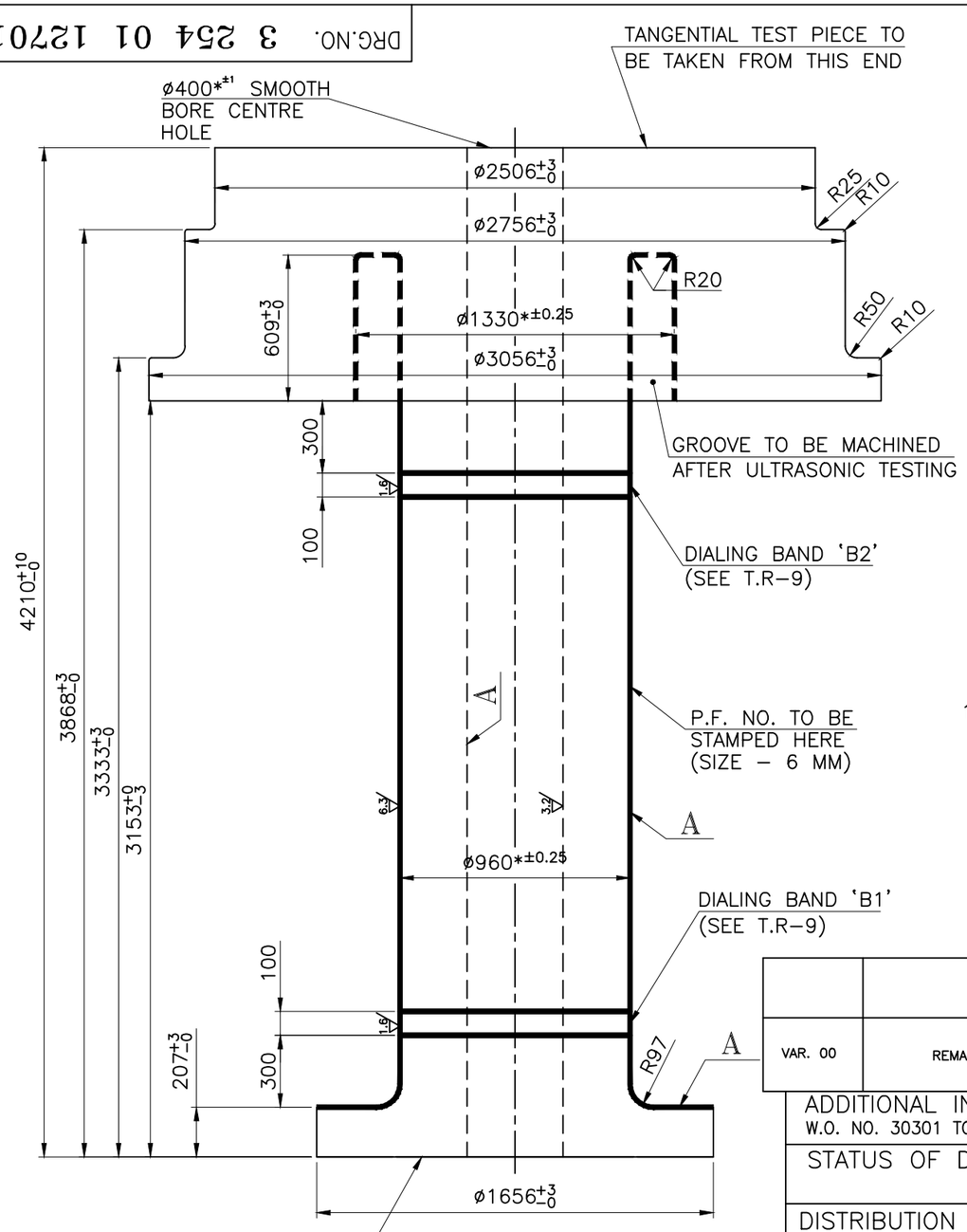
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG.NO. 3 254 01 12701



TECHNICAL REQUIREMENTS:-

1. P.F. NUMBERS ARE TO BE STAMPED(SIZE-6MM) AT PLACE SHOWN ON DRAWING AND RESTAMPED JUST AFTER MACHINING.

UNIT NO.	P.F. NO.	UNIT NO.	P.F. NO.
1	311571	7	311577
2	311572	8	311578
3	311573	9	311579
4	311574	10	311580
5	311575	11	311581
6	311576	12	311582

2. SURFACE FINISH OF MACHINED SURFACES SHALL BE 6.3 MICRONS ALL OVER UNLESS OTHERWISE STATED.
3. ALL FACES SHOULD BE PARALLEL AND SQUARE TO THE AXIS TO THE SHAFT.
4. INSPECTION SHALL BE CARRIED OUT IN THE PRESENCE OF BHEL/THIRD PARTY/CUSTOMER.
5. SHAFT FORGING, INCLUDING THE BORE, SHALL BE PAINTED WITH ANTI-RUST PAINT TO BP0690084.
6. 6 COPIES OF TEST CERTIFICATES SHALL BE SUBMITTED. THE P.F. NOS. OF THE FORGINGS AND THE CAST NOS. OF THE BILLETS SHALL BE QUOTED ON THE CORRESSPONDING COPIES OF THE TEST CERTIFICATES.
7. DIAMETRIC DIMENSIONS MARKED THUS * AND PORTIONS OF SHAFT MARKED 'A' ARE FINAL FINISHED AND THESE SHALL BE CO-AXIAL AND CONCENTRIC. ALSO THESE PORTIONS SHALL BE ADEQUATELY PROTECTED TO AVOID DAMAGE DURING TRANSPORTION/HANDLING.
8. WELD REPAIR & COLD WORKING OF THE FORGING IS NOT PERMISSIBLE AT ANY STAGE.
9. DIALING BAND B1 & B2 SHALL BE USED FOR RESETTING SHAFT AT BHEL WORKS. THEY SHALL BE DIALLED WITHIN 0.05 MM.
10. INSPECTION SHALL BE DONE AS PER CUSTOMER APPROVED Q.A. PLAN.

IMPORTANT NOTES FOR SUPPLIER:

1. THE SUPPLIER IS TO CONFIRM COMPLIANCE TO THE DRAWING AND PRODUCT STANDARD HG10035 (REV-07) CLAUSE-BY-CLAUSE. ANY DEVIATION SHALL BE CLEARLY BROUGHT OUT IN THE OFFER.
2. CLAUSE-BY-CLAUSE COMPLIANCE OF QA PLAN NO. QSP/HG/104 (TWO SHEETS) AND CUSTOMER APRROVED QA PLAN SHALL BE CONFIRMED BY THE SUPPLIER.
3. OFFERS NOT MEETING THE ABOVE REQUIREMENTS, MAY BE REJECTED IN THE FIRST INSTANCE ITSELF.

			001	BOTTOM SHAFT FORGING					NA	NA	61661	
								HG10035				
VAR. 00	REMARKS	VAR NO.	ITEM NO.	DESCRIPTION	STD.	DRAWING NO.	IT. NO.	MATL. CODE.	A/C	UNIT	UNIT WT.	GS.
							VAR	MATL. SPCN.			QTY.	

ADDITIONAL INFORMATION
W.O. NO. 30301 TO 12-A-23154

STATUS OF DRAWING U

DISTRIBUTION OF PRINTS
HGE - 1 HGM - 1
TEX - 1

उत्पाद का प्रकार या ग्राहक / परियोजना का नाम
TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

POLAVARAM HEP (12X80MW)
(ANDHRA PRADESH POWER GENERATION CORPORATION LIMITED)

भारत हेवी इलेक्टिकल्स लिमिटेड
भोपाल
BHARAT HEAVY ELECTRICALS LTD.
BHOPAL

	नाम NAME	हस्ता. SIGN	दि. DATE	NO.OF VAR
बनाया DRN	RKP		12.07.22	वेरि की संख्या
जांचा CHD	AKV		12.07.22	
स्वीकृत APPD	RG		12.07.22	NA

REV	DATE	
01	10.02.23	ALTERED
		CHECKED
		APPROVED

ZONE

DIAMETER SYMBOL 'ø' IS REMOVED FROM LENGTH DIMENSIONS.

विभाग एचजीई DEPT HGE	UNTOL DIMS	अनुपात SCALE	भार कि.ग्रा. WEIGHT(kg)	असे. ड्राईंग का संदर्भ REF TO ASSY DRG	मद क. ITEM NO.	मद संख्या NO.OFITEM
कोड CODE 403	32500001404	NTS	61661	-	-	001

TITLE शीर्षक
BOTTOM SHAFT FORGING

DRAWING NO. 3 254 01 12701 पुन. REV 01

पृष्ठ क. SHT NO. 01 पृष्ठों की सं. NO.OF SHT. 01

REF.DRG.NO.
SIGN.DATE
INVENTORY NO.

SPECIFICATION FOR SHAFT/THRUST COLLAR FORGINGS FOR HYDROGENERATOR

1. GENERAL:

1.1 Shaft/ Thrust collar forgings for Hydrogenerators shall be procured in rough machined condition, as per requirements given in this specification and forging drawing made for individual project**.**

2. CONDITION OF DELIVERY :

Normalised/ Normalised & Tempered.
Rough machining of the forgings shall be carried out unless otherwise specified on the order/drawing.

3. DIMENSION AND TOLERANCES :

The dimensions and tolerances shall be as specified on the order/drawing. Wherever these are not specified, the machining allowances and tolerances shall be as specified below :

For rough machined drawings: +2/-0 on outside diameter and +0/-2 on inside diameter.

4. MANUFACTURE :

Forgings shall be manufactured from steel produced by the open hearth, electric or such other process as may be agreed to between BHEL and the manufacturer.

The steel for this forging shall be vacuum degassed to protect the forgings from harmful effects of hydrogen and other gases.

The steel shall be fully killed. Sufficient discard shall be made from each ingot to ensure freedom from pipe, segregation and other defects.

The amount of hot working and finishing temperature shall be such as to ensure complete soundness and adequate uniformity of structure and mechanical properties after heat treatment. The forgings shall not be overheated.

The minimum reduction ratio when forgings are made out of ingots shall be 4:1, for all ruling sections unless otherwise agreed between BHEL & supplier before placement of order.

5. HEAT TREATMENT :

Forgings shall be normalised at suitable temperature to give the mechanical properties specified.

6. FINISH:

As mentioned in the drawing.

7. FREEDOM FROM DEFECTS :

Forgings shall be free from defects such as cracks, flakes, seams, segregation, harmful non-metallic inclusions and other defects which may affect the utility of the forgings.

8. CHEMICAL COMPOSITION :

The melt analysis of steel and permissible variation in the composition of the forgings from the melt analysis shall be as follows:

Element	**Melt analysis Percent**		**Permissible Variation, Percent**
	Min.	**Max.**	
Carbon	0.24	0.32	± 0.02
Silicon	0.10	0.35	± 0.03
Manganese	1.30	1.70	± 0.10
Sulphur	--	0.035	+ 0.006
Phosphorus	--	0.035	+ 0.006

Notes :
Elements not quoted above shall not be added to the steel, other than for the purpose of finishing the heat and shall not exceed the following limits:

Element	**Percent, Max.**
Nickel	0.30
Chromium	0.30
Copper	0.30
Molybdenum	0.15
Vanadium	0.05
Tin	0.05

9. TEST SAMPLES:

9.1 Test samples should be cut from the heat treated forgings by cold process only and shall receive no further heat treatment.

Test samples shall be cylindrical in shape.

(a) Radial test piece shall be taken from one end of the forging.
(b) Tangential test piece shall be taken from other end of the forging.
(c) Test piece diameter shall be 16mm min. (as per IS-1608:1995, amd. No. 1, May2002, table5)

Test piece shall be cut as below:
(i) For solid forgings: At a distance of one – third radius or one-sixth diagonal from the outer surface.
(ii) For hollow forgings: Midway between the inner and outer surface of the wall thickness.

10. MECHANICAL PROPERTIES:

The test pieces shall show the following properties for all ruling sections. Test methods are specified below:

10.1	Tensile test	: IS: 1608
10.2	Hardness test (Brinell)	: IS: 1500
10.3	Charpy Impact Value (2mm U-Notch)	: IS: 1499
10.4	Mechanical properties	

i.	Tensile strength (in any direction)	560 N/mm^2 Min	
ii.	Yield strength (in any direction)	335 N/mm^2 Min	
iii.	Elongation 5.65 $\sqrt{}$ so gauge length	Radial	- 10% Min
		Tangential	- 12% Min
iv.	Charpy impact value (2 mm U notch)	Radial	- 23 joules Min
		Tangential	- 29 joules Min
v.	Hardness (Brinnel) for reference only	156 -212	

11. N.D.T.

11.1 Each forging shall be tested ultrasonically in accordance with BHEL Standard No. AA0850101 after final completion of all operation on the forging.
All transition zones shall be subject to magnetic particle test as per above standard, before application of antirust compound.

11.2 Boroscopic test for central hole in case of shaft forging shall be carried out to AA0850101 before application of antirust compound.

12. TEST CERTIFICATES:

Three copies of test certificates shall be supplied unless otherwise stated on the order.
In addition, the supplier shall ensure to enclose one copy of the test certificate along with their dispatch documents to facilitate quick clearance of the material.
The following details shall be furnished in the test certificate

i) Reduction Ratio.
ii) Dimensional Inspection.
iii) Details of heat treatment.
iv) Chemical composition including trace elements.
v) Result of mechanical tests.
vi) Result of ultrasonic test.

13. INSPECTION AT SUPPLIER'S WORKS:

Tests and inspection are to be conducted in the presence of purchaser's representative. The representative shall have free access at all times while the work on the contract is being performed. All facilities without charge to be provided to purchaser during inspection including provision of test specimen and its testing. If necessary supplier shall make necessary arrangement for carrying out the test elsewhere.

14. REJECTION AND REPLACEMENT:

In the event of any forging proving defective in the course of preparation, machining, testing or erection such forging shall be rejected, notwithstanding any previous certification of satisfactory testing and /or inspection.
The supplier shall undertake to replace the rejected forgings at his own cost and the rejected forgings shall be sent back to the supplier after fulfilling the commercial terms and conditions.

15. PACKING AND MARKING :

The shaft forging shall be properly protected with anticorrosive compounds.
Forgings shall be suitable packed to prevent corrosion and damage transit.

16. DOCUMENT TO BE SUBMITTED ALONG WITH OFFER:

Manufacturing process chart comprising of manufacturing sequence, forging sequence, heat treatment cycle with stage wise test schedule.

NOTE: WITHOUT THIS DOCUMENT, OFFER WILL BE CONSIDERED INCOMPLETE.

Rev. 00 – Prepared by- H.S.Duggal, Approved by- M.C.Nath (19th June, 2001)
Rev. 01 – Clause 2, 4, 7 & 13 – Modified. Clause 14, 15 & 16 added
Rev. 02 – Clause 11.2 added.
Rev. 03 – Clause 1.2 modified
Rev. 04 – Clause 9 modified (7th September, 2004)
Rev. 05 – Clause 10.4(iii), (iv) updated (8th March,2005)
Rev. 06 – Clause 1.2 deleted
Rev. 07 – Clause 10.4.(iv) updated

QGX-9

QUALITY ASSURANCE DEPARTMENT

QA PLAN FOR: FORGINGS | PI NO: _____ | SHEET 1 of 2

QA PLAN NO: QSP/HG/104 | DATE: 13/10/1993 | REVISION: 01 | DATE: 14/01/2016

SL. NO.	COMPONENT/ASSY/ OPERATION	CHARACTERISTICS	CLASS	TYPE	QUANTUM OF CHECK	REF. DOC.	RECORD FORMAT	INSPECTION AGENCY	REMARKS
1.0	Forging stock (ingot or bloom)	a) Material certification	Major	Review	100%	Spec/ Drawing	TC	Supplier/BHEL/ Customer	
		b) Material identification	Major	Review	100%	Spec/ Drawing	TC	Supplier/BHEL/ Customer	
1.2	Forging	a) Visual and process checks	Major	Review	100%	Approved forging process	Supplier QC record	Supplier/BHEL/ Customer	
		b) Heat treatment	Critical	Heat treatment	100%	Spec	TC	Supplier/BHEL/ Customer	
		c) Marking of test samples as per drawing	Major	Review	100%	Drawing	Supplier QC record	Supplier/BHEL/ Customer	WITNESS
		d) Chemical analysis	Major	Chem	Sample	Spec	TC	Supplier/BHEL/ Customer	WITNESS
		e) Mechanical analysis	Major	Mech	Sample	Spec	TC	Supplier/BHEL/ Customer	WITNESS
		f) Ensure proof marking for availability of machining allowance	Major	Dimensional	100%	Drawing	Supplier QC record	Supplier/BHEL/ Customer	
		g) Marking of PF nos., etc. before rough machining	Major	Review	100%	Drawing	Supplier QC record	Supplier/BHEL/ Customer	
		h) Visual & dimensional checks of rough machined forgings	Major	Visual/ Dimensional	100%	Drawing	Supplier QC record	Supplier/BHEL/ Customer	WITNESS

PREPARED BY: -SD- | CHECKED BY: -SD- | APPROVED BY: -SD- | DATE: 13/10/1993

REVISION 01: 1) "Important note" has been added. 2) The "Type" field was blank for 1.2 c) & 1.2 g). 3) The "Record format" field was blank for Sl. No. 1.2 c). 4) The format has been updated.

PREPARED BY: 14/01/2016 | CHECKED BY: 14/01/16 | APPROVED BY: 15-1-2016 | DATE: 14/01/2016

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QGX-9

QUALITY ASSURANCE DEPARTMENT

QA PLAN FOR: FORGINGS
QA PLAN NO: QSP/HG/104 DATE: 13/10/1993

PI NO: _____
REVISION: 01

SHEET 1 of 2
DATE: 14/01/2016

SL. NO.	COMPONENT/ASSY/ OPERATION	CHARACTERISTICS	CLASS	TYPE	QUANTUM OF CHECK	REF. DOC.	RECORD FORMAT	INSPECTION AGENCY	REMARKS
		i) UT on forging and boroscopic examination	Major	NDT	100%	Drawing	TC	Supplier/BHEL/ Customer	**WITNESS**
		j) Final marking of PF nos., heat nos., identification, etc.	Major	Review	100%	Drawing	TC	Supplier/BHEL/ Customer	
		k) Painting, preservation, and packing	Major	Review	100%	Drawing	TC	Supplier/BHEL/ Customer	

ABBREVIATIONS: NDT - Non Destructive Testing, Mech - Mechanical, Chem - Chemical, Elec - Electrical, Spec - Specification, TC - Test Certificate, QC - Quality Control

IMPORTANT NOTE: Some of the above-mentioned tests may be witnessed by the customer. This shall be intimated at a later date.

PREPARED BY: -SD- CHECKED BY: -SD- APPROVED BY: -SD- DATE: 13/10/1993

REVISION 01: 1) "Important note" has been added. 2) The "Type" field was blank for 1.2 c) & 1.2 g). 3) The "Record format" field was blank for Sl. No. 1.2 c). 4) The format has been updated.

PREPARED BY: 14/01/2016 CHECKED BY: 14/01/16 APPROVED BY: 15/01/2016 DATE: 14/01/2016

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QUALITY ASSURANCE • BHEL BHOPAL • TURBINES & HYDRO GENERATORS

- ALL INSPECTION INCLUDING WITNESS TESTS SHALL BE INSPECTED BY TPIA (THIRD PARTY INSPECTION AGENCY)

BHOPAL	TECHNICAL PRE-QUALIFICATION REQUIREMENTS (TPQR) HYDRO GENERATOR ENGINEERING DIVISION	DOC. NO.: HGG-2210 DATE: 26-07-2022 REV.: 00 PAGE 01 OF 01

The bids are invited from manufacturer or their authorized representative for supply of shaft forging as per BHEL drawing, purchase specification and quality plan.

Following are the Technical Pre-Qualification Requirements (TPQR):

Sr. No.	Description of pre-qualification requirement	Vendor Response	
		Complied/ Not complied	Supporting Documents required to accept compliance
1)	Manufacturer of forging / their authorized representative.		Certificate of being manufacturer (for manufacturer) / authorization (for authorized representative).
2)	Experience of manufacturing steel shaft forging as per HG10035 or equivalent or higher grade (yield point) and supply of the same during last 10 years (see note-3) having following criteria: a) Minimum 3 supplies of individual forging weight of 25000.0 kgs. OR b) Minimum 2 supplies of individual forging weight of 31000 kgs. OR c) Minimum 1 supply of individual forging weight of 50000 kgs.		- Purchase order or - Test certificate & invoice.
3)	Capability of manufacturing shaft forging (Weight:-61661 Kg) as per BHEL drawing, specification and QA plan.		Self-certification of having the capability.
4)	Company shall be certified with ISO 9001. In case of authorized representative, valid ISO certificate of manufacturer is required.		Valid certificate to be submitted.
5)	Vendor to confirm its capacity to manufacture at least 50% of enquired quantity within 5 months of PO. (see note-5)		Supplier confirmation required.

Note:

1. Compliance to above Technical Pre-Qualification Requirements are mandatory. In absence of compliance of above requirements vendor TPQ application is liable to be rejected.
2. BHEL has the right to verify information / confirmation furnished, by asking additional documents, proofs etc.
3. The reference date will be the date of enquiry.
4. For each P.O submitted for point no 2 above, Vendor to provide Contact details such as mail-id, address and contact numbers of mentioned customer for verification purpose.
5. The condition mentioned at sr. no. 5 is to ascertain the suppliers manufacturing capacity and the same is not linked with any delivery schedule.

Prepared By **Checked By** **Approved By**