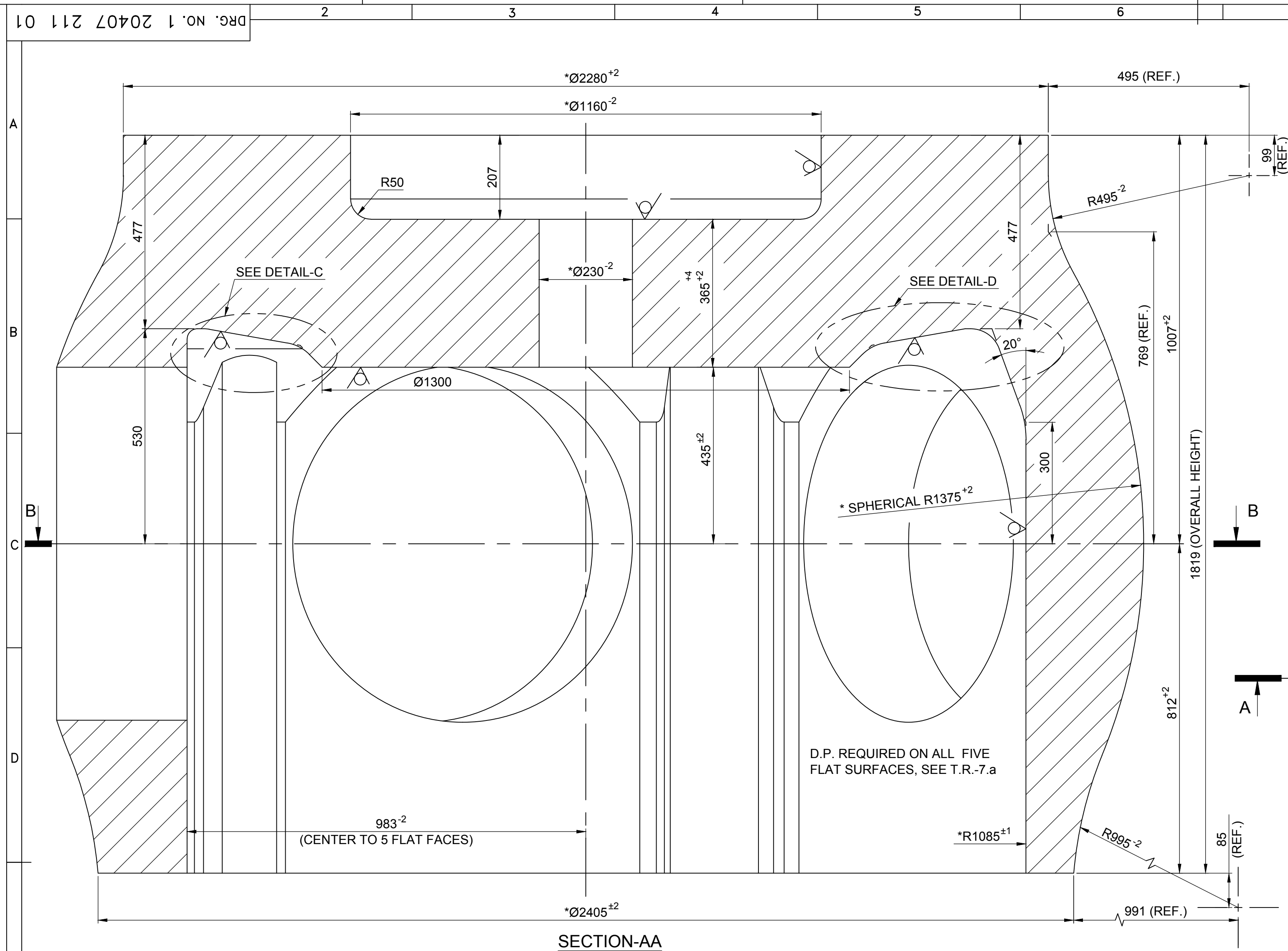


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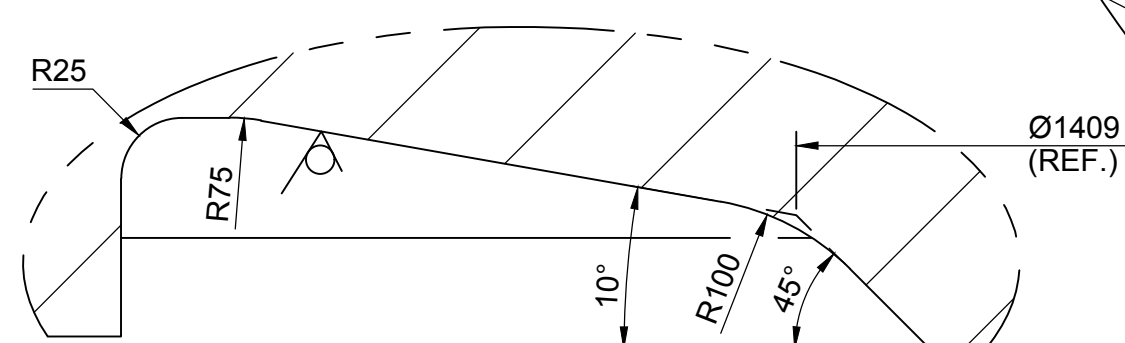


CAUTION FOR FOUNDER:

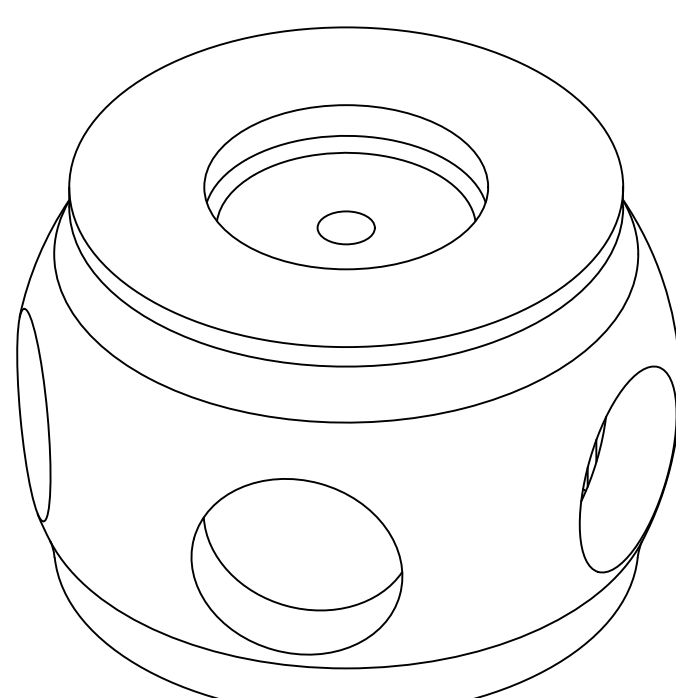
BEFORE START OF FOUNDRY WORK, VENDOR SHALL GET CONFIRMED THE LATEST REVISION NO. OF DRAWING FROM HYDRO TURBINE ENGINEERING, BHEL, BHOPAL. IN CASE OF SLIGHTEST DOUBT CONSULT HYDRO TURBINE ENGINEERING, BHEL, BHOPAL

### TECHNICAL REQUIREMENTS:

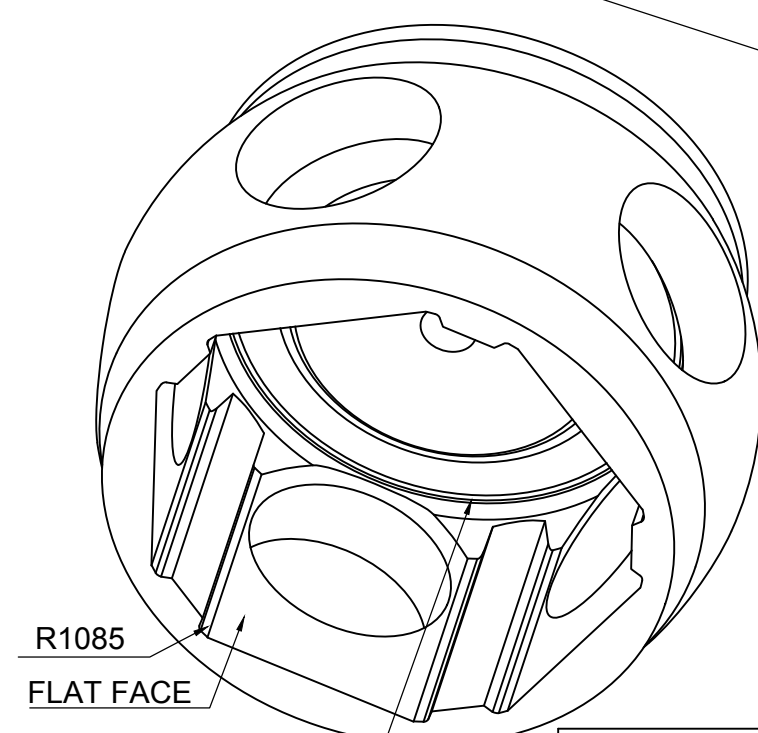
1. MATERIAL : 1.5% Mn STEEL CASTING TO IS:2708 GRADE-3.
2. CASTING TO BE SUPPLIED IN HEAT TREATED AND ROUGH MACHINED CONDITION WITH ADDITIONAL REQUIREMENTS AS PER BHEL SPECIFICATION HT00215 (LATEST REV.).
3. MACHINING TO BE DONE AT SUPPLIER'S WORKS TO THE DIMENSIONS, TOLERANCES AND SURFACE FINISHES SPECIFIED IN DRAWING AND NO FURTHER MACHINING ALLOWANCE TO BE ADDED BY THE SUPPLIER.  
SURFACES MARKED  $\nabla$  ARE AS CAST SURFACES WHICH ARE TO BE SUPPLIED IN GROUND CONDITION WITH SURFACE FINISH OF 12.5 MICRONS OR BETTER.
4. ROUGH MACHINED BORES  $\varnothing 870^{+5}_{-8}$  (FIVE NUMBERS) SHOULD BE IN SAME PLANE.  
\* MARKED DIAMETERS SHALL BE CONCENTRIC WITHIN 1 mm.
5. ALL UNSPECIFIED RADIUS TO BE R20.
6. THE CASTING TO BE THOROUGHLY CLEANED OF ALL SAND AND SCALE BY THE VENDOR.
7. NON DESTRUCTIVE TESTING:
  - a. D.P. ON  $\nabla$  MARKED SURFACES AND FIVE FLAT SURFACES AS SPECIFIED - ACCEPTANCE STANDARD AA 0850132 LEVEL II.
  - b. U.T. ALL OVER - ACCEPTANCE STANDARD AA 0850105 LEVEL II.
  - c. MPI ALL OVER TO ASTM E-125-63 GRADE II/AA 0850134 LEVEL II.
  - d. DOUBTFUL AREAS REVEALED DURING ULTRASONIC TESTING TO BE CHECKED BY RADIOGRAPHY.
8. INTEGRAL TEST PIECES ARE TO BE PROVIDED AT BOTH ENDS. THESE ARE TO BE REMOVED AT FOUNDER'S WORKS BY COLD METHOD IN PRESENCE OF BHEL INSPECTOR / BHEL APPOINTED THIRD PARTY.
9. ANY EXTRA MATERIAL TO BE REMOVED BY CHIPPING / GRINDING.



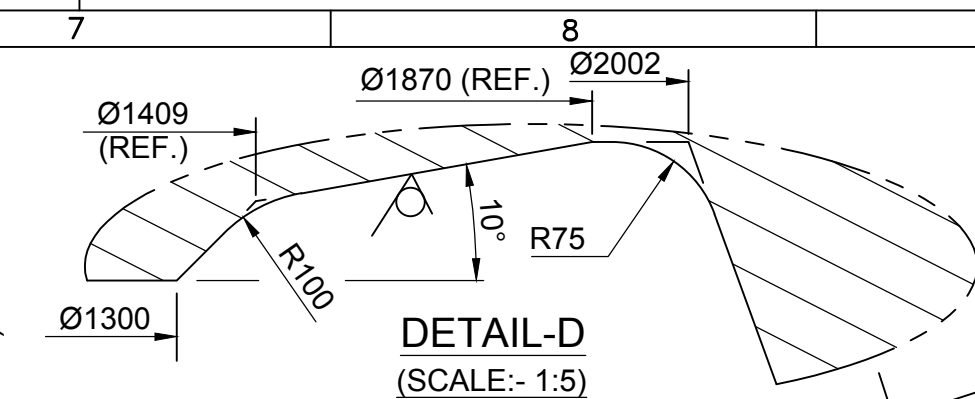
DETAIL-C  
(SCALE:- 1:3)



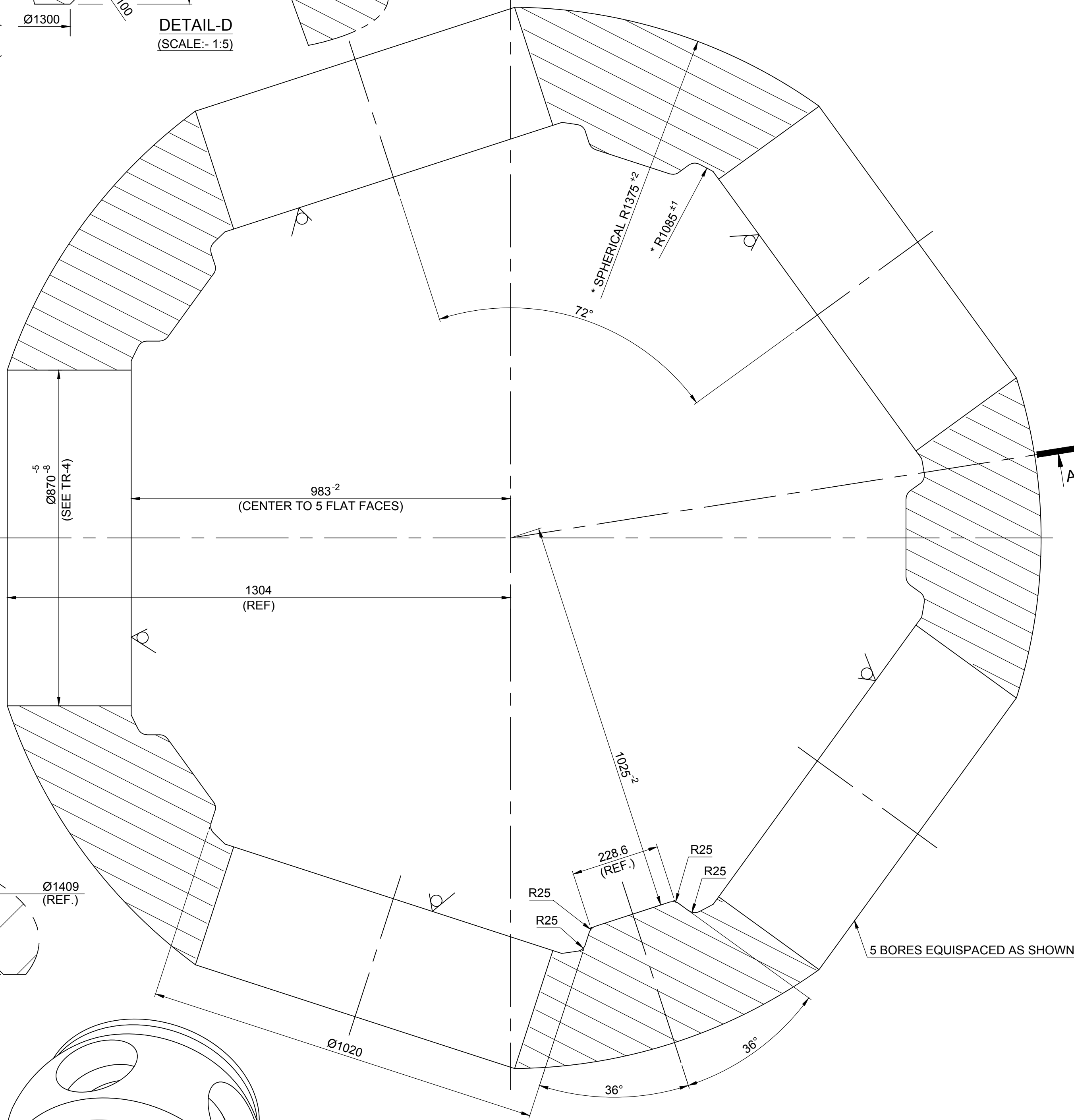
ISOMETRIC VIEW (TOP SIDE)  
(INDICATIVE VIEW)



ISOMETRIC VIEW (BOTTOM SIDE)  
(INDICATIVE VIEW)



DETAIL-D  
(SCALE:- 1:5)




SECTION-BB

										01	RUNNER HUB CASTING (ROUGH MACHINED)																														-																				30168.00																																																
																																									SEE TR-1																														001																																						
59	64	65	75	78	79	25	27	29		58	59	60	77	29	34	45	55	56	57	58	68	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100																																																											
VAR.00										REMARKS										ITEM NO.										DESCRIPTION										STD.										DRAWING NO.										MATL. CODE										MATL. SPCN.										UNIT WT.										QTY.										ZONE									

[illegible]



	<b>PRODUCT STANDARD</b> <b><u>HYDRO TURBINE ENGINEERING</u></b>	<b>HT 00215</b>
		<b>Rev. 05</b>
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<b><u>GENERAL REQUIREMENTS OF STEEL CASTINGS</u></b>		

### 1.0 APPLICATION:

These requirements are in addition to those included in the material specification and have been especially framed for the high performance castings subjected to severe conditions of operation e.g. B.F. valve door, spherical valve body & door, servomotor cylinders, end covers of spider for Pelton turbine, deflectors, nozzle bodies, Kaplan runner hub, bearing shell, stay vanes & stay ring etc.

### 2.0 MATERIAL SPECIFICATION

BHEL std. AA 19521 – 1.5% Mn steel casting / IS 2708 – Grade 1 / ASTM A 148 Gr 80-50 / BS 3100 GR A4 or any other specification as called on the drawing. Casting to be supplied in heat-treated condition.

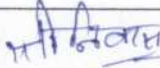


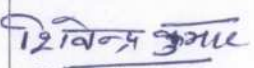
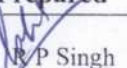

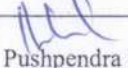

- 2.1 The test pieces shall show an average Charpy impact value of 30 Joules minimum over three test pieces. (However, the minimum value for each test piece shall not be less than 2/3 the average value). The test shall be conducted on a 2mm V-Notch at room temperature ( $23^{\circ} \pm 5^{\circ}\text{C}$ ).

### 3.0 DIMENSIONS/MACHINING REQUIREMENT:


- 3.1 Unless otherwise specified on the drawing, following will be applicable.
- 3.1.1 If the drawing calls for finish machined dimensions, the vendor shall supply the casting in rough machined condition leaving 3 - 5 mm m/cing allowance on tool point on all faces marked thus ✓ on the drawing for final machining at BHEL works.
- 3.1.2 If the drawing calls for rough machined dimensions, vendor shall supply the casting in rough machined condition to drawing dimensions.
- 3.1.3 Dimensions which are called with specific note for finish machining shall be supplied with finish machined dimensions and no allowances to be left on such dimensions by casting vendors.
- 3.2 For as cast surface permissible undulation to be as per sketch. X/L ratio should not be more than  $\pm 0.02$ .



As cast surfaces to have surface finish of 25 micron or better.

Rev. No.	Date of Rev.	Remarks	Approved 			
03	08.01.2015	Completely reviewed	V. S. Rao, AGM HOD - (HTE, HME, HPE & STE).			
04	08.02.2016	Clause 2.0 modified and Clause 3.2 added	Checked			
05	09.09.2022	Completely reviewed	 Alok Bharti, Sr. Mgr-HTE	 Harish Kumar, DGM-HTE	 Shivendra Kumar, DGM-HTE	Prepared
			 P. P. Singh Mgr./ HTE	 Navneet Dubey Mgr./ HTE	 Pushpendra Mani Mgr./ HTE	 Umesh Kumar Dy.Mgr/HTE

Saved in server as no. 42009900215

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<b><u>GENERAL REQUIREMENTS OF STEEL CASTINGS</u></b>		

#### 4.0 **NON DESTRUCTIVE TESTS:**

4.1 Scope: All castings shall be 100% examined by “Ultrasonic method (UT)”, “Magnetic particle inspection (MPI)” & DP test. Also refer the drawing.

The defects which cannot be definitely interpreted by “UT” shall be further examined by “radiography”.

#### 4.2 **PROCEDURE & ACCEPTANCE NORMS:**

	<b>NDT</b>	<b>Procedure</b>	<b>Acceptance Level</b>
A.	Ultrasonic Test	<b>ASTM– A609</b>	ASTM A609 Level-2 for thickness up to 50mm and Level -3 for thickness beyond 50mm. or BHEL Std. AA0850104 Level-II (up to 50mm thickness & below). Level-III (above 50mm thickness)
B.	Magnetic particle test.	<b>ASTM-E-709</b> or <b>BHEL Std. AA0850133</b>	ASTM-E-125-63 Degree-2 with no linear inclusions or cracks. or BHEL Std. AA0850134 Level-2
C.	Radiography test	<b>ASTM-E-1030-84</b>	ASTM-E-446, E-186, E-280 (as applicable to thickness)
D.	Dye Penetrant test	<b>CCH 70.1</b> or <b>BHEL Std. AA0850131</b>	CCH 70.1 RE 70-1 Class-2 or BHEL Std. AA0850132 Level -II


#### 5.0 **REPAIR OF CASTING:**

No major defect shall be repaired or welded without written sanction from BHEL or its representative. Defect shall be considered major if it exceeds 20% of wall thickness or 25mm whichever is smaller in depth, or that which exceeds 160 sq.cm. in area. A cluster of minor defects shall be considered a major defect. All other defects shall be considered minor.

The defects must be chipped down to sound metal and tested using appropriate NDT method such as magnetic particle / dye penetrant etc. When defects have been removed the vendor shall submit a drawing detailing the nature, location, shape & size of each defect to BHEL for approval along with proposed procedure for weld repair (electrodes to be used, preheating temp., post weld heat treatment etc.).

When the repair has been completed (after the consent of the purchaser), non-destructive tests previously carried out shall be repeated together with any additional tests (NDT) considered necessary by the purchaser's representative.

It is preferable to carry out weld repair prior to carrying out normal heat treatment of the casting. In case the weld repair is carried out after normal heat treatment then the casting shall be stress relieved / heat treated (as earlier) depending upon the extent of repairs. Record of all weld repair (including minor repairs) shall be furnished to BHEL along with the details of post weld heat treatment & NDT.

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<b><u>GENERAL REQUIREMENTS OF STEEL CASTINGS</u></b>		

## 6.0 **MEASUREMENT OF THICKNESS:**

When direct measurement of thickness is not possible ultrasonic method to be used to measure and record the thickness as per drawing.

## 7.0 **PAINTING:**

Casting shall be thoroughly shot blasted and supplied in unpainted condition.

## 8.0 **INSPECTION**

8.1 Inspection shall be carried out at vendor's works by BHEL inspector and / or by BHEL appointed third party inspection agency and / or customer's inspection agency as specified in enquiry / PO. All test samples shall be removed in the presence of inspection agency and hard stamped.

8.2 BHEL quality assurance plan wherever supplied along with PO / enquiry, shall be applicable. Else, vendor shall submit his QA Plan for approval by BHEL / BHEL's customer.

## 9.0 **TEST SAMPLES:**

Test pieces for mechanical tests shall be prepared from integrally cast keel blocks from each casting of weight above 500 kg.

### **Retesting**

If the results of mechanical tests are found unsatisfactory, retesting shall be performed on double the number of specimens which gave unsatisfactory results.

In case of unsatisfactory results shown by even one specimen on retesting, reheat-treatment is allowed after which the casting shall be treated as a new one.

## 10.0 **TEST CERTIFICATES:**

Following test certificates shall be supplied unless otherwise stated on the order.

- i) Dimensional inspection
- ii) Chemical composition
- iii) Results of mechanical tests including impact testing and hardness testing.
- iv) Results of NDT and additional tests called for in the drawing / purchase order.


## 11.0 **PACKING & MARKING:**

Castings shall be suitably packed to prevent corrosion and damage during transit. Each package or casting (when supplied separately) shall be legibly marked with the following information:

BHEL Order No.	:
BHEL Drg. No.	:
Heat No.	:
Casting Sl. No.	:
Identification No.	:
Weight	:
Vendor's Name	:

### **NOTE**

1. Identification details to be painted on the casting.
2. Hard stamped test pieces to be dispatched along with the casting.

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<b><u>GENERAL REQUIREMENTS OF STEEL CASTINGS</u></b>		

## **12.0 REJECTION & REPLACEMENT:**

In the event of any casting proving defective from foundry causes in the course of preparation, machining, testing or erection, such casting shall be rejected, notwithstanding any previous certification of satisfactory testing and/or inspection.

The vendor shall undertake to replace the rejected castings at his own cost and the rejected castings shall be sent back to the vendor after fulfilling the commercial terms and conditions.

## **13.0 GENERAL**

13.1 In case of any contradiction between the clauses of PO, this document & material specification, QA plan or drawing, the following hierarchical order of overriding will be applicable.


1. Drawing - **(most important)**
2. P.O
3. HT 00215
4. QA plan
5. Material specification.

13.2 Vendor has to compulsorily supply 2 nos. test pieces per heat with proper identification for testing at BHEL works.

13.3 Before start of manufacturing, vendor has to get confirmation of latest revision of the drawing from HT Engg. / BHEL. Vendor must also have the QA Plan approved before manufacturing starts.

## **14.0 DEVIATION FROM SPECIFICATION:**

Any deviation from the BHEL specifications shall be intimated by the vendor for approval by BHEL, Bhopal. In the absence of this, it /will be deemed that all our requirements given in the drawing and specification are acceptable to the vendor in totality.

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<b><u>GENERAL REQUIREMENTS OF STEEL CASTINGS</u></b>		

## **CHECK LIST**


(Check list to be filled in and submitted along with the offer)

1. Material shall be as per drg.	YES / NO
2. Dimensions shall be as per drg.	YES / NO
3. Heat treatment shall be done as per spec. of material	YES / NO
4. NDT shall be done as per spec	YES / NO
5. Impact testing shall be done	YES / NO
6. Hardness test shall done	YES / NO
7. Mechanical testing shall be done as per material specification	YES / NO
8. Chemical composition shall be done as per material specification	YES / NO
9. Type of furnace used	EAF / IF
10. TCs shall be submitted as per clause 10	YES / NO
11. Keel blocks shall be cast integral with each casting as per clause 9.0	YES / NO
12. Before dispatch each casting shall be properly marked	YES / NO
13. Nature of packing in which casting shall be shipped	
14. Deviations, if any (refer clause 14.0)	YES / NO



Date: \_\_\_\_\_

Vendor's Name and authorized signature



		<b>MANUFACTURER'S NAME AND ADDRESS</b> <b>BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL</b>			<b>MANUFACTURING QUALITY PLAN</b>				<b>PROJ:</b> MEIL POLAVARAM HEP (12X 80 MW) <b>PACKAGE:</b> ELECTROMECHANICAL <b>CONTRACT NO.:</b> MEIL/POLAVARAM <b>HEP/BHEL/3180/E&amp;M/001 DTD:17.05.2021</b>						
					<b>ITEM(S):</b> KAPLAN TURBINE, GOVERNOR, COOLING WATER & DRAINAGE DEWATERING SYSTEM		<b>QAP NO.:</b> QA/HT/2131 <b>REV. NO.:</b> 03 <b>DATE:</b> 26.09.2023 <b>PAGE:</b> PAGE 2 OF 7								
SL NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK(**)		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY				REMARKS
					M/C	B / A				D*	M	C	B	A	
1	2	3	4	5	6		7	8	9	D*	10				11
1.3	Runner hub	Chemical composition	Major	CT	Sample	Sample	Relevant material standard as per Drg		TC	✓	P	R	R	R	
		Mechanical properties	Major	MT	Sample	Sample			TC	✓	P	R	R	R	
		NDT on casting	Major	NDT	100%	100%			-do-	TC	✓	P	W	R	R
1.4	Turbine shaft Forging	Mechanical properties	Major	CT	Sample	Sample	-do-	TC	✓	P	R	R	R		
		Chemical composition	Major	MT	Sample	Sample	-do-	TC	✓	P	R	R	R		
		NDT on forging	Critical	NDT	100%	As per drg.	-do-	TC	✓	P	R	R	R	NDT as per drg.	
1.5	Guide vane (casting) / SS Plates	Chemical composition	Major	CT	Sample	Sample	-do-	TC	✓	P	W	R	R		
		Mechanical properties	Major	MT	Sample	Sample	-do-	TC	✓	P	R	R	R		
		NDT of casting/ welded joints as applicable	Major	NDT	100%	100%	-do-	TC	✓	P	R	R	R		
		Profile check & surface finish	Major	M / VIS	100%	100%	-do-	TC	✓	P	W	R	R	NDT as per drg	
1.6	Bar material for hardware used for coupling of shaft-runner & Gen. shaft-Turbine shaft						Drawing	TC	✓	P	W	R	R		
		Mechanical properties	Major	CT	Sample	Sample	Relevant material standard as per Drg	TC	✓	P	R	R	R		
		Chemical composition	Major	MT	Sample	Sample	-do-	TC	✓	P	R	R	R		
		UT of bar	Major	NDT	100%	As per drg.	-do-	TC	✓	P	R	R	R		

 <b>ASHISH SHARMA</b> Dy. Manager QAT Division Bhopal		<b>LEGEND:</b> * D: RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY SUBMITTED BY SUPPLIER IN QA DOCUMENTATION. M: MANUFACTURER/SUB-SUPPLIER, C: MAIN SUPPLIER FOR EM PACKAGE (BHEL), B-EPC CONTRACTOR (MEIL) A: OWNER (APGENCO)/OWNER'S AUTHORISED REPRESENTATIVE, P: PERFORM W: WITNESS AND V: VERIFICATION AS APPROPRIATE, CHP: CUSTOMER HOLD POINT TC: TEST CERTIFICATE, QCR: QUALITY CONTROL REPORT, JIR: JOINT INSPECTION REPORT, ET- ELECTRICAL TEST, M- MEASUREMENT, CT-CHEMICAL TEST, MT-MECHANICAL TEST, VIS-VISUAL CHECK		<b>FOR APGENCO USE</b>	<b>DOC. NO.:</b>	<b>REV. 00 CAT-B.</b>
		<b>REVIEWED BY</b>	<b>APPROVED BY</b>		<b>APPROVAL SEAL</b>	

**TENDER CONDITION****QUANTITY DISTRIBUTION AND DELIVERY SCHEDULE****1. Total quantity of Runner Hub castings can be distributed to maximum two vendors**

(A) When total quantity is ordered on L1 &amp; L2 vendors.

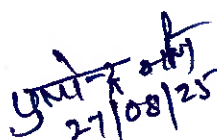
Sr. No.	Vendor	Qty. distribution	Lot qty.	Delivery schedule
1	L1	Hub -3 nos.	1 no.	Within 09 months of PO placement
			1 no.	Within 10 months of PO placement
			1 no.	Within 11 months of PO placement
2	L2	Hub -2 nos.	1 no.	Within 09 months of PO placement
			1 no.	Within 10 months of PO placement

(B) When total quantity is ordered on L1 vendor.

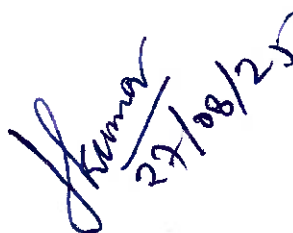
Sr. No.	Vendor	Qty. distribution	Lot qty.	Delivery schedule
1	L1	Hub -5 nos.	1 no.	Within 09 months of PO placement
			1 no.	Within 10 months of PO placement
			1 no.	Within 11 months of PO placement
			1 no.	Within 12 months of PO placement
			1 no.	Within 13 months of PO placement

**2. Splitting of Order**

- a) When L-1 rates as finalized, it shall be counter offered to the other bidders in case of splitting of order. In case any bidder(s) do not accept the L-1 rates, the counter-offer may be extended to other bidders.
- b) In case the numbers of qualified responses are three or more, the distribution shall be limited to two qualified responses i.e. L1 and L2, provided that the next lower bidder accepts the L-1 rates.
- c) In case of two qualified bidders, BHEL reserves the right to place total order quantity on L1 bidder only.



Pushpendra Mani  
Sr. Mgr./HTE



Harish Kumar  
Sr. DGM/HTE



Tejpal Singh Saini  
AGM-HOD/HTE