SPECIFICATION FOR OFF-LOADING OF

ENGINEERING SERVICES

PROJECT : TG TEST BED

EM TESTING, BHEL, Hyderabad – 32.

1 Introduction :

BHEL RC Puram is planning to setup Higher Capacity TG Test Bed at its works. For this purpose it is proposed to off load the Engineering works in the following areas:

1. Preparation of Plot Plan and Elevation view of Test facility.
2. Preparation of Piping layouts.
3. Preparation of Isometric drawings with BOM.
4. Pipe support and instruments supports.
5. Electrical Wiring Schedule and cable tray Layout.
6. Module Layout and interconnecting piping .
7. HT System (Transformer, Switch Gear, VFD, Drive motors etc.) layout.
8. Cable Sizing.
9. Electrical Cable Trenches & Piping Trenches Layout.

Tentative plot plan and P&I diagrams giving broad idea of the project are enclosed. These drawings are preliminary and should not be considered for defining the scope of work precisely.

2. Test Bed Details:

1. Location: BHEL, R.C.Puram, Hyderabad

2. Some of the typical parameters of Higher Capacity TG in table form is attached.

   - TG Rating.
   - Performance tests conducted.
   - Following Modules will be used during the testing:
     - Lube Oil Module (Test Plant)
     - Seal oil Module (Job Module)
     - Gas Module (Job Module)
   - Following Test Plant System will be used :
     - Cooling water System
     - Lube Oil Storage system
     - H2 & CO2 gas storage system
     - Fire Protection system

3. Scope of Engineering Services required:

A. Mechanical:

1. Lube oil system
2. Seal oil system
3. Cooling water system
4. CO_2/ H_2/ Air system
5. Drive system

Works-

1. Lay out drawing
2. System schematics
3. Piping Isometric drawing with support details
4. Bill of materials.

B. Electrical:

1. HT supply, breakers, cables
2. LT supply, breakers, MCC.
3. DC supply, breakers, MCC

Works-

1. Schematics
2. Cable sizing and routing
3. Termination and Terminal boards details
4. Cable trays/ trenches/ conduit details
5. Bill of materials.

C. Instrumentation and controls:

1. Complete test pit auxiliaries
2. Control room

Works-

1. Schematics
2. Cable sizing and routing
3. Termination and Terminal boards details
4. Cable trays/ trenches/ conduit/ Junction boxes selection and location details

5. Bill of materials.

D. Others:

1.0 Complete Test plant general arrangement drawings, ducting layout, piping layout, isometric drawings with bill of materials (BOM), Identification of any critical piping, pipe support design & drawings, Detailed plot plan showing details of trenches, platforms, foundation details of equipment for entire scope of the project. BOM for entire scope of the project. Tentative terminal points are marked on plot plan for reference. The preliminary plot plan and P & I may undergo any minor changes, and corresponding changes in the piping layouts shall have to be accommodated by vendor with out any price implication.

2.0 Based on the equipment details of Test facility, TG unit and Modules, complete piping layout and cable layout drawings have to be prepared. Equipment Layout, Isometrics with complete BOM are to be prepared. General fabrication drawings are to be given.

3.0 Isometrics are to be prepared for all pipes of dia. 1" and above, based on piping layouts, incorporating with Bill of material in specified format of BHEL. Isometric drawings shall also indicate the design data and erection notes.

4.0 BOM shall be furnished category-wise.

5.0 Drawings are to be made per scales and format is as per BHEL practice. Originals (1 set re-produceable) and final soft copies shall be handed over to BHEL on completion of contract.

4. Three no. of prints & one " Soft Copy " to be submitted as "Draft Copy ". BHEL will return one copy back to the bidder after necessary corrections. The bidder shall incorporate the changes and issue 3 prints as Rev. 00 and a soft copy. Subsequent revisions wherever required shall be submitted to BHEL in 3 prints along with soft copy.

1. As built drawings are to be completed and submitted by bidder based on feed back furnished by BHEL. Finally, 3 sets as final drawings, prints, softcopies in diskettes, to be submitted to BHEL.

2. Bidder to consider revisions which are normally required during the process of detail engineering.

3. Bidder shall consider no. of visits to BHEL for discussions and to get familiarized with the existing test bed layout.

5. PAYMENT SCHEDULE:

Terms of payment shall be as follows:

1. No advance shall be paid.
2. Payment shall be paid on pro-rata basis against the completion of milestones, to be mutually discussed and agreed upon.
3. Bid price shall be lump sum. It shall include all the expenses incurred by the bidder for the works. No amount will be paid extra in form of travel, lodging, taxes etc.
4. Payment towards as-built drawings and commissioning shall be 10% of total order value. The same shall be paid after commissioning of works at BHEL.

6. Reference Drawings enclosed:

Cooling Water system - Schematic
Lube Oil system - Schematic
TG schematics for various systems
Existing Test Bed layout
Preliminary layout of proposed Test bed
Electrical Single Line diagram

7. GENERAL INSTRUCTIONS TO BIDDERS

1. The bidder shall fully inform himself of the scope of work and shall seek clarifications required before submitting the bid. Incomplete and vague bids will be rejected.

2. Since time is the essence of the contract, the bidder shall offer a minimum schedule for engineering and also indicate the time schedule of inputs required to complete the engineering work.

3. Bidder shall offer firm price valid for at least 6 months.

4. Analysis and design carried out using computer shall be accompanied with a commentary defining all notations, description of methods / formulae used, units and defining the formats of the computer print with all input data.

5. **The bidders shall submit their offer in two parts, one Technical Bid and other Price Bid.**

6. Bidder shall submit their Technical Bid with **Earnest money deposit of Rs. 25,000/- (Rs. Twenty Five Thousand only)** by way of demand draft/ banker's cheque drawn in favour of Administrative Officer (Cash) , BHEL Ramachandrapuram, Hyderabad-502032. Offers without EMD shall be rejected.

7. No travel reimbursements, extra expense and any other expenses will be paid. **The Price Bid shall be in lump sum with statutory service charges.**

8. BHEL do no define or fix number of visits to BHEL for the works, But Vendor shall access the required number of visits to BHEL for the work content defined in specification.

9. All specifications and bill of quantities shall be prepared in packages and formats as directed by BHEL.

10. Since speedy delivery of document is essential for such a time schedule, it shall be responsibility of the bidder to ensure the courier / hand delivery will have to be accounted for by the bidder.

11. If in the opinion of BHEL, discussion / clarification across the table with the BHEL engineers is required, the bidder shall depute their engineers to BHEL. All the expenses incurred on such visits shall be inclusive of price bid.

12. Bidder shall separately indicate the estimated man-hours for carrying out the documentation design engineering work.

13. BHEL shall have the right to remove from engineering work any of the employees of bidder who in the opinion of BHEL is not suitable to perform job assigned to them or is delivering low quality of work or improper conduct or negligence in duty.

14. The bidder shall estimate revisions / modifications of drawing or document that can be anticipated in the project of such a nature based on his experience and include the same in the offer. No extra payments shall be made for any modifications / rectification that is considered necessary by BHEL. No extra payment shall also be made for the duplication / preparation of the required no., of copies to be submitted to

BHEL or due to bidder's errors or omissions. No extra payment shall also be made for revision / rectification / re-preparation of drawings / documents etc. submitted by bidder if the said modifications are demanded by BHEL on quality grounds.

15. The bidder shall familiarize himself fully with the standards / procedures / practices / quality requirements of BHEL to avoid any dispute at a later date.

16. BHEL shall not pay any amount, other than the fee / bid price specifically agreed, towards any cost incurred by the bidder by way of salaries to his employees (income and other taxes), insurance of any nature, benefits etc. BHEL's liability is limited to under the scope of work defined.

17. The bidder shall not commit any expenditure on behalf of BHEL without BHEL consent in writing during the execution of the work defined in the scope.

18. Bidder shall bear all expenses / fees / penalties if he infringes on patents / licenses of any person / organization in case of suits, court proceedings, damage claims etc. due to any reason whatsoever brought against the bidder.

19. The bidder shall ensure that he has all the national and international standards, codes, practices, statutory regulations etc. as applicable to the execution of the work. BHEL shall not provide any such documents to the sub-contractor.

20. Bidder shall collect input documents to the execution of the work from BHEL. Whenever applicable BHEL. BHEL shall provide only one set and duplication shall be responsibility of the sub-contractor.

21. BHEL reserves the right to terminate and suspend the contract and withdraw part of the scope of the work at any stage of its execution, if it is found the sub-contractor has not met his obligation or the performance / progress is not up to the expected standards and work is likely to suffer. In such an event BHEL shall give one-month notice in writing. BHEL reserves right to claim damages from the bidder including institution of judicial proceedings.

22. The bidder shall keep all information data, drawings etc., related to the work as confidential and shall not divulge it elsewhere. All drawings, documents, calculations including all originals prepared or obtained by the bidder during the work shall remain the property of BHEL and shall be handed over to BHEL on demand.

23. The bidder shall comply with all the application / statutory the laws and regulations of the country, the states concerned and territories in their design work.

24. In the event of any question or difference arising out in connection with the contract, whether during the progress of the work or after its completion, the purchaser and successful bidder shall nominate one arbitrator each, the arbitration shall be conducted in accordance with the latest provisions of the Indian Arbitration Act, 1990.

25. The bidder shall ensure that all engineering services required for the completeness of the project and to the ultimate satisfaction of BHEL shall be carried out. Any activity which has not been spelt out in this specification but is required for the completeness of the job for safe and efficient working of the systems engineered by the bidder shall rest with the bidder.

26. The bidder shall submit monthly progress report on the status of work entrusted to him.

27. The bidder shall be fully responsible for the accuracy and adequacy of the engineering services rendered by him. Any modifications / rectification, if required, in engineering and design shall be carried out expeditiously by the bidder at his own cost. Losses / damages occurred due to wrong engineering shall be compensated by the bidder and a maximum of 10% of the lump sum engineering fees shall be deducted towards bidder's errors.

28. If due to some unforeseen circumstances, it becomes necessary to suspend / terminate the project engineering work, the bidder shall be asked to stop work and he shall be paid only for the work done till date of notification and as per bills accepted by BHEL. No other damages / cancellation charges whatsoever arising out of such suspension / cancellation shall be payable by BHEL.

29. The successful bidder shall execute an agreement on Rs. 100/- non judicial bond paper for the period one year from the date of awardal of contract. Security Deposit equivalent to 10% of the contract value shall be deposited to BHEL after awardal of contract.

General Specification of 250 MW TG, Test Bed & Auxiliaries
(TYPE: THRI 1080/44)

SL.No.	Parameter	Unit	Quantity
1.	Rating	MVA	294.1
2.	Power	MW	250
3.	Voltage	kV	16.5
4.	Current	A	10291
5.	Speed	rpm	3000 or 3600
6.	Frequency	hz	50 or
7.	Power factor	pf	0.85
8.	Weight of Stator	T	232
9.	Weight of Rotor	T	43.3
10.	Weight of total assembly	T	282.3
11.	Cooling medium	Hydrogen	Purity: 99.5%
12.	Hydrogen operating pressure	bar	4
13.	Weight of Drive Motor	T	24

14.	Rating of Drive Motor	MVA	8 MVA/ 6 MW
15.	Power	MW	8 MVA
16.	Voltage	kV	4.16
17.	Current	A	2x550
18.	Speed	rpm	1500/ 3750
	Gear Box (as per motor speed)	Speed ration	1 : 2.5
19.	Frequency	hz	0 to 60 hz Variable
20.	Power factor	pf	0.70 to 0.95
21.	Drive Power VFD	VFD	8 MVA
22.	Rating	MW	6
23.	Seal Oil System		
	1. Seal Oil Unit I		
	2. Seal Oil Unit II		
	3. Seal Oil storage tank		
	4. Liquid level detectors		

	5. Seal Oil coolers		
	6. Seal Oil filter		
24.	Lube oil system	Capacity	1500 lpm
	1. Lube oil Pump I AC		
	2. Lube oil Pump II AC		
	3. Lube oil Pump DC (emergency)		
	4. Lube oil coolers		
	5. Lube oil filter		
	6. Lube oil storage Main Tank		
	7. Lube oil storage O/head Tank		
	8. Jacking oil system		
	9. Oil centrifuge		
25.	Cooling tower	Capacity	2 x 600 m^3/ hr
	1. Sump		
	2. Cooling water Pump I AC		
	3. Cooling water Pump II AC		
26.	H_2/ CO_2/ Purging air system	---	Requires storage, handling, transportation and stocking the filled & empty cylinders.
	1. Hydrogen distributor		
	2. CO_2 distributor		

	3. CO_2 Vapouriser		
	4. Gas control unit		
	5. Gas drier		
	6. Gas analyzer		
28.	HT Breakers	Nos.	8
29.	LT MCC	Nos.	2 AC/ DC
30.	PLC		
31.	DAS		
32.	Control Desk	Micro-processors	With Visual Screen Display
	1. Vibration monitoring		
	2. Temperature monitoring		
	3. Pressure monitoring		
	4. Large video screen display		
	5. Control of Drives		
	6. Control of drive motor		
	7. Excitation of generators		
	8. Annunciation and Protection		
33.	Fire Alarm System	---	---

34.	Access Control System	---	---
35	Battery station	Capacity	600 AH, 220V and 100 AH, 24 V

LIST OF TESTS CONDUCTED ON TURBO-GENERATORS

1. Pre-assembly tests:-

    1. Measurement of d.c. resistance of stator & rotor windings in cold condition.
    2. Measurement of d.c. resistance and insulation resistance of RTDs.
    3. Measurement of insulation resistance of stator & rotor windings before and after high voltage test.
    4. High Voltage test on stator and rotor windings.

2. Assembly activities:

    1. Lube oil, seal oil and jacking oil flushings.
    2. Measurement of insulation resistance Bearings.
    3. Air leak test on Turbo-generator assembly
    4. Installation of measurement probes, proximeters, sensors and instruments.

3. Post-assembly tests:-

    1. Mechanical run and measurement of vibrations at rated speed in air medium.
    2. Pressure distribution test.
    3. Co2/ Hydrogen filling.

4. Performance tests:-

1. Mechanical run and measurement of vibrations at rated speed in air medium.
2. Measurement of mechanical losses, short circuit characteristic and losses.
3. Measurement of mechanical losses, open circuit characteristic and losses.
4. Measurement of shaft voltage.
5. Checking of phase sequence.
6. Measurement of Rotor Impedance (rotor inside stator).
7. Measurement of insulation resistance of stator & rotor windings before and after high voltage test (m/c at rest).
8. High Voltage test on stator and rotor windings (m/c at rest).
9. Measurement of Polarization Index of stator winding.
10. Measurement of d.c. resistance of stator & rotor windings in cold condition.
11. Measurement of d.c. resistance and insulation resistance of RTDs.

5. Special tests:-

1. Heat run tests:

   a) Mechanical heat run test.

   b) Short circuit heat run test.

   c) Open circuit heat run test.

2. Voltage waveform analysis and determination of Telephone harmonic factor (THF).
3. Measurement of residual voltage of stator windings at rated speed.

4. Line to Line sustained short circuit test and determination of Negative sequence reactance (X_2).

5. Line to Line and to Neutral sustained short circuit test and determination of Zero sequence reactance (X_0).

6. Retardation test for determination of GD^2.

7. Three phase sudden short circuit test and determination of reactances and time constants.