

**RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD.**

**2 X 660 MW, SUPER-CRITICAL THERMAL POWER  
STATION**

**STAGE –V, UNIT 7 & 8 AT SURATGARH, RAJASTHAN**

**TECHNICAL SPECIFICATION  
FOR  
METAL EXPANSION BELLOWS**

**VOLUME – IIB**

**SPECIFICATION NO: PE-TS-392-100-M021 (REV-00)**



BHARAT HEAVY ELECTRICALS LIMITED, POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT,  
PLOT NO. 25, SECTOR-16A, NOIDA, INDIA

	TITLE:  <b>PREAMBLE</b>	SPECIFICATION NO. PE-SS-999-100-Q001	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET	1 OF 1

- 1.0 The tender document contains three (3) volumes. The bidder shall meet the requirements of all the three volumes.

1.1 **Volume-I (CONDITIONS OF CONTRACT)**

This consists of four parts as below:-

- Volume-IA : This part contains instructions to bidders for making bids to BHEL.
- Volume-IB : This part contains general commercial conditions of the tender & includes provision that vendor is responsible for the quality of item supplied by their sub-vendors.
- Volume-IC : This part contains special conditions of contract.
- Volume-ID : This part contains commercial conditions for erection & commissioning site work, as applicable.

1.2 **Volume-II (TECHNICAL SPECIFICATIONS)**

Technical requirements are stipulated in Volume-II which comprises of :-

- Volume-IIA : General Technical Conditions
- Volume-IIB : Technical Specification including Drawings, if any.

1.2.1 **Volume-IIB**

This volume is sub-divided into following sections :-

- Section-A : This section outlines the scope of enquiry.
- Section-B : This section provides "Project Information".
- Section-C : This section indicates technical requirements specific to the contract, not covered in Section-D.
- Section-D : This section comprises of technical specifications of equipments complete with data sheet A, B and C.

**Data Sheet - A** Specifies data and other requirements pertaining to the Equipment.

**Data Sheet - B** Specifies data to be filled by the bidder (Data Sheet-B is contained in Volume-III).

**Data Sheet - C** Indicates data/documents to be furnished after the award of contract as per agreed schedule by the vendor (as applicable).

1.2.2 **Volume-III (TECHNICAL SCHEDULES)**

This volume contains technical schedules and Data Sheets-B, which are to be duly filled by the bidder and the same shall be furnished with the technical bid as per instructions given in Document No. PE-SS-999-100-Q-002 in Volume-III.

- 2.0 The requirements mentioned in Section-C / Data Sheets-A of section-D shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-D.

	<b>TITLE:</b> <b>TECHNICAL SPECIFICATION</b> <b>METAL EXPANSION BELLOWS</b> <b>2X660 MW SURATGARH STPP</b>	SPECIFICATION NO. PE-TS-392-100-M 021	
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### ***VOL. IIB***

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# SECTION-A

## SCOPE OF ENQUIRY

	<b>TITLE:</b> <b>SCOPE OF ENQUIRY</b> <b>METAL EXPANSION BELLOWS</b> <b>2X660 MW SURATGARH STPP</b>	SPECIFICATION NO. PE-TS-392-100-M 021	
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## SCOPE OF ENQUIRY

1. This specification covers the Design, Manufacture, Inspection & Testing at vendor's and/or his sub-vendor's works, proper packing and delivery to site of the METAL EXPANSION BELLOWS as per the requirements mentioned in different sections of the specification for **2X660 MW SURATGARH STPP**.
2. The purpose of metallic expansion bellows is to reduce the reactions/forces & moment at the connected equipment terminals due to thermal expansion/contraction and/or vibration of connected equipment and piping. The arrangement of the bellows in the piping, design conditions, size, bellow spring rates, lengths, tag nos. and services etc. are furnished in Data Sheet-A. The bellows shall be installed / located in the position as indicated in the data sheets.
3. It is not the intent to specify herein all the details of design and manufacture. However the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser, who will interpret the meaning of drawing and specification and shall be entitled to reject any work or material, which in his judgment is not in full accordance herewith.
4. The omission of specific reference to any component/ accessories necessary for the proper performance of Metal Expansion Bellows shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of bellows at quoted prices.
5. Design/ drawings/ data sheets etc. shall be subject to approval of BHEL as per specification, in the event of order.
6. The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and shipping release issued by BHEL.

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## SECTION-B

## PROJECT INFORMATION

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## PROJECT INFORMATION

The bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information provided in this section will be for general guidance and shall not be contractually bidding on BHEL/OWNER. All relevant site data/information as may be necessary shall have to be obtained/ collected by the bidder.

2 X 660 MW SURATGARH STPP		
S.No	FEATURES	DETAILS
1	Owner	Rajasthan Rajya Vidyut Utpadan Nigam Ltd., Jaipur
2	Consulting Engineer	TATA Consulting Engineers Ltd.
3	Site Location	Prabat Nagar, Suratgarh Sriganganagar district, Rajasthan.
4	Latitude & Longitude	Latitude : 29 deg.10 min. N Longitude : 74 deg.01 min. E

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## SECTION-C

### SPECIFIC TECHNICAL REQUIREMENTS



	<b>SPECIFIC TECHNICAL REQUIREMENTS METAL EXPANSION BELLOWS 2X660 MW SURATGARH STPP</b>	SPECIFICATION NO. PE-TS-392-100-M 021	
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## 1 GENERAL

- 1.1 The Metal expansion Bellows shall meet the technical requirements and conform to the standard technical specifications and Data sheet A of Section D. In addition, the requirements of this Section-C shall also be complied with. However, wherever the details given in the standard technical specification of Section-D and Data sheet A are different, the requirements of Data sheet A shall prevail. Similarly in the event of contradictions between Section –C & Section –D/ Data sheet A, Section –D shall prevail.
- 1.2 The technical requirements for bellows shall, in general, be as per the attached standard Technical specification for bellows, and Data sheets A of Vol. II B Section D.
- 1.3 Based on BHEL's comments on design, EJMA calculations and constructional details, vendor may be required to make changes if needed so that the bellows meet the technical requirements of this specification. BHEL decision will be binding in case of any conflict and the vendor will have to comply with BHEL requirements.

## 2 SCOPE OF SUPPLY

- 2.1 The bellows to be supplied shall be as per Data sheet- A and Standard Technical Specification of Section D.
- 2.2 Special Tools and tackles, if any.
- 2.3 Drawings, datasheets, operation and maintenance manuals etc., as specified in Data Sheet-C.

## 3 QUALITY ASSURANCE AND TESTS

- 3.1 The Quality Plan enclosed with this specification specify minimum quality control requirement. During contract stage vendor shall furnish this Quality Plan duly signed & stamped for BHEL approval. The final quality plan may incorporate some changes based on customer comments (if any). Quality plans shall be approved by BHEL and customer (If necessary). All inspection and testing shall be carried out by BHEL/ BHEL representative and BHEL customer (if necessary). In case inspection is by both BHEL and their customer, then the inspection can be carried out jointly or separately, which will be informed later.
- 3.2 Type tests may be required to be done in line with clause 6.3 of Standard Technical specification of Vol. II B section D and quality plan. Final decision regarding conducting of type test will be conveyed by BHEL at a later date which will be binding on the vendor without commercial implication.

Note: There may be minor changes in quality plan depending on customer/consultant comments which will have to be accommodated by vendor at no extra cost.

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4 DOCUMENTS TO BE SUBMITTED ALONG WITH OFFER

- a) Compliance sheet as enclosed in Volume III.
- b) Drawings with following details (if asked for during clarifications):
  - i. Design data
  - ii. All necessary dimensions (with tolerance as per EJMA).
  - iii. Cross sectional arrangement.
  - iv. Arrangement of tie rods (limit rods) along with washers and nuts.
  - v. Arrangement of sleeves and cover.
  - vi. Bill of material and total weight.
  - vii. Welding standards and welding details.
  - viii. Flange details/butt welds end details.
  - ix. Design deflections and stiffness rates for each bellow.
  - x. Bellow element details.
  - xi. Painting details
  - xii. Testing requirements including test pressures.
- c) Design calculations as per EJMA for bellows & other components of bellow assembly such as tie rods, flanges washers etc. (if asked for during clarifications).
- d) Stress calculations for pressure carrying parts i.e. flanges, hinge plates, tie rods, gimbal rings etc. Finite element analysis for the same (if required by BHEL) may be required to be carried out on new and higher size bellows. In case FEA is to be done, then vendor will carry out the same at their own cost. No extra charges on this account will be admissible to vendors.
- e) Stress calculations for local stresses (if required by BHEL) where flanges are welded to pipe.
- f) Schedule of Deviations, duly filled, in format enclosed at Vol. III.
- g) Schedules of Price & Unit Price, duly filled, in format enclosed at Vol. III.
- h) Schedule of declaration, duly filled, in format enclosed at Vol. III.


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## 5 PAINING REQUIREMENT

SERVICE	SURFACE CLEANING	PAINTING DETAIL	COLOUR SHADE
Condensate suction line	SP3, Power tool cleaning	Bellows first shall be painted with two coats of Red oxide zinc chromate primer (alkyd base) with each coat of DFT equal to 25 microns conforming to IS:2074. Finish paint shall be three shop coats (DFT 35 microns each coat) of synthetic enamel paint (long oil alkyd) as per IS: 2932. Total DFT of primer and paint shall be 155 microns.	Sea green shade no. ISC -217
Flash Tank Vents	SP3, Power tool cleaning	2 coats (Total DFT 40 µm) of heat resistant aluminium paint to IS 13183 Gr.II.	Aluminium
TD BFP Exhaust	SP3, Power tool cleaning	2 coats (Total DFT 40 µm) of heat resistant aluminium paint to IS 13183 Gr.II.	Aluminium

## 6 TYPE TESTS

- 6.1 Type tests as per EJMA are required to be carried out for bellows. If type tests have been successfully done for earlier BHEL projects, then only Test certificates of same group of bellows for earlier project shall be reviewed and no type test need be carried out. These test certificates shall not be older than 5 years. For new group of bellows type test shall be carried out as per clause 6.3 of Standard technical specification of Vol. II B section D. Type test procedure approval or type test clearance shall be taken from BHEL prior to offering to routine test to BHEL, in case the test is to be done. Final decision regarding conductance of type test will be conveyed by BHEL at a later date, which will be binding on the vendor without commercial implication.

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# SECTION-D

## STANDARD TECHNICAL SPECIFICATION

### FOR

## METAL EXPANSION BELLOWS

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		VOLUME : IIB	
		SECTION: <b>D</b>	
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## 1 GENERAL

This specification covers the design, materials, construction features, manufacture and testing of Metal expansion bellows at Vendor's or/ and sub-Vendor's works inclusive of painting and packing requirements.

## 2 CODES & STANDARDS

- 2.1 The design, manufacture, performance and testing of the expansion bellows shall conform to the latest editions of the relevant codes and standards inclusive of the stipulations in the latest editions of Expansion Joint Manufacturers Association Standards (EJMA) as well as ASME Section III, ASME Section VIII, ASTM E-165 and ASME- B31.1.
- 2.2 In case of any conflict between the above Codes/Standards and this specification, the latter shall prevail and in case any further conflict in this matter, the interpretation of the specification by the Engineer shall be final & binding.

## 3 DESIGN REQUIREMENTS

- 3.1 The design calculations of bellows shall be as per EJMA.
- 3.2 Dimensional tolerance for the expansion bellows should be as per EJMA.
- 3.3 The expansion bellows shall be capable of withstanding design pressure and full vacuum also wherever applicable.
- 3.4 The expansion bellows shall be designed for the deflections /angulations indicated in data sheets- A. They should in addition be able to take an extra +5mm /1 Degree deflection in all directions to take care of any mismatch during erection. The spring rates of the bellows expansion joints shall be within the values specified.
- 3.5 The cyclic life of the expansion bellow shall be minimum of 10,000 cycles.
- 3.6 Stress relieving or annealing after forming of bellows is not recommended.
- 3.7 No pre-tension of bellows is permitted.

## 4 MATERIAL

- 4.1 The material of construction of main parts of bellows shall be as specified in Data Sheet - 'A' of Vol. IIB Section D.
- 4.2 The materials of construction of the remaining parts shall be to suit service conditions. These materials shall be subject to approval of the purchaser.
- 4.3 Materials used in manufacture of valves shall be of tested quality.


## 5 CONSTRUCTIONAL FEATURES

- 5.1 The type of the expansion joints shall be as indicated in the Data sheet- A.
- 5.2 All untied expansion joints shall have a minimum of two limit rods across the bellows to prevent the bellows from closing/opening under vacuum / pressure beyond limit.
- 5.3 Tied lateral angular expansion joints shall be provided with two tie rods to take vacuum/pressure thrust and these tie rods shall have spherical washers with sufficient

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clearances in flange holes to accommodate lateral deflections of bellows. These bellows shall be capable of taking care of angulation in one plane.

- 5.4 Spherical washers/hinges should have a low coefficient of friction preferably with P.T.F.E. lining.
- 5.5 Hinged bellow shall be provided with hinge plates and hinge pin permitting the bellows for angulating about one plane while taking the pressure thrust.
- 5.6 Gimbal bellows shall have a gimbal ring, which shall be circular or square with hinge plates and pins allowing the bellows to angulate in both planes while taking the pressure thrust.
- 5.7 The number of longitudinal weld seam shall be minimum & Circumferential welding of elements to make bellows is not permitted. The welding procedure and welder qualification shall be as per ASME Section IX.
- 5.8 Each expansion bellow shall be enclosed in a protective cover to protect the bellows from damage during shipping, installation and while in operation. The arrangement of such cover will enable the thermal insulation to be provided leaving the tie rods uncovered. The cover shall not restrict the free deflection of bellows.
- 5.9 Bidder to ensure that thinning due to forming shall be less than 15%.
- 5.10 Bellows shall be provided with complete round flanges housing the tie rods/limit rods.
- 5.11 The bellows shall be manufactured by hydraulic forming, roll forming or any other method specified in latest edition of EJMA. They should be formed from perfect cylinders of single ply.
- 5.12 All bellow elements shall be pickled after forming,
- 5.13 Equalising rings, where required, shall be either from high quality castings or from fabricated metal.
- 5.14 Butt welded expansion joints shall have adequate length of pipe so that site welding does not impair or reduce the joints efficiency.
- 5.15 Expansion joints will be furnished with internal sleeves of the same material as the bellows and installed with sufficient clearance to allow full rated deflection. The sleeves shall be welded on the flow inlet end of the joint only. The sleeve shall also be provided with a drain hole wherever necessary to avoid condensate accumulation.
- 5.16 The tie rods and limit rods shall be adequately sized to absorb pressure thrust and prevent buckling in vacuum service.

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## 6 TESTING AND INSPECTION

6.1 The items covered under this contract shall be subjected to inspection, testing and quality surveillance. The Inspection Agency shall, at all reasonable times have access to Vendor's works, Quality Control records and all facilities as reasonably required for carrying out the inspection and testing efficiently, and these shall be provided by the vendor free of cost

6.2 The minimum NDT/testing and inspection requirements for bellows shall be as per the attached Quality Plan. However, in case of order, final inspection and testing shall be carried out as per the final approved quality plan without any price implications.

### 6.3 TYPE TESTS (CYCLE LIFE, SQUIRM AND YIELD RUPTURE TESTS):

Type tests as per EJMA are required to be carried out for bellows. These shall be done as per classification given below:

#### 6.3.1 CLASSIFICATION OF BELLOWS FOR THE PURPOSE OF TYPE TEST

The bellows shall be classified as per parameters below. The bellows conforming to same combination of categories of these parameters shall constitute one group.

6.3.1.1 Material of Bellows: Three categories are envisaged - Carbon steel, stainless steel (e.g. SS-304, 321, 316 etc.) and High alloy steels (e.g. Inconel)

6.3.1.2 Profile of Convolutions: Each profile shall be considered as separate category (e.g. 'U' profile, 'V' profile, Lyra profile etc.).

6.3.1.3 Diameter of Bellows - The categories are as follows:

- Nominal dia upto 800mm NB.
- Nominal dia greater than 800mm NB upto 1600 NB.
- Each size above 1600mm NB shall be a separate category.

6.3.1.4 Design Pressure : Two categories are envisaged. First is for design pressure from full vacuum up to 5 Kg/cm<sup>2</sup> (g) second category is for pressure above 5 Kg/cm<sup>2</sup> (g) up to 10 Kg/cm<sup>2</sup> (g).

#### 6.3.2 Criteria of test:

From each group of bellows, as per clause 6.3.1 above, Type tests shall be carried out on two nos. of bellows which has maximum total stress as per EJMA among the bellows of the same group. One bellow shall be used for life cycle test and the other for Squirm & Yield rupture test. Other bellows of this group shall be qualified on the basis of this test.

#### 6.3.3 No. of Cycles

For the life cycle test, the number of test cycles shall be minimum 10,000 cycles. The squirm and yield pressure shall be as per approved pressure and calculations.

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## 7 PAINING


All parts which are not made of stainless steel or other corrosion resisting materials shall be cleaned, flushed and coated with anti-corrosive paints of approved make and quality before shipment. Before painting, the surfaces shall be thoroughly cleaned of grease, dirt etc.

## 8 CLEANING, PROTECTION FOR DESPATCH AND PACKING

All parts shall be properly boxed, crated or otherwise protected for transportation. Exposed finished surface shall be thoroughly greased before transportation. Joints shall be shipped at neutral length. They shall be provided with suitable erection and knock-off type temporary tie bars to prevent damage and misalignment during transit. These rods shall be tagged with instruction that they are to be left in place during erection but shall be removed before the system is placed in operation.

## 9 Bellows Tag Nos. shall be incorporated in all the dispatch documents.



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S.NO	DESCRIPTION		UNITS	DATA/PARTICULARS	
1	GENERAL	TAG NO.	-	E1, E2 & E4,E5	E3 & E6
2		QUANTITIES REQD. PER SET	NOS	ONE EACH	ONE EACH
3		TOTAL QTY. REQD.( FOR 3 UNITS)	NOS	EIGHT	FOUR
4		LOCATION	-	BFPT A & B EXHAUST TO CONDENSER	
5		FLUID	-	STEAM	
6		INSTALLATION	-	HORIZONTAL	HORIZONTAL
7	DESIGN & OPERATING PARTICULARS	TYPE	-	GIMBAL	HINGED ANGULAR
8		MATCHING PIPE (OD X THK)	MM	1829X16	1829X16
9		OPERATING PRESSURE	KG/CM <sup>2</sup> (A)	0.12	0.12
10		OPERATING TEMPERATURE	°C	49.06	49.06
11		DESIGN PRESSURE	KG/CM <sup>2</sup> (G)	2 & FULL VACUUM	2 & FULL VACUUM
12		DESIGN TEMPERATURE	°C	100	100
13		DESIGN FLOW VELOCITY	M/S	100	100
14		CYCLIC DESIGN LIFE	CYCLE	10,000	10,000
15		AXIAL COMPRESSION (DESIGN)	MM	N.A.	N.A.
16		AXIAL ELONGATION (DESIGN)	MM	N.A.	N.A.
17		LATERAL DEFLECTION (DESIGN)	MM	N.A.	N.A.
18		ANGULAR ROTATION (DESIGN)	DEGREE	1.5 <sup>0</sup>	1.5 <sup>0</sup>
19		I. OVERALL LENGTH II. BELLOWS CENTRE DISTANCE	MM MM	1200 N.A.	900 N.A.
20		MAX THEORETICAL INITIAL ELASTIC SPRING RATE: I) AXIAL II) LATERAL III) ANGULAR a) FOR FULL ASSEMBLY b) FOR EACH BELLOWS (IN CASE OF DOUBLE BELLOWS)	kg/mm KG/MM  Kg-m/deg kg-m/deg	N.A. N.A.  600 N.A.	N.A. N.A.  600 N.A. N.A.
21		MIN. FLANGE THICKNESS	MM	80	80
22		MIN. TIE ROD DIAMETER	MM	-	-
23		MIN. SLEEVE THICKNESS	MM	10	10
24		MIN GIMBAL RING THICKNESS/WIDTH	MM	75/300	-

	<b>TITLE:</b> <b>METAL EXPANSION BELLOWS</b> <b>2X660 MW SURATGARH STPP</b> <b>DATA SHEET- A</b>		SPECIFICATION NO. PE-TS-392-100-M 021	
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S.NO	DESCRIPTION		UNITS	DATA/PARTICULARS	
25		MIN. HINGE MAIN PLATE THICKNESS	MM	-	75
26		MIN. HINGE SUPPORT PLATE THICKNESS	MM	38	38
27		MIN. HINGE/ GIMBAL PIN DIAMETER	MM	90	90
28		MIN. GUSSET THICKNESS	MM	36	36
29		THICKNESS OF END PIPE LOCAL TO FLANGE	MM	30 (SEE NOTE BELOW)	30 (SEE NOTE BELOW)
30		MIN. VALUE OF LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (P SC)	KG/CM <sup>2</sup> (G)	4.5	4.5
31		MIN. VALUE OF LIMITING DESIGN PRESSURE BASED ON INPLANE INSTABILITY AND LOCAL PLASTICITY (PSI)	KG/CM <sup>2</sup> (G)	4.5	4.5
32	MATERIAL OF CONSTRUCTION	BELLOWS	-	ASTM 240 TP 304	ASTM 240 TP 304
33		SPOOL PIPES	-	SA 672 GR.B 70/ SA 672 GR.C 70	SA 672 GR.B 70/ SA 672 GR.C 70
34		TIE ROD/LIMIT ROD WITH NUTS	-	-	-
35		HINGE PLATE	-	IS 2062 GR.B/ SA515/516 GR.70	IS 2062 GR.B/ SA515/516 GR.70
36		GIMBAL RING	-	IS 2062 GR.B/ SA515/516 GR.70	N.A.
37		SPHERICAL WASHERS a) MATERIAL b) CASE HARDENED c) SURFACE FINISH	- HRC MICRON	N.A. N.A. N.A.	N.A. N.A. N.A.
38		HINGE PIN	-	CARBON STEEL CL.8.8	CARBON STEEL CL.8.8
39		INTERNAL SLEEVE	-	ASTM 240 TP 304	ASTM 240 TP 304
40		COVER	-	CARBON STEEL	CARBON STEEL
41		FLANGE (HOUSING TIE RODS/ HINGE PLATE)	-	IS 2062 GR.B/ SA515/516 GR.70	IS 2062 GR.B/ SA515/516 GR.70
42	END DETAILS	FLANGE a) MATERIAL b) RATING c) DRILLING	- - -	N.A. N.A. N.A.	N.A. N.A. N.A.
43		BUTTWELD DETAILS (TO SUIT MATCHING PIPE)	-	AS PER ASME B 16.25	AS PER ASME B 16.25
44		CODES/STANDARDS APPLICABLE	-	EJMA	EJMA
45		OTHER REQUIREMENTS	-	-	-

**NOTES:** THICKNESS OF END PIPE LOCAL TO FLANGE TO BE AS SPECIFIED. IT IS TO BE STEP MACHINED TO 16 MM NEAR THE BELLOWS CONVOLUTION AND EDGE PREPARED TO SUIT MATCHING PIPE AT OTHER END.



**TITLE:**  
**METAL EXPANSION BELLOWS**  
**2X660 MW SURATGARH STPP**  
**DATA SHEET- A**

SPECIFICATION NO. PE-TS-392-100-M 021

VOLUME : II B

SECTION: **D**

REV. NO.: 00

DATE: 24/06/2013

SHEET 3 OF 10

S.NO	DESCRIPTION	UNITS	DATA/PARTICULARS	
1	TAG NO.	-	<b>E7 , E8</b>	<b>E9</b>
2	QUANTITIES REQD. PER SET	NOS	ONE EACH	ONE
3	TOTAL QTY. REQD.( FOR 3 UNITS)	NOS	FOUR	TWO
4	LOCATION	-	<b>H.P. FLASH TANK VENT TO CONDENSER</b>	
5	FLUID	-	STEAM	
6	INSTALLATION	-	HORIZONTAL	VERTICAL
7	TYPE	-	GIMBAL	HINGED ANGULAR
8	MATCHING PIPE (OD X THK)	MM	1219X10	1219X10
9	OPERATING PRESSURE	KG/CM <sup>2</sup> (A)	0.11	0.11
10	OPERATING TEMPERATURE	°C	100	100
11	DESIGN PRESSURE	KG/CM <sup>2</sup> (G)	2 & FULL VACUUM	2 & FULL VACUUM
12	DESIGN TEMPERATURE	°C	210	210
13	DESIGN FLOW VELOCITY	M/S	100	100
14	CYCLIC DESIGN LIFE	CYCLE	10,000	10,000
15	AXIAL COMPRESSION (DESIGN)	MM	N.A.	N.A.
16	AXIAL ELONGATION (DESIGN)	MM	N.A.	N.A.
17	LATERAL DEFLECTION (DESIGN)	MM	N.A.	N.A.
18	ANGULAR ROTATION (DESIGN)	DEGREE	1.5 <sup>0</sup>	1.5 <sup>0</sup>
19	I. OVERALL LENGTH II. BELLOWS CENTRE DISTANCE	MM MM	900 N.A.	900 N.A.
20	MAX THEORETICAL INITIAL ELASTIC SPRING RATE: I) AXIAL II) LATERAL III) ANGULAR a) FOR FULL ASSEMBLY b) FOR EACH BELLOWS (IN CASE OF DOUBLE BELLOWS)	kg/mm KG/MM  Kg-m/deg kg-m/deg	N.A. N.A.  450 N.A.	N.A. N.A.  450 N.A.
21	MIN. FLANGE THICKNESS	MM	50	50
22	MIN. TIE ROD DIAMETER	MM	-	-
23	MIN. SLEEVE THICKNESS	MM	6	6
24	MIN GIMBAL RING THICKNESS / WIDTH	MM	60/225	-
25	MIN. HINGE MAIN PLATE THICKNESS	MM	-	40

	<b>TITLE:</b> <b>METAL EXPANSION BELLOWS</b> <b>2X660 MW SURATGARH STPP</b> <b>DATA SHEET- A</b>	SPECIFICATION NO. PE-TS-392-100-M 021	
		VOLUME : II B	
		SECTION: <b>D</b>	
		REV. NO.: 00	DATE: 24/06/2013
		SHEET 4	OF 10

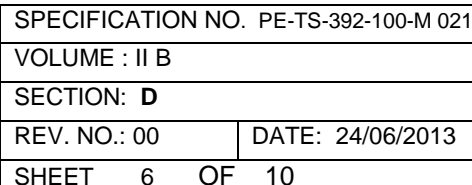
S.NO	DESCRIPTION	UNITS	DATA/PARTICULARS	
26	MIN. HINGE SUPPORT PLATE THICKNESS	MM	20	20
27	MIN. HINGE/ GIMBAL PIN DIAMETER	MM	60	60
28	MIN. GUSSET THICKNESS	MM	20	20
29	THICKNESS OF END PIPE LOCAL TO FLANGE	MM	20 (SEE NOTE BELOW)	20 (SEE NOTE BELOW)
30	MIN. VALUE OF LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (P SC)	KG/CM <sup>2</sup> (G)	4.5	4.5
31	MIN. VALUE OF LIMITING DESIGN PRESSURE BASED ON INPLANE INSTABILITY AND LOCAL PLASTICITY (PSI)	KG/CM <sup>2</sup> (G)	4.5	4.5
32	BELLOWS	-	ASTM 240 TP 304	ASTM 240 TP 304
33	SPOOL PIPES	-	SA 672 GR.B 70/ SA 672 GR.C 70	SA 672 GR.B 70/ SA 672 GR.C 70
34	TIE ROD/LIMIT ROD WITH NUTS	-	-	-
35	HINGE PLATE	-	IS 2062 GR.B/ SA515/516 GR.70	IS 2062 GR.B/ SA515/516 GR.70
36	GIMBAL RING	-	IS 2062 GR.B/ SA515/516 GR.70	N.A.
37	SPHERICAL WASHERS a) MATERIAL b) CASE HARDENED c) SURFACE FINISH	- HRC MICRON	N.A. N.A. N.A.	N.A. N.A. N.A.
38	HINGE PIN	-	CARBON STEEL CL.8.8	CARBON STEEL CL.8.8
39	INTERNAL SLEEVE	-	ASTM 240 TP 304	ASTM 240 TP 304
40	COVER	-	CARBON STEEL	CARBON STEEL
41	FLANGE (HOUSING TIE RODS/ HINGE PLATE)	-	IS 2062 GR.B/ SA515/516 GR.70	IS 2062 GR.B/ SA515/516 GR.70
42	FLANGE a) MATERIAL b) RATING c) DRILLING	- - -	N.A. N.A. N.A.	N.A. N.A. N.A.
43	BUTTWELD DETAILS (TO SUIT MATCHING PIPE)	-	AS PER ASME B 16.25	AS PER ASME B 16.25
44	CODES/STANDARDS APPLICABLE	-	EJMA	EJMA
45	OTHER REQUIREMENTS	-	-	-

**NOTE:** THICKNESS OF END PIPE LOCAL TO FLANGE TO BE AS SPECIFIED. IT IS TO BE STEP MACHINED TO 10 MM NEAR THE BELLOWS CONVOLUTION AND EDGE PREPARED TO SUIT MATCHING PIPE AT OTHER END.



SHEET 5 OF 10

S.NO	DESCRIPTION		UNITS	DATA/PARTICULARS	
1	GENERAL	TAG NO.	-	E10 , E11	E12
2		QUANTITIES REQD. PER SET	NOS	ONE EACH	ONE
3		TOTAL QTY. REQD.( FOR 3 UNITS)	NOS	FOUR	TWO
4		LOCATION	-	L.P. FLASH TANK VENT TO CONDENSER	
5		FLUID	-	STEAM	
6		INSTALLATION	-	HORIZONTAL	VERTICAL
7	DESIGN & OPERATING PARTICULARS	TYPE	-	HINGED ANGULAR	HINGED ANGULAR
8		MATCHING PIPE (OD X THK)	MM	914X10	914X10
9		OPERATING PRESSURE	KG/CM <sup>2</sup> (A)	0.11	0.11
10		OPERATING TEMPERATURE	°C	100	100
11		DESIGN PRESSURE	KG/CM <sup>2</sup> (G)	2 & FULL VACUUM	2 & FULL VACUUM
12		DESIGN TEMPERATURE	°C	150	150
13		FLOW VELOCITY AT OPERATING CONDITION	M/S	100	100
14		CYCLIC DESIGN LIFE	CYCLE	10,000	10,000
15		AXIAL COMPRESSION (DESIGN)	MM	N.A.	N.A.
16		AXIAL ELONGATION (DESIGN)	MM	N.A.	N.A.
17		LATERAL DEFLECTION (DESIGN)	MM	N.A.	N.A.
18		ANGULAR ROTATION (DESIGN)	DEGREE	1.5 <sup>0</sup>	1.5 <sup>0</sup>
19		I. OVERALL LENGTH II. BELLOWS CENTRE DISTANCE	MM MM	900 N.A.	900 N.A.
20		MAX THEORITICAL INITIAL ELASTIC SPRING RATE: I) AXIAL II) LATERAL III) ANGULAR a) FOR FULL ASSEMBLY b) FOR EACH BELLOWS (IN CASE OF DOUBLE BELLOWS)	kg/mm KG/MM  Kg-m/deg kg-m/deg	N.A. N.A.  150 N.A.	N.A. N.A.  150 N.A.
21		MIN. FLANGE THICKNESS	MM	45	45
22		MIN. TIE ROD DIAMETER	MM	-	-
23		MIN. HINGE PIN DIAMETER	MM	50	50
24		MIN. HINGE MAIN PLATE THICKNESS	MM	40	40



**NOTE:** THICKNESS OF END PIPE LOCAL TO FLANGE TO BE AS SPECIFIED. IT IS TO BE STEP MACHINED TO 10 MM NEAR THE BELLOWS CONVOLUTION AND EDGE PREPARED TO SUIT MATCHING PIPE AT OTHER END.



**TITLE:**  
**METAL EXPANSION BELLOWS**  
**2X660 MW SURATGARH STPP**  
**DATA SHEET- A**

SPECIFICATION NO. PE-TS-392-100-M 021

VOLUME : II B


SECTION: D

REV. NO.: 00

DATE: 24/06/2013

SHEET 7 OF 10

S.NO	DESCRIPTION		UNITS	DATA/PARTICULARS	
1	GENERAL	TAG NO.	-	E13	E14
2		QUANTITIES REQD. PER SET	NOS	ONE	ONE
3		TOTAL QTY. REQD.( FOR 3 UNITS)	NOS	TWO	TWO
4		LOCATION	-	STEAM DRAIN FLASH TANK VENT	
5		FLUID	-	STEAM	
6		INSTALLATION	-	VERTICAL	HORIZONTAL
7	DESIGN & OPERATING PARTICULARS	TYPE	-	HINGED ANGULAR	HINGED ANGULAR
8		MATCHING PIPE (OD X THK)	MM	813X10	813X10
9		OPERATING PRESSURE	KG/CM <sup>2</sup> (A)	0.11	0.11
10		OPERATING TEMPERATURE	°C	150	150
11		DESIGN PRESSURE	KG/CM <sup>2</sup> (G)	2 & FULL VACUUM	2 & FULL VACUUM
12		DESIGN TEMPERATURE	°C	210	210
13		FLOW VELOCITY AT OPERATING CONDITION	M/S	150	150
14		CYCLIC DESIGN LIFE	CYCLE	10,000	10,000
15		AXIAL COMPRESSION (DESIGN)	MM	N.A.	N.A.
16		AXIAL ELONGATION (DESIGN)	MM	N.A.	N.A.
17		LATERAL DEFLECTION (DESIGN)	MM	N.A.	N.A.
18		ANGULAR ROTATION (DESIGN)	DEGREE	1.5 <sup>0</sup>	1.5 <sup>0</sup>
19		I. OVERALL LENGTH II. BELLOWS CENTRE DISTANCE	MM MM	800 N.A.	800 N.A.
20		MAX THEORITICAL INITIAL ELASTIC SPRING RATE: I) AXIAL II) LATERAL III) ANGULAR a) FOR FULL ASSEMBLY b) FOR EACH BELLOWS (IN CASE OF DOUBLE BELLOWS)	kg/mm KG/MM  Kg-m/deg kg-m/deg	N.A. N.A.  90 N.A.	N.A. N.A.  90 N.A.
21		MIN. FLANGE THICKNESS	MM	40	40
22		MIN. TIE ROD DIAMETER	MM	-	-
23		MIN. HINGE PIN DIAMETER	MM	40	40
24		MIN. HINGE MAIN PLATE THICKNESS	MM	40	40

	<b>TITLE:</b> <b>METAL EXPANSION BELLOWS</b> <b>2X660 MW SURATGARH STPP</b> <b>DATA SHEET- A</b>	SPECIFICATION NO. PE-TS-392-100-M 021	
		VOLUME : II B	
		SECTION: <b>D</b>	
		REV. NO.: 00	DATE: 24/06/2013
		SHEET 8 OF 10	

S.NO	DESCRIPTION		UNITS	DATA/PARTICULARS	
25		MIN. HINGE SUPPORT PLATE THICKNESS	MM	20	20
26		MIN. SLEEVE THICKNESS	MM	6	6
27		MIN. GUSSET THICKNESS	MM	N.A.	N.A.
28		MIN. VALUE OF LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (P SC)	KG/CM <sup>2</sup> (G)	4.5	4.5
29		MIN. VALUE OF LIMITING DESIGN PRESSURE BASED ON INPLANE INSTABILITY AND LOCAL PLASTICITY (PSI)	KG/CM <sup>2</sup> (G)	4.5	4.5
30	MATERIAL OF CONSTRUCTION	BELLOWS	-	ASTM 240 TP 304	ASTM 240 TP 304
31		SPOOL PIPES	-	SA 672 GR.B 70/ SA 672 GR.C 70	SA 672 GR.B 70/ SA 672 GR.C 70
32		TIE ROD/LIMIT ROD WITH NUTS	-	N.A.	N.A.
33		HINGE PLATE	-	IS 2062 GR.B/ SA515/516 GR.70	IS 2062 GR.B/ SA515/516 GR.70
34		GIMBAL RING	-	N.A.	N.A.
35		SPHERICAL WASHERS a) MATERIAL b) CASE HARDENED c) SURFACE FINISH	- HRC MICRON	N.A. N.A. N.A.	N.A. N.A. N.A.
36		HINGE PIN	-	CARBON STEEL CL.8.8	CARBON STEEL CL.8.8
37		INTERNAL SLEEVE	-	ASTM A240 TP 304	ASTM A240 TP 304
38		COVER	-	CARBON STEEL	CARBON STEEL
39		FLANGE (HOUSING TIE RODS/ HINGE PLATE)	-	IS 2062 GR.B/ SA515/516 GR.70	IS 2062 GR.B/ SA515/516 GR.70
40	END DETAILS	FLANGE a) MATERIAL b) RATING c) DRILLING	- - -	N.A. N.A. N.A.	N.A. N.A. N.A.
41		BUTTWELD DETAILS (TO SUIT MATCHING PIPE)	-	AS PER ASME B 16.25	AS PER ASME B 16.25
42		CODES/STANDARDS APPLICABLE	-	EJMA	EJMA
43		OTHER REQUIREMENTS	-	-	-





**TITLE:**  
**METAL EXPANSION BELLOWS**  
**2X660 MW SURATGARH STPP**  
**DATA SHEET- A**

SPECIFICATION NO. PE-TS-392-100-M 021

VOLUME : II B


SECTION: D

REV. NO.: 00


DATE: 24/06/2013

SHEET 9 OF 10

S.NO	DESCRIPTION	UNITS	DATA/PARTICULARS
1	TAG NO.	-	E15 , E16, E17
2	QUANTITIES REQD. PER SET	NOS	ONE EACH
3	TOTAL QTY. REQD.( FOR 2 UNITS)	NOS	SIX
4	LOCATION	-	MAIN CONDENSATE SUCTION
5	FLUID	-	CONDENSATE
6	INSTALLATION	-	HORIZONTAL
7	TYPE	-	UNTIED
8	MATCHING PIPE (OD X THK)	MM	559X10
9	OPERATING PRESSURE	KG/CM <sup>2</sup> (A)	0.105
10	OPERATING TEMPERATURE	°C	45.4
11	DESIGN PRESSURE	KG/CM <sup>2</sup> (G)	2 & FULL VACUUM
12	DESIGN TEMPERATURE	°C	60
13	FLOW VELOCITY AT OPERATING CONDITION	M/S	0.96
14	EXTREMELY TURBULENT FLOW (AS PER CLAUSE C-3.2.5 OF EJMA)	YES/NO	NO
15	CYCLIC DESIGN LIFE	CYCLE	10,000
16	AXIAL COMPRESSION (DESIGN)	MM	6.0
17	AXIAL ELONGATION (DESIGN)	MM	N.A.
18	LATERAL DEFLECTION (DESIGN)	MM	3.0
19	ANGULAR ROTATION (DESIGN)	DEGREE	N.A.
20	I. OVERALL LENGTH II. BELLOWS CENTRE DISTANCE	MM MM	900 N.A.
21	MAX THEORITICAL INITIAL ELASTIC SPRING RATE: I) AXIAL II) LATERAL III) ANGULAR a) FOR FULL ASSEMBLY b) FOR EACH BELLOWS (IN CASE OF DOUBLE BELLOWS)	KG/MM KG/MM  Kg-m/deg kg-m/deg	55 50  N.A. N.A.
22	NO OF TIE RODS	NOS	2
23	MIN. FLANGE THICKNESS	MM	30
24	MIN. TIE ROD DIAMETER	MM	30


	<b>TITLE:</b> <b>METAL EXPANSION BELLOWS</b> <b>2X660 MW SURATGARH STPP</b> <b>DATA SHEET- A</b>		SPECIFICATION NO. PE-TS-392-100-M 021
			VOLUME : II B
			SECTION: <b>D</b>
			REV. NO.: 00      DATE: 24/06/2013
		SHEET    10    OF    10	

S.NO	DESCRIPTION		UNITS	DATA/PARTICULARS
25		MIN. SLEEVE THICKNESS	MM	1.5
26		MIN. GUSSET THICKNESS	MM	N.A.
27		MIN. VALUE OF LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (P SC)	KG/CM <sup>2</sup> (G)	4.5
28		MIN. VALUE OF LIMITING DESIGN PRESSURE BASED ON INPLANE INSTABILITY AND LOCAL PLASTICITY (PSI)	KG/CM <sup>2</sup> (G)	4.5
29	MATERIAL OF CONSTRUCTION	BELLOWS	-	ASTM 240 TP 304
30		SPOOL PIPES	-	SA 672 GR.B 70/ SA 672 GR.C 70/
31		TIE ROD/LIMIT ROD WITH NUTS	-	CARBON STEEL (CL. 6.8 & 6.0)
32		HINGE PLATE	-	N.A.
33		GIMBAL RING	-	N.A.
34		SPHERICAL WASHERS a) MATERIAL b) CASE HARDENED c) SURFACE FINISH	- HRC MICRON	N.A. N.A. N.A.
35		HINGE PIN	-	N.A.
36		INTERNAL SLEEVE	-	ASTM 240 TP 304
37		COVER	-	CARBON STEEL
38		FLANGE (HOUSING TIE RODS/ HINGE PLATE)	-	IS 2062 GR.B/ SA515/516 GR.70
39	END DETAILS	FLANGE a) MATERIAL b) RATING c) DRILLING	- - -	N.A. N.A. N.A.
40		BUTTWELD DETAILS (TO SUIT MATCHING PIPE)	-	AS PER ASME B 16.25
41		CODES/STANDARDS APPLICABLE	-	EJMA
42		OTHER REQUIREMENTS	-	-

<b>MAIN SUPPLIER</b> <b>BHEL-PEM,NOIDA</b> 	<b>MANUFACTURER'S NAME AND ADDRESS</b>	<b>MANUFACTURING QUALITY PLAN</b>		<b>PROJECT : 2X660 MW SURATGARH STPP</b>			
				<b>CUSTOMER : DVC</b>			
		<b>ITEM : ME BELLWS</b> <b>(550, 800, 900, 1200, 1800 NB)</b> <b>SUB-SYSTEM: POWER</b> <b>CYCLE PIPING</b>		<b>QP NO. PE-QP-392-100-M021</b> <b>REV.NO.:00</b> <b>DATE: 24/06/2013</b> <b>PAGE: 1.... OF...5.</b>		<b>SPEC NO. : PE-TS-392-100-M021 REV-00</b>	
				<b>VOLUME : IIB</b>		<b>SECTION: D</b>	


SL No	COMPONENT & OPERATIONS	CHARACTERIST-ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT #	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C / N					D	M	C	
1.0 MATERIAL														
	MATERIAL FOR BELLOWS / PIPE ENDS / PLATES FOR PIPES / FLANGES / LUGS / HINGE PLATES / GIMBLE RING / SLEEVE / PIN / TIE ROD	CHEMICAL COMPOSITION	MAJOR	CHEMICAL ANALYSIS	ONE PER HEAT		BHEL DRAWING / APPROVED DRAWING / TECH SPEC	MTC (or) CHECK TEST CERTIFICATE	√	P	V		CORELATED TC TO BE REVIEWED BY BHEL QC.	
		MECHANICAL PROPERTIES		UTS, YS & PERCENTAGE OF ELONGATION	ONE PER HEAT				√	P	V		REFER NOTE NO:3	
		DIMENSIONAL CHECK		MEASUREMENT	100 %	100 %			-	P	V			
		SURFACE EXAMINATION	MINOR	VISUAL	100 %	100 %			-	P	V			
2.0 WELDING														
2.1	1) WELDING PROCEDURE	CORRECTNESS OF PROCEDURE	CRITICAL	VERIFICATION OF WPS	100 %		IS 7307 / ASME SEC IX	IS 7307 / ASME SEC IX	IS 7307 / ASME SEC IX	√	P	V		REFER NOTE NO: 4
	2) PROCEDURE QUALIFICATION	WELD SOUNDNESS		DESTRUCTIVE TESTS	IS 7307 / ASME SEC IX	√				P	V			
	3) WELDER PERFORMANCE QUALIFICATION	WELDERS' PERFORMANCE		DESTRUCTIVE TESTS / NDE	IS 7310 / ASME SEC IX	√				P	W / V			

		<b>LEGEND:</b> * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. <b>** M:</b> MANUFACTURER/SUB-SUPPLIER <b>C:</b> MAIN SUPPLIER(BHEL)  <b>P:</b> PERFORM <b>W:</b> WITNESS AND <b>V:</b> VERIFICATION. AS APPROPRIATE	<b>DOC. NO.:</b>		<b>REV..... CAT.....</b>	
<b>MANUFACTURER/ SUB-SUPPLIER</b>	<b>MAIN-SUPPLIER</b>					
<b>SIGNATURE</b>			<b>REVIEWED BY</b>	<b>APPROVED BY</b>	<b>APPROVAL SEAL</b>	

<b>MAIN SUPPLIER</b> <b>BHEL-PEM,NOIDA</b> 	<b>MANUFACTURER'S NAME AND ADDRESS</b>	<b>MANUFACTURING QUALITY PLAN</b>				<b>PROJECT : 2X660 MW SURATGARH STPP</b>			
		<b>ITEM : ME BELLOWS</b> (550, 800, 900, 1200, 1800 NB)		<b>QP NO. PE-QP-392-100-M021</b> <b>REV.NO.:00</b>		<b>CUSTOMER : DVC</b>			
		<b>SUB-SYSTEM: POWER</b> <b>CYCLE PIPING</b>		<b>DATE: 24/06/2013</b> <b>PAGE: 2.... OF...5.</b>		<b>SPEC NO. : PE-TS-392-100-M021 REV-00</b>			
						<b>VOLUME : IIB SECTION: D</b>			


SL No	COMPONENT & OPERATIONS	CHARACTERIST-ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT #	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9		**			
					M	C / N				D*	M	C		
2.2	BUTT / GROOVE WELDS													
	1) BELLOWS AND PLATE FORMED PIPES	FITUP,SIZE OF WELD	MAJOR	VISUAL AND MEASUREMENT	100 %	-	APPD DRG / ASME SEC VIII – DIVISION 1	ASME SEC VIII – DIVISION 1	INTERNAL INSPECTION REPORTS	-	P	-		
		SOUNDNESS OF WELD	CRITICAL	PT FOR BELLOW LONG SEAM BEFORE FORMING	100 %		ASME SEC V / APPD. DRG	ASME SEC VIII – DIVISION 1	INTERNAL INSPECTION REPORTS	-	P	V		REVIEW OF FILM BY BHEL
				RT FOR BELLOW LONG SEAM BEFORE FORMING					LAB REPORT	√	P	V		
				RT FOR PIPE LONG SEAM					LAB REPORT	√	P	V		
	2) SEGMENTAL FLANGES	SURFACE DEFECTS OF WELDMENTS	MAJOR	PT	100 %	100 %	ASTM E 165	NO SURFACE DEFECT	INTERNAL INSPECTION REPORTS	√	P	V		
		INTERNAL DEFECTS OF WELDMENTS	MAJOR	RT	100 %		ASME SEC V/VIII	ASME SEC VIII – DIVISION 1	LAB REPORT	√	P	V		REVIEW OF FILM BY BHEL
				UT					LAB REPORT	√	P	V		
2.3	FILLET WELDS	SOUNDNESS OF WELDMENTS	MAJOR	PT	100 %		ASME SEC V / APPD. DRG	ASME SEC VIII – DIVISION 1	INTERNAL INSPECTION REPORTS	√	P	V		

		<b>LEGEND:</b> * RECORDS, IDENTIFIED WITH “TICK” (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. <b>** M:</b> MANUFACTURER/SUB-SUPPLIER <b>C:</b> MAIN SUPPLIER(BHEL)  <b>P:</b> PERFORM <b>W:</b> WITNESS AND <b>V:</b> VERIFICATION. AS APPROPRIATE	<b>DOC. NO.:</b>			<b>REV..... CAT.....</b>		
<b>MANUFACTURER/ SUB-SUPPLIER</b>	<b>MAIN-SUPPLIER</b>							
<b>SIGNATURE</b>			<b>REVIEWED BY</b>	<b>APPROVED BY</b>	<b>APPROVAL SEAL</b>			

<b>MAIN SUPPLIER</b> <b>BHEL-PEM,NOIDA</b> 	<b>MANUFACTURER'S NAME AND ADDRESS</b>	<b>MANUFACTURING QUALITY PLAN</b>		<b>PROJECT : 2X660 MW SURATGARH STPP</b>	
		<b>ITEM : ME BELLWS</b> <b>(550, 800, 900, 1200, 1800 NB)</b> <b>SUB-SYSTEM: POWER</b> <b>CYCLE PIPING</b>	<b>QP NO. PE-QP-392-100-M021</b> <b>REV.NO.:00</b> <b>DATE: 24/06/2013</b> <b>PAGE: 3.... OF...5.</b>	<b>CUSTOMER : DVC</b>	
				<b>SPEC NO. : PE-TS-392-100-M021 REV-00</b>	
				<b>VOLUME : IIB</b>	<b>SECTION: D</b>


SL No	COMPONENT & OPERATIONS	CHARACTERIST -ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT #	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	**			
					M C / N			D*	M	C		
<b>3.0 INSPECTION &amp; TESTS</b>												
3.1	BELLOWS CONVOLUTIONS	WORKMANSHIP	MAJOR	VISUAL	100 %	APPD. DRG		INTERNAL INSPECTION REPORTS	√	P	W	
		DIMENSIONS		MEASUREMENT					√	P	W	
		SURFACE DEFECTS ( INSIDE & OUTSIDE OF LONG SEAM)		PT		ASME SEC V	NO SURFACE DEFECT		√	P	W	
3.2	GIMBAL RING, HINGE PLATE, FLANGE, SHROUD,SLEEVE,PI N,TIE ROD,WASHER & NUTS	WORKMANSHIP & DIMENSIONS	MAJOR	VISUAL & MEASUREMENT	100 %	APPD. DRG		INTERNAL INSPECTION REPORTS	-	P	V	
3.3	SEGMENTAL FLANGE	STRESS RELIEVEING	MAJOR	REVIEW OF HT CHART	100 %	ASME SEC VIII		SR CHART	√	P	V	
3.4	ROUTINE TESTS	1) LEAK TIGHTNESS	CRITICAL	1) VACUUM TEST	100 %	1) 12 mm Hg (A)	NO LEAKAGE OR PERMANENT DEFORMATION	TEST REPORTS	√	P	W	CHP
				2)HYDROSTATIC PR. TEST		1) APPD. DRG / 3 Kg /Sq.cm(g)			√	P	W	
		2) DEFLECTION	CRITICAL	DEFLECTION TESTS	100 %	EJMA / TECH. SPEC / APPD. DRG	EJMA / TECH. SPEC / APPD. DRG	TEST REPORTS	√	P	W	
		3) THINNING	MAJOR	MOCK UP PIECE (or) UT	ONE / TYPE	EJMA / TECH. SPEC	NOT TO EXCEED 15% OF ACTUAL RAW MATERIAL THICKNESS	INTERNAL INSPECTION REPORTS	√	P	W	REFER NOTE NO: 6

		<b>LEGEND:</b> * RECORDS, INDENTIFIED WITH “TICK” ( √ ) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. <b>** M:</b> MANUFACTURER/SUB-SUPPLIER <b>C:</b> MAIN SUPPLIER(BHEL)  <b>P:</b> PERFORM <b>W:</b> WITNESS AND <b>V:</b> VERIFICATION. AS APPROPRIATE	<b>DOC. NO.:</b>			<b>REV..... CAT.....</b>		
<b>MANUFACTURER/ SUB-SUPPLIER</b>	<b>MAIN-SUPPLIER</b>							
<b>SIGNATURE</b>			<b>REVIEWED BY</b>	<b>APPROVED BY</b>	<b>APPROVAL SEAL</b>			

<b>MAIN SUPPLIER</b> <b>BHEL-PEM,NOIDA</b> 	<b>MANUFACTURER'S NAME AND ADDRESS</b>	<b>MANUFACTURING QUALITY PLAN</b>		<b>PROJECT : 2X660 MW SURATGARH STPP</b>			
		<b>ITEM : ME BELLOWS</b> (550, 800, 900, 1200, 1800 NB)		<b>QP NO. PE-QP-392-100-M021</b>		<b>CUSTOMER : DVC</b>	
		<b>SUB-SYSTEM: POWER</b>		<b>REV.NO.:00</b> <b>DATE: 24/06/2013</b>		<b>SPEC NO. : PE-TS-392-100-M021 REV-00</b>	
		<b>CYCLE PIPING</b>		<b>PAGE: 4.... OF...5.</b>		<b>VOLUME : IIB SECTION: D</b>	

SL No	COMPONENT & OPERATIONS	CHARACTERIST-ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT #	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9		**			
					M	C / N				D*	M	C		
	ROUTINE TESTS	4) SPRING RATE (ONLY AXIAL)	CRITICAL	STIFFNESS TEST	ONE / TYPE		EJMA / TECH. SPEC	TECH. SPEC	SPRING RATE CURVES REPORT	√	P	W		BELLOWS UNDER NORMAL CONDITION DEFLECTED TO THE VALUE AS SPECIFIED IN TECH SPEC. REFER NOTE NO. 6
		5) CLEANLINESS	MAJOR	VISUAL	100 %	100 %	TECH. SPEC / APPD. DRG	TECH. SPEC / APPD. DRG	INTERNAL INSPECTION REPORTS	√	P	V		
		6) PAINT THICKNESS		MEASUREMENT						√	P	V		
		7) WORKMANSHIP		VISUAL						√	P	V		
		8) MARKING		VISUAL						√	P	V		
3.5	TYPE TEST	1) CYCLE LIFE (10000 CYCLES), SQUIRM TEST, YIELD & RUPTURE	CRITICAL	DESTRUCTIVE TEST	REFER NOTE NO:1		APPD. TEST PROCEDURES / DATA SHEETS / DRGS	APPD. TEST PROCEDURES / DATA SHEETS / DRGS	TEST REPORTS	√	P	W		CHP- REFER NOTE NO: 1 & 5
3.6	ASSEMBLY	WORKMANSHIP & DIMENSIONS	MAJOR	VISUAL & MEASUREMENT	100 %	100 %	APPD. DRGS	APPD. DRGS	INTERNAL INSPECTION REPORTS	√	P	V		
4.0	DOCUMENTATION	COMPLETENESS OF RECORDS		VERIFICATION OF RECORDS& CERTIFICATES	100 %	100 %	TECH. SPEC / APPD. DRG	TECH. SPEC / APPD. DRG	INTERNAL INSPECTION REPORTS	√	P	V		
5.0	PACKING	SOUNDNESS OF PACKING		VISUAL	100 %	100 %	TECH. SPEC / APPD. DRG	TECH. SPEC / APPD. DRG	INTERNAL INSPECTION REPORTS	√	P	V		


		<b>LEGEND:</b> * RECORDS, IDENTIFIED WITH “TICK” (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. <b>** M:</b> MANUFACTURER/SUB-SUPPLIER <b>C:</b> MAIN SUPPLIER(BHEL)  <b>P:</b> PERFORM <b>W:</b> WITNESS AND <b>V:</b> VERIFICATION. AS APPROPRIATE	<b>DOC. NO.:</b>			<b>REV..... CAT.....</b>		
<b>MANUFACTURER/ SUB-SUPPLIER</b>	<b>MAIN-SUPPLIER</b>							
<b>SIGNATURE</b>			<b>REVIEWED BY</b>	<b>APPROVED BY</b>	<b>APPROVAL SEAL</b>			

<b>MAIN SUPPLIER</b> <b>BHEL-PEM,NOIDA</b> 	<b>MANUFACTURER'S NAME AND ADDRESS</b>	<b>MANUFACTURING QUALITY PLAN</b>		<b>PROJECT : 2X660 MW SURATGARH STPP</b>
		<b>ITEM : ME BELLOWS</b> (550, 800, 900, 1200, 1800 NB) <b>SUB-SYSTEM: POWER</b> <b>CYCLE PIPING</b>	<b>QP NO. PE-QP-392-100-M021</b> <b>REV.NO.:00</b> <b>DATE: 24/06/2013</b> <b>PAGE: 5.... OF...5.</b>	<b>CUSTOMER : DVC</b>
				<b>SPEC NO. : PE-TS-392-100-M021 REV-00</b>
				<b>VOLUME : IIB SECTION: D</b>

**NOTES:-**

1. a) Life cycle test shall be carried out on one bellow of each group as mentioned in Cl. No. 6.3 of Section D of the specification.  
  
b) Squirm & Yield – Rupture test shall also be carried out on one bellow (other than the bellow on which life cycle test has been carried out of each group as mentioned in Cl. No. 6 .3 of Section D of the specification)
2. Test reports for final performance tests, material test certificates and stage inspection records as indicted in the quality plan shall be submitted to BHEL for their scrutiny and approval.
3. In case co related test certificates are not available, check testing shall be carried out by vendor at approved lab.
4. In case welder is not qualified, witnessing will be done by main supplier i.e. BHEL.
5. If type tests at 3.5 (1) have been successfully done for earlier BHEL projects, then only TCs of same group of bellows for earlier project shall be reviewed and no type test need be carried out. Also TC's of same group of bellows shall not be older than 5 years. For new group of bellows type test shall be carried out as per clause 3.5 (1) and note no: 1. Type test procedure approval or type test clearance shall be taken from BHEL prior to offering to routine test to BHEL, in case the test is to be done. Final decision regarding conductance of type test will be conveyed by BHEL at a later date.
6. Bellows of the same type would mean those having the same diameter and convolutions.
7. All materials of construction shall be as per approved drawings / data sheet.


		<b>LEGEND:</b> * RECORDS, INDENTIFIED WITH “TICK” ( ✓ ) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** <b>M:</b> MANUFACTURER/SUB-SUPPLIER <b>C:</b> MAIN SUPPLIER(BHEL)  <b>P:</b> PERFORM <b>W:</b> WITNESS AND <b>V:</b> VERIFICATION. AS APPROPRIATE	<b>DOC. NO.:</b> _____ <b>REV..... CAT.....</b>		
<b>MANUFACTURER/ SUB-SUPPLIER</b>	<b>MAIN-SUPPLIER</b>				
<b>SIGNATURE</b>			<b>REVIEWED BY</b>	<b>APPROVED BY</b>	<b>APPROVAL SEAL</b>

	<b>TITLE:</b>  <b>DATA SHEET-C</b>	SPECIFICATION NO. PE-TS-392-100-M 021	
		VOLUME : II B	
		SECTION: D	
		REV. NO.: 00	DATE: 24/06/2013
		SHEET 1	OF 2

## **DRAWINGS, DOCUMENTS & DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT**

- 1 The successful bidder shall submit the following drawings/documents for approval within two weeks after award of contract:
  - 1.1 Relevant drawings of each bellow with full details inclusive of the following:
    - a) All necessary dimensions (with tolerance as per EJMA).
    - b) Cross sectional arrangement.
    - c) Arrangement of tie rods (limit rods) along with washers and nuts.
    - d) Arrangement of sleeves and cover.
    - e) Bill of material and total weight.
    - f) Welding standards and welding details.
    - g) Flange details/butt weld end details.
    - h) Design deflections and stiffness rates for each bellow.
    - i) Bellow element details.
  - 1.2 Quality plan.
  - 1.3 Design calculations as per EJMA for bellows & other components of bellow assembly such as tie rods, flanges washers etc.
  - 1.4 Stress calculations including Finite element analysis (if required by BHEL) for all pressure carrying parts i.e. flanges, hinge plates, tie rods, gimbal rings etc.
  - 1.5 Stress calculations for local stresses (if required by BHEL) where flanges/lugs are welded to pipe.
  - 1.6 Test procedures for type tests and spring rate test.
- 2 The following shall be submitted within the stipulated time period as per vendor's drawings/ documents schedule, but not later than one month before first dispatch:
  - 2.1 Instruction manual for erection, operation and maintenance.
  - 2.2 Storage instructions.
- 3 Before dispatch of the equipment the vendor shall furnish the following:
  - 3.1 Material Test certificates.
  - 3.2 Shop test reports and certificates.



	<b>TITLE:</b>  <b>DATA SHEET-C</b>	SPECIFICATION NO. PE-TS-392-100-M 021	
		VOLUME : II B	
		SECTION: <b>D</b>	
		REV. NO.: 00	DATE: 24/06/2013
		SHEET    2    OF    2	

4    Distribution of drawings / documents for all projects

After award of the contract the successful bidder shall furnish drawings/ documents as per following distribution schedule.

Sl. No.	Type of Document	No of Hard copies	No. of Soft copies
1	Documents submitted for Approval	2 Nos.	1 Nos.
2	Final Distribution (Approved Documents)	12 Nos.	2 Nos.(CD)
3	Test Certificates/Test Reports	4 Nos.	1 Nos.
4	O&M Manuals	12 Nos.	2 Nos.(CD)

**RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD.**

**2 X 660 MW, SUPER-CRITICAL THERMAL POWER  
STATION**

**STAGE –V, UNIT 7 & 8 AT SURATGARH, RAJASTHAN**

**VOLUME – III**

**TECHNICAL SCHEDULES**

**FOR**

**METAL EXPANSION BELLOWS**

**SPECIFICATION NO. PE-TS-392-100-M021 (REV-00)**



BHARAT HEAVY ELECTRICALS LIMITED, POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
PLOT NO. 25, SECTOR-16A, NOIDA, INDIA

	<b>TITLE:</b> <b>TECHNICAL SCHEDULES</b> <b>METAL EXPANSION BELLOWS</b> <b>2X660 MW SURATGARH STPP</b>	SPECIFICATION NO. PE-TS-392-100-M021	
		VOLUME : III	
		SECTION:	
		REV. NO.: 00	DATE: 24/06/2013
		SHEET 1	OF 1

## **CONTENTS**

<b>SL.NO</b>	<b>TITLE</b>
1	COMPLIANCE SHEET
2	SCHEDULE OF DEVIATIONS
3	SCHEDULE OF DECLARATIONS
4	SCHEDULE OF PRICES (As per enclosed format only)

	<b>TITLE:</b> <b>TECHNICAL SCHEDULES</b> <b>METAL EXPANSION BELLOWS</b> <b>2X660 MW SURATGARH STPP</b>		SPECIFICATION NO. PE-TS-392-100-M021
			VOLUME : III
			SECTION:
			REV. NO.: 00
	DATE: 24/06/2013		SHEET 1 OF 1

# INSTRUCTIONS REGARDING SCHEDULES AND COMPLIANCE SHEET TO BE FILLED BY BIDDER

1.0 Volume III comprises of following:-

1.1 Compliance Sheet : Filled by bidder

1.2 Schedules:

PART - A : Schedule of deviation & schedule of declaration

PART - B : Price Schedules

The Schedules and Compliance Sheets enclosed/indexed shall be completely filled up by the bidder and furnished with the bid duly signed and stamped by the bidder. Purchaser reserves the right to ask the bidder to fill 'additional schedules' which are not listed in the contents.

2.0 Schedule of deviation, schedule of declaration and compliance sheet shall be filled up by the bidder as per the instructions given below:

a) Duly filled Part - A schedules (Technical schedules) & compliance sheet shall be furnished with the technical bid, while Part - B Schedules (Price Schedules) shall be submitted with price bid in separate covers.

b) Un-priced copy of Part – B schedules shall also be furnished along with Part-A schedules in the technical bid.

	<b>TITLE:</b> <b>COMPLIANCE SHEET</b> <b>METAL EXPANSION BELLOWS</b> <b>2X660 MW SURATGARH STPP</b>	SPECIFICATION NO. PE-TS-392-100-M021	
		VOLUME : III	
		SECTION:	
		REV. NO.: 00	DATE: 24/06/2013
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The bidder shall sign and return a copy of this compliance sheet along with his offer, indicating his compliance to the points specified herein:

**A) Technical Details:** Bidder to tick (✓) whichever is applicable.

1	Specific Technical requirements of Vol. II B Section-C	<b>Accepted</b>	<b>Not Accepted</b>
2	Standard Technical Specification of Vol. II B Section-D	<b>Accepted</b>	<b>Not Accepted</b>
3	DATA SHEET-A of Vol. II B Section-D	<b>Accepted</b>	<b>Not Accepted</b>
4	Quality Plan	<b>Accepted</b>	<b>Not Accepted</b>
5	Documentation requirement as per Data sheet-C	<b>Accepted</b>	<b>Not Accepted</b>
6	As per technical specification if Type Tests are required to be carried out in line with technical specification/final approved QP/customer comments, vendors shall do so at their own cost. No extra charges on this account will be admissible to vendors.	<b>Accepted</b>	<b>Not Accepted</b>
7	Finite Element Analysis for bellows will be submitted in case of order (If applicable). If FEA is required to be done, vendors shall do so at their own cost. No extra charges on this account will be admissible to vendors.	<b>Accepted</b>	<b>Not Accepted</b>
8	All drawings and other documents will be modified in line with BHEL comments.	<b>Accepted</b>	<b>Not Accepted</b>
9	Bellows shall be provided with complete round flanges housing the tie rods/limit rods.	<b>Accepted</b>	<b>Not Accepted</b>
10	All bellows will be in single ply design.	<b>Accepted</b>	<b>Not Accepted</b>

B) Deviations to the technical specification are not acceptable. However, if there are any deviations due to unavoidable reasons then the same to be clearly specified in the schedule of deviation. In case of no deviations, schedule of deviations to be filled as NIL by bidder.

C) The offered materials should be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty.

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

	<b>TITLE:</b> <b>COMPLIANCE SHEET</b> <b>METAL EXPANSION BELLOWS</b> <b>2X660 MW SURATGARH STPP</b>	SPECIFICATION NO. PE-TS-392-100-M021		
		VOLUME : III		
		SECTION:		
		REV. NO.: 00	DATE: 24/06/2013	
		SHEET 2	OF	2

- D) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein. 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 , TUV or equivalent) for foreign bidders shall be included in the base price of the equipment by the bidder. This 3rd party inspection agency shall be approved by BHEL and will be decided in contract stage.
- E) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval.
- F) GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
- G) Bidder confirms that all drawings/documents in soft as well as hard copy shall be submitted within 2 weeks from placement of LOI's in the event of order. Within one (1) week of receipt of BHEL comments a technical representative of bidder shall come for meeting with BHEL along with revised documents to resolve all issues and incorporate all comments in the soft copy here for further submission to customer. Further on receipt of customer comments on the documents a technical representative from bidder shall come for meeting to resolve all issues and incorporate all comments in the soft copy at BHEL and resubmit the drawings/documents for approval and shall visit customer/customer's consultant if required for across the table approval of documents.
- H) Any special tools & tackles, if required, shall be in bidder's scope.
- I) Prices for recommended spares (if any) for three year operation shall be furnished separately and not to be included in the base price.
- J) Bidder confirms that offered model design is their proven model and they have designed, manufactured, supplied and tested the equipment of similar type and rating in at least two projects which are in satisfactory operation for last two years.

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL



**TITLE**  
**\* SCHEDULE OF DEVIATIONS**  
( ) From Technical Specifications (Volume –II B)


SPECIFICATION NO  
PE-TS-392-100-M021

VOL III 'PART-A'

SHEET ..... OF.....

We the undersigned hereby certify that the above mentioned are the only deviations.

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				COMPANY SEAL
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

	<b>TITLE</b>  <b>*SCHEDULE OF DECLARATIONS</b>	SPECIFICATION NO PE-TS-392-100-M021
		VOL III PART 'A'
		SHEET..... OF.....

\* Bidder shall include this schedule both in technical and Price offers

## DECLARATION

I .....certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated ..... and there is no deviation to the specification other than those listed in “Schedule of deviations” of this Vol III.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidder's Company Name .....

Authorised representative's Signature .....

Name .....

Bidder's Name

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL



	<b>TITLE:</b> <b>SCHEDULE OF UNIT PRICES*</b> <b>(METAL EXPANSION BELLOWS)</b>	SPECIFICATION NO. <b>PE-TS-392-100-M 021</b>	
		REV.00	DATE:24/06/2013
		VOLUME : III	PART 'B'
		SHEET 1 OF 1	

Bidder shall furnish unit prices (QUOTED) for each TAG NO. called for in this schedule below and shall furnish this schedule in price offer only.

**A) SUPPLY OF BELLOWS (2X660 MW SURATGARH STPP)**

S.NO.	** ITEM DESCRIPTION	UNIT PRICE (Rs.)			
		QTY PER UNIT	TOTAL QTY	UNIT EX-WORKS PRICE DULY PACKED (EACH TAG WISE)	TOTAL EX-WORKS PRICE DULY PACKED (EACH TAG WISE)
1.	GIMBAL BELLOWS TAG NOS. E1,E2, E4, E5 (1800 NB)	4	8		
2.	HINGED ANGULAR BELLOWS TAG NO. E3, E6 (1800 NB)	2	4		
3.	GIMBAL BELLOWS TAG NOS. E7,E8 (1200NB)	2	4		
4.	HINGED ANGULAR BELLOWS TAG NO. E9 (1200NB)	1	2		
5.	HINGED ANGULAR BELLOWS TAG NO. E10, E11, E12 (900NB)	3	6		
6.	HINGED ANGULAR BELLOWS TAG NO. E13, E14 (800NB)	2	4		
7.	UNTIED BELLOWS TAG NOS. E15, E16, E17 (550 NB)	3	6		
	<b>TOTAL</b>	17	34		

Points for vendors to consider:

- 1- If Type Tests are required to be carried out in line with technical specification/final approved QP/customer comments; vendors shall do so at their own cost. No extra charges on this account will be admissible to vendors.
- 2- If FEA are required to be done, Vendor will carry out the same at their own cost. No extra charges on this account will be admissible to vendors.

<b>BIDDER SHALL FURNISH THIS PRICE SCHEDULE IN HIS PRICE OFFER ONLY</b>				
PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				COMPANY SEAL
NAME	DESIGNATION	SIGNATURE	DATE	