TELANGANA STATE POWER GENERATION CORPORATION LIMITED (TSGENCO)
1X800 MW KOTHAGUDEM TPS STAGE-VII UNIT-12

VOLUME-II B

TECHNICAL SPECIFICATIONS
FOR
VIBRATION ISOLATION SYSTEM
FOR
TD BFP (2 NOS)
MD BFP (1 NOS)

SPECIFICATION NO. PE-TS-410-614-C001 (REV 0)

BHARAT HEAVY ELECTRICALS LIMITED
Project Engineering Management
PPEI BUILDING, HRD & ESI COMPLEX
Plot No. 25, Sector 16A
NOIDA, U.P. – 201301

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SECTION 'A'

SCOPE OF WORK

SCOPE

1. Supply of Vibration Isolation System (VIS)

i) Vibration Isolation System (VIS)
ii) Tools and facilities required for erection and commissioning including seaworthy packing & transportation etc. complete.

2. Supervision of erection and commissioning of the VIS.

Vendor shall deploy experienced manpower for setting the VIS in position and final adjustments after machine installation. Vendor shall also confirm the readiness at site before deploying the manpower for supervision of erection. Vendor shall furnish proposed erection strategy of the entire system and procedure for replacement of VIS and downtime involved.

3. Design & Engineering for the Vibration Isolation System

Design and engineering shall consist of the following:

i) Selection of Vibration Isolation System (VIS).
ii) Static and dynamic analysis and design of RCC deck slab (supporting arrangement for the equipment supported on VIS)
iii) Calculation of loads on supporting structure along with their points of application and deflection limitations.
iv) Calculation should establish that no dynamic loads are transferred to the structure supporting VIS and that the foundation system meets the amplitude/frequency requirements.
v) Checking of stiffness for structure supported on VIS.

4. Documentation

Vendor shall furnish following documents:

i) Bill of materials of various elements included in the supply along with detailed specifications of system and various items included in supply and standards local or international standards to which they conform.
ii) General Arrangement (GA) drawing showing location and supporting details of VIS.
iii) GA and reinforced concrete details drawings for deck slab including bar bending schedule.
iv) Embedment drawings showing location of all embedment and their details pertaining to RCC deck slab.
v) Design document.
vi) Methodology of providing the shuttering and its removal as well as concreting of deck slab, installation of VIS and sequence of above operation.
vii) Installation and maintenance manual indicating equipment, procedures, etc. necessary for installation/maintenance of VIS.

viii) List of power plants where such systems have been successfully installed for such applications.

ix) Performance certificate from the end user/customer for at least two successfully executed contracts for such system.

SECTION 'B'

PROJECT INFORMATION

PROJECT INFORMATION

1.	Owner	TELENGANA STATE POWER GENERATION CORPORATION LIMITED (TSGENCO)
2.	Project	1X800 MW KOTHAGUDEM TPS STAGE-VII, UNIT-12
3.	No of Units	1
4.	Consultant	DCPL
5.	Location	The site is located in the existing D colony of Kothagudem Thermal Power Station, which is at a distance 30 km from temple town of Bhadrachalam and 300 km from Hyderabad by road
6.	District	Khammam District
7.	Nearest Railway station	Bhadrachalam Road (BDCR)
8.	Nearest Airport	Vijaywada
9.	Nearest Seaport	Vizag

SECTION 'C'

SPECIFIC TECHNICAL REQUIREMENTS

1. General Requirement

1.01. In case of any conflict between section-C and section-D, Section-C will prevail over Section-D.

1.02. Bidder shall quote based on the input drawings as per Table-1 to satisfy the design requirement as per the relevant applicable codes refer annexure- I, and section –D.

Table-1

Sl. No	TITLE	DRAWING NO.
1	Foundation Arrangement for BFP & Drive Turbine (SH 1/3)	HY-DG-K28-139-0111 (R0)
2	Foundation Arrangement for BFP & Drive Turbine (SH 2/3)	HY-DG-K28-139-0111 (R0)
3	Foundation Arrangement for BFP & Drive Turbine (SH 3/3)	HY-DG-K28-139-0111 (R0)
4	Foundation Arrangement of MD BFP Set (SH ½)	HY-DG-1-18000-57695(R0)
5	Foundation Arrangement of MD BFP Set (SH 2/2)	HY-DG-1-18000-57695(R0)
6	General Arrangement of MD BFP Set	HY-DG-1-18000-57697(R0)

1.03. Bidder shall furnish the information about the entire range of spring units, damper units and spring cum damper units, manufactured by the vendor. The information to be furnished should include the load carrying capacity, stiffness (vertical & horizontal), damping resistance, dimension of spring and damper units as well as quality plan.

1.04. Steel helical springs and viscous dampers shall be provided by manufacturer with requisite experience and proven track record of similar installation in power plants of Unit capacity not less than 500 MW.

1.05. The nominal spring capacity shall be at least 25% higher than the actual spring-supported weight for the BFP foundation.

2. Seismic Loading:

The site falls in Zone-III as identified in the map in IS:1893-2002

3. Wind Loading :

The various design parameters as defined in IS: 875 (Part 3) to be adopted for the project site shall be as follows:

a. The basic wind speed "Vb" at ten metres above the mean retarding surface: 44 m/s.

b. The risk coefficient "K1" : 1.08

c. K3 : 1.0

d. K2 = As per table 2 of IS:875 (Part-3) corresponding to terrain (category 4)

e. K2 (bar) = As per Table 33 of IS: 875 (Part-3) corresponding to terrain(category 4)

4. **Material of construction**

i. Minimum Grade of Concrete: M30.
ii. TMT bars of grade Fe 500 conforming to IS 1786.

5. **Documents to be submitted by vendor**

i. Soft copy of all documents/drawings shall be furnished in pdf and AutoCAD format as applicable.
ii. Hard copies shall also be submitted.
iii. Submission of civil drawings/documents shall be as mentioned in the table below

	Drawing	Document
For Approval	Soft copy	Soft copy
For RFC	Soft copy + 5 nos. hard copies	1 sets of paper print + 2CD + soft copy

6. **Material (Design & Supply)**

6.01. Steel helical springs and viscous dampers shall consist of:

a. Steel helical spring units and viscous dampers along with viscous liquid including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads, etc.

b. Frames for pre-stressing of spring elements.

c. Suitable hydraulic jack system including electric pumps, high pressure tubes etc. required for the erection, alignment etc. of the spring units. One set of extra hydraulic jacks, and hand operated pumps shall also be provided.

d. Any other items may be required for the pre-stressing, erection, release of pre-stress, alignment and commissioning of the steel helical springs. and viscous dampers.

6.02. The objective of designing the supporting arrangement for any rotating equipment shall be so that the vibration level is maintained as minimum as possible under all operating conditions. Accordingly, respective rotating equipment shall be supported on RCC deck slab which in turn shall rest on vibration isolation unit consisting of steel helical springs and viscous dampers, which in turn shall be supported on RCC supporting structure. The above design shall form part of this specification.

6.03. The spring units shall have definite stiffness in both vertical and horizontal directions with the horizontal stiffness not less than 30% of vertical stiffness. The stiffness shall be such that the vertical natural frequency of any spring unit at its rated load carrying capacity is not more than 3 to 5 Hz.

6.04. The damper units or spring cum damper units shall be of viscous type offering velocity proportional damping. The damper units shall be suitable for temperatures ranging from 0 to 50^0 C. The damping resistance of the individual damper units shall be such that the designed damping can be provided using reasonable number of units. Damper shall have damping resistance ranging from 40 kN sec/m to 750 kN sec/m.

6.05. The sizes of the spring units, damper units and spring cum damper units shall be such that groups of such units can be accommodated on column heads in case of elevated foundations and on pedestals/walls in case of foundations at ground level.

6.06. The steel helical springs and viscous dampers shall be designed for ensuring "fit and forget" guarantee.

6.07. It shall be ensured that not more than 5% of the dynamic loads are transmitted to the substructure. Necessary provisions of DIN 4024 shall be adhered to whole designing the substructure. Substructure shall be designed for static loads.

6.08. For all equipment foundations supported on VIS system, the stiffness of the supporting substructure shall be at least ten (10) times that of spring elements as per DIN 4024.

7. Manufacturing & Testing

7.01. Complete manufacturing and testing of the steel helical springs and viscous dampers shall be done at the manufacturing shop of the approved vendor. For this purpose the vendor shall submit the detailed programme for approval of customer and take up the manufacturing / testing after approval of such program. The program shall include:

a) Manufacturing schedule and quality check exercised during manufacturing.
b) Detail of test to be carried out at the manufacturing shop with its schedule.
c) Special requirements, if any, regarding concreting of top deck.
d) Complete step- by- step procedure covering the installation and commissioning of the spring system.
e) Manuals for erection, commissioning, testing and maintenance of the steel helical springs and viscous dampers.
f) A checklist for confirming the readiness of the civil fronts for erection of steel helical springs and viscous dampers.
g) Checklist for equipment required at each stage of erection.
h) Bill of materials (data sheet) of various elements such as spring units, viscous dampers, with their rating, stiffness etc. included in the supply.
i) Bill of material (data sheet) for frames for pre stressing, hydraulic jack including electric pump, high pressure tubes, hand operated pump etc. with their rating and numbers.

j) Any other details which may be necessary to facilitate design and construction of the foundations / structures.

7.02. The springs shall conform to codes DIN 2089 and DIN 2096. The quality assurance and inspection procedure shall be finalised on the basis of the above codes and the quality plans be drawn accordingly.

8. Transportation

8.01. Steel helical springs and viscous dampers shall be suitably protected, coated, covered, boxed and crated to prevent damage or deterioration during transit and handling.

8.02. The vendor shall be responsible for any loss or damage during transportation, handling.

9. Erection and Commissioning

9.01. Complete erection and commissioning of the steel helical springs and viscous dampers including pre-stressing of elements, placing of elements in position, checking clearances on the shuttering of the RCC top deck, releasing of pre-stress in spring elements, making final adjustments and alignments etc. all shall be supervised by a specialist supervisor.

9.02. The scope of work shall be deemed to include all activities, which may not have been explicitly mentioned but are reasonably implied for the successful commissioning of steel helical springs and viscous dampers.

9.03. The vendor shall guarantee the performance of the steel helical springs and viscous dampers for 24 months from the date of commissioning of each machine which shall be termed as "Guarantee Period".

10. Realignment of Spring System

If any realignment of the steel helical springs and viscous dampers is required to be done for aligning the shaft or for any other reasons during the first one year of operation from the date of commissioning of the machine, the same shall be done by the vendor as and when asked for at no extra cost of the Owner..

ANNEXURE-I (Section-C)

Codes and Standards

Latest revision of following codes shall be used for the design of the spring supported foundations:

IS : 456 Code of practice for plain and reinforced concrete.

IS : 2974 Code of practice for design and construction of machine foundations.

IS : 1893 Criteria for earthquake resistant design of structures

DIN : 4024 Machine foundations; Flexible supporting structures for machine with rotating masses.

DIN : 2089 Helical compression springs out of round wire and rod: calculation & design.

DIN : 2096 Helical compression springs out of round wire and rod: quality requirements for hot formed compression springs.

VDI : 2056 Criteria for assessing mechanical vibrations of machine.

VDI : 2060 Criteria for assessing the state of balance of rotating rigid bodies.

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SECTION - D

SUB-SECTION – D26

VIBRATION ISOLATION SYSTEM

SPECIFICATION NO. PE-TS-999-600-C026

Bharat Heavy Electricals Limited

Project Engineering Management

C0NTENT

VIBRATION ISOLATION SYSTEM

1.00.00 SCOPE

This section covers supply, supervision of erection/ commissioning & design engineering of the vibration isolation system (VIS) suitable for ID/PA/FD Fans/ TDBFP/MDBFP/TURBOGENERATORS/MILLS .The vibration isolation system shall be of proven make and should be in successful operation for similar machines.

2.00.00 Supply of VIS

VIS shall be supplied complete along with recommended spares if any. The selection of VIS shall be done by the vendor, in case not done by customer , so that the amplitude at bearing locations are within permissible limits as per machine supplier recommendation or ISO10816 whichever is governing and no dynamic loads are transferred to the structure supporting VIS. Minimum 90 % isolation shall be achieved and the system shall be capable of withstanding Seismic/Wind forces.

3.00.00 Supervision of Erection and Commissioning

3.01.00 Manual

Vendor shall supply installation and maintenance manual indicating equipment, procedures etc. necessary for installation and replacement of VIS with downtime involved.

3.02.00 Tools and facilities

Vendor shall supply all tools and facilities as required for successful erection and commissioning of VIS. Vendor shall deploy experienced manpower to supervise successful installation of VIS

4.00.00 Design Engineering of Vibration Isolation System

4.01.00 Dynamic Analysis

The dynamic analysis shall consist of free vibration analysis and forced vibration analysis. Isolation efficiency of at least 90 % shall be obtained. The fundamental natural frequency shall be sufficiently above or below the

frequency corresponding to operating speed .Vibration amplitude shall be calculated at all bearing locations and shall satisfy the permissible limits as per ISO 10816 or as specified by the machine supplier. Transient analysis shall be carried out for the short circuit /blade failure condition with an appropriate force function if required by the machine supplier. The forces for which substructure is to be designed shall be furnished.

4.02.00 Static Analysis

The static analysis shall include the

a) Dead weights of machine stationary parts,
b) Dead weights of machine rotary parts
c) Loads due to machine power torque
d) Loads due to maximum allowable unbalance
e) Temperature loads
f) Loads due to blade unbalance/short circuit
g) Erections loads
h) Seismic Loads
i) Any other loads given by the supplier

Various load combinations must be investigated to obtain the most severe loads for foundation design purpose as per relevant IS codes or as per machine supplier recommendation whichever is more critical.

4.03.00 Check for Shaft Misalignment

Foundation deck must be adequately stiff to withstand all operating load combinations without excessively upsetting the rotor shaft alignment .The structural design must carefully be analysed for relative deflection for the members supporting machine shaft to satisfy the limits as given by machine supplier if any.

4.04.00 Design of RCC deck supported on VIS

Vendor shall provide General arrangement drawing of deck showing location and supporting detail of VIS, all embedment and their details as per the machine supplier drawing.
RCC design shall be done by working stress method for all machine foundations. Minimum reinforcement shall be governed by IS : 2974 as well IS : 456.
All documents/drawings shall be supplied in 25 (twenty five) prints. All calculations shall be supplied in 6 (six) sets. Soft copy of the drawings in Auto Cad shall be supplied along with the soft copy of the documents supplied

All documentation shall be in English language and all RCC/structural design shall be conforming to the relevant Indian Standard Code of practice.

5.00.00 Quality Plan and Test Certificate

Vendor shall furnish the quality plan and Test certificate for the hardware in their scope of supply. The quality plan shall be reviewed by BHEL /Consultant wherein the inspection and hold points shall be indicated. Vendor shall submit test certificate based on approved Quality Plan. Despatch of material by the vendor shall only take place after the receipt of Material Dispatch Clearance Certificate (MDCC) issued by BHEL/Consultant on the basis of test reports/test certificates submitted by the Vendor after manufacture.

6.00.00 Environmental Protection

VIS shall be suitably protected against environmental damages e.g. abrasion, discolouration, corrosion, oily water etc. to give a prolonged service matching the plant life.