NATIONAL THERMAL POWER CORPORATION LTD.
2X800 MW NTPC GADARWARA STPP STAGE-I (SG PKG)

VOLUME-II B

TECHNICAL SPECIFICATIONS
FOR
VIBRATION ISOLATION SYSTEM
FOR
ID FAN (4 NOS)
PA FAN (4 NOS)
FD FAN (4 NOS)

SPECIFICATION NO. PE-TS-395-618-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 (Excluded in vendor's scope)

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~~. **(Excluded from vendor's scope).**
iii) ~~GA and reinforced concrete details drawings for deck slab including bar bending schedule.~~ **(Excluded from vendor's scope).**
iv) ~~Embedment drawings showing location of all embedment and their details pertaining to RCC deck slab~~ **(Excluded from vendor's scope).**
~~v) Design document~~. **(Excluded from vendor's scope).**
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	NATIONAL THERMAL POWER CORPORATION LTD.
2.	Project	2X800 MW NTPC GADARWARA STPP STAGE-I(SG PKG)
3.	No of Units	2
4.	Consultant	NATIONAL THERMAL POWER CORPORATION LTD.
5.	Location	The site is located near villages Gangai & Umaraiya (about 9 kms from Gadarwara town in Narsingpur district of Madhya Pradesh. The major cities Bhopal & Jabalpur are located at about 210 kms & about 140 kms respectively from proposed project site. The nearest BG Railway station, Gadarwara on Jabalpur-Itarsi Section on central railway main Line is about 9 kms from proposed project site.
6.	District	Narsingpur district of Madhya Pradesh
7.	Nearest Major Town	Gadarwara
8.	Nearest Railway station	Gadarwara on Jabalpur-Itarsi Section on central railway main line is about 9 kms from proposed project site.
9.	Nearest Airport	Bhopal and Jabalpur are located about 240 kms and about 15 kms respectively from site.

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	GA DRAWING FOR ID FAN WITH FOUNDATION PLAN AND LOADING DATA SAF 44/20-2	1-00-099-28803 (R1)
2	GA DRAWING FOR PA FAN WITH FOUNDATION PLAN AND LOADING DATA PAF 20.5/11.2-2	1-00-100-28804 (R1)
3	GA DRAWING FOR FD FAN WITH FOUNDATION PLAN AND LOADING DATA FAF 26.6/12.5-1	1-00-098-28802 (R1)

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. Customer shall select springs (no. and type) based on the information furnished in 1.03 above by the bidder during detailed engineering and the bidder shall be required to supply the springs finally selected by Customer.

1.05. The steel helical springs and viscous damper supplied should be of proven make.

2. Seismic Loading:

Seismic loads shall be calculated adopting the site specific seismic information as specified in annexure-II

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 ground level: 39 m/s.

b. The risk coefficient "K1" : 1.06

c. Category of terrain : Category 2

Note: Notwithstanding the values of the above mentioned parameters, the design wind pressure so computed at any point shall not be taken less than 1500 N/sq.metre for all classes of structures, i.e. A,B & C, as defined in IS: 875 (Part-3).

4. Material (Design & Supply)

4.01. 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.

4.02. The design of the supporting arrangement for the equipment supported on steel helical springs and viscous dampers shall be done by owner. The supporting arrangement shall consist of an RCC deck supported on steel helical spring units and viscous dampers which in turn shall be supported on RCC substructure. The RCC deck shall be provided by owner.

4.03. The spring units should have stiffness in both vertical and horizontal directions with the horizontal stiffness not less than 50% of vertical stiffness. The stiffness should be such that the vertical natural frequency of any spring unit at its rated load carrying capacity is not more than 3 Hz.

4.04. The damper units or spring cum damper units should be of viscous type offering velocity proportional damping. The damper units should be suitable for temperatures ranging from 0 to 50^0 c. The damping resistance of the individual damper units should be such that the designed damping can be provided using reasonable number of units. Damper units shall have damping resistance ranging from 40kNsec/m to 300 kNsec/m.

4.05. The sizes of the spring units, damper units, spring cum damper units should 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.

4.06. The steel helical springs and viscous dampers shall be designed for a minimum operating life of 30 years.

5. Manufacturing & Testing

5.01. Complete manufacturing and testing of the steel helical springs and viscous dampers shall be done at the manufacturing shop of the 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 quality plan. The quality plan 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.

5.02. 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.

6. Transportation

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

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

7. Erection and Commissioning

7.01. 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.

7.02. 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.

7.03. 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".

8. **Supervision**

The supervision of installation of steel helical springs and viscous dampers including pre-stressing, placing, releasing and alignment of spring units shall be done by a specialist supervisor of vendor, trained for this purpose.

9. **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.

ANNEXURE-I (Section-C)

Codes and Standards

Some of the relevant applicable Indian standards and codes, etc. applicable to this section of the specification are listed below:

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.

ANNEXURE – II (SECTION-C)

ANNEXURE-EQ (GARDARWARA)

Gadarwara Thermal Power Project

CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1):2002 and IS:1893 (Part 4):2005. Pending finalization of Parts 2, 3 and 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for structures other than the buildings and industrial structures including stack-like structures.

A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Annexure-I.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Annexure-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 and Part 4).

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a)	Steel structures	:	2%
b)	Reinforced Concrete structures	:	5%
c)	Reinforced Concrete Stacks	:	3%
d)	Steel stacks	:	2%

Method of Analysis

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).

In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).

For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$ However, no reduction is permitted if $\bar{V}_B$ is less than V_B.

For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (Ah) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Annexure-I. Further, the spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the building falls to the left of the peak in the spectral acceleration curve.

Design/Detailing for Ductility for Structures

The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.

ANNEXURE – 1

SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various site specific seismic parameters for the project site shall be as follows:

1)	Peak ground horizontal acceleration (MCE)	: 0.18 g
2)	Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra	
a)	for ordinary moment resisting steel frames designed and detailed as per IS:800	: 0.0525
b)	for braced steel frames designed and detailed as per IS:800	: 0.039
c)	For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920	: 0.0315
d)	for steel chimney	: 0.079
e)	for design of structures not covered under 2 (a) to 2 (d) above and under 3 below	: 0.0525
3)	Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted	: 0.105

Note: g = Acceleration due to gravity

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.

ANNEXURE – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)	
	2%	5%
0	1	1
0 03	1	1
0.04	1 287	1.178
0.05	1.564	1.337
0.06	1.835	1 482
0.07	2.101	1.618
0.08	2.361	1.746
0.09	2.618	1.866
0.1	2.871	1.982
0.105	2.996	2.037
0.11	3.121	2.092
0.115	3.245	2.145
0.12	3.368	2.198
0.123	3.442	2.229
0.127	3.500	2.270
0.13	3.500	2.300
0.135	3.500	2.500
0.14	3.500	2.500
0.145	3.500	2.500
0.15	3.500	2.500
0.2	3.500	2.500
0.25	3.500	2.500
0.3	3.500	2.500
0.35	3.500	2.500
0.4	3.500	2.500
0.43	3.500	2.500
0.45	3.500	2.500
0.48	3.500	2.500
0.49	3.369	2.500
0.5	3.302	2.500
0.52	3.175	2.212
0.555	2.975	2.072
0.56	2.948	2.054
0.565	2.922	2.035
0.57	2.896	2.018
0 575	2.871	2.000
0.58	2.847	1.983
0.585	2 822	1 966

ANNEXURE – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)	
(Sec)	2%	5%
0.59	2 798	1.949
0 595	2.775	1 933
0 6	2.752	1.917
0 65	2.540	1.769
0.7	2.359	1.643
0.75	2.201	1.533
0.8	2.064	1.438
0.85	1.942	1.353
0.9	1.834	1.278
0.95	1.738	1.211
1	1.651	1.150
1.05	1.572	1.095
1.1	1.501	1.045
1.15	1.436	1.000
1.2	1.376	0.958
1.25	1.321	0 920
1.3	1.270	0.885
1.35	1.223	0.852
1.4	1.179	0.821
1.45	1.139	0.793
1.5	1.101	0.767
1.55	1.065	0.742
1.6	1.032	0.719
1.65	1.001	0.697
1.7	0.971	0.676
1.75	0.943	0.657
1 8	0.917	0 639
1 85	0 892	0.622
1.9	0.869	0.605
1 95	0 847	0.590
2	0 826	0.575
2 05	0.805	0 561
2 1	0.786	0.548
2.15	0.768	0.535
2.2	0.750	0.523
2.25	0 734	0.511
2.3	0.718	0.500
2.35	0.703	0.489
2 4	0.688	0.479

ANNEXURE – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)	
	2%	5%
2.45	0.674	0.469
2.5	0.660	0.460
2.55	0.647	0.451
2.6	0.635	0.442
2.65	0.623	0.434
2.7	0.611	0.426
2.75	0.600	0.418
2.8	0.590	0.411
2.85	0.579	0.404
2.9	0.569	0.397
2.95	0.560	0.390
3	0.550	0.383
3.05	0.541	0.377
3.1	0.533	0.371
3.15	0.524	0.365
3.2	0.516	0.359
3.25	0.508	0.354
3.3	0.500	0.348
3.35	0.493	0.343
3.4	0.486	0.338
3.45	0.479	0.333
3.5	0.472	0.329
3.55	0.465	0.324
3.6	0.459	0.319
3.65	0.452	0.315
3.7	0.446	0.311
3.75	0.446	0.307
3.8	0.435	0.303
3.85	0.423	0.299
3.9	0.413	0.295
3.95	0.402	0.291
4	0.392	0.288

VOLUME: II B

SECTION - D

SUB-SECTION – D26

VIBRATION ISOLATION SYSTEM

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

Bharat Heavy Electricals Limited

Project Engineering Management

CONTENT

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

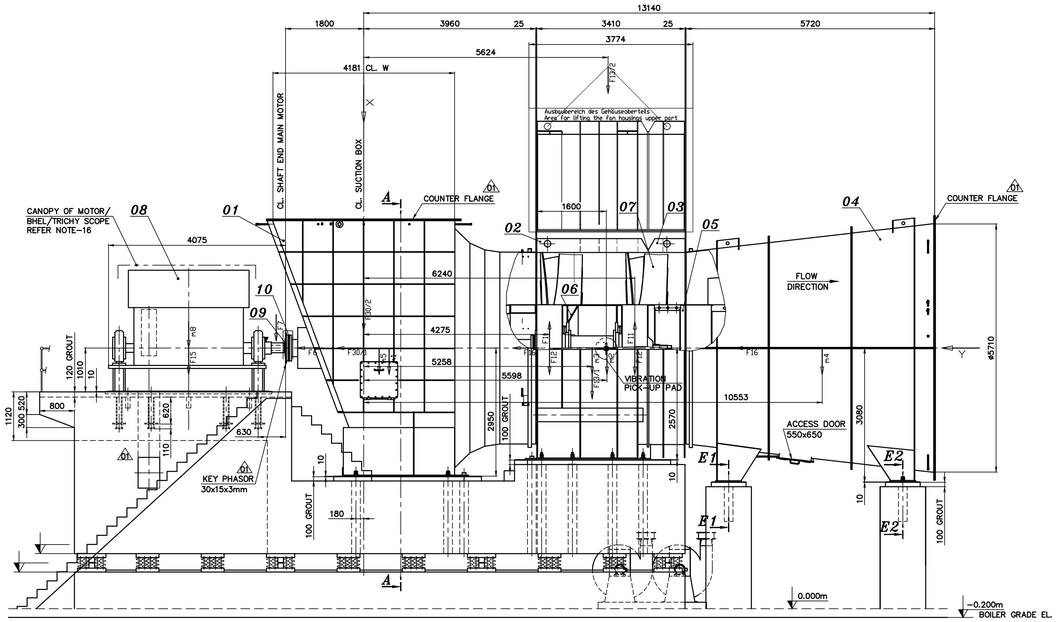
Vendor shall furnish the quality plan and Test certificate for the hardware in their scope of supply. The quality plan shall be reviewed by BHEL /Consultant wherein the inspection and hold points shall be indicated. Vendor shall submit test certificate based on approved Quality Plan. Despatch of material 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.

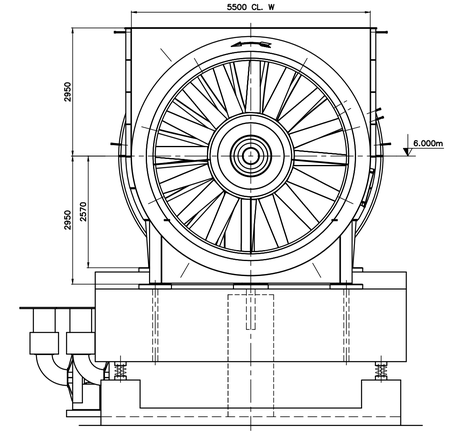
6.00.00 Environmental Protection

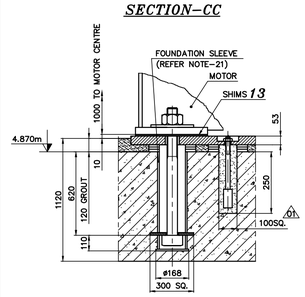
VIS shall be suitably protected against environmental damages e.g. abrasion, discolouration, corrosion, oily water etc. to give a prolonged service matching the plant life.

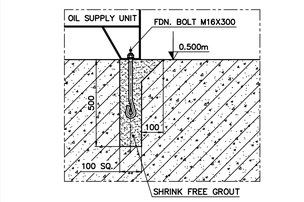
MAX.ALLOWABLE BEARING VIBRATION: 01

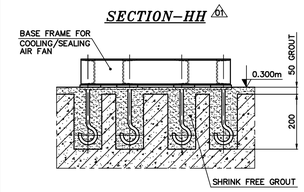
SET POINTS FOR VIBRATION:	
ALARM	TRIP
7mm/s [rms]	14mm/s [rms]

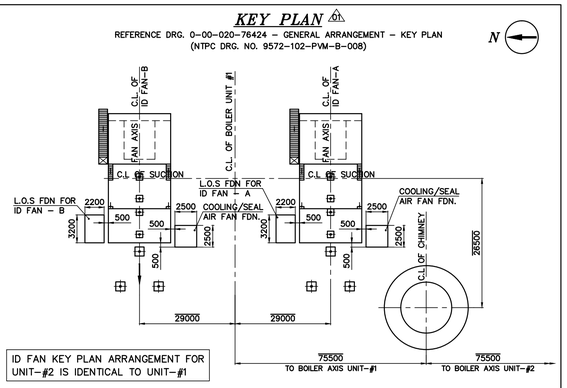




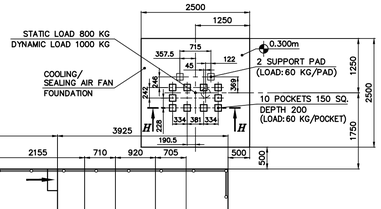


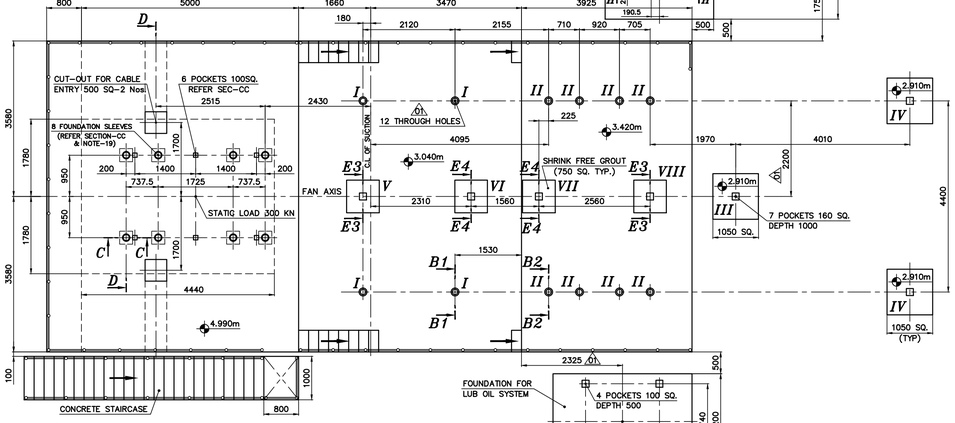


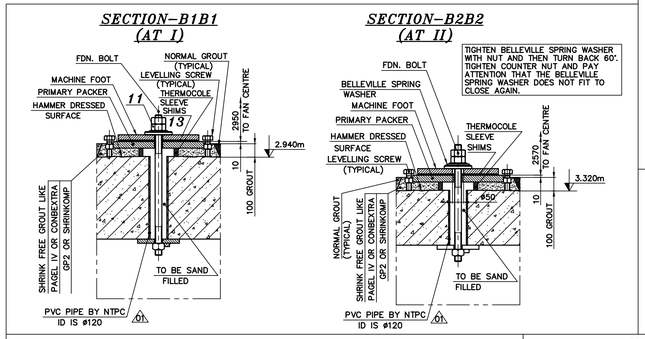


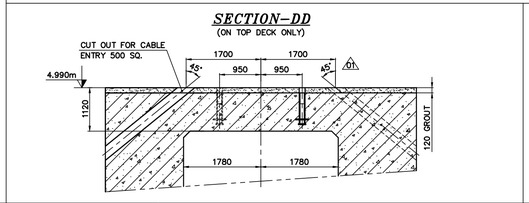


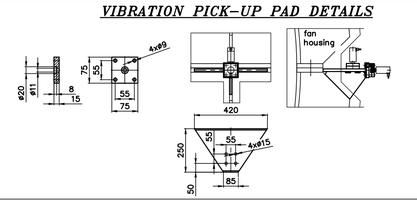
ID FAN KEY PLAN ARRANGEMENT FOR UNIT–#2 IS IDENTICAL TO UNIT–#1

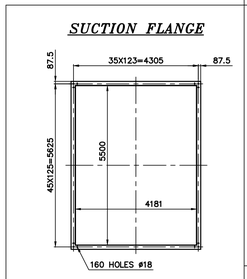


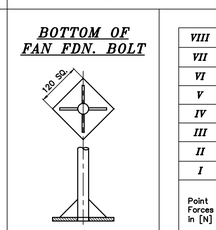








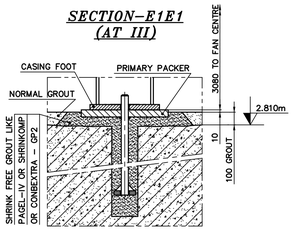


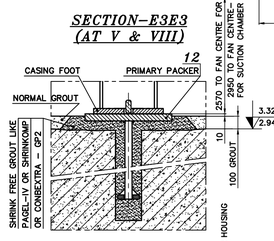


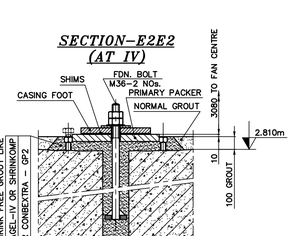
VIII			±2100	±10200	±11300 ±238400
VII			±226200 −96100	±10200	±11300 ±238400
VI			±61000	±17300	±2200
V			±3500	±17300	±2200
IV	+60600	±2300	±12200	±12200	±2300
III	+91200	±3700	±18300	±12000	±3700
II	+99500	±3300 ±70700	±19900	±19900	±2900 ±62000
I	+72000	±2200	±14400	±14400	±2200
Point Forces in [N]	Dead Load Vertical	Dynamic Load Vertical	Stat. horiz. Dead Load horiz.in axial Direction	Stat. horiz. Dead Load horiz. across to the axis	Dyn. horiz. Dyn. Load horiz. across to the axis

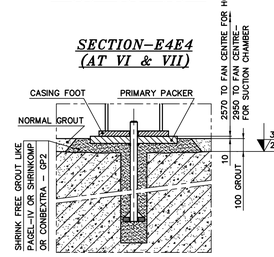
13	SHIMS	S.S	AS REQD.	
12	PRIMARY PACKER	IS : 2062	AS REQD.	
11	FOUNDATION FASTENERS FOR FAN	ASTM A105	19	
10	COUPLING GUARD	IS : 1079	1	
09	SPACER COUPLING	STEEL	1	
08	MOTOR WITH FNDN. FASTENERS	5925 KW/597 RPM	1	
07	BLADES	GGG 40 OR EQUIVALENT (NODULAR CAST IRON)	16	
06	IMPELLER HUB	LOAD RING: WstE500 OR EQUIVALENT Welding hub, Support ring, Others: P355NH OR EQUIVALENT	1	
05	HOUSING CORE (FAN HOUSING HUB)	IS : 2062 OR EQUIVALENT	1	
04	DIFFUSER	IS : 2062 OR EQUIVALENT	1	
03	OUTLET GUIDE VANE ASSY.	IS : 2062 OR EQUIVALENT	1	
02	IMPELLER HOUSING	IS : 2062 OR EQUIVALENT	1	
01	SUCTION CHAMBER	IS : 2062 OR EQUIVALENT	1	
SL NO	DESCRIPTION	MATERIAL	QTY.	

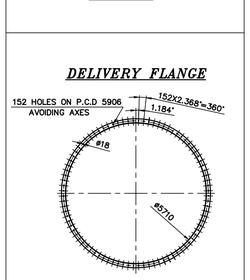
BILL OF MATERIAL











30/2		−78603	Stat. and dyn. forces caused by air stream of suction box in vert. direction
30/1		−5731	Stat. and dyn. forces caused by air stream of suction box in horiz. direction
16		65079	Axial thrust of the fan (due to pressure increase)
15		604640	Load during starting sequence by short-circuit torque of the motor
14	–		Foundation
13/2		123210	Max. load when lifting the fan housings upper part
13/1		118960	Max. load when lifting the rotor assembly
12		476640	Unbalance in case of damage
11		22452	Max. rotating load due to unbalance of the fan rotor
10	–		Oil supply unit with oil filling
9	–		Frame of the motor
8	–		Drive motor
7		14025	Radial load on motor shaft
6		21375	Axial thrust on motor shaft for motor with fixed bearing
5	2550		Intermediate shaft with coupling
4	17800		Diffuser with tail fairing
3	12126		Complete rotor assembly
2	27910		Fan housing with straightener vane section
1	19460		Suction box nose fairing & inlet nozzle and intermediate shaft cover
ID. NO.	(m) MASS IN (KG)	(F) FORCE IN (N)	DESIGNATION

MOTOR BEARING DATA:

TYPE	– SLEEVE BEARING
SIZE	– DE & NDE – ø250
LUBRICANT	– IOC SERVOPRIME–VG 46 OR EQUIVALENT
LUBRICATION	– RING LUBRICATED
OIL FILLING QTY.	– 17.5 LITRE PER BRG.

MOTOR COOLER DATA:

WATER FLOW RATE (FOR TWO ELEMENTS)	= 350 LPM
WATER INLET / OUTLET TEMPERATURE	= 39°C/45°C
PRESSURE DROP	= 380 mbar
OPERATING PRESSURE	= max. 6 bar
TEST PRESSURE	= 9 bar

NOTES:–

01. THE LOADS INDICATED ON FOUNDATION ARE WITHOUT ALLOWANCES FOR VIBRATIONS. CIVIL DESIGNERS ARE RESPONSIBLE FOR PROPER DESIGN OF FOUNDATION TAKING INTO ACCOUNT OF THE ALLOWANCES FOR VIBRATION ALSO.
02. THE DIFFERENT NATURAL FREQUENCY OF THE FOUNDATION HAVE TO BE 20% AWAY FROM THE SPEED FREQUENCY, fnmax = n/60 AND 15% AWAY FROM THE DOUBLE OF THE SPEED FREQUENCY, 2 x fnmax. THIS MEANS : 0.8xfn TO 1.2xfn AND 0.85x(2xfn) TO 1.15x(2xfn). SPEED FREQUENCY fnmax. = 9.8 HZ (2 * fnmax.) = 19.7 HZ
03. THE STIFFNESS OF THE FOUNDATION HAS TO BE ATLEAST CF>1.0E+06 N/mm IN LONGITUDINAL, TRANSVERSAL AND VERTICAL DIRECTIONS RELATING TO THE FAN AXIS. IT HAS TO BE TAKEN INTO CONSIDERATION THAT ON SETTLING OF THE FOUNDATION THE TOTAL NATURAL FREQUENCIES OF THE FOUNDATION CAN ARISE DUE TO THE SOIL COMPACTION AND THE RESULTING INCREASES OF THE ELASTIC MODULUS. AN UNEVEN SETTLING OF THE FOUNDATION HAS TO BE EXCLUDED.
04. THE RATIO OF THE FOUNDATION MASS TO THE ROTOR MASS HAS TO BE GREATER THAN 20. 01
05. ADOPT IS: 2974 / PART–IV FOR THE FOUNDATION DESIGN.
06. THE CONNECTING DUCTS AT INLET AND OUTLET OF FAN MUST BE SELF SUPPORTED AND SHOULD NOT BE WELDED WITH EXPANSION JOINTS.
07. FOUNDATION POCKETS SHOULD BE PERPENDICULAR TO THE FLAT SURFACES OF FOUNDATION.
08. ACCURATE TEMPLATES SHALL BE USED FOR LOCATING CORES FOR POCKET HOLES TO ENSURE THEIR DIMENSIONAL ACCURACY.
09. TOLERANCE BETWEEN ANY TWO POCKET CENTRES IS ±5 mm.
10. TOLERANCE ON CONCRETE LEVELS $^{+0}_{-25}$ mm.
11. IN AREAS WHERE SOLE PLATES AND ANCHOR PLATES ARE TO BE INCORPORATED IN FOUNDATION CONCRETE, THE SIZE OF THE COARSE AGGREGATE USED SHALL NOT EXCEED 20 mm AND DOWN GRADED TO FACILITATE CHIPPING AND SCRAPPING AND THEREBY ENSURING MAXIMUM CONTACT ON THE MATING AREAS.
12. NON–SHRINK GROUT IS TO BE USED. REFER GENERAL SPECIFICATIONS ISSUED BY BHEL/RANIPET FOR NON–SHRINK GROUT. THIS ALSO CONTAINS THE PREPARATIONS OF PRIMARY PACKERS & SHIMS.
13. GROUTING SHOULD BE DONE ONLY AFTER FINAL ALIGNMENT OF FAN.
14. ELEVATION & POCKET DEPTHS SHOWN IN FOUNDATION PLAN ARE INCLUDING GROUTING THICKNESS.
15. GROUTING IS IN SCOPE OF ERECTION GROUP OF BHEL/AUTHORISED AGENCY.
16. HANDRAILS, STEEL PLATFORMS, STAIRS, STEEL LADDERS & CANOPY FOR MOTOR AND THEIR EMBEDMENTS ARE IN THE SCOPE OF BHEL/TRICHY.
17. FAN FOUNDATION SHOULD NOT BE USED AS SUPPORT FOR OTHER STRUCTURES OR EQUIPMENTS.
18. FOUNDATION CONFIGURATION SHOWN IN THIS DRAWING IS ONLY INFORMATIVE/TYPICAL. TYPE AND DETAILS OF FOUNDATION ARE TO BE FINALISED BY CIVIL DESIGNERS.
19. FOR MOTOR ERECTION, REFER MOTOR SUPPLIER'S ERECTION MANUAL.
20. BASE FRAME, SOLE PLATE, FOUNDATION BOLTS, FDN. SLEEVE & FASTENERS RELATED TO MOTORS ARE IN THE SCOPE OF MOTOR SUPPLIER (BHEL BHOPAL UNIT)
21. FOUNDATION SLEEVE OF THE MOTOR IS TO BE EMBEDDED IN THE CONCRETE AS PER THE DIMENSION SHOWN. AFTER CONCRETE HAS SET, THE EXCESS PROTRUDING HEIGHT TO BE SUITABLE CUT–OFF.
22. BHEL BHOPAL'S DRAWING "OUTLINE AND GENERAL ARRGT. OF ID FAN MOTOR" WITH DRAWING NO 14020041258 (NTPC DRG NO 9572–102–BPL–PVE–B–001) TO BE REFERRED FOR ID FAN MOTOR DETAILS. 01
23. ALL ELEVATIONS ARE WITH RESPECT TO EL(+/–) 0.0 M WHICH CORRESPONDS TO RL(+) 358.5 M ABOVE MSL. 01

FAN DETAILS:–

TYPE	: SAF 44/20–2
NO. OF FANS PER BOILER	: TWO (IDENTICAL)
WEIGHT OF ROTATING PARTS	: 12500 Kg
GD^2 OF FAN	: 30000 kg.m^2
SPEED OF FAN	: 590 RPM

MOTOR DETAILS:–

MAKE	: M/s. BHEL/BHOPAL 01
RATING	: 5925 KW /597 RPM/381 AMP/11 KV
FRAME SIZE	: 11F4553–3
WEIGHT OF MOTOR	: 30000 Kg
GD^2 OF MOTOR	: 4760 kg.m^2
MOTOR DRG. NO.	: 1 402 00 41258

LOADING ON MOTOR FOUNDATION

REACTION DUE TO WEIGHT ON EACH SIDE (G)		= 150 kN
MAX. SHORT CIRCUIT FORCE (MS)		= 508 kN
REACTION DOWNWARD	(MS+G)	= 658 kN
REACTION UPWARDS	(MS–G)	= 358 kN

MOTOR NOTES:

01. THE FORCES OCCUR ALTERNATELY INDEPENDENT OF THE DIRECTION OF ROTATION. (REFER LOADING ON FOUNDATION TABLE).
02. THE TRANSFER OF VIBRATION FROM SURROUNDING EQUIPMENT HAS TO BE AVOIDED BY SUITABLE LAYOUT OF FOUNDATION.
03. THE FIRST NATURAL FREQUENCIES OF THE FOUNDATION AFTER ERECTION OF THE MACHINE MUST DIFFER ATLEAST +25% & –20% FROM ONE & TWO TIMES RUNNING SPEED FREQUENCIES & TWO TIMES THE ELECTRICAL FREQUENCY.

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY	APPR'D BY
01	1) NTPC COMMENTS UPDATED VIDE–REFER: CC: PE: 102:446 dtd. 01.10.13 a) KEY PLAN ADDED. b) SETPOINT DATA FOR VIBRATIONS UPDATED. c) MOTOR DETAILS UPDATED. 2) COUNTER FLANGE & KEY PHASOR SLOT ADDED. 3) NOTE Nos. 22 & 23 ADDED.	29.01.2014	P.S.N	S.AGARWAL	V.P.SHYAM
00	ISSUED FOR NTPC REVIEW	16.09.2013	P.S.N	S.AGARWAL	V.P.SHYAM

BHEL CUSTOMER NOS. R815 & R816

NTPC DRG NO 9572–102–RPT–PVM–B–008

CUSTOMER NTPC — NTPC LIMITED. (A Government of India Enterprise)

PROJECT GADARWARA SUPER THERMAL POWER PROJECT
STAGE–I 2 x 800MW
STEAM GENERATOR PACKAGE

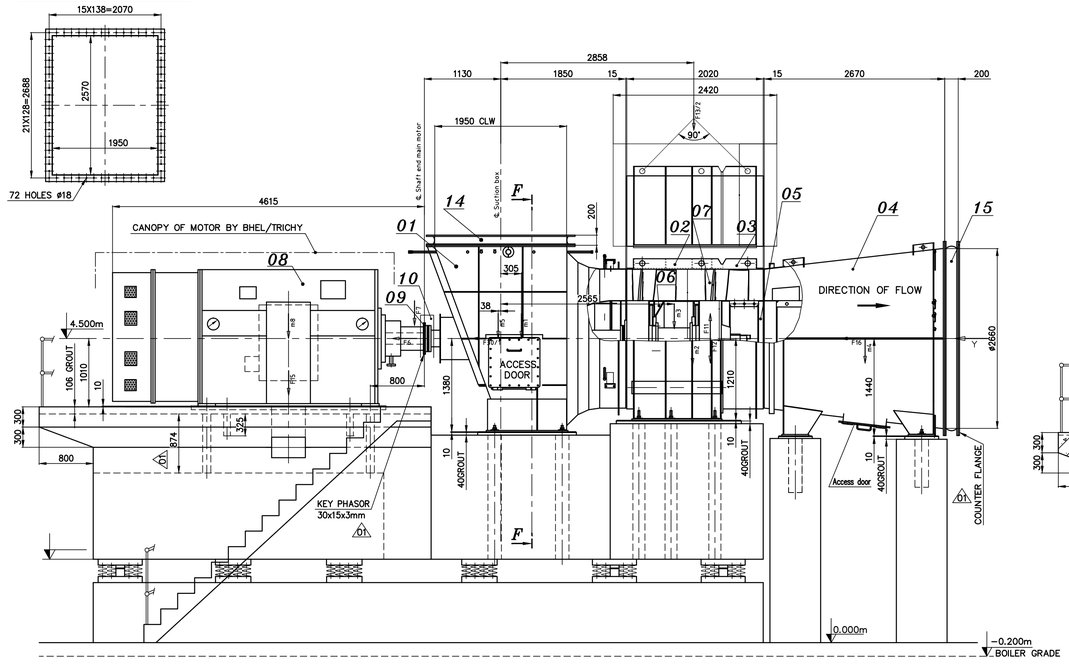
BHARAT HEAVY ELECTRICALS LIMITED.,
BOILER AUXILIARIES PLANT
RANIPET – 632 406

TITLE GA DRAWING FOR ID FAN WITH FOUNDATION PLAN AND LOADING DATA SAF 44/20–2

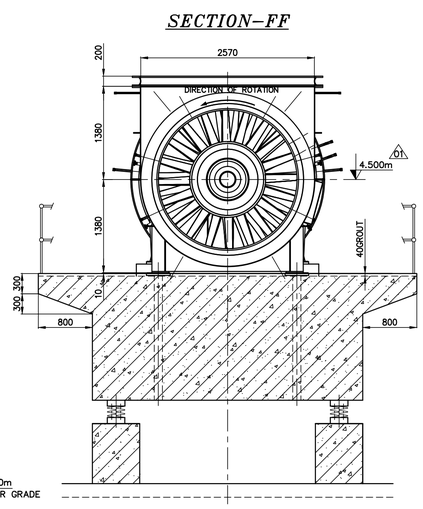
ALL DIMENSIONS IN MILLIMETRE | PROJECTION | SCALE NTS | BHEL DRG. NO. 1–00–099–28803 | REV. 01

Size A1

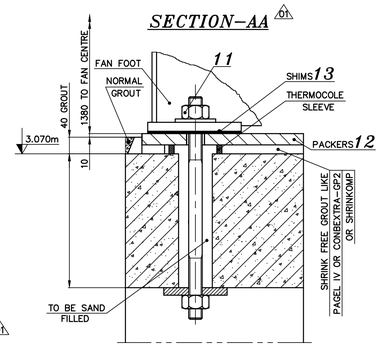
SUCTION FLANGE



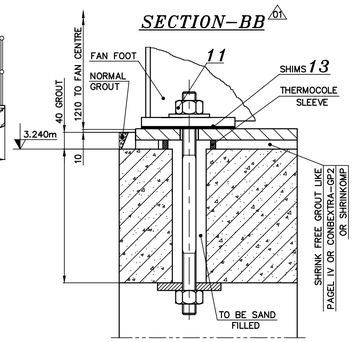
SECTION–FF



SECTION–AA

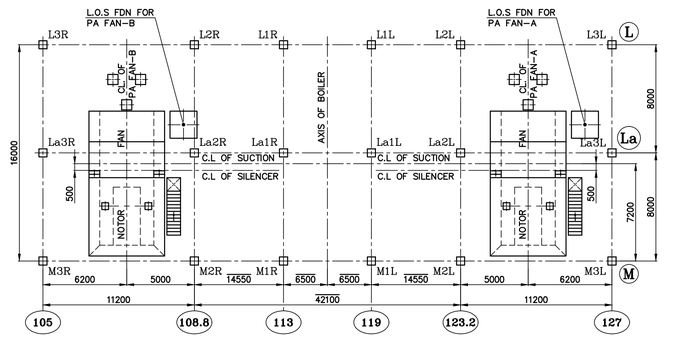


SECTION–BB



KEY PLAN

REFERENCE DRG. 0-00-022-76413 – GENERAL ARRGT. – PLAN SECTION "04-04"
(NTPC DRG. NO-9572-102-PVM-B-006)



NOTES:–

01. THE LOADS INDICATED ON FOUNDATION ARE WITHOUT ALLOWANCES FOR VIBRATIONS. CIVIL DESIGNERS ARE RESPONSIBLE FOR PROPER DESIGN OF FOUNDATION TAKING INTO ACCOUNT OF THE ALLOWANCES FOR VIBRATION ALSO.
02. THE DIFFERENT NATURAL FREQUENCIES OF THE FOUNDATION HAVE TO BE 20% AWAY FROM THE SPEED FREQUENCY, fnmax = n/60 AND 15% AWAY FROM THE DOUBLE OF THE SPEED FREQUENCY, 2 X fnmax. THIS MEANS: 0.8xfn TO 1.2xfn and 0.85x(2xfn) TO 1.15x(2xfn).
    SPEED FREQUENCY fnmax = 25 HZ
    (2 * fnmax) = 50 HZ
03. THE STIFFNESS OF THE FOUNDATION HAS TO BE AT LEAST CF > 1.0E+06 N/mm IN LONGITUDINAL, TRNSVERSAL AND VERTICAL DIRECTIONS RELATING TO THE FAN AXIS. IT HAS TO BE TAKEN INTO CONSIDERATION THAT ON SETTLING THE FOUNDATION THE TOTAL NATURAL FREQUENCIES OF THE FOUNDATION CAN ARISE DUE TO THE SOIL COMPACTION AND THE RESULTING INCREASES OF THE ELASTIC MODULUS. AN UNEVEN SETTLING OF THE FOUNDATION HAS TO BE EXCLUDED.
04. THE RATIO OF THE FOUNDATION MASS TO THE ROTOR MASS HAS TO BE GREATER THAN 20.
05. ADOPT IS: 2974 / PART–IV FOR THE FOUNDATION DESIGN.
06. THE CONNECTING DUCTS AT INLET AND OUTLET OF FAN MUST BE SELF SUPPORTED AND SHOULD NOT BE WELDED WITH EXPANSION JOINTS.
07. FOUNDATION POCKETS SHOULD BE PERPENDICULAR TO THE FLAT SURFACES OF FOUNDATION.
08. ACCURATE TEMPLATES SHALL BE USED FOR LOCATING CORES FOR POCKET HOLES TO ENSURE THEIR DIMENSIONAL ACCURACY.
09. TOLERANCE BETWEEN ANY TWO POCKET CENTRES IS ±5 mm.
10. TOLERANCE ON CONCRETE LEVELS $^{+0}_{-25}$mm.
11. IN AREAS WHERE SOLE PLATES AND ANCHOR PLATES ARE TO BE INCORPORATED IN FOUNDATION CONCRETE, THE SIZE OF THE COARSE AGGREGATE USED SHALL NOT EXCEED 20 mm AND DOWN GRADED TO FACILITATE CHIPPING AND SCRAPPING AND THEREBY ENSURING MAXIMUM CONTACT ON THE MATING AREAS.
12. NON–SHRINK GROUT IS TO BE USED. REFER GENERAL SPECIFICATIONS ISSUED BY BHEL/RANIPET FOR NON–SHRINK GROUT. THIS ALSO CONTAINS THE PREPARATIONS OF PRIMARY PACKERS & SHIMS.
13. GROUTING SHOULD BE DONE ONLY AFTER FINAL ALIGNMENT OF FAN.
14. ELEVATIONS & POCKET DEPTH SHOWN IN FOUNDATION PLAN ARE INCLUDING GROUTING THICKNESS.
15. GROUTING IS IN SCOPE OF ERECTION GROUP OF BHEL/AUTHORISED AGENCY.
16. HANDRAILS, STEEL PLATFORMS, LADDERS & CANOPY FOR MOTOR AND THEIR EMBEDMENTS ARE IN THE SCOPE OF BHEL/TRICHY.
17. FAN FOUNDATION SHOULD NOT BE USED AS SUPPORT FOR OTHER STRUCTURES OR EQUIPMENTS.
18. FOUNDATION CONFIGURATION SHOWN IN THIS DRAWING IS ONLY INFORMATIVE/TYPICAL. TYPE AND DETAILS OF FOUNDATION ARE TO BE FINALISED BY CIVIL DESIGNERS.
19. FOR MOTOR ERECTION, REFER MOTOR SUPPLIER'S ERECTION MANUAL.
20. BASE FRAME, SOLE PLATE, FOUNDATION BOLTS, FDN. SLEEVE & FASTENERS RELATED TO MOTORS WILL BE IN THE SCOPE OF MOTOR SUPPLIER (BHEL BHOPAL UNIT)
21. ALL ELEVATION ARE WITH RESPECT TO EL(+/–) 0.0 M WHICH CORRESPONDS TO RL(+) 358.5 M ABOVE MSL. 01
22. BHEL BHOPAL'S DRAWING "OUTLINE AND GENERAL ARRGT. OF PA FAN MOTOR" WITH DRAWING NO 14020041257 (NTPC DRG NO 9572–102–BPL–PVE–B–003) TO BE REFERRED FOR PA FAN MOTOR DETAILS. 01

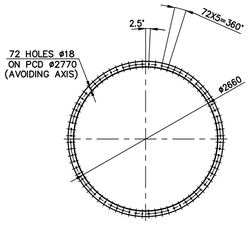
FAN DETAILS:

TYPE	: PAF 20.5/11.2–2
NO. OF FANS PER BOILER	: TWO (IDENTICAL)
WEIGHT OF ROTATING PARTS	: 2900 kg
GD^2 OF FAN	: 1200 kg.m^2
SPEED OF FAN	: 1490 RPM

MOTOR DETAILS: 01

RATING	: 4125 KW/1494 RPM/243 AMP/11 KV
TYPE	: 1LA7925–4
MAKE	: M/s. BHEL/BHOPAL
WEIGHT OF MOTOR	: 15800 kg
WEIGHT OF ROTATING PARTS	: 4500 kg
GD^2 OF MOTOR	: 1236 kg.m^2
MOTOR DRG. NO.	: 1 402 00 41257

DELIVERY FLANGE



30/2		10617	Stat. and dyn. forces caused by air stream of suction box in vert. direction
30/1		25410	Stat. and dyn. forces caused by air stream of suction box in horiz. direction
16		33545	Axial thrust of the fan (due to pressure increase)
15		226830	Load during starting sequence by short–circuit torque of the motor
14	–		Foundation
13/2		21860	Max. load when lifting the fan housings upper part
13/1		20780	Max. load when lifting the rotor assembly
12		90070	Unbalance in case of damage
11		11128	Max. rotating load due to unbalance of the fan rotor
10	–		Oil supply unit with oil filling
9	–		Frame of the motor
8	–		Drive motor
7		3630	Radial load on motor shaft
6		2133	Axial thrust on motor shaft for motor with fixed bearing
5	660		Intermediate shaft with coupling
4	3030		Diffuser with tail fairing
3	2900		Complete rotor assembly
2	4950		Fan housing with straightener vane section
1	3130		Suction box with nose fairing & inlet nozzle and intermediate shaft cover
ID. NO.	(m) MASS IN (KG) INCLUDING INSULATION	(F) FORCE IN (N)	DESIGNATION

SECTION–CC

SECTION–DD

FOUNDATION LOAD DATA

LOAD POINT	+↓ FORCE [N] STATIC VERTICAL	+↓ ↑− FORCE [N] DYNAMIC VERTICAL	+→ FORCE [N] STATIC HORIZONTAL IN AXIAL DIRECTION	+ ↔ − FORCE [N] STATIC HORIZONTAL ACROSS TO AXIS	+ ↔ − FORCE [N] DYN. HORIZONTAL ACROSS TO AXIS
I	+25300	±400	±7900	±1500	±400
II	+31100	±2200 ±18300	±5600	±800	±1900 ±15600
III	+15600	±500		±2100	±500
IV	+10400	±500		±2100	±500

SECTION–EE

SECTION–GG

MOTOR SHAFT END

SECTION–AA

MOTOR BEARING LUBRICATION DETAILS: 01

	DE	NDE
BEARING SIZE	ø180X150	ø180X150
OIL FLOW RATE	5.6 LPM	5.6 LPM
MAX. OIL INLET PRESSURE	0.2 TO 0.5 Kg/cm^2	0.2 TO 0.5 Kg/cm^2
OIL GRADE	ISO VG 68	ISO VG 68
LUBRICATION TYPE	FORCED OIL LUBRICATION	

FOUNDATION LOAD OF MOTOR

MAX. FORCE CALCULATED FROM THE MAX. IMPULSE TORQUE – FM = 170 KN
FORCE EXERTED BY WEIGHT ON EACH SIDE---------- FG = 79 KN
FOUNDATION LOAD ON EACH SIDE COMPRESSION – FA = FM+FG = 249 KN
TENSILE FORCE -------- FB = FM–FG = 91 KN
THE FORCE OCCUR ALTERNATIVELY INDEPENDENT OF THE DIRECTION OF ROTATION.

SL NO	DESCRIPTION	MATERIAL	QTY.
15	OULET EXPANSION JOINT	IS:2062 & RUBBER	1
14	INLET EXPANSION JOINT	IS:2062 & RUBBER	1
13	SHIMS	S.S	AS REQD.
12	PRIMARY PACKER	IS : 2062	8
11	FOUNDATION FASTENERS FOR FAN	ASTM A105	15
10	COUPLING GUARD	IS : 2062	1
09	SPACER COUPLING	STEEL	1
08	MOTOR WITH FNDN. FASTENERS	4125 KW /1494 RPM	1
07	BLADES	ENAC–AISI9MgT6	36
06	IMPELLER HUB	S355J2G3	1
05	HOUSING CORE	IS : 2062	1
04	DIFFUSER	IS : 2062	1
03	OUTLET GUIDE VANE ASSY.	IS : 2062	1
02	IMPELLER HOUSING	IS : 2062	1
01	SUCTION CHAMBER	IS : 2062	1

BILL OF MATERIAL

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY	APPR'D BY
01	1) NTPC COMMENTS UPDATED VIDE REFERENCE: CC:PE: 102:556 dtd. 21.10.13 a) KEY PLAN ADDED. b) FAN AND ITS FOUNDATION DETAILS ALTERED. c) MOTOR DETAILS UPDATED. 2) COUNTER FLANGE & KEY PHASOR SLOT ADDED.	28.01.2014	P.S.N	S.AGARWAL	V.P.SHYAM
00	ISSUED FOR NTPC REVIEW	05.09.2013	P.S.N	S.AGARWAL	V.P.SHYAM

BHEL CUSTOMER NOS. R815 & R816

NTPC DRG NO 9572–102–RPT–PVM–B–009

CUSTOMER NTPC — NTPC LIMITED. (A Government of India Enterprise)

PROJECT GADARWARA SUPER THERMAL POWER PROJECT
STAGE–1 2 x 800MW
STEAM GENERATOR PACKAGE

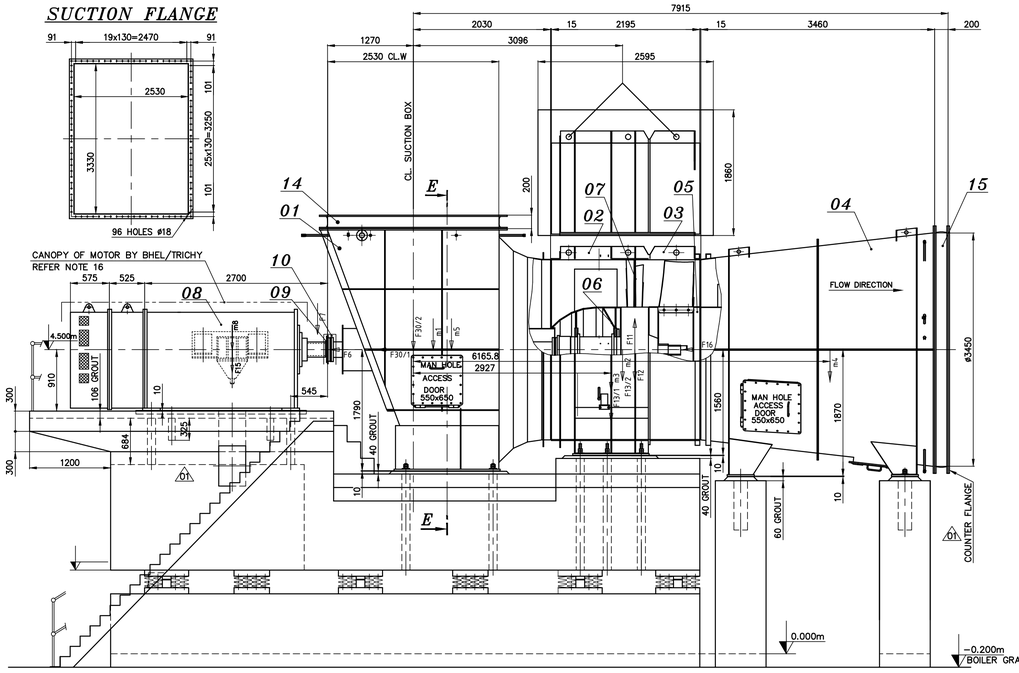
BHARAT HEAVY ELECTRICALS LIMITED.,
BOILER AUXILIARIES PLANT
RANIPET – 632 406

TITLE
GA DRAWING FOR PA FAN WITH FOUNDATION PLAN AND LOADING DATA PAF 20.5/11.2–2

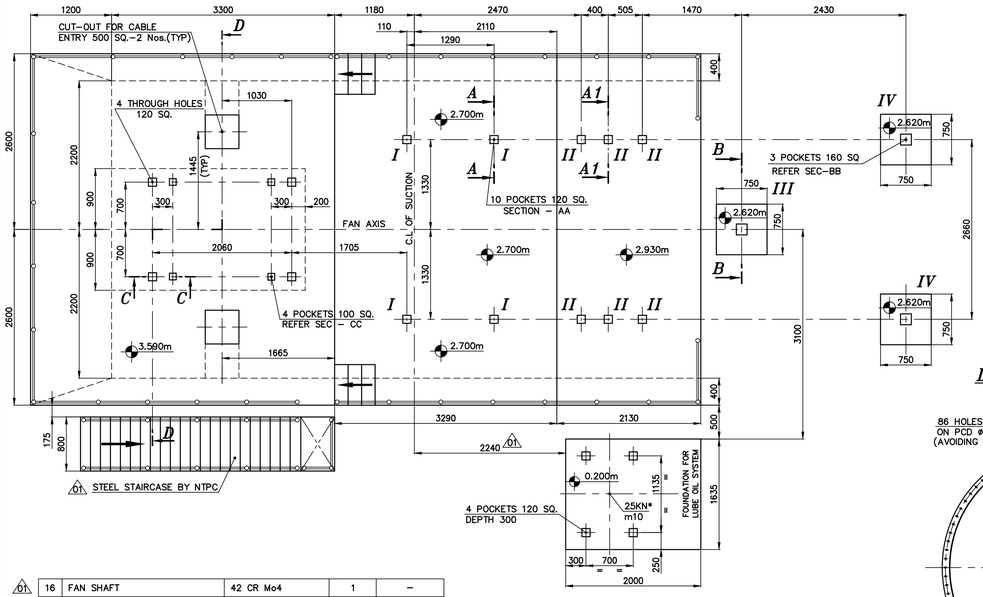
ALL DIMENSIONS IN MILLIMETRE | PROJECTION | SCALE NTS | BHEL DRG. NO. 1–00–100–28804 | REV. 01

Size A1

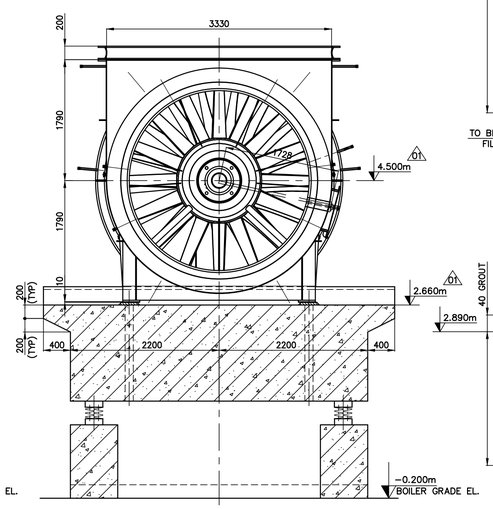
SUCTION FLANGE



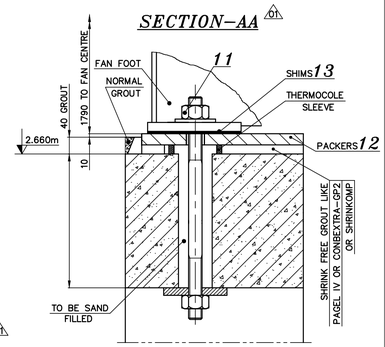
FOUNDATION PLAN



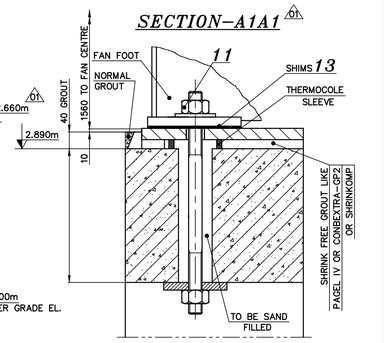
SECTION–EE



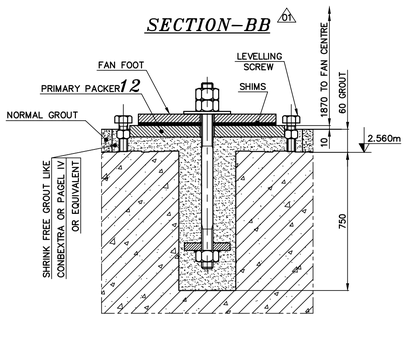
SECTION–AA



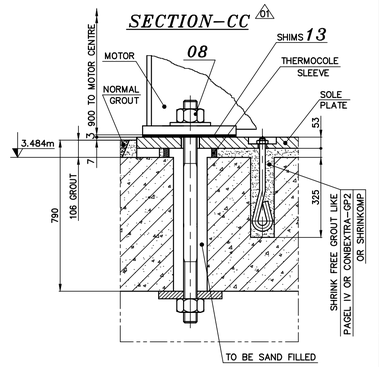
SECTION–A1A1



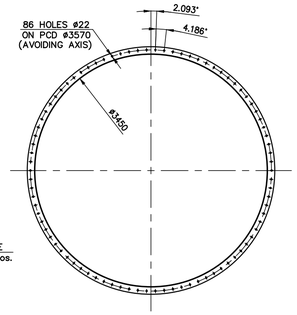
SECTION–BB



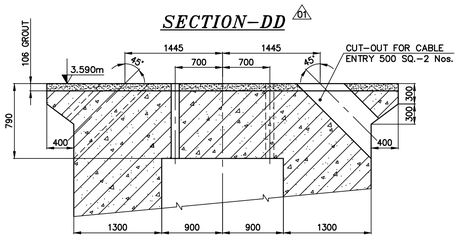
SECTION–CC



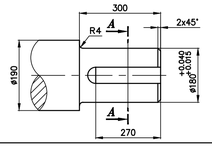
DELIVERY FLANGE



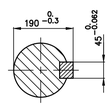
SECTION–DD



MOTOR SHAFT END



SECTION–AA



01	16	FAN SHAFT	42 CR Mo4	1	–
	15	OULET EXPANSION JOINT	IS:2062 & RUBBER	1	–
	14	INLET EXPANSION JOINT	IS:2062 & RUBBER	1	–
	13	SHIMS	S.S	AS REQD.	–
	12	PRIMARY PACKER	IS : 2062	8	20
	11	FOUNDATION FASTENERS FOR FAN	ASTM A105	15	–
	10	COUPLING GUARD	IS : 2062	1	–
	09	SPACER COUPLING	STEEL	1	–
	08	MOTOR WITH FNDN. FASTENERS	2100 KW / 996 RPM	1	–
	07	BLADES	ENAC–AISI9MgT6	14	–
	06	IMPELLER HUB	S355J2G3	1	–
	05	HOUSING CORE	IS : 2062	1	8
	04	DIFFUSER	IS : 2062	1	6
	03	OUTLET GUIDE VANE ASSY.	IS : 2062	1	6
	02	IMPELLER HOUSING	IS : 2062	1	10
	01	SUCTION CHAMBER	IS : 2062	1	6
	SL NO	DESCRIPTION	MATERIAL	QTY.	THICKNESS (MM) 01

BILL OF MATERIAL

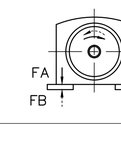
ID. NO.	(m) MASS IN (KG) INCLUDING INSULATION	(F) FORCE IN (N)	DESIGNATION
30/2		12401	Stat. and dyn. forces caused by air stream of suction box in vert. direction
30/1		52856	Stat. and dyn. forces caused by air stream of suction box in horiz. direction
16		19535	Axial thrust of the fan (due to pressure increase)
15		139260	Load during starting sequence by short–circuit torque of the motor
14	–		Foundation
13/2		31520	Max. load when lifting the fan housings upper part
13/1		19570	Max. load when lifting the rotor assembly
12		99480	Unbalance in case of damage
11		7044	Max. rotating load due to unbalance of the fan rotor
10	–		Oil supply unit with oil filling
9	–		Frame of the motor
8	–		Drive motor
7		3685	Radial load on motor shaft
6		1635	Axial thrust on motor shaft for motor with fixed bearing
5	670		Intermediate shaft with coupling
4	4810		Diffuser with tail fairing
3	2000		Complete rotor assembly
2	7140		Fan housing with straightener vane section and nose fairing
1	4500		Suction box with inlet nozzle and intermediate shaft cover

FOUNDATION LOAD DATA

LOAD POINT	+↓ FORCE [N] STATIC VERTICAL	+↓ ↑− FORCE [N] DYNAMIC VERTICAL	+→ FORCE [N] STATIC HORIZONTAL IN AXIAL DIRECTION	+◁▷− FORCE [N] STATIC HORIZONTAL ACROSS TO AXIS	+◁▷− FORCE [N] DYN. HORIZONTAL ACROSS TO AXIS
I	+32700	±400	±13300	±100	±400
II	+32400	±1400 ±20000	±3300	±15300	±1200 ±7100
III	+21300	±500		±100	±500
IV	+13100	±500		±100	±500

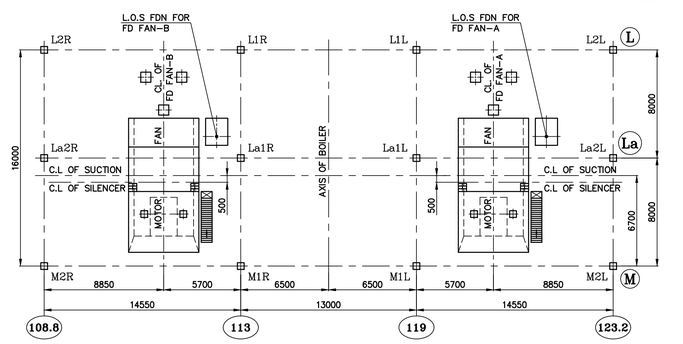
FOUNDATION LOAD OF MOTOR

MAX. FORCE CALCULATED FROM THE MAX. IMPULSE TORQUE – FM = 160 KN
FORCE EXERTED BY WEIGHT ON EACH SIDE---------- FG = 60 KN
FOUNDATION LOAD ON EACH SIDE COMPRESSION – FA = FM+FG = 220 KN
TENSILE FORCE -------- FB = FM–FG = 100 KN
THE FORCE OCCUR ALTERNATIVELY INDEPENDENT OF THE DIRECTION OF ROTATION.



KEY PLAN 01

REFERENCE DRG. 0–00–022–76413 – GENERAL ARRGT. – PLAN SECTION "04–04"
(NTPC DRG. NO–9572–102–PVM–B–006)



NOTES:–

01. THE LOADS INDICATED ON FOUNDATION ARE WITHOUT ALLOWANCES FOR VIBRATIONS. CIVIL DESIGNERS ARE RESPONSIBLE FOR PROPER DESIGN OF FOUNDATION TAKING INTO ACCOUNT OF THE ALLOWANCES FOR VIBRATION ALSO.
02. THE DIFFERENT NATURAL FREQUENCIES OF THE FOUNDATION HAVE TO BE 20% AWAY FROM THE SPEED FREQUENCY, fnmax = n/60 AND 15% AWAY FROM THE DOUBLE OF THE SPEED FREQUENCY, 2 X fnmax. THIS MEANS: 0.8xfn TO 1.2xfn and 0.85x(2xfn) TO 1.15x(2xfn).
SPEED FREQUENCY fnmax = 16.5 HZ
(2 * fnmax) = 33.0 HZ
03. THE STIFFNESS OF THE FOUNDATION HAS TO BE AT LEAST CF > 1.0E+06 N/mm IN LONGITUDINAL, TRNSVERSAL AND VERTICAL DIRECTIONS RELATING TO THE FAN AXIS. IT HAS TO BE TAKEN INTO CONSIDERATION THAT ON SETTLING THE FOUNDATION THE TOTAL NATURAL FREQUENCIES OF THE FOUNDATION CAN ARISE DUE TO THE SOIL COMPACTION AND THE RESULTING INCREASES OF THE ELASTIC MODULUS.
AN UNEVEN SETTLING OF THE FOUNDATION HAS TO BE EXCLUDED.
04. THE RATIO OF THE FOUNDATION MASS TO THE ROTOR MASS HAS TO BE GREATER THAN 20. 01
05. ADOPT IS: 2974 / PART–IV FOR THE FOUNDATION DESIGN.
06. THE CONNECTING DUCTS AT INLET AND OUTLET OF FAN MUST BE SELF SUPPORTED AND SHOULD NOT BE WELDED WITH EXPANSION JOINTS.
07. FOUNDATION POCKETS SHOULD BE PERPENDICULAR TO THE FLAT SURFACES OF FOUNDATION.
08. ACCURATE TEMPLATES SHALL BE USED FOR LOCATING CORES FOR POCKET HOLES TO ENSURE THEIR DIMENSIONAL ACCURACY.
09. TOLERANCE BETWEEN ANY TWO POCKET CENTRES IS ±5 mm.
10. TOLERANCE ON CONCRETE LEVELS $^{+0}_{-25}$ mm.
11. IN AREAS WHERE SOLE PLATES AND ANCHOR PLATES ARE TO BE INCORPORATED IN FOUNDATION CONCRETE, THE SIZE OF THE COARSE AGGREGATE USED SHALL NOT EXCEED 20 mm AND DOWN GRADED TO FACILITATE CHIPPING AND SCRAPPING AND THEREBY ENSURING MAXIMUM CONTACT ON THE MATING AREAS.
12. NON–SHRINK GROUT IS TO BE USED. REFER GENERAL SPECIFICATIONS ISSUED BY BHEL/RANIPET FOR NON–SHRINK GROUT. THIS ALSO CONTAINS THE PREPARATIONS OF PRIMARY PACKERS & SHIMS.
13. GROUTING SHOULD BE DONE ONLY AFTER FINAL ALIGNMENT OF FAN.
14. ELEVATIONS & POCKET DEPTH SHOWN IN FOUNDATION PLAN ARE INCLUDING GROUTING THICKNESS.
15. GROUTING IS IN SCOPE OF ERECTION GROUP OF BHEL/AUTHORISED AGENCY.
16. HANDRAILS, STEEL PLATFORMS, LADDERS & CANOPY FOR MOTOR AND THEIR EMBEDMENTS ARE IN THE SCOPE OF BHEL/TRICHY.
17. FAN FOUNDATION SHOULD NOT BE USED AS SUPPORT FOR OTHER STRUCTURES OR EQUIPMENTS.
18. FOUNDATION CONFIGURATION SHOWN IN THIS DRAWING IS ONLY INFORMATIVE/TYPICAL. TYPE AND DETAILS OF FOUNDATION ARE TO BE FINALISED BY CIVIL DESIGNERS.
19. FOR MOTOR ERECTION, REFER MOTOR SUPPLIER'S ERECTION MANUAL.
20. BASE FRAME, SOLE PLATE, FOUNDATION BOLTS, FDN. SLEEVE & FASTENERS RELATED TO MOTORS WILL BE IN THE SCOPE OF MOTOR SUPPLIER (BHEL BHOPAL UNIT)
21. ALL ELEVATION ARE WITH RESPECT TO EL(+/–) 0.0 M WHICH CORRESPONDS TO RL(+) 358.5 M ABOVE MSL. 01
22. BHEL BHOPAL'S DRAWING "OUTLINE AND GENERAL ARRGT. OF FD FAN MOTOR" WITH DRAWNG NO 14020041254 (NTPC DRG NO 9572–102–BPL–PVE–B–002) TO BE REFERRED FOR FD FAN MOTOR DETAILS. 01

FAN DETAILS:

TYPE	: FAF 26.6/12.5–1
NO. OF FANS PER BOILER	: TWO (IDENTICAL)
WEIGHT OF ROTATING PARTS	: 2000 kg
GD^2 OF FAN	: 1400 kg.m^2
SPEED OF FAN	: 990 RPM

MOTOR DETAILS:

MAKE	: M/s. BHEL/BHOPAL
TYPE	: 1LA7903–6 01
RATING	: 2100 KW/996 RPM/133 AMP/11 KV
WEIGHT OF MOTOR	: 12000 kg
WEIGHT OF ROTATING PARTS	: 2950 kg
GD^2 OF MOTOR	: 652 kg.m^2
MOTOR DRG. NO.	: 1 402 00 41254
BEARINGS	DE: ROLLER BRG–NU 238 BALL BRG–6238 MC 3 NDE: ROLLER BRG–NU 232M
LUBRICATION	: IOC GREASE SERVOGEM 3 OR EQUI.

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY	APPR'D BY
01	1) NTPC COMMENTS UPDATED VIDE REFERENCE: CC:PE: 102:557 dtd. 21.10.13 a) KEY PLAN ADDED. b) FAN AND ITS FOUNDATION DETAILS ALTERED. c) BOM UPDATED. d) ELEVATION LEVEL INDICATED IN SEC–AA, A1A1, BB CC & DD. 2) COUNTER FLANGE ADDED.	28.01.2014	P.S.N	S.AGARWAL	V.P.SHYAM
00	ISSUED FOR NTPC REVIEW	06.09.2013	P.S.N	S.AGARWAL	V.P.SHYAM

BHEL CUSTOMER NOS. R815 & R816

NTPC DRG NO 9572–102–RPT–PVM–B–007

CUSTOMER एनटीपीसी NTPC — NTPC LIMITED. (A Government of India Enterprise)

PROJECT
GADARWARA SUPER THERMAL POWER PROJECT
STAGE–I 2 x 800MW
STEAM GENERATOR PACKAGE

बीएचईएल BHEL — BHARAT HEAVY ELECTRICALS LIMITED.,
BOILER AUXILIARIES PLANT
RANIPET – 632 406

TITLE
GA DRAWING FOR FD FAN WITH FOUNDATION PLAN AND LOADING DATA FAF 26.6/12.5–1

ALL DIMENSIONS IN MILLIMETRE
PROJECTION
SCALE NTS
BHEL DRG. NO. 1–00–098–28802
REV. 01

Size A1