


|  |   |   |  |                                       |                |                           |                |
|--|---|---|--|---------------------------------------|----------------|---------------------------|----------------|
|   | <b><u>BHARAT HEAVY ELECTRICAL LIMITED</u></b>                                       |   |  |                                       |                | <b>Enquiry No. :</b>      |                |
|  | <b><u>UNIT'S ADDRESS:</u></b>   |   |  |                                       |                | <b>Due Date :</b>         |                |
|  | <b><u>CONTACT PERSON'S NAME/DESIGN./PHONE NO./E-MAIL (FROM PURCHASE DEPTT.)</u></b> |   |  |                                       |                | <b>Supplier Qtn. No.:</b> |                |
|  |   |   |  |                                       |                | <b>Date :</b>             |                |
| <b><u>SPECIFICATION CUM COMPLIANCE CERTIFICATE OF VACUUM IMPREGNATION PLANT</u></b>  |   |   |  |                                       |                |                           |                |
| <b>NOTE:-</b>  |   |   |  |                                       |                |                           |                |
| 1. Vendor must submit complete information against clause no. 19(Qualifying Conditions). The offer meeting this clause would only be processed.  |   |   |  |                                       |                |                           |                |
| 2. The "Offered" Column and where applicable, the "Deviations" & "Remarks" Column of this format shall be filled in by the Vendor and submitted along with the offer. Inadequate / incomplete, ambiguous, or unsustainable information against any of the clauses of the specifications/requirements shall be treated as non-compliance. |   |   |  |                                       |                |                           |                |
| 3. The offer and all documents enclosed with offer should be in English language only.   |   |   |  |                                       |                |                           |                |
| <b>NAME &amp; ADDRESS OF THE SUPPLIER :</b>  |   | <b>NAME &amp; ADDRESS OF THE INDIAN AGENT :</b> |  |                                       |                |                           |                |
| <b>TELEPHONE NOS.:</b>   |   | <b>TELEPHONE NOS.:</b>                          |  |                                       |                |                           |                |
| <b>FAX NOS.:</b>   |   | <b>FAX NOS.:</b>                                |  |                                       |                |                           |                |
| <b>E-MAIL ADDRESS :</b>  |   | <b>E-MAIL ADDRESS :</b>                         |  |                                       |                |                           |                |
| <b>SCOPE: SUPPLY, ERECTION &amp; COMMISSIONING OF VACUUM IMPREGNATION PLANT.</b>   |   |   |  |                                       |                |                           |                |
| <b>SNO</b>   | <b>DESCRIPTION FOR BHEL REQUIREMENT</b>   |   |  | <b>SPECIFIED / TO BE CONFIRMED BY</b> | <b>OFFERED</b> | <b>DEVIATIONS</b>         | <b>REMARKS</b> |
| <b>1.0 PURPOSE</b>   |   |   |  |                                       |                |                           |                |

| SNO | DESCRIPTION FOR BHEL REQUIREMENT   | SPECIFIED / TO BE CONFIRMED BY | OFFERED | DEVIATIONS | REMARKS |
|-----|--|--------------------------------|---------|------------|---------|
| 1.1 | The vacuum impregnation plant will be used for impregnating High Voltage stator capsules and rotors for Motors/ Alternators. Vacuum pressure impregnation ensures the filling of voids between the different layers of insulation tapes by epoxy resin in the assembled insulated bars/ coils within the assembled coil slot. The sequence of vacuum impregnation process for wound stator / wound rotor of electrical motors is generally as follows. | Vendor to confirm.             |         |            |         |
|     | (i) Heating the vacuum chamber to temperature 70°C to 80°C.  |                                |         |            |         |
|     | (ii) Loading the charge (object to be impregnated) and continuing with heating.  |                                |         |            |         |
|     | (iii) Evacuating the chamber to <0.1m bar within a time duration of 2 to 3 hours and maintaining the vacuum level for 10 - 15 hours.   |                                |         |            |         |
|     | (iv) Introducing epoxy impregnating resin (10 to 15 kilo litres within 20 minutes) into impregnation vessel while maintaining vacuum level during this period to 0.9 m bar or lower.   |                                |         |            |         |
|     | (v) Maintaining vacuum level again to< 0.1m bar.   |                                |         |            |         |
|     | (vi) Breaking of vacuum in steps to 1 atmosphere and pressurising to 4 bar and maintaining for 3 to 5 hours.   |                                |         |            |         |
|     | (vii) Releasing pressure gradually to atmospheric level and simultaneously pumping back the resin to storage tank  |                                |         |            |         |
|     | (viii) Removing the charge from impregnation chamber.  |                                |         |            |         |
| 1.2 | <b>EQUIPMENT DETAILS: The VPI plant shall be complete with the following major parts</b>   |                                |         |            |         |
|     | (i) Horizontal Impregnation Chamber.- 1 No (Capacity as per 2.2.1)   |                                |         |            |         |
|     | (ii) Resin Storage Tank.- 2 Nos, capacity- suitable  |                                |         |            |         |
|     | (iii) Compressed Air System- 1 Set   |                                |         |            |         |
|     | (iv) Vacuum Pumping System 2 Nos + 1 No Standby  |                                |         |            |         |
|     | (v) Brine Heating and Circulation System   | Vendor to confirm              |         |            |         |
|     | (vi) Cooling Water(Tower) Plant-1 No   |                                |         |            |         |
|     | (vii) Brine Chilling Plant -1 No   |                                |         |            |         |
|     | (viii) Control Panel (PLC & SCADA)- 1 Set  |                                |         |            |         |
|     | (ix) Motorized Trolley, with separate impregnation tray, for movement of job into and out of the Impregnation Chamber for horizontal impreg  |                                |         |            |         |

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|            | (x) Capacitance Measuring Equipment- 1 No  |   | Vendor to specify.             |         |            |         |
|            | (xi) Hydraulic system,Pneumatic control air system.  |   |                                |         |            |         |
|            | (xii) Erection material eg pipes, fittings, insulation materials, electrical control and power cabling etc.  |   |                                |         |            |         |
|            |  |   |                                |         |            |         |
| <b>2.0</b> | <b>SPECIFICATION:</b>  |   |                                |         |            |         |
| <b>2.1</b> | <b>Construction:</b>   |   |                                |         |            |         |
| 2.1.1      | The plant shall be designed and constructed in line with requirements of standards for vacuum and pressure operation. The plant shall be capable of being operated continuously. The design and construction shall include the safe operation of the equipment as well as safety for the operators.  |   | Vendor to Confirm              |         |            |         |
| 2.1.2      | All pumps, motors, controls, piping, thermal insulation, fittings, instrumentation, valves, gauges, interconnecting cabling / wiring etc, required for the various components of the plant should be included (Complete details and schematic diagram of the plant should be furnished). Battery limits for the plant should be clearly mentioned. |   | Vendor to Confirm              |         |            |         |
| <b>2.2</b> | <b>Vacuum Impregnation Chamber:</b>  |   | Vendor to Confirm              |         |            |         |
| 2.2.1      | Mounting:  | Horizontal (total capacity - 35000 L approx. )    | Vendor to Confirm              |         |            |         |
| 2.2.2      | Internal diameter:   | 2.5 Meters (to suit stator capsule of 1500 mm OD) | Vendor to Confirm              |         |            |         |
| 2.2.3      | Cylindrical length:  | 7.0 Meters  | Vendor to Confirm              |         |            |         |
| 2.2.4      | Operating vacuum:  | <0.1 mbar   | Vendor to Confirm              |         |            |         |
| 2.2.5      | Operating temperature:   | 70°C to 80°C                                      | Vendor to Confirm              |         |            |         |
| 2.2.6      | Operating pressure:  | 6 bar   | Vendor to Confirm              |         |            |         |
| 2.2.7      | Load Bearing Capacity (without resin)  | To suit the application                           | Vendor to confirm              |         |            |         |

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| 2.2.8  | The impregnation chamber shall be double walled construction fabricated out of boiler quality steel following the latest design and fabrication techniques. (Complete details should be furnished). Pressure testing of Impregnation chamber has got to be done by competent authority and certificate to be submitted by the vendor. | Vendor to Confirm              |         |            |         |
| 2.2.9  | The chamber should have arrangement for heating using hot brine solution flowing in double wall jacket mounted between the inner and outer wall. The brine solution is to be heated using electrical heating system. Suitable temperature indicator and safety control system to be provided.   | Vendor to Confirm and specify. |         |            |         |
| 2.2.10 | Hydraulically operated mechanism for quick opening, closing and locking (bayout) of the door along with suitable vacuum tight seal (Viton) for the door shall be provided.  | Vendor to Confirm              |         |            |         |
| 2.2.11 | The arrangement for connecting impregnating resin to the impregnation tray shall be through suitable flexible Stainless Steel pipe. Flexible Stainless Steel pipe to be included in scope of supply with 1 set extra.   | Vendor to Confirm              |         |            |         |
| 2.2.12 | Arrangement for draining resin back to resin storage tank from impregnation tray. (Details should be furnished)   | Vendor to Confirm              |         |            |         |
| 2.2.13 | The vacuum chamber shall have the following accessories:  | Vendor to Confirm              |         |            |         |
|        | a) Electro Pneumatically operated valves for resin inlet and outlet, connections for vacuum and pressure.   | Vendor to Confirm              |         |            |         |
|        | b) Vacuum, pressure, temperature sensors and indicators . (Details like type, make and specification should be furnished)   | Vendor to specify              |         |            |         |
|        | c) Limit Level switches Sensors for resin level monitoring. (Details should be furnished)   | Vendor to specify              |         |            |         |
|        | d) Suitable illumination Port for viewing the jobs placed in the impregnation tray . (Number, spacing, wattage and type of light fitting should be furnished)   | Vendor to Confirm              |         |            |         |
|        | e) Suitably spaced double-walled observation glasses windows with heating arrangement to be provided (Size and space of observation windows to be furnished)  | Vendor to Confirm              |         |            |         |
|        | f) Pressure safety valves.  | Vendor to Specify              |         |            |         |
|        | g) Feed-through connections for measuring operating parameters of the chamber . i.e. Vacuum, Pressure, Temperature, Capacitance & tan Delta to be provided. (1 additional set to be provided)   | Vendor to Specify              |         |            |         |
| 2.2.14 | The chamber shall be provided with all necessary auxiliaries for safe and proper operation, inspection and maintenance of the plant.  | Vendor to Confirm              |         |            |         |



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| 2.4.7     | Desired Heating-up Time from Storage Temperature to Impregnation temperature   | From 10°C to 70°C in 2 hours  | Vendor to confirm.             |         |            |         |
| 2.4.8     | Temperature Regulation at Impregnation Temperature: $\pm 2^{\circ}\text{C}$  |   | Vendor to Confirm              |         |            |         |
| 2.4.9     | Desired re-cooling Time for Resin  | a) From 70°C to (30°C to 40°C) by water cooling system in 2 hours b) By Brine Chilling System system from (30°C-40°C) to less than 10°C in 3 to 4 hours | Vendor to confirm.             |         |            |         |
| 2.4.10    | Temperature Regulation at Storage Temperature of less than 10°C + 0°C, - 2°C   |   | Vendor to Confirm              |         |            |         |
| 2.4.11    | The resin storage tanks shall be of welded double-jacket construction manufactured from steel sheet and conforming to international vacuum regulations. The resin storage tanks shall be vacuum pressure tight. Each storage tank is to be supported vertically on three supporting legs. Each resin storage tank shall be double jacketed & equipped with stainless steel spiral tube for heating and cooling of the resin. |   | Vendor to furnish details.     |         |            |         |
| 2.4.11.1  | Thickness of sheet steel   |   | Vendor to Specify              |         |            |         |
| 2.4.11.2  | Diameter and Thickness of stainless steel tube   |   | Vendor to Specify              |         |            |         |
| 2.4.11.3  | Overall length of stainless steel tube   |   | Vendor to Specify              |         |            |         |
| 2.4.11.4  | Should be provided with Swing Fly nut bolting dished tank cover with 'Viton' door 'O' Ring   |   | Vendor to Confirm              |         |            |         |
| 2.4.11.5  | Each tank shall be fitted with slow two-speed (approx 16rpm/32rpm) motorized agitator with auto shut-off system and suitable De-gassing system (Details should be furnished)   |   | Vendor to confirm              |         |            |         |
| 2.4.11.6  | Design Temperature   |   | Vendor to Specify              |         |            |         |
| 2.4.11.7  | Design Vacuum / Pressure   |   | Vendor to Specify              |         |            |         |
| 2.4.11.8  | Should be provided with inspection glasses and suitable lighting   |   | Vendor to Confirm              |         |            |         |
| 2.4.11.9  | Each resin storage tanks shall be provided with suitable Pneumatic Ball valves for resin inlet, outlet and sampling (Complete description to be furnished)   |   | Vendor to confirm              |         |            |         |
| 2.4.11.10 | Each resin storage tanks shall be provided with suitable Pneumatic Ball valves for Vacuum line, Compressed Air line, Ventilation line etc (Complete description should be furnished)   |   | Vendor to confirm              |         |            |         |
| 2.4.11.11 | Suitable gauges, temperature sensors / indicators should be provided for both resin and heating(cooling) Brine (Complete description should be furnished)  |   | Vendor to Confirm              |         |            |         |

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| 2.4.11.12 | Suitable safety relief valves should be provided for each storage tank and it's heating system (Complete description should be furnished)  | Vendor to Confirm              |         |            |         |
| 2.4.11.13 | Each resin storage tank shall be provided with re-usable filters for filtering resin returning from impregnation vessel.Filter description and filter size   | Vendor to confirm              |         |            |         |
| 2.4.11.14 | Resin Level Indicator with High / Low alarm  | Vendor to Specify              |         |            |         |
| 2.4.12    | De-gassing unit is to be provided so that resin is degassed while returning to the storage tank (Complete details should be provided)  | Vendor to Confirm              |         |            |         |
| 2.4.13    | Complete piping between storage tanks and from storage tanks to / from Vacuum Impregnation Chamber should be included  | Vendor to Confirm              |         |            |         |
| 2.4.14    | Resin Pipeline should be double jacketed & insulated for Brine heating/ cooling  | Vendor to Confirm              |         |            |         |
|           |  |                                |         |            |         |
|           | <b>2.5 Compressed Air System:</b>  |                                |         |            |         |
| 2.5.1     | The compressed air system complete with air compressor and matching refrigerated air dryer shall be suitable for meeting the operational requirements of the impregnationsystem. (Complete description of compressed air control system should be furnished)   | Vendor to Confirm              |         |            |         |
| 2.5.2     | <b>Air Compressor:</b> Oil-free Water Cooled compressor (Preferably of reputed Indian/International make) complete with inter-coolers, after cooler, control valves, safety valves, relief valves, pressure switches, pressure gauge, inlet valve, air filter and other accessories (Complete details and catalog should be furnished) | Vendor to Specify              |         |            |         |
| 2.5.2.1   | Type   | Vendor to Specify              |         |            |         |
| 2.5.2.1   | Make & Model of Air Compressor   | Vendor to Specify              |         |            |         |
| 2.5.2.2   | Flow Rate:   | Vendor to Specify              |         |            |         |
| 2.5.2.3   | Pressure:  | Vendor to Specify              |         |            |         |
| 2.5.2.4   | Compressed air storage tank capacity & pressure rating   | Vendor to Specify              |         |            |         |
| 2.5.3     | Closed circuit cooling water system complete with pumps, cooling tower, interconnecting piping etc (Complete details should be furnished)  | Vendor to Specify              |         |            |         |
| 2.5.4     | <b>Refrigerated Air Dryer:</b> preferably of reputed Indian make (Complete details and catalog should be furnished)  | Vendor to Specify              |         |            |         |

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| 2.5.4.1    | Dew Point: minus 60°C   | Vendor to confirm              |         |            |         |
| 2.5.4.2    | Make & Model  | Vendor to Specify              |         |            |         |
|            |   |                                |         |            |         |
| <b>2.6</b> | <b>Vacuum Pumping System:</b>   |                                |         |            |         |
| 2.6.1      | Vacuum Pumping System for Vacuum Impregnation Chamber:  | Vendor to Specify              |         |            |         |
| 2.6.1.1    | Backing Pump: Make, Model, Capacity (Rotary Oil Seal Pumps)   | Vendor to Specify              |         |            |         |
| 2.6.1.2    | Main Vacuum Pump: Make, Model, Capacity (Roots Pump)  | Vendor to Specify              |         |            |         |
| 2.6.2      | Vacuum Pumping System for Resin Storage Tanks:  | Vendor to Specify              |         |            |         |
| 2.6.2.1    | Backing Pump: Make, Model, Capacity (Rotary Oil Seal Pumps)   | Vendor to Specify              |         |            |         |
| 2.6.2.2    | Inter connected condensers in vacuum pumping system line to absorb resin vapours. Details and construction to be furnished.   | Vendor to Specify              |         |            |         |
| 2.6.3      | All instrumentation and valves required for the Vacuum System should be included  | Vendor to Confirm              |         |            |         |
| 2.6.4      | Type, Make and details of Vacuum Gauges   | Vendor to Specify              |         |            |         |
| 2.6.5      | Type, Make and details of Vacuum Gauges   | Vendor to Specify              |         |            |         |
| 2.6.6      | Automatic safety valve should be provided for each main vacuum pump to close the suction and exhaust lines in the event of switching-off of the pumps or in the event of power failure (Details should be furnished)  | Vendor to Confirm              |         |            |         |
| 2.6.7      | Vacuum Pumping System should be capable of handling resin vapours   | Vendor to Confirm              |         |            |         |
| 2.6.8      | Complete Vacuum pipeline and fittings should be included  | Vendor to Confirm              |         |            |         |
| 2.6.9      | Necessary Vacuum Pressure switches for automatic control should be included   | Vendor to Confirm              |         |            |         |
| 2.6.10     | One Vacuum Pumping System comprising of 1 nos Rotary Oil Seal Pump and 1 nos Roots Pump shall be provided as common standby for the Impregnation Chamber (Complete Details should be furnished) Inter connection of rotary Oil Seal Pump of Vacuum Chamber & of Resin storage tank should be provided | Vendor to Confirm              |         |            |         |
|            |   |                                |         |            |         |
| <b>2.7</b> | <b>Brine Heating / Cooling and Circulation System:</b>  |                                |         |            |         |



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| 2.7.1      | It should be possible to heat the brine solution using electrical heating system.Design of electrical system has to be done by the vendor. Suitable temperature indicator and control system to be provided.  | Vendor to Confirm and specify. |         |            |         |
| 2.7.2      | Heat Exchange with electrical heating arrangement details and KW rating of Heater to be specified. Details of Thermic Fluid and it's properties if used in the Heat Exchanger to be furnished by the vendor.  | Vendor to specify              |         |            |         |
| 2.7.3      | Brine Storage Tank: Capacity:   | Vendor to Specify              |         |            |         |
| 2.7.4      | Brine Storage Tank should be manufactured out of SS306 steel (Details of construction of the brine storage tank including thermal insulation should be furnished)   | Vendor to Confirm              |         |            |         |
| 2.7.5      | Details of Brine circulation pump, piping and instrumentation should be furnished.  | Vendor to Specify              |         |            |         |
| 2.7.6      | The system should include stand-by Brine Circulation Pump with motor  | Vendor to Confirm              |         |            |         |
| <b>2.8</b> | <b>Cooling Tower:</b>   |                                |         |            |         |
| 2.8.1      | Required capacity cooling tower complete with motor pump sets, valves, control panel, for cooling water requirements for first stage cooling of resin storage tanks & Air Compressor,vacuum pumps and condensers to be specified.   | Vendor to Confirm              |         |            |         |
| 2.8.1.1    | Protection devices to be provided for 1st stage cooling of vessels in resin storage tank, vacuum pump, Condensers etc.  | Vendor to Confirm              |         |            |         |
| 2.8.2      | Time for cooling resin from 70°C max operating temperature to 30°C-40°C(Around 2 hours).General Specification of Cooling Tower as per enclosed Annexure-III.  | Vendor to Confirm              |         |            |         |
| 2.8.3      | Pump: Quantity, Type, Make, Model, Material of Construction, Motor KW, Flow and Pressure  | Vendor to Specify              |         |            |         |
| 2.8.4      | Parallel cooling of resin in all the storage tanks should be possible at a time   | Vendor to Confirm              |         |            |         |
|            |   |                                |         |            |         |
| <b>2.9</b> | <b>Brine Chilling Plant:</b>  |                                |         |            |         |
| 2.9.1      | Brine chilling plant should be complete with compressor, refrigerant circuit, condenser, evaporator, tank of suitable capacity, feed pumps, valves, control panels etc complete with interconnect piping with thermal insulation, fittings, instrumentation, wiring and cabling (Complete description of the chiller including make, model, technical parameters, refrigerant used etc should be furnished) refrigerant should be non-CFC.General Specification of Brine Chilling Plant should be as per enclosed Annexure-I. | Vendor to Confirm              |         |            |         |
| 2.9.2      | Time for cooling resin from 30°C-40°C to less than 10°C ( Around 4 hours).  | Vendor to Confirm              |         |            |         |

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| 2.9.3       | Temperature Regulation of stored resin. ( + 0°C, -2°C)  | Vendor to Confirm              |         |            |         |
| 2.9.4       | Feed pump: Quantity, Type, Make, Model, Material of Construction, Motor KW, Flow and Pressure   | Vendor to Specify              |         |            |         |
| 2.9.5       | Parallel cooling of resin in all the storage tanks should be possible at a time   | Vendor to Confirm              |         |            |         |
| 2.9.6       | <b>Pumping System for circulation of Brine:</b><br>The Brine circulation in storage Tank & vacuum vessel should have independent operations.  | Vendor to Confirm              |         |            |         |
| 2.9.7       | All brine pumps to be used for heating and cooling for the VPI system should b provided with SS impeller & glandless seal construction. Each brine pumping should be provided with 1 set of stand by pump.  | Vendor to Confirm              |         |            |         |
| <b>2.10</b> | <b>Hydraulic System :</b> Suitable Hydraulic system for door lifting & clamping to be provided. Details should be submitted by the Vendor.  | Vendor to Specify              |         |            |         |
| 2.10.1      | The system should be centralised. Hydraulic Tank shall preferably be located at floor level   | Vendor to Specify              |         |            |         |
| 2.10.2      | Make Rexroth / Vickers Sperry or equivalent from a reputed manufacturer (details to be submitted)   | Vendor to Specify              |         |            |         |
| 2.10.3      | Filtration System, Details to be submitted  | Vendor to Specify              |         |            |         |
| 2.10.4      | Failure Indication  | Vendor to Specify              |         |            |         |
| 2.10.5      | Automatic shut off provision, Details to be submitted.  | Vendor to Specify              |         |            |         |
| 2.10.6      | Hydraulic Pump capacity (Flow/ Pressure)  | Vendor to Specify              |         |            |         |
| 2.10.7      | Each Pump should have an Independent motor. Tandem Pumps should not be used   | Vendor to Specify              |         |            |         |
| 2.10.8      | First filling of all required Oils & Grease etc to be supplied by vendor. Indigenous (Indian) source of Indian equivalent and specification of oil/grease are also to be provided by the vendor.  | Vendor to Specify              |         |            |         |
| <b>2.11</b> | <b>OPERATION &amp; CONTROL SYSTEM:</b>  |                                |         |            |         |
| 2.11.1      | VPI plant shall be equipped with control panel containing all the equipments necessary for operation, controlling and recording. The operation shall be fully automatic with computer control including data acquisition system. (Complete details should be furnished) as well as manual control system. | Vendor to Confirm              |         |            |         |

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| 2.11.2      | Necessary SCADA Software and Hardware should be included complete with HMI (Make, Details of the SCADA System should be furnished).In case of system platform change in future, the software should be upgradable free of cost for next 10 years. In addition to the SCADA, MIMIC Panel is also required. .  | Vendor to specify details.     |         |            |         |
| 2.11.3      | The VPI plant should be controlled by a suitably programmed PLC. All required modules and interfacing cables shall be included   | Vendor to Confirm              |         |            |         |
| 2.11.3.1    | PLC shall be ALLEN BRADLEY/GE-FANUC/MODICON/ MITSUBISHI/ SIEMENS MAKE ONLY. (Make, Model and Details to be furnished)  | Vendor to Specify              |         |            |         |
| 2.11.3.2    | PLC Programming shall be in Statement List (STL) and ladder diagram (LAD). It should have copy, cut, print functions etc.  | Vendor to Confirm              |         |            |         |
| 2.11.3.3    | It should have Off line and on-line programming and editing with capability of power flow monitoring and debugging, forcing of I/Os etc  | Vendor to Confirm              |         |            |         |
| 2.11.4      | Necessary manual controls should also be provided for operation of the plant (Details should be furnished)   | Vendor to Confirm              |         |            |         |
| 2.11.5      | Control panel shall have digital vacuum indicators / controllers, pressure indicators / controllers, temperature   | Vendor to Confirm              |         |            |         |
| 2.11.6      | Inkjet printer for printout of essential impregnation parameters   | Vendor to Confirm              |         |            |         |
| 2.11.7      | <b>UPS FOR SCADA / PLC SYSTEM:</b>   |                                |         |            |         |
|             | UPS of 30 minutes for battery back up SCADA / PLC system with inbuilt cooling and charge status display.Sealed Maintenance Free Battery to be provided for back up.  | Vendor to specify.             |         |            |         |
|             |  |                                |         |            |         |
| <b>2.12</b> | <b>ELECTRICAL SYSTEM :</b>   |                                |         |            |         |
| 2.12.1      | 415V + 10% / -10%, 50HZ +/-3 %, 3 Phase AC (3 wire system with out neutral) Power Supply Source will be provided by BHEL at a single point near the Plant as per layout recommended by Vendor. All types of cables, connections, circuit breakers etc. required for connecting BHEL's power supply point to different parts of the Plant / control cabinets, shall be the responsibility of vendor. Requirement of grounding/earthing with required material details is to be informed by vendor well in advance so that same could be incorporated during construction of foundation. | Vendor to Confirm              |         |            |         |

| SNO    | DESCRIPTION FOR BHEL REQUIREMENT   | SPECIFIED / TO BE CONFIRMED BY | OFFERED | DEVIATIONS | REMARKS |
|--------|--|--------------------------------|---------|------------|---------|
| 2.12.2 | <b>CONTROL PANEL:-</b> A floor mounted sheet metal control panel to be provided complete with MCCB for incoming Power Supply, all contacters, relays,starters, timer, single phasing preventer, MCCBS & HRC fuses, step down transformer for control voltage etc. The front side of the panel should beprovided with temp. & vacuum measuring recoder, digital, temp. & vacuum indicator, Pirani 6 point vacuum Gauge, Dial type vacuum manometer, digital temp. indicator for chilled water inlet / outlet, resin tmperatur in resin storage tank,temperature of vacuum chamber,percentage of resin in resin storage tank & other important procss parameter, mimic diagram with indicating LED , emergency stop switch, suitable switches forPLC/ semi-automatic / manual and inching operation for different process system e.g. for Vacuum, Heating, resin flooding,pressursing,Vacuum Breaking etc, indicating lamps for Power Supply, Status monitoring and fault enunciation with alarm etc, with desired inter locks and electrical safety provisions, indication and operation of all electro-pneumatic valves, Air-compressor and dryer, Hydraulic System for door clamping and door-lifting , chilling plant interlocking and indication. | VENDOR TO CONFIRM              |         |            |         |
| 2.12.3 | Panel AC of of reputed make & sufficient capacity to be provided for electrical / electronic panel as per annexure II enclosed.  | VENDOR TO CONFIRM              |         |            |         |
| 2.12.4 | The process should be operated, controlled and supervised from the control desk by siemens / bradley make PLC system. Details of PLC system to be spcified .In the event of a power failure, the plant should automatically revert to a safe operating state. The essential parameter of each process phase (Heating, Vacuum, resin flooding, prssurisation etc.) should be logged for quality assurance purpose and record.   | VENDOR TO SPECIFY              |         |            |         |
| 2.12.5 | It should be ensured that the process can be completed under manual control in the event of failure of any component.  | VENDOR TO CONFIRM              |         |            |         |
| 2.12.6 | The actual operating state of the equipment should always be displayed on a mimic diagram.   | VENDOR TO CONFIRM              |         |            |         |
| 2.12.7 | Automatic correct sequence control and interlocking of relevent equipment components should be provided.   | VENDOR TO CONFIRM              |         |            |         |
| 2.12.8 | <b>Tropicalisation:</b> All electrical / electronic equipment shall be tropicalized  | Vendor to Confirm              |         |            |         |

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|----------|---|--------------------------------|---------|------------|---------|
| 2.12.9   | All electrical & electronic control cabinets, panels, and fittings should be flame, dust and vermin proof.  | Vendor to Confirm              |         |            |         |
| 2.12.10  | All electrical components in the cabinets should be mounted on DIN Rail   | Vendor to Confirm              |         |            |         |
| 2.12.11  | All electrical and electronic panels including operator's panel should be provided with fluorescent lamps for sufficient illumination and power receptacles of 220Volts, 5/15 Amp AC. All adapters/receptacles should have compatibility with Indian equivalents.   | Vendor to Confirm              |         |            |         |
| 2.12.12  | Motors shall conform to IEC Standards   | Vendor to Confirm              |         |            |         |
| 2.12.13  | All cables moving with traversing equipment should be installed in Caterpillar/ Drag chain. Additionally, all the Cable trays, hoses, cable drag chains etc required for laying of cables should be included in the offer.  | Vendor to Confirm              |         |            |         |
| 2.12.14  | Vendor should ensure the proper earthing for all equipment of the Plant and its auxiliaries peripherals.  | Vendor to Confirm              |         |            |         |
| 2.12.15  | In-cycle hour counter with reset facility is to be included in the offer.   | Vendor to Confirm              |         |            |         |
|          |   |                                |         |            |         |
| 2.13     | <b>PNEUMATIC SYSTEM:(For Pneumatic valves and other control system.)</b>  | VENDOR TO CONFIRM              |         |            |         |
| 2.13.1   | <b>AIR COMPRESSOR:</b>  | VENDOR TO CONFIRM              |         |            |         |
| 2.13.1.1 | Independent Air Compressor (of reputed Indian make) with refrigerated type Dryer & Filter of suitable capacity for the total compressed air requirements for Pneumatic valves and other control system and to suit required air quality should be supplied. The compressor unit should be suitable for continuous duty operation. | VENDOR TO SPECIFY              |         |            |         |
| 2.13.1.2 | Make & Model of Air Compressor and Refrigerator type Dryer.   | VENDOR TO SPECIFY              |         |            |         |
| 2.13.1.3 | Capacity (Flow, Pressure & KW)  | VENDOR TO SPECIFY              |         |            |         |
| 2.13.1.4 | Sheet metal cabinet to house all pneumatic solenoid valve & other accessories of pneumatic line to be provided.   | VENDOR TO SPECIFY              |         |            |         |
|          |   |                                |         |            |         |
| 2.13.2   | <b>COMPRESSED AIR POINTS:</b>   | VENDOR TO CONFIRM              |         |            |         |

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|----------|--|--|--------------------------------------|---------|------------|---------|
| 2.13.2.1 | Compressed Air Point with manual ON/ OFF Valve and flexible pipe of suitable length for work piece cleaning.   |  | VENDOR TO SPECIFY                    |         |            |         |
| 2.14     | <b>SAFETY ARRANGEMENTS:</b>  |  |                                      |         |            |         |
|          | Following safety features in addition to other standard safety features should be provided for the Plant and its auxiliaries: (Complete description of Safety features should be furnished)  |  |                                      |         |            |         |
|          | 1.Plant should have adequate and reliable safety interlocks / devices to avoid damage to the Plant, workpiece and the operator due to the malfunctioning or mistakes. Plant functions should be continuously monitored and alarm / warning indications through lights (on Control Panels) / alarm number with messages (on HMI Display) should be available.Interlock safety alarmsystem on electric installation and heating system to be provided. |  | Vendor to Confirm                    |         |            |         |
|          | 2. A detailed list of all alarms / indications provided on Plant should be submitted by the supplier.  |  | Vendor to Confirm                    |         |            |         |
|          | 3. All the pipes, cables etc. on the Plant should be well supported and protected.   |  | Vendor to Confirm                    |         |            |         |
|          | 4. All the rotating parts used on Plant should be statically & dynamically balanced to avoid undue vibrations. All rotating parts should be provided with suitable guards  |  | Vendor to Confirm                    |         |            |         |
|          | 5. Emergency Switches at suitable locations as per International norms are to be provided.   |  | Vendor to Confirm                    |         |            |         |
|          | 6. Oil & water pipe lines should not run with electrical cable in the same tray / trench.  |  | Vendor to Confirm                    |         |            |         |
|          | 7. The Lighting & electrics inside the chamber shall be of flame proof type.   |  | Vendor to Confirm                    |         |            |         |
|          | 8. All Electrical fittings shall conform to IE Rules and IS/BS standard.   |  | Vendor to Confirm                    |         |            |         |
|          | 9. All Electrical equipment shall be suitably protected by IIRC fuses /MCBs /Overload  |  | Vendor to Confirm                    |         |            |         |
|          | 10. All Electrical equipment shall have double earthing.   |  | Vendor to Confirm                    |         |            |         |
|          | 11. The wiring / cabling shall be neatly dressed / clamped.  |  | Vendor to Confirm                    |         |            |         |
|          | 12. All rotating parts shall be suitably guarded.  |  | Vendor to Confirm                    |         |            |         |
|          | 13. The presurised vessels shall be hydraulic tested & certified by competent person.  |  | Vendor to Confirm                    |         |            |         |
|          | 14. Emergency rescue / escape features shall be provided for accidental entrapment of person in the chamber.   |  | Vendor to Confirm                    |         |            |         |
|          | 15. The wires and cables shall be of Fire retardant insulation.  |  | Vendor to Confirm                    |         |            |         |

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|      | 16. Suitable Fire Protection scheme is to be provided by supplier compatible to the system provided in BHEL.   | Vendor to Confirm              |         |            |         |
|      | 17. Suitable safety valve shall be provided at suitable place.   | Vendor to Confirm              |         |            |         |
|      | 18. The waste generated in the system should conform to MPPCB norms and disposal method as per MPPCB / Environmental rules is to be established.   | Vendor to Confirm              |         |            |         |
| 2.14 | <b>ENVIRONMENTAL PERFORMANCE &amp; COMPLIANCE OF REGULATIONS:</b>  |                                |         |            |         |
|      | The Plant shall conform to following factors related to environment :  |                                |         |            |         |
|      | (a) Maximum noise level shall be 85 dB(A) at normal load condition, 1 M away from the Plant with correction factor for back ground noise, if necessary. This will be measured as per international standards like DIN 45635-16. Supplier to demonstrate compliance to noise level, if so required. | Vendor to Confirm              |         |            |         |
|      | (b) There shall not be any emissions from the Plant except fumes of varnish fluid during Impregnation. Suitable vapour extraction system & Air Pollution control complete with suction & exhaust ducting system, valves, weather cowl etc should be provided (Details should be furnished)         | Vendor to Confirm              |         |            |         |
|      | (c) If any safety / environmental protection enclosure is required it should be built in the Plant by the vendor. (Details should be furnished)  | Vendor to Confirm              |         |            |         |
|      | (d) Paint of the Plant should be heat resistant and should not peel off and mix up with Resin.   | Vendor to Confirm              |         |            |         |
|      | e) All requirements of M.P. Factory Rules (Rule 73J) should be complied for Thermic Fluid (Rules detail enclosed)  | Vendor to Confirm              |         |            |         |
|      | f) Structural Stability of Plant   | Vendor to Specify & Confirm    |         |            |         |
|      | g) Pressure Vessel rules for Tanks   | Vendor to Confirm Compliance   |         |            |         |
| 3.0  | <b>DIAGNOSTIC SYSTEM:</b>  |                                |         |            |         |
| 3.1  | <b>TELE-DIAGNOSTIC SERVICE :</b>   |                                |         |            |         |



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| 3.1.1      | Tele-diagnostic service should be provided through International telephone lines along with required Hardware / Software package for the supplied PLC system for remote diagnosis and correction of the problems in of the Plant. This should be provided free of charge for the guarantee period. Terms and conditions for the service after guarantee period should be informed by vendor. Subsequently, it should be possible to use other platforms, such as Internet or ISDN, subject to their availability in future. | Vendor to Confirm              |         |            |         |
| 3.1.2      | Help guide should be provided to use the diagnostic system  | Vendor to Confirm              |         |            |         |
|            |   |                                |         |            |         |
| <b>4.0</b> | <b>LEVELING &amp; ANCHORING SYSTEM</b>  |                                |         |            |         |
| 4.1        | Complete anchoring system including foundation bolts, anchoring materials, fixators, leveling shoes etc shall be supplied for the Plant and all allied equipment  | Vendor to confirm              |         |            |         |
|            |   |                                |         |            |         |
| <b>5.0</b> | <b>TOOLS FOR ERECTION, OPERATION &amp; MAINTENANCE :</b>  |                                |         |            |         |
|            | Special tools and equipment required for erection of the Plant shall be brought by the vendor. Necessary tools like Torque Wrench, Spanners, Keys, grease guns etc.for operation and maintenance of the Plant should be supplied. List of such tools should be submitted with offer   | Vendor to Confirm              |         |            |         |
|            |   |                                |         |            |         |
| <b>6.0</b> | <b>ACCESSORIES:</b>   |                                |         |            |         |
| <b>6.1</b> | <b>MOTORIZED TROLLEY:</b> (This is required for movement of the job(s), placed in Impregnation Tray, into and out of the Horizontal Vacuum Impregnation Chamber   |                                |         |            |         |
| 6.1.1      | Max size of Impregnation Tray that should be supplied along with the trolley:   | Vendor to specify              |         |            |         |
| 6.1.2      | Max design load on trolley  | Vendor to Specify              |         |            |         |
| 6.1.3      | Size of Trolley   | Vendor to Specify              |         |            |         |
| 6.1.4      | Height of top of Trolley from rail level  | Vendor to Specify              |         |            |         |
| 6.1.5      | Rail for Trolley should also be included. Track width shall be 1445 mm. Folding section of rail complete with foldable pit cover shall also be provided if any pit is required in front of the Impregnation Chamber.  | Vendor to Confirm              |         |            |         |
| 6.1.6      | Drive arrangement for the trolley   | Vendor to Specify              |         |            |         |
| 6.1.7      | Complete construction details, drive arrangement, power supply cable management system and GA drawing of the trolley should be furnished along with the offer.  | Vendor to confirm              |         |            |         |



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|-------|--|--------------------------------|---------|------------|---------|
|       |  |                                |         |            |         |
|       | <b>6.2 CAPACITANCE MEASURING SYSTEM</b>  |                                |         |            |         |
| 6.2.1 | Suitable capacitance measuring system for measurement and recording of job capacitance during impregnation processes should be supplied.   | Vendor to Confirm              |         |            |         |
| 6.2.2 | Range of Capacitance to be measured. (1000pF to 25µF)  | Vendor to Confirm              |         |            |         |
| 6.2.3 | Accuracy of Measurement. ( $\pm 1\%$ )   | Vendor to Confirm              |         |            |         |
| 6.2.4 | Type of Instrument: Analog digital   | Vendor to confirm              |         |            |         |
| 6.2.5 | Test Voltage. (0 to 25 V)  | Vendor to Confirm              |         |            |         |
| 6.2.6 | Make, Model of Instrument (Catalog and complete technical details should be furnished)   | Vendor to Specify              |         |            |         |
|       |  |                                |         |            |         |
|       | <b>7.0 SPARES:</b>   |                                |         |            |         |
| 7.1   | Itemised breakup of mechanical, hydraulic, electrical and electronic spares used in the Plant in sufficient quantity as per recommendation of Vendor for 2 years of trouble free operation on three shifts continuous running basis should be offered by vendor.<br>The list to include following, in addition to other recommended spares: (Unit Price of each item of spare should be offered) | Vendor to Confirm              |         |            |         |
|       | <b>a) Mechanical &amp; Hydraulic Spares:</b> All types of pumps, All types of Valves, All types of vacuum , pressure switches / transducers, All types of filters, All types of seals  | Vendor to Confirm              |         |            |         |
|       | <b>b) Electrical /Electronic / PLC Spares:</b> All types of Relays, Contactors, Proximity Switches, Push Buttons, Indicating Lamps, Semiconductor Fuses, Special Fuses, Circuit Breakers, Main Power Switch, Operator's panel with Display Unit, I/O Cards for PLC etc.  | Vendor to Confirm              |         |            |         |
| 7.2   | Vendor to confirm that complete list of spares for Plant and accessories, along with specification / type / model, and name & address of the spare supplier shall be furnished along with documentation to be supplied with the Plant  | Vendor to Confirm              |         |            |         |
|       |  |                                |         |            |         |
|       | <b>8.0 DOCUMENTATION :</b><br>Four sets of following documents (Hard copies) in English language should be supplied along with the Plant   | Vendor to Confirm              |         |            |         |
| 8.1   | Operating manuals of Plant, PLC system & SCADA   |                                |         |            |         |
| 8.2   | Programming Manuals for PLC system & SCADA   |                                |         |            |         |

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|------------|--|--------------------------------|---------|------------|---------|
| 8.3        | Detailed Maintenance manual of Plant with all drawings of Plant assemblies/sub-assemblies/parts including Electrical / Pneumatic/ Coolant / Hydraulic circuit diagrams. All Assembly/ Sub Assembly Drawings shall be supplied with the part list also  |                                |         |            |         |
| 8.4        | Maintenance, Interface & commissioning manuals for PLC system.   |                                |         |            |         |
| 8.5        | Catalogues, O&M Manuals of all bought out items including drawings, wherever applicable.   |                                |         |            |         |
| 8.6        | Detailed specification of all rubber items and hydraulic/lube fittings   |                                |         |            |         |
| 8.7        | Operating Manuals, Maintenance Manuals & Catalogues for supplied Vacuum Pumps, Air-Compressor, Air-dryer, and all supplied Accessories.  |                                |         |            |         |
| 8.8        | PLC program print-outs with comments & cross references in English.  |                                |         |            |         |
| 8.9        | PLC program on CD & PLC data on floppy.  |                                |         |            |         |
| 8.10       | Complete original SCADA Software.  |                                |         |            |         |
| 8.11       | Complete Master List of parts used in the Plant shall be submitted by the vendor.  |                                |         |            |         |
| 8.12       | One additional set of all the above documentation on CD ROM, wherever possible.  |                                |         |            |         |
|            |  |                                |         |            |         |
| <b>9.0</b> | <b>TRAINING:</b>   |                                |         |            |         |
| 9.1        | BHEL Persons should be trained at supplier's Works for mutually agreed period in the area of (at least one week)<br>(a) Operation of the Plant & other supplied equipment.<br>(b) Electrical, Electronic & PLC maintenance of Plant & other supplied equipments.<br>(c) Mechanical & Hydraulic maintenance of the Plant & other supplied equipments.<br>(d) SCADA programming and Maintenance. | Vendor to Confirm              |         |            |         |
| 9.2        | Air-fare, boarding & lodging for the trainees shall be borne by BHEL.  | Vendor to Confirm              |         |            |         |
| 9.3        | Competent, English speaking experts shall be arranged by the vendor during training for  | Vendor to Confirm              |         |            |         |
| 9.4        | Vendor to quote for training on man / week basis   | Vendor to Confirm              |         |            |         |
|            |  |                                |         |            |         |
| <b>10</b>  | <b>FOUNDATION:</b>   |                                |         |            |         |

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|------|--|--------------------------------|---------|------------|---------|
|      | Vendor shall submit the preliminary layout drawing for getting BHEL's approval within one month from the date of Letter of Intent (LOI)/ P.O. Soil condition data will be furnished by BHEL alongwith the approval. Complete Foundation Design including details, like Static/ Dynamic load details etc. and final Layout Drawings shall be submitted by the supplier within three months after getting BHEL's approval. The Layout should consist of all requirements pertaining to complete plant and all accessories, including space requirement. BHEL will construct complete foundation for the machine after receipt of complete foundation drawing from the vendor under his supervision. The vendor shall also indicate detailed specifications of grouting compound and grouting procedure etc. for foundation bolts of various items of the plant . | ,                              |         |            |         |
|      |  |                                |         |            |         |
|      | <b>11.0 ERECTION &amp; COMMISSIONING</b>   |                                |         |            |         |
| 11.1 | Supplier to take full responsibility for carrying out the erection, start up, testing of machine, it's control system & all other supplied equipment.<br>Service requirement like power, air & water shall be provided by BHEL at only one point to be indicated by supplier in their foundation/layout drawings. Other requirements like crane shall also be provided by BHEL. Details of these requirements should be informed by vendor in advance.   | Vendor to Confirm              |         |            |         |
| 11.2 | Erection & Commissioning of all accessories like Air Compressor, Air Dryer, Trolley, Capacitance Meter etc shall also be responsibility of the vendor.   | Vendor to Confirm              |         |            |         |
| 11.3 | Supply of all pipes & fittings--- for vacuum, resin, brine compressed air, Pneumatic control air line (copper), water line , Hydraulic pipe line.Brine pipe should be SS306.   | Vendor to Confirm              |         |            |         |
| 11.4 | Erection of pipe line  | Vendor to Confirm              |         |            |         |
| 11.5 | Insulation of resin pipes, resin storage tanks brine tanks and brine heating and cooling line & vacuum chamber.Resin storage tanks & resin pipes should be insulated with PUF.   | Vendor to Confirm              |         |            |         |
| 11.6 | Electrical cabling .   | Vendor to Confirm              |         |            |         |
| 11.7 | Installation of complete plant.  | Vendor to Confirm              |         |            |         |
| 11.8 | Painting – in line with BHEL colour code – scheme.   | Vendor to Confirm              |         |            |         |
| 11.9 | Flushing of vacuum tank and resin / vacuum pipe. Suitable cleaning agent to be included in suppliers scope.  | Vendor to Confirm              |         |            |         |

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| 11.10.      | Grill Type platform covering of all pits, operating platform for impregnation tank resin storage tank, heat exchangers, etc. With ladders where ever required to be provided.  | Vendor to Confirm              |         |            |         |
| 11.11       | Successful proving of BHEL components by the supplier shall be considered as part of commissioning. All tests, as mentioned at <b>clause 15</b> (Machine Acceptance) shall form part of the commissioning activity.  | Vendor to Confirm              |         |            |         |
| 11.12       | Tools, Tackles, instruments and other necessary equipment required to carry out all above activities should be brought by the supplier.  | Vendor to Confirm              |         |            |         |
| 11.13       | Commissioning spares, required for commissioning of the plant within stipulated time, shall be brought by the supplier on returnable basis.  | Vendor to Confirm              |         |            |         |
| 11.14       | All Cover Plates required for the plant and its peripherals including pits, if any, shall be supplied and installed by the vendor. The plates should be sourced from India   | Vendor to Confirm              |         |            |         |
| 11.15       | Portion, if any, of the machine, accessories and other supplied items where paint has rubbed off or peeled during transit or erection should be repainted and merged with the original surrounding paint by the vendor. For this purpose, the vendor should supply sufficient quantity of touch-up paint of various colours of paint used. | Vendor to Confirm              |         |            |         |
| 11.16       | Laying of pipelines, fittings, interconnecting cables; fixing and interconnection of the instruments / sensors including impulse lines; erection of storage tanks, cooling towers; and complete thermal insulation for pipelines, tanks etc shall form part of the erection to be carried out by vendor                                    | Vendor to Confirm              |         |            |         |
| 11.17       | Schedule of Erection and Commissioning shall be submitted with the offer.  | Vendor to Confirm              |         |            |         |
| 11.18       | Charges, duration, terms & conditions for E&C should be furnished in detail separately by vendor along with offer.   | Vendor to Confirm              |         |            |         |
|             |  |                                |         |            |         |
| <b>12.0</b> | <b>ACCURACY TESTS:</b>   |                                |         |            |         |
| 12.1        | Accuracy test for required vacuum, pressure, temperature and time cycle for the parameters mentioned in the specification shall be done and the equipment supplied should be proved for the required parameters.   | Vendor to Confirm              |         |            |         |
| <b>13.0</b> | <b>AMBIENT CONDITIONS &amp; THERMAL STABILITY :</b>  |                                |         |            |         |

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| 13.1        | Total machine including control system and all supplied items should work trouble free and efficiently under following operating conditions and should give specified accuracies.<br>Power Supply: Voltage: 415 V - 10%, +10%<br>Frequency: 50 Hz +3%, - 3%<br>No. of phases = 3, 3 wire no neutral.<br>Ambient Conditions: Temperature = 5°C to 50°Celsius<br>Relative Humidity = 95% max.<br>(Vendor to confirm that all equipment of the plant is suitable for above)   | Vendor to Confirm              |                         |            |         |
| 13.2        | Weather conditions are tropical, Atmosphere may be dust laden during some part of the year.  | Vendor to Confirm              |                         |            |         |
| <b>14.0</b> | <b>PROVEOUT OF BHEL COMPONENTS :</b>   |                                |                         |            |         |
| 14.1        | Drawings / details of proveout components are enclosed. Vendor to submit preliminary process, time study recommended by them along with the offer. Complete prove out shall be done by Vendor at BHEL works to the specified process accuracy. Component for proveout-shall be provided by BHEL. Vendor should submit settings, process sheets, time studies etc. in advance for the prove out components. Vendor shall be fully responsible for proveout components as per requirements specified by BHEL to the full satisfaction of BHEL. Clarifications, if any, required by vendor, regarding accuracy requirements of the proveout components, whether specified or not, should be discussed and cleared by vendor during initial technical discussions. Vendor to prove the process-time committed. | Vendor to confirm              | As per attached Sketch. |            |         |
| <b>15</b>   | <b>MACHINE ACCEPTANCE: (Tests/Activities to be Performed by Vendor)</b>  | Vendor to confirm              |                         |            |         |
| <b>15.1</b> | <b>Tests / Activities to be carried out at supplier's works on the Plant before dispatch:</b>  |                                |                         |            |         |
| 15.1.1      | All components of the plant shall be offered for a physical check of dimensions and completeness of supply.  |                                |                         |            |         |
| 15.1.2      | Test / calibration Certificate shall be produced for verification for vacuum pumps, chillers, gauges, sensors etc  |                                |                         |            |         |

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|--------|---|--------------------------------------|---------|------------|---------|
| 15.2   | Test / Activities to be carried out at BHEL works while commissioning the machine ;   |                                      |         |            |         |
| 15.2.1 | The plant should be tested for continuous running for 1 to 2 Impregnation cycle. If any break down occurs during this test, the test should be repeated for few more cycles.  |                                      |         |            |         |
| 15.2.2 | Demonstration of all features of the plant, SCADA, PLC system & all accessories to the satisfaction of BHEL for their efficient and effective use.  |                                      |         |            |         |
| 15.2.3 | Demonstration by actual use of all supplied accessories to their full capacity.   |                                      |         |            |         |
| 15.2.4 | Job prove out.  |                                      |         |            |         |
| 15.2.5 | Two weeks supervision of independent operation of the plant by BHEL after job proveout.   |                                      |         |            |         |
| 15.2.6 | Training of BHEL personnel in operation & maintenance of complete plant & accessories by the supplier's experts / engineers during their stay at BHEL works   |                                      |         |            |         |
|        |   |                                      |         |            |         |
|        |   |                                      |         |            |         |
| 16.0   | PACKING:  |                                      |         |            |         |
| 16.1   | Sea worthy & rigid packing for all items of the plant Control System, all Accessories and other supplied items to avoid any damage/loss in transit. When the equipment is despatched in containers, all small loose items shall be suitably packed in boxes | Vendor to confirm                    |         |            |         |
|        |   |                                      |         |            |         |
| 17.0   | GUARANTEE :   |                                      |         |            |         |
| 17.1   | 24 months from the date of acceptance of the plant after commissioning.   | Vendor to confirm                    |         |            |         |
|        |   |                                      |         |            |         |
| 18.0   | GENERAL : The vendor should submit the following information:   |                                      |         |            |         |
| 18.1   | Plant Model   | Vendor to Specify                    |         |            |         |
| 18.2   | Total connected load (KVA):   | Vendor to Specify                    |         |            |         |
| 18.3   | Floor area required (Length, Width, Height) for complete plant & accessories  | Vendor to Specify                    |         |            |         |
| 18.4   | Painting of Plant Equipment / Electrical Panels: RAL 6011 Apple Green (Polyurethane Paint)  | Vendor to Confirm                    |         |            |         |
| 18.5   | Total weight of the plant equipment   | Vendor to Specify                    |         |            |         |
| 18.6   | Weight of heaviest part   | Vendor to Specify                    |         |            |         |

| SNO         | DESCRIPTION FOR BHEL REQUIREMENT   | SPECIFIED / TO<br>BE CONFIRMED<br>BY | OFFERED | DEVIATIONS | REMARKS |
|-------------|--|--------------------------------------|---------|------------|---------|
| 18.7        | Dimensions of largest part   | Vendor to Specify                    |         |            |         |
| 18.8        | Vendor to submit, along with offer, the reference list of customers where similar plants have been supplied mentioning the customer, Machine Model, major specifications of the supplied equipment, Control System detail, Year of Supply etc  | Vendor to Confirm                    |         |            |         |
| 18.9        | Detailed catalogues , sketch/ photographs of the plant and accessories should be submitted with the offer.   | Vendor to Confirm                    |         |            |         |
| 18.1        | Hydraulic, Pneumatic & oil pipings should be preferably metallic except places where flexible pipings are essential.All the pipes required for the same shall be included in the standard scope of the plants.   | Vendor to Confirm                    |         |            |         |
|             |  |                                      |         |            |         |
|             |  |                                      |         |            |         |
| <b>19.0</b> | <b>QUALIFYING CONDITIONS :</b>   | Vendor to Confirm                    |         |            |         |
| 19.1        | Only those vendors, who have supplied and commissioned at least one Vacuum Impregnation Plant with Impregnation Tank of Internal Diameter 2.5m or higher, Length 7 m or higher and Resin Storage Tank with useful storage capacity of 8000 liters or higher per tank , for similar applications in the past and such plant is presently working satisfactorily for more than one year (more than six months if supplied to BHEL) after commissioning should quote. |                                      |         |            |         |
| 19.2        | The following information is to be submitted by the vendor about the companies where similar plants have been supplied. This is required from all the vendors for qualification of their offer:  |                                      |         |            |         |
|             | 1. Name of the customer / company where similar plant is installed. (Copy of Purchase Order should be furnished)   |                                      |         |            |         |
|             | 2. Complete postal address of the customer.  |                                      |         |            |         |
|             | 3. Year of commissioning. (Copy of Commissioning Report should be furnished)   |                                      |         |            |         |
|             | 4. Application for which the plant is supplied .   |                                      |         |            |         |
|             | 5. Name and designation of the contact person of the customer.   |                                      |         |            |         |
|             | 6. Phone, FAX no. and email address of the contact person of the customer.   |                                      |         |            |         |
|             | 7. Performance certificate from the customers regarding satisfactory performance of the plant supplied to them   |                                      |         |            |         |
|             |  |                                      |         |            |         |
| <b>20.0</b> | <b>OTHER FEATURES: (To be Included only if required)</b>   |                                      |         |            |         |
|             |  |                                      |         |            |         |

| SNO         | DESCRIPTION FOR BHEL REQUIREMENT   | SPECIFIED / TO<br>BE CONFIRMED<br>BY | OFFERED | DEVIATIONS | REMARKS |
|-------------|--|--------------------------------------|---------|------------|---------|
| <b>20.1</b> | <b>NETWORKING:</b>   |                                      |         |            |         |
| 20.1.1      | Plant control should have necessary hardware and software for interfacing with gigabit Ethernet Local Area Network with 100 MB/sec through UTP cables for related data transfer. This network will also be connected to wide area network/Internet. The networking should have following capabilities. | Vendor to Confirm                    |         |            |         |
|             | a) The plant shall appear as a node in the Entire Network. (Network Neighborhood)  |                                      |         |            |         |
|             | b) The data transfer shall be simple, provided sharing access is allowed between any PC and the plant across the network.  |                                      |         |            |         |
|             | c) The program transfer between PLC system and network should also be possible in PLC Mode.  |                                      |         |            |         |
|             |  |                                      |         |            |         |
| <b>20.2</b> | <b>MACHINE MONITORING SYSTEM (MMS) SIGNALS</b>   |                                      |         |            |         |
| 20.2.1      | Following MMS signals would be made available on a specifically earmarked terminal strip. These MMS signals would be sourced from a PLC output card separately.  | Vendor to Confirm                    |         |            |         |
|             | a) Control ON  |                                      |         |            |         |
|             | b) Cycle ON  |                                      |         |            |         |