NTPC- SAIL POWER CORPORATION LTD (NSPCL).

1X250 MW NSPCL ROURKELA TPP-III

TECHNICAL SPECIFICATION
FOR
VIBRATION ISOLATION SYSTEM
FOR

ID FAN (2 NOS) FOUNDATION

SPECIFICATION NO. : PE-TS-427-618-C001 (Rev 0)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA-201301

	TITLE : TECHNICAL SPECIFICATION FOR VIS FOR ID FAN (2 NOS) FOUNDATION	SPECIFICATION NO. PE-TS-427-618-C001	
		SECTION	
		REV. NO. 0	DATE 13.10.2016

CONTENTS

This Technical Specification consists of two Sections:

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

01. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

02. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations.'

03. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.

04. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

05. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description& quantities as per the specification shall prevail).

06. QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.

    The charges for 3rd party inspection (Lloyds, or equivalent) for imported components shall be included in the base price of the equipment by the bidder.

07. All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval.

08. GA drawings/ datasheet / QP as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.

09. All sub vendors shall be subject to BHEL/CUSTOMER approval.

10. Any special tools & tackles, if required, shall be in bidder's scope.

SECTION-I

SPECIFIC TECHNICAL REQUIREMENTS

1.0 SCOPE

1.01 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.

1.02 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.

1.03 DESIGN & ENGINEERING FOR THE VIBRATION ISOLATION SYSTEM AND TOP DECK (INCLUDED 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 not more than 5 % of the dynamic loads are transmitted to the substructure supporting VIS and that the foundation system meets the amplitude/frequency requirements.
v) Checking of stiffness for structure supported on VIS.

1.04 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. **(Included in vendor's scope).**
iii) GA and reinforced concrete details drawings for deck slab including bar bending schedule. **(Included in vendor's scope).**
iv) Embedment drawings showing location of all embedment and their details pertaining to RCC deck slab-**(Included in vendor's scope).**
v) Design document. **(Included in 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.

2.0 GENERAL:

2.1 In case of any conflict between section –I and section-II, section-I will prevail over section-II.

2.2 The vibration isolation system shall consist of steel helical spring units and viscous dampers.

2.3 Bidder shall quote based on the input drawings as per Table-1 to satisfy the design requirement as per the relevant applicable codes in annexure- A and section - II.

Table-1

Sl. No	TITLE	DRAWING NO.
1	GENERAL ARRANGEMENT OF ID FAN – NDZV 40	1-00-099-29092 (R1)

2.4 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.

2.5 The Bidder should do the engineering/design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck. The vibration isolation system supplied shall be of a proven make. The Bidder who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance force comparable to the machine proposed by the vendor. The vibration isolation systems installed by the Bidder or his sub-contractor in such machines should have been working satisfactorily for at least five years.

3.0 DOCUMENTS TO BE SUBMITTED BY VENDOR

3.1 Document submission schedule after the award of contract shall be as below:

PACKAGE	BHEL DRG NO	DRG TITLE	Drg Submission schedule
VIS FOR TD/MD BFP	**Primary Documents** - affecting Manufacturing/ Delivery Directly		
	PE-V0-427-618-C201	Data sheet of VIS for ID Fan	R-0 within Two (02) weeks from LOI/PO & subsequent revisions within 10 days of comments received from BHEL/customer.
	PE-V0-427-618-C202	QAP of VIS for ID Fan	
	PE-V0-427-618-C203	Test certificate of VIS for ID Fan	
	PE-DC-427-618-C005	Static & dynamic Analysis of VIS for ID Fan	
	PE-DG-427-618-C001	Civil GA drwg of ID Fan	

	Secondary Documents - NOT affecting Manufacturing / Delivery Directly		
	PE-DG-427-618-C002	RC details of Top Deck of ID Fan	R-0 within Two (02) weeks of Cat-I(or)II approval on GA drawing

3.2 The documents shall be submitted as mentioned below:

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-2.

Table-2

	Drawing	Document
For Approval	Soft copy + 5 nos. hard copies	Soft copy + 5 nos. hard copies
For RFC	Soft copy + 5 nos. hard copies	

4.0 SEISMIC LOADING:

The site specific seismic spectrum information as specified in annexure-B and IS 1893 shall be followed.

5.0 WIND LOADING:

Wind loading shall be in accordance with Indian Standard Code IS: 875 (Part 3) for a basic wind speed of 39 m/sec.

Design wind pressure and forces shall be as per the provisions of IS : 875. Consideration for off shore wind velocity arising out of cyclonic storm shall also be taken into account while designing the structure. Stresses induced due to dynamic effect of wind shall be considered in design.

6.0 MATERIAL OF CONSTRUCTION

i. Minimum grade of concrete: M35.
ii. Reinforcing bars will be TMT bars of grade Fe500 conforming to IS-1786.

7.0 MATERIAL (DESIGN & SUPPLY)

7.1 Steel helical springs and viscous dampers shall consist of:

i. 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.

ii. Frames for pre-stressing of spring elements.

iii. Suitable hydraulic jack system including electric pumps, high pressure tubes etc. required for the installation, alignment etc. of the spring units. Two extra hydraulic jacks, and one hand operated pump and spares for the hydraulic jack system as required.

iv. 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.

7.2 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.

7.3 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 should 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.

7.4 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.

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

7.6 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 while designing the substructure. Substructure shall be designed for static loads.

7.7 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.

8.0 MANUFACTURING & TESTING

8.1 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 programme. The programme (quality plan) shall include:

i. Manufacturing schedule and quality check exercised during manufacturing.
ii. Detail of test to be carried out at the manufacturing shop with its schedule.
iii. Special requirements, if any, regarding concreting of top deck.
iv. Complete step- by- step procedure covering the installation and commissioning of the spring system.
v. Manuals for erection, commissioning, testing and maintenance of the steel helical springs and viscous dampers.
vi. A checklist for confirming the readiness of the civil fronts for erection of steel helical springs and viscous dampers.
vii. Checklist for equipment required at each stage of erection.
viii. Bill of materials (data sheet) of various elements such as spring units, viscous dampers, with their rating, stiffness etc. included in the supply.
ix. 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.
x. Any other details which may be necessary to facilitate design and construction of the foundations / structures.

8.2 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.

9.0 ERECTION AND COMMISSIONING AND SUPERVISION

9.1 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 after machine installation etc..

9.2 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 completion of the work for which these specifications are intended.

10.0 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.

11.0 TRANSPORTATION

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

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

12.0 INSPECTION REQUIREMENTS

12.1 Minimum requirement for quality plan shall be as per quality plan attached in section –II of the specification. Quality plan shall be subject to approval during detail engineering. No price implication shall be admissible to QP approval by BHEL/Customer.

12.2 Inspection for imported item shall be done from third party like Lloyd or equivalent and certificate shall be submitted for review of BHEL.

12.3 In case of new bidder, bidder may need to carry out damping test, stiffness test etc. during customer approval stage before price bid opening. No price implication shall be admissible for these tests.

ANNEXURE-A

Codes and Standards

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

IS: 456	Codes 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.

SECTION-II

STANDARD TECHNICAL SPECIFICATION

1.0 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.

2.0 SUPPLY OF VIBRATION ISOLATION SYSTEM (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 ISO 10816 whichever is governing and no dynamic loads are transferred to structure supporting VIS. Minimum 90% isolation shall be achieved and the system shall be capable of withstanding Seismic/Wind forces.

3.0 SUPERVISION OF ERECTION AND COMMISSIONING

3.01 Manual

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

3.02 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.

4.0 DESIGN ENGINEERING OF VIBRATION ISOLATION SYSTEM

4.01 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 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) Erection loads
h) Seismic loads
i) Any other loads given by the supplier

Various loads 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 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 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.

5.0 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.

6.0 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.

SECTION-II

REFERENCE QUALITY PLAN

Manufacturer's logo	Manufacturer's name and Address	**MANUFACTURING QUALITY PLAN (I-QAP)** **ITEM** : Vibration isolation system **Equipment:** **Spring Unit**: Module name as per Vendor	QP No: Rev : Date : Page :	Project: Main supplier: BHEL BHEL P.O NO:

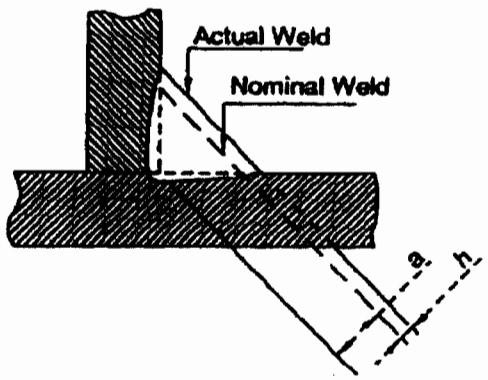
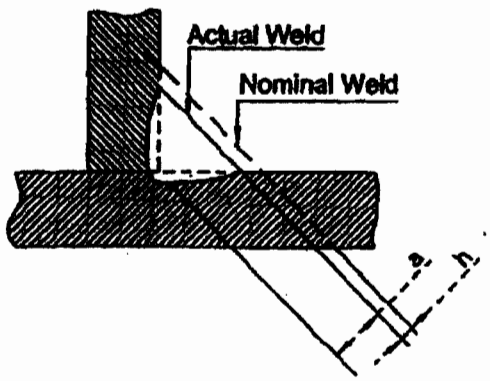
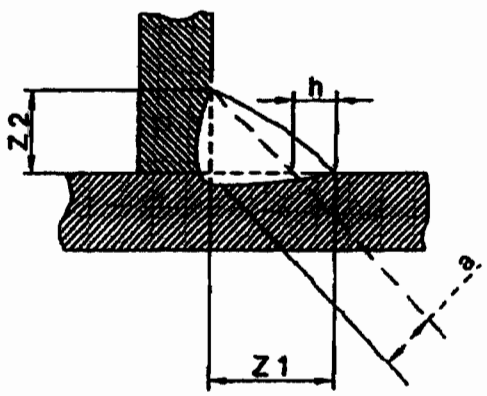
Sl. No. 1	COMPONENT AND OPERATION 2	CHARACTERISTICS 3	CLASS 4	TYPE OF CHECK 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENT 7	ACCEPTANCE NORMS 8	FORMAT OF RECORD 9	AGENCY 10				REMARKS 11
									D	M	C	B	
1	**Materials**												
1.1	For boxes	Chemical/Mechanical	Minor	Verify	One / Heat	IS 2062/DIN EN 10025/ JVHT 02/JVHHT 01B00/SAILMA 350 HI/SAILMA 350 or equivalent	Same as column "7"	Certificate	√	P	V	V	
1.2	For Springs	a) Chemical	Major	Verify	One / Lot	50 Cr V 4 As per DIN 17221 or 51 Cr V 4 As per EN10089 or Equivalent	Same as column "7"	Certificate	√	P	V	V	
		b) Grain Size	Major	Verify	One / Lot	ASTM E 112	ASTM 5 or finer	Certificate	√	P	V	V	
		c) NMI	Major	Verify	One / Lot	IS 4163	ABCD series T/H-2.0/1.5	Certificate	√	P	V	V	
		d) Micro structure	Major	Verify	One / Lot	--	DIN 17221or equivalent	Certificate	√	P	V	V	
1.3	Springs at Manufacturer's end	Hardness	Major	Test	One/Lot	IS 1500	415-460 BHN	Certificate	√	P	V	V	
1.4	Springs at Manufacturer's end	Decarburization	Major	Test	One / Lot	IS 6396	Max. depth 0.5% of bar dia - partial	Certificate	√	P	V	V	
1.5	Springs at Manufacturer's end	NDE after compression	Major	Test	100%	IS 3703	No cracks	Certifcate	√	P	V	V	
1.6	Springs (at vendor end)	Spring Rate	Major	Test	AQL 4.0	DIN 2096	Same as column "7"	Lab Register	√	P	V	V	
1.7	Adhesive pads (jute),4mm thick, Steel shims	Dimensions (mm)	Minor	Measure / Visual	5 %	Drawing	DIN 7168 Sg	Internal Record	√	P	V	V	
1.8	Viscoliquid	Viscosity/ Penetration speed (mm/sec)	Major	Test	Sample	DIN 53019 or equivalent	Same as column "7"	Certificate	√	P	V	V	
1.9	Studs & Nuts	Chemical Dimensions (mm)	Minor Minor	Verify Measure	One / Lot 5%	IS 1367 (Grade 6.8 & Class 6) IS 4218 (Tolerance Class 6g & 6H)	Same as column "7" Same as column "7"	Lab Test Report	√	P	V	V	
2	In Process Inspection												
2.1	Welding	Visual / Surface exam (mm)	Major	Visual / Measure	10% on welds	Annexure-1(attached)	Same as column "7"	Certificate	√	P	V	V	
		NDE	Major	DPT	10% Random	ASTM / E 165	Same as column "7"	Certificate	√	P	V	V	
2.2	Boxes	Dimensions (mm)	Major	Measure	10%	Drawing & data sheet	EN ISO 13920 C	Internal record	√	P	V	V	
3	Final Inspection												
3.1	Shot Blasting	Picture	Major	Compare	10%	EN ISO12944-4	SA – 2 ½	Certificate	√	P	V	V	
3.2	Painting	Thickness (180 microns)	Major	Measure / Visual	10%	Annexure-2(attached)	Same as column "7")	Certificate	√	P	V	V	
3.3	Spring Unit	Dimensions (Except HF&HV)	Minor	Measure	10%	Drawing / Datasheet	EN ISO 13920 C	Internal Record	√	P	W	V	
3.4	Constant of Spring Units (Vertical; Kv)	Load Vs Displacement (kN/mm)	Critical	Test	10%	DIN 2096 & DIN 2089	Data Sheet	Certificate	√	P	W	V	
3.5	Document Control	Verification of above documents (TC/IR)	Major	Compare	All	MQP	Same as column "7"	Certificate	√	P	V	V	
3.6	Packing / Marking	Visual	Major	Visual / Compare	100%	As per vendor's standard	Same as column "7"	Certificate	√	P			

MANUFACTURER/ SUB-CONTRACTOR CONTRACTOR	LEGEND: # RECORDS, IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION M: MANUFACTURER/ SUB-CONTRACTOR C: : MAIN SUPPLIER, B: CUSTOMER INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGNATURE OF APPROVING AUTHORITY WITH SEAL

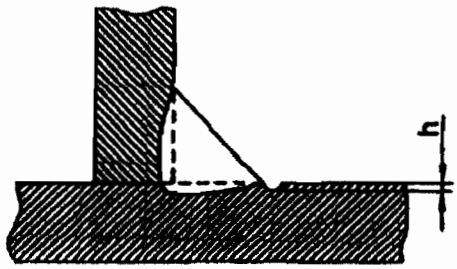
ANNEXURE - 1

WELDING

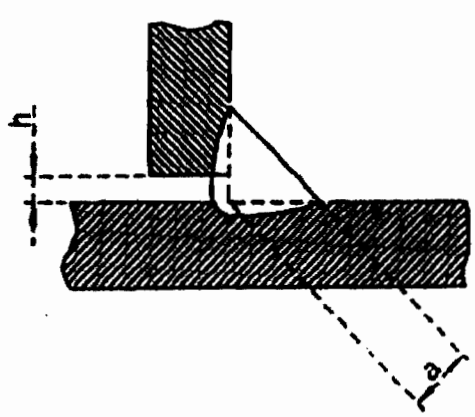
WELDING DETAILS

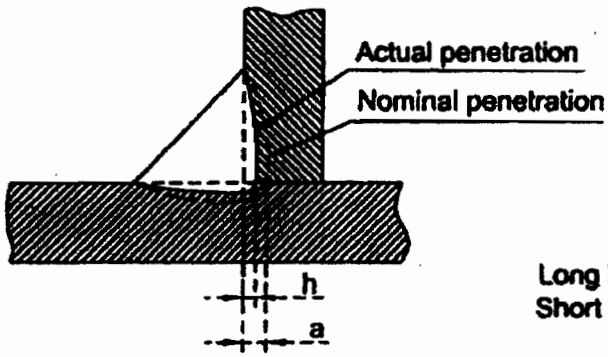
Sl No	Imperfection Designation	Outside status	Limits for Imperfection with reference to quality level: DIN EN 25817 / D
1.	Excessive convexity		$h \leq 1mm + 0.25\ b$; max. 5mm
2.	Fillet weld having a throat thickness smaller than the nominal value		Short imperfections: $h \leq 0.3$ mm + 0.1.a ; max. 2mm Long imperfections: Not Permitted
	A fillet weld with an apparent throat thickness smaller than that prescribed should not be regarded as being imperfect if the actual throat thickness with a compensating greater depth of penetration complies with the nominal value.		
3.	Excessive asymmetry of fillet weld		$h \leq 2mm + 0.2\ a$
	It is assumed that the asymmetric fillet weld has not been expresly prescribed.		

WELDING DETAILS

Sl No	Imperfection Designation	Outside status	Limits for Imperfection with reference to quality level: DIN EN 25817 / D
4.	Undercut		
		Smooth transition is required	h ≤ 1.5mm
5.	Gas pores and porosity	The following conditions and limits for imperfections shall be fulfilled	
		a) Maximum dimension of the summation of the projected or surface crack area of the imperfection.	4%
		b) Maximum dimension of a single pore for -butt welds -fillet welds	 d ≤ 0.5 s d ≤ 0.5 a
		c) Maximum dimension for a single pore	5 mm
6.	Localised (clustered) porosity	The total pore area within the cluster should be summed and calculated as a percentage of the greater of the two areas; an envelop surrounding all the pores or a circle with a diameter corresponding to the weld width.	
		The permitted porous area should be local. The possibility of masking other imperfections should be taken into consideration.	
		The following conditions and limits for imperfections shall be fulfilled:	
		a) Maximum dimension of the summation of the projected or suface crack area of the imperfection	16%
		b) Maximum dimension of a single pore for -butt weld -fillet weld	 d ≤ 0.5 s d ≤ 0.5 a
		c) Maximum dimension for localised clustered porosity.	4mm

WELDING DETAILS

Sl No	Imperfection Designation	Outside status	Limits for Imperfection with reference to quality level: DIN EN 25817 / D
7.	Elongated cavities, worm holes	Long imperfections for -butt welds -fillet welds In any case, maximum dimension for elongated cavities, worm holes	 $h \leq 0.5\ s$ $h \leq 0.5\ a$ 2mm
		Short imperfections for -butt welds -fillet welds In any case, maximum dimension for elongated cavities, worm holes	 $h \leq 0.5\ s$ $h \leq 0.5\ a$ 4mm or Not Larger Than Thicknes (NLTT)
8.	Solid inclutions (other than copper)	Long imperfections for -butt welds -fillet welds In any case, maximum dimension for elongated cavities, worm holes	 $h \leq 0.5\ s$ $h \leq 0.5\ a$ 2mm
		Short imperfections for -butt welds -fillet welds In any case, maximum dimension for elongated cavities, worm holes	 $h \leq 0.5\ s$ $h \leq 0.5\ a$ 4mm or Not Larger Than Thicknes: (NLTT)
9.	Lack of fusion (Incomplete fusion)		Permitted, but only intermittently and not breaking the surfaces
10.	Bad fit-up, fillet weld	 An excessive or insufficient gap between the parts to be joined. Gaps exceeding the appropriate limit may in cases be compensated for by a corrsponding increase in the throat.	$h \leq 1mm + 0.3\ a$ max. 4mm

Sl No	Imperfection Designation	WELDING DETAILS Outside status	Limits for Imperfection with reference to quality level: DIN EN 25817 / D
11.	Incomplete penetration		Long inperfections: Not permitted Short imperfections: h ≤ 0.2 s, max. 2mm
12.	Cracks	All types of cracks	Not Permitted
13.	Crater cracks		Permitted
14.	Spatters	Fused welding splashes are material trickless (drops) fused to the basic material or welding seam.	Permssible
15.	Stray flash or arc strike	Ignition points are local fuses caused by the electric arc on the surface of the basic material or welding seam.	Permssible

Abbreviations

a nominal fillet weld throat thickness (fillet thickness), in mm
b width of weld reinforcement, in mm
d pore diameter in mm
h size (height or width) of imperfection, in mm
l length of imperfction, in mm
s nominal butt weld thickness or, in the case of partial penetration, the prescribed depth of penetration, in mm
t tube-wall- or plate thickness, in mm
z leg length of fillet welds (in case of isoscele-right angle triangular section z = a . / 2) in mm

ANNEXURE-2

CORROSION PROTECTION PAINTING

REQUIREMENTS

1. Painting of steel parts

All steel parts must be coated immediately after short blasting according to EN-ISO 12944-4. Surface must be free of fat.

a. Material:
   M/s Southfield paints –RAL 6011 Green or equivalent
   M/s Toyo paints – RAL 1000 Black or equivalent
   M/s Akzo Nobal Coatings India Pvt. Ltd. – RAL 1004 Yellow colour or equivalent

b. Execution:
   Painting is performed as given below:
   Layer thickness:
   -Standard:
   One layer coating thickness of minimum 100 microns.
   -Long term protection:
   Two layers coating to total thickness of minimum 180 microns.

c. Mixing of paint compounds:
   The compounds (mother paint, accelerator, thinner) must be mixed according to instructions of the paint manufacture. The mixing procedure has to be adjusted to the ambient climatic situation.

d. Coating:
   Coating is performed with spray gun. Baking temperature 80 °C. furnace exposing time 45 minutes.

e. Coating thickness control:
   Measurements to be taken at 5 random points. Acceptable thickness is 10% below specified thickness.

2. Springs

All the springs must be powder coated by "Electrostatic powder coating spray process" (EPS).

a. Preparation:
   Springs must be oil free
b. Execution:
   Electrostatic spray coating with an epoxy polyester powder. Baking temperature 190 °C +10 °C. furnace exposing time of 40 minutes.
   Colour: Black.
c. Coating thickness:
   Coating thickness must be minimum of 70 microns.

Note.

1. The colour of paint is subjected to as per customer requirement.

Annexure-B

6.0 GROUND MOTION CHARACTERISTICS

6.1 There are no records of strong ground motion available in the region around the site. An artificial time history of ground motion has been generated such that its spectra (5% damping) match the chosen target spectra. The time history of ground motion is shown in Fig. 2 and Appendix-III contains the listing of ground acceleration normalised to unit gravity at equal time intervals of 0.01 sec. Figure 3 gives the shape of normalised acceleration spectra for 0.8, 1.0, 1.6, 2, 3, 5, 7 and 10% damping. The equation (13) can be used to calculate the digital values of normalized acceleration spectral values. Various parameters used in the equation for the different damping values are given in Table- II.

$$S_a/(PGA) = \begin{cases} 1; & 0.00 \le T \le 0.030 \\ (T/0.030)^{\alpha}; & 0.030 \le T \le T_1 \\ A; & T_1 \le T \le T_2 \\ V/T; & T_2 \le T \le T_3 \\ D/T^2; & T \ge T_3 \end{cases} \qquad (13)$$

The values of α, A, V, T_1, T_2, T_3 and D are given in the following Table

Table II – Equations for response spectra (Median) (normalised to 1 'g') for various values of percentage of damping for Rourkela Power Plant Project Site, Orissa (Refer Eq. 13).

Damping %	α	T_1 (s)	A	T_2 (s)	V (s)	T_3 (s)	D (s^2)
0.800	1.885	0.080	6.350	0.280	1.778	2.000	3.556
1.000	1.642	0.082	5.210	0.290	1.563	2.100	3.439
1.600	1.327	0.083	3.860	0.330	1.312	2.200	2.887
2.000	1.248	0.083	3.560	0.330	1.210	2.200	2.663
3.000	1.016	0.085	2.880	0.350	1.037	2.300	2.488
5.000	0.746	0.090	2.270	0.360	0.817	2.500	2.125
7.000	0.608	0.090	1.950	0.360	0.702	2.500	1.825
10.000	0.467	0.090	1.670	0.360	0.601	2.500	1.563

7.0 SEISMIC DESIGN CRITERIA

7.1 The "Criteria for Earthquake Resistant Design of Structures and Equipment" is recommended as follows:

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 finalisation 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 Appendix-IV.

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-3 in IS: 1893 (Part 1) and Annexure B of IS: 1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-IV 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).

7.2 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)	ND Cooling Towers	: 2%
e)	Steel stacks	: 2%

7.3 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 (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 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 (A_h) 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 Appendix-IV. 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.

7.4 Design/Detailing for Ductility

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

8.0 RECOMMENDATIONS

8.1 The estimated PGA value based on the Seismotectonics modelling of the region around the site for Fault-1 is 0.20g.

8.2 The design acceleration response spectra for MCE and DBE conditions can be obtained by multiplying the normalised acceleration spectra (Fig. 3) by 0.20g and 0.10g, respectively.

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

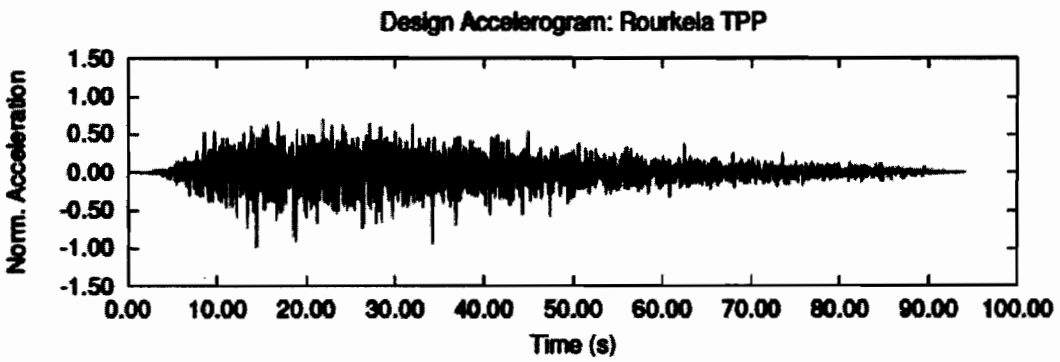


Fig. 2 Time history of ground motion for Rourkela Thermal Power Project site, Orissa.

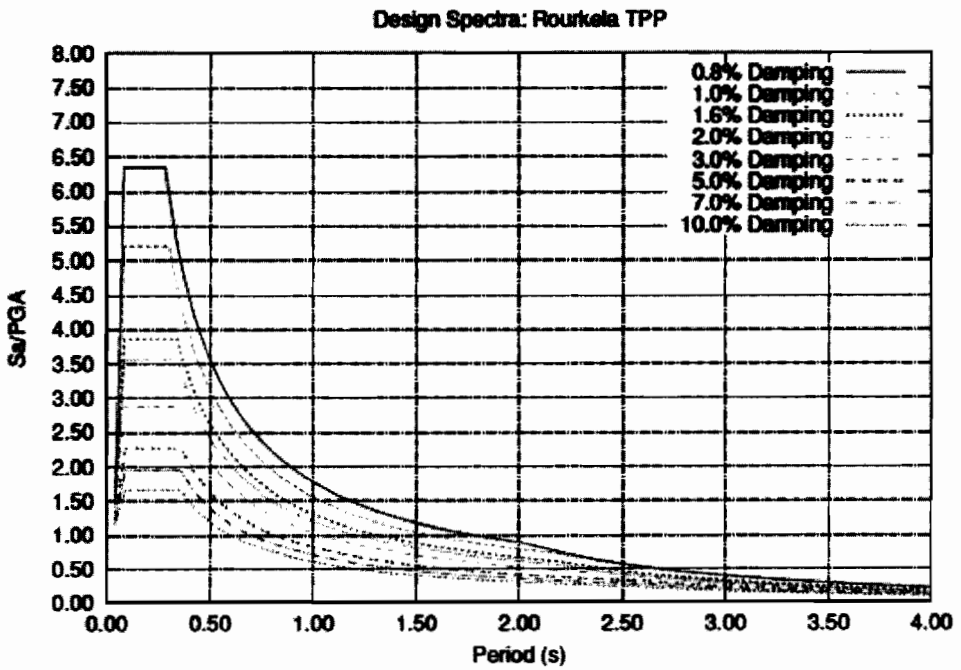
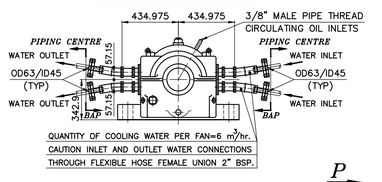


Fig. 3 Normalised horizontal spectral acceleration for various conditions Rourkela Thermal Power Project Site, Orissa.

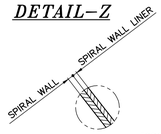
WATER CONNECTING DETAILS OF 9' RTL BEARING



QUANTITY OF COOLING WATER PER FAN=6 m^3/hr.
CAUTION INLET AND OUTLET WATER CONNECTIONS THROUGH FLEXIBLE HOSE FEMALE UNION 2" BSP.

ELEVATION

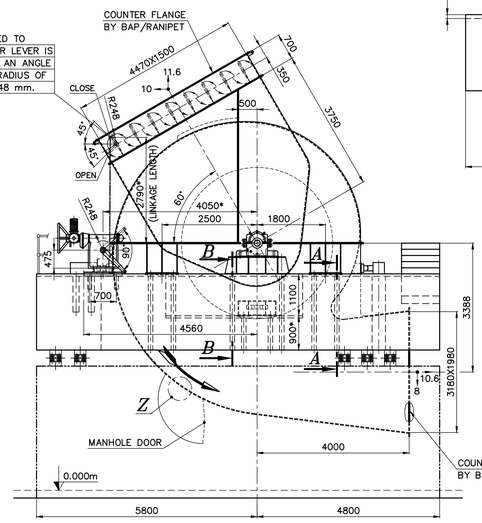
DETAIL–Z



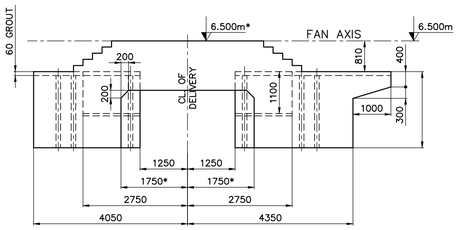
VIEW–P

(WITHOUT MOTOR & ITS FOUNDATION)

TORQUE REQUIRED TO ACTUATE DAMPER LEVER IS 1200 kg.m WITH AN ANGLE OF 0–90° AND RADIUS OF THE LEVER IS 248 mm.

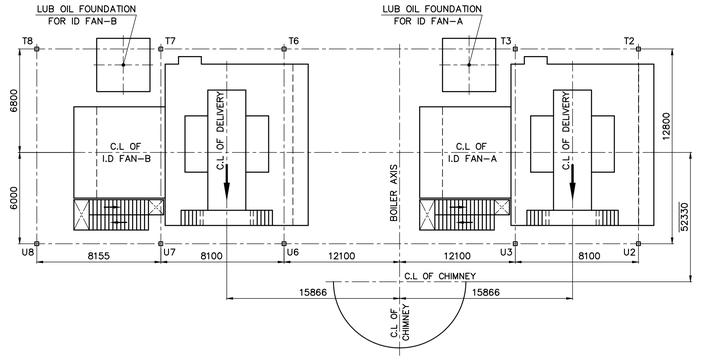


VIEW–Q*

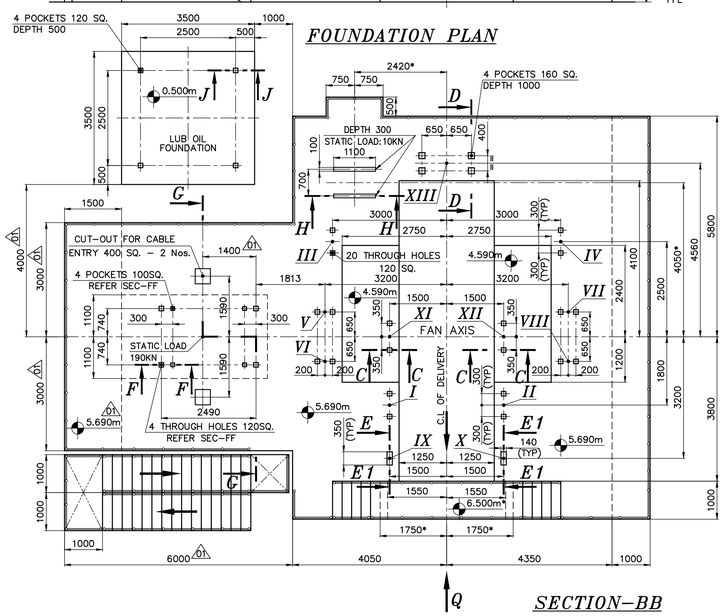


KEY PLAN

REFERENCE DRG. 0–00–515–93665
KEY PLAN SHOWN IS INFORMATIVE ONLY.
FOR EXACT LOCATION, REFER BOILER LAYOUT DRAWINGS



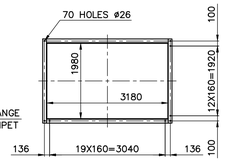
FOUNDATION PLAN



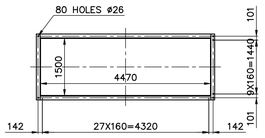
LOAD DATA FOR FOUNDATION

LINE	LOAD POINT	LOAD CASE	SUPPORTING FORCE RESULTING FROM OWN WEIGHT	MAX. PERMISSIBLE UNBALANCE FORCE REFERRED TO SUPPORTING POINT			FORCE DUE TO AXIAL THRUST	SUPPORTING FORCE RESULTING FROM PERSONS, INSTALLATIONS, BRG. THRUST & NORMAL MOMENT OF MOTOR			SUPPORTING FORCE DUE TO THERMAL EXPANSION	
			KN	KN			KN	KN			KN	
			V		±V	±Hy	Hx	V	Hx	Hy	Hx	Hy
	1		2	3	4	5	6	7	8	9		
1	I		75	1				−20			±9.7	±7.8
				2								
2	II		75	1				−20			±9.7	±7.8
				2								
3	III		153	1				−19			±15.4	±18.5
				2								
4	IV		153	1				−19			±15.4	±18.5
				2								
5	V		52	1	56.5		±26					
				2	36.0	56.5						
6	VI		52	1	56.5		±26					
				2	36.0	56.5						
7	VII		50	1	54.5							
				2	34.0	54.5						
8	VIII		50	1	54.5							
				2	34.0	54.5						
9	IX		4.5	1							±1.2	
				2								
10	X		4.5	1							±1.2	
				2								
11	XI		4.5	1						±42.5	±1.2	
				2								
12	XII		4.5	1						±42.5	±1.2	
				2								
13	XIII		7	1								±1.6
				2								

DELIVERY FLANGE



SUCTION FLANGE



NOTES:–

01. THE LOADS INDICATED ON FOUNDATION ARE WITHOUT ALLOWANCES FOR VIBRATIONS. CIVIL DESIGNER IS RESPONSIBLE FOR PROPER DESIGN OF FOUNDATION TAKING INTO ACCOUNT OF THE ALLOWANCES FOR VIBRATION ALSO.
02. THE NATURAL FREQUENCY OF THE FOUNDATION SHOULD BE MINIMUM +20% AWAY FROM THE OPERATING FREQUENCY OF THE FAN. THE NATURAL FREQUENCY OF THE CONNECTING DUCT AND SUPPORTING STRUCTURE SHOULD BE CLEARLY AWAY FROM THE OPERATING FREQUENCY OF THE FAN.
03. ADOPT IS: 2974 / PART–IV FOR THE FOUNDATION DESIGN.
04. THE CONNECTING DUCTS AT INLET AND OUTLET OF FAN ARE SELF SUPPORTED AND SHOULD NOT BE WELDED WITH EXPANSION JOINTS.
05. FOUNDATION POCKETS SHOULD BE PERPENDICULAR TO THE FLAT SURFACES OF FOUNDATION.
06. ACCURATE TEMPLATES SHALL BE USED FOR LOCATING CORES FOR POCKET HOLES TO ENSURE THEIR DIMENSIONAL ACCURACY.
07. TOLERANCE BETWEEN ANY TWO POCKET CENTRES ±5 mm.
08. TOLERANCE ON CONCRETE LEVELS +0mm/−25mm.
09. 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 THEREBY ENSURING MAXIMUM CONTACT ON THE MATING AREAS.
10. 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.
11. GROUTING SHOULD BE DONE ONLY AFTER FINAL ALIGNMENT OF FAN.
12. ELEVATIONS SHOWN IN FOUNDATION PLAN INCLUDE GROUT THICKNESS.
13. GROUTING IS IN THE SCOPE OF ERECTION GROUP.
14. HANDRAILS, STEEL PLATFORMS & CANOPY OF MOTOR AND THEIR EMBEDMENTS ARE IN THE SCOPE OF BHEL/TRICHY.
15. FAN FOUNDATION SHOULD NOT BE USED AS SUPPORT FOR OTHER STRUCTURES OR EQUIPMENTS.
16. FOUNDATION CONFIGURATION SHOWN IN THIS DRAWING IS ONLY INFORMATIVE/TYPICAL. TYPE AND DETAILS OF FOUNDATION ARE TO BE FINALIZED BY CIVIL DESIGNER.
17. FOR MOTOR ERECTION, REFER MOTOR SUPPLIER'S ERECTION MANUAL.
18. LUB OIL SYSTEM WILL BE PROVIDED WITH SUITABLE CANOPY.
19. SOLE PLATE, FOUNDATION BOLTS & FASTENERS RELATED TO MOTORS WILL BE IN THE SCOPE OF MOTOR SUPPLIER (BHEL BHOPAL UNIT)
20. 01 ALL ELEVATIONS ARE WITH RESPECT TO T.G HALL FINISHED FLOOR LEVEL AS EL. (+)0.00m, WHICH CORRESPONDS TO RL. 219.0m.
BOILER AND ESP AREA FINISHED FLOOR LEVEL AT EL. (−)0.200m, WHICH CORROSPONDS TO RL. 218.8m.

FAN DETAILS:–

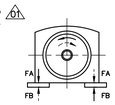
TYPE	: NDZV 40
WEIGHT OF FAN WITHOUT MOTOR & COUPLING	: 57000 kg
WEIGHT OF ROTATING PARTS	: 14500 kg
GD^2 OF FAN	: 90000 $kg.m^2$
SPEED OF FAN	: VARIABLE (RANGE 150 RPM TO 750 RPM)
NO. OF FANS PER BOILER	: TWO (BOTH IDENTICAL)

MOTOR DETAILS:– 01

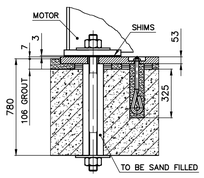
MAKE	: M/s. BHEL/BHOPAL
FRAME SIZE	: 2RN7805–8
RATING	: 3800KW/745RPM/401AMP/6.6KV
WEIGHT OF MOTOR	: 18500 kg
WEIGHT OF ROTATING PARTS	: 6250 kg
GD^2 OF MOTOR	: 3412 $kg.m^2$
MOTOR DRAWING NO.	: 1 40 200 41402

FOUNDATION LOADING DATA OF MOTOR 01

MAX. FORCE CALCULATED FROM THE MAX. IMPULSE TORQUE – FM = 340 KN
FORCE EXERTED BY THE WEIGHT ON EACH SIDE ——— FG = 92.5 KN
FOUNDATION LOAD ON EACH SIDE COMPRESSION —FA = FM+FG = 432.5 KN
TENSILE FORCE ——————————FB = FM–FG = 247.5 KN
THE FORCE OCCUR ALTERNATIVELY INDEPENDENT OF THE DIRECTION OF DIRECTION



SECTION–FF 01



MOTOR COOLER DATA:– 01

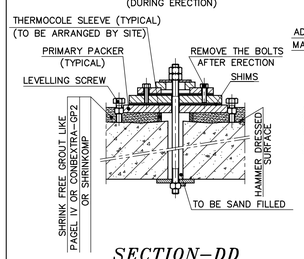
WATER PRESSURE DROP ACROSS COOLER ———— = 0.4 kg/cm^2
TEMP. RISE OF WATER ACROSS COOLER ———— = 5 °C
WATER INLET TEMP. ———— = 38 °C
MAX. OPERATING PRESSURE OF WATER ———— = 6 kg/cm^2
TOTAL REQUIREMENT OF WATER ———— = 510 LPM

MOTOR BEARING LUBRICATION DETAILS: 01

	DE	NDE
BEARING SIZE	22–ø225	22–ø225
OIL FLOW RATE	7 LPM	7 LPM
MAX. OIL INLET PRESSURE	0.2 TO 0.5 kg/cm^2	0.2 TO 0.5 kg/cm^2
MAX. OIL INLET TEMP.	40°C	40°C
OIL GRADE	ISO VG 68 OR EQUI.	ISO VG 68 OR EQUI.
LUBRICATION TYPE	FORCED OIL LUBRICATION	

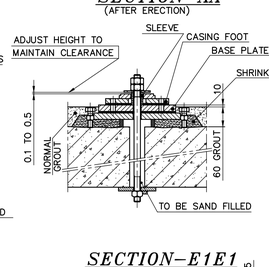
SECTION–AA

(DURING ERECTION)

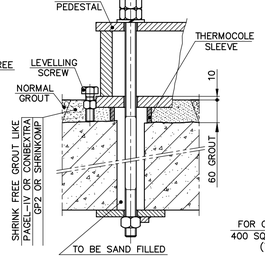


SECTION–AA

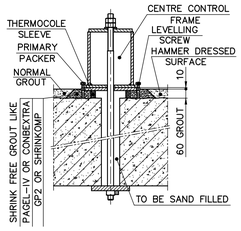
(AFTER ERECTION)



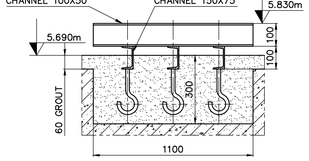
SECTION–BB



SECTION–CC

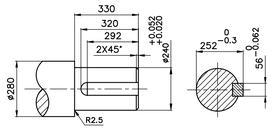


SECTION–HH*

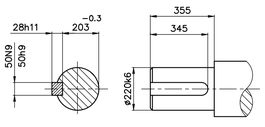


DIMENSIONS / ITEMS MARKED WITH "*" WILL BE CONFIRMED LATER.

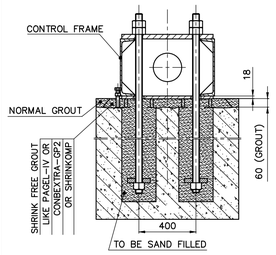
MOTOR SHAFT END 01



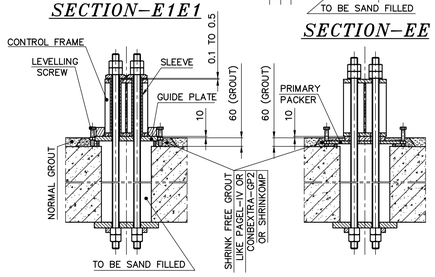
FAN SHAFT END



SECTION–DD

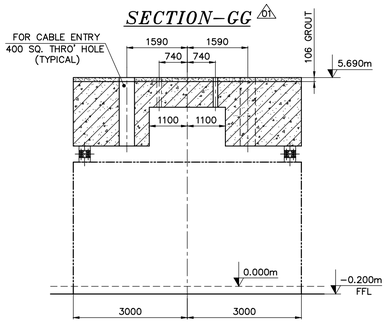


SECTION–E1E1

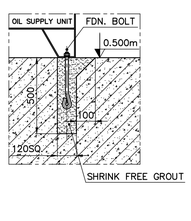


SECTION–EE

SECTION–GG 01



SECTION–JJ 01



REV	DATE	ALTERED	CHECKED	APPROVED
01	24.09.2016	P.S.N	S.AGARWAL	P.M.J

01. MOTOR AND MOTOR FOUNDATION DETAILS UPDATED.
02. SECTION–FF & SECTION–GG ALTERED.
03. NOTE 20 ADDED.
04. TITLE BLOCK UPDATED.
05. SECTION–JJ ADDED.

CUSTOMER NO. R377

CUSTOMER: NTPC–SAIL 01 POWER COMPANY (P) LIMITED

CONSULTANT: मेकॉन लिमिटेड 01 MECON LIMITED

PROJECT: ROURKELA PP–II EXPANSION PROJECT (1X250 MW)
810 TPH, 155 Kg/cm (g), 540°C 01

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

DRAWN	P.SARAVANAN
CHECKED	S.AGARWAL
APPROVED	P.M.JAVID
DATE	17.09.2016
ALL DIMENSIONS ARE IN MILLIMETRES	
SCALE	N.T.S

TITLE: GENERAL ARRANGEMENT OF ID FAN – NDZV 40

BHEL DRG No.: 1–00–099–29092 REV. 01

NTPC DRG No: SHEET 01

Size A1