> <li>(e) Support Table : Carbon Steel to IS-2062</li> </ul> <p>All other materials used shall be compatible with the service requirement and shall be of tested quality. In case resilient seating is found necessary, details of same with hardness, material etc shall be indicated in the tender.</p> |                 |
| 5.4.5                                                                                                                                                | All the mounting plates, base plates, along with foundation bolts, nuts, washers etc as required shall be supplied by the bidder. All items required for completing the installation of the spring assemblies shall be supplied under this section.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |
| 5.4.6                                                                                                                                                | The support saddles shall be welded to the respective C.W. pipe at site by the Bidder. Bidder shall ensure that the supports can be placed in their respective position with the C.W. pipes already installed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |
| 5.4.7                                                                                                                                                | The spring assemblies shall be set at shop for loads when filled up with water. The design shall however; permit that at site load adjustment to an extent of $\pm 10\%$ of specified loads shall be possible and even after this adjustment, the system shall allow free movement of C.W. pipes under loaded and empty conditions. The offer shall clearly indicate method of adjustment proposed.                                                                                                                                                                                                                                                                                                      |                 |
| 5.4.8                                                                                                                                                | The locking device to be provided for the spring assemblies shall be such that it is possible to easily unlock the springs even when there is certain                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |

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| <p>amount of unbalance between the load applied on the springs and the spring reactions. This is very important as there might always be certain difference between the theoretically calculated load for which the springs will be pre-compressed at shop and the actual load that will be applied on the springs during operating conditions.</p> <p>5.4.9 After installation of the spring supports at site with pre- compressed springs in locked condition, the C.W. pipes shall be filled up with water and then the springs shall be released by unloading the springs. If water in C.W. pipe is required to be drained out for any repairs/maintenance works, the springs shall be locked first and then the water from the pipes shall be drained out so as to avoid undue upliftment of the pipe because of loss of weight due to draining of water from the pipe. The system shall be restored after repair/maintenance works by filling up the pipes with water and then releasing the locks of the springs.</p> <p>The above operation of the spring supports shall have to be demonstrated at site to the entire satisfaction of the Owner.</p> <p>5.4.10 It shall be possible to take out the whole spring assembly for maintenance. Arrangement for lubrication of springs and other frictional parts shall also be provided to reduce frictional resistance.</p> <p>The spring box housing shall have drain plugs to allow draining of accumulated water/other liquid etc.</p> <p><b>6.0 <u>PAINTING</u></b></p> <p><b>6.1 <u>LARGE DIAMETER PIPING</u></b></p> <p>6.1.1 Before application of the paint, the internal and external surfaces shall be thoroughly cleaned with wire brush or blasting as required for removal of loose dirt, mill scales etc. Manufacturer's recommendation shall strictly be followed in the application of paint.</p> <p>6.1.2 Inner surface of each section of the pipe of size 600 NB and above shall be given adequate number of coats of epoxy resin based red oxide primer paint or approved equal so as to achieve the required dry film thickness (DFT) as described in Volume-II of this specification. Inner surface painting shall be</p> |                                                    |                 |

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| <p>applied at the fabrication yard before laying the pipes in position, leaving about 200 mm at both ends for welding of joints. This portion shall be painted after completion of laying and jointing.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |
| 6.1.3                                                                                                                                                                                                       | <p>Outside surface of pipes and fittings including hangers and supports that will be over ground or in a pit shall be given one (1) coat of coal tar primer before dispatch from fabrication yard. After installation, the part of the pipe line from where priming coat has been rubbed off shall be retouched with primer. Then two coats of Synthetic Enamel paint of approved quality and colour shall be applied. The paint must be compatible with the applied coal tar primer.</p>                 |                 |
| 6.1.4                                                                                                                                                                                                       | <p>Outside surface of all valves and accessories supplied by the Owner but erected on the piping system by the Contractor shall also be given one (1) coat of synthetic enamel paint of approved quality and colour.</p>                                                                                                                                                                                                                                                                                  |                 |
| 6.1.5                                                                                                                                                                                                       | <p>Outside surface of buried pipes and fittings shall be provided with corrosion protection as follows :</p> <p>One coat of coal tar primer of approved quality followed by coal tar based synthetic primer and single layer of 4 mm coal tar tape conforming to AWWA-C-203: 2002/IS-15337: 2003. The pipes that will be buried underground shall be spark tested after completion of wrapping of each sections/field jointing to check the quality of insulation that has been provided on the pipe.</p> |                 |
| 6.1.6                                                                                                                                                                                                       | <p>The coating thickness shall be measured either by elcometer or coating thickness gauge.</p>                                                                                                                                                                                                                                                                                                                                                                                                            |                 |
| 6.1.7                                                                                                                                                                                                       | <p>The pipes that will be buried underground shall be spark tested after completion of wrapping of each sections/field jointing to check the quality of insulation that has been provided on the pipe.</p>                                                                                                                                                                                                                                                                                                |                 |
| <b>7.0</b>                                                                                                                                                                                                  | <b><u>DRAWINGS, CURVES &amp; INFORMATION REQUIRED</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |
| 7.1                                                                                                                                                                                                         | <p>For Drawing, Data and Information required along with BID refer <b>Volume VIII</b>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                |                 |

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| <p align="center"><b><u>ANNEXURE-I</u></b></p> <p align="center"><b><u>BUTTERFLY VALVE – TYPE- I</u></b></p> <p align="center"><b><u>(ELECTRICAL ACTUATOR OPERATED)</u></b></p> |                                                                |                                                                     |
| <b>1.0</b>                                                                                                                                                                      | <b>DESCRIPTION</b>                                             | <b>SPECIFICATION</b>                                                |
| 1.1                                                                                                                                                                             | Service                                                        | : Condenser Cooling and Auxiliary Cooling Water System              |
| 1.2                                                                                                                                                                             | Duty                                                           | : Continuous                                                        |
| 1.3                                                                                                                                                                             | Location                                                       | : Condenser Inlet and Outlet, ACW pump discharge – indoor           |
| 1.4                                                                                                                                                                             | Liquid handled                                                 | : Cooling water                                                     |
| 1.5                                                                                                                                                                             | Temperature                                                    | : 33°C (design)                                                     |
| <b>2.0</b>                                                                                                                                                                      | <b><u>PERFORMANCE REQUIREMENT</u></b>                          |                                                                     |
| 2.1                                                                                                                                                                             | Rated capacity (m <sup>3</sup> /hr)                            | : Bidder to indicate as per guidelines in Section-I of this volume. |
| 2.2                                                                                                                                                                             | Design Pressure, kg/cm <sup>2</sup> (g)                        | : Bidder to indicate as per guidelines in Section-I of this volume. |
| 2.3                                                                                                                                                                             | Design temperature (°C)                                        | : Bidder to indicate as per guidelines in Section-I of this volume. |
| 2.4                                                                                                                                                                             | Maximum Pressure drop when fully open, kg/cm <sup>2</sup> (g). | : Bidder to indicate as per guidelines in Section-I of this volume. |
| 2.5                                                                                                                                                                             | Seismic Category                                               | : Non-Seismic                                                       |
| 2.6                                                                                                                                                                             | Maximum Differential Pressure, kg/cm <sup>2</sup> (g)          | : Bidder to indicate as per guidelines in Section-I of this volume. |

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| <b>3.0</b>                                                                                                                                           | <b><u>DESIGN FEATURES</u></b>                      |   |                                                           |
| 3.1                                                                                                                                                  | Type                                               | : | Butterfly (Electrical Actuator Operated)                  |
| 3.2                                                                                                                                                  | Pressure Rating                                    | : | 150 #                                                     |
| 3.3                                                                                                                                                  | End Connection with Standard                       | : | SO FF Flanged AWWA C207                                   |
| 3.4                                                                                                                                                  | Special Features                                   | : | Leak Tight in both directions                             |
| 3.5                                                                                                                                                  | Stem Orientation/Hand Wheel Position               | : | Vertical                                                  |
| 3.6                                                                                                                                                  | Actuator                                           | : | Electrical with Hand wheel provision for Manual Operation |
| 3.7                                                                                                                                                  | Design Standard                                    | : | AWWA-C504- CL. 150A                                       |
| 3.8                                                                                                                                                  | Accessories                                        | : | Gear Reducer, Hand wheel, etc.                            |
| 3.9                                                                                                                                                  | Face To Face Dimensions Std                        | : | As Per AWWA- C504                                         |
| 3.10                                                                                                                                                 | Extended Stem Required                             | : | No                                                        |
| 3.11                                                                                                                                                 | Type Of Body                                       | : | Short Body (Flanged)                                      |
| <b>4.0</b>                                                                                                                                           | <b><u>MATERIAL OF CONSTRUCTION</u></b>             | : |                                                           |
| 4.1                                                                                                                                                  | Body/Bonnet/Disc                                   | : | IS 210, Gr. FG 260                                        |
| 4.2                                                                                                                                                  | Stem                                               | : | SS 304                                                    |
| 4.3                                                                                                                                                  | Seal                                               | : | EPDM                                                      |
| 4.4                                                                                                                                                  | Gasket                                             | : | Nitrile Rubber                                            |
| 4.5                                                                                                                                                  | Valve Internal Hardware                            | : | SS - 304                                                  |
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| 4.6                                                                                                                                     | Bolts/Stud                               | :             | IS:1363, Class 4.6     |
| 4.7                                                                                                                                     | Nuts                                     | :             | IS : 1363              |
| 4.8                                                                                                                                     | Shaft Bearing                            | :             | Leaded Bronze          |
| 4.9                                                                                                                                     | Seat Ring                                | :             | Stainless Steel SS 316 |
| 4.10                                                                                                                                    | Hand Wheel                               | :             | Malleable Iron         |
|                                                                                                                                         |                                          |               |                        |
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| <p style="text-align: center;"><b><u>ANNEXURE-II</u></b></p> <p style="text-align: center;"><b><u>BUTTERFLY VALVE – TYPE-II</u></b></p> <p style="text-align: center;"><b><u>(ELECTRO-HYDRAULIC OPERATED)</u></b></p> |                                                               |   |                                                                   |
| <b>SR. NO.</b>                                                                                                                                                                                                        | <b>DESCRIPTION</b>                                            |   | <b>SPECIFICATION</b>                                              |
| 1.0                                                                                                                                                                                                                   | Service                                                       | : | Circulating Water System                                          |
| 2.0                                                                                                                                                                                                                   | Duty                                                          | : | Continuous                                                        |
| 3.0                                                                                                                                                                                                                   | Location                                                      | : | CW pump discharge – indoor                                        |
| 4.0                                                                                                                                                                                                                   | Liquid handled                                                | : | Cooling water                                                     |
| 5.0                                                                                                                                                                                                                   | Temperature                                                   | : | 33°C (design)                                                     |
| 6.0                                                                                                                                                                                                                   | <b><u>PERFORMANCE REQUIREMENT</u></b>                         |   |                                                                   |
| 6.1                                                                                                                                                                                                                   | Rated capacity (m <sup>3</sup> /hr)                           | : | Bidder to indicate as per guidelines in Section-I of this volume. |
| 6.2                                                                                                                                                                                                                   | Design Pressure, kg/cm <sup>2</sup> (g)                       | : | Bidder to indicate as per guidelines in Section-I of this volume. |
| 6.3                                                                                                                                                                                                                   | Design temperature (°C)                                       | : | Bidder to indicate as per guidelines in Section-I of this volume. |
| 6.4                                                                                                                                                                                                                   | Maximum Pressure drop when fully open, kg/cm <sup>2</sup> (g) | : | Bidder to indicate as per guidelines in Section-I of this volume. |
| 6.5                                                                                                                                                                                                                   | Seismic Category                                              | : | Non-Seismic                                                       |
| 6.6                                                                                                                                                                                                                   | Maximum Differential Pressure, kg/cm <sup>2</sup> (g)         | : | Bidder to indicate as per guidelines in Section-I of this volume. |
| 7.0                                                                                                                                                                                                                   | <b><u>DESIGN FEATURES</u></b>                                 |   |                                                                   |
| 7.1                                                                                                                                                                                                                   | Type                                                          | : | Butterfly (Electro-Hydraulic Operated, Lug Type)                  |

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| SR. NO.                                                                                                                                              | DESCRIPTION                                        |   | SPECIFICATION                 |
| 7.2                                                                                                                                                  | Pressure Rating                                    | : | 150 #                         |
| 7.3                                                                                                                                                  | End Connection With Standard                       | : | SO FF Flanged AWWA C207       |
| 7.4                                                                                                                                                  | Special Features                                   | : | Leak Tight in both directions |
| 7.5                                                                                                                                                  | Stem Orientation/Hand Wheel Position               | : | Vertical                      |
| 7.6                                                                                                                                                  | Actuator                                           | : | Electro-Hydraulic Operated    |
| 7.7                                                                                                                                                  | Design Standard                                    | : | AWWA-C504- CL. 150A           |
| 7.8                                                                                                                                                  | Accessories                                        | : | Hand wheel, etc.              |
| 7.9                                                                                                                                                  | Face to Face Dimensions Std                        | : | As Per AWWA- C504.            |
| 7.10                                                                                                                                                 | Extended Stem required                             | : | No                            |
| 7.11                                                                                                                                                 | Type of Body                                       | : | Wafer Type - Short Body       |
| 8.0                                                                                                                                                  | <b><u>MATERIAL OF CONSTRUCTION</u></b>             |   |                               |
| 8.1                                                                                                                                                  | Body/Bonnet                                        | : | C.I. IS 210, Gr. FG 260       |
| 8.2                                                                                                                                                  | Disc                                               | : | 2% Ni C.I. IS 210, Gr. FG 260 |
| 8.3                                                                                                                                                  | Gland Packing                                      | : | Impregnated Teflon            |
| 8.4                                                                                                                                                  | Power Actuator                                     | : | Electro-Hydraulic             |
| 8.5                                                                                                                                                  | Stem                                               | : | SS 304                        |
| 8.6                                                                                                                                                  | Seal                                               | : | Nitrile Rubber                |
| 8.7                                                                                                                                                  | Gasket                                             | : | Nitrile Rubber                |
| 8.8                                                                                                                                                  | Valve Internal Hardware                            | : | SS - 304                      |

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