VOLUME - IA
TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED

TECHNICAL CONDITIONS OF CONTRACT (TCC)
Contents

1.0 Project Information (6 nos of Sewage Treatment Plants for Raipur Development Authority)

1	Customer	:	Raipur Development Authority, Raipur, Chhatisgarh
2	Project Title	:	Civil, Structural & Architectural works for 6 nos of Sewage Treatment Plants
3	Location	:	5 nos of STPs in Kamal Vihar, Raipur & 1 no in Indraprastha -Phase-II

Table A) Location & Capacity Details of STPs

STP No.	Sector No.	Capacity (MLD)
STP-1	1 (Kamal Vihar)	7.400
STP-2	6 (Kamal Vihar)	4.330
STP-3	12 (Kamal Vihar)	7.050
STP-4	11a (Kamal Vihar)	1.790
STP-5	11b (Kamal Vihar)	0.872
STP-6	Indraprastha Scheme- Phase II	3.980

4	Address Detail	:	5 nos of STPs in Kamal Vihar, Raipur & 1 no in Indraprastha -Phase-II, Raipur, Chhatisgarh
5	Nearest Railway Station	:	Raipur Railway Station
6	Road Approach	:	Raipur
7	Nearest Air Port	:	Raipur
11	Ambient Air Temperature (Average)	:	a) Maximum : 46^0 C b) Minimum : 01^0 C
12	Average Relative Humidity	:	23-95 %
13	Climatic Condition	:	Humid Sub Tropical Climate

Bidder is advised to visit the project sites and appraise himself about the local conditions and infrastructure available in the area for fulfilling their commitments under the contract. BHEL will not admit any claims whatsoever on account of Contractor's non-familiarization of local conditions.

2.0 SCOPE OF WORK

This section list major scope of work for Erection & Commissioning for Mechanical & Electrical packages for 6 nos of Sewage Treatment Plants for Raipur Development Authority, Raipur, Chhattisgarh to be carried out by contractor, but not limited to following for safe, speedy completion of this package. Following are the major scope of the work for this work,

1. Receipt of materials at site/ stores from road carriers, unloading, verification, etc.

- All above Kamal Vihar STPs located at a distance between two is of 2-3 Kms.
- Indraprastha (IP) -6th STP is located at a distance of 8-9 Kms from Kamal Vihar (KV) location.
- Since locations are different, to avoid multiple handling & shifting, it is also proposed to identify 3 possible locations for storing and preservation of project materials (1 Storage place at IP & 2 at KV).

2. Drawing of the materials from stores inside/outside the STP sites and transportation to respective site stores.

3. Preservation of components during storage and erection at site.

4. Leveling and alignment, erection, testing, commissioning, trial operation and handing over to customer for the equipment / packages supplied by PE&SD & other units of BHEL for 6 nos of Sewage Treatment Plants for Raipur Development Authority, Raipur, Chhattisgarh, and associated equipment/materials .

5. Deployment of necessary manpower and Tools & Plants for completing the works as per applicable standards and specifications.

6. Installation and removal of temporary piping and equipment for carrying out Chemical Cleaning.

7. Final painting.

8. Facilitate the customer to obtain approvals from statutory authorities.

9. Removal of surplus material, scraps out of fabrication yard, temporary infrastructures, subsequent cleaning up and handing over of plant to owner as per tender.

10. Handling of Spares.

11. Support for erection and commissioning including PG Test.

12. Storage area development, lighting arrangement, fencing , watch & ward at different location of STPs are the part of this contract. as instructed by BHEL site engineer.

2.1 The work to be performed under the scope of this tender mainly consists of but not limited to complete E&C works for Mechanical & Electrical package and their operation and maintenance for specified period of the following,

A. Main plant STP

The main plant STP includes the following equipment:

- Raw Sewage Pumping Station Receiving Chamber
- Coarse Screen Channels
- Raw Sewage Pumping station
- Inlet Chamber
- Mechanical & Manual Fine screen Channels
- Grit Chambers
- Sequential Batch Reactor (SBR) Units
- Aeration system
- Return Sludge and Excess Sludge Pumps
- Disinfection (Chlorination) Units
- Sludge dewatering pumps.
- MCC
- PLC
- Piping with supports within the STP
- Electrical and Instrumentation Cabling with supports within the STP
- HVAC
- Fire Protection system
- Automation and control within the STP

A. MECHANICAL TERMINAL POINTS

Sl. No.	Main Equipment/Systems	Terminal Points
1.	Raw sewage inlet	At the inlet of respective STP Boundary

2.	Service water	Shall be arranged by Contractor.
3.	Treated sewage	Treated sewage effluent transfer pump
4.	Solid waste	Solid waste from the mechanical screen, grit equipment & centrifuge has to be disposed by the contractor as directed by BHEL/RDA

B. <u>ELECTRICAL TERMINAL POINTS</u>

1.	Input Power(Normal)	415V, 3phase, 50Hz, 4wire **~1250kVA** normal supply shall be arranged by Contractor.
2.	Input power(emergency)	415V, 3phase, 50Hz, 4wire **~450kVA** emergency supply shall be arranged by Contractor. OR No terminal point with customer and emergency power requirement will be met through 415V, DG set by contractor
3.	DC Supply	Not Applicable.
4.	UPS Supply	No terminal point with customer and required UPS supply for control system will be internally generated.
5.	Earthing	No terminal point with customer.
6.	Communication system	No scope, hence No terminal point with customer

2.1.8 GENERAL

2.1.8.1 The drawings enclosed with this tender are intended to give the tenderer a general idea of the type and extent of work involved. The drawings are as such only indicative and not to be considered as the exact construction drawings.

Further this is to be noted that the drawings and the documents furnished along with this specification are the sole property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.

2.1.8.2 The scope of work will also include such other related works although they may not be specifically mentioned in the above paragraph and all such incidental items not specified but reasonably imply and necessary for completion of the job as a whole all as desired and as directed by the engineer.

2.1.8.3 The detail scope of work covered above is not a comprehensive list of items of work involved. The detail scope of work may vary considerably depending on the actual construction requirements.

2.1.9 ALSO INCLUDED IN THE SCOPE

Unless otherwise specified, the work to be provided by the contractor for the items mentioned in the "Schedule of items", shall include but not be limited to the following.

2.1.9.1 Furnishing all labor, materials, supervision, construction plans, equipment, supplies, transport, to and from the site, fuel, electricity, compressed air, water, transit and storage insurance, plant security and all other incidental items and temporary works not shown on specified but reasonably implied or necessary for the proper completion, maintenance and handling over the works, except in accordance with the stipulations laid down in the contract documents and additional stipulations as may be provide by the engineer during the course of works.

2.1.9.2 Furnishing samples of all materials required by the engineers for testing/inspection and approval for use in the works. The samples may be retained by the engineer for final incorporation in the works.

2.1.9.3 Furnishing test reports for the products used or intended to be used, if called for the specifications or if so desired by the engineer.

2.1.9.4 Giving all notices, paying all fees, taxes etc., in accordance with the general conditions of contract, that are required for all works including temporary works.

2.1.9.5 Arranging manufacturer's supervision for items of work done as per manufacturer's specifications when so specified.

2.1.9.6 Providing all incidental items not shown or specified but reasonably implied or necessary for the successful completion of the work in accordance with contract.

2.1.10 WORK BY OTHERS

No work under the specification will be provided by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

FOR FURTHER DETAILED SCOPE OF WORKS REFER RELEVANT TECHNICAL SPECIFICATIONS PROVIDED IN THE SUBSEQUENT CHAPTERS IN THE TCC

S. No.	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
3.1	**ESTABLISHMENT**			
3.1.1	**FOR CONSTRUCTION PURPOSE**:			
a	Open space for office (as per availability)		Yes	
b	Open space for storage (as per availability)		Yes	Location will be finalized after joint survey.
c	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
d	Bidder's all office equipment, office / store / canteen consumables		Yes	
e	Canteen facilities for the bidder's staff, supervisors and engineers etc		Yes	
f	Fire fighting equipment like buckets, extinguishers etc		Yes	
g	Fencing of storage area, office, canteen etc of the bidder		Yes	
3.1.2	**FOR LIVING PURPOSES OF THE BIDDER**			
a	Open space for labour colony (as per availability)		Yes	
b	Labour Colony with internal roads, sanitation, complying with statutory requirements		Yes	
3.2.0	**ELECTRICITY**			
3.2.1	**Electricity For construction purposes** of Voltage 415/440 V		Yes	Shall be arranged by Bidder
a	Single point source		Yes	
b	Further distribution including all materials, Energy Meter, Protection devices and its service		Yes	
c	Duties and deposits including statutory clearances if applicable		Yes	
3.2.2	**Electricity for the office, stores, canteen etc. of the bidder**			
a	Single point source		Yes	Shall be arranged by Bidder

S. No.	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
b	Further distribution including all materials, Energy Meter, Protection devices and its service & also for Employer site office establishment		Yes	
c	Duties and deposits including statutory clearances if applicable		Yes	
3.2.3	**Electricity for living accommodation of the bidder's staff, engineers, supervisors etc**			Not applicable
a	Single point source			
b	Further distribution including all materials, Energy Meter, Protection devices and its service			
c	Duties and deposits including statutory clearances if applicable			
3.2.4	Employer site office with power supply at Two location as instructed by BHEL site engineer		**Yes**	
3.3.0	**WATER SUPPLY**			
3.3.1	**For construction purposes**			Shall be arranged by Bidder
a	Making the water available at single point		Yes	
b	Further distribution as per the requirement of work including supply of materials and execution		Yes	
3.3.2	**Water supply for bidder's office, stores, canteen etc**			
a	Making the water available at single point		Yes	
b	Further distribution as per the requirement of work including supply of materials and execution		Yes	
3.3.3	**Water supply for Living Purpose**			Not applicable
a	Making the water available at single point			
b	Further distribution as per the requirement of work including supply of materials and execution			

S. No.	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
3.4.0	**LIGHTING**			
a	For construction work (supply of all the necessary materials) 1. At office/storage area 2. At the preassembly area 3. At the construction site /area		Yes	
b	For construction work (execution of the lighting work/ arrangements) 1. At office/storage area 2. At the preassembly area 3 At the construction site /area		Yes	
c	Providing the necessary consumables like bulbs, switches, etc during the course of project work		Yes	
d	Lighting for the living purposes of the bidder at the colony / quarters		Yes	
3.5.0	**COMMUNICATION FACILITIES FOR SITE OPERATIONS OF THE BIDDER**			
a	Téléphone, fax, internet, intranet, e-mail etc.		Yes	
3.6.0	**COMPRESSED AIR wherever required for the work**		Yes	
3.7.0	**Demobilization of all the above facilities**		Yes	
3.8.0	**TRANSPORTATION**			
a	For site personnel of the bidder		Yes	
b	For bidder's equipments and consumables (T&P, Consumables etc)		Yes	

Sl. No	Description PART II 3.9.0 CONSTRUCTION FACILITIES	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
3.9.1	**Engineering works for construction:**			
a	Providing the construction drawings for all the works covered under this scope	Yes		
b	Drawings for construction methods	Yes		
c	As-built drawings – where ever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes		**YES**	In consultation with BHEL
d	Shipping lists etc for reference and planning the activities	Yes		In consultation with BHEL
e	Preparation of construction (Concreting B/W, etc.) schedules and other input requirements		Yes	In consultation with BHEL
f	Review of performance and revision of site construction schedules in order to achieve the end dates and other commitments	Yes	Yes	In consultation with BHEL
g	Weekly construction schedules based on S. No. e. hard copy to Construction manager, by email to HO.		Yes	In consultation with BHEL
h	Daily construction / work plan based on S. No. g. hard copy to Construction manager, by email to HO.		Yes	In consultation with BHEL
i	Periodic visit of senior official of the bidder to site to review the progress so that works are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months.		Yes	
j	Arranging the materials required for Work		Yes	

Sl. No	Description PART II 3.9.0 CONSTRUCTION FACILITIES	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
k	Coordination for inspection &checking and getting clearance from customer		Yes	
l	Preparation of formats for completion of activities		Yes	

Sl	Description	Specifications	Qty.
A.	**HANDLING & LIFTING EQUIPMENT**:		
1.	Hydraulic jack.	Capacity-25 T lift = 200 mm Dia of the table, piston = 90 mm Min. height above the ground level = 260 mm, Force on the lever = 30 Kg. Length of the level = 625 mm	4 Nos.
2	Screw Jack (ratchet type)	Capacity: 5T lift 200 mm	4 Nos
3.	Jack bolts	Min. ht. 75 mm, lift- 30 mm dia of bolt - 36 mm	16 Nos.
4.	Hand ratchet Jack	Capacity -5T stroke: 370 mm Height above the ground level 90 mm Force on the Level – 50 Kg	2 Nos.
5.	Hand ratchet Jack with chain and hooks.	Capacity- 1.5 lift-- 2M Arm length -440 mm force on the lever-55 Kg. Min. distance between the top and bottom Hook: 440 mm, Hook size = 40 mm	6 Nos.
6.	Chain pulley blocks	Capacity - 3T, lift -6m	4 Nos.
7.	Steel ropes with loops as per Site requirement		
8.	Eye bolts CSNO2 as per site requirement		
B.	**MACHINERY:**		
1.	Power saw	H. P. -1.5 Blade length 600 mm throats 200 mm, strokes/min = 60	1 No.
2.	Elec. Air compressor	Capacity -5m3/minute With air receiver (Tank) pressure = 7 atp Tank capacity = 3.5 M3 3 phase electrical motor: 440 V, 50 C/s air cooled, With pressure gauge, starter for Motor, auto-start/stop, necessary Valves, tank with drain and Safety valve OR 2 of 2.6 M3/min. 6 atp tank: 1. 8 M3 all other things are same as above.	1 No
3.	Bench grinder with twoWheels	H. P. =1, RPM =2900, wheel dia =200 mm Thickness = 25 mm, 440V 3 phase 50 c/s	1 No

4.	Portable electrical drilling Machine dia: 15 mm	Dia. of the drill =15 mm Power=350 watts 250V, 50 c/s	2 Nos.
5.	Flexible shaft portable elec. Grinding machine	Shaft dia, =20 mm, Length-5M Min. RPM = 2800 Input -1.3 kW With various shaped grinding wheels	1 No.
6.	Portable pneumatic drill with Morse taper No-3 dia 32 mm	Drill dia. 32 mm Air condenser 1.8 M3/min. working pressure 5/7 atp RPM -190/360	1 No.
	Portable pneumatic grinder	Wheel dia=100 mm Thickness=20 mm Working pressure 5/7 atp	1 No.
	Portable pneumatic grinder	Wheel dia=200 mm Thickness=40 mm Working pressure 5/7 atp.	1 No
	Chamfering machine Portable size 75 to 250 mm dia	Czechoslovakian make (CKD) 6.8 KW 415 V motor with a starter on a trolley with a universal shaft coupling chamfering tool. Jaws are to accommodate the sizes 75 to 250 mm. OR similar one	1 No.
	Hydraulic pipe bending	1/2" to 2" mean radius of bend 45 to 230 mm with machine, hand operated with the blocks for 1/2",3/4.', ;1",1 1/4", 1 1/2", 1 3/4" and 2"	1 set
	Gas welding & cutting set with pressure gauges for oxygen and acetylene	Cutting & welding up to 50 mm	1 set
	Welding transformer setwith regulator	350 A, AC Max = 450 Amps Min = 75 Amps About 30 KVA Secondary = 85 V, Primary = 400/440V	4 sets
	Welding D. C. Generator set with regulator	320 A, DC 90 V, Max: 320 Amps, Min: 30 A Motor KVA: 20, 2910 RPM 440V	4 sets
	Annealing Transformer and inductor	Full set suitable for annealing alloy steel pipes (Mat. 13 cr. 44 Mo), after welding annealing temp reqd. 600ºC to 720°C similar to A.C.L.C. Belgium makes)	1 set
	Argon welding equipment		2 No.
	Electrode drying oven automatic with temp control	Capable of accommodating 6 or 8 packets electrodes	1 No.

	Camera for Iridium 192 5 curies isotope and manipulator rod. Iridium\ 192 isotope		1 No.
	Plastic cassettes 10 x 48 cm		2 Nos.
	Lead screens	10 X 48 cm	2 sets
	Lead letters	12 mm	2 sets
	Lead numbers	12 mm	2 sets
	Gevaret D-4 films	10 x 48 cm	2 pkts
	Developer to make 13.5 liter		1 tin
	Fixer to make 13.5 liter		1 No.
	Tube bending machine (5 to 25 mm)		1 No.
	Portable needle grinder pneumatic / electrical		1 No.
	All common tools like straight edge, fitters vice vernier calipers, micrometers, dial gauges, lever type dial gauges, feeler gauges, surface plate, spanners, screw drivers, hammers, mallets etc. tools as required by RE at site to be brought by the Contractor.		
D.	**<u>MISCELLANEOUS:</u>**		
	Gas Hose Oxygen and Acetylene	Bore dia, 10 mm 25, 50 & 75M lengths each	2 sets
	Wire brushes for welders	150 x 25 mm 3 rows wire bristles 5 rows wire bristles	 6 Nos. 6 Nos.
	Gas cutting nozzles cleaning kit		2 sets
E	**<u>TOOLS AND TACKLES</u>:**		
	1. Set of Torque spanners (M 6 to M 64) 2. Feeler gauges (length 300; 200 mm of different widths) 3. Flexible Torch lights with mirror 4. Inside and outside micrometers (0 to 250 mm, dia in different steps) 5. Lever type and plunger type dial indicators 6. Micron dial indicators 7. Leaf feeler gauges (0.03 and 0. 05 mm) 8. Depth gauges up to 400 mm 9. Lead wire measuring gauges 10. Magnifying glasses		

F. CONSUMABLES:-

1. Birkosit
2. Hylomer
3. Led plate 200
4. Loctite 221,601,621
5. Molykote 321 R
6. Industrial Grease

NOTE: -

i) All the tools should be procured in sufficient quantities by the Contractor.

ii) The list of tools & tackles mentioned above are indicative only. The contractor has to mobilize the required tools & Plant in sufficient quantity to carry out the material receipt, unloading, issue of material with proper records, erection, testing and commissioning. However, on instruction of Resident Construction Manager, additional tools and tackles has to be arranged by Bidder for smooth E & C activities of the project.

BHEL will not provide any tool, plants or any testing facility/apparatus for the work. It will be contractor's responsibility to arrange all required tools, plants and other testing apparatus, etc. at their own cost. The prices quoted & finalized are inclusive of the charges towards providing such T&P. No extra payment will be entertained on account of this.

However, subject to availability, BHEL may provide few T&P to the contractor for expediting and in larger interest of the project. In case any such facility is provided to the contractor, BHEL will make necessary recovery in the running account/final bills towards the hire charges. A departmental charge @ 5% will also be affected such cases. The decision of BHEL on the hire charges will be final and binding on contractor.

6.1 TIME SCHEDULE

6.1.1
The entire work of erection testing and commissioning of Sewage Treatment Plant as detailed elsewhere in the Tender Specification shall be completed within Six months for execution+3 months for testing, commissioning, handing over & demobilization from the date of commencement of work at site.

6.1.2
During the total period of contract, the contractor has to carry out the activities in a phased manner as required by BHEL and the program of milestone events.

6.1.3
The erection work shall be commenced on the mutually agreed date between the bidder and BHEL engineer and shall be deemed as completed in all respect only when the unit is in operation. The decision of BHEL in this regard shall be final and binding on the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.

6.2 COMMENCEMENT OF CONTRACT PERIOD

The date of commencement of contract period shall be the mutually agreed date between the bidder and BHEL engineer to start the work. In case of discrepancy the decision of BHEL engineer will be final.

6.3 MOBILISATION FOR ERECTION, TESTING, ASSISTANCE FOR COMMISSIOING ETC.,

6.3.1
The activities for erection of equipments, Screens, Blowers, etc. shall be started as per directions of Construction manager of BHEL.
6.3.2
The contractor has to augment his resources in such a manner that following major milestones of the project are achieved on specified schedules:

TENTATIVE SCHEDULE

Activity	**Tentative schedule**	
	Start Month	**End Month**
Mobilization for Site Establishment	**Dec' 21**	**Dec' 21**
Erection of Pumps	**Jan' 22**	**Feb' 22**
Erection of Decanter	**Feb' 22**	**Mar' 22**
Erection of MCC panels	**Feb' 22**	**Mar' 22**
Testing & Commissioning	**Mar' 22**	**Mar' 22**
Handing Over	**Mar' 22**	**Mar' 22**

In order to meet above schedule in general, and any other intermediate targets set, to meet customer/project schedule requirements, contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL
In general, the Contractor need to mobilize material handling facilities with required T&Ps and site office establishment for employer (Porta cabins, Office assistants, Watch & ward personnel etc) immediately after ordering.

6.2 CONTRACT PERIOD

For the purpose of contract, the period shall be taken as Six months for execution+3 months for testing, commissioning, handing over & demobilization. Completion of the work shall be as per BHEL Bar Charts revised from time to time. In order to expedite the work, the contractor has to deploy manpower on two-shift basis during erection and during pre-commissioning and commissioning period manpower should be provided round the clock basis as per site requirement without any extra cost to BHEL.

6.3 GUARANTEE PERIOD
The guarantee period of twelve months shall commence from the date of completion of all works as certified by the BHEL site engineer

7.1 The progressive payment for the work on accepted price of contract value will be released on the basis of running account bills & other bills as per the provisions of relevant clauses of GCC and SCC.

7.2 The following documents are to be submitted along with the Running Account Bills for process of payment

7.2.1 Tax Invoice with details of GSTIN number of BHEL and contractor.
7.2.2 Measurement books duly filled and signed officials of BHEL and contractor
7.2.3 Provident Fund Remittance challan of previous month.
7.2.4 ESI Remittance challan of previous month.
7.2.5 Invoice submitted along with running bills to indicate the GST tax amount charged and bear the GSTIN Number.
7.2.6 Bill submitted subsequently to be accompanied with a declaration that GST tax liability on the earlier bill has been discharged.
7.2.6.1 By paying money to the Government (along with Tax paid Challan Copy)
7.2.6.2 By utilization of Input GST tax Credit

1.1
The work covered under this specification is of highly sophisticated nature, requiring the best quality of workmanship for construction, engineering and construction management. The Bidder should ensure timely completion of work. The Bidder must have adequate quantity of tools, construction aids, equipment's etc., in his possession. He must also have on his rolls adequate, trained, qualified and experienced supervisory staff and skilled personnel.

1.2
The work shall be executed under the usual conditions affecting industrial construction and in conjunction with numerous other operations at site. The Bidder and his personnel shall co-operate with the personnel of other agencies, co-ordinate his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.

1.3
All the work shall be carried out as per the instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of working shall be final and binding on the Bidder.

1.4
The Bidder shall at his cost perform any services, tests etc, although not specified but nevertheless required for the completion of work.

1.5
Contractor shall execute the work as per sequence prescribed by BHEL at site. The sequence of activities, methodology will be decided by the BHEL engineers depending upon the availability of material, drawings, work fronts etc. No claims for extra payment from the Contractor will be entertained on the grounds of deviation from the methods and sequence of construction advised and agreed by BHEL engineer or for any reasons whatsoever.

1.6
All the necessary certificates and licenses required to carry out this work are to be arranged by the Contractor expeditiously at his cost.

1.7
The work to be carried out under the scope of these specifications covers the complete work of collection from stores/storage yard, handling, transporting, unloading at construction site, temporary storage at site in open/closed stores, temporary storing of contractor's own construction material, using the same in the work, carrying out all other activities as defined in the scope of work enumerated in chapter-2, Part-I of TCC document, Bill of Quantities and elsewhere till handing over of the entire work. The work shall conform to dimensions and tolerances specified in the various drawings, documents etc. That will be provided during the course of installation. If any portion of the work is found to be defective in workmanship or not conforming to drawings or other specifications, the Contractor shall dismantle and re-do the work duly replacing the defective materials at his cost failing which the work will be got done by BHEL at the cost and risk of the contractor.

1.8
The terminal points as decided by BHEL shall be final and binding on the Contractor.

1.9
During the course of execution of this work, certain rework/ modification/ rectification/ repairs/ fabrication/dismantling etc. will be necessary on account of feedback from various other units completed earlier and also on account of design discrepancies and manufacturing defects and site operation/maintenance requirements. Contractor shall carryout such rework/ modification/rectification/fabrication/repairs etc., promptly and expeditiously. Claims of contractor, if any, for such works will be dealt as per relevant clauses of General Conditions of Contract.

1.10
Daily log sheets indicating the details of work carried out, man-hours, consumables used etc, shall be maintained by the Contractor and got signed by BHEL engineer every day.

1.11
All tools and tackles, fixtures, equipment, materials, manpower, supervisors/ engineers, consumables etc. required for this scope of work shall be provided by the Contractor. All expenditure including taxes and incidentals in this connection will have to be borne by him unless otherwise specified in the relevant clause.

1.12
The contractor shall make adequate security arrangements including employment of security personnel and ensure protection from theft, fire, pilferage, damage and loss of materials/equipment's issued to him for the work. Special care will have to be taken to guard against pilferage / theft of cement, steel and/or other materials.

1.13
Contractor shall ensure proper housekeeping and remove all scrap materials periodically from various work area covered in the scope and deposit the same at the place earmarked for this purpose. In case of contractor's failure to do the same, BHEL reserves the right to remove scrap at contractor's cost and risk.

1.14
Access to site for inspection by BHEL and customer engineers shall be made available by the contractor at all times.

1.15
As Built Drawings: Contractor shall be supplied with two extra copies of the layout & detailed drawings. Contractor to incorporate in one of the copy with Red ink all the changes / deviations / alterations etc carried out at site due to various reasons, with site engineer's endorsement. Marked up drawings shall be submitted to BHEL for approval.

1.16
Site Inspection: The owner / employer or his authorized agents may inspect various stages of work during the currency of the contract awarded to him. The contractor shall make necessary

arrangements for such inspection and carry out the rectification pointed out by the owner / employer without any extra cost to the owner / employer. No cost whatsoever such duplication of inspection of work be entertained.

1.17
Field Quality Assurance Formats: It is the responsibility of the contractor to collect and fill up the relevant concrete pour card/FQA Log sheets and present the same to BHEL after carrying out the necessary checks as per the log sheets and obtaining the signature of BHEL / Customer in token of their acceptance. Monthly Running Bill Payment to the contractor will be linked with the submission of these Log sheets.

1.18
All packing and forwarding material shall be returned as soon as the material is unpacked. The location for storage of such materials shall be as indicated by BHEL Engineer.

1.19
Contractor shall furnish the consumption details of chemicals, lubricants, TIG welding filler wire, welding electrodes and other consumables on monthly basis.

1.20
The terminal points decided by BHEL should be final and binding on the contractor for deciding the scope of work and effecting payment for the work done.

1.21
The work shall conform to dimensions and tolerances specified in the various drawings / documents that will be provided during various stages of erection. If any portion of work is found to be defective in workmanship, not conforming to drawings or other stipulations due to contractor's fault, the contractor shall dismantle and re-do the work duly replacing the defective materials at his cost, failing which the work will be got done by BHEL and recoveries will be effected from the contractor's bills towards expenditure incurred including cost of materials and departmental overheads of BHEL.

1.22
The contractor shall perform any services, tests etc. Which may not be specified but nevertheless required for the completion of work within quoted rates.

1.23
All cranes, transport equipment, handling equipment, tools, tackles, fixtures, equipment, materials, manpower, supervisors/ engineers, consumables etc required for this scope of work shall be provided by the contractor. All expenditure including taxes and incidentals in this connection will have to be borne by him unless otherwise specified in the relevant clauses. The contractor's quoted rates should be inclusive of all such contingencies.

1.24
All works such as cleaning, leveling, aligning, trial assembly, dismantling of certain equipment / components for checking and cleaning, surface preparation, fabrication of sheets, tubes and pipes as per general engineering practice and as per BHEL engineer's instructions at site, cutting, gouging, weld depositing, grinding, straightening, chamfering, filing, chipping, drilling, reaming, scrapping, lapping, fitting up etc., as may be applicable in such erection works and which are treated incidental to the erection works and necessary to complete the work satisfactorily, shall be carried out by the contractor as part of the work within the quoted rates.

1.25
The contractor shall make all fixtures, temporary supports, steel structures required for jigs & fixtures, anchors for load and guide pulleys required for the work. BHEL will not provide any steel for this.

1.26
Plant materials should not be used for any temporary supports / scaffolding / preparing pre-assembly bed etc.

1.27
The details of equipment to be erected under this contract is generally as per the Bill of Quantities. These details are approximate and meant only to give a general idea to the tenderer about the magnitude of the work involved. Actual quantum and type of equipment will be based on the erection documents which will be furnished in the course of erection and the weight and quantity as per the relevant engineering documents will only be admissible for the billing purpose.

1.28
All works such as cleaning, levelling, aligning, hot alignment, trial assembly, dismantling of certain equipment/components for checking and cleaning, surface preparation, fabrication of sheets, tubes and pipes as per general engineering practice and as per BHEL engineer's instructions at site, cutting, grinding, straightening, chamfering, filling, machining, chipping, drilling, reaming, scraping, lapping, shaping, fitting-up, drilling of holes, making dowel pins, minor rectification of foundation bolts etc. are incidental to the erection/commissioning and any other work/activity which is necessary to complete the work satisfactorily, shall be carried out by the contractor as part of the work.

1.29
Cleaning, servicing, lubrication of actuators, pumps, headers, control valves, other valves, tanks, vessels etc. during erection and commissioning stages is in the scope of work of Contractor including supplying of gaskets/packings and etc for replacement.

1.30
All the materials during pre-assembly, storing shall be stored well above ground level as necessary to avoid water ingress etc, by use of wooden/ concrete blocks/ sleepers. No material shall be stored directly on the ground at any time. Concrete blocks/ Sleepers have to be provided by the contractor.

1.31
The contractor shall carry out any other tests as desired by BHEL engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning and commissioning, to demonstrate the completion of any part or whole of work performed by the contractor.

1.32
After chemical cleaning/pickling of lubricating system (including oil piping, oil tank and other fittings) of rotating machines, oil flushing for lubricating systems as per instructions of BHEL engineer shall be carried out. Rotating machinery and other system as per scope of tender specification before and after oil flushing is in the scope of work.

1.33
Transportation of oil drums, filling of oil for flushing, first fill of lubricants and subsequent topping up during commissioning and post commissioning is included in the scope of this contract. The contractor shall have to return all the empty drums to the customer/BHEL stores. Similarly, for various pre-commissioning/ commissioning activities/ processes mentioned in various clauses, transport of chemicals, charging of chemicals into the system and returning of remaining and/or the empty containers of the chemicals to customer/BHEL stores is the responsibility of the contractor.

1.34
The contractor shall perform all required services which may not be specified herein but nevertheless required for the completion of work within quoted rates as per the instructions of BHEL & suit the site requirement.

1.35
All expenditure including taxes and incidentals in this connection will have to be borne by the contractor unless otherwise specified in the relevant clauses elsewhere here. The contractor's quoted rates shall include of all such contingencies. In this connection refer relevant clause of general conditions of contract.

1.36
The contractor shall take due precaution during Materials Handling and Erection, testing & commissioning of equipment/works under these specifications to avoid deface, injure, damages, destruction by contractor or his workmen or servants to any pipelines, railway lines, roads, canals, cables, culverts, drains, sewer, telephone &telegraph lines, water mains, dykes, poles, pillars, fences, wires, supports and embedment's and other underground or over ground works, Structural or constructions whatsoever and shall at his own cost and initiative forthwith restore and repair any damage thereto the entire satisfaction of customer/BHEL at his own expense or in default, the

customer/ BHEL site engineer may cause the same to be made good by other agency or by other means and deduct the expense with BHEL overhead (of which the site engineer's decision is final) from any sums that may be then or at any time thereafter become due to the contractor or from his security deposit or any other money due.

1.37
As such, the marine cover and erection all risk cover insurance for the project for permanent incorporation of materials and services at site lies with customer. The contractor shall have to take necessary all risk insurance policy (motor vehicles act, worker's compensation act, fatal accidents act, personal injuries insurance act, emergency risk insurance act and/or other industrial legislation from time to time India with insurance company(ies) approved by owner) **for his manpower and his employees deployed at site under work compensation act including but not limited to third party insurance at STP Plant project along with his T&Ps before starting of the work and shall submit the necessary document/policy in support of above to BHEL/customer at site. This will be also essential for taking the gate pass/entry pass etc. from customer & their related departments/security at site. The insurance policy taken shall be kept in-force till completion of contract. The workmen's compensation insurance and third party insurance liability limits shall be as customer specification. Contractor shall indemnify the customer /BHEL harmless against such losses, which are on account of contractor.**

1.38
Recoveries will be made from contractor's bills for any liability accrued to BHEL/CUSTOMER for the accidents and refund of the same shall be considered later, after the claim is fully settled by insurance authorities.

1.39
Customer has taken the marine cover and erection all risk cover insurance for the project for permanent incorporation of materials and services at site. However contractor shall take all due precautions, arrange & follow the safety & security requirements/regulations for materials issued to him & works under his execution and shall be responsible for safety & security of these materials & works for any loss or damages. For any damage / loss to the material during inland transportation, storage, erection, final testing, commissioning stage etc., contractor shall intimate promptly to BHEL/customer and shall prepare & submit the necessary detailed report / documents / information, facilitating inspection / discussions by the officials / surveyors deputed by insurer with all expenditure on contractor's account. Contractor shall take care for timely information for conducting survey, submission of monetary estimate & furnish the requisite documents to surveyors/insurer, taking necessary precautions so that the loss/damage is not aggravated further, protecting damaged goods etc. As part of scope of work.

Contractor shall promptly make repair / rectify/replace and make good any damage or loss to HPEP/BHEL materials and works on above account as per instructions of BHEL engineer incharge at site without any delay & waiting for settlement of insurance claim from insurer. Contractor's claim (if any) for such works will be settled as per applicable item rate of contract after settlement of claim from insurer / customer & after ascertaining / establishing

that contractor is not responsible for such loss or damages. The contractor's claim for such repair / replacement shall not be more than the payment settled by insurer / customer and in such case the contractor's payment will be limited to seventy percent of settled amount by insurer/customer against claim amount.

1.40
The contractor shall submit survey report/performance report of the tools and plants deployed by him and being utilized on the work under the scope. These survey reports/performance reports are to be obtained by contractor from the customer of BHEL/insurance authorities and submitted to BHEL at no extra cost.

1.41
Contractor shall deploy & maintain, the separate exclusive workforce / manpower arrangements and T&Ps resources including the Cranes & heavy lift equipment /arrangements for Material Handling and Erection & Commissioning scope of works.

1.42
All vehicles/ electrical motors devices shall have to be provision of fire extinguisher/muffler facilities etc.

1.43
Contractor shall provide FIRST AID / emergency medical facilities & Emergency Vehicle facilities at project premise/work site to meet any exigency / emergency requirement and shall maintain these facilities throughout the contract period & extension period (if any) as scope of work.

1.44
The equipment/systems/piping/components under these specification shall require to connect / hookup with other systems / equipment / piping / components / terminal points etc. of Customer / other erection vendors. Contractor shall carry out the termination of these systems / equipment / piping with customer/other vendor's terminal points and shall involve welding, bolting/flange joints, cutting, edge preparation, radiography, NDE etc. of terminal point systems (which may not be included in these specifications and may have been erected by other vendor) shall be carried out by contractor as per instruction of BHEL engineer at site including welding / bolting of counter/matching flange joints as scope of work. Decision of BHEL engineer shall be final and binding on contractor.

1.45
As such the external barricading of project plot area will be carried out by civil agency as scope of civil works. Contractor under these specification shall carry out his internal barricading/ cordoning off (as applicable) of area of his operations, providing safety nets, safety tapes, passenger trolley for high height working etc. as per safety requirements/safety concern and regulations enforced by CUSTOMER/BHEL at site before under taking the day-to-day works. All such works/arrangements shall be carried out by contractor as scope of work.

1.46
For structures, supports, stairways, platforms, galleries, hand rails, grills, etc. the structural materials may have to be cut to required profile in order to suit the requirement as incidental to the work. Also it may sometimes be necessary to remove some of the erected members to facilitate erection of bigger / pre-assembled equipment. In such cases, the removal and re-erection of such works as agreed by BHEL Engineer will have to be done by contractor as incidental to work.

1.47
All the handrails and toe guards shall be provided as per drawing and safety requirements. After cutting the floor grills to suit the site condition, the cut edges shall be painted with two coats of cold galvanizing paints conforming to Indian Standard.

1.48
For any items or class of work not specified herein but required for total completion of work, the same shall be carried out as per BHEL requirement. However, payment of these items/class of work shall be regulated on the basis of rate arrived at by either of the following methods:

a) Based on rate of identical/similar items in the rate schedule.
b) Based on the rate arrived from nearby items in the rate schedule.

Wherever any item rate for similar type of work or nearby item rate does not exist in the rate schedule, rate will be worked out on the basis of work element or from fundamentals of estimation.

CHAPTER-2
EQUIPMENT INSTALLATION - MECHANICAL

2.1 Erection of Common System Equipment and Balance of plant Equipment with other related equipment & auxiliaries at site is in the scope of work.

2.2 For the skid mounted equipment, the checking and realignment required at site is in the scope of work.

2.3 Components like filters, meshes etc., received loose are to be erected in position by contractor.

2.4 Air Compressor, Blowers will be supplied in individual assembled sections with inside insulation. Site job involves complete assembly and erection.

2.5 The piping shall be site routed. The contractor shall complete the job within quoted rate.

2.6 Fabricated/pre-fabricated parts/ components etc. have to be checked for dimensional accuracy, configuration, proper matching and minor rectifications, wherever necessary will have to be done before erection. This will involve making appropriate bed of steel structures over the concrete locks. Steel, in random sizes, for this purpose will be provided by BHEL from the packing materials / scraps etc., where as necessary concrete blocks shall be arranged by the contractor. Bed shall be fabricated as per requirement. These shall be dismantled & returned to BHEL at appropriate stage. No separate payment for making / dismantling such bed is envisaged.

2.7 Any fixtures, concrete block supports, steel structures, required for temporary supporting for pre-assembly or checking and welding for lifting and handling during pre-assembly and erection shall be arranged by the contractor.

2.8 It shall be the responsibility of the contractor to provide temporary ladders on un-accessible areas for inspection etc., in a manner prescribed by BHEL using their own material till such time as permanent stairways are completed.

2.9 Welding of all attachments on casing, non-pressure parts, pressure parts/ piping , equipment, tanks, vessels etc. including those required for insulation work is in the scope of work.

2.10 Ducts / expansion bellows are normally supplied in loose wall plates / segments and these are to be assembled and welded at site before erection. All joints connecting ducts, expansion pieces and dampers shall be seal welded. These welds have to be tested by LPI and made leak proof as per technical instruction / requirement.

2.11 Structural items shall be cut to required suitable sizes and adjusted/trimmed as part of work.

2.12 The platforms of permanent nature for approaching different equipment like actuators, valves, instruments etc. as per site / BHEL client's requirements, which may not be indicated in drawings, but essential for safe access, shall be made by the contractor from structural steel / materials supplied in random lengths / sizes as per scope of work as per instruction of BHEL Engineer at site.

2.13 Rain hood protection shall be provided for the equipment etc. located outside/ in open space as per drawings & instructions.

2.14 Erection at site involving welding, bolting, tack welding, insulation at joints ,work and erection of Aviation Light and lightening arrestor. All these works are covered under the scope of work of contractor under these specifications.

CHAPTER- 3
PIPING INSTALLATION

3.1 The scope of work in piping system (air, Gas, Water, Oil, etc.) will include cutting to required length, spool preparation, threading, branches & stubs welding, edge preparation, laying, fixing and welding of the elbows/fittings/valves etc., fixing supports/hangers/shock absorbers/ guides and restraints etc. and carrying out all other activities/works to complete the erection and also carrying out all pre-commissioning/ commissioning operations mentioned in these specifications as per BHEL engineer's instructions and/or as per approved drawings. **Weld joints and NDT requirement for all Integral piping and other piping as applicable under tender specification shall be as per drawings/schemes and suiting to site requirement. The necessary drawings/documents for these weld joints will be provided at site during execution of work.**

3.2 Contractor shall carry out the erection and complete the piping works of respective system as per sequence, schedule and program decided by BHEL engineer/customer at site in order to achieve the commissioning schedule of respective equipment/ systems and over all commissioning schedule of project as whole.

3.3 Carrying out of piping as per the specifications between equipment constituting terminal points, whether the terminal equipment fall within the scope of the work/specification or not, is within the scope of the work/ specification. The contractor shall complete terminal joints at either ends, with due NDE & PWHT if applicable, for all the piping schemes covered in the scope of work.

3.4 Fit up and welding/bolting/fastening of piping to the terminal points (such as stubs, valves, flanges on terminal points/equipment, stubs on headers, battery limits etc) forming part of the scope of work/specification and stress relieving and radiography of joints so made are also within the scope of work. Permanent fasteners and gaskets will be supplied by BHEL.

3.5 Interconnection/ Hook-up, if any, with the existing system shall form part of work. Such interconnections, hook-ups may require shut down of running plant and the relevant work has to be completed within such planned shutdowns. This may call for working with enhanced resources and on extended hours. Contractor's offer shall cover all such contingencies.

3.6 All drains / vents / relief / escapes / safety valve piping to various tanks/ sewage / drain canal / sump / atmosphere etc. from the stubs on the piping and equipment erected by contractor is completely covered in the scope of this tender specification.

3.7 As far as possible pre-assembly shall be done. The pipe laying shall be carried out from the available terminal point/points or any other area between the terminal points. The erection can be carried out on temporary supports to obtain proper alignment and welding. After fixing the permanent supports, all the temporary supports shall be removed. The alignment, distances and loading of the supports shall be checked and the required settings to be ensured as per requirement.

3.8 All welded joints should be painted with anticorrosive paint immediately after completion of radiography and stress relieving works. Necessary paints and other consumables for the above work are in the scope of the contractor.

3.9 Layout of field routed/ small bore piping shall be done as per site requirement. Necessary sketch for routing these lines should be got approved from BHEL by the contractor. There is a possibility of slight change in routing the above pipe lines even after completion of erection. Such changes will be incidental to work hence no separate/ additional payment will be made.

3.10 Normally valves will have prepared edges for welding. But, if it becomes necessary, the contractor shall prepare new edges or recondition the edges by grinding or chamfering to match the corresponding tubes and pipes. All fittings like "T" pieces, weld neck flanges, reducers, etc., shall be suitably matched with pipes for welding (this is applicable to piping work also).

3.11 Hydraulic / pressure testing of pipelines, wherever called for, shall be conducted as part of work till satisfactory results are obtained.

3.12 Connection (flanged, bolted, welded) of piping to the terminal points/equipment etc. is in the scope of work even though such terminal point/equipment may not form part of this work. All NDE including radiography of joints so made, post-weld-heat-treatment if any, is also within the scope of work/specification. The terminal points work is inclusive of cutting of existing lines, edge preparation, welding/blanking and hook up work.

3.13 It should be ensured that all the terminal point connections are done without transferring any undue load or strain to the other equipment. Necessary protocols have to be prepared for such fit-up along with BHEL /customer representative before connecting. All NDE including radiography of joints so made, post weld heat treatment if any, are also within the scope of work / specification.

3.14 The non-IBR piping will be sent as plain pipes. The attachments for tapping points and / or supports will be sent as loose items. Site work will involve fabrication, drilling, fitting, pre-heating, welding, NDE & PWHT as per applicable BHEL documents. Rate quoted shall take account of all these work as no separate payment is envisaged for such work.

3.15 For integral piping all attachments etc will be supplied as loose items and are to be welded to the main pipes at site as per instructions. Necessary drilling of holes on main pipe for welding stub shall also be done at site by the contractor.

3.16 Underground / buried piping (if any) shall involve rapping & coating protective coating as per drawing requirement. Erection, laying, welding, Wrapping & Coating of this pipe shall be carried out and payment for all such work shall be paid as applicable carbon steel piping erection & commissioning.

3.17 The following items of work shall be incidental and forming part of piping fabrication and erection:

(1) To locate cause of vibrations in equipment/auxiliaries/pipelines and carrying out necessary corrections in case the same is attributed to the contractor.
(2) Fabrication and erection & welding of racks, steel supports, guides, restraints for all the piping. Steel for this purpose will be supplied by BHEL free of charge in random and running lengths.
(3) Erection of filters, flow nozzles/ flow indicators/ flow orifices other measuring elements in the piping. These may have been supplied either by BHEL or their customer. This may involve cutting of pipe lines, fresh edge preparation and welding with stress relieving wherever applicable.
(4) Fabrication / making of bends for pipes and tubes of diameter upto 65mm.
(5) Matching of all fittings like tees, bends, flanges, reducers valves, socket fittings, etc with pipes for welding.
(6) Servicing of valves and actuators etc.
(7) Cleaning of all pipes by chemicals/wire brushing / blowing by compressed air.
(8) Welding of root valves with small length of piping to the pressure, flow and level tapping points on piping or flow nozzles/orifices/metering/ measuring elements fixed on piping.
(9) welding of blanks with stress relieving if required on a temporary basis.

3.18 SERVICE & INSTRUMENT AIR PIPES

3.18.1 Laying of S.S. /G.I. Pipes with fittings and supports of instrument air lines/process air shall include air blowing, hacksaw / cutting from running length to the size, threading, welding, installation of isolation valves, headers, root valves, moisture traps, check valves, supports and clamps etc by providing the required consumables shall be carried out by contractor.

3.18.2 Line shall be provided with proper slope as per drawing / standards and shall be supported at recommended pitching.

CHAPTER-4
WELDING & HYDRO TESTING

4.1 The method of welding (viz) arc, TIG or other method will be indicated in the detailed drawing/documents. BHEL engineer will have the option of changing the method of welding as per site requirement.

4.2 Welding of all attachments to piping shall be done only by the qualified and approved welders.

4.3 All the welders (structural and piping) shall be tested and approved by BHEL engineer before they are actually engaged on work though they may possess the IBR/other certificate. BHEL reserves the right to reject any welder without assigning any reason.

4.4 Unsatisfactory and continuous poor performance may result in discontinuation of concerned welder.

4.5 Removal of welding slag and burrs by hand files, with brushes and/or flexible grinders will be carried out simultaneously.

4.6 The welded surface shall be cleaned of slag and painted with primer paint to prevent rusting, corrosion. For this consumables like paint etc will be in the contractor's scope.

4.7 Joint fit-ups, should be protected, where required, by use of tapes/protective paint as may be prescribed by BHEL. The contractor shall supply consumables like protective paints/tapes etc.

4.8 On all oil, instrument, gas, air (Instrument air/services air) piping, Cooling water Piping, etc. both TIG welding and subsequent arc welding or total TIG welding process is to be adopted as instructed by BHEL engineer.

4.9 All weld joints on piping shall be ground / filed / dressed on completion of welding as per instructions BHEL engineer.

4.10 The Contractor shall procure all electrodes and filler wires of approved quality / brand as per the standards and specifications of BHEL and instruction of BHEL Engineer.

4.11 The purchase of electrodes shall be accompanied by proper test certificate and these certificates should be submitted regularly for the scrutiny of BHEL engineer.

4.12 BHEL engineer is entitled to stop any welder from his work if his work is unsatisfactory for any technical reason or if there is a high percentage of rejection of joints welded by

him, which, in the opinion of BHEL engineers, will adversely affect the quality of welding though the welder has earlier passed the tests prescribed. The fact that the welders have passed the test does not relieve the contractor from his contractual obligations to check the performance of the welders. Contractor shall submit a monthly performance record of all welders.

4.13 All welded joints shall be subject to acceptance by BHEL engineer whose decision will be final and binding.

4.14 All joints shall be offered for visual inspection after root run. Subsequent welding should be made only after the approval of root run.

4.15 HYDROSTATIC TESTING, PRESERVATION AND OTHER TESTS

4.15.1 Contractor shall carry out the following tests required to complete the erection and commissioning of the STP Set:

(1) Hydraulic testing of piping & Vessels(if any):Required capacity Hydraulic test pump/Fill pump and other necessary arrangement shall be provided by contractor to carry out hydraulic testing, Chemical cleaning of the equipment and piping as part of scope of work under this tender specification.
(2) Ultrasonic test
(3) Dye Penetrant test
(4) Magnetic Particle Test.

All above facilities (men, materials, equipment, consumables etc) with operating engineer/experienced person and proper approach wherever required shall be provided by the contractor for satisfactory completion of the above tests.

4.15.2
Contractor shall lay all necessary temporary piping, welding, supports, install pumps, valves, pressure gauges, electric cables and switches etc, required for the Air leak test, Chemical cleaning etc.. After the test is over, all the temporary piping, pumps, etc will be removed. It may also specifically be noted that servicing, erection and dismantling of piping and equipment for conducting above tests will be done by the contractor. No separate payment shall be made for this purpose.

4.15.3
All the above tests shall be repeated till all the equipment, piping and systems satisfy the technical and statutory requirements. All related works form part of the scope.

4.15.4
For the installation of temporary system as above BHEL will provide only the piping, structural items for supports and access platforms, tanks/ plates for fabrication of tank, valves, gauges and their fittings, and thermal insulation only. These will be supplied in random sizes / lengths. However, fabrication, erection, dismantling of the same after completion of the process, and handing over back to BHEL stores will be the responsibility of the contractor. All above works shall be carried out by contractor. The works of all other temporary piping for remaining applicable tests shall be carried by contractor as scope of work. All pumps of adequate capacities and specifications to meet the requirement, suitable motors and their starters, foundation/ frames, cables, switches etc shall be arranged by the contractor (other than which are to be provided by BHEL free of hire charges on returnable basis).
Cleaning, servicing of tanks, valves, pumps, equipment, during various stages of erection and commissioning are in the scope of work. Gaskets, packing & spares for replacement will be provided free of charges by BHEL.

4.15.5
Hydro test of piping may have to be repeated several times to meet technical and statutory requirements before application of insulation.

4.15.6
While conducting hydraulic test of steam lines, water lines, oil lines either individually or grouping a few lines or in portions. Blanks/spools may have to be put up at terminal points, strainers, walls, flanges etc. After conducting the tests, the blanks shall be removed and the lines restored. Contractor shall carry out all such incidental work to satisfactorily conduct the hydro test. Wherever work is involved in the terminal points, Contractor shall carryout the same as per instruction of BHEL engineer. The decision of BHEL engineer is final and the same is binding on the contractor.

The contractor shall carry out any other tests as desired by BHEL engineers on erected equipment covered in the scope of this contract during testing and commissioning to demonstrate the satisfactory completion of any part or whole of work performed by the contractor.

4.15.7
For various pre-commissioning / commissioning activities / processes mentioned in various clauses, transport of chemicals from BHEL/ customer's stores, charging of chemicals into the system and returning of remaining chemicals and the empty containers of the chemicals to customer / BHEL stores is the responsibility of the contractor.

4.15.8
During trials/ tests, pre-commissioning / commissioning, replacing / changing mechanical / other seals of equipment like pumps, removal and cleaning / replacing of filters etc is within the scope of work.

4.15.9
In case any defect is noticed during tests, trial runs of all equipment and their auxiliaries, such as interferences, rubbing, loose components, abnormal noise or vibration, strain on connected equipment etc., the contractor shall immediately attend to these defects and take necessary corrective measures. If any readjustment and realignment are necessary, the same shall be done as per BHEL engineer's instructions. Claim, if any, for these works from the contractor shall be governed by relevant clauseses.

4.15.10
Contractor shall cut / open / dismantle work, if needed, as per BHEL engineer's instructions during commissioning for inspection, checking and make good the works after inspection is over.
Similarly, during the course of erection, if certain portion of equipment erected by the contractor has to be undone for enabling other contractors / agencies of BHEL / customer to carry out their work, contractor shall carry out such jobs expeditiously and promptly and make good the job after completion of work by other contractors / agencies of BHEL / customer as per BHEL engineer's / agencies of BHEL / customers instructions. Claims, if any, in this regard shall be governed as per relevant clauses .

4.16 **PRESERVATION OF COMPONENTS**

Contractor shall arrange for preservation of components/ materials issue to him as per BHEL's storage and preservation manual and/or as per instructions of BHEL engineer.

One or more of following methods shall be adopted for preservation:

Coating with preservative paints/lubricant/inhibitors.

Capping/wrapping/covering.

Filling/immersion in oil/chemicals etc.

CHAPTER-5
EQUIPMENT INSTALLATION -ELECTRICAL AND C&I

The work will comprise of, *but not limited to the following:*

5.1 **Installation of Control panels and LT Switchgear**

5.1.1

Electrical control panels, Electronic Control panels, Unit Supervisory Control DESK,LT Switchgear, 415V LT MCCs are normally supplied in suit of either one/two/three or loose shipping sections with integral base frame or loose base frame. These panels may have to be installed as stand-alone or in-group consisting of number of panels in each row, depending upon the plant layout and foundation arrangement.

5.1.2

The panels shall be transported from stores to the place of installation in vertical position. Care shall be taken such that the Switches, Lamps, Instruments etc. mounted on the panel does not get damaged during transit.

5.1.3

Installation of panel shall include fixing of base frame, leveling, alignment, fixing of anti-vibration pads, removal of side covers, fixing of cubicle interconnection hardware's, Bus bar jointing, wiring interconnection, Welding and Grouting of panels and base frames, mounting of panel Canopy wherever supplied as part of panel, drilling of gland plates, sealing of panels/ cable entries. Where the base frame is not supplied as part of panel supply, the contractor shall fabricate the base frame from structural items at site. Payment for such fabrication will be effected on measured quantity at the rate applicable for structural steel fabrication and installation. Special material required for fireproof sealing of the panels shall be supplied by the contractor within the quoted rates. Proper sealing of all the holes and Cable entries (even if the cable has been laid by others) in the panel is in the contractor's scope.

5.1.4

Panels have to be shifted to their locations through floor openings, temporary openings like floor grills, door etc. which shall be a part of work and no claim whatsoever will be entertained with regard to non-availability of opening as per shortest route etc. Panels have to be erected at different locations and elevation in end user's (M/s RDA) LT Switchgear room, Unit Control Room etc.

5.1.5

Panel and instruments once erected in position should be properly protected using necessary care to prevent ingress of dust/moisture. This will have to be periodically cleaned and surroundings have to be kept tidy.

5.1.6

Whenever the panels to be mounted on cable trenches, channel supports have to be provided across the cable trench over which the base frame of panel shall be mounted. For such work, Structural Steel fabrication & installation rate shall be applicable.

5.1.7
Normally the panels shall be supplied with meters, relays, electronic modules, contactors, pushbuttons etc mounted and pre-wired. However, if such devices are supplied loose/separately for safety in transit, contractor shall mount the same, as part of panel installation work and no extra payment shall be made for this.
5.1.8
Supplier's instruction manuals, packing slips, door keys etc. Received along with the panels will be handed over to BHEL's engineer on opening of the panels.
5.1.9
Regular cleaning of the panels as per the instruction of BHEL engineer till handing over of the set to customer is to be carried out by the contractor free of cost.

5.2 415V MOTOR CONTROL CENTERS (MCC) & DC DISTRIBUTION BOARDS

5.2.1

Motor control centers are single / double front draw out type consisting of circuit breakers units, contactor/starter, switch fuse units, protection & metering relays/ instruments etc. arranged in multi tier construction. These MCC are mainly supplied to cater to the requirements of drives, valve actuators etc.

5.2.2

DC distribution Board is single front non-draw out type consisting of MCCB/SFU, contactors, starters, fuse units, MCB etc arranged in multi-tier construction. DCDB shall be located in LT switchgear room to cater the dc supply requirement.

5.2.3

The scope of work for the LT switch board and DCDB covers receipt of materials from stores, transportation to the respective location, erection, testing, commissioning and handing over.

5.2.4

Rubber mats shall be supplied by Contractor for LT switchgear and the same shall be laid wherever required as part of work.

5.2.5

The scope of work for the LT switch board and DCDB covers receipt of materials from stores, transportation to the respective location, erection, testing, commissioning and handing over.

a) Checking of installation for correctness.
b) Mechanical functional checking/ adjustment of individual breaker.
c) Measurement of Insulation resistance of individual breaker, complete switchgear board and combined insulation resistance of individual breaker with cable connected to drives.

d) Testing of Protection Relay, Thermal over relay, Power transducers, Energy/ Ammeters, Voltmeters, Power factor, frequency & metering etc. in static & dynamic condition relay

e) Conducting test such as Insulation Resistance measurement, Ratio, polarity, magnetization characteristic, winding resistance on CT and PT.

f) Checking of electrical control & protection interlock of individual breaker and integration with other system.

g) Calibration of energy meters, tri-vector meters, voltmeters, ammeters, power current & voltage transducers etc.

h) Provide assistance for checking the electrical operation of individual breakers from remote panels / MMI package in End user's scope).

5.3 Cable Laying (Power / Control / Instrumentation shielded cables / Triad Cable / plug-in cables / UTP cables for Ethernet / armored / Un-Armored, single / multi-core, PVC/HR PVC / FRLS / Teflon / XLP insulation)

5.3.1 Cable laying (erection) will include:

a) Cutting to the required length, laying in overhead/underground cable trench/ through pipes/flexible conduits. Cable rollers have to be used as per requirement. The contractor shall prepare the drum schedule in order to minimize the wastage.

b) Dressing/Clamping in tray etc.

c) Drilling of holes in gland plates in panels and junction boxes for the entry of cable.
d) Cable glanding, splicing, dressing of spliced wire inside the panel and JBs
e) Providing printed ferrules. Wherever required ferrules shall be one-piece heat shrinkable type. **Contractor has to arrange for suitable ferrule printing machine(s).**
f) Termination by using crimp type lugs copper tinned/ aluminum (insulated/ un-insulated).
g) Providing identification cable tags, aluminum at both the ends and at appropriate interval (30m) throughout the route length. Tags to be arranged by the contractor.
h) Continuity checking, insulation resistance checking, High Voltage test on HT cables, as applicable.
i) LT Power cable trefoil clamps (Die cast Aluminum of good quality) are to be arranged by the contractor within the quoted rates.

5.3.2 Entry to the panels, JB may be from top, side or bottom. All cable shall be supported and clamped near the panels/JBs.

5.3.3 Wherever cable glanding is not possible, either due to the gland plate size limitations or more number of cable entries, suitable alternative arrangement as specified by BHEL/end user shall be done. Pre-Fab plug-in cables, for such cases, cables may have to be lifted inside the panel

either making cut-out in gland plate and providing Rubber profile for sharp edge protection or alternatively, provide 4/6" PVC pipe coupling gland and these pipe coupling gland shall be supplied by contractor within the quoted rate of cable laying.

5.3.4 Copper Tinned lugs of various type (pin, ring, fork, snap-on), PVC cable ties, PVC ferrules (printed), PVC buttons and tapes, cable identification tag of metallic, clamping and dressing material with hardware, PVC sleeves etc shall be supplied by the contractor within the quoted rate for cable laying. The quality of material shall be got approved from BHEL engineer prior to their procurement.

5.3.5 All care should be taken to avoid abrasion, tension, twisting, kinking, and stretching of cables during installation.

5.3.6 Cable shielding – all signal cables are supplied with bare shielded copper wire/with braided wire shield, generally shield wire is kept isolated at instrument/field device end and continuity is maintained through JBs and getting earth at panel end only. While terminating the shield wire either in panel or JBs, PVC sleeves is to be used to avoid two-point earthing. Supply of PVC sleeves of appropriate color is in contractor's scope.

5.3.7 Wherever cable ducts/tray, conduits pass through fire barriers such as walls, floors etc., the openings/ passage shall be sealed using fireproof/ weatherproof sealing compound. Similarly cable entry in panels, MCC, Instruments, Electrical Actuators etc are also required to be sealed. These shall be done as per the specifications of BHEL. Required consumable shall be in contractor scope of supply within quoted rate for cabling.

5.3.8 Normally, junction boxes are received with mounted cables glands. While terminating the cables as per drawings, the cable glands to be removed and fixed. Wherever cable glands are not received along with junction boxes, no separate payment will be made for fixing the cable glands to the junction boxes including the drilling of holes.

5.3.9 Many of the cables may have to be laid in the cable trenches constructed by end user. For this purpose, the cover of trenches has to be opened for working inside. All safety precautions have to be observed while laying the cables in the trench. After completing the work, the trench has to be cleaned and covers put back into position. The contractor, if required, shall do de-watering of trenches.

5.3.10 Terminations:

The types of cable terminations are as detailed below:

a) Power cable: Crimping hydraulic / Manual

b) Control cable: Manual crimping

c) Crimped/soldered plug-in-type Screwed type.

All console devices / computer peripherals shall be screwed, crimped, soldered plug in type.

UTP cable with RJ 45 connector. The contractor shall arrange for special tools and skilled manpower required for any type of cable termination (like fiber optic jointing kit and RJ45 crimping tool etc) as mentioned above. Additionally ferrule printing machine(s) for printing of sleeved ferrules of various sizes will also be arranged by the Contractor.

5.3.11

Looping wire at terminal block of panels and electrical actuator as shown in the inter-connection diagram is to be done by contractor at no extra cost.

5.4 Wastage allowance

Contractor shall carefully plan the cutting schedule of each cable drum in consultation with BHEL site engineer such that wastages are minimized. Recovery will be made in case the wastages are exceeding the wastage allowances fixed in this contract.

The erection contractor shall make every effort to minimize wastage during erection work. In any case, the wastage shall not exceed the following limits;

Power Cables	**1.5%**
Control & Instrumentation Cables	**2.0%**
Fabrication steel	**2.0%**
Impulse pipe/tubes/GI pipes/copper tube	**1.0%**

If however, the bidder quotes for more wastage than specified above, the excess portion will be considered for adjustment during the tender evaluation at the quoted supply rate of material. If the actual wastage be more than the specified figure, then equivalent price of the excess portion will be deducted from the contractor's bill. Cable cut-pieces in lengths 10 m & above in both the above categories will be considered as useable and shall be taken in to account for computing net issued quantity when returned to BHEL stores/storage yard.

5.5 CABLE TRAYS/CABLE DUCTS

5.5.1
Various types of sheet metal, Galvanized Cable Tray, i.e. Perforated, Ladder type, sheet metal duct, solid bottom trays, pre-fabricated structural trays etc., shall be supplied by Contractor in standard lengths along with accessories and hardware viz coupler plate, tray covers and tray clamps etc.

5.5.2 Installation of cable tray/cable duct shall include cutting, laying, jointing, fixing tee/reducers/ bends/clamps, fixing of tray covers, hardware, welding of tray supports as per tray route layout etc.

5.5.3

Supply, Fabrication of bends/tee/ reducers from straight length is within the scope of work and rate quoted shall be inclusive of this. All site welds of cable trays shall be painted with approved primer and cold galvanizing paint, which shall be arranged by the contractor.

5.5.4

In case, structural cable trays, bends, tees, reducers etc., are required to be fabricated from structural steel and installed, unit rate applicable for fabrication and installation of structural steel shall be applicable in such instances.

5.5.5 Cable trays/duct etc may have to be routed underground in cable trench, overhead on structure, along the walls, floors etc. for various applications.

5.6 STRUCTURAL STEEL SUPPLY, FABRICATION AND INSTALLATION

5.6.1

Structural steel material like MS angles, channels, beams, flats, plates etc. shall be supplied by Contractor in running meter and the same shall be used for fabrication of panel base frame, cable tray supports, Canopies for instruments/panels/ drives/JB's/Push Buttons etc., Instrument/Junction box frames, Impulse Pipe/Instrument Air Pipe supports and instruments etc.

5.6.2

This shall include cutting to size, contouring of ends for connections if required, Welding, Grinding of excess weld deposits/burrs, drilling of holes for mounting of device/instrument, installation at location, leveling, alignment, providing bracings and painting etc. No gas cut holes will be permitted.

5.6.3

All the fabricated supports/frames for instruments, trays, pipes, electrical equipments, etc., shall be epoxy painted after sand blasting and surface preparation as per painting specifications. Paints and other associated items are in the scope of the contractor.

5.6.4

Frame installation at site may involve mounting either on concrete floor by grouting/using anchor fasteners or on steel structure by welding etc. All consumables including anchor fasteners shall be arranged by the contractor. Where required, as part of work, concrete floors may have to be chipped out to reinforcement depth for anchoring the frames. Wherever grouting is required, contractor shall arrange all the required material including cement/grout mix, shuttering, labour etc., and meet all other requirements as part of work.

5.6.5

In certain packages, members of frames/rack for mounting of junction boxes/ instruments may be supplied readymade. These have to be assembled prior to installation. The installation rate as quoted shall include assembly of the frames.

5.6.6

Gas cutting of tray/impulse pipe support and holes in frame is not permitted. Only hacksaw cutting/ drilled hole shall be permitted.

5.7 Earthing installations

5.7.1All equipments shall be earthed by two separate and distinct connections. Earthing terminals will be available in all equipment supplied by BHEL.

5.7.2

The earthing conductors supplied by Contractor shall be of mild steel/GI strip/ wires. All connections from equipment to main earthing conductors shall be made as illustrated in earthing drawing / as per instruction of BHEL engineer.

5.7.3

A continuous earthing conductor shall be installed in all cable trays and securely clamped to each tray section by suitable connectors to form a continuous earthing system. When two or more trays supporting power cables run in parallel, a continuous earthing conductor shall be provided on trays only with tap offs to the control cable trays. All valve and damper motors and rapping motors will be earthed to this conductor.

5.7.4

All joints in the earthing system shall be welded type. Earthing connections to all equipments including motors shall be bolted type.

5.7.5

Earthing connections shall be free from tinning scale paint, enamel, grease, rust or dirt at the time of making joint.

5.7.6 Metallic sheaths, screens/shields and armor of all multicore cables shall be bonded and earthed.

5.7.7 Earthing conductors along their run on columns, beams, walls etc. shall be supported by suitable cleats at intervals of 750 mm.

5.7.8 Welded joints on GI earthing conductors shall be coated with one coat of bituminous paint in case of buried earth grid or earth flats to be laid in cable trench. For site welded GI strips/wires which are exposed these are required to be painted with one coat of cold galvanising zinc paint. Contractor to arrange the required paints and other items at his cost.

5.8 INTEGRATED TESTING OF CONTROLS AND PROTECTIONS & RELAY TESTING

5.8.1

Integrated electrical testing/commissioning of LT MCC & other electrical panels and associated equipment shall involve various activities like relay testing/setting, simulation checks, testing of energy meters, on/off line functional checks on integrated system. The brief scope of work under the "integrated testing/ commissioning of generator controls and protections relay panel & associated equipments" is defined as below, but not limited to the following.

a) Relay testing in static condition for generator, transformers, and associated system by secondary current injection at different current and recording the time duration.

b) Testing and checking of control and protection interlock scheme in static condition and simulation of protection device contact from internal and external devices.

c) Measurement of Insulations, Winding Resistance, Polarization Index of winding of Generator & associated equipment/ system, DC resistance test & Impedance test on rotor, Brushless excitation system at the time of rotor insertion as well as during pre-commissioning stage / commissioning stage/ post commissioning stage.

d) Relay setting and checking the stability of protection relays in static and dynamic condition during the OCC (open circuit characteristic) & SCC (short circuit characteristic)

e) Functional checks / testing of synchronizing schemes during the static and dynamic by simulation / back charging of generator transformer conditions.

f) Monitoring & recording the various parameters during open circuit and short circuit conditions test on generator & associated field equipment like generator transformer, unit auxiliary transformer. Recording and monitoring measurement.

g) Testing of protection current transformer for ratio test by primary injection, magnetization characteristic, polarity test, and IR measurement. Functional checks of relays of protection system by primary injection.

h) Testing of potential transformer for ratio test by voltage ratio, polarity test, insulation resistance measurement etc, testing of surge capacitors, PT isolator in PTPS cubicle etc. (theses are housed in generator side line & neutral cubicle).

i) Measurement of Insulation resistance of individual equipment and connected together.

j) Tan delta test on generator & other equipments as required.

k) Calibration of energy meters, tri-vector meters, voltmeters, ammeters, current & power transducers etc.

l) Providing temporary shorting link on bus duct or any other location while testing & normalization after the test.

m) Testing & commissioning generator circuit breaker.

n) High voltage test on inter connecting cable between generator and line/ neutral side cubicle.

o) Testing of relays, meters, internal devices, functional checks of electrical panels LT MCC and other panels/ equipments.

p) Contractor shall discuss & finalize testing procedure with BHEL engineer in-charge for the test to be conducted on generator control & relay panel testing. Drawing & documents

shall be provided by BHEL at the time of testing. BHEL decision in this regard shall be final and biding on the contractor.

q) Checking & testing of neutral grounding transformer & resistor.

r) Compilation of test records.

s) In case contractor has not done similar work, they are free to tie –up with experienced agency who has carried out similar nature of work and having adequate resources i.e. Experienced manpower, T&P / testing/ measuring instruments. Contractor shall submit documents in support of such tie –up arrangement of such parties along with the offer. Credential of such parties shall be submitted with technical bid along with tie-up MOU.

t) It is to be noted in general that for any testing of protection relays, MCC etc., where the contractor is not sufficiently experienced, they shall arrange for the services of suitable agencies for carrying out the work, within the quoted rates.

u) In case of party quoting for the work have their own resource or resourced capability to take up relay testing etc. At site, the evidence of same is to be annexed to the technical bid

5.8.2 OR ALTERNATIVELY

a) As indicated, contractor is free to tie up with experienced agency that has done similar work. The following parties are recommended by BHEL as agencies capable of carrying out these activities:

i. M/S ELCON ENGG

701, CENTRE POINT, ALKAPURI
R C DUTT ROAD, VADODARA 390007
CONTACT PERSON: SHRI ARVIND MEHTA
PH NO 0265-2359152

ii. PINNEL POWER SYSTEM

PILLAIYAR KOIL STREET
JAFFER KHAN PET
CHENNAI 600083
PH NO 044-24718925, 24891975.

iii. CONSULT INDIA, MUMBAI

CONTACT PERSON: SHRI JINGRE.
PH NO 022-25333727

iv. HI TECH ENGINEERING SERVICES

PLOT NO 127, 5TH CROSS STREET, AVM COLONY
VIRUGAMBAKKAM
CHENNAI 600092
CONTACT PERSON: SHRI S. SUBRAMANIEM
PH NO 044-23763520

v. VOLTECH ENGINEERS

ARUNODAYA APARTMENTS,
FLAT B-4, I FLOOR,
27, 2ND MADLEY ST,
T.NAGAR, CHENNAI
CONTACT PERSON: GEETHA
PH NO: 044-28341230

In such event where the relay testing facilities are outsourced by the bidder, the tie-up action taken in this regard by the bidder should be clearly mentioned in their offer (technical bid) and it should be made clear that from which of the above recommended parties such services shall be sourced.
In case the tie-up for the above is with some other party other than those recommended by BHEL, then sufficient proof of the credentials and experience of the party in this field of work shall be annexed to the technical bid.

5.9 CONTROL & INSTRUMENTATION

5.9.1
Contractor shall mount all flow indicators, centrifugal/speed switches of motors, accumulators, pressure regulators, etc which are received loose and which are to be erected/mounted at site on air lines, water lines, oil lines, auxiliaries and firemen floor and other operating floors on power house and other equipment. These are to be mounted during erection for finalizing routing/position etc. They are to be dismantled after completion of erection work and handed over to BHEL for calibration. After calibration, these instruments shall be remounted by the contractor in their respective positions just before commissioning.

5.9.2
Certain instrumentation like, pressure gauges, power cylinders, flow meters, valve actuators, flow indicators, etc are received in assembled condition as integral part of equipment. Contractor shall dismantle such equipment at an appropriate stage under the instruction of BHEL and hand them

over to BHEL for calibration and storage. Contractor shall re-erect them in position just before commissioning of the equipment.

5.9.3

Seal welding of Thermowells, plugs before Hydro test of equipment and piping systems is also within the scope of this work/specification. Contractor shall also remove the seal welded plugs by process of grinding and fix and seal weld Thermowells after Hydro test/steam blowing of lines.

5.9.4

Providing necessary engineer/supervisors/technicians/electricians as required by BHEL engineer for drying out the LT motors is within the scope of the work. Job includes testing the motor for finding out PI & IR values and making necessary cabling connection for heating for dry out from the nearest source of supply and maintaining and controlling the temperature till the IR and PI values are achieved as per standards. However, BHEL will provide necessary motorised insulation testers for this purpose. The contractor shall provide necessary power cables and other tools and consumables for the above works free of charges. Before undertaking dry out/trial run of HT motors, the end shields and covers shall be opened on both the ends of the motor for inspection, cleaning and greasing of bearings.

5.9.5

Welding of all Thermowells, draft, pressure and temperature instrumentation points, and all other instrumentation points on piping, and auxiliaries is within the scope of this work.

5.9.6

All Motors shall be preserved with space heaters(if any) on, and provided with proper cover till the commissioning of the motors.

5.9. 7

Mounting of instrumentation on equipment shall be the part of scope of work and contractor shall render necessary services for their commissioning.

5.9.8

Trial run of all motors including checking direction of rotation in uncoupled condition, check alignment and re-couple the motor to driven equipment.

5.9.9

After initial trial of rotating equipment, control and power cabling for motors and other equipment/instrumentation may have to be disconnected for checking alignment and resetting/realignment/hot alignment. Contractor will have to provide services for disconnection and reconnection of control and power cables.

5.9.10

Certain instrumentation like pressure switches, air sets, filter regulators, pressure gauges, and junction boxes, power Cylinders, dial thermometers, flow meters, valve actuators, flow indicators etc. are received in assembled condition as integral part of equipment. Contractor shall dismount

such instruments for calibration and hand over the same to c & i erection agency of BHEL. Mounting of such instruments will be done by the C&I erection agency.

5.9.11 Field instrumentation

a) Various type of primary/secondary/ indicating/ recording instrument for pressure, temperature, flow, level, speed, turbo-supervisory and analytical measurement shall be supplied either loose or mounted along with the equipment.

b) Scope of work under calibration, erection// testing/ commissioning shall include calibration, setting, adjustment, supply and fixing of instrument tag plates as specified by BHEL, report making, installation, servicing, minor repairs, putting instrument into service, signal checking from field upto the functional group panels and remote indicating/recording instrument, functional checks, interlock and protection/alarm checks by simulating the field devices, trouble shooting during pre-commissioning/ commissioning and till the unit is handed over to the customer.

c) Contractor shall establish calibration laboratory with adequate facilities and they should arrange standard test instruments duly calibrated from the agencies approved by BHEL. Calibration report of the same should be submitted prior to start of calibration of the field instruments/devices.

d) It is the responsibility of contractor to make erection, calibration/ testing and commissioning protocols for various equipments/devices installed by them and they should get duly certified by customer/BHEL engineer and should be submitted to BHEL engineer regularly. However, sample formats will be given by BHEL and have to be printed by contractor in adequate numbers.

e) Installation of instrument shall also include drilling of holes and tapping for mounting of instrument and local instrument frames/panels and supply of hardware for mounting of the instrument.

f) Some devices line solenoid valves, position feedback transmitters, limit switches, air filter regulators, airlock relays, positioners etc., are supplied assembled along with mechanical equipments like pneumatic control valves, power cylinders, trip valves, dampers, motorised actuators, etc. These will need removal, calibration/testing, refixing, adjustment, etc., and commissioning. Separate payment shall not be made for this. The rates quoted for the commissioning of these equipments (viz., pneumatic control valves, power cylinders, trip valves, dampers, etc.) should take care of the above. Also, the contractor shall remove such devices prior to erection either at site or at store to avoid damages/pilferages and keeping in safe custody and the same shall be installed prior to commissioning of such equipment.

g) Transmitter enclosure / open racks for various packages which are to be erected and commissioned at various locations of the Boiler, turbine and outdoors, shall be supplied with internal tubing, air filter regulators, rotameters, provision of continuous or intermittent purging arrangements wherever required, etc. The quoted rates for these racks / enclosures shall include the erection and commissioning of all such items inside these racks / enclosures.

h) Sometimes recalibration of equipments may become necessary due to reasons not attributable to the contractor, e.g. Lapse of Time after first calibration, Need for change in range/parameter, etc. If re-calibration is required due to no fault of the contractor, the rates payable for re-calibration shall be as under:

i) Recalibration Charges = 60% of the Percentage Stage Payment for Calibration

j) The contractor shall keep record of such instrument with the reason for re-calibration and certified by the BHEL Engineer.

k) **Note:** For recalibration of skid mounted items or other systems where lumpsum rates are quoted, the recalibration charges, if admissible, will be calculated from the relevant unit rates quoted for same / similar items elsewhere in the rate schedule. The decision of BHEL Engineer shall be final and binding on the contractor.

l) For the very few cases where required, the contractor shall carry out re-orientation of bottom/top entry arrangement for process connection if needed due to site condition in existing instrument rack/enclosure/JB and re-location of existing instrument including removing of the existing tubing and re-installation of the same at appropriate location due to any change in grouping of the instrument and no extra payment shall be applicable.

m) In certain cases instruments / devices are supplied on equipment or drawn by other agencies as part of mechanical package. The same are to be received or to be collected from other agencies for keeping in safe custody to avoid damages. The same are to be erected back after calibration for which unit rate shall be applicable for erection and calibration. Contractor shall maintain record of such instrument duly certified by BHEL engineer. However for removal of such instrument, no separate rate/payment shall be applicable.

n) For such of those instruments/devices such as temperature gauge/switches, pressure gauge/switches, transmitter pressure/flow/ level/DP, level probe/switch etc, which are received, assembled with mechanical equipments and are to be calibrated, only calibration rate will be paid as per applicable rate for respective instruments/devices. No payments shall be made for removal and re-fixing of such instruments.

o) Wherever thermowells are supplied along with temperature gauges, thermocouples, temperature switches, thermostats, etc., the contractor has to co-ordinate with the mechanical engineer for identification and fixing of thermowells on the pipeline. However actual fixing of thermowells on pipeline and seal welding shall be done by mechanical contractor and is not a part of instrument installation.

p) All field mounted instruments are to be located in such a way as not to obstruct walk-ways or plant equipment access but shall be easily accessible for maintenance. Hand rails shall not be used for mounting or supporting instruments.

q) Racks/stands and supports for instruments and transmitters shall be fixed on RCC column/floor by chipping and grouting or by welding to steel structure. In no case these shall be welded to floor grills.

r) The power cylinders support/base erection will be welded to steel structure or by grouting. The power cylinder will be properly aligned and linkage mechanism wherever required shall be connected to the driven equipment. All accessories for power cylinders line air sets, solenoid valves, air lock, limit switches, if supplied loose, shall be fixed, aligned and connected up.

s) When installing flow and pressure transmitters/switches for Liquid /steam/condensate vapor services, the instrument is to be mounted below its primary element or tapping point. For gas service applications, the instrument is to be mounted above Primary element tapping point.

t) During erection and commissioning stage, the site mounted instrument shall be protected suitably. Contractor shall provide suitable security arrangement in main control room, and other areas where equipments are positioned, at no extra cost.

u) All brackets/racks and support steel work for tubing impulse lines/instruments shall be painted with two coats of primer and two coats of final color prior to installation. Paints, etc supply in the scope of contractor.

v) Contractor shall arrange for own fire fighting equipments for the materials stored under contractor's custody.

5.9.12 LAYING OF PIPES/TUBES (IMPULSE PIPE)

a) Installation of impulse pipe of CS/AS/SS material shall include cleaning, air flushing, cutting to length from the running meter, edge preparation, cold bending, welding of sockets/ reducers/ tee/ cross/ isolating valves/union nut and nipples/tail pieces etc.,

mounting of SS/CS three/five valve manifolds and compression fittings, condensate pot/equalizing vessel, providing supports, clamping, conducting leak test/hydraulic pressure test, painting and other accessories as per instrument hook-up diagram. Piping works shall involve either arc or TIG welding.

b) IBR certified welders shall be deployed for welding of impulse pipe and contractor shall take approval for welder and welding consumables from BHEL site engineer.

c) All fittings and accessories for impulse pipe and air line shall be provided by BHEL. Quoted rate for piping shall include cost of installation of such fittings as no separate rate is envisaged.

d) Contractor shall provide GI clamps for impulse pipe and GI pipes within the quoted rates for installation of the same.

5.9.13 **INSTRUMENT & SERVICE AIR PIPING (SS/GI PIPE)**

Laying of pipe (SS/GI) for instrument air line shall include air blowing, cutting from the running meter length, threading, installation of Elbows/ Tee/Reducer/ Moisture traps/Auto drain pot/check valves/isolating valves, supporting clamping, conducting leak test etc. Threaded joints of air pipeline shall be made leak proof by using Teflon tapes or sealing compound. Seal welding of threaded joints may be called for if required. This shall be done within the quoted rate.

5.9.14 **COPPER TUBING/PIPE/SS TUBE**

Installation of Copper Tube/SS Tube/Copper pipe shall include cutting into required length, laying, bending, cleaning, brazing wherever required, fixing of fittings like compression Fittings/Tees/End connectors/straight connectors/bulk heads/valves etc. Supporting, clamping including supply of clamps and hardware, flushing and conducting leak test. Suitable tube cutters, benders and de burring tools will be used for such jobs.

5.9.15 Guidelines for handling and storage of electronic cubicles / subassemblies / loose items.

a) Immediately after unloading at site, the electronic equipment should be kept in a covered area. Handling and lifting of package should be done without jerks or impacts. Packing case should not be dropped or slid along the floor under any circumstances. Suitable forklift should be used to move the case to its final position. All above points are to be strictly followed as electronic equipment may get damaged due to vibration and shock.

b) After unloading at site, the package of the equipment shall be inspected for external damage. In case the package is damaged, package number and details of damage should be noted. The details of damage should be reported to concerned site engineer.

c) Cases should be opened/unpacked using correct nail pullers. While opening the planks, care should be taken to see that equipment inside is not damaged. Cases should

not be unpacked in areas where they are exposed to rain, water/liquid splashing, dust or other harmful materials like chlorine gas, sulphur dioxide etc.

d) After opening the case, all supports provided for transport are to be removed with due care.

e) Hinged frames should not be opened when equipment is not secured to floor as this is likely to cause it to topple over. The hinged frame can be opened only if the equipment is still fixed on to bottom wooden pallet.

5.9.16 Storage

a) The equipment should be preferably in its original package and should not be unpacked until it is absolutely necessary for its installation or advised by BHEL engineer. The equipment should be best protected in its cases. It should be arranged away from walls.

b) The wooden pallet provided for packing itself can be retained for raised platform to protect equipment from ground damps, sinking into around and to circulate air under the stored equipment. This will also help in lifting packing with fork-lifter.

c) Periodic inspection if silica gel placed inside the equipment is necessary. It has to be replaced or regenerated when de - colorization takes place.

d) Due care should be taken to ensure that the equipment is not exposed to fumes, gases etc., which can affect electrical contacts of relays and terminal boards.

e) The storage room and the equipment should be checked at regular interval to ensure protection from termites, mould growth, condensation of water etc., which can damage the equipment.

f) All the equipments, materials and goods kept in the store room should be identified and registered in a book. Inspection report should be recorded. Any discrepancy observed should be communicated to site engineer.

g) The packing material shall be retained if the cubicle is to be repacked after inspection.

h) All subassemblies should be kept in a separate place where it is easily accessible.

i) Subassemblies should have a protective cover in case it is stored without wooden packing/case to prevent accumulation of dust. Silica gel packets should also be kept along with it.

j) Subassemblies should not be stacked one above the other.

k) The loose items supplied for the main equipment falls into various categories like tools, cables, prefabricated cables, console inserts, recorders, VDU/CRT, other display units,

printers, sensors and transducers, cable glands, cable ducts, frames, racks, etc. These are to be categorised and stored separately.

5.9.17 Guidelines for handling of electronic modules

a) All the modules shall be handled by qualified persons only.

b) Electronic modules should only be touched when it is absolutely essential to do so.

c) Before touching any electronic module, the operator should discharge the static electricity by earthing himself or better still, ensure constant discharge by wearing an earthed wrist strap.

d) The operator should not wear clothing made entirely from synthetic fibers, but a mixture containing at least 65% cotton.

e) The PCB should always be held by front panel or by module frame and electronic components / connectors should never be touched.

f) The electronic modules should not be placed close to television sets or CRT units.

g) Soldering irons and any other tools used must be grounded.

h) All modules using CMOS components are packed in antistatic bags when transported loose to avoid ESD failures. The antistatic bags must always be used to transport modules at site from one place to the other.

5.9.18 MISC. INSTRUMENT/ EQUIPMENT CALIBRATION, ERECTION, TESTING, AND COMMISSIONING

a. contractor shall carry out testing & commissioning of panels, electrically operated valves, pneumatic control valves, pneumatic trip valves, solenoid valves, limit switches, HT/LT motors including drying out, and any other integral devices forming part of various mechanical skids/equipments, & piping etc.

b. The scope of commissioning of electrically operated actuators for valves, dampers, gates etc., will include meggering, adjustments of mechanical/ electrical or electronic position transmitters, setting of limit/torque switches, cable checking, internal wiring checking, cleaning / heating for increase in IR value, local/remote operation, replacement of limit/torque switches if required, etc.

c. The scope of commissioning of devices like solenoid valves, feedback position transmitters, limit switches, air filter regulators, airlock relays, positioners etc., which are integral part of pneumatic control valves / power cylinders / trip valves

electrically operated valves etc., will involve adjustments / servicing, calibration etc. As incidental to work, contractor shall remove such devices prior to erection either at site or at store to avoid damage/pilferage and for keeping in safe custody. These shall be installed at appropriate stage as instructed by BHEL. The above removal and re fixing will be done within the quoted rates.

d. Whenever additional instrumentation work viz gauges, transmitters, temperature elements and laying of impulse piping, is to be carried out for performance guarantee test, the same has to be executed by the contractor as per the rate applicable already provided in the rate schedule.

e. Certain instrumentation like pressure switches, pressure gauges, dial thermometers, transmitters etc. are received in assembled condition as integral part of equipments. Dismounting, calibration, and re-erection of such instruments, where required for safe keeping or any other purpose as instructed by engineer, is in the scope of work. Only the rate applicable for calibration for respective instrument item will be paid.

f. All batteries for various AC and DC systems are to be taken into service as per standard method of initial charging and discharging, recording specific gravity values, etc. Contractor has to make arrangement for suitable loads during charging / discharging cycle.

g. Battery charging/discharging is a continuous process and skilled manpower shall be deployed by the contractor round-the-clock.

h. Contractor shall arrange suitable load, cables, safety equipment and consumables for discharging the battery during charging and discharging cycle at his cost.

i. Contractor shall provide skilled manpower for periodic maintenance after the battery are fully charged for the activities such as checking of electrolyte level, specific gravity, topping up with distilled water and cleaning till the set is handed over to customer and record of the same shall be maintained and submitted before handing over of the system.

j. Wherever panels, pneumatic power cylinders and control valves have been erected by the mechanical contractor, calibration/ commissioning has to be carried out by the contractor..

k. In the case of electronic water level indicator, electrodes may be supplied loose and the same need to be fixed in the pressure vessel as per the drawings. No extra charges will be payable.

l. The calibration of position transmitters of the NRVs in the turbine extraction system has to be carried out by the contractor. Position transmitters are to be erected by contractor if supplied loose.

m. Dimension and weight as mentioned against control panels, MCCs, etc. in rate schedule are only approximate and there may be changes in dimension and weight in actual supply of the equipment and no rate variation shall be applicable on this account.

n. Wherever brief description of the system is given under various sub-heads, it is only for the understanding system requirements. It does not indicate the total specification of work. For such system, other clauses are also applicable wherein work details are specified.

o. Normally, cable glands on junction boxes side are received in mounted condition. While terminating the cables as per drawings, the cable glands are to be removed and fixed. Wherever cable glands are not received along with junction boxes, the cable glands as per the requirement shall be provided by Contractor and the contractor has to make necessary holes/adjust the available holes in the JB for fixing these. No separate payment will be made for drilling of holes and fixing the cable glands to the junction boxes. Nameplates for JBs will be supplied separately. These are to be suitably written and fixed onto the JBs. Wherever nameplates for JBs are not supplied, the JB no. are to be written with paint on JBs for identification. Separate payment will not be made for this.

p. The push buttons and indicators in C&I systems are provided as loose with different type of connectors. The fixing of connectors and their wiring from push buttons to indicators shall be the responsibility of contractor. No separate payment will be made for fixing of connectors. The cable laying and termination charges will be paid as per applicable rate schedule.

5.9.19 Calibration, testing & commissioning

Calibration, testing & commissioning activity as specified in this technical specification and rate schedule against various equipment, devices, systems etc. are broadly described hereunder. However, there may be some overlapping between the activities, i.e. Erection, calibration and

testing, commissioning. The classification of each activity is only a guideline for understanding the volume of work in each activity. The contractor shall have no claim for performing or providing manpower assistance for such overlapping work, which is also within the scope of work.

Scope of work under erection/calibration/testing/commissioning shall include calibration, setting, adjustment, writing instrument tag number with paint, report making, installation, servicing, minor repairs/servicing, putting instrument into service, signal checking from field upto the functional group panels and remote indicating instrument, functional checks, interlock and protection/alarm checks by simulating the field devices, trouble shooting during pre-commissioning/post-commissioning till system is handed over to the customer.

Contractor shall establish calibration laboratory with adequate facilities and they should arrange standard test instruments duly calibrated from recognized agencies and calibration report of the same to be submitted prior to start of calibration of the field instruments/devices.

A. Calibration

- Verification of instruments for range, type etc; with respect to instrument schedule, data sheet or system document.
- Codification of instruments as per system tag numbers
- Calibration/adjustment of instrument as per system requirement/set values.
- Providing head correction in case of pressure measuring instruments.
- Verification of installation of instruments for range, type, tag number as per physical location of process point as per process, instrumentation diagram.
- Checking and ensuring the proper functioning of instruments.
- All the recorders shall be made functional with proper chart movement and ink marking.
- Preparation of computerised calibration certificates in the formats specified by BHEL Engineers and getting those signed by the customer is in the scope of the contractor.

Completion of erection and commissioning protocols with customer.

B. Erection

- Drawal of material from store, verification, inspection as per shipping list, drawings and documents.
- Preservation, upkeep, safe custody of the erected equipment till handing over.
- Verification of installation as per drawing and document for the correctness of cabling, JBs, impulse pipe, various field device, panels, instruments etc.
- Continuity check & IR value of cables.
- Verification of correction of cable termination with respect to instrument, electrical hook-up diagram, panel interconnection diagram, JB schedule.
- Checking earthing of the equipments and cable shield wire continuity.
- Energizing the functional group control panels and field devices.
- Flushing of impulse pipe before making the instruments process connections through.
- Any leakage damages to impulse pipe, field device connections, air connections etc. Shall be fully attended by contractor.

- Wherever thermowells are supplied along with temperature gauges, thermocouples, temperature switches, thermostats, etc., the contractor has to co-ordinate with the mechanical contractor for identification and fixing of thermowells on the pipeline. However actual fixing of thermowells on pipeline and seal welding shall be done by mechanical contractor and is not a part of instrument installation.

C. TESTING & COMMISSIONING

- Checking/verification of binary/analog input and output signal from field and panel and upto recording/indicating instrument/MMI monitors.
- Adjustment, testing, calibration of pneumatic drive (control valve, trip valve, power cylinder for gate/dampers etc), electrical actuator operated valve/gate/dampers of other functional elements.
- Checking and operating electrical/pneumatic drive through functional group panel, remote control desk, PMS/MMI, CRT operation and repeatability and smooth operation to be checked.
- Checking the interlock, protection and alarm for various processes by stimulation of field devices/process changes.
- Functional check of sub-loop control, sub group control and auto loop and fine-tuning.
- Adjustment of limit switches/feed back position transmitter checking the L.S. of actuator for correct position indication and repeatability shall be ensured.
- LT motor IR value measurement, bearing/winding RTD checking, checking the LT load connector, providing assistance for trial run of motor which includes monitoring temperature rise winding/bearing during trial run.
- Contractor shall prepare calibration/testing report/protocols.
- During trial run of various systems, the performance of any instrument found erratic, un-satisfactory are required re-adjustment, re-calibration etc. Contractor shall attend to the defects.
- Observing and checking the performance of the various devices on load/process variation. Any deficiencies/defect noticed during the variable load conditions, the same shall be attended promptly.
- Observe the proper functioning of sub-group/sub-loop control.
- Check the operation of various control in manual /auto mode for smooth functioning.
- Clearing of all defective signals arising during commissioning and during trial operation of unit.
- Any wiring correction or minor modification in control panel wiring noticed during the pre-commissioning, it shall be carried out.

D. Post-commissioning

- Contractor shall rectify the defect observed/informed by customer during the trial run.
- Contractor shall submit the as- built drawing as per guidelines and instruction of BHEL engineer.

- After trial run/handing over of the equipment, if due to unforeseen reasons, certain works crop up, the contractor shall provide all the assistance.

E. PG Test Assistance

- For PG test assistance, laying of impulse pipes, cables, etc. and installation of instrument tapping points shall be done by the contractor. These activities may be carried out at any point of time before or after Completion of Facilities. Payments will be made as per item rates of comparable similar or identical items in the rate schedule. Such temporary installations shall have to be dismantled and returned to BHEL Stores, after the completion of PG Test for which no separate payment is admissible.

5.9.20

The work under this scope being quite sophisticated and also quite extensive, for proper planning, monitoring, reporting, etc of ongoing works, the contractor shall establish his own computer(s) and printer(s) at his site office, along with suitable operator(s), consumables, etc. ***Non-establishment of above equipment will attract penalty @ Rs 20000 (Rs Ten thousand only) per month.***

5.10 TROUBLESHOOTING DURING PLANT OPERATION

During pre commissioning / commissioning stages when the plant will be under various stages of operation, it will be necessary to have continuous (day and night) presence of suitable manpower along with required tools to attend to any defects etc that may arise during such operation. The contractor will be required to put such personnel in shifts in both electrical and C&I area. The bidder must also take this aspect into consideration.

5.11
Certain instrumentation like pressure switches, air sets, filters, regulators, pressure gauges, junction boxes, power Cylinders, dial thermometers, flow meters, valve actuators, flow indicators, centrifugal/speed switches of motors, accumulators etc. are received in assembled condition as integral part of equipment. Contractor shall dismount, where instructed so, such instruments for calibration and storage/re-erection. Calibration will be done by C&I erection agency.

5.12
Fixing and seal welding of thermo wells & plugs of equipment or other piping system is within the scope of work. Contractor shall also remove the seal welded plugs by process of grinding and fix and seal weld thermo wells after hydro test/ of lines as part of work.

5.13

Actuators/drives of valves, dampers, gates, powered vanes etc. May have to be serviced, lubricated, before erection, during pre-commissioning & commissioning, including carrying out minor adjustments required as incidental to the work.

5.14
All electrical motors have to be tested for IR & PI values prior to the trial run. Where required, dry out may have to be carried out by using external heating source. Contractor shall make all arrangements in this regard and complete the work as instructed. BHEL will provide the motorized insulation testers.

CHAPTER-8
PRE-COMMISSIONING TESTS, COMMISSIONING AND POST COMMISSIONING

6.1
Commissioning of the STP equipment with associated Aux. and other Equipment with auxiliaries shall involve the following tests though not limited to these, various testing, trial runs of various equipment erected and systems installed;

(a) Trial run of Pumps other various rotating machineries / pumps.

(b) Trial run of all motors/ drives for various auxiliaries.

(c) Chemical Cleaning of various systems & piping, Oil flushing of lube oil system, Air cleaning/blowing of pipelines, closed systems, Tanks and Vessels.

(d) Flushing of all pipelines by air/oil/water/Chemicals/steam as the case may be.

(e) Servicing of all valves, fittings.

(f) Manual/mechanical cleaning of Pumps, tanks /vessels and other various equipment erected by the contractor. This may have to be repeated several times during the commissioning process.

(g) Chemical cleaning of piping systems as per requirement. Contractor shall carry out disassembly and reassembly of vulnerable components like gauges, instruments etc. as instructed by BHEL during this process.

(h) Trial operation

(i) Full load operation

The above activities/tests/trial runs may have to be repeated till satisfactory results are obtained and also to meet the technical and statutory requirements.

6.2
Contractor shall lay temporary pipelines with fittings and accessories etc. as instructed by BHEL engineer for the purpose of pre-commissioning and commissioning activities like chemical cleaning, oil flushing etc. of piping and other equipment as part of the scope of work. Temporary

installations shall be dismantled by contractor and returned to BHEL stores as specified elsewhere in this T.S.

6.3
The contractor shall provide necessary assistance to facilitate/enable electrical and instrumentation testing and commissioning of equipment under this scope of work, to BHEL and their Testing & Commissioning agency.

6.4
The contractor shall carry out any other test as desired by BHEL engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning and commissioning, to demonstrate the completion of any part or parts of work performed by the contractor.

6.5
In case any malfunctioning and / or defect is found during tests / trial runs such as loose components, undue noise or vibrations, strain on connected equipment etc. The contractor shall immediately attend to these defects/ malfunctioning and take necessary corrective measures. If any readjustment and realignments are necessary, the same shall be done as per BHEL engineer's instructions, free of cost.

6.6
The cleaning of Lube oil tank etc. is in general by wire brush / abrasive paper etc. In case of tenacious rusting spots found if any, the same shall be cleaned thoroughly mechanically by buffing wheel etc. If manual / mechanical cleaning is not proper, the cleaning by sand blasting as per instructions of BHEL engineer before and after oil flushing is responsibility of contractor.

6.7
The contractor shall associate for initial and subsequent fillings of gas in generator gas system as and when required till unit is handed over to Customer.

6.8
The contractor shall carry out leak test of generator air cooling system to the satisfaction of BHEL engineer.

6.9
Replacing/changing mechanical/other seals of equipment, pumps etc. during commissioning stage is within the scope of work.

6.10
During the stages of commissioning, and till Unit is handed over, if any part of STP Plant and auxiliaries need repair/rectification/rework/replacement, the same shall be done expeditiously and

promptly by the contractor. Contractor's claim if any, for such repair/rectification/rework/ replacement etc. for reasons not attributable to the contractor, will be governed by relevant clauses of this specification. The parts to be replaced shall however, be provided by BHEL free of cost.

6.11
During this period, though BHEL's and customer's engineers will also be associated in the work, the contractor's responsibility will be to make available resources in his scope till such time the commissioned units are taken over by the customer.

6.12
In case any malfunctioning and/or defects are found during tests, trial run such as loose component, undue noise or vibration, strain on connected equipment etc., The contractor shall immediately attend to these defects/ malfunctions and take necessary corrective measures. If any readjustment or realignment is necessary, same shall be done as per BHEL engineer's instruction.

6.13
The pre-commissioning activities will start prior to cleaning of Piping systems and will continue till STP Plant is handed over to customer. Simultaneous commissioning checks, activities will be in progress in various areas like trial run of various equipment, checking of equipment erected, making ready for trial runs, filling up of lubricants, chemicals etc. All these works need specialised gangs including electricians, Instrument Technicians, Fitters, in each area to render assistance to BHEL commissioning staff. Contractor shall earmark separate manpower for various commissioning activities. This manpower shall not be disturbed or diverted. The mobilisation of these commissioning gangs shall be sufficient so that planned commissioning activities are taken up in time and also completed as per schedule and the work is to be undertaken round the clock if required.

6.14
Contractor shall cut open works if needed as per BHEL engineer's instructions during commissioning for inspection, checking and make good the works after inspection is over, without any extra payment.

6.15 After the start of commercial operation of machine, commissioning activities will continue. It shall be the responsibility of contractor to provide following manpower along with supervisor as part of commissioning assistance for a period of three months **per Unit**.

1)	Supervisor	2 Nos.
2)	Pipe fitter/Millwright fitter	2 Nos.
3)	welder	2 Nos.
4)	Rigger	2 Nos.
5)	Electrician/instrument technician	1 No. each
6)	unskilled worker	6 Nos.

6.16
The above figures shows only minimum required over and above labour required for completing pending erection and commissioning works and clearing of punch lists. Contractor has to provide number of personnel and other resources as per work demand.

6.17
It shall be specifically noted that above employees of the contractor may have to work round the clock along with BHEL commissioning engineers.

6.18
During commissioning, opening of valves, changing of gaskets, checking, realigning of rotating and other equipment, attending to leakages in piping, tanks etc. and adjustments of erected equipment may arise. Valves shall be serviced and lubricated to the satisfaction of BHEL engineer during the erection and commissioning as per BHEL engineer's instructions.

6.19
It is the responsibility of the contractor to provide for necessary resources till the completion of work under these specifications, even in case erection, testing and commissioning of the STP Plant and other equipment are delayed due to reasons not attributable to the contractor.

CHAPTER-7
PAINTING

7.1
All protective paints for the protection of weld joint fit-ups, application of primers on finished weld joints are in the scope of contractor.

7.1.1
The primer and thinner will be provided by contractor as part of scope of work along with other like arrangements for surface preparation and paint application like sand/shot-blasting, consumables like surface cleaning agents, paint brush, brush cleanser, labour and necessary tools and plants as required for completion of work.

7.1.2
Contractor shall submit manufacturer's batch test certificate / test certificate from BHEL approved laboratory for the primers and paints. Prior approval of BHEL for each and every batch of the primer & paints shall be mandatory. In order to achieve a desired minimum paint dry film thickness (DFT) as specified in BHEL drawing, number of coats may be applied and method of application shall be as recommended by the paint manufacturer. **Contractor shall arrange required paints & primers and other consumables for above works.**

7.2
Preservation of all components/equipment during various stages of erection, commissioning till handing over is in the contractor's scope. All prescribed methods of surface cleaning prior to application of preservative paint shall be followed by the contractor. **Contractor has to arrange all primer and paints, and other consumables like wire brush, painting brush required for this work.**

7.3
All exposed metal parts of the equipment including piping, supports, structures, railing, tanks/vessels, Common System Equipment, Balance of Plant Equipment with associated auxiliaries etc. as covered under these tender specifications, as applicable shall be painted after thoroughly cleaning the surface from dust, rust, greases, oils, scales, etc, by wire brush, scrapping etc; as specified in relevant erection documents.

The above parts shall then be painted with specified no. Of coats of specified paint over the shop primer/paint. Also, where the shop primer/paint has peeled off, the affected area shall be cleaned thoroughly by the specified method and then primer coat applied. Similarly, certain components may be supplied without any primer/paint coat from shop. The surface of such items shall be cleaned as per specifications, coated with suitable primer and then coated with final paint coats. The dry film thickness after final coat should be as per specification.

7.4
In addition, color banding, legend and identification marking, direction of flow/rotation marking etc. Is part of work.

7.5
The surface preparation/cleaning, treatment, Identification marking Colour Codes and Final/Finish painting works shall be carried out by contractor as per BHEL/ Customer Specification .For any non-confirmation/dispute between BHEL / Customer specification, the procedure/instructions as laid down in customer & their consultant's specification shall supersede BHEL specification and shall be binding on contractor.

Painted surface thickness as per standard shall be demonstrated by the contractor. Paint thickness measurement instrument shall be in the scope of contractor.

Painting the inner side of aluminum/GI/steel cladding, with anti-corrosive paint as specified. Also all other accessories for painting, cleaning the surfaces etc. shall be arranged by the contractor.

Touch-up painting of switchgear panel, 415 Volt LT MCC, Control Panels or any other equipment /devices wherever necessary.

7.6 STRUCTURALS

Structural components may be supplied by BHEL without any primer/paint coat. The surface of such items shall be cleaned as per specifications and then coated with two coats of Primer.

7.7 PANELS, JUNCTION BOXES

7.7.1
Panels and Junction Boxes shall be Touch-up painted as and where original shop paint is peeled off. Necessary surface cleaning and preparation shall be done by the contractor as per relevant painting codes followed by two coats of Primer and two coats of Finish Paint.

7.7.2
The contractor shall provide the Primer (ROZC as per IS:2074) for the scope of painting work indicated in Section-4 as well as for protection of site weld joints and gas cut locations. Contractor shall also arrange to provide the required thinner and other consumables, T&P etc required for application of ROZC Primer. All paints and thinners shall be sourced only from BHEL approved manufacturers.

7.7.3
In addition, color banding, legend and identification marking; direction of flow/rotation marking etc. is part of the work.

7.7.4
Contractor shall ensure that all steel structure used for electrical installation shall be painted with one coat of Red Oxide Zinc Chromate primer and two coats of Aluminum Alkyd paints of approved shade for indoor installations. However for outdoor installations and corrosive areas like Battery room , contractors shall carry out hot dip Galvanization.

TECHNICAL WRITEUP OF THE SEWAGE TREATMENT PLANT (STP)

1. INTRODUCTION

The following write-up describes the process of each unit of STP to be installed by BHEL. This document is useful to know the working process of each unit of sewage treatment plant. This STP is designed on "SEQUENCING BATCH REACTOR (SBR)" technology.
M/s. SFC Technologies Pvt. Ltd. has provided the design and engineering for pre, secondary and post treatment and supply of SBR decanter, aeration grid with diffusers and PLC for entire Sewage treatment plant.

2. WASTEWATER CHARACTERISTICS AND EFFLUENT CRITERIA

2.1 Raw Sewage Quality:

Sl. No.	Parameters	UOM	Values
1	pH		6.0 to 8.5
2	Biochemical Oxygen Demand (BOD_5)	mg/l	250
3	Chemical Oxygen Demand (COD)	mg/l	425
4	Total Suspended Solids (TSS)	mg/l	375
5	Total Kjeldahl Nitrogen (TKN)	mg/l	40
6	Total Phosphorous (TP)	mg/l	7
7	Fecal Coliform	MPN/100 ml	1×10^5

2.2 Treated sewage quality shall attain the following limits or even better:

Sl. No.	Parameters	UOM	Values
1	pH		6.0 to 8.0
2	Biochemical Oxygen Demand (BOD_5)	mg/l	≤ 10
3	Chemical Oxygen Demand (COD)	mg/l	≤ 50
4	Total Suspended Solids (TSS)	mg/l	≤ 10
5	Total Nitrogen (TN)	mg/l	≤ 10
6	Total Phosphorous (TP)	mg/l	≤ 2

7	Ammonical Nitrogen (NH_3-N)	mg/l	≤ 5
8	Fecal Coliform	MPN/100 ml	≤ 230

3. TREATMENT PROCESS

3.1 Raw Sewage Pumping Station Receiving Chamber

The deep gravity outfall sewers will discharge the raw sewage into a Receiving chamber. The Receiving chamber will distribute the flow for process units. The Receiving chamber consists of sluice gates on upstream for flow regulation. The receiving chamber is water tight to prevent seepage of the sewage out of the receiving chamber and is open to sky.

3.2 Coarse Screen Channels

There are two screens, one mechanical screen working and one manual screen standby of 20 mm clear spacing. The mechanical and manual bar screens are 10 mm thick Stainless Steel (SS 304) flats. The mechanical coarse screens are of Inclined Rake Type. Bin and chute arrangement are provided to take the screenings dropped from chute. Manually operated CI gates are provided at the upstream and downstream ends to regulate the flow.

3.3 Raw Sewage Pumping Station

Sewage enters into wet well of the pumping station after screening. Three (2W + 1SB) submersible type non-clog raw sewage pumps are provided for pumping the raw sewage into the inlet chamber. The pumps have automatic coupling arrangement at discharge end for removal and a guide pipe and chain in SS 304 for removal and lowering of pumps.

3.4 Inlet Chamber

Inlet Chamber of STP will receive the flow from Raw Sewage Pumping Station. It reduces the velocity of sewage before entering in to fine screen. Max sewage retention time in stilling chamber is 30 second.

3.5 Mechanical & Manual Fine Screen Channels

One Mechanical Fine Screens (Working) and one Manual Fine Screen (Standby) is provided in Fine Screen Channels. The clear opening is 6 mm for Mechanical Fine Screen and 10 mm for Manual Fine Screen. The Mechanical and Manual Screens are made of SS 304 flats (3 mm for Mechanical and 10 mm for Manual Screen). Bin and Chute arrangement are provided to take the screenings. Screenings dropped from Chute are collected in a wheel Burrow. Manually operated CI Sluice Gates are provided at the upstream and downstream ends to regulate the flow.

3.6 Grit Chambers

One Mechanical Grit Chamber (Working) along with one Manual Bypass Channel (Standby) are provided after Fine Screen Channels. One tapered Inlet Channel running along one side with adjustable Influent Deflectors for entry of sewage into the Grit

Chamber and one tapered Outlet Channel for collecting the de-gritted sewage, which overflow over an adjustable Weir into the Outlet Channel. A sloping Grit Classifying Channel in to which the collected grit is classified.

The grit from screw classifier is collected in a Wheeled Trolley. Manually operated CI Sluice Gates are provided at entrance of the Inlet Channel of the Grit Chambers as well as Bypass Channel to regulate the flow.

3.7 Sequential Batch Reactor (SBR) Units

The Sequential Batch Reactor (SBR) process utilizes a fill-and-draw reactor. The complete process is divided into cycles with each cycle duration of 2 – 4 hours. All the subsequent treatment Steps – Fill/Aeration, Settling and Decanting take place sequentially and independently without overlapping. During Fill/Aeration phase, the sewage is filled into SBR Basins and part of the treated sewage along with activated sludge shall be recycled with the help of recycle pumps. Air is supplied for aeration with the help of Air Blowers. During settling phase, the filling/aeration is stopped and the mixed content is allowed to settle under perfect settling conditions. Filling, during settling or decanting will not be accepted. During decanting phase, the supernatant is removed from top with the help of Decanters and excess sludge is wasted with the help of waste pumps.

The system should work on a gravity influent condition. No influent / sewage equalization Tanks or flash filling is accepted. The system is designed for maximum F/M ratio of 0.18 Kg BOD/Kg MLSS day and MLSS maintained in the basin should range from 3500 to 5000 mg/l. The excess sludge produced is fully digested. Sludge production rate is about 0.60 – 1.20 Kg / Kg of BOD removed. A minimum total Sludge Retention Time (SRT) of 10 days shall be maintained to ensure digested sludge.

3.8 Aeration System

Fine Bubble Type, EPDM / PU Membrane Diffusers of panel / tubular type are provided for aeration. The air blower arrangement is capable of handling total water level and bottom water level operation conditions controlled by process sensors such as DO, Temperature and Level. Each set of Air Blowers have dedicated standby. Each blower is operated through Variable Frequency Drive.

3.9 Return Sludge and Excess Sludge Pumps

Dedicated return sludge and excess sludge pumps are provided in each SBR basin. The pumps are of submersible / horizontal centrifugal type suitable for handling biological sludge of 0.8 – 1% solids consistency. Each basin is provided with suitable lifting arrangements to facilitate lifting of these pumps if required for maintenance.

3.10 Disinfection (Chlorination) Units

Treated sewage from SBR unit is taken to chlorination tank by RCC Channel/RCC Pipe. Gas Chlorine/NaOCl is added for disinfection at suitable dosing rate. Baffle walls are provided in the Tank to facilitate hydraulic mixing of treated sewage.

3.11 Sludge Dewatering Units

Sludge dewatering units comprising of sludge sump and pump house, centrifuge house and dewatering polymer dosing system.

3.12 Automation and Control

PLC based automation system is provided with application software based on Rockwell or equivalent to control SBR system including all gates, air blowers, pumps, valves and decanters. HMI Panel comprises of personal computer with 22" LCD Monitor, Multi Media Kit, Printer, Internet Connection, RS-View, RS-Links (Gateway Version), Process and Operator Software with dynamic Flow Charts, Pictures, Screens, Alarms, Historical Trends, Reports etc.

SCADA based Automation System to monitor the following parameters continuously in each SBR Basins:

a. Fill Volume
b. Discharge Volume
c. Temperature
d. DO Level
e. Oxygen Uptake Rate
f. Air Blower Speed
g. Decanter Speed

4. TERMINAL POINTS

Sl. No.	Main Equipment/Systems	Terminal Points
5.	Raw sewage inlet	At the inlet of receiving chamber
6.	Service water	To be arranged by Contractor
7.	Treated sewage	Treated sewage effluent transfer pump
8.	Solid waste	Solid waste from the mechanical screen, grit equipment & centrifuge has to be disposed by the contractor as directed by BHEL
9.	Power supply	Electrical power of 3ph, 415volts, 50 Hz will be supplied at the incomer of the MCC panel of the plant by BHEL.

5. ELECTRICAL LOAD LIST OF VARIOUS EQUIPMENT OF STP

5.1 STP-1: 7.4MLD

Tentitive Load List & Transformer Sizing

SR. NO.	EQUIPMENT NAME	TAG	KW	Load Factor	BKW	FEEDER TYPE	DUTY (C/I)	EFF	PF	DIVERSITY FACTOR	NOS. OF UNITS				MAXIMUM DEMAND IN KW	MAXIMUM DEMAND IN KVA	REMARK
											WORKING	STANDBY		TOTAL			
			(A)	(B)	(C)			(D)	(E)	(F)	(G)	(H)	(I)	(J)	K=C*G	L=C*G/D*E*F	
	RAW SEWAGE PUMP HOUSE																
1	Mechanical Coarse Bar Screen		1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
2	Flat Belt Conveyor		1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
3	Raw Sewage Transfer Pumps		22	0.85	18.70	SS	C	0.93	0.9	1	1	1	1	3	18.70	22.34	
	STP																
4	Mechanical Fine Bar Screen		1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
5	Flat Belt Conveyor		1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
6	Detritor																
	a. Grit Collection Mechanism		1.5	0.85	1.28	DOL	C	0.8	0.81	1	1	0	0	1	1.28	1.97	
	b. Grit Washing/Classifier Mechanism		2.2	0.85	1.87	DOL	C	0.82	0.82	1	1	0	0	1	1.87	2.78	
	c. Organic Return Pumps		0.75	0.85	0.64	DOL	C	0.77	0.78	1	1	0	0	1	0.64	1.06	
7	SBR Air Blowers		55	0.85	46.75	MCCB	I	0.93	0.89	1	1	1	1	3	46.75	56.48	
8	RAS Pumps		2.2	0.85	1.87	STAR DELTA	I	0.82	0.82	1	2	0	0	2	3.74	5.56	
9	Decanters		0.55	0.85	0.47	VFD	I	0.73	0.73	1	2	0	0	2	0.94	1.75	
10	SAS Pumps		3.7	0.85	3.15	DOL	I	0.85	0.82	1	2	0	0	2	6.29	9.02	
11	Auto Valves/Sluice Gates		0.75	0.85	0.64	RDOL	I	0.77	0.78	4	8	0	0	8	5.10	2.12	
12	Chlorination System																
	a. Water Booster Pumps		2.2	0.85	1.87	DOL	C	0.82	0.82	1	1	1	0	2	1.87	2.78	
	b. NaOH Solution Pump		2.2	0.85	1.87	DOL	I	0.82	0.82	1	1	1	0	2	1.87	2.78	
	c. Air Blower		1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
13	Sludge Sump Air Blowers		3.7	0.85	3.15	DOL	I	0.85	0.82	1	1	1	0	2	3.15	4.51	
14	Centrifuge Feed Pumps		2.2	0.85	1.87	DOL	I	0.85	0.82	1	1	1	0	2	1.87	2.68	
15	Centrifuge		18.5	0.85	15.73	STAR DELTA	I	0.92	0.84	1	1	0	1	2	15.73	20.35	
16	Dewatering Polymer Dosing System																
	a. Agitators for Dosing Tanks		0.75	0.85	0.64	DOL	I	0.77	0.78	1	1	0	0	1	0.64	1.06	
	b. Dosing Pumps		0.37	0.85	0.31	DOL	I	0.71	0.65	1	1	1	0	2	0.31	0.68	
17	Service Water Pumps		2.2	0.85	1.87		C	0.82	0.82	1	1	1	0	2	1.87	2.78	
18	Electrical Hoist with Travelling Trolley																
	a. 3 HP		2.2	0.85	1.87	DOL	I	0.82	0.82	1	4	0	0	4	7.48	11.12	
19	Plant Area Lighting		18.5	1	18.50	MCCB	I	1	1	1	1	0	0	1	18.50	18.50	
20	Treated Sewage Transfer Pump		30	0.85	25.50	STAR DELTA	C	0.92	0.89	1	1	1	1	3	25.50	31.14	
21	Bio-Filter Centrifugal Blower		5.5	0.85	4.68	DOL	C	0.86	0.88	1	1	1	0	2	4.68	6.18	
													TOTAL KW		175.13	217.51	TOTAL KVA

NOTE:
A. Motor ratings are Tentitive and may vary due to following
1. any variation in hydraulic levels, change in orientation, etc.
2. Actual connected motor rating provided by mfg. selected by the successful bidder
B. Future equipments are not part of this tender. Hence not included in Transformer rating.

Total Load In KVA	217.51
Consider 20% Margin	261.01
Selected Transformer Rating In KVA	315

5.2 STP-2: 4.33MLD

Tentitive Load List & Transformer Sizing

SR. NO.	EQUIPMENT NAME	KW	Load Factor	BKW	FEEDER TYPE	DUTY (C/I)	EFF	PF	DIVERSITY FACTOR	NOS. OF UNITS				MAXIMUM DEMAND IN KW	MAXIMUM DEMAND IN KVA	REMARK
										WORKING	STANDBY	FUTURE	TOTAL			
		(A)	(B)	(C)			(D)	(E)	(F)	(G)	(H)	(I)	(J)	K=C*G	L=C*G/D*E*F	
	RAW SEWAGE PUMP HOUSE															
1	Mechanical Coarse Bar Screen	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
2	Flat Belt Conveyor	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
3	Raw Sewage Transfer Pump	15	0.85	12.75	STAR DELTA	C	0.93	0.9	1	1	1	1	3	12.75	15.23	
	STP															
4	Mechanical Fine Bar Screen	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
5	Flat Belt Conveyor	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
6	Detritor															
	a. Grit Collection Mechanism	1.5	0.85	1.28	DOL	C	0.8	0.81	1	1	0	0	1	1.28	1.97	
	b. Grit Washing/Classifier Mechanism	2.2	0.85	1.87	DOL	C	0.82	0.82	1	1	0	0	1	1.87	2.78	
	c. Organic Return Pumps	0.75	0.85	0.64	DOL	C	0.77	0.78	1	1	0	0	1	0.64	1.06	
7	SBR Air Blowers	37	0.85	31.45	VFD/SS	I	0.92	0.89	1	1	1	1	3	31.45	38.41	
8	RAS Pumps	1.5	0.85	1.28	DOL	I	0.8	0.81	1	2	0	0	2	2.55	3.94	
9	Decanters	0.55	0.85	0.47	VFD	I	0.73	0.73	1	2	0	0	2	0.94	1.75	
10	SAS Pumps	2.2	0.85	1.87	DOL	I	0.82	0.82	1	2	0	0	2	3.74	5.56	
11	Auto Valves/Sluice Gates	0.75	0.85	0.64	RDOL	I	0.77	0.78	4	8	0	0	8	5.10	2.12	
12	Chlorination System															
	a. Water Booster Pumps	2.2	0.85	1.87	DOL	C	0.82	0.82	1	1	1	0	2	1.87	2.78	
	b. NaOH Solution Pump	2.2	0.85	1.87	DOL	I	0.82	0.82	1	1	1	0	2	1.87	2.78	
	c. Air Blower	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
13	Centrifuge Feed Pumps	1.1	0.85	0.94	DOL	I	0.85	0.82	1	1	1	0	2	0.94	1.34	
14	Centrifuge	11	0.85	9.35	STAR DELTA	I	0.89	0.82	1	1	0	1	2	9.35	12.81	
15	Sludge Sump Air Blower	2.2	1.85	4.07	DOL	I	0.82	0.82	1	1	1	0	2	4.07	6.05	
16	Dewatering Polymer Dosing System															
	a. Agitators for Dosing Tanks	0.75	0.85	0.64	DOL	I	0.77	0.78	1	1	0	0	1	0.64	1.06	
	b. Dosing Pumps	0.37	0.85	0.31	DOL	I	0.71	0.65	1	1	1	0	2	0.31	0.68	
17	Service Water Pumps	2.2	0.85	1.87	STAR DELTA	C	0.82	0.82	1	1	1	0	2	1.87	2.78	
18	Electrical Hoist with Travelling Trolley															
	a. 2 HP	1.5	0.85	1.28	DOL	I	0.8	0.81	1	4	0	0	4	5.10	7.87	
19	Plant Area Lighting	11	1	11.00	MCCB	I	1	1	1	1	0	0	1	11.00	11.00	
20	Treated Sewage Transfer Pump	22	0.85	18.70	STAR DELTA	C	0.92	0.84	1	1	1	1	3	18.70	24.20	
21	Bio-Filter Centrifugal Blower	7.5	0.85	6.38	STAR DELTA	C	0.87	0.88	1	1	1	0	2	6.38	8.33	
												TOTAL KW		128.77	164.35	TOTAL KVA

NOTE:
A. Motor ratings are Tentitive and may vary due to following
1. any variation in hydraulic levels, change in orientation, etc.
2. Actual connected motor rating provided by mfg. selected by the successful bidder
B. Future equipments are not part of this tender. Hence not included in Transformer rating.

Total Load In KVA	164.35
Consider 20% Margin	197.22
Selected Transformer Rating In KVA	250

5.3 STP-3: 7.05MLD

Tentitive Load List & Transformer Sizing

SR. NO.	EQUIPMENT NAME	KW	Load Factor	BKW	FEEDER TYPE	DUTY (C/I)	EFF	PF	DIVERSITY FACTOR	NOS. OF UNITS				MAXIMUM DEMAND IN KW	MAXIMUM DEMAND IN KVA	REMARK
										WORKING	STANDBY	FUTURE	TOTAL			
		(A)	(B)	(C)			(D)	(E)	(F)	(G)	(H)	(I)	(J)	K=C*G	L=C*G/D*E*F	
	RAW SEWAGE PUMP HOUSE															
1	Mechanical Coarse Bar Screen	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
2	Flat Belt Conveyor	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
3	Raw Sewage Transfer Pump	22	0.85	18.70	SS	C	0.93	0.9	1	1	1	1	3	18.70	22.34	
	STP															
4	Mechanical Fine Bar Screen	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
5	Flat Belt Conveyor	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
6	Detritor															
	a. Grit Collection Mechanism	1.5	0.85	1.28	DOL	C	0.8	0.81	1	1	0	0	1	1.28	1.97	
	b. Grit Washing/Classifier Mechanism	2.2	0.85	1.87	DOL	C	0.82	0.82	1	1	0	0	1	1.87	2.78	
	c. Organic Return Pumps	0.75	0.85	0.64	DOL	C	0.77	0.78	1	1	0	0	1	0.64	1.06	
7	SBR Air Blowers	55	0.85	46.75	VFD	I	0.93	0.89	1	1	1	1	3	46.75	56.48	
8	RAS Pumps	2.2	0.85	1.87	STAR DELTA	I	0.82	0.82	1	2	0	0	2	3.74	5.56	
9	Decanters	0.55	0.85	0.47	VFD	I	0.73	0.73	1	2	0	0	2	0.94	1.75	
10	SAS Pumps	3.7	0.85	3.15	DOL	I	0.85	0.82	1	2	0	0	2	6.29	9.02	
11	Auto Valves/Sluice Gates	0.75	0.85	0.64	RDOL	I	0.77	0.78	4	8	0	0	8	5.10	2.12	
12	Chlorination System															
	a. Water Booster Pumps	2.2	0.85	1.87	DOL	C	0.82	0.82	1	1	1	0	2	1.87	2.78	
	b. NaOH Solution Pump	2.2	0.85	1.87	DOL	I	0.82	0.82	1	1	1	0	2	1.87	2.78	
	c. Air Blower	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
13	Sludge Sump Air Blowers	3.7	0.85	3.15	DOL	I	0.85	0.82	1	1	1	0	2	3.15	4.51	
14	Centrifuge Feed Pumps	1.5	0.85	1.28	DOL	I	0.85	0.82	1	1	1	0	2	1.28	1.83	
15	Centrifuge	18.5	0.85	15.73	STAR DELTA	I	0.92	0.84	1	1	0	1	2	15.73	20.35	
16	Dewatering Polymer Dosing System															
	a. Agitators for Dosing Tanks	0.75	0.85	0.64	DOL	I	0.77	0.78	1	1	0	0	1	0.64	1.06	
	b. Dosing Pumps	0.37	0.85	0.31	DOL	I	0.71	0.65	1	1	1	0	2	0.31	0.68	
17	Service Water Pumps	1.5	0.85	1.28	STAR DELTA	C	0.8	0.81	1	1	1	0	2	1.28	1.97	
18	Electrical Hoist with Travelling Trolley															
	a. 3 HP	2.2	0.85	1.87	DOL	I	0.82	0.82	1	4	0	0	4	7.48	11.12	
19	Plant Area Lighting	15	1	15.00	MCCB	I	1	1	1	1	0	0	1	15.00	15.00	
20	Treated Sewage Transfer Pump	30	0.85	25.50	STAR DELTA	C	0.92	0.89	1	1	1	1	3	25.50	31.14	
21	Bio-Filter Centrifugal Blower	5.5	0.85	4.68	DOL	C	0.86	0.88	1	1	1	0	2	4.68	6.18	
												TOTAL KW		170.44	212.34	TOTAL KVA

NOTE:	A. Motor ratings are Tentitive and may vary due to following		
	1. any variation in hydraulic levels, change in orientation, etc.		
	2. Actual connected motor rating provided by mfg. selected by the successful bidder	Total Load In KVA	212.34
	B. Future equipments are not part of this tender. Hence not included in Transformer rating.	Consider 20% Margin	254.81
		Selected Transformer Rating In KVA	315

5.4 STP-4: 1.79MLD

Tentive Load List & Transformer Sizing

SR. NO.	EQUIPMENT NAME	KW	Load Factor	BKW	FEEDER TYPE	DUTY (C/I)	EFF	PF	DIVERSITY FACTOR	NOS. OF UNITS				MAXIMUM DEMAND IN KW	MAXIMUM DEMAND IN KVA	REMARK
										WORKING	STANDBY	FUTURE	TOTAL			
		(A)	(B)	(C)			(D)	(E)	(F)	(G)	(H)	(I)	(J)	K=C*G	L=C*G/D*E*F	
1	Raw Sewage Transfer Pump	5.5	0.85	4.68	SS	C	0.93	0.9	1	1	1	1	3	4.68	5.59	
2	SBR Air Blower	22	0.85	18.70	MCCB	I	0.92	0.84	1	1	1	1	3	18.70	24.20	
3	RAS Pumps	0.75	0.85	0.64	STAR DELTA	I	0.77	0.78	1	2	0	0	2	1.28	2.12	
4	Decanters	0.55	0.85	0.47	VFD	I	0.73	0.73	1	2	0	0	2	0.94	1.75	
5	SAS Pumps	1.1	0.85	0.94	DOL	I	0.78	0.78	1	2	0	0	2	1.87	3.07	
6	Auto Valves/Sluice Gates	0.75	0.85	0.64	RDOL	I	0.77	0.78	4	6	0	0	6	3.83	1.59	
7	Chlorination System															
	a. NaOCl Solution Pump	0.19	0.85	0.16	DOL	I	0.65	0.65	1	1	1	0	2	0.16	0.38	
8	Centrifuge Feed Pumps	0.75	0.85	0.64	DOL	I	0.85	0.82	1	1	1	0	2	0.64	0.91	
9	Centrifuge	7.5	0.85	6.38	STAR DELTA	I	0.87	0.88	1	1	0	1	2	6.38	8.33	
10	Sludge Sump Agitator	0.75	0.85	0.64	DOL	I	0.77	0.78	1	1	0	0	1	0.64	1.06	
11	Dewatering Polymer Dosing System															
	a. Agitators for Dosing Tanks	0.37	0.85	0.31	DOL	I	0.71	0.65	1	2	0	0	2	0.63	1.36	
	b. Dosing Pumps	0.37	0.85	0.31	DOL	I	0.71	0.65	1	1	1	0	2	0.31	0.68	
12	Service Water Pumps	2.2	0.85	1.87	STAR DELTA	C	0.82	0.82	1	1	1	0	2	1.87	2.78	
13	Electrical Hoist with Travelling Trolley															
	a. 1 HP	0.75	0.85	0.64	DOL	I	0.77	0.78	1	1	0	0	1	0.64	1.06	
	a. 2 HP	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
14	Plant Area Lighting	7.5	1	7.50	MCCB	I	1	1	1	1	0	0	1	7.50	7.50	
15	Treated Sewage Transfer Pump	11	0.85	9.35	STAR DELTA	I	0.89	0.82	1	1	1	1	3	9.35	12.81	
16	Bio-Filter Centrifugal Blower	2.2	0.85	1.87	DOL	I	0.82	0.82	1	1	1	0	2	1.87	2.78	
												TOTAL KW		62.54	79.96	TOTAL KVA

NOTE:	A. Motor ratings are Tentitive and may vary due to following		
	1. any variation in hydraulic levels, change in orientation, etc.		
	2. Actual connected motor rating provided by mfg. selected by the successful bidder	Total Load In KVA	79.96
	B. Future equipments are not part of this tender. Hence not included in Transformer rating.	Consider 20% Margin	95.95
		Selected Transformer Rating In KVA	120

5.5 STP-5: 0.872MLD

Tentive Load List & Transformer Sizing

SR. NO.	EQUIPMENT NAME	KW	Load Factor	BKW	FEEDER TYPE	DUTY (C/I)	EFF	PF	DIVERSITY FACTOR	NOS. OF UNITS				MAXIMUM DEMAND IN KW	MAXIMUM DEMAND IN KVA	REMARK
										WORKING	STANDBY	FUTURE	TOTAL			
		(A)	(B)	(C)			(D)	(E)	(F)	(G)	(H)	(I)	(J)	K=C*G	L=C*G/D*E*F	
1	Raw Sewage Transfer Pump	5.5	0.85	4.68	SS	C	0.93	0.9	1	1	1	1	3	4.68	5.59	
2	SBR Air Blowers	22	0.85	18.70	MCCB	I	0.92	0.84	1	1	1	0	2	18.70	24.20	
3	RAS Pumps	0.75	0.85	0.64	STAR DELTA	I	0.77	0.78	1	2	0	0	2	1.28	2.12	
4	Decanters	0.55	0.85	0.47	VFD	I	0.73	0.73	1	2	0	0	2	0.94	1.75	
5	SAS Pumps	1.1	0.85	0.94	DOL	I	0.78	0.78	1	2	0	0	2	1.87	3.07	
6	Auto Valves/Sluice Gates	0.75	0.85	0.64	RDOL	I	0.77	0.78	4	6	0	0	6	3.83	1.59	
7	Chlorination System															
	a. NaOCl Solution Pump	0.19	0.85	0.16	DOL	I	0.65	0.65	1	1	1	0	2	0.16	0.38	
8	Centrifuge Feed Pumps	0.75	0.85	0.64	DOL	I	0.85	0.82	1	1	1	0	2	0.64	0.91	
9	Centrifuge	7.5	0.85	6.38	STAR DELTA	I	0.87	0.88	1	1	0	0	1	6.38	8.33	
10	Sludge Sump Agitator	0.75	0.85	0.64	DOL	I	0.77	0.78	1	1	0	0	1	0.64	1.06	
11	Dewatering Polymer Dosing System															
	a. Agitators for Dosing Tanks	0.37	0.85	0.31	DOL	I	0.71	0.65	1	2	0	0	2	0.63	1.36	
	b. Dosing Pumps	0.37	0.85	0.31	DOL	I	0.71	0.65	1	1	1	0	2	0.31	0.68	
12	Service Water Pumps	2.2	0.85	1.87	STAR DELTA	C	0.82	0.82	1	1	1	0	2	1.87	2.78	
13	Electrical Hoist with Travelling Trolley															
	a. 1 HP	0.75	0.85	0.64	DOL	I	0.77	0.78	1	1	0	0	1	0.64	1.06	
	a. 2 HP	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
14	Plant Area Lighting	7.5	1	7.50	MCCB	I	1	1	1	1	0	0	1	7.50	7.50	
15	Treated Sewage Transfer Pump	5.5	0.85	4.68	STAR DELTA	I	0.89	0.82	1	1	1	1	3	4.68	6.41	
16	Bio-Filter Centrifugal Blower	2.2	0.85	1.87	DOL	I	0.82	0.82	1	1	1	0	2	1.87	2.78	
												TOTAL KW		57.86	73.55	TOTAL KVA

NOTE:
A. Motor ratings are Tentitive and may vary due to following
1. any variation in hydraulic levels, change in orientation, etc.
2. Actual connected motor rating provided by mfg. selected by the successful bidder
B. Future equipments are not part of this tender. Hence not included in Transformer rating.

Total Load In KVA	73.55
Consider 20% Margin	88.26
Selected Transformer Rating In KVA	100

5.6 STP-6: 3.98MLD

Tentitive Load List & Transformer Sizing

SR. NO.	EQUIPMENT NAME	KW	Load Factor	BKW	FEEDER TYPE	DUTY (C/I)	EFF	PF	DIVERSITY FACTOR	NOS. OF UNITS				MAXIMUM DEMAND IN KW	MAXIMUM DEMAND IN KVA	REMARK
										WORKING	STANDBY	FUTURE	TOTAL			
		(A)	(B)	(C)			(D)	(E)	(F)	(G)	(H)	(I)	(J)	K=C*G	L=C*G/D*E*F	
	RAW SEWAGE PUMP HOUSE															
1	Mechanical Coarse Bar Screen	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
2	Flat Belt Conveyor	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
3	Raw Sewage Transfer Pump	15	0.85	12.75	STAR DELTA	C	0.93	0.9	1	1	1	1	3	12.75	15.23	
	STP															
4	Mechanical Fine Bar Screen	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
5	Flat Belt Conveyor	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
6	Detritor															
	a. Grit Collection Mechanism	1.5	0.85	1.28	DOL	C	0.8	0.81	1	1	0	0	1	1.28	1.97	
	b. Grit Washing/Classifier Mechanism	2.2	0.85	1.87	DOL	C	0.82	0.82	1	1	0	0	1	1.87	2.78	
	c. Organic Return Pumps	0.75	0.85	0.64	DOL	C	0.77	0.78	1	1	0	0	1	0.64	1.06	
7	SBR Air Blowers	37	0.85	31.45	VFD/SS	I	0.92	0.89	1	1	1	1	3	31.45	38.41	
8	RAS Pumps	1.5	0.85	1.28	DOL	I	0.8	0.81	1	2	0	0	2	2.55	3.94	
9	Decanters	0.55	0.85	0.47	VFD	I	0.73	0.73	1	2	0	0	2	0.94	1.75	
10	SAS Pumps	2.2	0.85	1.87	DOL	I	0.82	0.82	1	2	0	0	2	3.74	5.56	
11	Auto Valves/Sluice Gates	0.75	0.85	0.64	RDOL	I	0.77	0.78	4	8	0	0	8	5.10	2.12	
12	Chlorination System															
	a. Water Booster Pumps	2.2	0.85	1.87	DOL	C	0.82	0.82	1	1	1	0	2	1.87	2.78	
	b. NaOH Solution Pump	2.2	0.85	1.87	DOL	I	0.82	0.82	1	1	1	0	2	1.87	2.78	
	c. Air Blower	1.5	0.85	1.28	DOL	I	0.8	0.81	1	1	0	0	1	1.28	1.97	
13	Centrifuge Feed Pumps	1.1	0.85	0.94	DOL	I	0.85	0.82	1	1	1	0	2	0.94	1.34	
14	Centrifuge	11	0.85	9.35	STAR DELTA	I	0.89	0.82	1	1	0	1	2	9.35	12.81	
15	Sludge Sump Air Blower	2.2	1.85	4.07	DOL	I	0.82	0.82	1	1	1	0	2	4.07	6.05	
16	Dewatering Polymer Dosing System															
17	a. Agitators for Dosing Tanks	0.75	0.85	0.64	DOL	I	0.77	0.78	1	1	0	0	1	0.64	1.06	
	b. Dosing Pumps	0.37	0.85	0.31	DOL	I	0.71	0.65	1	1	1	0	2	0.31	0.68	
17	Service Water Pumps	2.2	0.85	1.87	STAR DELTA	C	0.82	0.82	1	1	1	0	2	1.87	2.78	
18	Electrical Hoist with Travelling Trolley															
	a. 2 HP	1.5	0.85	1.28	DOL	I	0.8	0.81	1	4	0	0	4	5.10	7.87	
19	Plant Area Lighting	11	1	11.00	MCCB	I	1	1	1	1	0	0	1	11.00	11.00	
20	Treated Sewage Transfer Pump	18.5	0.85	15.73	STAR DELTA	C	0.92	0.84	1	1	1	1	3	15.73	20.35	
21	Bio-Filter Centrifugal Blower	3.7	0.85	3.15	STAR DELTA	C	0.85	0.82	1	1	1	0	2	3.15	4.51	
												TOTAL KW		122.57	156.69	TOTAL KVA

NOTE:
A. Motor ratings are Tentitive and may vary due to following
1. any variation in hydraulic levels, change in orientation, etc.
2. Actual connected motor rating provided by mfg. selected by the successful bidder
B. Future equipments are not part of this tender. Hence not included in Transformer rating.

Total Load In KVA	156.69
Consider 20% Margin	188.03
Selected Transformer Rating In KVA	250

6. SAMPLING AND ANALYSIS - TESTS TO BE CARRIED OUT DURING O & M

SAMPLING PROTOCOL FOR STP PROCESS			
Sr. No	**Parameter**	**Frequently Sampling**	**Type of Sample**
1.	Influent & Effluent Temperature	Daily	Grab
2.	Influent & Effluent pH	Daily	Grab
3.	Influent and Final Effluent BOD5	Daily	Composite
4.	Influent and Final Effluent COD	Daily	Composite
5.	Influent and Final Effluent TSS	Daily	Composite
6.	Influent and Effluent Ammonical Nitrogen & TKN	3x / week	Composite
7.	Effluent Total Residual Chlorine	Daily	Grab or Composite
8.	Influent and Effluent Fecal & Total Coliforms	3x / week	Grab
9.	Influent and Effluent PO4-P & Total Phosphorous	3x / week	Composite
10.	Influent and Effluent Total Nitrogen	3x / week	Grab
11.	Aeration Tank- D.O. MLSS, and SVI , MLVSS	Daily	Grab
12.	Secondary Sludge VSS, TSS and Specific Gravity	3x / week	Grab
14.	Dewatered Sludge after Centrifuge % Solids	3x / week	Grab
15.	Total dissolved solids (TDS)	3x / week	Grab

7. List of records to be maintained

a. Consumption of chemicals on weekly basis.
b. Hours of operation of all pumps, blowers, etc.
c. Flow meter reading of raw sewage, permeate etc.
d. Hours of operation of DG set during power failure
e. Consumption of Diesel, kerosene, lubricants, etc.
f. Electrical unit consumption in each shift
g. Breakdown and corrective/preventive actions
h. Process failures and corrective/preventive actions
i. Lab monitoring records for all parameters of feed & permeate
j. Records for receipt and use of spares, dosing chemicals, etc.
k. Pay quittance and attendance register
l. EPF, ESI, Service Tax and Pan No