2X660 MW UDANGUDI STPP STAGE-I

TECHNICAL SPECIFICATION
FOR
METAL EXPANSION BELLOWS

SPECIFICATION NO: PE-TS-435-100-M021 REV-00

BHARAT HEAVY ELECTRICALS LIMITED, POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA

C O N T E N T S

SECTION-I: SPECIFIC TECHNICAL REQUIREMENTS

1. GENERAL

1.1. The Metal Expansion Bellows shall meet the technical requirements and conform to the requirements of Section-I and Data Sheet of section II. However, in the event of contradictions between Section-I & Data sheet of Section-II, Data Sheet will prevail.

1.2. Vendor to manufacture bellows as per final BHEL approved GA drawings which will be prepared in accordance with reference drawings & DATA Sheet. Any ambiguity in constructional/dimensional detail must be communicated to BHEL. Such changes, if any, will be subjected to BHEL approval and will NOT have any cost implication on BHEL.

2. SCOPE OF SUPPLY

2.1 The bellows to be supplied shall be as per Data Sheet. For detail, refer the same.

2.2 Special Tools and tackles, if any.

3. CODES & STANDARDS

3.1 The design, manufacturing, 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 edition of Expansion Joint Manufacturers Association Standards (EJMA), ASME Section IX, ASME B 16.25, ASME Section VIII, ASTM E-165, ASME SEC-V and ASME- B31.1.

3.2 In case the specification differs with the requirement of Codes/Standards, the specification shall govern.

4. DESIGN REQUIREMENTS

4.1 The design calculations of bellows shall be as per latest edition of EJMA.

4.2 Dimensional tolerance for the expansion bellows should be as per latest edition of EJMA.

4.3 The expansion bellows shall be capable of withstanding design pressure and 50mm of Hg (abs).

4.4 FEA analysis shall be carried out for Tied, Hinged and Gimbal Bellows of all sizes. The FEA report shall be submitted for approval of GA drawings. However, if the FEA of same sized bellows with similar parameters have been carried out, then test reports of same can be submitted for the approval of GA drawings. But, these reports shall not be older than 10 (ten) years from the date of placement of purchase order.

4.5 The expansion bellows shall be designed for the deflections indicated in GA drawing. The spring rates of the bellow expansion joint shall be within +15% to -30% of the values specified in GA drawing.

4.6 Designed cycle life of the expansion bellows shall be minimum of 10,000 cycles.

4.7 Stress relieving or annealing/heat treatment after forming of bellows is not recommended.

4.8 No pre-tension of bellows is permitted.

5. MATERIAL

5.1 The material of construction of bellows shall be as indicated in Data sheet and GA drawings.

5.2 The materials of construction of the remaining parts shall be to suit service conditions. These materials shall be subject to approval of the BHEL.

5.3 Materials used in manufacturing of bellows shall be of tested quality.

6. CONSTRUCTIONAL FEATURES

6.1 METALLIC BELLOWS

a) 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, 304 grade stainless steel.

b) 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.

c) All bellow elements shall be pickled after forming.

d) Butt welded expansion joints shall have adequate length of pipe so that site welding does not impair or reduce the metallic expansion bellows efficiency.

e) Bidder to ensure that thinning due to forming shall be less than 15%.

6.2 SLEEVES & SHROUDS

a) Expansion joints will be furnished with 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 bellows only. The sleeves shall also be provided with a drain hole wherever necessary to avoid condensate accumulation.

b) Bellows shall have shrouds with an arrow indicating the direction of flow on the outside. These are the external steel covers provided to protect bellows from physical damages during shipping, installation and while in operation. The arrangement of shrouds shall be suitable for supporting insulation where necessary and shall be detachable. Shrouds shall not restrict the free deflection of bellows.

6.3 TIE BARS & LIMIT RODS

a) 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.

b) Tied lateral angular expansion joints shall be provided with two tie rods to take care of vacuum/pressure thrust. These tie rods shall have spherical washers with sufficient clearances in flange holes to accommodate lateral deflections of bellows. These bellows shall be capable of taking care of angulation in one plane.

c) Spherical washers/hinges should have a low coefficient of friction preferably with P.T.F.E. lining.

d) Bellows shall be provided with complete round flanges housing the tie rods/ limit rods.

6.4 HINGE & GIMBAL COMPONENTS

a) Hinged bellows shall be provided with hinge plates and hinge pin permitting the bellows for angular rotation about one plane while taking care of pressure thrust.

b) Gimbal bellows shall have a gimbal ring, which is square (as indicated in standard GA drawing) with hinge plates and pins allowing the bellows to angulate in both planes while taking care of pressure thrust.

7. QUALITY ASSURANCE, TESTING AND INSPECTION

7.1 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.

7.2 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 BHEL's customer comments (if any). Quality plans shall be approved by BHEL and/or the customer. All inspection and testing shall be carried out by BHEL/ BHEL representative and the customer (as applicable). In case, inspection is by both BHEL and the customer, then the inspection can be carried out jointly or separately, which will be informed accordingly. In case of the foreign bidder, inspection shall be carried out by reputed third party.

7.3 For foreign bidders, charges for third party inspection (Lloyds, TUV or equivalent) shall be included in the base price of the item by the bidder. This third party agency shall be approved by BHEL. Bidder to inform the same in the offer and mention the same in Quality Plan.

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

7.4 Bellows shall be subject to all test and inspection required by the applicable codes and standards as per quality plan and those specified below. The vendor shall fully shop assemble the expansion bellow and perform test to demonstrate that its performance is as specified:

a) All welds shall be dye-penetrant tested as per ASTM E-165/ASME SEC-V. Post cleaning of dye penetrant shall be taken care.

b) Material test certificates for both chemical and mechanical properties as per the relevant code shall be furnished.

c) The expansion bellow shall be assembled and hydro-statically tested with calibrated gauge at shop at 1.5 times the design pressure for a period of half-an hour.

d) The expansion bellow shall be subject to vacuum test with calibrated gauge at the shop at a pressure of 50 mmHg (abs) for a period of half-an hour.

e) All attachment welds and fillet welds in the bellow assembly shall be either magnetic particle tested or dye-penetrant tested or as per quality plan.

f) Axial spring rate test (stiffness test) for verifying actual spring rate with theoretical value with a tolerance of +15% to -30%.

g) Deflection test is to ensure that the bellow deflect for the designed movement in any direction when induced individually or simultaneously without any obstruction. Deflection test shall be carried out considering the effects of combined movement of axial, lateral and angular (equivalent axial movement per convolution shall be calculated as per EJMA).

h) Examination of radiography including radiographic techniques, radiographic examination of the longitudinal seam of the bellows should be performed before the bellow is convoluted. No lack of fusion is allowed. The test procedures shall be as per ASME SEC-V & acceptable norms as per ASME SEC VIII.

i) Test will be witnessed by the customer / consultants/ BHEL unless otherwise waived.

8. TYPE TESTS (CYCLE LIFE, SQUIRM AND YIELD RUPTURE TESTS)

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

Based on Diameter of Bellows: The categories are as follows:

a) Nominal diameter up to 800mm NB.
b) Nominal diameter greater than 800mm NB & up to 1600 NB.
c) Each size above 1600mm NB shall be a separate category.

8.2 If type tests have been successfully done for earlier BHEL projects for the bellows of the same type* in a group (as indicated in cl. 8.1 above), then test certificates of same will be reviewed and no type test needs to be carried out. But, these test certificates shall not be older than 5 (five) years from the date of bid opening of this project i.e. 15.12.2015. However, in this case, type test clearance shall be taken from BHEL prior to offering to routine test. In case no type test has been conducted for earlier projects or type test reports are older than 5 years, type test shall be carried out and type test procedure approval shall be taken from BHEL prior to offering to routine test.

Final decision regarding conductance of type test will be conveyed by BHEL at a later date after award of contract, which will be binding on the bidder without commercial implication.

Note: 1) Same *type* means bellows having same height, pitch, general shape of convolution profile, ply thickness and type of bellow materials.*

2) If Type Tests & FEA are required to be carried out in line with technical specification, then the charges for the same shall deemed to be included in the unit quoted prices of main item and shall not be indicate as a separate head in the price bid.

8.3 CRITERIA OF TEST

Type tests, as per EJMA, shall be carried out on two bellows of any size from each group of bellows (as per clause 8.1 above). One bellow shall be used for life cycle test and the other for Squirm & Yield rupture test. Accordingly, all the bellows of the group shall be qualified on the basis of this test.

8.4 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.

9. PAINTING REQUIREMENT:

Painting shall be as per below mentioned detail.

a) The paint shall conform to class -1 quality from any leading/reputed manufacturer like Asian paints (india) Ltd., Bombay paints, Berger paints India Ltd., Good lass Nerolac Paints Ltd., Graware Paints, Jenson & Nicholson, Shalimar Paints. In case the paint is from any other manufacturer, vendor to take prior approval from customer.

b) Painting procedure shall be as given below:

SERVICE	SURFACE CLEANING	PAINTING DETAIL	COLOUR SHADE
Condensate suction line	SP3, Power tool cleaning	**Primer**: One coat of DFT 75 microns (min.) of solvent based IZS-VS of 60%. Zn Dust-1.77kg/ltr minimum. Zn dust by weight-minimum 85%. Pot life 12 hrs/21 degree. Paint to meet compositional & performance specification for SSPC paint 20, Level 1. **Touch up:** one coat of DFT 75 Microns (min.) of two component Zinc rich primer meeting performance and compositional specifications of SSPC paint 20 level 2. **Mid coat:** 2 coats of high build high solid lamellar MIO based Epoxy Mid Coat of DFT 100 microns (min.) each. **Finish Coat**: 2 coats of polyamide cured Epoxy coating of DFT 25 microns (min.) each. **Total DFT 325 microns (min.)**	Sea green shade no. ISC -217
Flash Tank Vents			Aluminum
TD BFP Exhaust			

10. CLEANING

10.1 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.

10.2 Prior to inspection and shipment, the expansion bellows shall be cleaned from inside and outside to remove all manufacturing wastes, scrap, mill scale, rust, etc.

10.3 Each expansion bellows shall be prepared for shipment in such a manner that the quality, cleanliness and finish shall be maintained during shipment.

11. PROTECTION, PACKING & DESPATCH

11.1 Each expansion bellows shall be fitted with a 2 mm thick rectangular stainless steel name plate indicating the following:

a) Manufacturer's Name
b) Expansion Joint Size & Type
c) Tag No.
d) Assembly Weight.

All detail shall be engraved 1 mm deep and filled with black enamel paint

11.2 Bellows Tag Number shall be incorporated in all the dispatch documents.

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11.3 Exposed finished surface of metal expansion bellows shall be thoroughly greased before transportation and suitably protected in such a way so as to minimize the possibility of damage and deterioration during transit and storage.

11.4 The bellows has to be dispatched in total assembled form and shall be shipped at neutral length. They shall be provided with suitable erection and knock-off type temporary tie rods/ shipping brackets, wherever required,

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. These rods shall be provided in yellow colour.

11.5 Proper care shall be taken to avoid damage to the painted surface during transit and storage.

11.6 Expansion joints weighing more than 250kgs are to be provided with lifting lugs.

11.7 Bellows shall be packed in following manner:

a) First layer of hessian cloth.

b) Second layer of bubble sheet wrapping.

c) Third layer of stretch sheet wrapping.

d) Wrapped Bellows up to 1200 NB (inclusive) size shall be packed in wooden box suitable for handling and storage.

e) Wrapped Bellows above 1200 NB shall be placed in wooden box suitable for storage purpose. The box shall have clear marking that "The bellows to be handled separately from box."

f) The wooden boxes shall be suitable for storage at site in tropical climate conditions for a period of 15-18 months.

11.8 Vendor to provide soft copy of photos/snaps of duly packed ME Bellows. The soft copies to be provided by vendor to BHEL after final inspection of ME Bellows.

11.9 Clearance for dispatch of ME Bellows will be given only after verification of satisfactory packing conditions of ME Bellows from vendor's works.

12. DOCUMENTS TO BE SUBMITTED ALONG WITH OFFER

Bidder shall submit the following documents duly filled, signed and stamped along with the bid:

- Compliance sheet
- Documents as per the list indicated in the NIT

The above are the only documents which will be used for technical evaluation unless other documents are asked for during technical clarifications. Any other technical document enclosed with the bid shall be ignored for the purpose of technical evaluation. All other documents attached with the specification are for information of the bidder and no comments shall be marked on these.

13. DOCUMENTS TO BE SUBMITTED AFTER AWARD OF PROJECT.

Category-A (Primary Documents):

1. GA Drawing indicating all necessary dimensions (with tolerance as per EJMA), cross sectional arrangement, arrangement of tie rods or limit rods or hinge arrangement or gimbal arrangement as applicable, along with washers, nuts, pins, arrangement of sleeves and shroud, bill of material incorporating all material of construction (MOC) of various parts & relevant standard to which MOC confirms to and total weight, welding standards and welding details, flange details/butt weld end details, design deflections, stiffness rates for each bellow and painting detail.

2. Quality plan duly signed and stamped.

Submission and resubmission of the above documents shall be considered for delay analysis by BHEL.

Category-B (Secondary Documents):

1. Type Test reports in accordance with clause No. 8 of technical specification

Or

Type test procedures (if type test is not performed/ Valid type test report is not available).

2. Axial spring rate test procedure for ME bellows.
3. Project specific, routine test procedure (hydro, vacuum and deflection) for ME bellows.

Approval on these documents shall be obtained before final inspection.

14. EXCLUSIONS

Erection & commissioning at site are excluded from the bidder's scope.

SECTION-II

DATA SHEET

PART-1: BOQ FOR METAL EXPANSION BELLOWS

SL. NO.	ITEM DESCRIPTION			QTY PER UNIT	TOTAL QTY
	SIZE (NB)				
1	2000	GIMBAL BELLOWS	E1,E2,E4,E5,	4	8
2	2000	HINGED ANGULAR BELLOWS	E3,E6	2	4
3	1100	GIMBAL BELLOWS	E11	1	2
4	1100	HINGED ANGULAR BELLOWS	E7,E8,E9,E10	4	8
5	300	UNTIED BELLOWS	E12,E13,E14,E15	4	8
6	500	UNTIED BELLOWS	E16,E17,E18	3	6
TOTAL				18	36

NOTE: If Type Tests & FEA are required to be carried out in line with technical specification then the charges for the same shall deemed to be included in the unit quoted prices of main item. Bidder shall not indicate these charges as a separate head in the price bid.

PART-2: GENERAL CONSTRUCTIONAL DETAIL

CONSTRUCTIONAL DETAILS FOR METAL EXPANSION BELLOWS							
SL. NO.	**CONSTRUCTIONAL DETAIL**	**GIMBAL**	**HINGED**	**GIMBAL**	**HINGED**	**UNTIED**	**UNTIED**
	BELLOWS SIZE (NB)	**2000**	**2000**	**1100**	**1100**	**300**	**500**
1	PIPE SIZE (OD X THK)	2032X16	2032X16	1118X10	1118X10	323.9X9.53	508X9.53
2	ASSEMBLY TYPE	SINGLE	SINGLE	SINGLE	SINGLE	UNIVERSAL	UNIVERSAL
3	OVERALL LENGTH (MM)	1100	900	900	900	500	600
4	PLY THICKNESS (MM)	1.2	1.2	1.2	1.2	0.6	0.6
5	BELLOWS WIDTH (MM)	49	49	40	40	20	20
6	BELLOWS PITCH(MM)	33	33	40	40	20	20
7	CONVOLUTION	10	10	4	4	5+5	5+5
8	TANGENT THICKNESS (MM)	1.2	1.2	1.2	1.2	0.6	0.6
9	TANGENT LENGTH (MM)	20	20	20	20	20	20
10	COLLAR THICKNESS (MM)	2	2	1.2	1.2	1	1
11	COLLAR LENGTH (MM)	20	20	20	20	20	20
12	SPOOL/MID PIPE LENGTH (MM)	NA	NA	NA	NA	90	150
13	SLEEVE THICKNESS (MM)	10	10	6	6	1.5	1.5
14	ROUND FLANGE THICKNESS (MM)	60	60	30	30	16	20
15	SQUARE GIMBAL RING THICKNESS (MM)	60	NA	36	NA	NA	NA
16	SQUARE GIMBAL RING WIDTH (MM)	350	NA	200	NA	NA	NA
17	HINGE MAIN PLATE THICKNESS (MM)	NA	60	NA	36	NA	NA
18	HINGE SUPPORT PLATE THICKNESS (MM)	30	30	18	18	NA	NA
19	HINGE PIN/GIMBAL PIN DIA. (MM)	75	75	45	45	NA	NA
20	GUSSET PALTE THICKNESS (MM)	30	30	20	20	NA	NA
21	TIE ROD DIA. (MM)	NA	NA	NA	NA	25	30
22	TIE ROD LENGTH (MM)	NA	NA	NA	NA	490	600
23	THICKNESS OF END PIPE LOCAL TO FLANGE (MM)*	22	22	16	16	9.53	9.53

NOTE:

1. *Thickness of end pipe local to flange to be as specified. It is to be step machined equal to pipe thickness near the bellows convolution and edge prepared to suit matching pipe ID at other end.
2. Thickness of pressure parts indicated are minimum requirements and the same shall be as per Finite Element Analysis.

PART-3: MATERIAL OF CONSTRUCTION DETAIL

TABLE-1

SL. NO	PART NAME	MATERIALS FOR BELLOWS/PRESSURE PARTS/OTHER ATTACHMENTS
1	BELLOWS	ASTM 240 TP 304
2	INTERNAL SLEEVE	ASTM 240 TP 304
3	COLLAR	ASTM 240 TP 304
4	END PIPE/MID PIPE OR SPOOL PIPE	SA 672 GR.B 70/ SA 672 GR.C 70/ SA515 GR. 70/516 GR.70/SA106GR.B
5	HINGE PLATE SUPPORT FLANGE/HOUSING FLANGE/RING	IS 2062 GR.B/ SA515 GR. 70/516 GR.70
6	HINGE PIN / GIMBAL PIN	CARBON STEEL CL.8.8
7	GIMBAL PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B
8	HINGE MAIN PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B
9	HINGE SUPPORT PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B
10	GUSSET PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B
11	TIE ROD/LIMIT ROD WITH NUT & LOCKNUT	CARBON STEEL (CL. 6.8 & 6.0)
12	SPHERICAL WASHER	SA515Gr.60/ SA515Gr.70 /SA516Gr.60/SA516Gr.70
13	EXTERNAL SLEEVE/COVER/SHROUD & SHROUD SUPPORT	IS 2062 Gr. A/B
14	CIRCLIPS/WASHER	MILD STEEL
15	BOLT & NUT	IS1367 CL6.8/6.0
16	ANY OTHER COMPONENT	SPECIFIED BY BIDDER AND SHALL BE SUITABLE FOR INTENDED DUTY

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-435-100-M021 REV-00	DATE: 27.05.2022
	CUSTOMER : M/S TANGEDCO		QP NO.: PE-QP-435-100-M021 REV-00	DATE: 27.05.2022
	PROJECT: 2X660 MW UDANGUDI STPP ST-I		PO NO.:	DATE:
	ITEM: ME BELLOWS	SYSTEM: POWER PIPING	SECTION: II	SHEET 1 OF 6

Sl No.	COMPONENT & OPERATIONS	CHARACTERISTICS	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	D	M	C	N	
					M	C/ N					**			
1.0	**RAW MATERIAL**													
1.1	MATERIAL FOR BELLOWS AND ASSEMBLY PARTS (SHEET/ PIPE / PLATES/ ROD / BAR)	CHEMICAL COMPOSITION	MA	CHEMICAL ANALYSIS	ONE PER BATCH/LOT/HEAT		APPROVED DRAWING		MTC (or) CHECK TEST CERTIFICATE	√	P	V	-	CORELATED TC W.R.T HEAT/BATCH/LOT TO BE REVIEWED BY BHEL QC. REFER NOTE NO:3
		MECHANICAL PROPERTIES		UTS, YS & PERCENTAGE OF ELONGATION	ONE PER BATCH/LOT/HEAT					√	P	V	-	
		DIMENSIONAL CHECK		MEASUREMENT	100 %	100 %			INTERNAL INSPECTION REPORTS	-	P	V	-	
		SURFACE EXAMINATION	MI	VISUAL	100 %	100 %				-	P	V	-	
2.0	**WELDING**													
2.1	1) WELDING PROCEDURE	CORRECTNESS OF PROCEDURE	CR	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	100%					√	P	V	-	
	3) WELDER PERFORMANCE QUALIFICATION	WELDERS' PERFORMANCE		DESTRUCTIVE TESTS / NON DESTRUCTIVE TEST OF A TEST COUPON	100%		IS 7310 / ASME SEC IX	IS 7310 / ASME SEC IX	IS 7310 / ASME SEC IX	√	P	W / V	-	REFER NOTE NO: 4

BHEL						BIDDER/VENDOR	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	GAURAV DIXIT	Gaurav Dixit	Checked by:	Ashish Panigrahi	Ashish Panigrahi		
Reviewed by:	sweta singhal	Sweta Singhal	Reviewed by:	HARISH KUMAR	Harish Kumar		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-435-100-M021 REV-00	DATE: 27.05.2022
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	PROJECT: 2X660 MW UDANGUDI STPP ST-I		PO NO.:	DATE:
	ITEM: ME BELLOWS	SYSTEM: POWER PIPING	SECTION: II	SHEET 2 OF 6

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	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	N	
2.2	**BUTT / GROOVE WELDS**													
	1) BELLOWS AND PLATE FORMED PIPES	FITUP,SIZE OF WELD	MA	VISUAL AND MEASUREMENT	100 %	-	APPD DRG / ASME SEC VIII – DIVISION 1	ASME SEC VIII – DIVISION 1	INTERNAL INSPECTION REPORTS	-	P	-	-	
		SOUNDNESS OF WELD	CR	PT FOR BELLOWS LONG SEAM BEFORE FORMING	100 %		ASTM E 165	NO SURFACE DEFECT	INTERNAL INSPECTION REPORTS	-	P	V	-	
				RT FOR BELLOWS LONG SEAM BEFORE FORMING	100 %		ASME SEC V / APPD. DRG	ASME SEC VIII – DIVISION 1	RT REPORT	√	P	V	-	REVIEW OF FILM BY BHEL DURING INSPECTION FOR SL. NO. 3.1
				RT FOR PIPE LONG SEAM					RT REPORT	√	P	V	-	
	2) SEGMENTAL FLANGES	SURFACE DEFECTS OF WELDMENTS	MA	PT	100 %	100 %	ASTM E 165	NO SURFACE DEFECT	INTERNAL INSPECTION REPORTS	√	P	V	-	
		INTERNAL DEFECTS OF WELDMENTS i) FOR THICKNESS 40 MM & BELOW	MA	RT	100 %		ASME SEC V	ASME SEC VIII – DIVISION 1	RT REPORT	√	P	V	-	REVIEW OF FILM BY BHEL DURING INSPECTION FOR SL. NO. 3.1
		ii)FOR THICKNESS ABOVE 40 MM		UT			ASTM A388 &A435	ASTM A388 &A435	UT REPORT	√	P	V	-	
2.3	FILLET WELDS	SOUNDNESS OF WELDMENTS	MA	PT	100 %		ASME SEC V	ASME SEC VIII – DIVISION 1	INTERNAL INSPECTION REPORTS	√	P	V	-	

BHEL						BIDDER/VENDOR	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	GAURAV DIXIT	Gaurav Dixit	Checked by:	Ashish Panigrahi	Ashish Panigrahi		
Reviewed by:	sweta singhal	Sweta Singhal	Reviewed by:	HARISH KUMAR	Harish Kumar		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-435-100-M021 REV-00	DATE: 27.05.2022
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	ITEM: ME BELLOWS	SYSTEM: POWER PIPING	SECTION: II	SHEET 3 OF 6

SL NO	COMPONENT & OPERATIONS	CHARACTERISTICS	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	D*	**			
					M C / N					M	C	N	
3.0	**INSPECTION & TESTS**												
3.1	BELLOWS CONVOLUTIONS	WORKMANSHIP	MA	VISUAL	100 %	APPD. DRG		INTERNAL INSPECTION REPORTS	√	P	W	-	
		DIMENSIONS		MEASUREMENT					√	P	W	-	
		SURFACE DEFECTS (INSIDE & OUTSIDE OF LONG SEAM)		PT		ASTM E 165	NO SURFACE DEFECT		√	P	W	-	
		THINNING		MOCK UP PIECE (or) UT	ONE / TYPE	EJMA	NOT TO EXCEED 15% OF ACTUAL RAW MATERIAL THICKNESS	INTERNAL INSPECTION REPORTS	√	P	W	-	REFER NOTE-6
3.2	FLANGE, SHROUD, SLEEVE,TIE ROD,WASHER & NUTS	WORKMANSHIP & DIMENSIONS	MA	VISUAL & MEASUREMENT	100 %	APPD. DRG		INTERNAL INSPECTION REPORTS	-	P	V	-	
3.3	SEGMENTAL FLANGE	STRESS RELIEVEVING	MA	REVIEW OF HT CHART	100 %	ASME SEC VIII		SR CHART	√	P	V	-	
3.4	ROUTINE TESTS	1) LEAK TIGHTNESS	CR	1) VACUUM TEST	100 %	1) 50 mm Hg (A)	NO LEAKAGE OR PERMANENT DEFORMATION	TEST REPORTS	√	P	W	-	
				2)HYDROSTATIC PR. TEST		1) APPD. DRG / 1.5 TIMES OF DESIGN PRESSURE			√	P	W	-	
		2) DEFLECTION	CR	DEFLECTION TESTS (EQUIVALENT AXIAL)	100 %	EJMA / APPD. DRG/ APPD. TEST PROCEDURE	EJMA / APPD. DRG/ APPD. TEST PROCEDURE	TEST REPORTS	√	P	W	-	

BHEL						BIDDER/VENDOR	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	GAURAV DIXIT	Gaurav Dixit	Checked by:	Ashish Panigrahi	Ashish Panigrahi		
Reviewed by:	sweta singhal	Sweta Singhal	Reviewed by:	HARISH KUMAR	Harish Kumar		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-435-100-M021 REV-00	DATE: 27.05.2022
	CUSTOMER : M/S TANGEDCO		QP NO.: PE-QP-435-100-M021 REV-00	DATE: 27.05.2022
	PROJECT: 2X660 MW UDANGUDI STPP ST-I		PO NO.:	DATE:
	ITEM: ME BELLOWS	SYSTEM: POWER PIPING	SECTION: II	SHEET 4 OF 6

SL NO	COMPONENT & OPERATIONS	CHARACTERISTICS	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	D*	**			
					M	C / N					M	C	N	
	ROUTINE TESTS	3) SPRING RATE (ONLY AXIAL)	CR	STIFFNESS TEST	ONE/ EACH SIZE AND SPRING RATE OF BELLOW		EJMA / APPD GA DRAWING/ APPROVED TEST PROCEDURE	EJMA / APPD GA DRAWING/ APPROVED TEST PROCEDURE	SPRING RATE CURVES REPORT	√	P	W	-	BELLOWS UNDER NORMAL CONDITION DEFLECTED TO THE VALUE AS SPECIFIED IN. APPD. DRAWING/ APPROVED TEST PROCEDURE
		4) CLEANLINESS	MA	VISUAL	100 %	100 %	APPD. DRG	APPD. DRG	INTERNAL INSPECTION REPORTS	√	P	V	-	
		5)WORKMANSHIP		VISUAL						√	P	V	-	
		6) MARKING		VISUAL						√	P	V	-	
3.5	TYPE TEST	CYCLE LIFE (10000 CYCLES), SQUIRM TEST, YIELD & RUPTURE	CR	DESTRUCTIVE TEST	REFER NOTE NO:1		BHEL/CUSTOMER APPD. TEST PROCEDURES / APPD. GA DRGS	BHEL/CUSTOMER APPD. TEST PROCEDURES / APPD. GA DRGS	TEST REPORTS	√	P	W	-	REFER NOTE NO: 2, 5 & 6
3.6	ASSEMBLY	WORKMANSHIP & DIMENSIONS	MA	VISUAL & MEASUREMENT	100 %	100 %	APPD. DRGS	APPD. DRGS	INTERNAL INSPECTION REPORTS	√	P	W	-	
4.0	PAINTING	SURFACE PREPARATION, PAINT THICKNESS & COLOUR OF PAINT		VISUAL & MEASUREMENT	100%	100%	APPD. DRG	APPD. DRG	INTERNAL INSPECTION REPORTS	√	P	V	-	PHOTOGRAPHS OF BELLOWS AFTER PACKING TO BE SEND TO BHEL-PURCHASE GROUP (PG) FOR VETTING BY BHEL-ENGINEERING BEFORE ISSUING MDCC
5.0	PACKING	SOUNDNESS OF PACKING		VISUAL	100 %	100 %	AS PER NOTE-9	AS PER NOTE-9	INTERNAL INSPECTION REPORTS	√	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	GAURAV DIXIT	Gaurav Dixit	Checked by:	Ashish Panigrahi	Ashish Panigrahi
Reviewed by:	sweta singhal	Sweta Singhal	Reviewed by:	HARISH KUMAR	Harish Kumar

BIDDER/VENDOR	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

NOTES: -

1. In case of foreign supplier, all test certificates shall be furnished by the supplier, duly witnessed/verified by supplier's TPI.

2. a) Life cycle test shall be carried out on one bellow of each group as mentioned in the technical 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 below.

   Based on Diameter of Bellows: The categories are as follows:

   a) Nominal diameter up to 800mm NB.
   b) Nominal diameter greater than 800mm NB up to 1600 NB.
   c) Each size above 1600mm NB shall be a separate category.

3. For, clause 1.1, in case co related test certificates are not available, check testing shall be carried out by vendor at approved lab (NABL).

4. Welding to be done only by qualified welders. For qualified welders, WPS & PQR shall be reviewed by BHEL.

5. If type tests as mentioned at cl.3.5 and note2 above, have been successfully done for earlier BHEL projects for the bellows of the same type (refer note-6) in a group (as indicated above), then only TCs of same shall be reviewed and no type test needs to be carried out. But TC's of the bellows shall not be older than 5 years from the date of bid opening of this project i.e. 15.12.2015. However, type test clearance shall be taken from BHEL/Customer prior to offering to routine test. In case the type test is to be done, type test procedure approval shall be taken from BHEL/Customer.

6. Bellows of the same type would mean those having the same height, pitch, general shape of convolution profile, ply thickness and type of bellow materials.

7. All materials of construction shall be as per approved GA drawing.

8. Manufacturing tolerances for fabricated assemblies containing expansion joints shall be as per EJMA/Approved GA drawing.

BHEL						BIDDER/VENDOR		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	GAURAV DIXIT	Gaurav Dixit	Checked by:	Ashish Panigrahi	Ashish Panigrahi			Reviewed by:			
Reviewed by:	sweta singhal	Sweta Singhal	Reviewed by:	HARISH KUMAR	Harish Kumar			Approved by:			

9. Packing: Bellows shall be packed in following manner:

a) First layer of hessian cloth, second layer of bubble sheet wrapping and third layer of stretch sheet wrapping.
b) Wrapped Bellows shall be placed in wooden box suitable handling. Wrapped Bellows up to 1200 NB (inclusive) size shall be packed in wooden box suitable for handling and storage. Wrapped Bellows above 1200 NB shall be placed in wooden box suitable for storage purpose. The box shall have clear marking that “The bellows to be handled separately from box.”
c) The wooden boxes shall be suitable for storage at site in tropical climate conditions for a period of 15-18 months.
d) Photographs of the wooden box (with LR No.) in which items are finally packed is to submitted to BHEL before dispatch. Clearance for dispatch of items will be given only after receipt of above photos.

10. BHEL reserves the right for conducting repeat tests, if required.
11. The latest revision/year of issue of all the standard indicated in the Quality plan shall be referred.
12. Instruments used for test shall have valid calibration certification with traceability to National level (NABL)
13. Statutory requirements will be complied.

LEGENDS:

*: Records, identified with "Tick"(√) shall be essentially included by supplier in QA Documentation.

** **M**: Supplier/ Manufacturer/ Sub-Supplier
P: Perform
MA: Major Characteristic
MTC: Mill Test Certificate
RT: Radiography Test
C: Main Supplier/BHEL/ Third Party Inspection agency
W: Witness
MI: Minor Characteristic
PT: Penetrant Test
D: Documentation
N: Customer
V: Verification
CR: Critical Characteristic
UT: Ultrasonic Test

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	GAURAV DIXIT	Gaurav Dixit	Checked by:	Ashish Panigrahi	Ashish Panigrahi
Reviewed by:	sweta singhal	Sweta Singhal	Reviewed by:	HARISH KUMAR	Harish Kumar

BIDDER/VENDOR	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

COMPLIANCE SHEET

I hereby comply/not comply (*) to all the requirements of this technical specification in totality.

*** In case the bidder does not comply to the technical specification, the deviations shall be explicitly listed in the technical deviation sheet of GCC. Deviations listed in technical deviation sheet shall only be considered.**

Name of Bidder / Authorized Representative: - _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Designation: - _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Signature: - _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

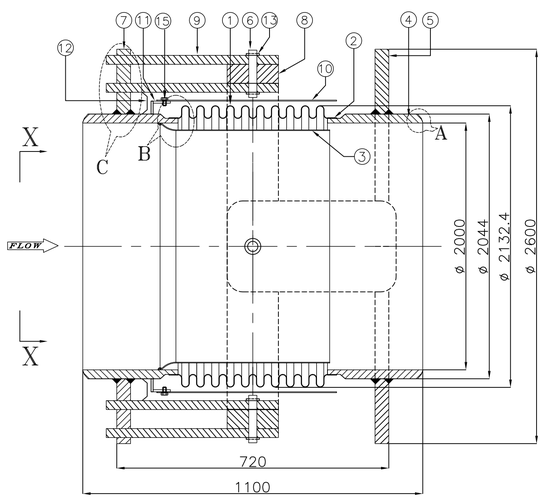
Company Seal: - _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

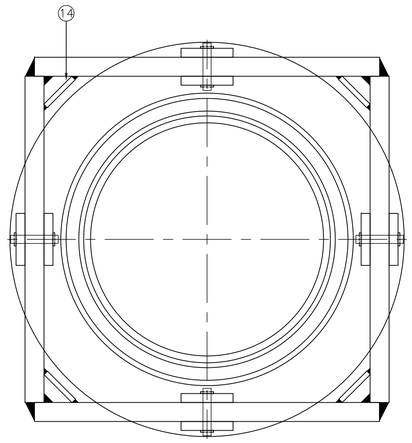
Date: - _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

ANNEXURE-1
GA DRAWINGS OF ME BELLOWS

DRAWING NO. PE-DG-435-100-M171

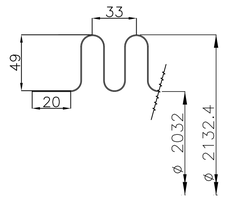
FIRST ANGLE PROJECTION | ALL DIMENSIONS ARE IN MM





VIEW X–X

BELLOW : 1.2 THK x 1PLY
No. OF CONV. : 10
DEPTH OF CONV. : 49
PITCH OF CONV. : 33



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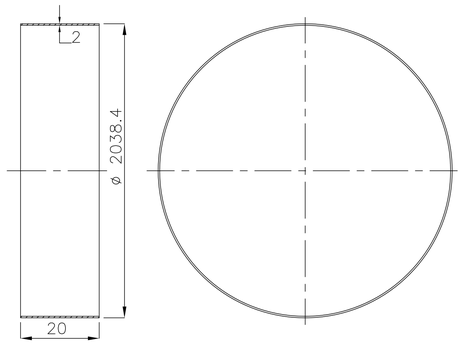

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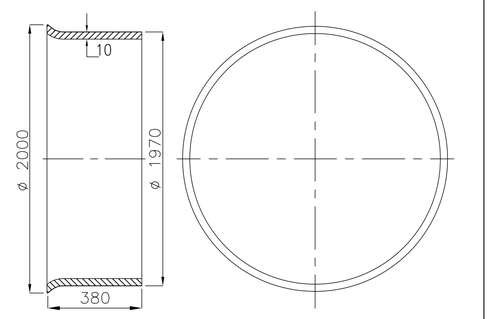

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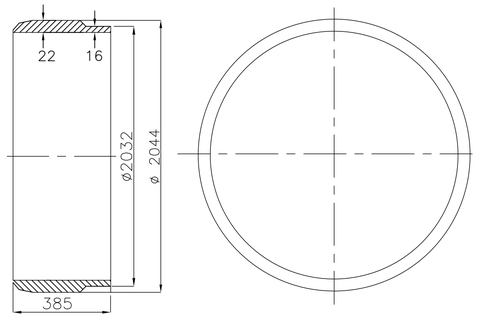
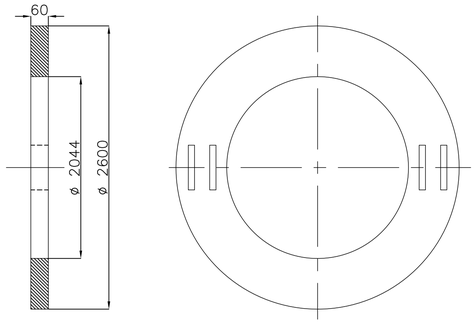


DETAIL OF SL.NO.4



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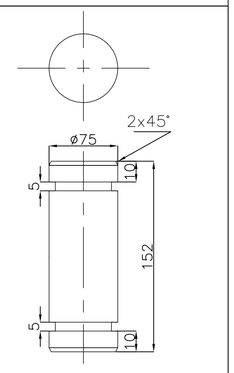

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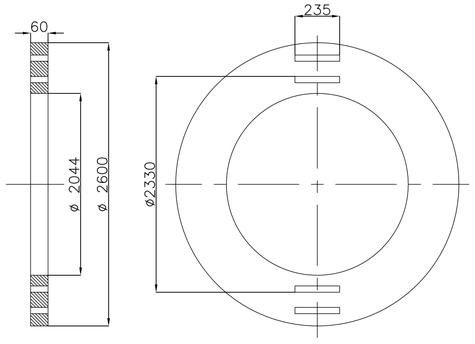

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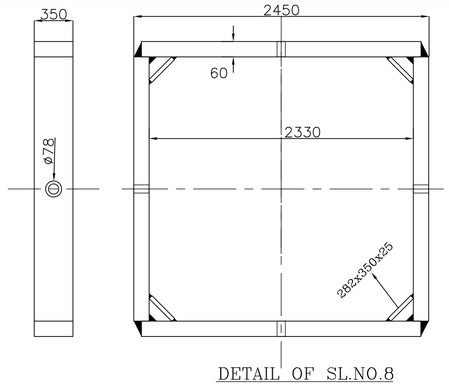

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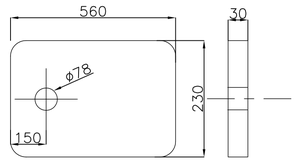

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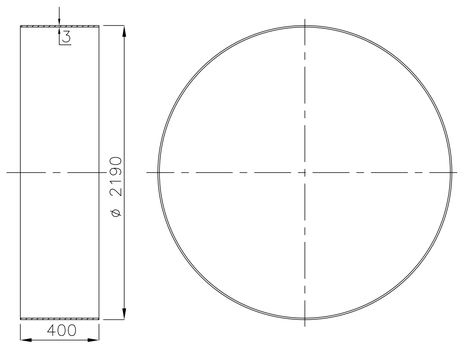

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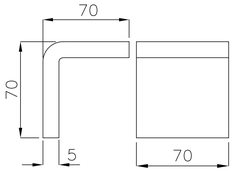

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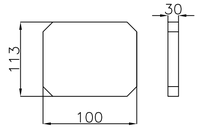

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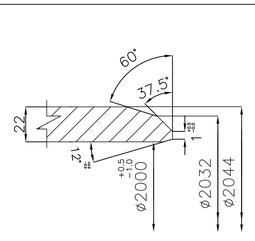
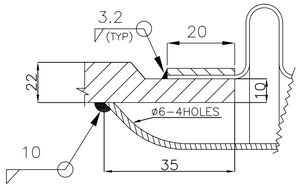
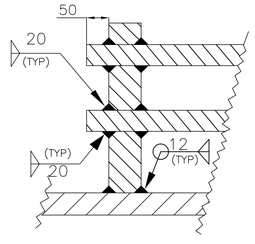


DETAIL–A



DETAIL–B



DETAIL–C

BELLOW DETAILS

SL NO		DESCRIPTION	UNITS	DATA/ PARTICULARS.
1	GENERAL	TAG No.	-	E1, E2, E4 & E5
2		QUANTITIES PER UNIT	Nos.	04
3		TOTAL QUANTITY	Nos.	08
4		LOCATION	-	BFPT-A & B EXHAUST TO CONDENSER
5		FLUID	-	STEAM
6		INSTALLATION	-	HORIZONTAL
7	DESIGN & OPERATING DATA	PIPE SIZE(ODxTHK)	mm	2032x16
8		OPERATING PRESSURE	Kg/cm²(A)	0.1
9		DESIGN PRESSURE	Kg/cm²(G)	1.1
10		HYDRO TEST PRESSURE (FOR 30 Min.)	Kg/cm²(G)	1.65
11		VACUUM TEST PRESSURE(FOR 30 Min.)	mm-Hg	50mm of Hg (ABS)
12		OPERATING TEMPERATURE	°C	45.82
13		DESIGN TEMPERATURE	°C	120
14		BELLOW CYCLE LIFE	Nos.	255676
15		ANGULAR DEFLECTION (DESIGN)	DEGREE	3
16		AXIAL SPRING RATE	Kg/mm	65.4
17		ANGULAR SPRING RATE	Kg-M/Deg.	618.81
18		TOTAL EQUIVALENT MOVEMENT	mm	56.874
19		OVERALL LENGTH	mm	1100
20		BELLOW CONVOLUTED LENGTH	mm	330
21		LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (Psc)	Kg/cm²	15.32
22		LIMITING INTERNAL DESIGN PRESSURE BASED ON INPLANE INSTABILITY (Psi)	Kg/cm²	3.82
23		TOTAL STRESS (St)	Kg/cm²	7154.1

BILL OF MATERIAL PER BELLOW

SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	1No
2	COLLAR	SA240TP304	2 Nos.
3	SLEEVE	SA240TP304	1 No.
4	END PIPE	SA672B70/SA672C70/SA515Gr.70 /SA516Gr.70	2 Nos.
5	HINGE SUPPORT FLANGE #1	IS 2062 Gr. B/SA 515 / 516 Gr.70	1 No.
6	HINGE PIN	CARBON STEEL CLASS 8.8	4 Nos.
7	HINGE SUPPORT FLANGE #2	IS 2062 Gr. B/SA 515 / 516 Gr.70	1 No.
8	SQ GIMBAL RING	IS 2062 Gr. B/SA 515 / 516 Gr.70	1 Nos.
9	HINGE SUPPORT PLATE	IS 2062 Gr. B/SA 515 / 516 Gr.70	8 Nos.
10	SHROUD (COVER)	IS 2062 Gr. A/B	1 No.
11	SHROUD (COVER) SUPPORTS	IS 2062 Gr. A/B	4 Nos.
12	GUSSET	IS 2062 Gr. B/SA 515 / 516 Gr.70	8 Nos.
13	CIRCLIP 2mm THK. (DETAIL NOT SHOWN)	MS	8 Nos.
14	STIFFNER	IS 2062 Gr. B/SA 515 / 516 Gr.70	4 Nos.
15	BOLT & NUT-M8	IS 1367 CL6.8/6.0	AR

NOTES:–

1. BELLOW DESIGN CODE : EJMA LATEST EDITION.
2. WELDING CODE/STD : ASME SEC IX.
3. BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
4. INSPECTION & TESTING : AS PER APPROVED QP.
5. SURFACE PREPARATION: SP3, POWER TOOL CLEANING.
6. PAINTING DETAILS :
   i) Primer: One coat of DFT 75 microns (min.) of solvent based IZS–VS of 60%. Zn Dust– 1.77kg/ltr minimum. Zn dust by weight–minimum 85%. Pot life 12 hrs/21 degree. Paint to meet compositional & performance specification for SSPC paint 20, Level 1.
   ii) Touch up: one coat of DFT 75 Microns (min.) of two component Zinc rich primer meeting performance and compositional specifications of SSPC paint 20 level 2.
   ii) Mid coat: 2 coats of high build high solid lamellar MIO based Epoxy Mid Coat of DFT 100 microns (min.) each.
   iv) Finish Coat: 2 coats of polyamide cured Epoxy coating of DFT 25 microns (min.) each. Total DFT 325 microns (min.)
   v) Colour shade: Aluminium.
7. SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE REMOVED AFTER INSTALLATION.
8. STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
9. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
10. EXPANSION JOINTS WEIGHING MORE THAN 250KGS ARE TO BE PROVIDED WITH LIFTING LUGS.
11. DRAWING IS NOT TO SCALE.
12. THICKNESS OF PRESSURE PARTS INDICATED ARE MINIMUM REQUIREMENTS AND THE SAME SHALL BE AS PER FINITE ELEMENT ANALYSIS.

ELECTRONIC FILE NAME: 435_100_M171_00

CUSTOMER	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED, TANGEDCO HEAD QUARTERS, 1ST FLOOR, NEW EB QTRS., 144,ANNASALAI, CHENNAI 600002.
CONSULTANT NAME	TATA CONSULTING ENGINEERS LIMITED BENGALURU
PROJECT NAME	2 X 660 MW UDANGUDI STPP STAGE – I
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

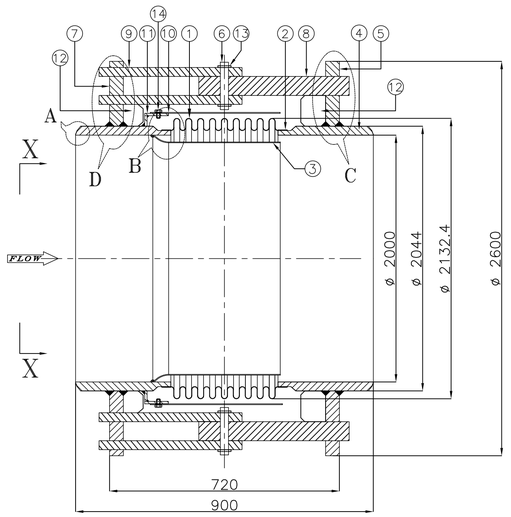
JOB NO. 435
STATUS CONTRACT
DISTRIBUTION

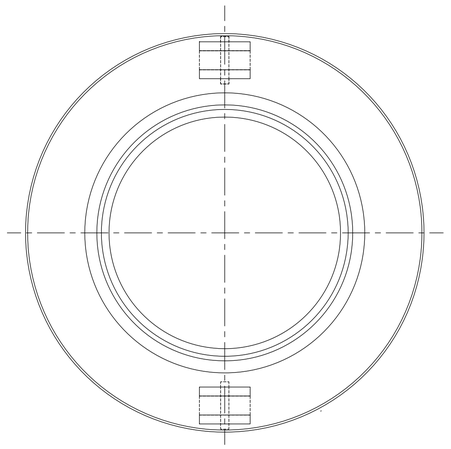
REV.	DATE	ALTD	CHD	APPD

DEPT CODE		NAME	SIGN	DATE
M	DRN	GD		27.05.22
	DESN	GD		27.05.22
	CHD	SM		27.05.22
	APPD	SK		27.05.22

TITLE: GA OF GIMBAL BELLOW– SIZE 2000NB

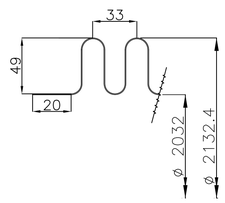
DEPT. | SCALE | SIGN | DRAWING NO. PE–DG–435–100–M171 | SHEET 01 OF 06 | REV. 00 | SIZE-A0





VIEW X–X

BELLOW : 1.2 THK x 1PLY
No. OF CONV. : 10
DEPTH OF CONV. : 49
PITCH OF CONV. : 33



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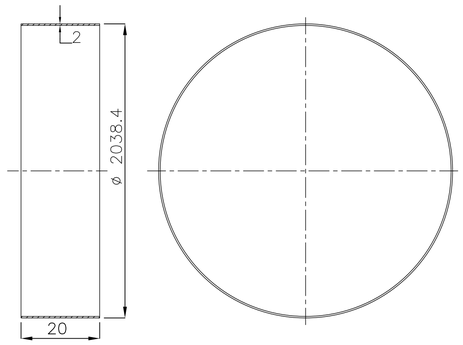

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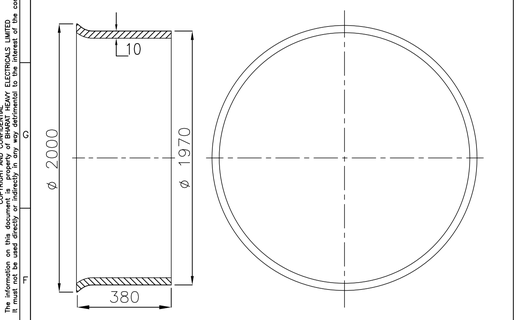

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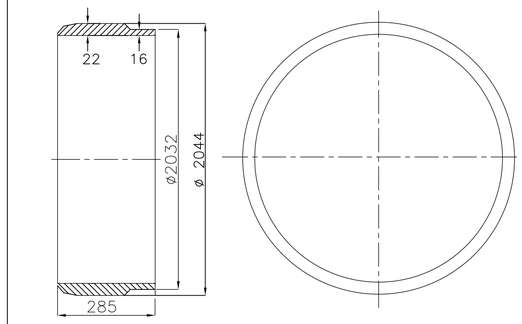

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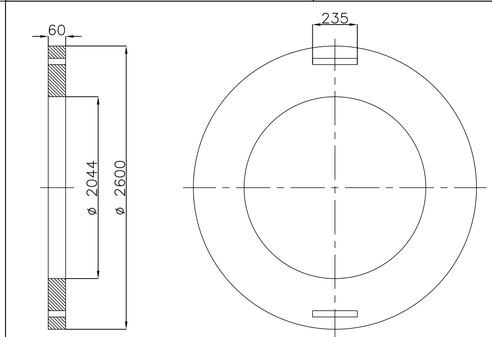
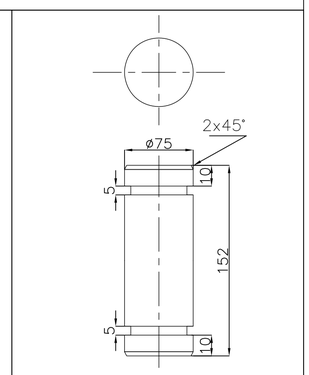
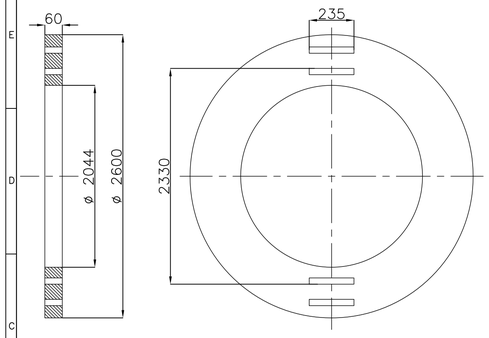


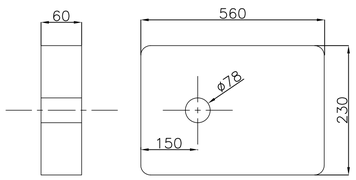
DETAIL OF SL.NO.5



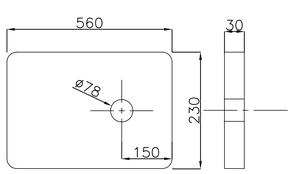
DETAIL OF SL.NO.6



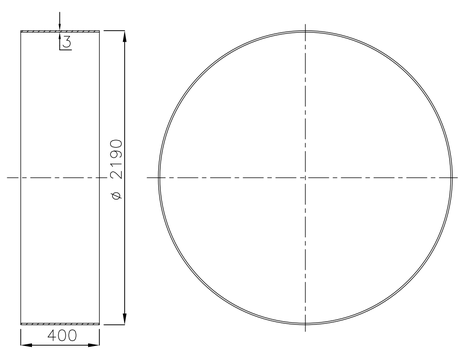
DETAIL OF SL.NO.7



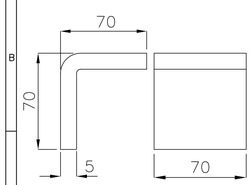
DETAIL OF SL.NO.8



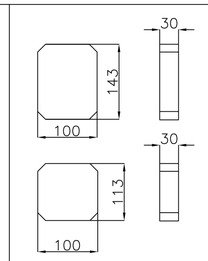
DETAIL OF SL.NO.9



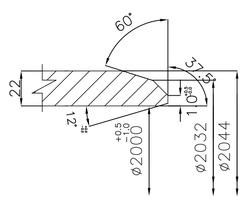
DETAIL OF SL.NO.10



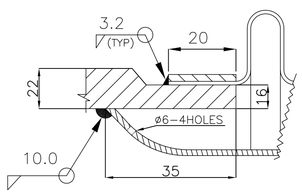
DETAIL OF SL.NO.11



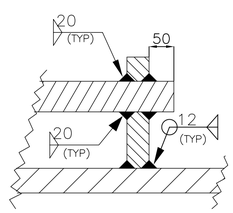
DETAIL OF SL.NO.12



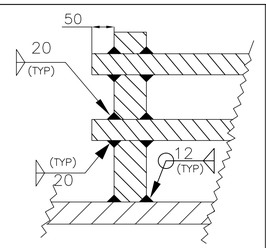
DETAIL–A



DETAIL–B



DETAIL–C



DETAIL–D

BELLOW DETAILS

SL NO		DESCRIPTION	UNITS	DATA/ PARTICULARS.
1	GENERAL	TAG No.	-	E3 & E6
2		QUANTITIES PER UNIT	Nos.	02
3		TOTAL QUANTITY	Nos.	04
4		LOCATION	-	BFPT-A & B EXHAUST TO CONDENSER
5		FLUID	-	STEAM
6		INSTALLATION	-	HORIZONTAL
7	DESIGN & OPERATING DATA	PIPE SIZE(ODxTHK)	mm	2032x16
8		OPERATING PRESSURE	Kg/cm²(A)	0.1
9		DESIGN PRESSURE	Kg/cm²(G)	1.1
10		HYDRO TEST PRESSURE (FOR 30 Min.)	Kg/cm²(G)	1.65
11		VACUUM TEST PRESSURE(FOR 30 Min.)	mm-Hg	50mm of Hg (ABS)
12		OPERATING TEMPERATURE	°C	45.82
13		DESIGN TEMPERATURE	°C	120
14		BELLOW CYCLE LIFE	Nos.	255676
15		ANGULAR DEFLECTION (DESIGN)	DEGREE	3
16		AXIAL SPRING RATE	Kg/mm	65.44
17		ANGULAR SPRING RATE	Kg-M/Deg.	618.81
18		TOTAL EQUIVALENT MOVEMENT	mm	56.87
19		OVERALL LENGTH	mm	900
20		BELLOW CONVOLUTED LENGTH	mm	330
21		LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (Psc)	Kg/cm²	15.32
22		LIMITING INTERNAL DESIGN PRESSURE BASED ON INPLANE INSTABILITY (Psi)	Kg/cm²	3.82
23		TOTAL STRESS (St)	Kg/cm²	7154.1

BILL OF MATERIAL PER BELLOW

SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	1No
2	COLLAR	SA240TP304	2 Nos.
3	SLEEVE	SA240TP304	1 No.
4	END PIPE	SA672B70/SA672C70/SA515 Gr.70/SA516Gr.70	2 Nos.
5	HINGE SUPPORT FLANGE #1	IS 2062 Gr. B/SA 515 / 516 Gr.70	1 No.
6	HINGE PIN	CARBON STEEL CLASS 8.8	2 Nos.
7	HINGE SUPPORT FLANGE #2	IS 2062 Gr. B/SA 515 / 516 Gr.70	1 No.
8	HINGE MAIN PLATE	IS 2062 Gr. B/SA 515 / 516 Gr.70	2 Nos.
9	HINGE SUPPORT PLATE	IS 2062 Gr. B/SA 515 / 516 Gr.70	4 Nos.
10	SHROUD (COVER)	IS 2062 Gr. B	1 No.
11	SHROUD (COVER) SUPPORTS	IS 2062 Gr. B	4 Nos.
12	GUSSET	IS 2062 Gr. B/SA 515 / 516 Gr.70	4+4 Nos.
13	CIRCLIP 2mm THK. (DETAIL NOT SHOWN)	MS	4 Nos.
14	BOLT & NUT-M8	IS 1367 CL6.8/6.0	AR

NOTES:–

1. BELLOW DESIGN CODE : EJMA LATEST EDITION.
2. WELDING CODE/STD : ASME SEC IX.
3. BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
4. INSPECTION & TESTING : AS PER APPROVED QP.
5. SURFACE PREPARATION: SP3, POWER TOOL CLEANING.
6. PAINTING DETAILS :
   i) Primer: One coat of DFT 75 microns (min.) of solvent based IZS–VS of 60%. Zn Dust– 1.77kg/ltr minimum. Zn dust by weight–minimum 85%. Pot life 12 hrs/21 degree. Paint to meet compositional & performance specification for SSPC paint 20, Level 1.
   ii) Touch up: one coat of DFT 75 Microns (min.) of two component Zinc rich primer meeting performance and compositional specifications of SSPC paint 20 level 2.
   ii) Mid coat: 2 coats of high build high solid lamellar MIO based Epoxy Mid Coat of DFT 100 microns (min.) each.
   iv) Finish Coat: 2 coats of polyamide cured Epoxy coating of DFT 25 microns (min.) each. Total DFT 325 microns (min.)
   v) Colour shade: Aluminium.
7. SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE REMOVED AFTER INSTALLATION.
8. STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
9. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
10. EXPANSION JOINTS WEIGHING MORE THAN 250KGS ARE TO BE PROVIDED WITH LIFTING LUGS.
11. DRAWING IS NOT TO SCALE.
12. THICKNESS OF PRESSURE PARTS INDICATED ARE MINIMUM REQUIREMENTS AND THE SAME SHALL BE AS PER FINITE ELEMENT ANALYSIS.

CUSTOMER: TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED, TANGEDCO HEAD QUARTERS, 1ST FLOOR, NEW EB QTRS., 144,ANNASALAI, CHENNAI 600002.

CONSULTANT NAME: TATA CONSULTING ENGINEERS LIMITED, BENGALURU

PROJECT NAME: 2 X 660 MW UDANGUDI STPP STAGE – I

JOB NO. 435
STATUS CONTRACT
DISTRIBUTION

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

REV.	DATE	ALTD	CHD	APPD

DEPT CODE		NAME	SIGN	DATE
M	DRN	GD		27.05.22
	DESN	GD		27.05.22
	CHD	SW		27.05.22
	APPD	SK		27.05.22

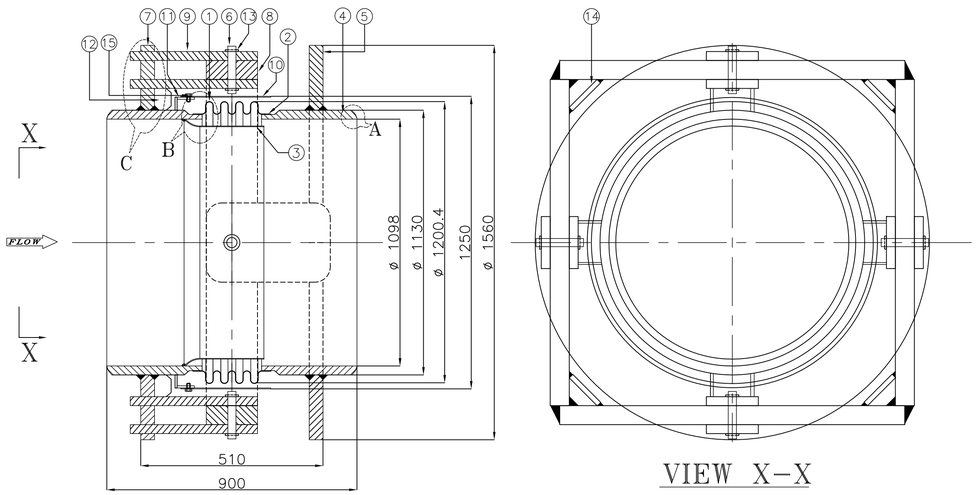
TITLE: GA OF HINGED ANGULAR BELLOWS– SIZE 2000NB

DRAWING NO. PE–DG–435–100–M171
SHEET 02 OF 06 REV. 00
SIZE-A0

ELECTRONIC FILE NAME 445_100_M171_00

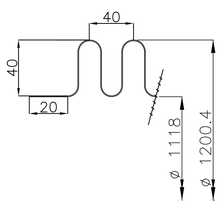
DRAWING No. PE-DG-435-100-M171

CUSTOMER'S DRAWING NO.

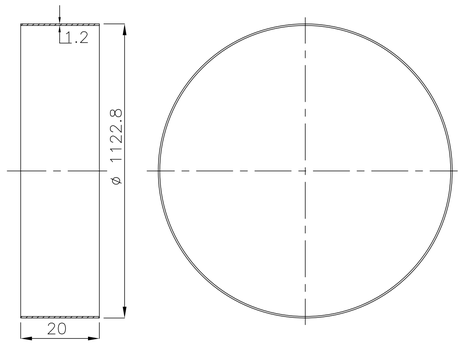


VIEW X–X

BELLOW : 1.2 THK x 1PLY
No. OF CONV. : 4
DEPTH OF CONV. : 40
PITCH OF CONV. : 40



DETAIL OF SL.NO.1



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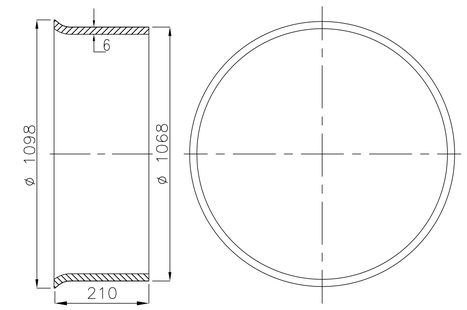
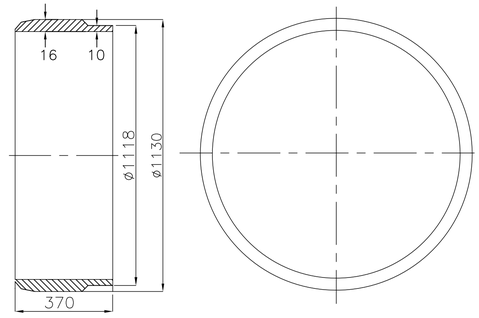
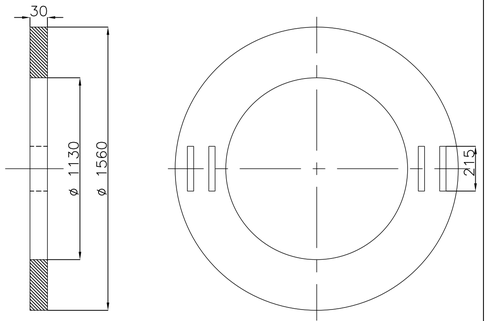


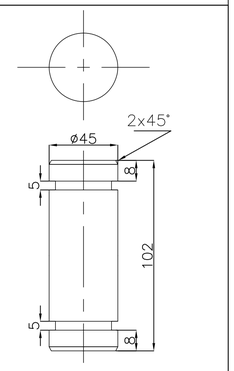
DETAIL OF SL.NO.3



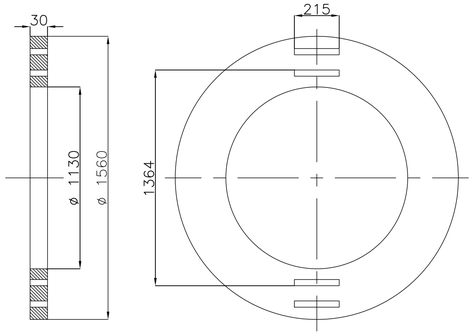
DETAIL OF SL.NO.4



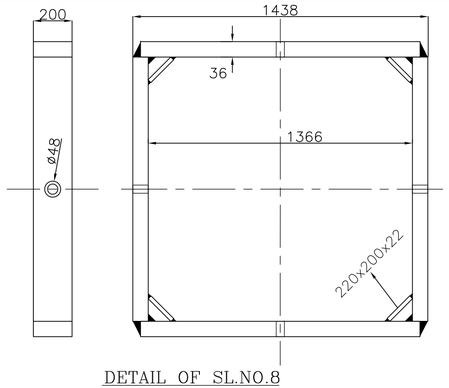
DETAIL OF SL.NO.5



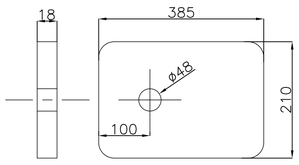
DETAIL OF SL.NO.6



DETAIL OF SL.NO.7



DETAIL OF SL.NO.8



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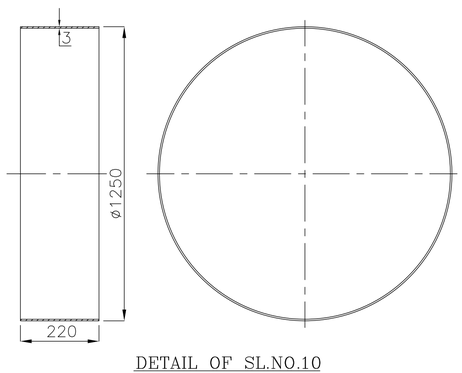
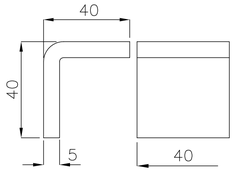
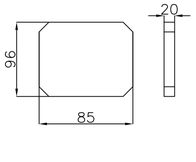


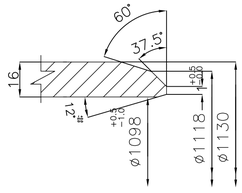
DETAIL OF SL.NO.10



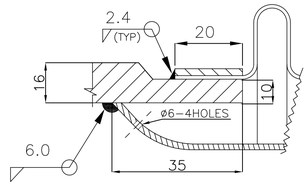
DETAIL OF SL.NO.11



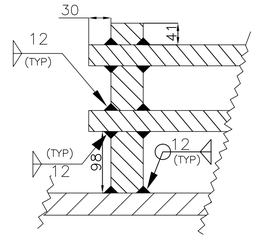
DETAIL OF SL.NO.12



DETAIL–A



DETAIL–B



DETAIL–C

BELLOW DETAILS

SL NO		DESCRIPTION	UNITS	DATA/ PARTICULARS.
1	GENERAL	TAG No.	-	E11
2		QUANTITIES PER UNIT	Nos.	01
3		TOTAL QUANTITY	Nos.	02
4		LOCATION	-	FLASH TANK-A VENT
5		FLUID	-	STEAM
6		INSTALLATION	-	HORIZONTAL
7	DESIGN & OPERATING DATA	PIPE SIZE(ODxTHK)	mm	1118x10
8		OPERATING PRESSURE	Kg/cm²(A)	0.12
9		DESIGN PRESSURE	Kg/cm²(G)	1.1
10		HYDRO TEST PRESSURE (FOR 30 Min.)	Kg/cm²(G)	1.65
11		VACUUM TEST PRESSURE(FOR 30 Min.)	mm-Hg	50mm of Hg (Abs)
12		OPERATING TEMPERATURE	°C	100
13		DESIGN TEMPERATURE	°C	120
14		BELLOW CYCLE LIFE	Nos.	14068
15		ANGULAR DEFLECTION (DESIGN)	DEGREE	3
16		AXIAL SPRING RATE PER CONVOLUTION	Kg/mm	151.20
17		ANGULAR SPRING RATE	Kg-M/Deg.	443.43
18		TOTAL EQUIVALENT MOVEMENT	mm	30.64
19		OVERALL LENGTH	mm	900
20		BELLOW CONVOLUTED LENGTH	mm	160
21		LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (Psc)	Kg/cm²	63.58
22		LIMITING INTERNAL DESIGN PRESSURE BASED ON INPLANE INSTABILITY (Psi)	Kg/cm²	5.86
23		TOTAL STRESS (St)	Kg/cm²	11675

BILL OF MATERIAL FOR SINGLE BELLOW

SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	1No
2	COLLAR	SA240TP304	2 Nos.
3	SLEEVE	SA240TP304	1 No.
4	END PIPE	SA672B70/SA672C70/SA515 Gr.70/SA516Gr.70	2 Nos.
5	HINGE SUPPORT FLANGE #1	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	1 No.
6	HINGE PIN	CARBON STEEL CLASS 8.8	4 Nos.
7	HINGE SUPPORT FLANGE #2	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	1 No.
8	SQ GIMBAL RING	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	1 Nos.
9	HINGE SUPPORT PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	8 Nos.
10	SHROUD (COVER)	IS 2062 Gr. A/B	1 No.
11	SHROUD (COVER) SUPPORTS	IS 2062 Gr. A/B	4 Nos.
12	GUSSET	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	8 Nos.
13	CIRCLIP 2mm THK. (DETAIL NOT SHOWN)	MS	8 Nos.
14	STIFFNER	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	4 Nos.
15	BOLT & NUT-M8	IS 1367 CL6.8/6.0	AR

NOTES:–

1. BELLOW DESIGN CODE : EJMA LATEST EDITION.
2. WELDING CODE/STD : ASME SEC IX.
3. BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
4. INSPECTION & TESTING : AS PER APPROVED QP.
5. SURFACE PREPARATION: SP3, POWER TOOL CLEANING.
6. PAINTING DETAILS :
   i) Primer: One coat of DFT 75 microns (min.) of solvent based IZS–VS of 60%. Zn Dust– 1.77kg/ltr minimum. Zn dust by weight–minimum 85%. Pot life 12 hrs/21 degree. Paint to meet compositional & performance specification for SSPC paint 20, Level 1.
   ii) Touch up: one coat of DFT 75 Microns (min.) of two component Zinc rich primer meeting performance and compositional specifications of SSPC paint 20 level 2.
   ii) Mid coat: 2 coats of high build high solid lamellar MIO based Epoxy Mid Coat of DFT 100 microns (min.) each.
   iv) Finish Coat: 2 coats of polyamide cured Epoxy coating of DFT 25 microns (min.) each. Total DFT 325 microns (min.)
   v) Colour shade: Aluminium.
7. SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE REMOVED AFTER INSTALLATION.
8. STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
9. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
10. EXPANSION JOINTS WEIGHING MORE THAN 250KGS ARE TO BE PROVIDED WITH LIFTING LUGS.
11. DRAWING IS NOT TO SCALE.
12. THICKNESS OF PRESSURE PARTS INDICATED ARE MINIMUM REQUIREMENTS AND THE SAME SHALL BE AS PER FINITE ELEMENT ANALYSIS.

REV.	DATE	DESN	CHD	APPD

JOB NO. 435
STATUS : CONTRACT
DISTRIBUTION

CUSTOMER: TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED, TANGEDCO HEAD QUARTERS, 1ST FLOOR, NEW EB QTRS., 144,ANNASALAI, CHENNAI 600002.

CONSULTANT NAME: TATA CONSULTING ENGINEERS LIMITED, BENGALURU

PROJECT NAME: 2 X 660 MW UDANGUDI STPP STAGE – I

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	GD		27.05.22
	DESN	GD		27.05.22
	CHD	SW		27.05.22
	APPD	SK		27.05.22

TITLE: GA OF GIMBAL BELLOWS SIZE–1100 NB

DEPT. MPL
SIGN

DRAWING NO. PE–DG–435–100–M171

SHEET 3 OF 6 REV. 00

SIZE-A0

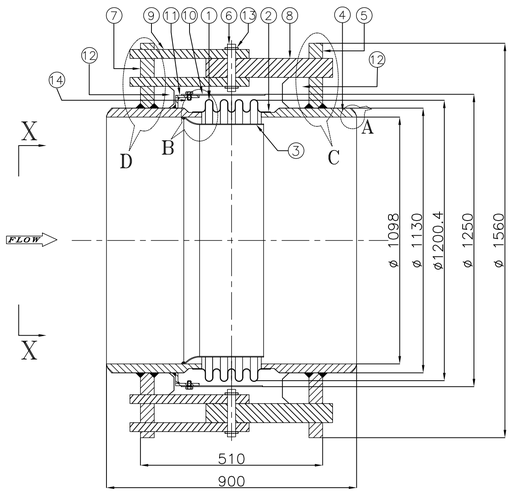
COMPUTER FILE NAME:

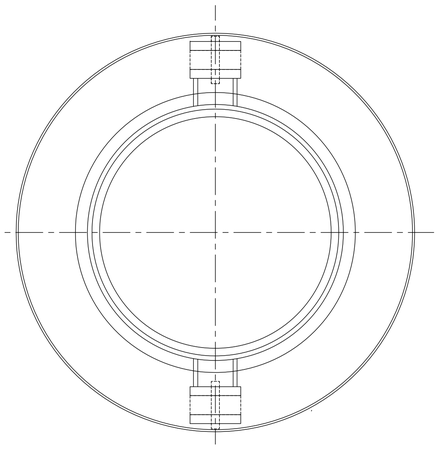
DRAWING No. PE-DG-435-100-M171

CUSTOMER'S DRAWING No.

FIRST ANGLE PROJECTION

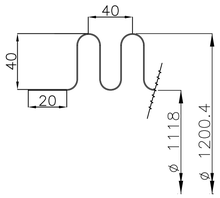
ALL DIMENSIONS ARE IN MM



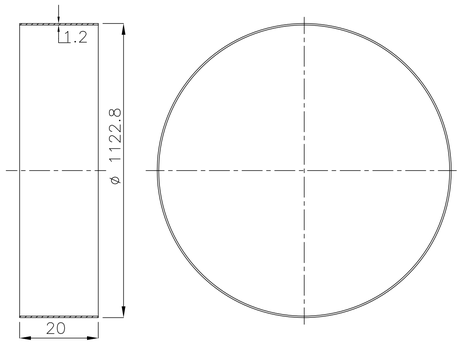


VIEW X–X

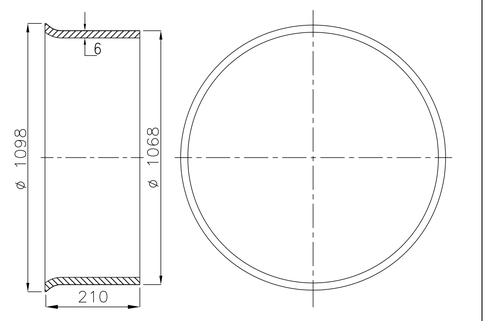
BELLOW : 1.2 THK x 1PLY
No. OF CONV. : 4
DEPTH OF CONV. : 40
PITCH OF CONV. : 40



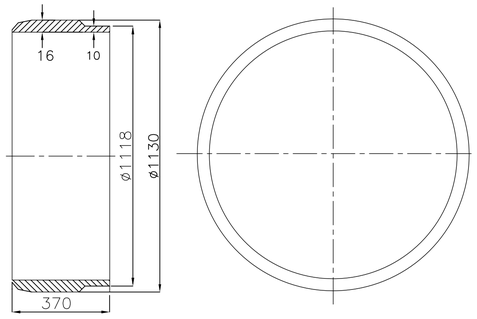
DETAIL OF SL.NO.1



DETAIL OF SL.NO.2



DETAIL OF SL.NO.3



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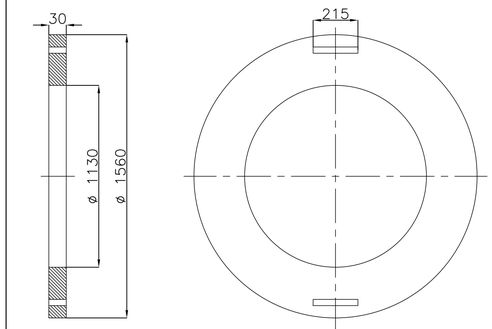

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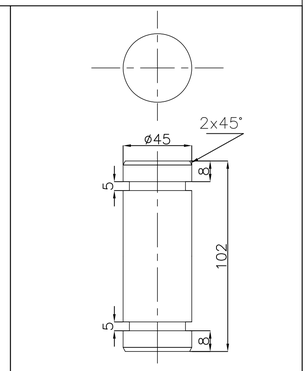

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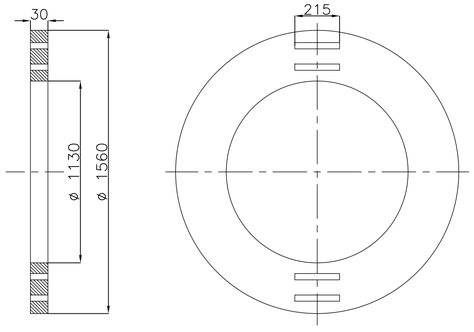

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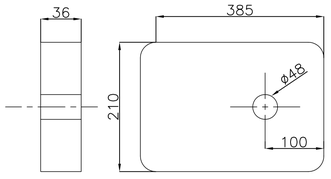
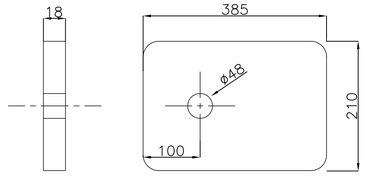


DETAIL OF SL.NO.8



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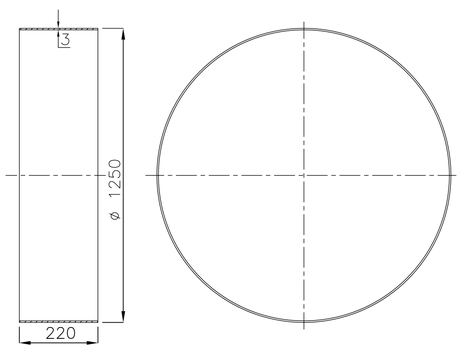

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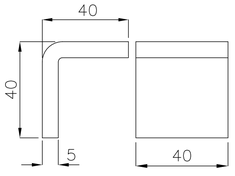

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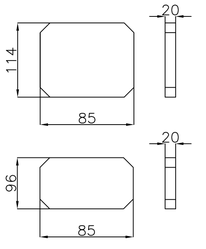

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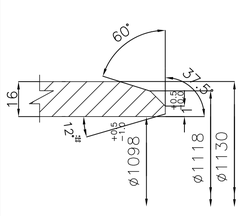
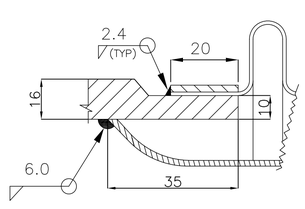
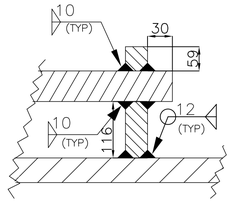


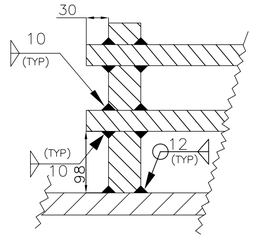
DETAIL–A



DETAIL–B



DETAIL–C



DETAIL–D

M

SL NO		DESCRIPTION	UNITS	DATA/ PARTICULARS.
1	GENERAL	TAG No.	-	E7, E8, E9, E10
2		QUANTITIES PER UNIT	Nos.	04
3		TOTAL QUANTITY	Nos.	08
4		LOCATION	-	FLASH TANK-A /B VENT
5		FLUID	-	STEAM
6		INSTALLATION	-	HORIZONTAL/ VERTICAL
7	DESIGN & OPERATING DATA	PIPE SIZE(ODxTHK)	mm	1118x10
8		OPERATING PRESSURE	Kg/cm²(A)	0.12
9		DESIGN PRESSURE	Kg/cm²(G)	1.1
10		HYDRO TEST PRESSURE (FOR 30 Min.)	Kg/cm²(G)	1.65
11		VACUUM TEST PRESSURE(FOR 30 Min.)	mm-Hg	50mm of Hg (Abs)
12		OPERATING TEMPERATURE	°C	100
13		DESIGN TEMPERATURE	°C	120
14		BELLOW CYCLE LIFE	Nos.	14068
15		ANGULAR DEFLECTION (DESIGN)	DEGREE	3
16		AXIAL SPRING RATE PER CONVOLUTION	Kg/mm	151.20
17		ANGULAR SPRING RATE	Kg-M/Deg.	443.43
18		TOTAL EQUIVALENT MOVEMENT	mm	30.64
19		OVERALL LENGTH	mm	900
20		BELLOW CONVOLUTED LENGTH	mm	160
21		LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (Psc)	Kg/cm²	63.58
22		LIMITING INTERNAL DESIGN PRESSURE BASED ON INPLANE INSTABILITY (Psi)	Kg/cm²	5.86
23		TOTAL STRESS (St)	Kg/cm²	11675

BILL OF MATERIAL FOR SINGLE BELLOW

SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	1No
2	COLLAR	SA240TP304	2 Nos.
3	SLEEVE	SA240TP304	1 No.
4	END PIPE	SA672B70/SA672C70/SA515 Gr.70/SA516Gr.70	2 Nos.
5	HINGE SUPPORT FLANGE #1	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	1 No.
6	HINGE PIN	CARBON STEEL CLASS 8.8	2 Nos.
7	HINGE SUPPORT FLANGE #2	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	1 No.
8	HINGE MAIN PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	2 Nos.
9	HINGE SUPPORT PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	4 Nos.
10	SHROUD (COVER)	IS 2062 Gr. A/B	1 No.
11	SHROUD (COVER) SUPPORTS	IS 2062 Gr. A/B	4 Nos.
12	GUSSET	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	8 Nos.
13	CIRCLIP 2mm THK. (DETAIL NOT SHOWN)	MS	4 Nos.
14	BOLT & NUT-M8	IS 1367 CL6.8/6.0	AR

NOTES:–

1. BELLOW DESIGN CODE : EJMA LATEST EDITION.
2. WELDING CODE/STD : ASME SEC IX.
3. BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
4. INSPECTION & TESTING : AS PER APPROVED QP.
5. SURFACE PREPARATION: SP3, POWER TOOL CLEANING.
6. PAINTING DETAILS :
   i) Primer: One coat of DFT 75 microns (min.) of solvent based IZS–VS of 60%. Zn Dust– 1.77kg/ltr minimum. Zn dust by weight–minimum 85%. Pot life 12 hrs/21 degree. Paint to meet compositional & performance specification for SSPC paint 20, Level 1.
   ii) Touch up: one coat of DFT 75 Microns (min.) of two component Zinc rich primer meeting performance and compositional specifications of SSPC paint 20 level 2.
   ii) Mid coat: 2 coats of high build high solid lamellar MIO based Epoxy Mid Coat of DFT 100 microns (min.) each.
   iv) Finish Coat: 2 coats of polyamide cured Epoxy coating of DFT 25 microns (min.) each. Total DFT 325 microns (min.)
   v) Colour shade: Aluminium.
7. SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE REMOVED AFTER INSTALLATION.
8. STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
9. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
10. EXPANSION JOINTS WEIGHING MORE THAN 250KGS ARE TO BE PROVIDED WITH LIFTING LUGS.
11. DRAWING IS NOT TO SCALE.
12. THICKNESS OF PRESSURE PARTS INDICATED ARE MINIMUM REQUIREMENTS AND THE SAME SHALL BE AS PER FINITE ELEMENT ANALYSIS.

CUSTOMER	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED, TANGEDCO HEAD QUARTERS, 1ST FLOOR, NEW EB QTRS., 144,ANNASALAI, CHENNAI 600002.
CONSULTANT NAME	TATA CONSULTING ENGINEERS LIMITED BENGALURU
PROJECT NAME	2 X 660 MW UDANGUDI STPP STAGE – I
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

JOB NO. 435
STATUS: CONTRACT
DISTRIBUTION

REV.	DATE	DESN	CHD	APPD

DEPT CODE		NAME	SIGN	DATE
M	DRN	GD		27.05.22
	DESN	GD		27.05.22
	CHD	SW		27.05.22
	APPD	SK		27.05.22

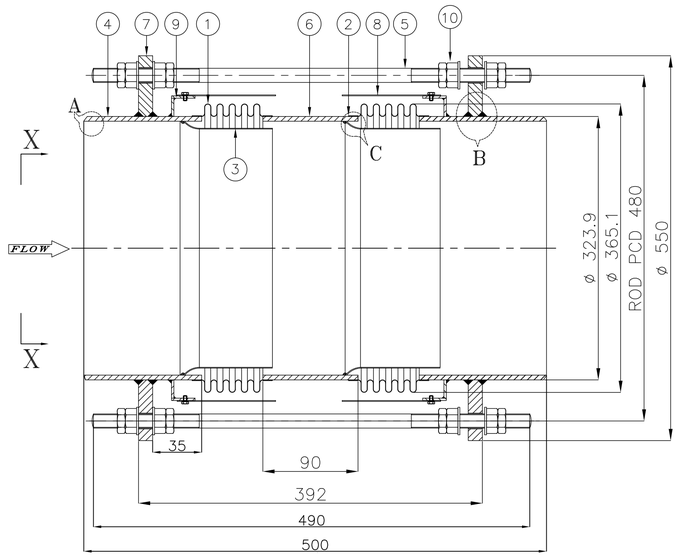
TITLE: GA OF HINGED ANGULAR BELLOWS SIZE–1100 NB

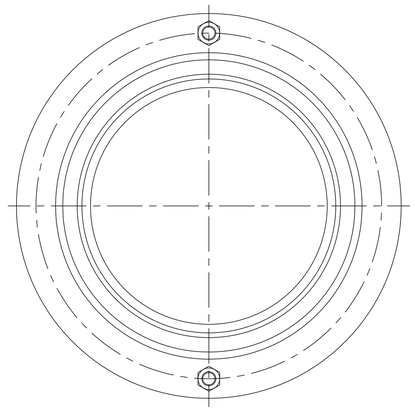
DEPT. MPL
SIGN

DRAWING NO. PE–DG–435–100–M171
SHEET 4 OF 6 REV. 00

SIZE–A0

COMPUTER FILE NAME:





VIEW X–X

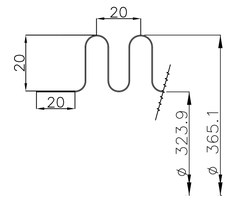
BELLOW DETAILS

SL NO		DESCRIPTION	UNITS	DATA/ PARTICULARS.
1	GENERAL	TAG No.	-	E12, E13, E14 & E15
2		QUANTITIES PER UNIT	Nos.	4
3		TOTAL QUANTITY	Nos.	8
4		LOCATION	-	MAIN CONDENSATE SUCTION
5		FLUID	-	CONDENSATE
6		INSTALLATION	-	VERTICAL
7	DESIGN & OPERATING DATA	PIPE SIZE(ODxTHK)	mm	323.9 x 9.53
8		OPERATING PRESSURE	$Kg/cm^2(A)$	0.092
9		DESIGN PRESSURE	$Kg/cm^2(G)$	2.0
10		HYDRO TEST PRESSURE (FOR 30 Min.)	$Kg/cm^2(G)$	3.0
11		VACUUM TEST PRESSURE(FOR 30 Min.)	mm-Hg	50mm of Hg (Abs)
12		OPERATING TEMPERATURE	°C	41.6
13		DESIGN TEMPERATURE	°C	60
14		BELLOW CYCLE LIFE	Nos.	22844
15		AXIAL COMPRESSION (DESIGN)	mm	17
16		LATERAL DEFLECTION (DESIGN)	mm	7
17		AXIAL SPRING RATE	Kg/mm	18.49
18		LATERAL SPRING RATE	Kg/mm	30.95
19		ANGULAR SPRING RATE	Kg-M/Deg.	NA
20		TOTAL EQUIVALENT MOVEMENT (FOR ASSEMBLY)	mm	35.56
21		TOTAL EQUIVALENT MOVEMENT (PER BELLOW)	mm	17.78
22		OVERALL LENGTH	mm	500
23		BELLOW CENTER DISTANCE	mm	190
24		BELLOW CONVOLUTED LENGTH	mm	100
25		LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (Psc)	Kg/cm^2	9.88
26		LIMITING INTERNAL DESIGN PRESSURE BASED ON INPLANE INSTABILITY (Psi)	Kg/cm^2	9.29
27		TOTAL STRESS (St)	Kg/cm^2	10628.15

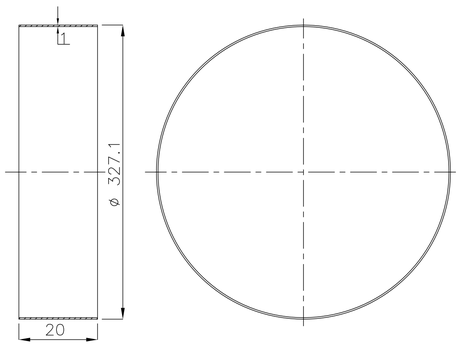
BILL OF MATERIAL FOR SINGLE BELLOW

SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	2 Nos.
2	COLLAR	SA240TP304	4 Nos.
3	SLEEVE	SA240TP304	2 Nos.
4	END PIPE	SA106Gr.B	2 Nos.
5	LIMIT ROD	IS 1367 CL 6.8	2 Nos.
6	SPOOL PIPE	SA106Gr.B	1 No.
7	ROUND FLANGE	IS 2062 Gr. B/SA 515 / 516 Gr.70	2 Nos.
8	SHROUD (COVER)	IS 2062 Gr. B	2 Nos.
9	SHROUD (COVER) SUPPORTS	IS 2062 Gr. B	8 Nos.
10	BOLT & NUT-M8	IS 1367 CL6.8/6.0	AR
11	NUT, LOCKNUT & WASHER (size M25)	IS 1367 CL6.8/6.0	AR

BELLOW : 0.6THK x 1PLY
No. OF CONV. : 5+5
DEPTH OF CONV. : 20
PITCH OF CONV. : 20



DETAIL OF SL.NO.1



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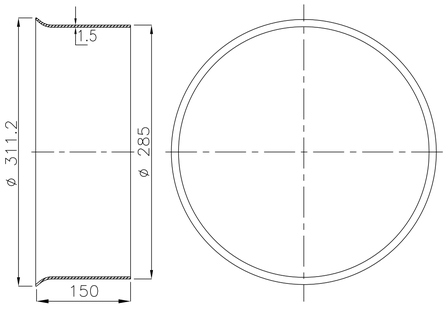

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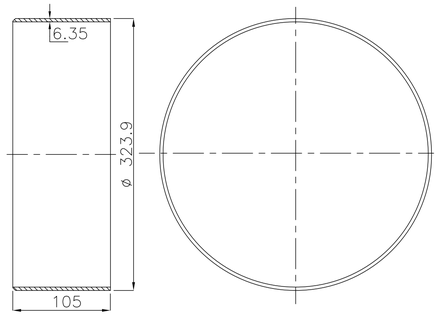

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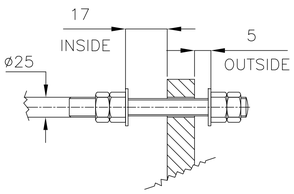

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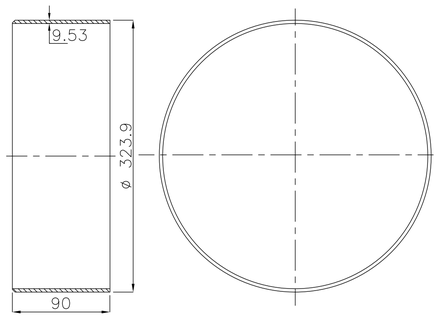

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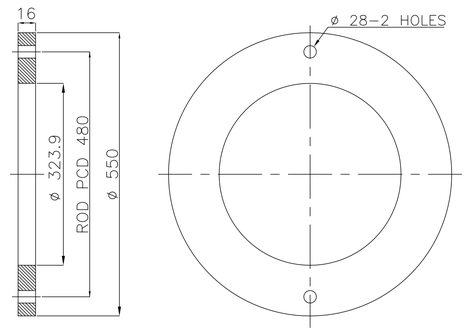

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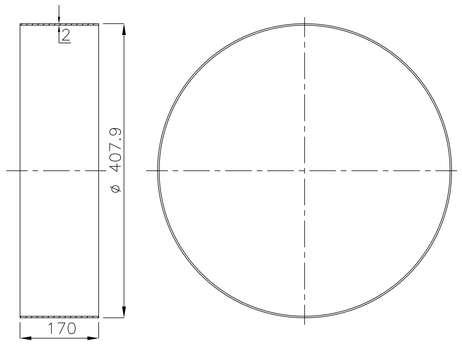

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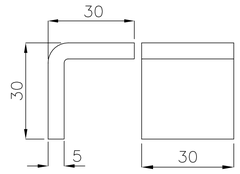

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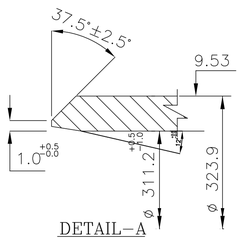
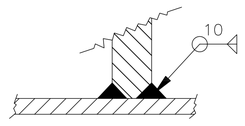
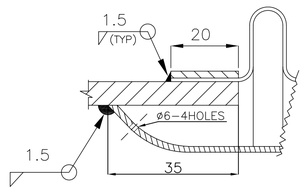


DETAIL–A



DETAIL–B



DETAIL–C

NOTES:–
1. BELLOW DESIGN CODE : EJMA LATEST EDITION.
2. WELDING CODE/STD : ASME SEC IX.
3. BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
4. INSPECTION & TESTING : AS PER APPROVED QP.
5. SURFACE PREPARATION: SP3, POWER TOOL CLEANING.
6. PAINTING DETAILS :
   i) Primer: One coat of DFT 75 microns (min.) of solvent based IZS–VS of 60%. Zn Dust– 1.77kg/ltr minimum. Zn dust by weight–minimum 85%. Pot life 12 hrs/21 degree. Paint to meet compositional & performance specification for SSPC paint 20, Level 1.
   ii) Touch up: one coat of DFT 75 Microns (min.) of two component Zinc rich primer meeting performance and compositional specifications of SSPC paint 20 level 2.
   ii) Mid coat: 2 coats of high build high solid lamellar MIO based Epoxy Mid Coat of DFT 100 microns (min.) each.
   iv) Finish Coat: 2 coats of polyamide cured Epoxy coating of DFT 25 microns (min.) each. Total DFT 325 microns (min.)
   v) Colour shade: Sea green shade no. ISC –217
7. SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE REMOVED AFTER INSTALLATION.
8. STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
9. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
10. EXPANSION JOINTS WEIGHING MORE THAN 250KGS ARE TO BE PROVIDED WITH LIFTING LUGS.
11. DRAWING IS NOT TO SCALE.
12. THICKNESS OF PRESSURE PARTS INDICATED ARE MINIMUM REQUIREMENTS AND THE SAME SHALL BE AS PER FINITE ELEMENT ANALYSIS.

JOB NO.	435			
STATUS	CONTRACT			
DISTRIBUTION				
REV.	DATE	DESN	CHD	APPD

CUSTOMER: TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED, TANGEDCO HEAD QUARTERS, 1ST FLOOR, NEW EB QTRS., 144,ANNASALAI, CHENNAI 600002.

CONSULTANT NAME: TATA CONSULTING ENGINEERS LIMITED, BENGALURU

PROJECT NAME: 2 X 660 MW UDANGUDI STPP STAGE – I

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	GD		27.05.22
	DESN	GD		27.05.22
	CHD	SW		27.05.22
	APPD	SK		27.05.22

TITLE: GA OF UNTIED BELLOW–SIZE 300NB

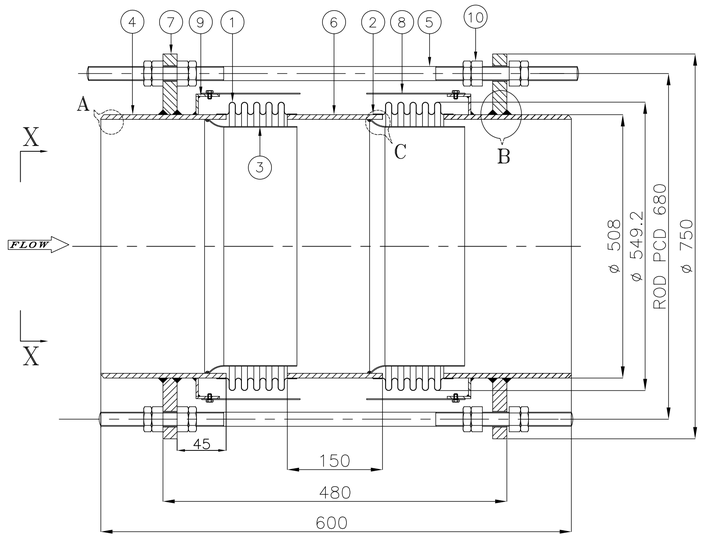
DEPT. MPL
SIGN

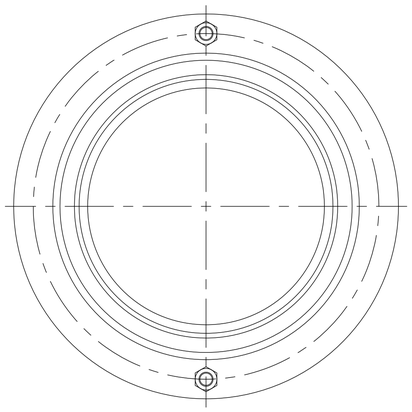
DRAWING NO. PE–DG–435–100–M171

SHEET 5 OF 6 REV. 00

SIZE-A0

COMPUTER FILE NAME:



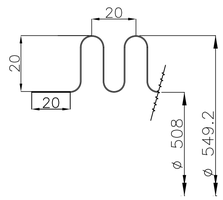


VIEW X–X

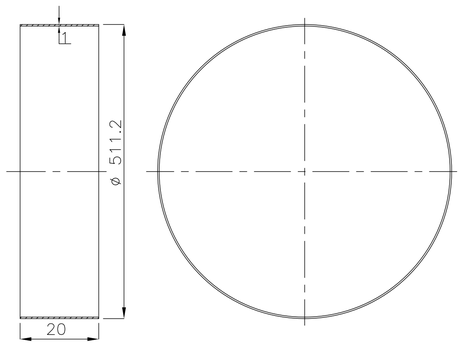
BELLOW DETAILS

SL NO		DESCRIPTION	UNITS	DATA/ PARTICULARS.
1	GENERAL	TAG No.	-	E16, E17 & E18
2		QUANTITIES PER UNIT	Nos.	3
3		TOTAL QUANTITY	Nos.	6
4		LOCATION	-	CEP A/B/C SUCTION
5		FLUID	-	CONDENSATE
6		INSTALLATION	-	HORIZONTAL
7	DESIGN & OPERATING DATA	PIPE SIZE(ODxTHK)	mm	508 x 9.53
8		OPERATING PRESSURE	Kg/cm²(A)	.092
9		DESIGN PRESSURE	Kg/cm²(G)	2.0
10		HYDRO TEST PRESSURE (FOR 30 Min.)	Kg/cm²(G)	3.0
11		VACUUM TEST PRESSURE(FOR 30 Min.)	mm-Hg	50mm of Hg (Abs)
12		OPERATING TEMPERATURE	°C	41.6
13		DESIGN TEMPERATURE	°C	60
14		BELLOW CYCLE LIFE	Nos.	19355
15		AXIAL COMPRESSION (DESIGN)	mm	15
16		LATERAL DEFLECTION (DESIGN)	mm	7
17		AXIAL SPRING RATE PER CONVOLUTION	Kg/mm	28.05
18		LATERAL SPRING RATE	Kg/mm	64.11
19		ANGULAR SPRING RATE	Kg-M/Deg.	NA
20		TOTAL EQUIVALENT MOVEMENT (FOR ASSEMBLY)	mm	35.28
21		TOTAL EQUIVALENT MOVEMENT (PER BELLOW)	mm	17.64
22		OVERALL LENGTH	mm	600
23		BELLOW CENTER DISTANCE	mm	250
24		BELLOW CONVOLUTED LENGTH	mm	100
25		LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (Psc)	Kg/cm²	14.98
26		LIMITING INTERNAL DESIGN PRESSURE BASED ON INPLANE INSTABILITY (Psi)	Kg/cm²	7.44
27		TOTAL STRESS (St)	Kg/cm²	10969.39

BELLOW : 0.6THK x 1PLY.
No. OF CONV. : 5+5
DEPTH OF CONV. : 20
PITCH OF CONV. : 20



DETAIL OF SL.NO.1



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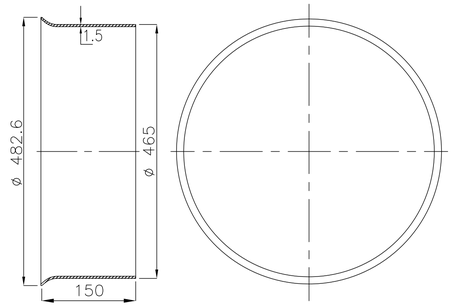

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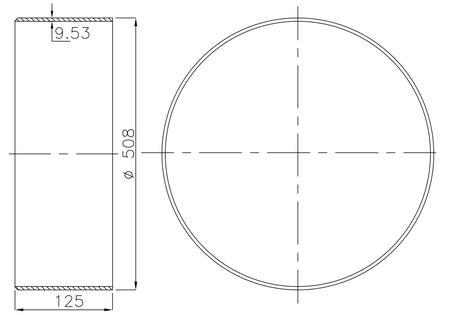

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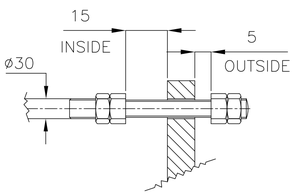

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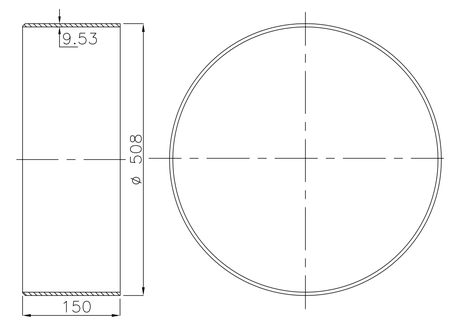

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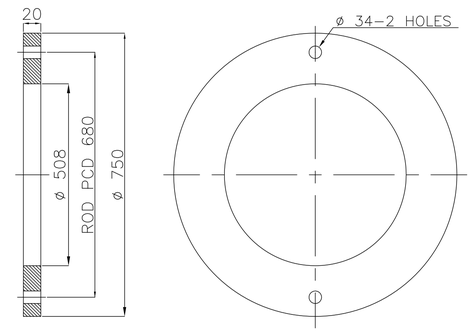

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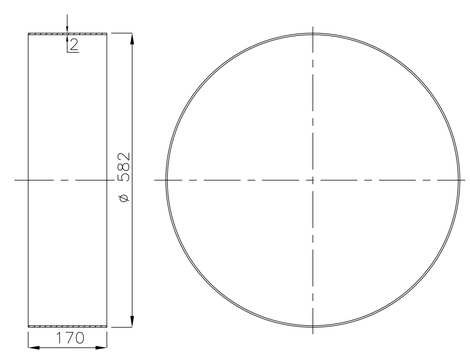

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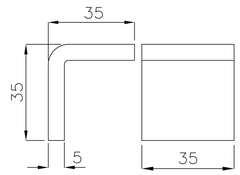

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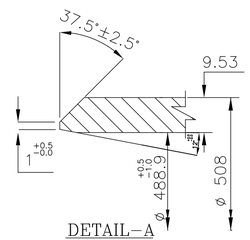
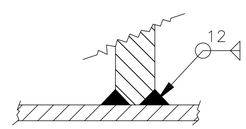
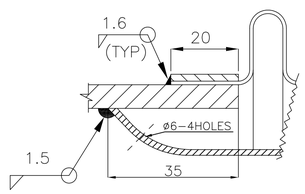


DETAIL–A



DETAIL–B



DETAIL–C

BILL OF MATERIAL FOR SINGLE BELLOW

SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	2 Nos.
2	COLLAR	SA240TP304	4 Nos.
3	SLEEVE	SA240TP304	2 Nos.
4	END PIPE	SA106Gr.B	2 Nos.
5	LIMIT ROD WITH NUTS	CS (CL. 6.8 & 6.0)	2 Nos.
6	SPOOL PIPE	SA106Gr.B	1 No.
7	ROUND FLANGE	IS 2062 Gr. B/SA 515 / 516 Gr.70	2 Nos.
8	SHROUD (COVER)	IS 2062 Gr. B	2 Nos.
9	SHROUD (COVER) SUPPORTS	IS 2062 Gr. B	8 Nos.
10	NUT, LOCKNUT & WASHER	IS 1367 CL6.8/6.0	8 SET

NOTES:–

1. BELLOW DESIGN CODE : EJMA LATEST EDITION.
2. WELDING CODE/STD : ASME SEC IX.
3. BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
4. INSPECTION & TESTING : AS PER APPROVED QP.
5. SURFACE PREPARATION: SP3, POWER TOOL CLEANING.
6. PAINTING DETAILS :
   - i) Primer: One coat of DFT 75 microns (min.) of solvent based IZS–VS of 60%. Zn Dust– 1.77kg/ltr minimum. Zn dust by weight–minimum 85%. Pot life 12 hrs/21 degree. Paint to meet compositional & performance specification for SSPC paint 20, Level 1.
   - ii) Touch up: one coat of DFT 75 Microns (min.) of two component Zinc rich primer meeting performance and compositional specifications of SSPC paint 20 level 2.
   - ii) Mid coat: 2 coats of high build high solid lamellar MIO based Epoxy Mid Coat of DFT 100 microns (min.) each.
   - iv) Finish Coat: 2 coats of polyamide cured Epoxy coating of DFT 25 microns (min.) each. Total DFT 325 microns (min.)
   - v) Colour shade: Sea green shade no. ISC –217
7. SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE REMOVED AFTER INSTALLATION.
8. STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
9. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
10. EXPANSION JOINTS WEIGHING MORE THAN 250KGS ARE TO BE PROVIDED WITH LIFTING LUGS.
11. DRAWING IS NOT TO SCALE.
12. THICKNESS OF PRESSURE PARTS INDICATED ARE MINIMUM REQUIREMENTS AND THE SAME SHALL BE AS PER FINITE ELEMENT ANALYSIS.

CUSTOMER	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED, TANGEDCO HEAD QUARTERS, 1ST FLOOR, NEW EB QTRS., 144,ANNASALAI, CHENNAI 600002.
CONSULTANT NAME	TATA CONSULTING ENGINEERS LIMITED BENGALURU
PROJECT NAME	2 X 660 MW UDANGUDI STPP STAGE – I
JOB NO. 435	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA
STATUS CONTRACT	
DISTRIBUTION	

REV.	DATE	ALTD	CHD	APPD

DEPT		NAME	SIGN	DATE
CODE	DRN	GD		27.05.22
M	DESN	GD		27.05.22
	CHD	SW		27.05.22
	APPD	SK		27.05.22

TITLE: GA OF UNTIED BELLOW-SIZE 500NB

DRAWING NO. PE–DG–435–100–M171

SHEET 06 OF 06 REV. 00

SIZE-A0

ELECTRONIC FILE NAME: 445_100_M171_00

Project: 2X660 MW UDANGUDI STPP STAGE-I

Package: METAL EXPANSION BELLOWS

CRITERIA FOR EVALUATION (TECHNICAL):

1. Technical Pre-Qualifying Requirements:

1.1 The bidder should have designed, in-house manufactured, tested, inspected and supplied metal expansion bellows (Gimbal / Hinged) with minimum size of 1600 NB (Min. Design pressure: 1.1 Kg/cm2(g), Min Design temperature: 50^0C), for use in power cycle piping of power plant or for similar application in other industries.

1.2 The item(s) mentioned in point 1.1 should have performed successfully for atleast one year. To establish meeting this requirement, the bidder shall conform to any one of the following clauses:

(i) Execution of two purchase orders for different End-users with the item(s) performing successfully for one (1) year from date of commissioning to the date of bid submission as defined in Notice Inviting Tender (NIT) by BHEL-PEM. Different projects of a customer shall be considered as different End-users.

(ii) Minimum one (1) repeat contract from two (2) different Purchasers (i.e. 2 Nos of Purchase orders from each purchaser). A contract shall be considered as repeat, when the second contract is given by the same purchaser after lapse of minimum one (1) year from supply completion of first contract.

(iii) Execution of one (1) purchase order as per sl. no. (i) above from one End-user and one (1) repeat contract from another Purchaser as per sl. No. (ii) above.

(iv) Three (3) repeat contracts from one (1) Purchaser. Second and third repeat contract shall be after lapse of minimum one (1) & two (2) years respectively from supply completion of first contract.

1.3 The bidder to furnish the following documents, as applicable, in support of the above:

a) For point 1.2(i): Performance certificates from End-user (duly signed & dated) specifying that the product is performing successfully for one (1) year from date of commissioning along with correlated purchase order(s).

b) For point 1.2 (ii) & (iv): Purchase order(s), Material dispatch clearance certificate (MDCC)/ Material receipt certificate (MRC)/Lorry receipt (LR)/supply invoice.

1.4 In addition to above, bidder should have the following facilities for Metal expansion bellows of max. size of each type as per BHEL requirement as mentioned in Data sheet of technical specification:

a) In-house capability of manufacturing metal expansion bellows.

b) In-house testing facilities for carrying out tests as per relevant standards & Quality plan. In case, the in-house testing facilities are not available, then bidder shall furnish undertaking that test(s) will be carried out from govt. approved lab or test house recognized by reputed customers.

PREPARED BY:	REVIEWED BY:	APPROVED BY:
GAURAV DIXIT Digitally signed by GAURAV DIXIT DN: cn=GAURAV DIXIT, o=BHEL, ou=PEM, email=gauravdixit@bhel.in, c=IN Date: 2022.05.31 09:12:33 +05'30'	SANJAY KUMAR Digitally signed by SANJAY KUMAR DN: cn=SANJAY KUMAR, o=BHEL, ou=PEM, email=sanjaykumar@bhel.in, c=IN Date: 2022.05.31 15:00:52 +05'30'	Bimal Kumar Agarwal Digitally signed by Bimal Kumar Agarwal Date: 2022.05.31 16:29:08 +05'30'
NAME: GAURAV DIXIT **DESIGNATION:** DY MGR **DEPT.:**PS-PEM/ MPL	**NAME:** SANJAY KUMAR **DESIGNATION**: SDGM **DEPT.:** PS-PEM/ MPL	**NAME**:B K AGARWAL **DESIGNATION:** DH/MPL

Bidder to submit supporting documents (Purchase order (s) / Certificate indicating capacity and details/undertaking of manufacturing & testing facilities) for point (a) & (b) above.

1.5 To establish business continuity, bidder is required to submit at least (2) Purchase order for any type of Metal expansion bellows (from Data Sheet Part-1 of technical specification) for minimum 300NB size in last 3 (three) years from date of bid submission as defined by BHEL-PEM in NIT.

2. Bidder to also comply with general points mentioned below:

2.1 Offers of the JV companies/ Joint bidders/ bidders having collaboration/ licensing agreement/ MOU/ Indian subsidiaries shall be evaluated as follows:

a) If bidder happens to be an Indian subsidiaries of foreign OEM, then the credentials of the foreign OEM can also be considered for meeting PQR.

b) If bidder happens to be the Joint Venture Company, then the credentials of any of JV partners can be also considered for meeting PQR.

c) If bidder happens to be the having valid collaboration agreement/ MOU/ licensing agreement with some other company, then the credentials of collaborator/ MOU partner/ licensing company can also be considered for meeting PQR.

Note: If bidder(s) qualifies on the basis of credentials of his principal/ JV partner/ Collaborator/ joint bidder etc., then the principal/ JV partner/ Collaborator/ MOU partner/ joint bidder shall be responsible for overall design vetting and warranty/ guarantee of the package. The scope matrix clearly defining their respective roles including design vetting, manufacturing of critical component, E&C etc. and warranty/ guarantee shall be submitted along with the offer.

2.2 Bidder to note that the arrangement of bidding (joint bid partners/ collaborator/ MOU partner/ licensing company etc.) once offered to BHEL as a part of bidding documents cannot be changed till the execution of contract(s).

2.3 Consideration of offer shall be subject to customer's approval of bidders, if applicable.

2.4 Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self-attested English translated document should also be submitted.

2.5 Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder/collaborators to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.

2.6 After satisfactory fulfillment of all the above criteria/requirement, offer shall be considered for further evaluation as per NIT and all the other items of the tender.

2.7 Bidder to ensure that Third Party/customer issued certificates being submitted as proof of PQR qualification should have verifiable details of document/ certificate issuing authority such as name & designation of issuing authority and its organization contact number and email-id etc. In case the same found not available, purchaser has right to reject such document from evaluation.