

CONTRACT NO.

**GUJARAT WATER SUPPLY & SEWERAGE BOARD  
GANDHINAGAR**

**(A WHOLLY OWNED GOVERNMENT OF GUJARAT UNDERTAKING)**



**Bid documents for " Dismantling, Repairing and fitting of Electromechanical accessories including required supply of spares at Mangwana HW (Mothada Section), Tal: Nakhtrana including supply of required accessories under M&R to Suthari RWSS Programme:2025-26 in Kutch District."**

**Estimated Cost : Rs.670009.25**

**VOLUME – II B –III**

**TECHNICAL SPECIFICATION & Data Sheet –Electromech.**

Executive Engineer  
Gujarat Water Supply & Sewerage Board  
Public Health Mechanical Division,  
Bhuj

## **GENERAL TECHNICAL CONDITIONS & REQUIREMENTS**

### **1 SCOPE OF CONTRACT**

- 1.1 This specification covers the manufacturing, testing at manufacturer's site, delivery at site, unloading, handling and storage at site, complete erection, final checkup painting, testing and commissioning of various mechanical equipments with valves , pipe, associated accessories as per price bid to be supplied under this contract to achieve a guaranteed performance coordinated with commercial conditions of the contract to the entire satisfaction of GWSSB.
- 1.2 Any minor / hidden item of work either supply and / or erection of materials / equipment which have not been specifically mentioned in the specifications but are necessary to complete the work for trouble free and efficient operation and guaranteed performance of the entire plant / system / equipment offered shall deemed to be included within the scope of this contract and shall be provided by contractor without any extra price to the GWSSB.
- 1.3 The project information is indicated in the enclosed specification. It is advisable that the bidder should visit the site and apprise himself of all the site conditions prior to preparing the bid.

### **2 EQUIPMENT AND SERVICES TO BE INCLUDED BY CONTRACTOR UNDER THESE SPECIFICATIONS: ( whichever is applicable as per price bid)**

- 2.1 Mechanical and electrical works required at various pumping stations under regional water supply scheme.
- 2.2 Pumping machineries with all the accessories as per specifications and data sheets. Suction and discharge MS pipe work, pipe including fittings from sump outlet to pump house outlet is in to the vendor's scope as indicated by the GWSSB with necessary pipe support etc shall be included in the offer.s
- 2.3 C.I. Sluice Valves, butterfly valves, DPC Valves, Air valves, expansion bellows etc. as per specifications. The individual delivery of each pump shall be provided with butterfly valve and DPCV valves, with velocity in delivery piping and valves not exceeding 2.5 m / sec, while velocity for suction shall be  $\leq 2.0$  m / sec and for common discharge header around 1.0 m / sec.
- 2.4 Pressure gauges of suitable range of Glycerin filled as per specifications with installation and drain valve.
- 2.5 Transformer & 415 Volt motor control center panel with various type of starter Panel, MCC panel as per specifications.
- 2.6 Power and panel cables, cable trays etc as per specifications and requirement for the pumping stations.
- 2.7 Earthing systems for the pumping station as per specification and requirement
- 2.8 L. T. electrical wiring with XLPE cable etc.

- 2.9 The contractor shall take the responsibility for all the testing and inspections at manufacturer's works to be conducted in manner as specified in this specification in the presence of GWSSB's representative. The inspection will be at the cost of contractor. The third party inspection shall also be carried out in the presence of the GWSSB representative i.e. jointly and inspection charges of third party agency shall initially be born the contractor, which shall be reimbursed by GWSSB.
- 2.10 Transportation of all equipments packed in the specified way from the manufacturer's works to the project site inclusive of all intermediate handling.
- 2.11 Unloading of equipments from railway wagons / trucks at site handling and proper storing at site in the approved way under security.
- 2.12 Opening of package, checking, tallying, sorting out and inspection of equipment received at the site and lodging of insurance claims if any.
- 2.13 Taking delivery of equipments / materials from contractor's site stores, transportation to erection site. If erection is delayed arrange for proper storage of the equipment / material in approval ways.
- 2.14 Erection inspection testing start up and running of the equipment and complete plant at guaranteed performance.
- 2.15 Erection of pipe and valves including all necessary hot deep GI bolts, nuts sleeves insert plate etc. to complete the piping system.
- 2.16 Furnishing all erection and commissioning supervision service. The contractor shall also arrange for maintenance of equipment during guarantee and commissioning period.
- 2.17 The contractor shall also arrange technical expert of equipment from proprietary supplier to site as and when felt necessary until the commissioning guarantee run of the plant is completed.
- 2.18 In case of range in the motor rating depending on the efficiency of the rating of the associated electrical equipment shall be modified accordingly.
- 2.19 Initial filling of oil lubricants, grease etc for the equipment.
- 2.20 Complete list of commissioning and maintenance spares parts for first 12 months' trouble free operation and maintenance of the mechanical and electrical equipment.
- 2.21 Complete list of recommended spare parts for two years' operation and special tools and tackles for erection and regular operation and maintenance of the mechanical and electrical equipment shall be furnished as per schedule of spare parts and accessories tools.
- 2.22 Require Nos. of all relevant drawings, Data and instruction manuals.
- 2.23 All ancillary work as per price bid.
- 2.24 Regular operation, routine maintenance break down maintenance inclusive of cost of replacement spares & materials of pumping station by qualified technicians, operators and electricians for Five years from the date of commissioning.
- 2.25 Any item of work either supply and / or erection of material equipment which have not been specifically mentioned in the specification but if necessary to complete the

work for trouble free and efficient operation and performance of the entire plant / system / equipment offered, shall deemed to be included within the scope of his contract and shall be provided by contractor without any extra cost to the GWSSB.

#### **2.26 RESPONSIBILITY**

It is the intention of the GWSSB to achieve coordinate effect. The installation erection of machinery is linked up with civil construction of pumping station testing and commissioning work is linked up with the obtaining of electrical connection / power GWSSB no doubt will be doing his best to see that these inter connected activities are completed at appropriate time. However, contractor is not entitled for any claim, escalation of whatsoever commissioning at a date later than the stipulated time. Necessary extension of time will be granted in case if it is established that the erection/ testing /commissioning could not be achieved in stipulated time on account of reasons beyond control of contractor. This factor should be carefully noted as no claim what so ever nature will be entertained on an account of such situations.

#### **2.27 GUARANTEE**

The contractor has to furnish guarantee for all the equipments supplied by him and complete pumping station for a period of 12 months from the date of handing over the pumping station to GWSSB.

#### **2.28 DELIVERY**

The contractor has to furnish the BAR – Chart & PERT Chart for the pumping station and the same followed strictly so as to commence the pumping station as per the schedule

#### **2.29 CO ORDINATION BETWEEN DIFFERENT AGENCIES**

It is the responsibility of the contractor to co ordinate with different agencies i.e. sub supplier and civil contractor so as to commissioning the pumping station in scheduled time.

#### **3.0 EQUIPMENT & SERVICE TO BE EXCLUDED FROM THIS CONTRACT**

3.1 Rising main beyond the vendor's scope of supply.

3.2 Construction of the pumping station and M.C.C. Room.

#### **4.0 THIRD PARTY INSPECTION**

Inspection and testing of the major electro - mechanical equipments such as Valves, shall be carried out by third party inspection agency in the presence of GWSSB's representative (i.e. jointly) at manufacturers' works. QAPs along with manufacturers' cross sectional drawings, characteristic curves (if any), material (s) of construction etc. for vacuum/ drain / dredging pumps, expansion bellows, motorized chain pulley blocks etc. shall have to be submitted by the bidder & get them approved prior to their procurement invariably. For all other items like two pole structure with accessories, cable, GI - MS pipes with specials, pressure gauge etc. internal test / quality / calibration certificates shall have to be furnished for review / acceptance.

4.1 That the equipment installed complies with specification in all particulars and is of the correct rating for the duty and site conditions.

- 4.2 That all items operate efficiently and quietly to meet the specified requirements.
- 4.3 That all non current carrying metal work is properly and safely grounded in accordance with the specifications.

The contractor shall provide all necessary instruments and labour for testing and shall make adequate records of test procedures and readings, shall repeat any tests requested by the consultant / GWSSB and shall provide test certificates signed by a properly authorized person such test certificates shall Cover all works.
- 4.4 If tests fail to demonstrate the satisfactory nature of the installation or any part thereof then no claims for the extra cost of modifications, replacements, or retesting will be considered. GWSSB's decision as to what constitutes a satisfactory test shall be final. The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere.
- 5 GWSSB reserves right to ask for the corporate guarantee from any or all the bidder for the performance and overall completeness in accordance to GWSSB's requirements. Specifically, for in time completion of contractual works in accordance to the technical requirements in best workmanship manner.
- 5.1 GWSSB reserves the right to split the work / distribute the works among bidders.
- 5.2 GWSSB reserves the right to accept or reject the tenders with technical deviation, at the discretion of competent authority.

## **GENERAL SPECIFICATIONS FOR SUPPLY OF EQUIPMENTS**

### **1.0 GENERAL**

This part covers conditions pursuant to the contract and will form an integral part of the contract. The following provisions shall supplement general conditions, detailed specification and requirements.

### **2.0 LIMIT OF CONTRACT**

Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipments and/or needed for erection, completion and safe operation of the equipments as required by applicable codes though they may not have been specifically detailed in the technical specification, unless included in the list of exclusions. All similar standard components / parts of similar standard equipments provided shall be interchangeable with one another.

### **3.0 ENGINEERING DATA**

- 3.1 The contractor shall furnish complete engineering data of each sets of equipment such as name of manufacturer, the type of model of each principal item of equipment proposed to be furnished and erected in the annexure, standard catalogues design, the specification number and the name of the project. If the standard catalogue pages are submitted the applicable items shall be indicated there in. All titles, noting, markings, and writing on the drawing shall be in English. All dimensions should be in metric units.
- 3.2 All manufacture fabrication works in connection with equipment prior to the approval of the drawing shall be at the contractor's risk. The contractor may make any changes in the design which are necessary to make any equipment conform to the provisions and intent of the contract and such changes will again be subject to the approval by the GWSSB. Approval the contractor's drawing or works by the GWSSB shall not relieve the contractor from any of the responsibility and liabilities under the contract.
- 3.3 Drawings shall include all installation and detailed piping drawings wherever applicable. All piping 100 millimeter and larger shall be routed in detail and smaller pipe shall be shown schematically or by isometric drawings. All drawings shall be fully corrected to agree with actual "As Built" construction.

### **4.0 DESIGN IMPROVEMENTS**

- 4.1 GWSSB may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.
- 4.2 If any such agreed upon change is such that it affects the price and schedule of completion, the party shall agree in writing as to the extent of any change in the price and / or schedule of completion before the contractor proceeds with the change. The following such agreement provision thereof shall be deemed to have been amended accordingly.

- 5.0 The following documents shall be sent by registered post to the GWSSB by contractor within 3 days from the date of dispatch, to enable the GWSSB to make progressive payments to the contractor.

INVOICE (6 copies)

PACKING LIST (6 copies)

TEST CERTIFICATE (3 copies)

- 5.1 The contractor shall prepare detailed packing list of all packages and containers, bundles & loose material forming each and every consignment dispatched to site. The contractor shall further be responsible for making all necessary arrangements or loading, unloading and other handling right from his work till the site and also till the equipment is erected, tested and commissioned. He shall be solely responsibility for proper storage and safe custody of all equipments.
- 5.2 All fine, rental, demurrages, warfare and other expenses incurred due to delayed clearance of the material or any other reason shall be to the account of the contractor.

## **6.0 PROTECTION TO PLANT**

- 6.1 All coated surface shall be protected against abrasions impact, discolorations and any other damages. All exposed threaded portion shall be suitably protected with either a metallic or non-metallic protecting device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable device to protect them from damage. The parts which are likely to get rusted due to exposure to weather, shall also be properly treated and protected in a suitable manner.

## **7.0 MATERIALS HANDLING AND STORAGE**

- 7.1 All the equipment furnished under the contract and arriving at the site shall be properly receive, un loaded transported and stored in the storage spaces by the contractor at his cost.
- 7.2 Contractor shall be responsible for examining all the dispatches and notify the GWSSB immediately of any damage, shortage discrepancy etc for the purpose of the GWSSB information only. The contractor shall submit to the GWSSB every week a report detailing all the receipts during the work. However the contractor shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at the site.
- 7.3 The contractor shall maintain and accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the GWSSB at any time.
- 7.4 All equipment shall be handled very carefully to prevent any damage or loss No bare wire ropes, string etc shall be used for unloading and/or handling of the equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the

actual location of the appropriate time so as to avoid damage of such equipment at site.

- 7.5 All electrical panels, control gears, motors and such other devices shall be properly dried by heating before they are installed and energized. Motor bearings, slip rings, commutates and other exposed parts shall be protected against moisture ingress and corrosion during storage and shall be periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.

All the electrical equipment, such as Motors, Generators, etc shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and record of such measured insulation values maintained by the contractor. Such records shall open for inspection by the GWSSB.

- 7.6 The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.
- 7.7 All the materials stored in the open or dusty location must be covered with suitable water proof and flame proof covering material wherever applicable.
- 7.8 The contractor shall be responsible for making suitable indoor storage facilities to store all equipments which require indoor storage. Normally all the electrical equipment, such as motors, control gears, generators exciters and consumable like electrodes, lubricants, etc shall be stored in the closed storage space. The GWSSB in addition may direct the contractor to move certain other materials which in GWSSB opinion will require indoor storage, to indoor storage areas which the contractor shall strictly comply with.

#### **8.0 CONTRACTOR'S MATERIALS AT GWSSB SITE**

- 8.1 The contractor shall bring to site all equipment, component, parts, materials, including construction equipments, tools and tackles for the purpose of the works under intimation to the GWSSB all such goods from the time of their being brought shall not on any account be removed or taken away by the contractor or his subcontractor without the written permission of the GWSSB. The contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.
- 8.2 The GWSSB shall have the lien on such goods for any sum or sums which may at any time be due to or owing to him by the contractor, under in respect of or by reasons of the contract. After giving a fifteen (15) days notice in writing of his intention to do so, the owner shall be at liberty to sell and dispose of any such goods in such as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfactions of such or sums due as aforesaid.

After the completion of the works, the contractor shall remove from the site under the direction of the purchaser the materials such as construction equipments, erection tools,



and tackles scaffolding etc with the written permission of the GWSSB if the contractor fails to remove such materials GWSSB to do so then the GWSSB shall have the liberty to dispose of such materials and credit the proceeds thereof to the account of the contractor.

## **9.0 FACILITIES TO BE PROVIDED BY THE GWSSB**

### **9.1 SPACE**

The contractor shall advise GWSSB within fifteen (15) days from the date of acceptance of the letter of intent, about his exact requirements of space for his office, mess rooms, storage area, pre-assembly and fabrication areas, labour colony area, toilets, etc the above requirement shall be reviewed by the GWSSB and land if available will be given to the contractor for construction of his temporary structures like office, storage sheds, labour and staff colony and other utilities, etc for his own as well as his sub use. It will not be binding to owner GWSSB to spare the land if not available. In that case contractor shall have to make his own arrangements. The material once supplied shall have to be stored and preserved by agency up till the commission Agency may deploy the person to protect the materials supplied by agency at their own cost.

## **10.0 CONSTRUCTION MANAGERMENTS**

10.1 Time is the essence of the contract and the contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time the contractor is falling behind schedule, he shall make necessary action to make good for such delays by increasing his work force or by working overtime or over wise accelerate the progress of the work to comply with the schedule and shall communicate such action in writing to the GWSSB satisfying that his action will compensate for the delay . The contractor shall not be allowed any extra compensation for such action.

## **11.0 CONTRACTOR'S COOPERATION WITH THE GWSSB**

In case where the performance of the erection work by the contractor the operation of the system facilities of the GWSSB such erection work of the contractor shall be scheduled to be performed only in the manner stipulated by GWSSB and the same shall be acceptable at all times to the contractor. The GWSSB may important such restrictions on the facilities if provided to the contractor such as electricity, water etc as the GWSSB may think fit in the interest of the itself and the contractor shall strictly adhere to such restrictions and cooperate with the GWSSB it will be the responsibilities of the contractor to provided all necessary temporary instrumentation and other measuring devices required during the start-up and operation of equipment systems which are erected by him. Before commission of any machine all old lubricants, greases etc shall be thoroughly removed, the part cleaned of all deleterious material and shall be freshly lubricated by sealed lubricants, of exact pacifications.

## **12.0 COOPERATION WITH OTHER CONSTRUCTIONS & FOR GWSSB**

The contractor shall agree to cooperative with the GWSSB other contractor and consultants of GWSSB and freely exchange with them such technical information and economical design features to avoid unnecessary duplication of efforts .The contractor shall attend design coordination meetings at his own cost whenever required.

## **13.0 FIELD OFFICE RECORDS**

13.1 The contractor shall maintain at his site office up to date copies of all drawings specifications and other contract documents and any other supplementary data complete with all the latest revisions thereto. The contractor shall also maintain in addition, the continuous records of all changes to the above contract documents, drawings, specifications, supplementary data etc. affected at the field and on completion of his total assignment under the contract shall incorporate all such changes on the drawings and other engineering data to indicate as installed conditions of the equipments furnished and erected under the contract. Such drawings and engineering data shall be submitted to the GWSSB in required number of the copies.

## **14.0 DESIGN COORDINATION**

14.1 The contractor shall be responsible for the selection and design of appropriate equipments to provide the basic coordinated performance of the entire system They also design requirement are detailed out in technical specifications. The design of various components, sub assemblies and assemblies shall be not got done, such that it facilities easy field assembly and maintenance. All the relating components shall be so selected that the natural frequency of the compact unit is not critical at or close to the operating range of the unit.

## **15.0 QUALITY ASSURANCE PROGRAMME**

To ensure that the equipment and services under scope of this contract whether manufactured or performed within the contractor's work or at his sub contractor's premises or at the owner's site or at any other place of work are in accordance with the specifications. The contractor shall adopt suitable quality assurance programme to such activities at all points, necessary such programme shall be outlined by the contractor and shall be finally accepted by the purchaser after discussions before the start of contract, and such agreed programme shall form part of the contract.

## **16.0 DEFECTS IN WORK OF OTHER CONTRACTOR**

16.1 The GWSSB shall be notified promptly by the contractor of any defects in the other contractor works, the GWSSB shall determine the corrective measures if any required to rectify this situation after joint inspection work and such decision by the GWSSB shall be binding on the contractor.

## **17.0 UNFORSEEN WORKING CONDITIONS**

17.1 The contractor shall confirm all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects, during

inclement weather conditions, monsoon, storms, etc and during other unfavorable construction condition. No field activities shall be performed by the contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precaution or measures are taken by the contractor in a proper and satisfactory manner in the performance of such works and with the concurrence of the purchaser. Such unfavorable construction conditions will in no way relive the contractor of his responsibility to perform the works as per schedule.

#### **18.0 PROTECTIVE GUARDS.**

- 18.1 Suitable guards shall be provided for protection of personal on all exposed rotating and / or moving machine parts. All such guards with necessary spaces and accessories shall be designed for easy installation and removal for maintenance purposes.

#### **19.0 WELDING**

- 19.1 If the manufacture has special requirement relating to the welding procedures for welds at the terminals of the equipment to procedure procured by the owned separate specifications. The requirement shall be submitted to the GWSSB in advance of commencement of erection work.

#### **20.0 NOISE AND VIBRATIONS**

- 20.1 The equipment supplied and erection by the bidder will comply with best design and erection and its working shall within permissible noise and vibration levels.

#### **21.0 EQUIPMENT BASES**

- 21.1 A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agree by the GWSSB each base plate shall support the unit and its drive assembly shall be of a neat design with anchoring the units.

#### **22.0 SHAFT ALIGNMENTS**

All the shafts of rotating equipment shall be properly aligned to these of the machine equipments to as perfect and accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid over heating of bearing or other conditions which may tend to shorten the life of the equipment. All bearings shafts and other rotating parts shall be thoroughly cleaned and suitable lubricated before starting.

#### **23.0 DOWELLING**

All the drive motors and other equipment shall suitable dowelled after alignment of shaft with tapered machine dowels as per direction of the GWSSB.

#### **24.0 PAINTING**

All exposed metal parts of the equipments including piping, structures railings etc. Wherever applicable after installation unless otherwise specified shall be surface protected and shall be first painted with at least primer paint used, after thoroughly cleaning all such parts of all dirt, rust Axles greases, oils and other foreign materials by wire brushing, scraping or sand blasting and the same being inspected and

approved or sand blasting and the same being inspected approved by the board for painting. Afterwards the above parts shall be finished with two coats of alloyed resin machinery enamel paints. The quality of the finished paints shall be as per standards of I.S.I or equivalent and shall be of the colour as approved by the GWSSB

#### **25.0 COLOUR CODE FOR PIPE SERVICES**

25.1 All pipe services wherever applicable are to be painted accordance with the owner's standard colour scheme by the contractor.

#### **26.0 LUBRICATION**

Equipments shall be lubricated by system suitable for duty of the equipment. Lubricant level indicators wherever provided shall be furnished and marked to indicate proper levels under both stand still and operating conditions.

#### **27.0 FIRST FILLING OF CONSUMABLES OIL AND LUBRICANTS:**

All the first fill of consumables such as oils, lubricants and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications into successful trial operation. They shall be furnished by the contractor unless specifically excluded under the in these specification and documents.

#### **CHECKOUT CONTROL SYSTEMS:**

After completion of wiring and cable furnished under separate specifications and laid as per the terms noted by the board the contractor shall check out the operation of all control system for the equipments furnished and installed under these specification and documents.

#### **28.0 EQUIPMENT PERFORMANCE GUARANTEE**

The performance guarantees of the equipments under the scope of the contract are detailed separately in the technical specifications. These guarantees shall supplement the general performance guarantee provisions covered under general terms and conditions.

#### **29.0 GUARANTEE**

In the event of any emergency where in the judgment of the board delay would cause serious loss or damage, repairs or adjustments may be made by the GWSSB or a third party chosen by the GWSSB without notice to the contractor or by surety. In the event such action is taken by the purchaser the contractors will be notified promptly and he shall assist whenever possible in making the necessary corrections. This shall not extinguish the contractor's liability under the terms and conditions of the contractor.

The cost of any special or general overhaul rendered necessary during the maintenance period due to the defect in the plant or defective work carried out the contractor the same shall be borne by the contractor.

In case of this effective parts which are not repairable at site but are essential for the commercial operation of the equipment, the contractor and the GWSSB shall naturally agree to a programme of replacement of renewal which will minimize interruption to the maximum extent, in to operation of the equipment. At the end of guarantee period the contractors liability except for the latest defects in respect of goods supplied by sub contractor to the contractor where a longer guarantee ( More than 12 months ) is provided by sub - contractors, the owner shall be entitled to the benefit of such longer guarantee. Then provisions contained in this clause will not be applicable.

If the owner has not operated the equipment according to generally approved industrial practices and in accordance with the conditions of operation specified and in accordance the operating manuals, if any.

### **30.0 RECOMMISSIONING TRIALS - TESTS START – UP**

On completion of erection of the equipment and before start up each items of the equipment shall be thoroughly cleaned and then inspected jointly by the GWSSB and the contractor for correctness and completion of installation and acceptability for start up, loading to initial pre-commissioning tests at site.

The list of pre-commissioning tests to be performed shall be as mutually agreed and include in the contractor's quality assurance programme. The contractors commissioning / start up board specifically identified as far as possible and the contractor shall be responsible for carrying out all pre-commissioning tests. On completion of inspection checking after pre-commissioning tests are satisfactorily over, the complete shall be placed on initial operation during which period the complete equipment shall be operated integral with sub systems and supporting equipments as complete plant.

### **31.0 TRIAL OPERATION**

The plant shall then be on trial operation during which period all necessary adjustments shall made while operating over the full load-range enabling the plant to be made ready for performance and guarantee tests.

The duration of trial operation of the complete equipment should be fourteen **(14) days or 200 Hrs.** (whichever occurs earlier) of initial operation or any other duration as may be agreed to between the contractors. The trial operation shall be considered successful provided that each item of equipment can operate continuously at the specified operating characteristics, for the period of trial operation.

For the period of trial operation, the time of operation with any load shall be counted. Minor interruptions not exceeding four (4) hours at a time caused during the continuous operation shall not affect the total during of trial operation.

However, if in the opinion of the, purchaser, the interruption is long, the operation shall be prolonged for the period if interruption. A trial report comprising of observations and

recordings of various parameters to be measured in respect of the above trial operation shall be prepared by contractor. This report, besides recording the details of the observation during trial run shall also including the dates of starts and finish of the trial operation and shall be signed by the representative of both the parties.

The report shall have sheets, recording all the details of interruptions occurred adjustment made and any minor repairs done during the trial operation, based on the observation necessary modification/repairs to the plant shall be carried out by the contractor to the full satisfaction of the GWSSB, to enable the latter on to accorded permission to carry out performance and guarantee tests on the plant.

### **32.0 PERFORMANCE AND GUARANTEE TEST**

- 32.1 The final test as to the performance and guarantees shall be conducted at site by the GWSSB. The contractor's shall make the equipment ready for such tests and assist by the GWSSB conducting such tests free of cost, such test shall be commenced after the successful completion of trial operation.
- 32.2 These trends shall be binding on both the parties of the contract to determine compliance of the equipment with the performance guarantee.
- 32.3 The available instrumentation and control equipment will be used during such tests and the GWSSB will be calibrate, all such measuring equipment and devices as far as practicable. However, immeasurable parameters shall be taken into account in a reasonable manner by the G.W.S.S.B, for the requirement of these tests. The tests will be conducted for the specified duty and as near to the specified conditions as practicable. The GWSSB will apply proper correction in calculation to take into account condition, which should not correspond to the specified condition.
- 32.4 Any special equipment, tools tackles required for the successful completion of the performance and guarantee tests shall be provided by the contractor, free of cost.
- 32.5 The guaranteed performance figure of the equipment's shall be provided by the contractor during these performance and guarantee cost should the results of these tests show any depressed from the guaranteed values, the contractor shall modify the equipments as required to enable them to meet the guarantees. In such case performance and guarantee tests shall be repeated one month, from the date of equipment is ready for re-tests and all cost for modification including labour materials and the cost of additional testing prove that the equipment meets the guarantees shall be borne by the contractor.
- 32.6 The specific tests to be conducted on equipments have been brought out in the technical specifications.
- 32.7 Performance and guarantee tests shall make allowance for instrumentation error as may be decided by the GWSSB.

### **33.0 REGISTRATION AND STATUTORY INSPECTION:**

- 33.1 All registration and statutory inspection fees if any in respect of this work pursuant to this contract shall be to the account of the contractor. However, any registration statutory

inspection fees lawfully payable under the provision of statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the owner shall be to account of the owner. Should any such inspection or registration need to be rearranged due to the fault of the contractor or his sub-contractor the additional fees for such inspection and/or registration shall be borne by the contractor.

#### **34.0 WORKS AND SAFETY REGULATION**

34.1 The contractor will notify the GWSSB of his intention to bring on the site any equipment or any container with liquid or gaseous fuel or other substance which may create hazard. The GWSSB shall have the right to prescribe the conditions for un keep of such hazardous equipments.

Before the contractor connects any electrical appliances to any plug or socket belonging to the other contractor or owner he shall:

- (a) Satisfy the Engineer in charge of GWSSB that the appliance is in good working conditions.
- (b) Inform the GWSSB of the maximum current rating voltage and phases power factor the appliances.
- (c) Obtain permission of the Board detailing the sockets to which the appliances may be connected.

34.2 The GWSSB shall not grant permission to connect until it is satisfied that

- (a) The appliance is in good condition and is fitted with suitable plug
- (b) The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthed metal sheet surrounding the cores.

34.3 No electrical cable in use by the contractor / GWSSB shall be disturbed without prior permission. No weight of any description will be placed on any such cable and no ladder or similar equipment will rest against or be attached to it, under which such equipment or container may be handled and used during the performance of the work and the contractor shall strictly adhere to such instruction. The GWSSB shall have the right to inspect any construction plant and to forbid its use if in its opinion it is unsafe. No claims due to such prohibition shall be entertained by the GWSSB.

34.4 Where it is necessary to provide and / or store petroleum products petroleum mixtures and explosives, the contractor shall be responsible for carrying out such provision and / or storage in petroleum Act explosives Act 1948 and petroleum inspector of Explosives of India. All such storage shall have prior approvals of the GWSSB in case any statutory authority the contractor shall be responsible for obtaining the same.

#### **35.0 ELECTRICAL SAFETY REGULATIONS:**

35.1 In no circumstances shall the contractor interfere with fuse and electrical equipment belonging to the GWSSB or other contractors.

- 35.2 No work shall be carried out on any live equipment. The equipment shall be made safe by the GWSSB and a permit to work be issued before work is carried out.
- 35.3 The contractor shall employ the necessary number of qualified full time electricians to maintain temporary electrical installation



## **GENERAL REQUIREMENTS (ADDITIONAL)**

### **1. Employer's Drawings (if any)**

- 1.1. The drawings listed in the tender document are the Employer's drawings and are provided by the Employer as illustrative of the specification.
- 1.2. All data and information furnished in the drawings by the Employer is given in good faith but the Employer does not accept the responsibility for the completeness and accuracy thereof. The same shall be verified by the contractor promptly pointing out errors or discrepancies thereof to the Engineer.

### **2. Drawings Furnished by the Employer (if any)**

- 2.1. The contractor shall carefully check all drawings and / or instructions furnished by the Engineer in charge before commencing any Work, and shall inform the EIC in writing, within a day from the receipt of the same, of any errors or omissions discovered, or of the difficulty to execute any works or part thereof in compliance with these drawings and / or the written instructions received from the EIC. Failing to do this, he shall be liable to execute at his own cost the necessary alterations to any works resulting from these errors or omissions.
- 2.2. The contractor will be furnished with 2 copies of any such drawings prepared by the Engineer. The contractor will also be furnished with two copies of all instructions as may be issued by the Engineer. One copy of all such drawings and instructions issued to the contractor shall be kept in his office at the site. No drawing or instruction shall be considered valid unless it has been signed by the Engineer.

### **3. Drawing Sheet Format**

- 3.1. All drawings provided by the contractor shall be on standard size sheets, prepared on computer with Auto Cad 14 and shall show the following particulars in a title block located in the lower right hand corner, in addition to the name of contractor and equipment manufacturer, date, scale, drawing number, revision number (R0 for drawings submitted initially, R1, R2, etc. for drawings submitted subsequently) and title:

**Gujarat Water Supply & Sewerage Board / Name of Project: Regional Water Supply Scheme**

A blank space of 90 mm x 100 mm shall be provided for the Engineer's approval stamp

and provision shall be made for details of revisions to be recorded.

- 3.2. All drawings submitted by the bidder / contractor shall use the English language and preferably SI units. All drawings shall be clearly and fully cross referenced to the other drawings as relevant.

### **4. Tender / Contract Drawings**

- 4.1. Drawings submitted by the bidder shall show all the essential items of the plant offered together with sufficient details to enable the general arrangement of the Plant to be determined.

- 4.2. The outline dimensional drawings submitted by the contractor shall include the following in addition to overall dimensions:

Parameters of equipment

Load details

Support details

Foundation pocket details

## **5. Submission and Approval of Drawings**

- 5.1. The following shall be the procedure for submission and approval of drawings:
- 5.1.1. The contractor shall submit 3 copies of the drawings to the Employer. All the drawings are to be signed by the contractor or his authorized representatives
- 5.1.2. The Engineer in charge's (EIC) representative will review the drawings and, if found fit for approval, the Employer will return 2 copies to the contractor duly approved.
- 5.1.3. In case the drawings / documents are not fit for approval but worth for review, the EIC's representative will mark the comments on the drawings and return 2 copies to the contractor. In such case, the contractor shall resubmit the revised drawings within two weeks as per sub clause 5.1.1 above and the same shall be repeated till the drawings are finally approved as per sub clause 5.1.2 above.
- 5.1.4. If the submitted drawings / documents are not worth for review, the contractor will be informed accordingly.
- 5.1.5. On receipt of the approved drawings as per sub clause 5.1.2 above, the contractor shall submit floppy and documents to the employer.
- 5.1.6. After tests on completion, the contractor shall submit, within 15 days of the conclusion of the tests, CD's of the "As Built Drawings" to the Employer.
- 5.2. When the drawings are received by the EIC's representative after revision by the contractor, he will only review the revision made and hence the contractor shall carefully identify all the revised details / dimensions and also describe the revisions in the revision block.
- 5.3. No drawings, with corrections made after taking the prints, will be accepted.
- 5.4. Approval of drawings by the Engineer shall not relieve the contractor of his responsibility in terms of the contract.

## **6. Operation and Maintenance Manuals**

- 6.1. The operation and maintenance manuals shall be arranged to provide separate volumes for each principal section of the Works and they shall relate to as built conditions and shall include all necessary drawings and diagrams for a proper understanding of the works.
- 6.2. The operation and maintenance manual shall be approved in draft form initially prior to commencement of erection by the EIC's representative and shall cover all items of the Works. For this purpose, three draft copies shall be submitted to the EIC's representative.

A mere collection of manufacturers' descriptive leaflets will not be acceptable in satisfaction of this clause. The operation and maintenance manual shall comprise both operating instructions and maintenance instructions.

- 6.3. The manuals shall include, but not be limited to the following information:
  - 6.3.1. Descriptive overview of the whole of the works.
  - 6.3.2. Descriptions of all systems installed, including mechanical, electrical, instrumentation, control systems with relevant design and operating parameters.
  - 6.3.3. Descriptions of all equipment supplied including manufacturer's leaflets, which shall be scheduled for easy reference.
  - 6.3.4. Schedules and manufacturer's catalogues for all equipment supplied, giving duties, electrical load, etc.
  - 6.3.5. Schedules of all equipment suppliers (and their local agents) including names, addresses, telephone & facsimile numbers and e-mail ID.
  - 6.3.6. Start up, operation and shut down instructions for all parts of the works. These shall include step by step directions on setting the plant to work listing all adjustments and settings necessary for the current functioning of the plant.
  - 6.3.7. Instructions on monitoring of plant performance and sample log sheets for each plant item, to be filled by operators on a routine basis.
  - 6.3.8. "Dos" and "Don'ts" in plant operation: Operator's attention shall be drawn to all operations considered to be dangerous to operators or likely to cause damage to the plant.
  - 6.3.9. Procedures to deal with breakdown and emergencies
  - 6.3.10. Safety requirements
  - 6.3.11. Checking, testing and replacement procedures to be carried out on all plant items on a daily weekly and monthly basis or at longer intervals to ensure trouble free operation. Full maintenance instructions for all equipment including planned maintenance schedules or charts giving daily, weekly, monthly, quarterly, half yearly, annual overhaul instructions together with recommended lubricants and spares. These shall also include details of routine maintenance work that will be within the competence of the normal maintenance staff and notification of maintenance work that will have to be done by the manufacturer, his agent or other specialist operator.
  - 6.3.12. Fault locations and remedy charts to facilitate tracing the cause of malfunctions or break down and correcting faults.
  - 6.3.13. Complete list of recommended lubricants and lubrications charts.
  - 6.3.14. A 'spares schedule' which shall consist of a complete list of item wise spares for all plant items with ordering references and part numbers.
  - 6.3.15. A complete list of manufacturer's instructions for operation and maintenance of all bought out equipment. The list shall be tabulated in alphabetical order giving the name of supplier

/ manufacture, identification of the Plant item giving the model number and the literature provided including instruction leaflets and drawing numbers.

- 6.3.16. Step by step procedure for the dismantling, repair and re assembly of all items of equipment.
- 6.3.17. Part list and drawings or exploded diagrams for each item of plant with construction particulars, materials of construction, mating components, clearances and tolerances, maximum wear permitted before replacements are to be done, etc
- 6.3.18. Record drawings of all systems installed, including general arrangements, conduit and wiring trunking systems, wiring diagrams, control schematics and valve charts, etc., to a reduced scale.
- 6.4. The contractor shall furnish 3 copies of the Operation and Maintenance Manual for each station. Each volume shall be durable and permanently bound within a stiff binder of a design to be approved by the Employer. They shall permit the subsequent incorporation of revisions to be necessary during the defect liability period.

## **7. Protection and Packing for Transportation**

- 7.1. Before any plant is dispatched from manufacturer's works it shall be properly prepared and packed and the contractor shall give the Employer at least 14 days notice that these preparations are to commence.
- 7.2. Prior to dispatch the plant shall be adequately protected by painting or by other approved means for the whole period of transit, storage and erection, against corrosion and incidental damage, including the effects of vermin, sunlight rain, high temperatures and humid atmospheres. The contractor shall be responsible for the plant being so packed and / or protected as to ensure that it reaches the Site intact and undamaged. The plant shall be packed to withstand rough handling in transit and all packages shall be suitable for storage including possible delays in transit.
- 7.3. The contractor shall be deemed to have included in the schedule of prices for all materials and packing cases necessary for the safe package, conveyance and delivery and storage of the plant with all protective and preservation measures.
- 7.4. Cases containing rubber rings, bolts and other small items shall not normally weigh more than 50 kg gross per case. No one package or bundle shall contain items of plant intended for incorporation in more than one section of the works. All items of plant shall be clearly marked for identification against the packing list.
- 7.5. Eye bolts, lifting hooks and brackets shall be provided for lifting the boxes, crates and packages. Every crate or package shall contain a packing list in a waterproof envelope. A duplicate copy of the packing list shall be sent by post to the EIC's representative at site.
- 7.6. All crates, packages, etc. shall be clearly marked with a waterproof material to show the weight and where the slings should be attached, and shall also have an indelible identification mark relating them to the packing lists. Packing cases shall be nonreturnable. Contractor shall have to clear the site including packing material.

- 7.7. Electrical equipment shall be enclosed in sealed air tight package with hygroscopic material, before being placed in packing cases on shock absorbent materials and secured by means of battens.

**8. Delivery, Unloading and Storing at Site**

- 8.1. The Contractor shall be responsible for checking all materials delivered to Site and shall keep the EIC or his representative fully informed of the state of deliveries. The contractor shall carry out, at his cost, all instructions of EIC or his representative for proper unloading, preservation, maintenance, storage and security of materials delivered to site until he fulfills all his obligations under the contract.
- 8.2. The contractor shall erect and maintain on the Site any temporary storage facility as required and approved by the EIC. If built up shed or area is provided by the Employer depending upon availability, the contractor shall have to pay rent as finalized by the EIC.
- 8.3. Multiple handling and movement of materials during storage and retrieval shall be avoided.

**MATERIALS AND WORKMANSHIP**

**1. Introduction**

- 1.1. This part of the specification sets out the general standards of materials to be supplied and the workmanship required to be ensured by the contractor. All component parts of the Works shall, unless otherwise specified, comply with the provisions of this part or be subject to the approval of the Employer. Particular attention shall be paid to a neat, orderly and well arranged installation carried out in a methodical competent manner.

**2. Reference Specifications and Standards**

- 2.1. Where reference is made in the Specification to a British Standard Specification (hereinafter abbreviated to 'B.S') issued by the British Standards Institution of 2, Park street, London W.I., or to an Indian Standard Specification (I.S.) issued by the Bureau of Indian Standards, (earlier known as Indian Standard Institution), Manak Bhavan, 9 Bahadur shah Zafar Marg, New Delhi 110 002, or American Society for Testing and materials (ASTM) issued by ASTM 1916 Race Street, Philadelphia, P.A., 19103, U.S.A. or American national Standards Institute (ANSI) issued by ANSI 1430, Broadway, New York, N.Y., 10018, U.S.A. or Japanese Industrial Standards (JIS) issued by Japanese Standards Association, 4-1-24, Akasaka, Minato-Ku, Tokyo 107, Japan or to any other equivalent Standard it shall be to the latest revision of that Standard at the tender opening date.
- 2.2. The contractor may propose at no extra cost to the Employer, the use of any relevant authoritative internationally recognized Reference Standard.
- 2.3. All details, materials and equipment supplied and workmanship performed shall comply with the specified Standards. If bidder offers equipment to other Standards, the equipment

/ material should be equal or superior to those specified and full details of the difference shall be supplied.

- 2.4. In the event of conflict between this specification and the codes for equipment, provisions of this specification shall govern. Certain specifications issued by national or other widely recognized bodies are referred to in this specification. In referring to the Standard Specifications the following abbreviations are used:

IS	:	Indian Standard
ANSI	:	American National Standards Institute
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society of Testing and Materials
AWS	:	American Welding Society
AWWA	:	American Water Works Association
ISO	:	International Organization for Standardization
DIN	:	Deutsches Institute fur Normung
BS	:	British Standard
IEC	:	International Electro technical Commission
IEE	:	Institution of Electrical Engineers
IEEE	:	Institute of Electrical and Electronic Engineers
NEMA	:	National Electrical Manufacturers Association
AGMA	:	American Gear Manufacturer's Association

### **3. Materials General**

- 3.1. All materials incorporated in the works shall be the most suitable for the duty concerned and shall be new and of reputed make / approved quality, free from imperfections and selected for long life and minimum maintenance. Non destructive tests, if called for in the Specification, shall be carried out. All submerged moving parts of the plant, or shafts and spindles or faces etc. in contact with them shall be of corrosion resistant materials. All parts in direct contact with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall maintain their properties without aging due to the passages of time, exposure to light or any other cause.

### **4. Workmanship General**

- 4.1. Workmanship and general finish shall be of first class quality and in accordance with best workshop practice.
- 4.2. All similar items of the plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall fit all similar items. Machining fits on renewable parts shall be accurate

and to specified tolerances so that replacements can be readily installed. All equipment shall operate without excessive vibration and with minimum noise. All revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds at any load up to the maximum there shall be no vibration due to lack of balance.

- 4.3. All parts which can be worn or damaged by dust shall be totally enclosed in dust proof housings. All materials incorporated in the works shall be the most suitable for the duty concerned, free from imperfections and selected for long life and minimum maintenance. All necessary accessories required for satisfactory and safe operation of the plant shall be supplied by the contractor unless it is specifically excluded from his scope. Suitable provision by means of eyebolts or other means are to be provided to facilitate handling of all items that are too heavy or bulky for lifting and carrying by two men.
- 4.4. If, after installation, the operation or use of the materials or equipment furnished by the contractor proves to be unsatisfactory. The Employer shall have the right to operate or use such materials or equipment until correction of defects, errors or omissions, by repair or by partial or complete replacement, can be made without interfering with the plant operations. Except for any warranty provided for elsewhere in this contract or unless otherwise agreed upon in advance, the period of such operation or use, pending correction of defects, will not exceed 1 year.

## **5. Welding**

- 5.1. Welding shall comply with the latest revision of the BS 5135 Code.
- 5.2. Welders shall be qualified in accordance with the requirement of the appropriate section of BS 4871. The Engineer shall have the right to call for further qualification from time to time from any welder who in the opinion of the EIC does not produce weld in accordance with the qualification. Each welder shall be assigned a number and letter. Each welded end shall clearly be identified as to its welder marking the welder's code adjacent to the welds. A record chart shall be maintained for each welder showing the procedures, for which he has qualified, the date of such qualification, the type of defects produced and their frequency. The EIC shall disqualify the welder whose work requires a disproportionate amount of repairs. All procedures where required shall be qualified as per BS EN 283-3.
- 5.3. Inspection and quality of surveillance shall not be limited to the examination of finished welds. The techniques employed shall be based on methods which are known to produce good results and which have been verified at Site by actual demonstration.
- 5.4. Haphazard striking of the electrodes for establishing an arc shall not be permitted. The arc shall be struck either on the joint or on a starting tag. The starting tag shall be of the same material or a material compatible with the base metal being welded. In case of any inadvertent strike on place other than the welding, the area affected shall be ground flushed and examined by liquid penetration method.
- 5.5. Generally, a stringer bead technique shall be used with a slight oscillation of necessary to avoid slag and to minimize the number of beads needed to fill exceed 3 times the wire diameter. Vertical welds shall be made in upward direction. For all pipes above 300 mm



dia., welding shall be done whenever possible, by 2 welders working simultaneously along both sides of the pipe.

- 5.6. The root pass shall have less than 1.5 mm internal reinforcement. Defects like icicles, burn through and excessive “such back” etc. shall be cause for rejection of welds.
- 5.7. Final welds shall be suitable for appropriate fabrication of the non-destructive examination of the weld. If grinding is necessary, the weld shall be blended into the parent metal without gouging or thinning of the parent metal in any way. Uneven and excessive grinding may be a cause for rejection. Fillet weld shall preferably be convex and free from undercutting and overlap at the toe of weld. Convexity and concavity shall not exceed 1.5 mm. The leg lengths shall not exceed the specified size by more than 1.5 mm.
- 5.8. All attachments such as lugs, brackets and other non pressure parts shall also be done by qualified welders in accordance with the design details and materials specifications. Temporary attachments shall be removed in a manner that will not damage the parent metal. Areas of temporary attachments shall be dressed smooth and examined by ultrasonic or liquid penetration methods.
- 5.9. All tack welds shall be made using qualified procedure and welders, the number of size of tack welds shall be kept as small as to consist of adequate strength and joint alignments. All tack welds shall be examined visually for defects and if found defective shall be completely removed. As welding proceeds, tack welds shall be either removed completely or shall be properly prepared by grinding or filling their starting ends so that they may be satisfactorily incorporated in the welds. Unacceptable defects shall be removed by grinding machine or chipping or gouging. Flame gouging may be permitted provided gouged surfaces are ground at least by 1.0 mm below the deepest indentation.
- 5.10. All weld repairs shall be carried out using the approved welding procedures and welders. Re welded areas shall be reexamined by the methods specified for the original welds and repair procedures shall be duly qualified by the EIC’s representative.

## **6. Pre heating and Post heating Treatment**

- 6.1. Pre heating and post heating treatment shall conform to the relevant application codes. Preheating not exceeding 121<sup>0</sup> C for all carbon steel construction above 25 mm thickness would be mandatory. Such pre heating would be maintained during flame cutting, flame or arc gouging, welding and repairs and may be done by gas heating by gas torches / gas rings with neutral flame. The temperature shall be checked by temperature indicating crayons. However, such pre heating will not be necessary for welds less than 6 mm size. In large diameter pipe fabricated out of plate materials, production control test plates in accordance with the BS 4870 part 1 Table 6 to represent 30 % of the long seams and each welder’s performance would be mandatory.

## **7. Electrodes**

- 7.1. All electrodes shall be stored in their original sealed containers under dry conditions. Electrodes shall remain identified until consumed. All electrodes shall be dried before use. Drying ovens shall be provided in work areas for drying purposes. Electrodes withdrawn



from oven shall be promptly used and excess unused electrodes shall be promptly returned to oven.

## **8. Examination / NDT / Radiography**

- 8.1. The various stages of examination and types shall be as stipulated in the respective fabrication Codes. Radiographic examination shall be carried out as per provisions of BS 2600 or BS 2910. Ultrasonic tests where called for shall be carried out as per provisions of BS 3926, magnetic particle tests shall be carried out as per BS 6072. Liquid penetration tests shall be carried out as per BS 6443.

## **9. Stainless Steel Welding**

- 9.1. All welding consumable such as electrodes, filler weirs, argon gas for shielding and purging shall be of high quality and the proposed brand shall be furnished for approval of the EIC. Weld deposits shall have similar or higher physical properties and similar chemical composition to the members joined.
- 9.2. All electrodes shall be purchased in sealed containers only and stored in their packing intact. The packets opened shall be consumed as early as possible. The electrodes removed from the containers shall be kept in holding ovens at temperatures recommended by electrode manufacturer. Special care shall be taken in avoiding mixing of electrodes in the oven. The electrodes and filling wires shall be free from rust, oil, grease, earth and other foreign matter.
- 9.3. Argon gas with purity 99.5 % shall be used for shielding and purging. The purity of gas shall be certified by the gas manufacturers.
- 9.4. Non destructive examination of the welds shall be carried out to ensure quality of weld.
- 9.5. The electric current for welding shall be direct current, straight polarity (electrode negative). The welding current shall be kept minimum possible to ensure minimum heat affected zone in the parent material. Other side of the weld joint shall be periodically flushed with argon gas.

## **10. Castings**

- 10.1. Cast iron shall be of standard grey close grained quality. The structure of the castings shall be homogeneous and free from non metallic inclusions and other injurious defects. All surfaces of castings which are not machined shall be smooth and shall be carefully fettled to remove all foundry irregularities.
- 10.2. Minor defects in depth not exceeding 12.5 percent of total metal thickness and which will not ultimately affect the strength and serviceability of the casting may be repaired by approved welding techniques. The EIC shall be notified of large defects and no repair welding of such defects shall be carried out without prior approval of the EIC. If the removal of metal for repair should reduce the stress resisting cross section of the casting by more than 25 percent, or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then casting shall be rejected. Test coupons cast simultaneously with the main castings shall be identified to check physical, chemical analysis of casting. Major defects on casting are not acceptable.

Castings repaired by welding for minor defects shall be stress relieved after such welding. Non destructive tests as directed by the EIC will be required for any casting containing defects whose extent cannot otherwise be judged, or to determine where repair welds have been properly made.

## **11. Forging**

- 11.1. All major stress bearing forging shall be made to a Standard specifications. Forging shall be subjected to magnetic particle testing or dye penetration test at the areas of fillets and change in section. The testing shall be conducted after rough machining (10 microns). Any defect which will not machine out during the final machining, will be gouged out fully, inspected by dye penetration or magnetic particle inspection to ensure that the defect is fully removed and repaired using an approved repair procedure. Any indication, which proves to penetrate deeper than 2.5 % of the finished thickness of the component, shall be reported to the EIC giving the details like location, length, width and depth. For the magnetic particle inspection the choice of wet or dry particles shall be at the Contractor's discretion.
- 11.2. All forging shall be demagnetized after test and shall be heat treated for the relief of residual stresses.

## **12. Design Life**

- 12.1. The works as a whole shall be new, of sound workmanship, robustly designed for a long reliable operating life and shall be capable of 24 hours per day continuous operation for prolonged period in the climatic and working conditions prevailing at the Site, and with the minimum of maintenance. Particular attention shall be given to temperature changes, the stability of paint finish for high temperatures, the rating of engines, electrical machinery, thermal overload services, cooling systems and the choice of lubricants for possible high and prolonged operating temperatures. The contractor shall be called upon to demonstrate this for any component part either by service records, or evidence of similar equipment already installed elsewhere or relevant type tests. Routine maintenance and repair shall as far as possible not requires the services of highly skilled personnel.
- 12.2. The plant shall be designed to provide easy access to and replacement of component parts which are subject to wear, without the need to replace whole units. No parts in contact with water shall have a life from new to replacement or repair of less than five years.
- 12.3. Design features shall include the protection of plant against damage caused by vermin, dirt, dust and dampness and to reduce risk of fire. Plant shall operate without undue vibration, and parts shall be designed to withstand the maximum stresses under the most severe condition of normal service. Materials shall have a high resistance to change in their properties due to the passage of time, exposure to light, temperature and any other cause which may have a detrimental effect upon the performance or life of the Works.
- 12.4. Plant located outside lockable areas / building shall have additional features to prevent unauthorized operation.

## **13. Lubrication**

- 13.1. A complete schedule of recommended oils and other lubricants shall be furnished by the contractor. The number of different types of lubricants shall be kept to a minimum. The schedule and the name of the supplier of the lubricants shall be submitted to the EIC.
- 13.2. Contractor shall indicate indigenously available equivalent lubricants with complete specification, to enable the Employer to arrange for regular supply.
- 13.3. Where lubrication is effected by means of grease, preference shall be given to a pressure system which does not require frequent adjustment or recharging. Frequent, for this purpose, means more than once in a month and grease systems having shorter periods between greasing should be avoided. Where necessary for accessibility grease nipples shall be placed at the end of the extension piping, and, when a number of such points can be grouped conveniently, the nipples shall be brought to a battery plate mounted in a convenient position. All grease nipples shall be of the same size and type for every part of the plant. Arrangements shall be provided to prevent bearings being overfilled with either grease or oil.
- 13.4. Where more than one type of special grease is required a grease gun for each special type shall be supplied and permanently labeled.
- 13.5. Oil containers shall be supplied complete with oil level indicators of the sight glass type, or where this is not practicable, with dipsticks. The indicators shall show the level at all temperatures likely to be experienced in service. The levels shall be clearly visible in the sight glass type from the normal access floor to the particular item of Plant and they shall be easily dismantled for cleaning. All sight glasses shall be firmly held and enclosed in metal protection in such manner that they cannot be accidentally dislodged.
- 13.6. All lubrication systems shall be designed so as not to cause a fire or pollution hazard and particular care shall be taken to prevent leakage of lubricants and to avoid leaking lubricants coming into contact with any electrical equipment, heated surfaces or any other potential source of fire.

#### **14. Name Plate**

- 14.1. Each item of the plant shall have permanently attached to it in a conspicuous position, a name plate and rating plate. Upon these shall be engraved or stamped, the manufacturer's name, type and serial number of plant, details of the loading and duty at which the item of plant has been designed to operate, and such diagrams as may be required by the EIC. All indicating and operating devices shall have securely attached to them or marked upon them designations as to their function and proper manner of use.
- 14.2. Name plates, rating plates and labels shall be of a non-flame propagating materials, either non hygroscopic or transparent plastic with engraved lettering of a contrasting colour. Fixing shall be by means of non corrosive screws, drive rivets or adhesives shall not be used.
- 14.3. Warning labels shall be provided where necessary to warn of dangerous circumstances or substances. Inscriptions or graphic symbols shall be black on a yellow background.
- 14.4. Instruction labels shall be provided where safety procedures such as wearing of protective clothing are essential to protect personnel from hazardous or potentially hazardous

conditions. These labels shall have inscriptions or graphic symbols in white on a blue background.

**15. Nuts, Bolts, Studs and Washers**

- 15.1. Nuts, bolts, studs and washers for incorporation in the plant shall conform to the requirements of the appropriate standard. Nuts and bolts shall be of the best quality of specified grade, machined on the shank and under the head and nut
- 15.2. Fitted bolts shall be a light driving fit in the reamed holes they occupy, shall have the screwed portion of such a diameter that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at site.
- 15.3. Washers, locking devices and anti vibration arrangements shall be provided where necessary. Jointing hardware for the entire Plant shall be provided with sufficient spares to cater for site losses.
- 15.4. Where bolts pass through structural members taper washers shall be fitted, where necessary, to ensure that no bending stress is caused in the bolt. Where there is a risk of corrosion, bolts, nuts and studs shall be designed so that the maximum stress does not exceed half the yield stress of the material under any conditions. All bolts, nuts and washers which are subject to frequent adjustment or removal in the course of maintenance and repair shall be made of nickel bearing stainless steel.
- 15.5. The contractor shall supply all holding down, alignment and leveling bolts complete with anchorages, nuts, washers and packing required to attach the plant to its foundations, and all bed plates, frames and other structural parts necessary to spread the loads transmitted by the plant to concrete foundations without exceeding the design stresses.

**16. Allowance for Wastage**

- 16.1. The contractor shall supply reasonable excess quantities to cover wastage of those consumable which will be normally subject to waste during erection, commissioning and setting to Work.

**17. Painting – General**

- 17.1. The contractor shall be responsible for the cleaning, preparation for painting, and priming or otherwise protecting, as specified, all parts of the plant at the place of manufacture prior to packing.
- 17.2. Parts may be cleaned but surface defects may not be filled in before testing at the manufacturer's works. Parts subject to hydraulic test shall be tested before any surface treatment. After test, all surfaces shall be thoroughly cleaned and dried out, if necessary by washing with an approved de-watering fluid prior to surface treatment. Except where the specification provides to the contrary all painting materials shall be applied in strict accordance with the paint manufacturer's instructions.
- 17.3. All protective coatings shall be suitable for use in warm humid climates. All primers, under coats and finishes shall be applied by brush or airless spray, except where otherwise specified. Consecutive coats shall be in distinct but appropriate shades. All paints shall be

supplied from the store to the painters, ready for application, and addition of thinners or any other material shall be prohibited.

## **18. Painting at Place of Manufacture**

- 18.1. Steel and cast iron parts shall be sand blasted to near white cleaning before painting. Edges, sharp corners etc. shall be ground to a curve before sand blasting. A primer coat of a zinc rich epoxy resin based coating with at least 75 microns dry film thickness is to be provided. In addition the parts are to be provided with adequate number of coats of coal tar epoxy polyamine coating to a dry film thickness of 175 microns including primer coating.

## **19. Painting at Site**

- 19.1. Immediately on arrival at the site, all items of plant shall be examined for damage to the paint coat applied at the manufacturer's works, and any damaged portions shall be cleaned down to the bare metal, all rust removed, and the paint coat made good with similar paint.
- 19.2. After erection, such items which are not finish painted shall be done so and, items that have been finish painted at the manufacturer's works shall be touched up for any damaged paint work. For finish painting, two coats of synthetic enamel conforming to IS: 2932 shall be applied. Dry film thickness of each coat shall be at least 25 microns.
- 19.3. The dry paint film thickness shall be measured by Electrometer or other instruments approved by the Employer. In order to obtain the dry film thickness specified, the contractor shall ensure that the coverage rate given by the paint manufacturer will enable this thickness to be obtained. Strength of adhesion shall be measured with an adhesion tester and this value shall not be less than 10 kg/cm<sup>2</sup>. Painted fabricated steel work which is to be stored prior to erection shall be kept clear of the ground and shall be laid out or stacked in an orderly manner that will ensure that no water or dirt can accumulate on the surface. Suitable packing shall be laid between the stacked materials. Where cover is provided, it shall be ventilated.

## **20. Noise and Vibration**

- 20.1. The Contractor shall provide a quiet installation. All items of plant and equipment shall be carefully chosen with a view to minimizing sound levels.
- 20.2. The Contractor shall provide and fix all material for the prevention of transmission of noise and vibration through the structure. Where appropriate all fans, A/C package unit, compressors and other motive plant shall be mounted on resilient mountings. All rotating plant shall be statically and dynamically balanced.

## **21. Galvanizing**

- 21.1. Wherever galvanizing has been specified the hot dip process shall be used. The galvanised coating shall be of uniform thickness. Weight of zinc coatings for various applications shall not be less than those indicated below:

### **a) Fabricated steel**

- |    |   |                 |
|----|---|-----------------|
| I  | Thickness less than 2 mm but not less than 1.2 mm | 340 gms / sq mm |
| ii | Thickness 2 mm and above                          | 460 gms / sq mm |

**b) Fasteners**

I	Up to nominal size M10	270 gms / sq mm
ii	Over M10	300 gms / sq mm

- 21.2. Galvanising shall be carried out after all drilling, punching, cutting, bending and welding operations have been carried out. Burrs shall be removed before galvanising. Any Site modification of galvanised parts should be covered well by zinc rich primer and aluminum paint.

**22. Support for Pipe work & Valves**

- 22.1. All necessary supports, saddles, slings, fixing bolts & foundation bolts shall be supplied to support the pipe work. Valve and other equipments mounted in the pipe work shall be supported independent of the pipes to which they connect.

**DETAILED TECHNICAL SPECIFICATIONS**  
**PART I: MECHANICAL**

## **ITEM NO:-01 & 05 M S PIPES & M S SPECIALS**

All pipes, fittings, bolts, nuts, jointing materials and appurtenances for piping to be required for execution of the works shall be manufactured and erected in accordance with the erection plans, specifications and directives of the department. All pipe work and fittings shall be to a class in excess of the maximum pressure attained in service including any surge pressure.

The pipe work installation shall be so arranged to offer ease of dismantling and removal of pumps or other major items of equipment. Expansion bellows with tie rods shall be included in the suction and delivery pipe work of all pumps for easy dismantling as specified in price bid. All loose flanges shall be secured to fixed flanges by suitable tie bolts. All pipe work shall be adequately supported with purpose made fittings. When passing through walls, pipe work shall incorporate a puddle flange. Flange adapters and unions shall be fitted in pipe work runs wherever necessary to permit the simple disconnection of flanges, valves and equipment. The final outlet connection of the pipe work shall match the connecting point of the transmission main.

Flanged joints shall be full face, fabric reinforced rubber gaskets, pierced to take the bolts, and the face of all flanges shall be machined to give a true angle of 90<sup>0</sup> to the center line of the pipe or fittings. All necessary supports, saddles, slings, fixing bolts and foundation bolts shall be supplied to support the pipe work and its associated equipment in an approved manner. Valves, meters and other devices mounted in the pipe work shall be supported independently of the pipes to which they are connected.

The whole of the jointing work and materials necessary to fix and connect the pipes, including adequate and efficient pipe support shall be included in the contract. The bidder shall be responsible for ensuring that the internal surface of all pipe work is thoroughly cleaned before and during erection and before commissioning. Cleaning shall include removal of all dirt, rust, scale and welding slag due to site welding. Before dispatch from the manufacturers' works, the ends of the pipes, branch pipes etc. shall be suitably capped and covered to prevent any accumulation of dirt or damage. This protection shall not be removed until immediately prior to connecting adjacent pipes, valves or pumps. All small bore pipes shall be blown through with compressed air before connection is made to instruments and other equipment. No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of the department.

Material of steel pipes and fittings shall conform to IS: 2062. Fabrication and testing shall be in accordance with IS: 1239 / IS: 3589 for pipes and IS: 6392, ISO 7005 or BS 4504 for flanges. Carbon content & other chemical properties shall be within specified limits of governing IS. Minimum corrosion allowance shall be 2 mm for pipes and fittings which are not mortar lined.



All the underground buried mild steel piping shall be protected by the application of hot coal tar enamel and fiber glass wrapping. The coating shall consist of one coal tar primer coat, one coal tar enamel coat, wrapping of fiber glass and one more coat of enamel and then final wrap of enamel impregnated fiber glass.

Thickness of pipe for pump house pipe system i. e. suction, delivery, common suction and discharge headers (if any) & header by pass and shall not be less than what is prescribed in relevant IS standards without negative tolerance if specified otherwise in the price bid.

## VALVES

### 1.1 General

- 1.1.1 Valves shall be as per internationally recognized standards. Flanges shall be machined on faces and edges to ISO 7005, IS 6392 or BS 4504.
- 1.1.2 Valves shall be double flanged type and the face shall be parallel to each other and flange face should be at right angles to the valve centerline. Back side of valve flanges shall be machined or spot faced for proper seating of the head and nut.
- 1.1.3 Valve buried or installed in underground chamber, where access to a hand wheel would be impractical, shall be operated by means of extension spindle and/or keys.
- 1.1.4 Valve shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position.
- 1.1.5 The valve stem, thrust washers, screws, nuts and all other components exposed to the water shall be of a corrosion resistant grade of stainless steel.
- 1.1.6 Valves shall be free from sharp projections.
- 1.1.7 Butterfly, non return valves and non rising spindle sluice valves size are small hence shall be provided without bypass arrangement. Butterfly shall have a gear mechanism operating arrangements with indicator to see the open close status.
- 1.1.8 Governing standards for butter fly, sluice, dual plate check (non return), reflux valves are tabulated below.

Sr. No.	Description	Standards
1	Sluice valves for water works purposes Class - I	IS: 14846 - 2000
2	Butterfly valve for water works purposes	IS : 13095 - 1991 / BS 5155
3	Dual Plate Check Valve	API 594 / API 598
4	Reflux valve	IS : 5312

- 1.1.8 The tolerance on the valve dimensions shall be as per relevant standard / code but not exceeding the following;

- 1) Face to face  $\pm 3$  mm
- 2) CD of flange  $\pm 3$  mm
- 3) Bolt circle diameter  $\pm 2$  mm
- 4) Thickness of flange  $\pm 2$  mm

Dimensional tolerance on casting shall be as indicated in IS : 5519

- 1.1.9 For sluice valves located below floor, suitable floor stands for extension bonnets as required shall be provided. These shall be complete with proper extension stamps, valve stem coupling hand wheel above offer shall be minimum 600 mm.
- 1.1.10 Testing for all types of valves
- 1.1.11 All valves shall be tested, hydraulically as per relevant standards. Body test and test shall be carried out and check for water tightness.
- 1.1.12 Materials certificate physical & chemical analysis certificates of all component of the valve shall be furnished to GWSSB.
- 1.1.13 Certified hydraulic test report for all body casting shall be furnished to GWSSB.

## **ITEM NO:02 Sluice Valves**

**Sluice Valve PN 1.6 IS:14846 (latest edition) Providing and supplying ISI mark CI D/F Sluice valve as per IS:14846 (latest edition) of following class and diameter including all taxes, insurance, transforamtion, freight charges octroi, inspection charges, loading-unloading conveynce to departmental store. stacking etc. complete. PN 1 with hand wheel/cap operated (PD type short body)**

- 1.3.1 Sluice valve shall conform to IS 14846 - 2000 relevant internationally recognized standards. Ends shall be flanged & drilled as per IS 1538.
- 1.3.2 They shall be of non rising spindle type. The valve shall be furnished with a bushing arrangement for replacement of packing without leakage. They shall also have renewable channel and shoe linings. The gap between the shoe and channel shall be limited to 1.5 mm.
- 1.3.3 The gate face rings shall be securely pegged over the full circumference.
- 1.3.4 Valve of 450 mm and above shall be provided with thrust bearing arrangement for ease of operation. Valve of diameter 400 mm and above shall be provided with enclosed gear arrangement for ease of operation. The operation gear of all valves shall be such that they can be opened and closed by one man against an unbalanced head 15 % in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 400 N.
- 1.3.5 All valves, spindles and hand wheels shall be positioned to give good access for operational personnel.
- 1.3.6 All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

**Specifications & M.O.C. of Sluice valve:**

<b>1</b>	<b>General</b>	
1.1	Type	Both end flanged hand wheel / Gear operated / Actuator Operated (As per price bid)
1.2	Rating of valves	As per Price Bid
1.3	Manufacturing Standard	IS 14846 - 2000
1.4	Sizes and quantity	As per price bid
<b>2</b>	<b>Materials of construction</b>	
2.1	Non rising Stem	High tensile brass as per IS or high tensile steel AISI - 410
2.2	Body / Bonnet / Wedge / Hand Wheel	CI - IS 210 FG 260
2.3	Stem Nut / Renewable body seat / wedge face ring	Bronze Grade IS: 318 LTB - 2
2.4	Stem packing (renewable valve open on stem)	Jute & Hemp as per IS : 5414
2.5	Bonnet Nuts	Carbon steel as per IS - 1367 CL 4.0
2.6	Bonnet Bolts	Carbon steel as per IS - 1363 CL 4.6
2.7	Bonnet Gasket	Rubber IS : 638 Type - B
2.8	Hydrostatic Test Pressure	
	Body	As per IS 14846
	Seat	As per IS 14846

**ITEM NO:-03 REFLUX Valve**

**Providing and supplying ISI mark CI D/F Reflux Valves as per IS:5312 (Latest Edition) of following class and diameter including all taxes, insurance, transportation, freight charges, octrol, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. including Lowering, laying and jointing in position following C. I. / D/F Reflux valves including cost of all labour, jointing material, including nut bolts and giving satisfactory hydraulic testing, etc. complete.**

- 1.4.1 The valve shall be suitable for mounting on a horizontal pipeline and flow direction shall be clearly embossed on the valve body.
- 1.4.2 Valves shall possess high speed closing characteristics and be designed for minimum slam condition when closing.
- 1.4.3 Dual plate check valves shall conform to API 594 and API 598. They shall have metal to metal sealing. The spring action shall optimize the equal closing rates of each plate especially when the friction coefficients are uneven due to one plate resting upon one another. The plates shall not drag on the seat while opening. The plates shall not vibrate under full or partial flow condition.

- 1.4.4 In case of the nozzle check valve, the disc shall be correctly positioned at all times to achieve fully non slam closure. The spring shall be fully shielded from the flow stream by the central flow diffuser.
- 1.4.5 Tilting disc non return valve shall incorporate a double offset shaft with a variable angle tilt disc configuration. Sealing shall be metal to metal. The disc shall be stable and shall not vibrate under full or partial load conditions.
- 1.4.6 Valve of diameter greater than 450 mm shall be provided, in addition to others, feet and jacking screws. Hinge pins / shaft shall preferably be square in section to ensure positive location of flaps and provide for secure fixing.

**Specifications & M.O.C.:**

<b>Sr. No.</b>	<b>General</b>	
1.1	Type	Both end flanged
1.2	Rating of valves	AS per Price Bid
1.3	Manufacturing Standard	API 594 / 598
1.4	Sizes and quantity	As per price bid
1.5	Maximum pressure drop at design flow rate (mwc)	0.5
1.6	Maximum permissible leakage rate (cc/hr/mm diameter)	7.0
<b>2</b>	<b>Materials of construction</b>	
(a)	Body	Cast Iron IS 210 Gr. FG 260
(b)	Door & Door Face	Cast Steel IS 2062 Gr. B A 216 GR WCB With 13% Cr. Steel overlay (On seating surface only)
(c)	Stop, hinge pin & washer	Stainless Steel AISI 431
(d)	Seat ring (Body)	EPDM Rubber
(e)	Bearings (Body & Plate lug)	PTFE
(f)	Seat ring (Body)	SS AISI - 410
(g)	Spring	Stainless Steel AISI 304
(h)	Hardware	Carbon Steel IS 1367 CL 4.6/4.0
(i)	End Cover	Mild Steel

**ITEM No:-04 EXPANSION BELLOWS**

**Expansion Bellow PN 1.6 Supply, installation, testing & commissioning of flange ends**  
**Expansion Bellow as per EJMA standards of overall length of minimum 300 mm,**  
**designed for 15 mm axial compression and 5 mm axial extension with tie rods etc. of**  
**following MOC & pressure ratings. MOC: Bellows: SA 240 Gr. 304; Internal Sleeve:**

**SA 240 Gr. 304; Weldends: IS 2062 Gr. B; Flanges: IS 2062 Gr. B (Drilling as per IS 1538/IS 6392) & Limit Rods & Nuts: CS-IS 1367.**

- The metallic single expansion bellows with all parts shall be manufactured as per EJMA standards. The rating of metallic expansion bellows is PN 1.0 as specified in data sheet & price bid. The bellow shall have both flanged ends of suitable thickness. Material of construction for bellow elements and all other parts are tabulated below. Bellow shall have minimum axial extension of 5 mm & minimum axial compression shall be 15 mm. It shall have adequate capacity to compress and expand within the limit mentioned in its entire life cycle of minimum 7000 cycles which shall be retained for the entire design period. The period shall have to be specifically mentioned by the bidders. Bellows shall have to be subjected to hydrostatic test at required pressure depending on pressure nomenclature for hold time of minimum 30 minutes.

**Materials of Construction:**

Sr. No.	Component	Material
(a)	Bellows / Collar / Internal sleeve	SS 240 GR 304
(b)	Limit Rods	CS IS :1367, CL-4.6
(c)	Nut & lock nut	CS IS :1367, CL-4.0
(d)	Lugs / Flanges / Weldend	IS: 2062 Gr. B

**ITEM No:-05 As per Item No:-01**

**ITEM NO:-06 Thrust Block**

**Thrust Block Supply at site, installation, testing and commissioning of lying reinforced cement cinctrete in foundation, thrust block/ piping support etc. with black trap crush metal as coarse aggregate for raft, grillage footing with necessary centering frame work consollidating as per directive in 1:2:4 ratio.**

RCC thrust blocks of adequate size and shape in required grade shall be provided on bend for anchorage as per design requirement to transmit the hydraulic thrust / force to the ground, spreading over a sufficient area, depending upon the type of soil met with.

Thrust blocks shall be provided for both horizontal and vertical bends wherever required in the pipeline to effectively transfer the hydrostatic thrust developed to the surrounding ground.

The Contractor has to submit his own design with steel reinforcement details and getting approved before executing the work.

The PCC shall be in M-15 grade. The minimum 70kg/Cum. Steel shall be provided for thrust block.

**Reinforcement**

All reinforcement steel shall be CRS FE-500 conforming to relevant I.S. for all RCC structure with conforming to IS. All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirt, dust, or any other substance that will destroy or reduce bond.

The rate shall be paid per cum. of completed work As per BOQ.

#### **ITEM No:-07 Butterfly Valve**

**Butterfly Valve PN 1.6 IS:13095 (latest edition) Providing and supplying ISI mark CI D/F Butterfly valve as per IS:13095 (latest edition) of following class and diameter including all taxes, insurance, transforamtion, freight charges octroi, inspection charges, loading-unloading conveynce to departmental store. stacking etc. complete.**

- 1.2.1 Resilient seated butterfly valve shall be as per IS 13095 – 1991 / BS 5155. Valve shall be suitable for mounting in any position.
- 1.2.2 The valve seat shall be of integrally cast or replaceable design. When the valve is fully closed, the seal shall seat firmly so as to prevent leakage. The seat surfaces shall be machined smooth to provide a long life for the seal.
- 1.2.3 All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve.
- 1.2.4 Valve shall be suitable for throttling purpose.
- 1.2.5 All valve, spindles and hand wheels shall be positioned to give good access for operational personnel.
- 1.2.6 Valve of diameter 450 mm and above shall be provided with enclosed gear arrangement for ease of operation. The operation gear shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 400 N.
- 1.2.7 All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

#### **Specifications & M.O.C. of Butterfly valve:**

<b>1</b>	<b>General</b>	
1.1	Type	Both end flanged hand wheel / Gear operated / Actuator Operated
1.2	Rating of valves	PN 1.6
1.3	Manufacturing Standard	IS 13095 / BS 5155
1.4	Sizes and quantity	As per price bid
<b>2</b>	<b>Materials of construction</b>	
2.1	Internal Hardware	Stainless Steel AISI - 304
2.2	Body/ Disc	CI. IS 210 FG 260
2.3	Body ring ( Retainer/seat)	Stainless steel AISI -304
2.4	Shaft	Stainless steel AISI-410
2.5	Disc seat	EPDM rubber/ Nitrile rubber

2.6	Bush & Thrust Pad	G.M. IS :318 LTB-2 / Teflon
2.7	Body seat	Stainless steel AISI -304

### **ITEM NO:-09 Valve Chambers and Manholes**

1. Inside size of chamber as per price bid.
2. Additional excavation required to be done shall be carried out as per instruction of Engineer-in-charge. For foundation chamber 15 cm. thick 1:3:6 PCC shall be provided and 23 cm. up to 1.5 m. depth and beyond 1.5 m. depth 35 cm thick BB masonry walls in CM 1:6 shall be constructed.
3. Second Class bricks of Standard size shall be brought by the Contractor & shall got approval before use in the work from the Engineer-in-charge.
4. 12 mm thick cement plaster in CM 1:3 shall be provided on inside and outside of walls up to 20 cm below from G.L. Cement pointing in CM 1:3 shall be provided for outside below G.L. from 20 cm.
5. 20 mm dia MS bar steps shall be provided and fixed in wall at 30 cm c/c for facilitating access into the chamber. First step should be at a depth of 0.5 m from top and last step should be 0.5 m above bottom.
6. Chamber shall be covered with 150 mm thick RCC 1:2:4 pre cast or cast in situ slab in four parts with key hole to insert key for operation.
7. Reinforcement for the cover slab shall be provided considering heavy traffic load.
8. Curing of concrete, BB masonry, RCC etc. shall be done using chemical or water for 14 days.
9. 12 mm dia MS bar handles minimum two nos. shall be provided to each piece of slab during the time of casting of slab.
10. Sides of chamber shall be refilled properly with selected excavated earth.
11. All the above items shall be carried out in workman like manner as per prevalent sound engineering practice and instruction of Engineer-in-charge.

Materials such as Cement, sand, coarse aggregate, bricks, reinforcement, water etc. to be used for this work shall be confirming to specification laid down in material section.

#### **1. Location**

Chamber shall be constructed at places approved by the Employer's Representative. Where valves are provided for maintenance of the pipeline.

#### **2. Excavation / P.C.C.**

Excavation, shoring, dewatering/ P.C.C. etc. for the pits of chambers, laying of pipes and fittings/specials shall be done in accordance with Employer's Requirements described elsewhere in the document.

#### **3. Bed Concrete**

The bed concrete 150 mm thick for chamber shall be done in C.C. 1:4:8 as directed by the Engineer-in-charge using trap metal of 25 mm to 40 mm.

#### **4. Bricks**

Bricks used for construction of manholes shall conform to the relevant Indian Standards. They shall be sound, hard, and homogeneous in texture, well burnt in kiln without being vitrified, table molded, deep red, cherry or copper coloured, of regular shape and size and shall have sharp and square and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing ungrounded particles, which absorb water more than 1/6th of their weight when soaked in water for twenty-four hours, shall be rejected. Over burnt or under burnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 50 kg/sq.cm. The class and quality requirements of bricks shall be as laid down in IS: 1077.

The size of the brick shall be 23.0 x 11.5 x 7.5 cm. unless otherwise specified; but tolerance up to 3 mm in each direction shall be permitted. Only full size brick shall be used for masonry work. Brick bats shall be used only with the permission of Employer's Representative to make up required wall length or for bonding. Sample bricks shall be submitted to the Employer's Representative for approval and bricks supplied shall conform to approved samples. If required by the Employer's Representative, brick sample shall be tested as per IS: 3495 by Contractor. Bricks rejected by the Employer's Representative shall be removed from the Site within 24 hours.

#### **5. Cement Mortar**

Mortar for masonry shall be as per IS: 2250. Chambers shall be constructed in brick masonry with cement mortar (1:6) unless otherwise specified. Gauge boxes for sand shall be of such dimensions that one bag containing 50 kg. of cement forms one unit. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be as approved by the Employer's Representative. If required by the Employer's Representative sand shall be thoroughly washed till it is free of any contamination.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry conditions. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall be used within 25 minutes of mixing. Mortar left unused in the specified period shall be rejected.

The Contractor shall arrange for tests on mortar samples if so required by Employer's Representative. Re-tempering of mortar shall not be permitted.

#### **6. Brick Masonry**



All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work of Chambers shall be in the proportion specified in drawing. Brick work 230 mm thick and over shall be laid in English Bond unless otherwise specified. 115 mm thick brick work shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Bricks shall be laid with frogs uppermost.

All brickwork shall be in plumb and square/ circular unless otherwise shown on drawing and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be leveled. The thickness of brick courses shall be kept uniform. For walls of thickness greater than 230 mm both faces shall be kept in vertical planes unless otherwise specified. All interconnected brickwork shall be carried out at nearly one level so that there is uniform distribution of pressure on the supporting structure and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 45 degrees. But in no case the level difference between adjoining walls shall exceed 1.25M. Workmanship shall conform to IS: 2212.

Brick shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 12 mm by raking tools daily during the progress of work when the mortar is still green, so as to provide a proper key for the plastering to be done. When plastering is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If mortar in the lower courses has begun to set, the joints shall be raked out to a depth of 12 mm before another course is laid.

## **7. Cement Plaster**

All joints in masonry shall be raked to a depth of 12 mm with hooked tool made for the purpose when the mortar is still green and in any case within 48 hours of its laying. The surface to be rendered shall be washed with fresh clean water free from all dirt, loose material, grease etc. and thoroughly wetted for 6 hours before plastering work is commenced. Concrete surfaces to be rendered will however be kept dry. The wall should not be too wet but only damp at the time of plastering. The damping shall be uniform to get uniform bond between the plaster and the wall.

The proportion of the cement mortar shall be as approved on relevant drawings. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as per relevant I.S. The mortar

thus mixed shall be used immediately and in no case shall the mortar be allowed to remain for more than 25 minutes after mixing with water.

Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days. Plastering shall be done on inner face of brick masonry in cement mortar (1:3) and 15 mm thick unless otherwise specified. Cement pointing in C: M (1:3) shall be done on outside the chamber including racking out joints, curing etc. complete as directed by the engineer-in-charge.

#### **8. Cement Concrete Block**

The C.C. blocks for the chamber shall be constructed in cement concrete of M15 grade to take care of weight of valves.

#### **9. Pipe Entering or Leaving Chamber**

Whenever a pipe enters or leaves a chamber, bricks on edge must be cut to a proper form and laid around the upper end of the pipe so as to form an arch. All around the pipes, there shall be a joint of cement mortar (1:2) 13 mm thick between it and the bricks.

#### **10. Precast Reinforced Cement Concrete Slab with key holes**

Precast Reinforced cement concrete top slab shall be casted in pieces for covering the chamber. Necessary keyholes shall be provided at appropriate place for operation of spindle of valve. The minimum thickness of slab shall be 100mm and same shall be casted in C.C. of M20 grade. The required reinforcement shall be provided. The top & bottom surface of precast slab shall be finished with cement mortar 1:3.

#### **11. Measurement and Payment**

-As per payment schedule.

#### **12. Extra depth of valve chamber. beyond 1.00 mt. depth.**

The work shall be measured and paid for additional meter depth of chamber beyond 1.0 m depth. The work in general shall be carried out as per instructions & approval of engineer in charge.

## **ITEM NO:10 Excavation Work ( Earth Work)**

### **Applicable Codes**

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

IS 3764 - 1992	Excavation work - Code of Safety.
IS 2720	Methods of test for soils:
(Part-1) - 1983	Part 1 Preparation of dry soil samples for various tests.
(Part-2) - 1986	Part 2 Determination of Water Content.
(Part-4) - 1985	Part 4 Grain size analysis.
(Part-5) - 1985	Part 5 Determination of liquid and plastic limit.
(Part-7)	Part 7 Determination of water content - dry density relation using light compaction.
(Part-9)	Part 9 Determination of dry density - moisture by constant weight of soil method.
(Part-14) –1983	Part 14 Determination of density index (relative density) of cohesion less soils.
(Part-22) –1978	Part 22 Determination of organic matter.
(Part-26) –1987	Part 26 Determination of pH Value.
(Part-27) –1987	Part 27 Determination of total soluble sulphates.
(Part-28) –1974	Part 28 Determination of dry density of soils in place by the sand replacement method.
(Part-33) –1971	Part 33 Determination of the density in place by the ring and water replacement method.
(Part-34) –1972	Part 34 Determination of density of soil in place by rubber balloon method.
(Part-38) –1976	Part 38 Compaction control test (Hilf Method ).

### **General:**

The Contractor shall furnish all tools, plant, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the work in accordance with the Employer's Requirements.

The Contractor shall survey the site before excavation and set out all lines and establish levels for various works such as grading, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/grid lines at 8m intervals or nearer, if necessary, based on ground profile and thereafter properly recorded.

The excavation shall be carried out to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night.

Excavated material shall be dumped in regular heaps, bunds, riprap with regular slopes within the lead specified and leveling the same so as to provide natural drainage. Rock/soil & murrum excavated shall be stacked properly as approved by the Employer's Representative. As a rule, all softer material shall be laid along the center of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately. Top soil shall be stock piled separately for later re- use.

**Clearing:**

The area to be excavated / filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are encountered during excavation, they shall also be removed. The material so removed shall be disposed off as approved by the Employer's Representative. Where earth fill is intended, the area shall be stripped of all loose/ soft patches, top soil containing objectionable matter/ materials before fill commences.

**Excavation:**

All excavation work shall be carried out by mechanical equipment unless, in the opinion of Employer's Representative, the work involved requires it to be carried out by manual methods. Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on the drawings provided by the Contractor or such other lines and grades as may be agreed with the Employer's Representative. Rough excavation shall be carried out to a depth of 150mm above the final level. The balance shall be excavated with special care.

Soft pockets shall be removed below the final level and extra excavation filled up with lean concrete as approved by the Employer's Representative. The final excavation should be carried out just prior to laying the blinding course.

To facilitate the permanent works the Contractor may excavate, and also backfill later, outside the lines shown on the drawings provided by the Contractor as agreed with the Employer's Representative. Should any excavation be taken below the specified elevations, the Contractor shall fill it up with concrete of the same class as in the foundation resting thereon, up to the required elevation at no cost to the Employer.

All excavations shall be to the minimum dimensions required for safety and ease of working. Prior approval of the Employer's Representative shall be obtained by the Contractor in each individual case, for the method proposed for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval shall not in any way relieve the Contractor of his responsibility for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope.

**Rock:****General:**

'Rock' means a natural aggregate of mineral crystals, which for its excavation would normally require the use of heavy pneumatic/hydraulic breaker and/or cutting equipment or explosives. The term shall exclude any material that can be removed by ordinary excavating machinery and which in any individual mass has a volume not exceeding 1m<sup>3</sup> or 0.25m<sup>3</sup> where the net width of excavation is less than 2 m. Ordinary excavating machinery means a hydraulic back hoe with rated output of 50 kW or less.

Before classification of material as rock the Contractor shall demonstrate to the satisfaction of the Employer's Representative his inability to excavate it without resort to heavy percussion tools complete with rock bits, hydraulic wedges or blasting. Excavation by the use of explosive will not normally be permitted except for pipeline.

Material shall not be classified as rock unless the Employer's Representative has agreed to such classification on the basis of such a demonstration before its excavation. Excavations where rock has been encountered and classified as such shall not be backfilled before examination of the excavated faces by the Employer's Representative to enable the extent of the rock excavation to be determined.

**Excavation by the Use of Explosives**

Unless otherwise stated herein, I.S. Specification "IS: 4081: Safety Code for Blasting and related Drilling Operations" shall be followed. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions shall be taken to preserve the rock below and beyond the lines specified for the excavation, in the soundest possible condition. The quantity and strength of explosives used shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by Employer's Representative, shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structures as a result of blasting operations. In case of damage to permanent or temporary structures, Contractor shall repair the same to the satisfaction of Employer's Representative at his cost. As excavation approaches its final lines and levels, the depth of the charge holes and number of explosives used shall be progressively and suitably reduced.

The contractor shall obtain a valid Blasting License from the authorities concerned. No explosive shall be brought near the work in excess of quantity required for a particular amount of firing to be done; and surplus left after filling the holes shall be removed to the magazine. The magazine shall be built as far possible from the area to be blasted. Employer's Representative's prior approval shall be taken for the location proposed for the magazine.

In no case shall blasting be allowed closer than 30 meters to any structure or to locations where concrete has just been placed. In the latter case the concrete must be at least 7 days old.

For blasting operations, the following points shall be observed.

- i) Contractor shall employ a competent and experienced supervisor and licensed blaster in-charge of each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out.
- ii) Before any blasting is carried out, Contractor shall intimate Employer's representative and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.
- iii) Contractor shall ensure that all workmen and the personnel at site are excluded from an area within 200 m radius from the firing point, at least 15 minutes before firing time by sounding warning whistle. The area shall also be given a warning by sounding a distinguishing whistle.
- iv) The blasting of rock near any existing buildings, equipment or any other property shall be done under cover and Contractor has to make all such necessary muffling arrangements. Covering may preferably be done by MS plates with adequate dead weight over them. Blasting shall be done with small charges only and where directed by Employer's Representative; a trench shall have to be cut by chiseling prior to the blasting operation, separating the area under blasting from the existing structures.
- v) The firing shall be supervised by a Supervisor and not more than 6 (six) holes at a time shall be set off successively. If the blasts do not tally with the number fired, the misfired holes shall be carefully located after half an hour and when located, shall be exploded by drilling a fresh hole along the misfired hole (but not nearer than 600 mm from it) and by exploding a new charge.
- vi) A wooden tamping rod with a flat end shall be used to push cartridges home and metal rod or hammer shall not be permitted. The charges shall be placed firmly into place and not rammed or pounded. After a hole is filled to the required depth, the balance of the hole shall be filled with stemming, which may consist of sand or stone dust or similar inert material.
- vii) Contractor shall preferably detonate the explosives electrically.
- viii) explosives shall be exploded by means of a primer, which shall be fired by detonating a fuse instantaneous detonator (F.I.D) or other approved cables. The detonators with F.I.D. shall be connected by special nippers.
- ix) In dry weather and normal dry excavation, ordinary low explosive gunpowder may be used. In damp rock, high explosive like gelatin with detonator and fuse wire may be used. Underwater or for excavation in rock with substantial accumulated seepage electric detonation shall be used.

- x) Holes for charging explosives shall be drilled with pneumatic drills, the drilling pattern being so planned that rock pieces after blasting will be suitable for handling without secondary blasting.
- xi) When excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level.
- xii) Any rock excavation beyond an over break limit of 75 mm shall be filled up as instructed by Employer's Representative, with concrete of strength not less than M10. Stopping in rock excavation shall be done by hand trimming.
- xiii) Contractor shall be responsible for any accident to workmen, public or Employer's property due to blasting operations. Contractor shall also be responsible for strict observance of rules, laid by Inspector of explosives, or any other Authority duly constituted under the State and / or Union Government as applicable at the place of excavation.

#### **Stripping Loose Rock:**

All loose boulders, detached rocks partially and other loose material which might move therewith not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of Employer's Representative, to fall or otherwise endanger the workmen, equipment, or the work shall be stripped off and removed from the area of the excavation. The method used shall be such as not to render unstable or unsafe the portion, which was originally sound and safe.

Any material not requiring removal in order to complete the permanent works, but which, in the opinion of Employer's Representative, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed.

#### **Classification of Strata:**

The decision regarding, classification of strata shall rest with the Engineer in charge and his decision shall be final and binding to the contractor.

All the materials encountered in the excavation shall be classified as under: -

#### **ORDINARY SOIL AND SOFT MURRUM:**

These will include all materials of an earthy or sandy nature, which can be easily ploughed or small shingle, and gravel, which can be easily removed.

#### **HARD MURRUM:**

This shall include all kinds of disintegrated rock or shale or inundated clay which can be removed with a shovel without difficulty and which do not require blasting.

**SOFT ROCK:**

This shall include all materials which is rock or hard conglomerate, all decomposed and whether rock, highly fissured rock old masonry and also soft rock boulders bigger than 1/2 cubic meter and other varieties of rock. Which do not require blasting and which can be removed with the pie crowbars wedges and hammer.

**HARD ROCK:**

This shall include rocks, occurring in masses, which could best be removed by chiseling or by blasting.

**Fill, Backfilling and Site Grading:****General:**

All fill material shall be subject to the Employer's Representative's approval. If any material is rejected by Employer's Representative, the Contractor shall remove the same forthwith from the site. Surplus fill material shall be deposited/disposed off as directed by Employer's Representative after the fill work is completed.

No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with to the approval of the Employer's Representative.

**Material:**

To the extent available, selected surplus spoil from excavations shall be used as backfill. Backfill material shall be free from lumps, organic or other foreign material. All lumps of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murrum or earth to fill the voids and the mixture used for filling.

If fill material is required to be imported, the Contractor shall decide to bring such material from outside borrow pits. The material and source shall be subject to the prior approval of the Employer's Representative. The approved borrow pit areas shall be cleared of all bushes, roots of trees, plants, rubbish, etc. Topsoil containing foreign material shall be removed. The materials so removed shall be disposed of as directed by Employer's Representative. The Contractor shall provide the necessary access roads to borrow areas and maintain the same if such roads do not exist.

Filling in pits and trenches around foundations of structures, walls, etc.

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches, etc., shall be cleared of all debris, and filled with earth in layers not exceeding 15 cm, each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Employer's Representative. Earth shall be ramming with approved mechanical compaction



machines. Usually no manual compaction shall be allowed unless the Employer's Representative is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and leveled to a proper profile to the approval of the Employer's Representative.

**Plinth Filling:**

Plinth filling shall be carried out with approved material as described hereinbefore in layers not exceeding 15cm, watered and compacted with mechanical compaction machines. The Employer's Representative may, however, permit manual compaction by hand tampers where he is satisfied that mechanical compaction is not possible. The finished level of the filling shall be trimmed to the level/slope specified.

The thickness of each unconsolidated fill layer can in this case be up to a maximum of 300mm. The Contractor will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used and the approval of the Employer's Representative obtained prior to commencing filling.

The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated, then filled and consolidated.

**Sand Filling in Plinth and Other Places:**

Where backfilling is required to be carried out with local sand it shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Employer's Representative has inspected and approved the fill.

**Filling in Trenches:**

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipe and drains have been tested and passed. The backfilling material shall be properly consolidated taking due care so that no damage is caused to the pipes.

Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the center line of the pipe shall be done by hand compaction with selected approved earth in layers not exceeding 8 cm; backfilling above the level of the center line of the pipes shall be done with selected earth by hand compaction, or other approved means in layers not exceeding 15 cm.

In case of excavation of trenches in rock, the filling up to a level 30 cm above the top of the pipe shall be done with fine materials such as earth, murrum, etc. The filling up to the level of the centerline of the pipe shall be done by hand compaction in layers not exceeding 8 cm whereas the filling above the centerline of the pipe shall be done by hand compaction or approved means in layers not exceeding 15 cm. The filling from a level 30 cm above the top

of the pipe to the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 15 cm mixed with fine material as available to fill up the voids.

Filling of the trenches shall be carried out simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

#### **General Site Grading:**

Site grading shall be carried out as indicated in the drawings and as approved by the Employer's Representative. Excavation shall be carried out as specified in the Employer's Requirements. Filling and compaction shall be carried out as specified under Clause 2.7 and elsewhere unless otherwise indicated below.

If no compaction is called for, the fill may be deposited to the full height in one operation and leveled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and leveled uniformly and compacted as indicated in Clause 2.7 before the next layer is deposited.

To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the Contractor.

Field compaction tests shall be carried out in each layer of filling until the fill to the entire height has been completed. This shall hold good for embankments as well. The fill will be considered as incomplete if the desired compaction has not been obtained.

The Contractor shall protect the earth fill from being washed away by rain or damaged in any other way, the Contractor shall remove the affected material and make good.

If so specified, the rock as obtained from excavation may be used for filling and leveling to indicate grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12-ton roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.

#### **Fill Density:**

The compaction, under the plant road area and building plinths shall comply with minimum 95% compaction by Standard Proctor at moisture content differing not more than 4% from the optimum moisture content. The Contractor shall demonstrate adequately by field and laboratory tests that the specified density has been obtained. In other areas the soil should be backfilled and compacted suitably as specified by the Engineer.

#### **Timber Shoring:**

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 25 cm x 4 cm sections or as approved by the Employer's Representative. The boards shall generally be placed in position vertically side by side without any gap on each side of the excavation and shall be secured by horizontal walling of strong wood at maximum 1.2 meter spacing, strutted with bullies or as approved by the Employer's Representative. The length of the bully struts shall depend on the width of the trench or pit. If the soil is very soft and loose, the boards shall be placed horizontally against each side of the excavation and supported by vertical walling, which in turn shall be suitably strutted. The lowest boards supporting the sides shall be taken into the ground and no portion of the vertical side of the trench or pit shall remain exposed, so as to render the earth liable to slip out.

Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. The type of timbering shall be as approved by the Employer's Representative. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of excavations, trenches, pits, etc. from collapsing.

Timber shoring may also be required to keep the sides of excavations vertical to ensure safety of adjoining structures or to limit the slope of excavations, or due to space restrictions or for other reasons. Such shoring shall be carried out, except in an emergency, only under instructions from the Employer's Representative.

The withdrawal of the timber shall be done carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded with, systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber.

In the case of open timbering, the entire surface of the side of trench or pit is not required to be covered. The vertical boards of minimum 25 cm x 4 cm sections shall be spaced sufficiently apart to leave unsupported strips of maximum 50 cm average width. The detailed arrangement, sizes of the timber and the spacing shall be subject to the approval of the Employer's Representative. In all other respects, the Employer's Requirements for close timbering shall apply to open timbering.

In case of large pits and open excavations, where shoring is required for securing safety of adjoining structures or for any other reasons and where the planking across sides of excavations/pits cannot be strutted against, suitable inclined struts supported on the excavated bed shall be provided. The load from such struts shall be suitably distributed on the bed to ensure no yielding of the strut.

#### **Dewatering:**

The Contractor shall ensure that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rain water so as to enable the works to be carried out in reasonably dry conditions in accordance

with the construction planning. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. The method of pumping shall be approved by Employer's Representative, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least (7) seven days after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Employer's Representative to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved by the Employer's Representative. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a buildup of water in the opinion of the Employer's Representative obstructs the progress of the work, leads to unsanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

When there is a continuous inflow of water and the quantum of water to be handled is considered in the opinion of Employer's Representative, to be large, a well point system-single stage or multistage, shall be adopted. The Contractor shall submit to the Employer's Representative, details of his well point system including the stages, the spacing, number and diameter of well points, headers etc., and the number, capacity and location of pumps for approval.

#### **Rain Water Drainage:**

Grading in the vicinity of excavation shall be such as to exclude rain/ surface water draining into excavated areas. Excavation shall be kept clean of rain and such water as the Contractor may be using for his work by suitably pumping out the same. The scheme for pumping and discharge of such water shall be approved by the Employer's Representative.

## **ITEM:-11 Drain (Dewatering) Pump Set:**

Drain (horizontal mono dewatering submersible) pump set shall be as per IS: 14220 / 1994 with latest amendments. The standard specifies the technical requirement for three phase mono submersible pump sets commonly used in sump for handling clear cold water for application in water supply etc. The duty point of the set should be located at the optimum efficiency point of the pump rating curves and there should not be steep fall in efficiency in the operating range. The pump with single stage and RPM of shall be 2900 operating on  $415 \pm 10$  % volts, 3 phase & 50 Hz frequency.

Minimum motor horse power rating, cable size, starting system and delivery size shall be as specified in the data sheet.

Features of construction shall be as follows.

### **Pump:**

The pump casing should be free from blow holes, sludge inclusion and other detrimental defects. Casing should be provided with renewable wearing rings except in radial flow pump set. Casing should be provided with wearing rings. Casing should be hydraulically tested up to 1.5 times shut off pressure. Shut off head shall be at least 105 % of maximum head range.

### **Impeller:**

Impeller should be of closed type, ensuring required performance and free of cavitations. The material of impeller will be as per spec shown in data sheet.

### **Shaft:**

The pump & motor shall be unbuilt on common shaft. Below the impeller shaft assembly, shaft protection sleeve shall be provided. It shall have surface finishing of 0.75 Microns. The material of shaft shall be as per Annexure - III.

### **Motor:**

The submersible motor shall conform to IS: 9283 / 1994 with latest revision. It should be totally enclosed squirrel cage induction type water cooled and water lubricated sealed against entry from outside water.

The windings shall be of wet type. The thrust bearing should be of wet type water lubricated and designed to take all untoward load at most unfavorable running conditions. Front and rear bearing housing and thrust bearing housing should preferably be fixed separate replaceable bolts / studs and (not threaded connections) to the starter to facilitate easy dismantling. Full proof sealing arrangement by sand guard shall be preferred in the motor inlet body to prevent open well water impurities like sand, silt from entering the motor bearing stator and motor should be impregnated with a superior varnish class B thermal insulation properties by vacuum pressure or epoxy paints on stator cold rolled stamping used and rotor shall be painted with Polyurethane paint & backed properly under controlled temperature condition and not by manual or gravity flow to remove air pocket so that these are thoroughly filled up by varnish. Motor rotor should be preferably lead

shot blasted. Subsequently rotor body should be baked repeatedly under controlled conditions to ensure long life of paint and hard finish to the surface to avoid corrosion before power coating.

The material of construction of rotor shaft shall be as specified in data sheet and provided with sleeves having materials as per detailed material of construction in the bearing portion. The windings should be accessible to facilitate checking and locating any faults without disturbing all the coils and also to enable replacement of any defective coils. It should be possible to rewind the Stator with readymade protested coils in order to save time during the repair. Kelvin Bridge / digital resistance meter shall be treated preferable for measurement of hot and cold resistance of winding for evaluated temperature rise. Full proof arrangement should be made for stopping the rotating of shifting of stampings inside the stator body due to operation of pump sets. Earth leakage current should not be more than 50 milli amperes at rated voltage.

The HP rating of motor shall be decided on minimum power margin over and above the power required on duty point shall be 25 % and bidder has to supply motor of minimum HP rating considering 25 % reserve power margin.

Starting method shall be direct on line.

**Cable:**

Motor shall be provided with three core flat PVC water proof and flexible copper submersible cable in single length and of suitable size as per actual requirement. The cross sectional areas should be sufficient so as not to cause voltage drop of more than 2.5 % of nominal voltage i.e. 10 volts at 400 volts throughout the length of the cable size of the

Following points shall be applicable for the manufacture of the pump set:

- (1) Casing individually tested to hydraulic test pressure 1.5 times of shut off pressure.
- (2) All rotating parts should be individually balanced on machine for rated RPM according to the relevant IS (and vibrations of the assembly during the testing shall not exceed to 80 micron peak to peak).
- (3) Impeller closed type
- (4) Motor Wet type
- (5) Brass / Carbon steel drain plug provided.
- (6) Compensating device provided
- (7) Stator varnished by vacuum pressure method or EPOXY painted (if cold rolled stamping used).
- (8) Rotor varnished by vacuum pressure method or Epoxy Paint methane paint duty properly backed.
- (9) Rotor painted and baked under controlled condition or powder coated.
- (10) Winding easily assembled.
- (11) Winding subjected to 1.5 KV for 30 seconds
- (12) Matching grooves for stopping from rotation and shifting

- (13) SS / Brass suction strainer preferred.
- (14) Stud and nuts shall be of alloy steel and nut shall be Nyloc Nut.
- (15) Stator end ring shall be of bronze metal or M S.
- (16) Stator is rewind able with readymade protested coils in each type of motor offered
- (17) Cable confirming to IS: 694.

**Testing and performance As Per IS: 14220 with latest revision:**

Pump shall be tested as per IS: 14220 and motor shall be tested as per IS: 9283 at manufacturers works. Bidder shall have to give internal test report.

**Materials Of Construction**

Sr. No.	Description	Material (s)
1	Shaft sleeve when used	Grade X04 Cr. 12, X12 Cr 12 or X 20 Cr 13 Conforming to IS: 1570 (part-5) 1985
2	Motor bearing housing and base	Grade FG 200 of IS: 210/1993
3	Pump & Motor Shaft (Common)	Grade X04 Cr 12, X12 Cr 12 or X20 Cr 13 Conforming to IS: 1570 (Part-5) 1985 or Grade 40C8 or 45C8 Conforming to IS: 1570 (Part-2/ Sec.1) 1979
4	Bearing Bush	Leaded tin bronze Grade LTB3, LTB4 or LTB5 of IS: 318 / 1981 or resin bonded carbon or PTFE bonded carbon
5	Rotor	Electrical sheet steel and electro grade copper rods conforming to IS: 613 / 1984 or Aluminum dia cast rotor conforming to IS: 617 / 1984
6	Stator Core	Electrical sheet steel and PVC insulated winding wire/polymer insulated winding wires or with any suitable plastic covered wires conforming to IS: 8783 / 1978
7	Winding Wire	i ) For motors other than water filled motor: Enameled copper conductor conforming to IS: 4800 ( Part-7) 1970 ii ) For water filled motors: (a) Enameled copper conductor to IS: 4800 (Part-7) /1970 or (b) PVC insulated winding wire conforming to IS :8783 / 1978 or (c) With polymer insulated such that the test on

		insulated resistance satisfied
8	Breather and diaphragm	Nitrile rubber
9	Cable	PVC insulated and PVC sheathed 3 core flat type conforming to IS: 694/1990 or PVC insulated polymer sheathed 3 core flat type
10	Cable Gland	Nitrile rubber
11	Thrust Bearing face combinations	Bronze- ferrobestos, Brass - Ferro tests, Carbon - Stainless steel, Bronze suitable elastomer or any other suitable combinations
12	Water drain plug	Bronze / Brass / Stainless steel / Suitable Plastic
13	Impeller	High tensile brass conforming to IS: 304 / 1981 or leaded tin Bronze LTB 2 of IS: 31 8/ 1981
14	Casing	Cast iron Grade FG 200 of IS: 210 / 1993, Alloy steel casing conforming to IS: 3444/1987
15	Sand Guard	Bronze Or S.S.



## **INSTALLATION, TESTING AND COMMISSIONING**

### **1. Erection - General**

- 1.1. The Contractor's staff shall include adequate and competent erection engineers with proven, suitable, previous experience on similar contracts to supervise the erection of the works and sufficient skilled, semi-skilled and unskilled labour to ensure completion of works in time. The contractor shall not remove any representative, erector or skilled labour from the site without prior approval of the Engineer in charge (EIC) or Engineer in charge's representative.
- 1.2. The Contractor shall ensure that no installation or erection work shall commence until full and unconditionally approved working drawings, signed and stamped by the EIC are available at site.
- 1.3. The Contractor's erection staff shall arrive on the site on dates to be agreed by the EIC. Before they proceed to the site, however, the contractor shall first satisfy himself, as necessary, that sufficient plant of his (or his sub contractor's) supply has arrived on site so that there will be no delay on this account.
- 1.4. One erection engineer who shall be required to be the contractor's representative shall be conversant with the erection and commissioning of the complete works. Should there be more than one erector, one shall be in charge and the contractor shall inform the EIC in writing which erector is designated as his representative and is in charge. Erection engineer is to report to project manager.
- 1.5. The Contractor shall be responsible for setting up and erecting the plant to the line and levels of reference and of the positions, levels dimensions and alignment, appliances and labour in connection therewith. The checking of setting out of any line or level by the EIC or EIC's representative shall not in any way relieve the contractor of his responsibility for the correctness thereof.
- 1.6. Erection of plant shall be phased in such a manner so as not to obstruct the work being done by other contractors or operating staff who may be present at the time. Before commencing any erection work, the contractor shall check the dimension of structures where the various items of Plants are to be installed and shall bring any deviations from the required position, lines or dimensions to the notice of the EIC. Plant shall be erected in a neat and workmanlike manner on the foundations and at the locations shown on the approved drawings. Unless otherwise directed by the EIC, the contractor shall adhere strictly to the aforesaid approved drawings. If any damage is caused by the contractor during the course of erection to new or existing plant or buildings or any part thereof, the contractor shall, at no additional cost to the Employer, make good, repair or replace the damage, promptly and effectively as directed by the EIC and to the EIC's satisfaction.
- 1.7 Erection of plant shall be phased in such a manner so as not to obstruct the work being done by other contractors or operating staff who may be present at the time. Before commencing any erection work, the contractor shall check the dimension of structures where the various items of Plants are to be installed and shall bring any deviations from the required position, lines or dimensions to the notice of the EIC. Plant shall be erected in a neat and workmanlike manner on

the foundations and at the locations shown on the approved drawings. Unless otherwise directed by the EIC, the contractor shall adhere strictly to the aforesaid approved drawings. If any damage is caused by the contractor during the course of erection to new or existing plant or buildings or any part thereof, the contractor shall, at no additional cost to the Employer, make good, repair or replace the damage, promptly and effectively as directed by the EIC and to the EIC's satisfaction.

- 1.8. The contractor shall align all equipment and holding down bolts and shall inform the Employer before proceeding with grouting in the items concerned. The contractor shall ensure that all equipment is securely held and remains in correct alignment before, during and after grouting in.
- 1.9. The approval by the Employer of the contractor's proposals for rigging and hoisting any items of the plant into final positions shall not relieve the contractor from his responsibility for damage to completed structures, parts or members thereof or other installed equipment. He shall at his own cost make good, repair or replace any damaged or injured items, whether structural, electrical, architectural, or of any other description, promptly and effectively to the satisfaction of the Employer.
- 1.10. No plants or other loads shall be moved across the floors of structures without first covering the floors with timber of sufficient size so that applied loads will be transferred to floor beams and girders of steel or concrete. If it is required to reduce bending stresses and deflection, the beams and girders shall be provided with temporary supports.
- 1.11. During erection of the plant the EIC will inspect the installation from time to time in the presence of the contractor's site representative to establish conformity with the requirements of the specifications. Any deviations and deficiencies found or evidence of unsatisfactory workmanship shall be corrected as instructed by the EIC.

## 2. Leveling and Grouting of Machinery

- 2.1. He shall undertake sufficiently in advance chipping of any unevenness of concrete on foundations, anchor bolt pockets, cutouts etc. to achieve uniform level of reference for erection. All concrete surfaces receiving grout shall be hacked as required to ensure better bonding with grouting.
- 2.2. Contractor shall undertake the inspection of all components to be erected sufficiently in advance to check their soundness and conformity to drawings and the inspection records shall be signed by the Engineer as approval for undertaking the installation of the components. Any damage, shortfalls etc. shall be made good to the satisfaction of the EIC.
- 2.3. All grout for equipment shall be carried out using non shrinkable continuous grout materials with suitable frame work of at least 12 mm thickness. Surfaces to receive the grout shall be hacked and roughened and laitance shall be removed by wire brushing or blast of air. Concrete surface shall be blown off by compressed air before commencing grouting. Grouting shall be done in one continuous operation from one side such that grout flows in a single wave until grout reaches all confined spaces with no air pockets and air from all confined spaces is expelled. A hydro static head of 150 mm shall be maintained during grouting operations. All grouting shall be carried out

in the presence of the EIC's representative. All lines and levels shall be checked up after grout is set. Block outs shall be closed using cement concrete of the same grade as that of the parent structure.

### **3. Records, Procedures and Reports**

3.1. The Contractor shall maintain records pertaining to the quality of installation / erection work and inspection, testing, compliance with all technical requirements in respect of all his works as described in the previous paragraphs. The reporting formats shall be in the approved formats. The contractor shall submit such records to the Engineer after the completion of any particular work before submitting the bill of supply / progress of work. Such report shall comprise shop inspection reports, shop testing reports, material test reports, based on which dispatch clearances are provided, all the quality control reports of welding, erection and alignment records.

3.2. All the above mentioned records shall be submitted in the final form duly countersigned by the EIC's representative attesting conformity to specifications and his approval of installation, and duly incorporating all the additions, alternations, and information as required by the EIC on the basis of preliminary reports giving the progress of the work. Such records notwithstanding, any records submitted earlier with bill of supply / progress etc. shall be duly bound and submitted to the EIC in six copies by the contractor on his notification of the mechanical completion of erection.

### **4. General Preparations before Completion of the Plant**

4.1. The following documents should be completed in accordance with the contract schedule before completion of erection. The Employer and the contractor shall preserve and control these documents in a safe and appropriate place on Site in order the both parties personnel can make use of them at any time.

#### **4.1.1. Technical Documents**

- a) Operation and Maintenance manual
- b) Design documents including the contractor's design data, drawings and specifications.
- c) Tools and test equipment list
- d) Spare parts list
- e) Lubricant list

#### **4.1.2. Procedures**

- a) Mechanical testing procedure
- b) Electrical testing procedure
- c) Instrumentation testing procedure

d) Detailed Pre commissioning and commissioning procedure

e) Detailed Performance Test procedure

#### 4.1.3. General and Coordination Documents.

a) Detailed organisation charts for pre commissioning and commissioning showing lines of authorities and responsibility and functions of all key personnel.

b) The job description of the members of the team.

c) The scheduled dates of assignment of each member to pre commissioning and commissioning Organisation.

d) A detailed schedule showing the time sequence which the contractor anticipates to follow for the various steps in completion of erection, pre commissioning and commissioning of each unit and equipment.

e) The regulations for safety, hygiene and discipline.

f) The practical organisation of the relationship (meetings, reports, etc.) between the contractor and the Employer at the phases of pre commissioning and commissioning.

g) Emergency communication route.

#### 4.2. Manpower

4.2.1. Required manpower shall be provided as agreed between the contractor and the Employer in a manpower mobilisation plan which shall include the number and qualifications of the operator and maintenance personnel to be furnished by the Employer for the plant.

### 5. Completion of Erection

5.1. The completion of plant under erection by the contractor shall be deemed to occur, if all the units of the plant are structurally and mechanically complete and will include among other such responsibilities the following:

5.1.1. Plant in the scope of the contract has been erected, installed and grouted as per specifications.

5.1.2. Installation checks are completed and approved by the EIC.

5.1.3. The erected plants are totally ready for commissioning checks.

5.2. At the stage of completion of erection, the contractor shall ensure that all the physical, aesthetic and workmanship aspects are totally complete and the Plant is fit and sound to undergo tests on completion and subsequent pre commissioning checks.

5.3. Upon achieving the completion as described above the contractor shall notify the EIC by a written notice intimating completion of erection and notify the EIC for inspection. The EIC / EIC's representative shall proceed with the inspection of such units within 14 days of such a notice.

- 5.3.1. The EIC shall certify completion when there are no defaults in the works or
- 5.3.2. The EIC shall inform the contractor list of deficiencies for rectification hereinafter referred as Punch list and the contractor shall complete the rectification work within a jointly agreed period before pre commissioning activities and obtain the EIC's acceptance or approval of the same before proceeding with the same.
- 5.3.3. The EIC may inform the contractor that the works are accepted with the 'Punch' list (items which do not hamper operability, safety or maintainability) and allow the Contractors to proceed with the pre commissioning checks when the contractor undertakes to complete such outstanding works within an agreed time during defects liability period. Taking over shall be based on rectification of all deficiencies as advised by Punch lists.
- 5.4. The erection period indicated by the contractor would be deemed to cover all the activities up to completion as stipulated in previous paragraphs, notice of completion by the contractor, inspection by the EIC for completion and contractor rectification of all deficiencies as noticed by the deficiency / Punch list, and acceptance by the EIC of such rectification's prior to tests on completion.
- 5.5. Minor defects, which in the opinion of EIC which do not hamper operability and maintainability will not be taken into account for deciding mechanical completion. Such defects shall be rectified concurrent to commissioning checks before tests on completion. However, the EIC's decision in this regard is final.
- 5.6. The commissioning period as notified by the contractor shall be deemed to occur beyond the date of completion and shall include all periods of pre commissioning, trials and tests on completion.
- 5.7. It is in the contractor's interest to offer the sections / units / systems progressively under identified milestones within overall erection period, duly completed for rectification of any deficiencies pointed out by the Engineer and to achieve mechanical completion before undertaking the tests on completion within the specified erection period. The EIC also reserves the right to withhold the cost as estimated to be equivalent to the rectification of deficiencies pointed out to the Contractor until such a time such deficiencies are rectified to the satisfaction of the EIC.

## **6. Pre commissioning**

- 6.1. After the completion of erection, pre commissioning activities listed below shall be carried out to make the plant ready for commissioning. All instruments, materials and provisions necessary for conducting site tests shall be provided by the contractor at his own cost.
- 6.2. Upon completion of erection of each piece of equipment, facility or discrete part of the plant, mechanical checks and tests shall be carried out according to the contractor's check list. The mechanical checks and tests shall be to establish that:

- 6.2.1. The Plant is erected in accordance with the contractor's construction drawings, pipe work drawings, instrument diagrams, etc. issued for the plant.
- 6.2.2. The materials are installed and mechanically function in accordance with the contract and
- 6.2.3. Applicable codes as listed in the contract are followed for materials and workmanship.
- 6.3. Items such as painting, thermal insulation and final clean up which do not materially affect the operation or safety of the Plant will be excluded. All these items shall be listed and completed after pre commissioning or commissioning at the discretion of the contractor but before acceptance.
- 6.4. The contractor shall prepare and maintain at site test forms and records which shall include:
  - 6.4.1. Description of type of test or check
  - 6.4.2. Date and times of test or check
  - 6.4.3. Identification of equipment and facilities
  - 6.4.4. Test pressure, test data and results, including remarks, if any
  - 6.4.5. Signature of the contractor's personnel attesting to data recorded, if any, checks, tests and records thereof shall be carried out by the contractors' construction forces.
- 6.5. Wherever the Employer's witness or attesting of the check or test is required, the Employer's personnel shall attend such check and test. For this purpose, the contractor shall keep the Employer informed of a day to day test plan schedule. The test plan schedule may be revised from time to time to reflect the actual progress of the work and test.
- 6.6. Any items found incomplete or requiring repair or adjustment shall be marked as such on the test records and then reported by the contractor to the Employer and the contractor's personnel in charge of the relevant construction area.
- 6.7. Checking procedures shall be repeated until all the items on the check list are cleared.
- 6.8. A complete set of test records shall be handed over to the Employer on completion.
- 6.9. The tests on the different mechanical and electrical equipment shall include but not limited to:
  - 6.9.1. Pumps, Pipe work and Valves
    - a) 1.5 times the shut off pressure or twice the working pressure whichever is higher to test the soundness of the joints. Provision of the necessary pumps, gauges, blank flanges, tapping etc. for carrying out these tests shall be included in the contract.
    - b) Leakage tests shall be carried out on all erected pipe work, pumps and valves immediately after erection and where possible before being built in.
    - c) Operating tests shall be conducted on valves.

- d) The pump set shall be tested for performance. The vibration and noise levels shall be checked to be within the specified.
- e) The pump shall be tested through the operating range as per BS 5316 Part I Class C / ISO 2548 with all working (excluding stand by) pumps at a time for all the pumps.  
**However, no negative tolerance shall be permitted on the tested pump efficiency.**

#### 6.9.2. Pump motors

Condition of winding insulation be tested and insulation values shall be restored to required level by suitable heating arrangements locally.

#### 6.9.3. Cranes

The crane and lifting tackle shall be tested to 125 % of the safe working load. The contractor shall arrange the test load. Deflection and speed tests shall also be conducted.

#### 6.10. Instrumentation

The tests on the instrumentation equipment shall include but not be limited to:

- a) All cables shall be tested for polarity, continuity and insulation resistance. The common mode dc voltage at each signal input terminal shall be measured and recorded.
- b) The pre commissioning tests on the various main categories of plant shall be as listed below:
- c) The resistance of each electronic loop shall be measured.
- d) Electronic equipment shall have been energised for at least 24 hours before testing begins.
- e) The zero setting of each display instrument including any local indicator on or associated with a transmitter shall be checked.
- f) The correct calibration of each item in each control or monitoring loop shall be checked by the introduction of appropriate signal at each source, at five cardinal points of the range for increasing and decreasing signals.

#### 6.10.2. The following tests methods shall be used:

- a) Pressure operated devices – dead weight testers or portable calibrators
- b) Level operated devices – actual level variation or simulation thereof. Instrument zero reading shall be checked against a bench mark:
- c) For controlling devices the contractor shall demonstrate the correct operation of the loop including the regulating devices. Each automatic controller shall be set to the appropriate estimated values of the terms which shall be optimised during the plant

start up. Each control valve shall be checked during the plant start up. Each control valve shall be checked by operation of the manual control on the associated controller and the correct stroking verified. Valve petitioners, electro pneumatic converters and gauges shall be checked during these tests.

- d) All systems shall be checked for “fail safe” operation.
- e) Initiating devices not covered by the foregoing e.g. plant stop / start controls shall be checked in conjunction with the testing of the associated switchgear and machine.

6.10.3. The contractor shall also demonstrate the data transfer as per data transfer schedule between pumping stations.

## **7. Commissioning**

7.1. After the completion of pre commissioning activities the final checks and preparations necessary for start up of the plant shall be carried out. The contractor shall submit to the Employer a written notice of mechanical completion which shall include:

7.1.1. Identity of a part of the plant considered mechanically complete,

7.1.2. A copy of all relevant completed test reports,

7.1.3. The date on which the completion of the tests was achieved,

7.1.4. Check list and

7.1.5. A request for issuance of a mechanical completion certificate in respect of that part.

7.2. Within fourteen (14) days from the date of receipt of the contractor’s written notice, the Employer shall:

7.2.1. In the case of acceptance, issue a mechanical completion certificate.

7.2.2. In the case of objection, submit a rejection statement setting forth remaining items to be completed or defects or deficiencies to be corrected before mechanical completion status can be accepted. When the Employer rejects the contractor’s notice the contractor shall take any necessary action to complete or correct the items marked and give the Employer a second notice of mechanical completion.

7.3. After the issuance by the Employer of a mechanical completion certificate, commissioning activities listed below shall be carried out to enable the start up and operation of the plant. Procedures are described as below:

7.3.1. Commissioning Procedure shall be carried out in a methodical sequence as follows

a) Warming up

b) Start up

c) Initial running



d) Operability adjustment

e) Stable operation

f) Final adjustment

7.3.2. At all stages of commissioning sequence, the plant shall be operated at optimum plant conditions. To ensure this, the contractor may make minor adjustment to the conditions indicated in the operation and maintenance manual as necessary.

7.3.3. The contractor shall check the operating conditions of the plant by constantly monitoring operating data.

7.3.4. The contractor shall specify for each discrete part of the plant the operational data to be recorded and the manner in which the data is to be taken.

7.3.5. All the operating data shall be recorded by the Employer on the forms to be mutually agreed. A copy of the operating log and analytical data from initial operation through to the completion of performance test shall be made available by the Employer to the contractor for evaluation.