TECHNICAL SPECIFICATIONS

1.0 GENERAL DESCRIPTION

The following technical specifications, code of practice etc. referred herein are part of the Item Specification and work shall be executed accordingly. The technical requirements given hereunder are only indicative and not descriptive and the Supplier shall ensure that the equipment and accessories supplied are complete in all respects for the smooth operation of the plant and should be suitable for the rated output.

Items which are not covered under Technical Specification shall be carried out as per relevant IS Specification or as per manufactures specification approved by Accepting Authority or as directed by Engineer-in-charge. In case of discrepancy between technical specification and item specification provided along with Bill of Quantities, the Item Specification shall prevail.

2.0 SCOPE OF WORK

The scope of work shall include supply, erection, testing, commissioning of mechanical, instrumentation and electrical works for Procurement of **Inductively Coupled Plasma Mass Spectrometer (ICP-MS) with Microwave Digester** for Oushadhi Plant at Kuttanellur, Thrissur. All electrical and necessary instrumentation and controls for smooth and safe operation of various systems of plant shall be in the scope of the Supplier. These shall conform to the specifications and standards laid down by the Kerala State Electrical Inspectorate. The Supplier would do all necessary activities to get prior advice/approval from the Inspectorate for the design/ schematic diagrams of all power/control wiring of all equipment, including those supplied by other manufacturers prior to commencement of manufacture in order to avoid rework and consequent delay.

3.0 CODES AND STANDARDS

The design, manufacture and testing of the equipment shall comply with the latest editions of appropriate standards.

Unless mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards shall govern in respect of design, workmanship and properties of materials and methods of testing. In case where suitable Indian Standards are not available, generally accepted codes and practices shall be adopted.

All equipment shall comply with the statutory requirements of the Govt. of India and Government of Kerala. The equipment fabrication and installation shall conform to the provision of statutory and other regulations in force such as the Indian Factories Act, Indian Explosives Regulations, Kerala State Pollution Control Board, etc. Approval of

drawings by statutory agencies, if required, shall be arranged by the successful Contractor at no extra cost to the Purchaser.

In cases where the offer deviates from the specified standards, the Tenderer shall indicate clearly in his offer the reasons for deviation, standards proposed to be adopted by him and the details thereof.

4.0 SPECIAL REQUIREMENTS

4.1 SITE FACILITIES

The Tenderer shall indicate clearly the proposed work and procedure to be carried out at the Purchaser's site and take approval prior commencement of works at site.

Electricity for work to be executed at site will be made available near the work site free of cost. The Contractor shall ensure that the facilities are not misused or wasted. The Purchaser will not be responsible for the delays arising from non-availability of power due to reasons beyond the control of the Purchaser.

Only open area at work site will be allotted to the Contractor for carrying out site work. The Contractor shall indicate approximate space requirements.

Accommodation, transportation and food of workmen and supervisors of the Contractor shall be the responsibility of the Contractor.

4.2 STORAGE

All equipment and material to be stored at site in Contractor's risk. The Contractor shall store the equipment, commissioning spares etc. in a place which is dry and free of dust and frost. He shall also ensure that there is no penetration of impurities in the equipment, damage or rusting during storage.

4.3 SAFETY AND ENVIRONMENTAL ASPECTS

The total system should have adequate built-in precautions to prevent any fire or explosive hazards.

Safety systems should be as per relevant IS codes.

4.4 STATUTORY APPROVALS

Obtaining all statutory approvals shall be in the scope of the Supplier. These include but not restricted to approvals from Electrical Inspectorate, Pollution Control Board, Inspectorate of Factories and Boilers, Inspector of Explosives, etc. including prior approvals, wherever required.

5.0 SPECIFICATIONS

Specifications for Inductively Coupled Plasma Mass Spectrometer (ICP-MS)

Inductively Coupled Plasma Mass Spectrometer (ICP-MS) for quantification, of trace elements in Ayurvedic formulations, Siddha formulations, raw drugs (herbal/mineral) with following items: Sample introduction system consisting of nebulizer, spray chamber, peristaltic pump, Radio frequency power generator for plasma with detachable single piece quartz torch, Interface compartment comprising of Sampler cone and skimmer cone ,ion focussing system, Quadrupole mass analyser ,ion detector, specific software system, vacuum system and compatible accessories for instrument-essential gas supply, system cooling and routine maintenance. The specific requirements with respect to each component are as follows.

I. System Application

- Computer controlled fully automatic ICP- MS system.
- Multi-elemental analysis in ppb and ppt levels with required sensitivity and stability.
- The system should be a space saving, compact model that can fit into allocated lab space with all the sub- systems and accessories.
- Should have dedicated gas channels for collision and reaction gases with independent mass controller for each gases
- Corrosion-resistant exteriors should be provided
- Model number of the equipment proposed to be supplied to be clearly mentioned.

II. Sample introduction system

- Autosampler with 150 or more vial positions.
- Nebulizer: Concentric Nebulizer with low sample flow rate.
- Spray Chamber: Peltier controlled Spray Chamber from temperature -10°C to + 20°C for enhanced stability, repeatability and provision for Organic Sample upgradation.
- Provision for Ultra High Matrix introduction for analysing both low and high TDS samples, better matrix decomposition and reduced interference from sample components.
- Must handle upto 25% TDS
- Peristaltic pump: Low pulsation high precision peristaltic pump with minimum three or four channels which can be controlled through the software.

III. Plasma

III.A. Radio Frequency Generator (Solid State)

- Power range: 380 W to 1600 W.
- 27.2 or 40 MHz Impedance Matching
- Auto-tuning to get maximum coupling efficiency.
- Easy attainment of plasma stabilization by rapid adjustment to changes in plasma and matrix composition.
- Provision for active cooling.

III.B. Torch

- Easy mountable single piece quartz torch
- Torch movement should allow for complete computer-control
- Auto tunable in x-y-z directions with independent movements in the three directions.
- Provision for Auto-alignment of the torch after routine maintenance with a reproducibility better than 0.1 mm in x-y- z directions.

III.C. Plasma Gas Control

- Provision for software-controlled regulation of gas flow.
- Should have at least 3 Mass Flow Controllers (MFC) or equivalent PC Controller for plasma, auxiliary makeup, carrier gases.
- Gases used should be controlled with mass flow controller and fully computer controlled.

IV. Interface system for ion extraction

- Standard sample and skimmer cones with large orifice diameters to suit all application and to prevent clogging and minimize signal drift. It should be easily mountable and dismountable.
- Made of Standard Nickel Cone
- Lens/ extraction cones or equivalent should be easy to maintain

V. Ion Focusing System

- Specifically designed efficient ion deflection system for removing all neutrals and photons from the Ion path.
- Deflects ions by 90º for optimal targeting to the Quadrupole analyser.
- Precisely controlled system with a collision cell and reaction cell for eliminating ionic interferences due to polyatomic species.
- Cell offering three modes of operation: Standard Mode, Collision Cell Mode, reaction cell mode and KED.
  - Reaction cell should allow use of all type of gases like Oxygen, Hydrogen, Ammonia in pure/premix form.

- Automated and software-controlled Switching of collision gases
- Automated Low mass cut off, cut off facility or equivalent technology should be there to remove unwanted polyatomic interferences formed due to free atoms.
- Zero maintenance for the cell

VI. Mass analyser

- Quadrupole mass analyser assembly to provide effective ion transmission, superior resolution and abundance sensitivity.
- Mass range: 5-260 amu or better
- RF Frequency: Fully Digital RF generator with frequency 2-3 MHz
- Abundance sensitivity: Low Mass Side: $\leq 5 \times 10^{-7}$, High Mass Side: $\leq 5 \times 10^{-7.}$
- Scan Speed: Greater than 3500 amu/s
- Mass stability: $< \pm 0.05$ amu over 8 hours of continuous operation.
- Resolution: Variable from 0.5 u to 1.0 u or better, user definable

VII. Ion Detector Assembly

- Solid State dual stage dynode discrete (with 9 orders) more magnitude of linear dynamic range.
- Should have, features of high-speed analog mode for transient signals and a true nine orders dynamic range.
- Minimum dwell time / integration time of 100 μs (in both pulse count and analog modes.
- Dual-stage detector assembly should come as a standard with the System.
- Dual-stage detector for analysis of both low level and high level analytes simultaneously.

VIII. Vacuum System

- Three stage or better differential pumping.
- Vacuum Pumps – Split flow turbo molecular pump.
- Pump down time <20 min after maintenance.

IX. Autosampler

- Autosampler with 150 or more vial positions.

X. Water Chiller

- The system should have a suitable re-circulating chiller changer of Internationally reputed company for plasma component cooling.

XI. Performance Specifications

- Multielement analysis
- Sensitivity specifications should be demonstrated and validated for the sample category specified by the user viz. Ayurveda, Sidha & Unani formulations, herbal and mineral raw drugs.
- Detection limits must confirm to prescribed Pharmacopeia standards.
- Guaranteed sensitivity specifications will be considered.

- **Sensitivity (Kcps/ppb)**

^{7}Li	55
$^{59}Co^{b}$	95
$^{115}In^{b}$	230
$^{238}U^{b}$	310

- **Detection Limits (ppt)**

^{9} Be	< 0.5	
^{115}ln	< 0.1	
^{209}Bi	< 0.1	
Oxides (%)	CeO/Ce	< 2
Double Charged (%)	Ba^{++}/Ba^{+}	< 3
Background (cps)	m/z 4.5	< 1
Stability (% RSD)	Short Term	< 2 (10 min)
	Long Term	< 3 (2 h)
Isotope Ratio Precision (% RSD)	^{107} Ag/^{109} Ag	< 0.1

XII. Branded Computer system - configurations complying with the requirements of the integrated ICP-MS instrument.

- Desktop with Intel Core i7 , 12th gen Processor
- Configuration for use with the above system to be provided.
- 16GB DDR4 3200 MHz RAM
- 4 USB Port or higher
- Gigabyte LAN, WiFi
- Windows 10 Pro 64 Bit
- Wireless Keyboard and Mouse
- 1TB SSD Ext Hard Disk
- Colour LaserJet Printer, Auto Duplex Printing

XIII. Software requirements for data evaluation

- Software control for automatic data acquisition and processing.
- System should have 21 CFR Part 11 compliance.
- Mass Spectrometer tuning and calibration auto and manual
- Data Validation (IQ/OQ/PQ for Software)
- Self-diagnostics.
- Multi element analysis capability, Isotope ratio and dilution in a single run.
- Cool Plasma or other facility to eliminate polyatomic interferences.
- Remote diagnostics.
- Software should control plasma, MS and other accessories like auto sampler.
- The system software shall support the following calibration curve fit modes for Quantitative analysis:
  - Linear least squares.
  - Weighted linear least Squares
  - Linear forced-through-zero least squares.
  - Quantitative analysis including external calibration, additions calibrations, method of standard additions, isotope ratios and isotope
  - Dilutions and semi quantitative analysis.
  - On-line help with quick steps to reference entire instrument user manual
- Software up gradations should be free of cost.

XIV. Accessories

- Nebulizer – 3 Numbers
- Plasma Torch- 3 Numbers
- Ni Sampling Cone- 6 Numbers
- Ni Skimmer Cone – 6 Numbers
- Exhaust unit.
- Vacuum Pump oil
- Argon Gas Cylinders-6 Numbers
- Gas cylinder for Collision cell gases –Helium-2Numbers
- Gas cylinder for Oxygen -1
- Gas cylinder for reactive gases – Hydrogen
- Gas cylinder regulators
- Gas manifold system.
- Compatible table with granite top.
- Gas purification panel.
- Fume hood with Stainless Steel pipe with hood and rain out motor stand
- Multi element standards

- UPS 20 KVA with 60 minutes back up with required electrical accessories.
- Operation kit comprising all required items pump tubing, transfer Tubing's, work coils etc., for start-up/regular operation of instrument.
- Operation and maintenance manual for each unit in both hard copy and soft copy.
- Service manual with set of required tools for each system/unit

XV. Comprehensive maintenance contract -5 year with preventive maintenance kits including all spare parts and accessories.

XVI. IQ/OQ/PQ of the system is required.

XVII. Instrumentation for Sample preparation - Microwave Digestion System

- For acid digestion applications of following samples for further analysis with AAS, ICP – OES or ICP – MS techniques.

  - ✓ Polyherbal formulations including fermented medicines, jaggery based products, oil based formulations etc.
  - ✓ Herbal raw drugs
  - ✓ Mineral ores
  - ✓ Herbo-mineral formulations
  - ✓ Water, wastewater,
  - ✓ Soil, sludge,
  - ✓ Environmental samples,
  - ✓ Natural products like resins, rock exudates etc.

- Microwave cavity chamber made of corrosion resistant, Stainless steel with multilayer fluoropolymer coating for physical protection as well as chemical resistance and should be less than 8 ltrs.

- Microwave power: 1000 watts or more using 1 or 2 magnetrons.

- In-built color touchscreen display with real-time graphical representation of reaction parameters and display of internal temperature of every individual reaction. External/ detachable controllers not acceptable.

- System should be offered with rotor of minimum 12 position or more with 12 vessels.

- Rotor should be made of lightweight AL Material for high pressure strength up to 150 bar or more and to ensure ultrafast cooling.

- Vessel material must be made of PTFE- TFM
- Required vessel volume is 50 ml or more.
- Minimum filling volume must be 3 ml or less.
- Maximum operating temperature required is $250^{O}C$ or more.
- Maximum operating pressure must be 45 bar or more.
- Maximum temperature required is $300^{O}C$.
- Maximum vessel pressure must be 80 bar or more.
- Sample weight be minimum 1.5 gm or higher per vessels.
- Must provide adequate requirements for vessel safety. Closure of the vessel must be possible by hand and overpressure release mechanism of the vessel must be controlled by means of metal springs for precise opening, pressure independent of the reaction temperature or sample weight. Venting with polymer/ plastic material springs not acceptable due to dependence on internal temperature and sample weight.
- A temperature calibrator for accurate temperature measurement must be supplied along with the instrument with minimum 3 years validity.
- Instrument should have built in exhaust for cooling the vessels inside the oven from 180 ^{O}C to $70^{O}C$ in less than 15 min. Documentary evidence to be provided.
- Instrument should be offered with glass inserts minimum 100 number for carrying out digestion with 1ml acid and for micro sample.
- Instrument should be offered with additional 12 vessels complete set along with the system.

Special conditions

- Vendor must quote for all essential pre- installation requirements including air-conditioning system and utility requirement for ICP-MS.
- Provide list of all consumables essential for routine functioning of the entire system.
- A list of all components that require frequent maintenance or replacement as consumables must be included.

- Specifications should be confirmed from the Technical Brochure and website of the manufacturer.
- CE certification mandatory
- Instrument should have 21 CFR Part 11 compliance.
- Good Service and Technical support are essential. Please provide testimonials form three reputed customers.
- On – site comprehensive training for scientific personnel operating the system and support services till customer satisfaction with the system. Training: 2 levels – 5 days during installation in our lab and subsequently at supplier's application lab for 2 persons at suppliers' cost, minimum of two times in a duration of 5 years or as per customer's requirement
- Vendor must provide complete technical guidance and support for method development and analysis, conforming to AYUSH drugs and herbomineral samples.
- Provision for validation of analysis results at Vendor's application Lab as and when required.
- The list of installations and users of complete system in India & abroad should be provided for reference. The company must have at least five working installations of the complete instrument globally. User list for this period, current contact details of users, Supply Orders and certificates of successful completion issued by the clients must be enclosed.
- Amount quoted should cover all charges, including customs duty, clearance charge, transportation, unloading, installation etc. and excluding GST.
- Onsite technical performance evaluation of the quoted model of the equipment will be carried out for those who qualify in the technical bid.
- Sensitivity specifications should be demonstrated and validated for the sample category specified by the user viz. Ayurveda, Sidha & Unani formulations, herbal and mineral raw drugs.
- The vendor should guarantee the supply of all types of spares/accessories for the Instrument system for a minimum period of 10 years after the warranty period and CMC service.

- The system should be complete functional unit in terms of hardware and software to demonstrate the intended specifications and applications to be supplied with all necessary ancillaries.
- The quote should be for supply, installation, commissioning and successful working demonstration of the instrument at the premises of M/s. Oushadhi Ltd, Kuttanellur, Thrissur, Kerala.
- Installation, calibration, standardization and commissioning shall be the responsibility of the vendor.

- Pre-installation requirements, including requirement for water/power supply, should be enclosed along with the tender.
- A compliance statement of the specifications should be provided along with the quote before placing order.

6.0 GENERAL REQUIREMENTS

6.1 The equipment supplied shall be complete in all respects with all necessary accessories and commissioning spares for operating it for the specified application. Equipment which are either operated under pressure or are likely to develop pressure shall be provided with safety valves, pressure gauges and vents with isolation valves. Electrically operated equipment shall be complete with necessary starters, control panel, push button stations, cabling, earthing etc. The earthing shall be linked to the nearest existing earth grid which will be available within 5-10 m from the equipment.

6.2 The thickness given in the data sheets is indicative only and the Tenderer shall check and satisfy before quoting. Nozzles shall be provided with stiffeners for reinforcement.

6.4 All rotating/moving parts shall be provided with adequate guard for safety.

6.5 The Supplier shall furnish complete design calculation with backup details for review and approval by the Purchaser/Consultant.

6.6 Pressure testing shall be arranged in the presence of a competent person and their certificate shall to be issued before provisional acceptance of the equipment.

6.7 Tenderer should include the cost of all required accessories in the quoted rate.

6.8 The Purchaser reserves the right to procure all the items specified in the tender or part thereof without assigning any reason.

7.0 DESIGN IMPROVEMENT/ ALTERNATE DESIGN

7.1 The system or equipment requirements given are indicative only. The Tenderer is free to quote the equipment of their own design provided it is superior to the specifications given and it satisfies with the Pre-qualification criteria. The Tenderers are advised to examine the feed materials and quote for suitable equipment to meet the performance requirement.

7.2 The Tenderer may incorporate latest designs in any of the specifications mentioned above with the prior approval of the Accepting Authority, which in his opinion are sure to give better performance. The technical deviations shall be clearly spelt out as per the Technical Deviation Statement Form provided in this tender document.

8.0 BATTERY LIMITS

8.1 FOUNDATION AND STRUCTURAL WORKS

The civil foundation required will be in the scope of supplier. Supply of foundation bolts, anchor bolts, grouting mixture etc. and grouting shall be in the scope of the Contractor. Grouting shall be carried out as per approved specifications. The supply and erection of working platform, if required, shall be in the scope of the Contractor. The supply of bolts, welding materials etc, for erecting those equipment to be supported on existing structural platform shall be included in the Contractor's scope.

8.2 ELECTRICAL AND INSTRUMENTATION

Based on the electrical details submitted by the Contractor, the Purchaser will arrange cabling upto the incomer of the electrical panel of the equipment. However, termination of the same will be in the scope of the Contractor. The Contractor shall also arrange the supply of electrical panels, interconnecting cables, starters, push button stations, earthing materials etc. The Purchaser will provide earthing network in the plant premises within 5-10 m. Earthing the equipment by connecting to the existing grid will be in the scope of the Contractor. The Contractor shall also provide necessary instrumentation and control systems, if specified.

9.0 SHOP INSPECTION AND TESTING

9.1 PROCEDURE

9.1.1 The Contractor shall conduct all tests required to ensure that the equipment supplied shall confirm to requirements of the applicable codes at various stages of fabrication / procurement, including raw material identification. All fabrication works, tests, test procedures and detailed quality plan proposed by the Contractor shall be submitted to the Purchaser / Consultants for approval. The Purchaser / Consultants shall be intimated well in advance regarding the testing of material / equipment so that they could witness the tests at the works. In certain cases, the Purchaser/Consultant may waiver the witnessing of the tests, but it does not absolve the Contractor for carrying out the same and submitting the test reports for approval.

9.1.2 All material used shall be tested for quality. The test certificate shall be made available to the Purchaser's / Consultant's representative. In case of non-availability of test certificates, material shall be tested by the Contractor at his own cost, to establish the conformance of the relative standards.

9.1.3 The representative of the Purchaser/ Consultant shall be given full access to the shop in which the equipment is being manufactured or tested and the Supplier shall carry out any change or modifications as pointed out by the Purchaser/ Consultants during inspection at no extra cost.

9.1.4 The Supplier shall despatch the equipment only after obtaining clearance from the Purchaser/ Consultants. However, the inspection and certification of the Purchaser/Consultant does not absolve the Supplier of his responsibilities towards the satisfactory operation and the guarantee/warranty of the system.

10.0 TESTS PROPOSED

The following are the tests that shall be arranged by the Contractor at his works.

10.1 Visual inspection for general workmanship and welding.

10.2 Dimensional check and nozzles shall be as per the approved drawings.

10.3 Hydraulic test to detect leakage:

11.0 PAINTING

11.1 SURFACE PREPARATION

All external surfaces shall be cleaned of loose substance and foreign material, e.g. dirt, rust, scale, oil, grease, welding flux, etc. so that the zinc phosphate primer coat adheres to the original metal surface. The work shall be carried out generally in accordance with IS:1477 (Part I) amended upto December 2010. The surface shall be cleaned either by sand blast to grade S.A.2.5 using graded sand or by acid pickling using dilute sulphuric or hydrochloric acid followed by thorough rinsing with fresh water.

11.2 PRIMER AND FINISH COATS

The prime coat shall be applied immediately after the surface preparation.

Paint shall be applied in accordance with manufacturer's recommendations as supplemented by this specification. The work shall generally follow IS: 1477 (Part II) amended up to December 2010.

The prime coats shall consist of two coat of Zinc phosphate primer.

Finish painting shall consist of three coats of epoxy paint as per manufacturer's specification.

Dry film thickness for each coat shall be about 25 microns and total dry film thickness shall not be lower than 125 microns.

No shipment shall be made unless clear despatch instructions are obtained from the Purchaser's representative.

All projected parts shall be properly protected to avoid damage during transit.

Touch up painting for damaged coats doing transit / erection should be done by the Contractor.

Prior to touch up painting, proper cleaning of the damaged portions shall be done.

12.0 COMMISSIONING

12.1 INSPECTION AND TESTING

After erection at the site and before commencement of commissioning, the Contractor shall arrange to demonstrate the tests as per clause 10.2 of this specification. He shall also ensure that all rotating/ moving parts of the equipment are moving freely without any undue fouling/vibration. Necessary precautions shall be taken before testing of all electrically operated equipment. The same shall be tested as per approved procedures.

12.2 PERFORMANCE TRIAL RUN

After completion of inspection and testing, the Contractor shall arrange the guarantee and performance run. The feed/ raw material required for conducting the performance run will be arranged by the Purchaser. The performance run shall include continuous operation of the equipment for a duration of 72 hours at the rated performance or operation of 6 ½ hours per day for a duration of 5 days

The performance trial run is to ensure that the system installed conforms to the required/demanded specification including the power consumption. All the parameters shall be demonstrated during the guarantee and performance run. Maximum deviation from the approved parameters shall be less than 5%. The Contractor shall arrange any spares that may become necessary during performance run or due to damage/break down free of cost and repeat the performance and guarantee run. Any consumable like grease, oil etc. required for trial run/commissioning shall be arranged by the Contractor at no extra cost.

12.3 POWER REQUIREMENT

Power required shall be quantified for two aspects: for normal operating conditions and power needed during start up conditions and peak load. The gland losses and losses in the driving system shall also be determined and submitted.

12.4 VIBRATION TESTING

The Contactor has to test and validate that the system is free of undue vibrations under normal operating mode.

12.5 The Contractor shall arrange training of the Purchaser's operators and maintenance personnel for operating it as per standard practice/safely.

13.0 DATA TO BE FURNISHED BY THE TENDERER

13.1 AT THE TIME OF SUBMISSION OF BID

The Tenderer shall submit all detailed technical specification, catalogues etc. for the equipment being quoted. Detailed drawings showing all the design, operational and maintenance features, major dimensions, details of foundations including layout, etc., shall be submitted along with the offer. Technical data for individual items of equipment in the form of a data sheet and details of all equipment within the battery limit shall be submitted along with the tender. The Tenderer shall also submit a general arrangement drawing and approximate layout showing the space requirement etc. Other specifications and relevant data shall be furnished by the Tenderer, wherever applicable. The following details are to be submitted along with the bid.

- Data Sheets
- Tentative General arrangement (GA) drawings
- Tentative drawings with dimensions of equipment
- Equipment specifications
- Empty weight
- Any special requirement during erection
- List of customers to whom similar units have been supplied
- Compliance Statement

13.2 AFTER AWARD OF WORK

The following details have to be submitted by the Contractor within fifteen days of receipt of Letter of Intent or Letter of Award of work for approval by the Purchaser/Consultants.

- Foundation drawings with load details, if applicable.
- Manufacturing, inspection and delivery schedule

- GA drawings
- Drawings with dimensions of equipment
- Equipment layout and elevation
- Empty weight
- Electrical control panel and other electrical system details, if applicable.
- Safety devices provided
- Details of bought out items like motors, gear box, electrical items etc.
- List of spare parts for 1 year operation.
- Service and spare parts availability with contact details
- Erection Manual.

13.3 BEFORE COMMENCEMENT OF TESTING / COMMISSIONING

The contractor shall submit six copies of the Operation and Maintenance Manual and As-built drawings along with a soft copy before the commencement of testing/ commissioning.