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## 1.0 SCOPE OF WORK

Vendor / Agency shall provide services for 3D Plant Modelling (using PDMS software from AVEVA,UK) and power plant design and design engineering so as to develop 3D model for a complete thermal or gas power plant including all major systems and facilities within the plant boundary (including the main plant area and auxiliary plant areas).

The 3D model shall primarily cover all major mechanical (Turbine and generator, heat exchangers, pumps, and electrical equipments (including power and distribution transformers, HT and LT switchgear, panels, etc.), piping & its supports, bus ducts, AC and ventilation ducting, cable trays etc inside and outside the TG building and civil and architecture related modeling.

Main equipment plan, TG hall Equipment layout drawings at various floors, transformer yard layout, bus duct/cable trench layout, composite piping layout and piping isometric and hanger drawings shall be extracted from the model.


The model shall be complete and accurate to the extent of getting the required mechanical and electrical layout 2D drawings and piping isometrics and hangers utilizing PDMS 2D & 3D draft modules. Model shall be utilized for checking interferences and also an engineering tool for arriving at optimum designs by BHEL and ultimate customer.

BHEL-PEM has done extensive customization of PDMS for executing thermal power projects. All the customization done and PDMS models of previous projects done by BHEL-PEM shall be made available to the vendor/agency. Normally, no major customization or new catalogue item creation is envisaged, the vendor/agency shall do so to meet any project specific requirements.

The vendor/agency shall agree to sign non-disclosure agreements to ensure information security of BHEL-PEM.

**Vendor / agency can if needed visit BHEL to ascertain the available customisation available and also study the outputs expected of him before responding to this Prequalification requirement.**

**The details of modeling and drawings given alongwith subsequent sections are representative only to familiarise the Vendor / agency with the work expected from him.**

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For each specific project awarded by BHEL the Vendor / agency who get qualified shall be required to quote based on project specific scope of work defined by BHEL. **It may be possible that the work related to building 3D model in PDMS model is only assigned to the Vendor / agency wherein BHEL shall be furnishing completely engineered plant in 2D drawings.**

## **2.0 Typical Job Content: MECHANICAL PLANT EQUIPMENT AND PIPING LAYOUT**

2.1 Vendor/Agency shall develop complete 3D model of piping and associated equipments to extract equipment layout, composite piping layout and piping isometric drawings showing all the interconnecting piping and stubs etc ,hanger attachment based on P&ID and shall generate following drawings/documents/ data as minimum, as per BHEL format.

### **2.1.1 EQUIPMENT LAYOUT**


Extraction of the following Equipment Layout Drawings from engineered 3D model.(typical list of drawing shall be as below)


- a) TG Building Equipment layout at 0.00m & (-) 5.6m level.
- b) TG Building Equipment layout at 4.5m level.
- c) TG Building Equipment layout at 7.5m & 10.0m level.
- d) TG Building Equipment layout at 15.5m level.
- e) TG Building Equipment layout at 20.6m & 25.6m level.
- f) TG Building Equipment layout at 30.6m&35.6m evel.
- g) Cross Section.
- h) Development of Main Equipment layout including the Boiler Area layout .


### **2.1.2. COMPOSITE PIPING LAYOUT DRAWINGS FOR:**


#### **a) CRITICAL PIPING:**


- i. Main steam piping from boiler super heater outlet to the turbine including safety valve and branch connections.
- ii. Cold Re-heat piping from turbine outlet to Re-heater inlet header including safety valve and branch connections.


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<p>iii. Hot Re-heat piping from Re-heater outlet header to turbine inlet including safety valve and branch connections.</p> <p>iv. HP and LP Bypass piping including warm up piping.</p> <p><b>b) POWER CYCLE PIPING :</b></p> <p>i. Feed water piping from boiler feed pump discharge to the inlet of the economizer including HP Heaters and bypass connections.</p> <p>ii. Extraction lines to HP/LP heaters &amp; Deaerator.</p> <p>iii. HP/LP Heater normal and alternate drain piping and vent piping</p> <p>iv. Condensate piping from the discharge of Condensate Extraction Pumps to Deaerator including GS Condenser, LP Heaters, Drain Cooler and bypass connections, excess return, minimum re-circulation, LP bypass spray etc.</p> <p>v. Auxiliary steam system piping from MS tap off to auxiliary steam header to various consumption points in the TG Building.</p> <p>vi. CEP suction piping</p> <p>vii. BFP suction &amp; recirculation piping</p> <p>viii. Piping around GSC, drain cooler etc (excluding Turbine Integral piping).</p> <p>ix. Air evacuation system piping</p> <p>x. Various drains, vents and safety valve discharge piping</p> <p>xi. Flash tanks drains and vents including drain manifolds.</p> <p>xii. Boiler and Deaerator filling.</p> <p>xiii. Deaerator overflow and drain piping.</p> <p>xiv. Any other piping system as required for a thermal power station.</p> <p><b>c) LOW PRESSURE PIPING :</b></p> <p>Low pressure (LP) piping shall cover the complete interconnecting piping within the TG building for following systems/services:</p> <p>i. Circulating water system.</p> <p>ii. Aux. cooling water system (ACW and DMCW) distribution piping</p>			


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<p>iii. D.M and Condenser make up piping – normal and emergency make-up</p> <p>iv. Condensate Surge Tank fill system.</p> <p>v. Instrument air system distribution piping in the TG building.</p> <p>vi. Service air system distribution piping in the TG building.</p> <p>vii. Drinking/Plant/Service/filtered water Piping.</p> <p>viii. Any other piping system for other plant auxiliary services as required.</p> <p>2.1.3 Individual piping system isometric drawings for critical and Power Cycle Piping (showing hanger/support points, stubs, welded lugs / clamp orientations etc) complete in all respects so that fabrication / erection drawings can be generated based on these using PDMS model /drawing input.Hanger support dwgs shall also be generated from the 3D model.</p> <p>2.1.4 Revision of 3D model/extraction of updated equipment layout drawings, composite piping and Piping Isometric drawings incorporating customers &amp; other units' comments, interfaces and as per Stress Analysis reports.</p> <p>2.1.5 Estimated BOM for Piping &amp; Fittings for procurement Planning for :</p> <ul style="list-style-type: none"> <li>○ Critical Cycle piping</li> <li>○ Power Cycle Piping</li> <li>○ Low Pressure Piping</li> <li>○ Small Bore Piping.</li> </ul> <p>2.1.6 Input data for Piping &amp; Equipment for Thermal Insulation design.</p> <p>2.1.7 Equipment &amp; Piping Load data, floor/ wall openings for Civil Design.</p> <p>2.1.8 Requirement of openings and embedded plates for civil design and supply.</p> <p>2.1.9 Requirement of extension spindle/chain operation of valves.</p> <p>2.1.10 Data for HP / LP Flash Tanks – Nozzle orientations / locations</p> <p>2.1.11 Drain/Vent - Valves/Traps requirement.</p> <p>As reg engineering outside TG hall Vendor / agency shall develop 3D model of piping and associated equipments as per P&amp;IDs &amp; extract piping layout drawings from the model and shall generate as per BHEL format.</p>			


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<p>i) 3D representation of entire power plant within boundary with details to extract 2D drawings such as Plot Plan ,Main Equipment Plan etc. BHEL may agree to accept such drawings independently made in AUTOCAD in case of time constraints provided 3D plant models are made to the satisfaction of BHEL.</p> <p>ii) Modeling of outside TG hall piping (excluding small bore piping i.e. less than or equal to 50NB) covered in the P&amp; IDs of PW, SW, CW/ACW, DMCW, IA, SA, DM Make-Up, Fuel Oil, Aux Steam pipes, etc.</p> <p>iii) Modeling of PEM vendor pipes routed on the pipe racks i.e. ETP, Fire Fighting, HVAC, chilled water, Mill Reject System, etc and extraction of drawings from 3D model</p> <p>iv) Modeling of unit engineered pipes in the pant and routed on pipe racks designed by PEM/Customer as needed</p> <p>v) Modeling of pipe cum cable trestle / pedestal including CHP / Ash handling vendor pipe trestles as needed</p> <p>vi) Finalization of pump house sizes &amp; locations (in plot plan) along with modeling of piping in and around pump house.</p> <p>vii) Bill of materials for piping &amp; fittings for all the above piping systems</p> <p>viii) Extraction of plan &amp; sectional drawings for pipe cum cable trestle / pedestal &amp; pipe routing in and around pump houses including revisions if any.</p> <p>ix) Release of plot plan and main plant layout drawings based on inputs received from different departments of PEM, customer, vendors &amp; units.</p> <p>x) Vetting of drawings / documents of other agencies viz. customer &amp; BHEL Units / vendor drawings including civil &amp; architectural drawings for interface engineering and piping layout engineering.</p> <p>xi) Review of all miscellaneous buildings including ESP Control Room, , DG set, DM Plant, Fire Water Pump House, ETP drawings, etc as per applicable scope in the project</p> <p>5.2 Following activities are included in the Vendor/Agency scope :</p>			

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<p>5.2.1 Preparation and revision of 3D model/extraction of updated Piping drawings incorporating customers &amp; other units' comments, interfaces and as per Stress Analysis reports or any other changes necessitated during engineering.</p> <p>5.2.2 Equipment &amp; Piping Load data for Civil Design.</p> <p>5.2.3 Requirement of openings/cutouts and embedded plates for pipes needed for civil design and supply</p> <p>5.2.4 Requirement of extension spindle/chain operation of valves.</p> <p>5.2.5 DM / CST Tanks – Nozzle orientations / locations</p> <p>5.2.6 PW / SW / DMCW Tanks - Nozzle orientations/locations</p> <p>5.2.7 Drain/Vent – Valves and Traps requirement.</p> <p>5.2.8 Overall modeling of boiler, mill bay, ESP, ID fans, chimney, misc. buildings / pump houses, roads, staircases, elevator, local platforms for PEM engineered piping, Floor slab, openings/cutouts etc. as required.</p> <p>5.2.9 Marking of drain &amp; vent stub requirement on P&amp;IDs based on piping layouts.</p> <p>5.2.10 Civil inputs for Floor / Wall Cutouts / Embedment requirements considering electrical and mechanical requirements for TG building ,misc pump houses etc.</p> <p><b>2.5 MAJOR EXCLUSIONS</b></p> <p>i. Stress analysis of piping systems and hanger engineering &amp; modeling.</p> <p>ii. Technical coordination, inputs from BHEL units / customer / vendors and attending outstation meetings.</p> <p>iii. Systems engineering , sizing of electrical and mechanical equipments.</p> <p><b>3.0 Typical Job Content: ELECTRICAL&amp; C&amp;I</b></p> <p><b>3.1 Vendor / agency shall engineer and develop the model and extract the following 2D drawings/documents/data as minimum as per BHEL format.</b></p> <p><b>3.1.1 ELECTRICAL &amp; CONTROL ROOM EQUIPMENT LAYOUTS</b></p> <p>a) Transformer yard layout</p>			

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<p>b) Isolated Phase bus duct and associated equipments layout (including support arrangement)</p> <p>c) Segregated Phase Bus duct layout (including support arrangement)</p> <p>i) From UAT/ST to 6.6 kV unit/stn. Switchgear</p> <p>ii) 6.6 kV stn. Tie</p> <p>iii) Tie bet. 6.6 kV unit and station Switchgear</p> <p>d) LV bus duct layout in main building (between dry type service transformers and PMCCs)</p> <p>e) Electrical equipment layouts in</p> <p>i) TG Hall at 0.00M, 4.5M, 10.5M, 15.5M</p> <p>ii) Switchgear room at 3.75M, 15.5M, 21.6M, 30.0M etc. / battery room at 8.75M etc. in E-F / F-H bay.</p> <p><b>3.1.2 CABLE TRAY &amp; SUPPORT / ELECTRICAL CABLE TRENCH LAYOUTS (WITH SECTION MARKING)</b></p> <p>a) Cable Tray/trench layout in transformer yard</p> <p>b) Cable tray layout in TG area</p> <p>i) At 0.00M (in cable trenches)</p> <p>ii) Below 4.5M floor</p> <p>iii) Below 10.5M floor</p> <p>iv) Below 15.5M floor</p> <p>v) At the ceiling of TG Hall / E-F bay</p> <p>vi) Any other area within Transformer Yard, TG Hall, etc</p> <p>c) In cable vaults at 0.00M, 11.75M and below raised platforms (i.e. wherever MCCs are placed on raised platform)</p> <p>d) Interconnectivity of cable trays of switch yard, transformer yard, TG hall (at different levels), cable vaults and risers connecting various floors, cable trestle/pipe rack etc./any other connectivity with the existing units or within new units.</p> <p>e) Cable tray sections data inputs to BHEL cable routing programme.</p> <p>f) Area wise cable trays, cable tray accessories and supports Bill of Material (BOM).</p>			

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<p><b>3.1.3</b> 3D Modelling of Main Control Room and Control equipment room in TG building and misc control rooms in pump houses and MAX packages</p> <p><b>4.0 Typical Job Content :CIVIL</b></p> <p><b>4.1</b> Complete 3D modeling of complete plant including power block including structural details of building(s), concrete general arrangement and component modeling e.g. stairs, trenches, ladders, platforms ,roads ,drains etc. The purpose of civil modeling is to get mechanical and electrical layout drawings utilizing the civil details shown in 3D model &amp; extraction of detailed civil dwgs is to be considered only if specifically confirmed by BHEL in specific order.</p> <p><b>4.1.1 STRUCTURE MODELING</b></p> <p>i) Modeling of main and secondary beams at all levels excluding stiffeners, gusset plates, brackets etc.The structure modeling of all auxiliary structures for supporting is also to be done.</p> <p><b>4.1.2 CONCRETE MODELING</b></p> <p>i) Modeling of all floors, indicating all floor cutouts, handrails, grating areas, platforms etc.</p> <p>ii) Modeling of all wall panels, roof panels indicating openings for doors, windows etc., and modeling of doors, windows, rolling shutters etc.</p> <p>iii) Modeling of all components etc., trenches, drains, sumps, handrails, ladders, stairways etc.</p> <p>iv) Modeling of column foundations &amp; pedestals, trenches, pits, sumps etc. below 0.0 M for interference checking.</p> <p><b>5.0 MECHANICAL AUX.PACKAGES</b></p> <p>3D Modelling and layout interface engineering related to Mechanical Aux packages related to mechanical and electrical layouts (typ packages indicated)</p> <p><b>5.1.1 HVAC SYSTEM</b></p> <p>a) AC Plant chilled water piping.</p>			

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<p>b) Ducting system for control room areas.  c) Ducting system for power house areas from all ventilation plants  d) Roof Extraction units in power house including various wall mounted fans as applicable</p> <p><b>5.1.2 FIRE PROTECTION SYSTEM</b></p> <p>a) Piping Layout for power house building  b) Transformer area piping layout</p> <p><b>5.1.3 ASH HANDLING /MILL REJECT SYSTEM FIRE PROTECTION SYSTEM</b></p> <p>Modelling for overall buildings, racks, piping ,trenches etc related to this .</p> <p><b>5.1.4 MATERIAL HANDLING : CRANES &amp; HOISTS</b></p> <p>EOT Crane to fit the layout/span</p> <p><b>5.1.5 WATER SYSTEM RELATED</b></p> <p>Cooling towers/pump houses, misc pump houses, Pretreatment plant, chlorination, DM plant ETP etc along with related piping, racks, trenches and cabling etc</p> <p><b>5.1.6 Misc Buildings</b></p> <p>3D Modelling of Stores , Workshop, Gate complex etc .Engineering and modeling of Service building ,Facility Building etc .</p> <p><b>6.0 GENERAL ENGINEERING INPUTS FROM BHEL</b></p> <p>Following major inputs will be provided by BHEL to Vendor/Agency to enable him to carry out plant equipment and piping layout engineering.</p> <p>i. TG Building equipment layout drawings ( Preliminary).  ii. Finalized scope of work and terminal points  iii. General Arrangement drawing for various BHEL in house and our vendor supplied equipments.  iv. Equipment Layout for Boiler and its auxiliaries  v. Proposition drawing of STG  vi. Piping Layout of turbine integral systems.  vii. P &amp;IDs.  viii. Pipe Schedules.</p>			

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- ix. Valve Schedule & GA drawings.
- x. Civil / Structural arrangements for TG Building.
- xi. Thermal Insulation Schedule.
- xii. Any other input required for completing modeling and engineering work.
- Xiii) All electrical and mechanical auxiliary equipment drawings and single line diagrams, cable details etc

#### **7.0 MAJOR EXCLUSIONS:**

- i. Stress analysis of piping systems.
- ii. Technical coordination outside BHEL/PEM , inputs from BHEL units / customer / vendors and attending out station (NCR) meetings.
- iii. Systems engineering , sizing of electrical and mechanical equipments etc.

#### **8.0 REVIEW OF 3D MODEL and CLASHES.**

Vendor/Agency shall be required to continuously interact with BHEL reg the 3D model and submit soft/hard clash reports as and when desired by BHEL . The 3D model if required will be exported for other packages for review reality and animation etc.