

**SPECIAL CONDITION ANNEXURE - 1**

**PR No. 145247010 Dt: 04.11.2025**

1. The indented items are required for NPCIL/ GHAVP & Fleet 700MWe Steam Generator Project.
2. Two-part bid. Open tender to be floated.
3. End Use and End User Certificates will not be provided.
4. Supply of Spherical Thrust bearings shall be as per **BHEL: 700MWe: SPH BRNG: FLEET: 001/Latest Revision**, Drawing no. **1-93-172-05239/Latest Revision**, Generic QAP ref. no. **BHEL: QAP: SPH BRNG: 001/Latest Revision**. Supplier to give clause by clause confirmation for all clauses mentioned in the respective technical Specification, drawing and Generic QAP.

Deviations, if any, shall be submitted along with the bid. The generic quality plan provided is tentative and the stages of inspection (review, witness & hold) may have minor changes during review of QAP after P.O.

5. For offer acceptance, the supplier shall have the capacity and experience to manufacture / produce the items as per NPCIL approved specification as indicated above and shall have the capability and experience to produce the item as per the quality standards intended in the specification. It may please be noted that the material will be accepted based on NPCIL approved specifications/drawings only.
6. **As a documentary proof of supplier's experience** in manufacturing the spherical thrust bearings, supplier shall submit along with the offer – the information on various facilities available with them for fabrication, examination and testing of the components, list of reference indicating supplies of component / similar component made earlier along with credentials such as the unpriced P.O, Signed Test Certificate & Shipping release document/ supply invoice copy/ bill of lading/ delivery challan. For heat treatment of components, supplier shall maintain the controlling and recording instruments with valid calibration and accreditation on the day of heat treatment.
7. Offers received will be evaluated by BHEL and NPCIL. Final acceptance of the offers will be based on NPCIL recommendation.
8. Due to stringent quality requirements, offers from traders/dealers/distributors/stockist shall not be entertained and will not be considered for evaluation.
9. Supplier has to submit the following Quality documents after the placement of P.O. for review and approval from BHEL and NPCIL.

Quality Assurance Plan(QAP) in line with attached sample QAP format.

Manufacturing drawings

Heat Treatment Plan (HT Plan)

Inspection and Testing Plan (ITP)

NDE Procedures, Technique sheets and Report Formats

10. The actual production of material is permitted only after approval of all documents required for manufacturing / inspection / testing activities by BHEL and NPCIL.

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**PR No. 145247010 Dt: 04.11.2025**

11. Supplier shall submit their QA Manual/Quality Manual in line with ISO 9001 (Latest version) in bidding stage itself for review and acceptance by BHEL
12. Inspection agency for imports are BHEL & “NPCIL or NPCIL appointed third party inspection (TPI) agency”. Inspection agency for indigenous supply are BHEL and NPCIL.
13. Chemical, Mechanical and Metallurgical tests shall be carried out in Labs having NABL or ISO/ IEC 17025 accreditation or Government approved labs.
14. Supplier shall submit Test Certificates of finished materials for our review. Dispatch clearance will be given after acceptance of Test Certificates by BHEL & NPCIL.
15. Supplier to submit his technical and commercial bid conforming to the above points as given in this annexure.
16. Supplier shall submit the experienced manpower details specific to Manufacturing, Quality and NDE requirements.
17. The material will be ordered in two sets as mentioned in the tender enquiry. **The manufacturing of first set is permitted only after the approval of QAP and test procedures as mentioned in clause no. 9.** The first set to be supplied after completion of all manufacturing activities. **The payment will be made for the first set upon receipt in pro-rata basis. The dynamic load testing of one bearing (To be provided by supplier free of cost) will be performed by BHEL as per specification and the same has to be supplied along with the first set. The manufacturing of second set is permitted only after successful completion of dynamic load testing only.**
18. On the successful event of Placement of P.O, during preliminary inspection by M/s BHEL, supplier shall provide a sample piece of raw material (steel) of suitable size, which is not more than 100x100x100mm from the same melt & HT batch for performing radiation testing of the sample to withstand Gamma and Neutron radiation accumulated dose of 60 Mrads over 40 years without degradation in performance. The specimen shall be cut in presence of BHEL. The item to be shipped to M/s BHEL premises by supplier. Radiation testing will be performed by BHEL.
19. Supplier to guarantee for the products supplied for a period of 18 months from the date of supply or 12 months from the date of commissioning whichever is earlier.
20. Documentation: Three sets of documents containing (i.) Test Certificates and respective test reports (ii.) copies of the approved quality documents and test procedure, (iii.) design change requisitions (if any) and (iv.) Drawing etc. to be provided along with the supply of items.

  
**M. ARUN KUMAR**  
Manager  
Engg & RPD / ATP  
BHEL, TRICHY - 620 014

## SPECIAL CONDITION ANNEXURE - B

### Requirements of Financial Soundness:

1. Import suppliers shall submit latest report from any reputed third party business rating agency like Dun &Bradstreet, Credit reform etc.
2. Indigenous supplier shall submit audited copies of annual reports (Balance Sheet), Profit & Loss statement for the last three years (or from the date of incorporation whichever is less) and GST Certificate.

This Special Condition Annexure-B (Financial Soundness) along with Special Condition Annexure-A (Technical Qualification requirements) together will form the Pre-Qualification requirements for this PR.

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**ASHWIN**  
**KUMAR**  
**MAROLI**

Digitally signed  
by ASHWIN  
KUMAR MAROLI  
Date:  
2022.04.13  
11:31:19 +05'30'

**Advanced Technology Product  
High Pressure Boiler Plant  
Tiruchirappalli – 620 014**

**Specification for Plain Thrust Spherical Bearing Assembly  
of Steam Generator's Vertical Support**

**Specification No.: BHEL: 700MWe: SPH BRNG: FLEET: 001**

Contract :	Nuclear Power Corporation of India Limited (NPCIL)
Project :	Fleet 700 MWe Steam Generator
Work Order :	D167 to D178-001-1-93-172-FLEET

BHEL / ATP - Engineering			NPCIL
Prepared by:	Reviewed by:	Approved by:	
Shamna Raj P Engr.	Nithin K Krishnan Sr.Engr.	M Arun Kumar Dy.Mgr.	

*M. ARUN KUMAR*  
 04/11/2025  
**M. ARUN KUMAR**  
 Manager  
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 BHEL, TRICHY - 620 014

REVISIONS			
REVISION No.	DATE	DESCRIPTION	ORIGINATOR
00	30.08.2022	Initial Issue	M.Arun kumar
01	17.05.2022	Revised incorporating customer comments	M.Arun kumar

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## TABLE OF CONTENTS

1.0	INSTRUCTIONS TO SUPPLIER .....	3
2.0	SCOPE OF EQUIPMENT TO BE SUPPLIED BY SUPPLIER.....	5
3.0	PLAIN THRUST SPHERICAL BEARING FUNCTIONAL REQUIREMENT .....	6
4.0	PLAIN THRUST SPHERICAL BEARING CONSTRUCTIONAL REQUIREMENT .....	7
5.0	DESIGN LOAD DETAILS .....	10
6.0	DRAWINGS AND DOCUMENTATION & REPORTS.....	11
7.0	IDENTIFICATION AND PACKAGING .....	12
8.0	SUPPLIER DATA SHEET(s).....	12
	APPENDIX A – LOCATION OF THRUST BEARING.....	14

## 1.0 INSTRUCTIONS TO SUPPLIER

- 1.1 This specification covers the technical requirements for design, procurement of materials, manufacture/fabrication, inspection, testing, guarantee, packing and supply of self-lubricating plain thrust spherical bearing assembly for 700MWe Steam Generator Support.
- 1.2 The requirements covered under this specification represents the minimum requirements and shall be fully met with.
- 1.3 This Engineering Specification is applicable for all the orders for plain thrust spherical bearing assembly to be placed under this enquiry.
- 1.4 No End User Certificate will be furnished by BHEL/NPCIL.
- 1.5 The Supplier shall complete and submit the Supplier Data Sheets and guarantees as per Section 8.0 of this specification with the equipment offered in full conformance with the specification. All omissions or exceptions to the requirements of this specification must be included in the EXCEPTIONS TO THE SPECIFICATION section of the Supplier data sheet(s). Without the complete data sheets and the EXCEPTIONS TO THE SPECIFICATION sheets, the proposal will not be evaluated.
- 1.6 The Supplier shall be governed by the following regulations, Codes, and standards, including their respective addenda, amendments, and errata. The design, fabrication, examination and testing shall be as per the latest edition of ASME Sec-III, Sub section –NF, Class-1 supports.

ASME Boiler & Pressure Vessel Code.

- Section II - Material Specification
- Section III Subsection NF - Components Support
- Section V - Non-Destructive Examination
- Section III Division 1 - Appendices

ISO Standards

- ISO 12240-3:1998 (Edn.) Spherical plain bearings — Part 3: Thrust spherical plain bearings.
- The applicable material standard shall be followed.

Also, the corresponding material standard of the material shall be referred by the supplier in their documents.

- 1.7 Supplier will defend any suit or proceeding brought against, and will protect, indemnify, save and hold harmless BHEL from and against all liabilities, awards, judgments, losses, costs and expenses (including reasonable attorney's fees) which BHEL incurs or to which BHEL becomes subject, in each case to the extent (i) arising from a claim that any Product or related materials or parts thereof constitute an infringement of any intellectual property or other proprietary right of a third party; or (ii) arising from or relating to any claim that the receipt and use of Products or parts/spares/tools /technical literature /drawings and diagrams thereof or any information provided by Supplier constitute violation of any rights of third party provided under the respective intellectual property laws.

## 2.0 SCOPE OF EQUIPMENT TO BE SUPPLIED BY SUPPLIER

Each Plain Thrust Spherical Bearing Assembly Set shall include, but is not limited to, the following components.

- Top Spherical Washer
- Bottom Spherical Washer

### Important Note:

The configuration of Plain Thrust Spherical Bearing Assembly shall be machined as per BHEL drawing no.: 1-93-172-05239 / latest revision requirements. The dimensions on the spherical mating surface are subject to confirmation from the supplier. Supplier to confirm the overall dimensions (Diameter, Height & Hole size) and surface finish of plain thrust washer indicated in the drawing. Details of greasing groove dimensions are suggestive in nature and to be confirmed by the supplier based on their design and experience. Workmanship and fabrication shall be of high quality and in accordance with best practices permitted to use in the Modern Nuclear Power Plant and shall conform to the requirement of ASME Sec-III, Sub Section-NF (Latest Edition).

Assemblies shall be supplied along with the following.

- a) Quantity shall be as per Tender enquiry
- b) Supplier to include in their scope of supply, if any, complete one set of special tools required for installation and / or maintenance of the Spherical Washer Assembly.
- c) Engineering Drawings & Inspection Reports (The inspection report must be approved by the purchaser and the report shall accompany the thrust spherical bearing when they are shipped)
- d) Type Test Report (One set of bearing, type tested shall not form part of supply) – **Not applicable as testing will be carried out by BHEL**

### 3.0 PLAIN THRUST SPHERICAL BEARING FUNCTIONAL REQUIREMENT

- 3.1 The Steam Generator is supported in vertical direction from two Girder Beam Assembly resting on the concrete wall. The support arrangement consists of Hanger Rod assembly which connects the girder with Steam Generator lugs at the bottom. The vertical load (self-weight of the Steam Generator, piping reactions, seismic load) will be taken by these two hanger rods. Two set of Spherical Washer Assembly are provided per hanger rod (See Drawing No.: **1-93-172-05239** / latest revision)
- 3.2 The purpose of the specified bearing provisions in the Hanger Rod Assembly is to ensure verticality of Steam Generator while safely transmitting the forces due to self-weight of Steam Generator including those arising due to thermal expansion, earthquakes and pipe rupture events as specified in design data of section 5.0 from the supporting lug of steam generator to Girder Beam Arrangement. The thrust bearing assembly is subjected to constant angular and oscillatory motion under specified forces during its lifetime.
- 3.3 The bottom Spherical bearings are retained in their hanger rod position by lock nut arrangement. The top Spherical bearing is retained by nut, filling washer and split pin arrangement.
- 3.4 During normal operations, Spherical bearings at both ends of hanger rods are provided to accommodate the marginal angular rotation of the Steam Generator due to the thermal expansion of connected piping.
- 3.5 The Spherical Washer Assembly should be designed for 40 years of effective service life without maintenance and for operation with the rated loads and cycles provided in design data of section 5.

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#### 4.0 PLAIN THRUST SPHERICAL BEARING CONSTRUCTIONAL REQUIREMENT

- 4.1 Material of top and bottom washer of Spherical Washer Assembly shall be in forged round condition. The material grades 817M40 (EN 24) or 34CrNiMo6 (EN 10269:1.6582) are suggested for top and bottom washer respectively. However, the supplier may select equivalent or superior material and material combination for meeting the functional requirement. The material shall be melted to the fine grain melting practice and vacuum degassed/ **Argon Oxygen Decarburized** and shall be fully killed.
- 4.2 Chemical properties and Mechanical properties **of top and bottom washer of Spherical Washer Assembly** shall comply with 817M40 (EN 24) or 34CrNiMo6 (EN 10269:1.6582) or the equivalent or superior material grade standards.
- 4.2.1 Impact test **of top and bottom washer material** shall be carried out as per applicable material specification. Additionally, impact test for all materials shall be carried out at 0°C as per ASME Sec. III Sub Sec. NF-2300.
- 4.3 **Materials of top and bottom washer** shall be subjected to Non-Destructive examination viz. Visual, Liquid penetrant/ Magnetic particle examination and 100% Ultrasonic examination as per ASME Sec. III Sub Sec. NF (Latest Edition).
- 4.4.1 Liquid penetrant examination / Magnetic particle examination **of top and bottom washer** shall be according to NF-2583.  
Acceptance standard: Linear non-axial indications are unacceptable. Linear axial indications greater than 25 mm in length are unacceptable.
- 4.4.2 Ultrasonic examination shall be according to NF-2584.
- a) Ultrasonic Method. Examination shall be carried out by the straight beam, radial scan method.
  - b) Examination Procedure. Examination shall be performed at a nominal frequency of 2.25 MHz with a search unit not to exceed 650 mm<sup>2</sup> area.
  - c) Calibration of Equipment. Calibration sensitivity shall be established by adjustment of the instruments so that the first back reflection is 75% to 90% of full screen height.
  - d) Acceptance Standards. Any discontinuity that causes an indication in excess of 20% of the height of the first back reflection or any discontinuity which prevents the production of a first back reflection of 50% of the 0 calibration amplitude is not acceptable.
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- 4.5 Heat Treatment of Bottom and Top washer components shall be carried out as per NF-2180 after proof machining keeping required minimum material on all dimensions.
- 4.6 The bottom washer shall have hardness between HRC 20 to 25 and the top washer shall have hardness between HRC 35 to 40. The hardness test shall be done according to the standard specified in the material specification to confirm the above hardness values. These values are only recommended. However, the supplier may provide suitable material combination meeting requirements of the specification.
- 4.7 Final machining shall be carried out after Heat Treatment to meet the final dimension. Axis of both top and bottom part of Spherical Washer Assembly set shall be concentric within 0.2mm.  
Tolerance on open dimensions shall be in accordance with IS: 2102 (Part-1) "Medium".
- 4.8 Components shall be subjected to Visual and Liquid penetrant examinations as per approved procedure after machining.  
Acceptance Standard for visual examination: No visible cracks or pores are acceptable.
- 4.9 Sliding surface (mating surface) concave / convex shall be lapped to the surface finish of not greater than 1.6 microns and at least 90% bearing contact shall be ensured in each Spherical Bearing Assembly set in final assembly. Then, each assembly shall be identified with proper numbering as pair.
- 4.10 Type test of Spherical Washer Assembly (the type test is under BHEL scope):
- Spherical washer assembly is expected to allow movement under specified loads and displacements for Design/Level-A (1000 cycles), Level-B (50 cycles), Level-C/D (10 cycles)
  - Suitable tests shall be carried out to demonstrate the above functionality on sample spherical washer assembly. Test scheme/procedure shall be subject to BHEL & NPCIL approval. **The above functionality test shall be carried out after radiation testing of a sample from top/bottom washer material.**
  - Test shall also be carried out to demonstrate rocking of the Spherical Washer Assembly at the Design load / Level-A load to the angle of 1°.
  - After testing, the mating surfaces shall be subject to visual and surface examination to ensure there is no appreciable degradation to affect the functionality.
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- e) The Spherical Washer Assembly set subjected to type testing shall not be part of supply.

#### 4.11 Workmanship

Workmanship and fabrication shall be of high quality and in accordance with the best practices pertinent to use in a modern nuclear power plant and shall confirm to the requirements for class I component supports as per ASME Sec. III, sub section NF.

#### 4.12 Quality Control (QC) and Quality Assurance

All quality control and quality assurance procedures shall conform to ASME Section III, Division I, Sub section NCA-3800 and NCA-4000 (Latest Edition).

Supplier shall submit a detailed Quality Assurance Plan (QAP) for approval of purchaser / NPCIL.

QAP should describe general practice and sequences of activities (such as non-destructive testing of material, fabrication, inspection heat treatment, control, etc.) to be performed during manufacture of items.

#### 4.13 Spare & Special Tools

Supplier shall supply, if any, complete one set of special tools and spare parts required for installation and / or maintenance of the special spherical bearing.

**5.0 DESIGN LOAD DETAILS**

<b>Design Conditions</b>					
Loading Conditions	Units	Load	Displacement in mm (Swing angle * in °)		Cycles
			East-west	North-South	
Design / Level- A	tons	192	+/- 10 (0.12°)	+/- 10 (0.12°)	1000
Level B	tons	280	+/- 15 (0.18°)	+/- 15 (0.18°)	50
Level C	tons	340	+/- 20 (0.24°)	+/- 20 (0.24°)	10
Level D	tons	422	+/- 20 (0.24°)	+/- 20 (0.24°)	10
<b>Operating Conditions</b>					
Temperature	Spherical washer shall be in contact with sleeve which is in contact with SG lug (~ Temperature 200°C) at an ambient temperature of 80°C during normal operation. Ambient temperature during accidental condition shall peak to 175°C within ~ 30 seconds and reduce to 80°C within approx. 3 hours' time.				
Humidity	%	Max 100%			
Environment	<b>Radiation:</b> It shall be designed to withstand Gamma and Neutron radiation accumulated dose of 60 Mrads over 40 years without degradation in performance.				
*→ These are displacements at SG bottom support lug i.e. at bottom spherical bearing assembly with respect to top spherical bearing assembly.					

## 6.0 DRAWINGS AND DOCUMENTATION & REPORTS

### 6.1 Submitted with Quotation

- 6.1.1 The Supplier to provide dimensional outline drawings of the bearing. The drawings to contain material combination, overall dimensions, finish, lubrication/ coating type, mounting connections, clearances required for proper installation and state the weights of all major components.
- 6.1.2 List of special tools and equipment as required for assembling, complete dismantling, and maintenance of all equipment supplied.
- 6.1.3 QAP for Purchaser's review.
- 6.1.4 Clause to clause acceptance for the specification.

### 6.2 Submitted During Contract

- 6.2.1 Detailed engineering arrangement drawings of the bearing assembly unit including interface information, etc. All materials shall be readily identifiable on Supplier's drawings specifically in Bill of Material.
- 6.2.2 All the fabrication drawings to be submitted to purchaser for approval before commencement of fabrication of Spherical Washer Assembly.
- 6.2.3 The quality plan to be submitted by supplier for purchaser's **approval prior to manufacture.**
- 6.2.4 Heat Treatment procedure to be submitted by supplier for purchaser's approval.
- 6.2.5 Non Destructives Examination (NDE) procedure for Penetrant test, **Magnetic Particle test** and Ultrasonic Examination of forged round bar to be submitted by supplier in line with annexure for purchaser's **approval prior to manufacture.**
- 6.2.6 Type testing procedure with supporting drawings shall be submitted for purchaser's **approval prior to manufacture.** – this is not applicable for the enquiry as type testing will be performed by BHEL.
- 6.2.7 **The following documents need to be submitted prior to dispatch clearance**
  - 6.2.7.1 As-built drawing for each Spherical Washer Assembly
  - 6.2.7.2 Material test certificates
  - 6.2.7.3 Inspection reports as per quality plans as approved by purchaser or his authorized agency before shipment of the bearing assembly

## 7.0 IDENTIFICATION AND PACKAGING

Identification marking and packaging shall be done as specified below.

- 7.1 Each bearing housing to be marked by electro etching or by any other suitable permanent marking method **on the OD side of washer** with following information as minimum.
- a) Manufacturer's Name and Year of Manufacture
  - b) Material Specification including melt number**
  - c) Part Number and / or Serial Number
  - d) Purchaser order / or Work Order number
  - e) Design Load and References of National & International standards.
- 7.2 All surfaces of the bearing assembly should be cleaned and should be free of oil, grease and other impurities before packing. Packing should be suitable for tropical conditions and protect the bearings and accessory parts against external damage during normal handling and shipping. It should be capable of withstanding storage period of about four years before its installation in the plant. Packaging shall be marked for identification, contents, destination, consignee and degree of handling care.

**8.0 SUPPLIER DATA SHEET(s)**

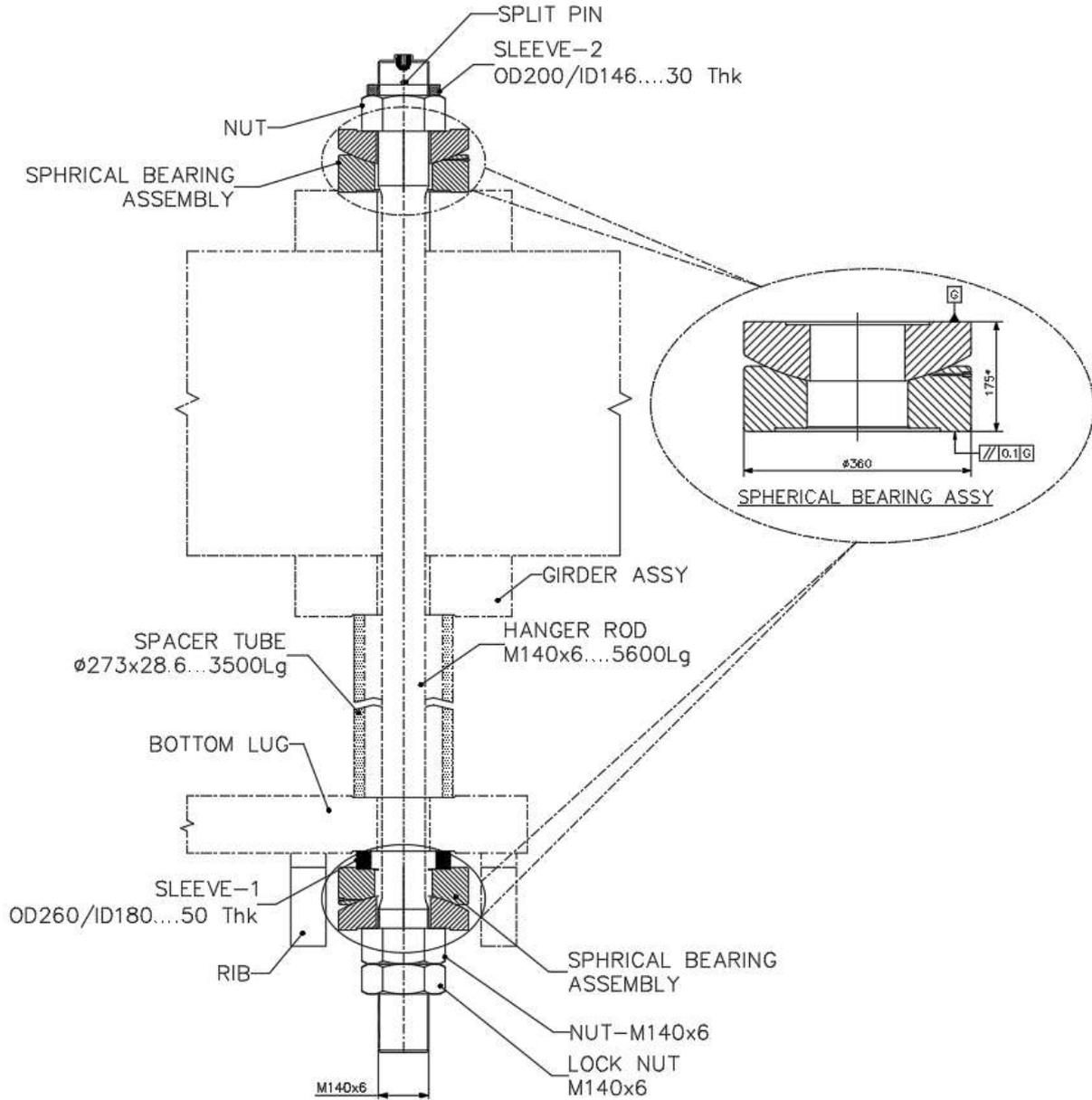
<b>Design &amp; Constructional Data</b>			
Parameter	Units	Value	Remarks
<b>Bearing Constructional Details</b>			
Top Spherical Washer Material			
Top Spherical Washer Material Hardness	HRC		
Bottom Spherical Washer Material			
Bottom Spherical Washer Material Hardness	HRC		
<b>Dimensional Details</b>			
Overall bearing height	mm		
Bearing Area	mm <sup>2</sup>		
<b>Bearing Design Data</b>			
Type of Arrangement		Spherical	
Co-efficient of friction for the given load and operating conditions			
<b>Performance Data</b>			
Type test Load	Ton	422	Level D
Allowable Max. Angular Movement	Degree	1	
Operating Temperature range	°C		

**Note: Exceptions to the Specification**

We have conformed to Sections 1.0 through 7.0 and Drg. no.: **1-93-172-05239** / Latest revision except as specifically noted as follows:

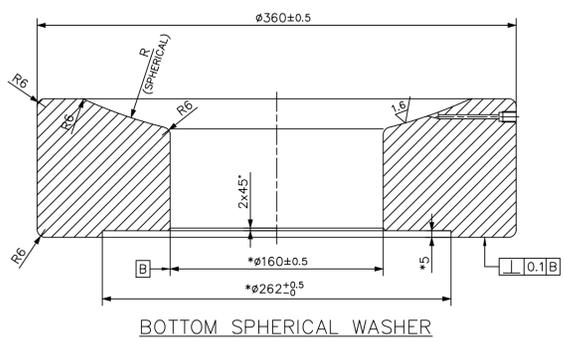
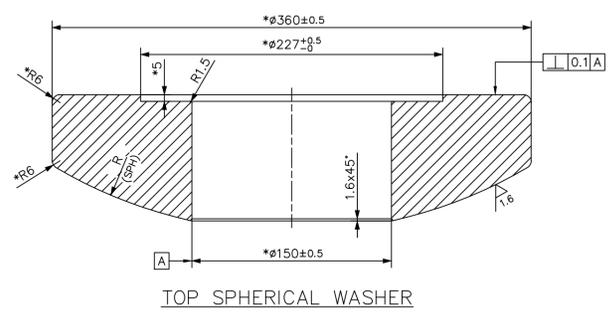
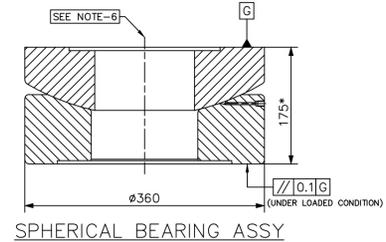
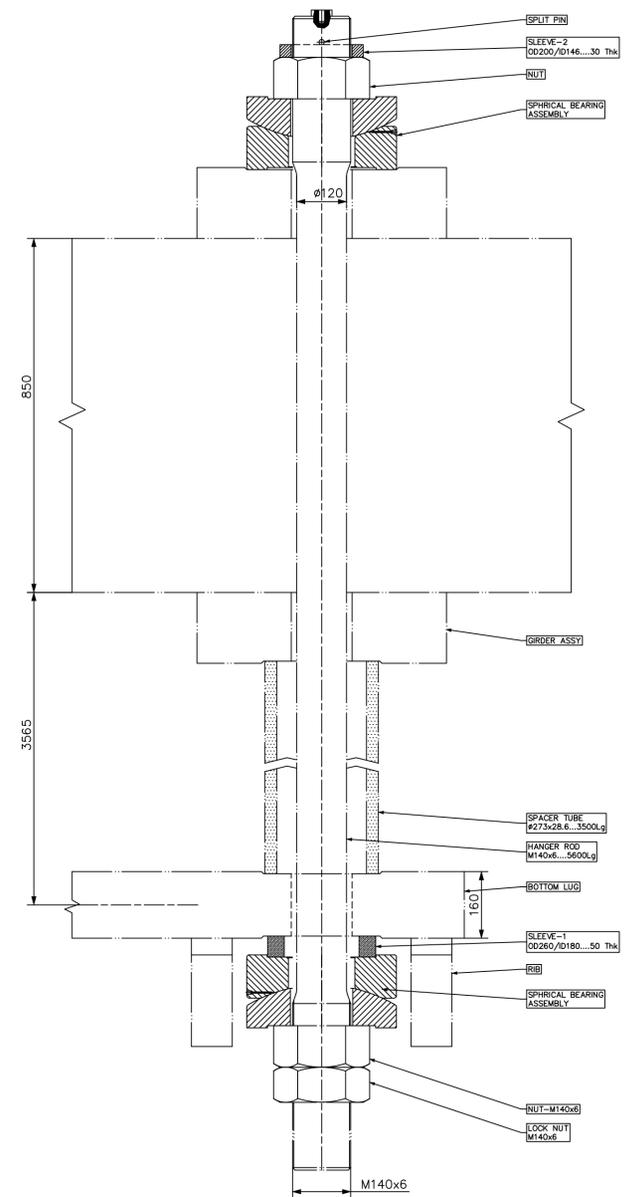
Enquiry Specification		Deviation	Accepted by BHEL
Clause No	Requirement		
			Yes/ No

**Appendix A – Location of Thrust bearing**



1-93-172-05239  
DRAWING NO.

ALL DIMENSIONS ARE IN MILLIMETERS



NOTES:-

- DESIGN VALIDATION, MATERIAL, MANUFACTURING & EXAMINATION SHALL BE AS PER APPLICABLE BHEL SPECIFICATION BHE:3800:700MWe:D157:001/LATEST REVISION AND PC-M-965/REV-00.
- MATERIAL DESIGN, FABRICATION EXAMINATION AND TESTING ETC., SHALL BE AS PER ASME SEC III SUB SECTION NF, CLASS-I SUPPORTS. FURTHER THEY SHALL MEET RELEVANT PROCEDURE APPROVED BY NPCIL.
- DETAIL DIMENSIONS & DESIGN SHALL BE PROVIDED BY THE SUPPLIER WITH AXIAL LOAD CAPACITY OF 422 TONNES FOR SPHERICAL WASHER ASSEMBLY.
- THE COMPONENT SHALL BE SUPPLIED AS CLOSE TO THE FINISHED SHAPE AS POSSIBLE.
- EASILY REMOVABLE RUST PREVENTIVE COATING SHALL BE APPLIED DURING SHIPPING TO ENSURE SEA-WORTHINESS AND FOR STORAGE IN TROPICAL CONDITIONS.
- AXIS OF BOTH TOP & BOTTOM PART OF SPHERICAL WASHER ASSEMBLY SET SHALL BE CONCENTRIC WITHIN 0.2
- ALL SHARP EDGES SHALL BE ROUNDED OFF.
- BRACKETED DIMENSIONS ARE FOR REFERENCE ONLY.
- MATERIAL:
  - SPHERICAL WASHER TOP : 817M40 (EN24)/EQUIVALENT OR SUPERIOR
  - SPHERICAL WASHER BOTTOM : 817M40 (EN24) / 34CrNiMo6/ EQUIVALENT (OR) SUPERIOR
- APPROXIMATE WEIGHT:
  - SPHERICAL WASHER TOP : 48 kg
  - SPHERICAL WASHER BOTTOM : 61 kg
- SPHERICAL WASHER SHALL BE SUPPLIED AS A SELF LUBRICATING TYPE STANDARD ITEM SUITABLE FOR FOLLOWING LOAD

CONDITIONS : DESIGN/LEVEL-A : 192 TONNES  
 LEVEL-B : 280 TONNES  
 LEVEL-C : 340 TONNES  
 LEVEL-D : 422 TONNES

- SPHERICAL WASHER ASSEMBLY SHALL ENSURE SMOOTH ROTATION OF HANGER ROD TO ALLOW DISPLACEMENT OF SG BOTTOM IN BOTH HORIZONTAL DIRECTIONS. DISPLACEMENTS AT SG BOTTOM SUPPORT LUG UNDER VARIOUS OPERATION CONDITIONS ARE AS FOLLOWS:

CONDITION	DISPLACEMENT (mm)	
	EAST-WEST *	NORTH-SOUTH*
DESIGN/LEVEL-A	±10	±10
LEVEL-B	±15	±15
LEVEL-C	±20	±20
LEVEL-D	±20	±20

(\* - FOR DIRECTION, REFER DRG. No. 1-93-171-05208/LATEST REV.

13. ENVIRONMENTAL CONDITIONS:

- TEMPERATURE:**  
SPHERICAL WASHER SHALL BE IN CONTACT WITH SLEEVE -1 WHICH IS IN CONTACT WITH SG LUG (~ TEMPERATURE 200°C) AT AN AMBIENT TEMPERATURE OF 80° C DURING NORMAL OPERATION, AMBIENT TEMPERATURE DURING ACCIDENTAL CONDITION SHALL PEAK TO 175°C WITHIN ~30 SECONDS AND REDUCE TO 80°C WITHIN APPROX. 3 HOURS TIME.
  - RADIATION:**  
IT SHALL BE DESIGNED TO WITHSTAND GAMMA AND NEUTRON RADIATION ACCUMULATED DOSE OF 60 MRADS OVER 40 YEARS WITHOUT DEGRADATION IN PERFORMANCE.
  - HUMIDITY :** 100% (MAX)  
SPHERICAL WASHER SHALL DESIGNED FOR 40 YEARS LIFE WITHOUT MAINTENANCE AND FOR OPERATION WITHIN THE RATED LOAD, ENVIRONMENTAL CONDITIONS AND ASSEMBLY DETAILS SPECIFIED.
- SIZE AND DETAILS OF SPHERICAL WASHERS SPECIFIED IN DRAWING ARE INDICATIVE. HOWEVER, DETAILS OF STANDARD SPHERICAL WASHER SHALL BE AS CLOSED AS POSSIBLE TO THE PROVIDED DIMENSIONS.
  - THE MATCHING COMPONENTS SHALL BE MODIFIED IF REQUIRED, BASED ON THE FINAL DIMENSIONS OF THIS COMPONENT SUBJECT TO NPCIL APPROVAL.

TOLERANCE IF NOT SPECIFIED SHALL BE AS BELOW (REFER IS 2102-m)

GENERAL TOLERANCES FOR FABRICATION	LINEAR		ANGULAR	
	0.5 TO 3	3 TO 6	0 TO 10	10 TO 50
FOR LINEAR	±1.5	±0.1	±0.8	±1°
FOR ANGLES	±1°	±0.1	±1.2	±30'
FOR MACHINING	IS2102-m	±0.2	±2.0	±20'
FOR WELDING	DIN EN ISO 13920:1996-11	±0.5	OVER 400	±5'

TYPE OF PRODUCT: 700MWe STEAM GENERATOR  
 OR NAME OF CUSTOMER/PROJECT: W.O.No.D167-001-1-93-172-FLEET (Customer Drg.: 700FLEET/3311/4230/DD/REV.01)

Bharat Heavy Electricals Ltd  
 UNIT: HIGH PRESSURE BOILER PLANT  
 TIRUCHIRAPALLI - 620014

DEPT: NC  
 CODE: 150  
 GRADE OF UNTOOL DIM: C/M/F  
 SCALE: NTS  
 WEIGHT (Kg):  
 REF TO ASSY / OLD DWG:  
 TITLE: SPHERICAL BEARING ASSEMBLY  
 CARD CODE: U 01  
 DRAWING NO.: 1-93-172-05239  
 REV: 00

NAME: NKK  
 SIGNATURE: [Signature]  
 DATE: 040821  
 DRN: MAK/EARUN  
 APPD: M.A.  
 NO. OF ITEMS: 060821

CAUTION: The information on this document is the property of BHPAT. It is to be used directly or indirectly in any way detrimental to the interest of the company.

Supplier's Name and Address		Generic Quality Plan for Plain Thrust Spherical Bearing Assembly				Project: FLEET 700MWe SG			
Supplier's Name and Address		Item: Spherical Thrust Washer		QP No.: To be filled by Supplier		W.O.: D167 to D178-001-1-93-172			
Supplier's Name and Address		Material: To be specified by supplier		Rev. No.: To be filled by Supplier		P.O No: To be filled			
Supplier's Name and Address		Sub-system: Steam Generator		Date: To be filled by Supplier		Dated :			
Supplier's Name and Address		Page No: 1 of 4							
Sl. No	Component & Operations	Characteristics	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Agency	Remarks
1.	2.	3.	4.	5.	6.	7.	8.	M B N	10.
<b>1.0</b>	<b>Raw Material (forged rod):</b>								
1.1	Testing	Chemical (Ladle)	T.C. Verification	Sample/heat	As per specification & Applicable standard		TC	P R R	Refer note-1 & 2
1.2		Mechanical (including impact at 0°C)	Physical	Sample/heat/ HT batch	As per specification, Applicable standard & MSTP		RD	P H R	Refer note-1 & 2
1.3		Chemical (Product)	Physical	Sample/Heat	As per specification, Applicable standard & MSTP		RD	P H R	Refer note-2
<b>2.0</b>	<b>Testing of raw material</b>								
2.1	Ultrasonic testing of blanks	Material Integrity	NDE of metal	100%	As per specification & approved UT procedure		RD	P H R	Refer note- 7
2.2	Proof Machining	Machining	Measurement	100%	As per specification		RD	P R R	
2.3	Heat Treatment	HT	Review of HT chart	100%	As per specification and HT Plan		RD	P W R	Refer Note - 4

Prepared	Reviewed & Approved	Reviewed & Approved	Reviewed & Approved
<b>SUPPLIER'S NAME: To be filled</b>			
BHEL		NPCIL	

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**M. ARUN KUMAR**  
 Manager  
 Engg & RPD / ATP  
 BHEL, TRICHY - 620 014

Supplier's Name and Address		Generic Quality Plan for Plain Thrust Spherical Bearing Assembly				Project: FLEET 700MWe SG						
Supplier's Name and Address		Item: Spherical Thrust Washer		QP No.: To be filled by Supplier		Material: To be specified by supplier		Rev. No.: To be filled by Supplier		P.O No: To be filled		
Sub-system: Steam Generator		Reference Document		Acceptance Norms		Format of Record		M		B N		
Sub-system: Steam Generator		Reference Document		Acceptance Norms		Format of Record		M		B N		
Sl. No	Component & Operations	Characteristics	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	M	B	N	Remarks	
<b>3.0</b>	<b>Bottom Washer :</b>											
3.1	Machining of bottom washer	Machining	Measurement of all dimensions	100%	As per Approved Drawing	As per Approved Drawing	IR	--	P	R	R	
3.2	Turning of spherical face (included bent plates)	Turning	Measurement of all dimensions	100%	As per Approved Drawing	As per Approved Drawing	IR	--	P	R	R	
3.3	Visual Check examination of bottom washer spherical face	Visual	Visual	100%	Free from Visual Defects	Free from Visual Defects	IR	--	p	H	R	
3.4	MT examination of bottom washer (before drilling of assembly holes)	Material Integrity	NDE of metal	100%	As per specification & approved MT procedure (procedure indicating the size & shape of the product at the time of NDE will be submitted for review & approval)	As per specification & approved MT procedure (procedure indicating the size & shape of the product at the time of NDE will be submitted for review & approval)	RD	√	P	H	R	Refer note-5,6 & 7
3.5	Hardness check	Hardness measurement	Hardness	100%	As per standard, ASTM A 370 & Specification	As per standard, ASTM A 370 & Specification	IR	√	P	H	R	Refer note-5
3.6	Dimension check after drilling of Assembly hole	Dimension check	Dimensions as per drawing	100%	As per Approved Drawing	As per Approved Drawing	IR	√	P	H	R	

Prepared		Reviewed & Approved		Reviewed & Approved	
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*(Signature)*  
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Supplier's LOGO	Supplier's Name and Address		Generic Quality Plan for Plain Thrust Spherical Bearing Assembly					Project: FLEET 700MWe SG				
			Item: Spherical Thrust Washer Material: To be specified by supplier Sub-system: Steam Generator	Reference Document	Acceptance Norms	Format of Record	Agency		W.O.: D167 to D178-001-1-93-172	P.O No: To be filled Dated :		
Sl. No	Component & Operations	Characteristics	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	M	B	N	Remarks	
3.7	MT examination of bottom washer (after drilling of assembly holes)	Material Integrity	NDE of metal	100%	As per specification & approved MT procedure		RD	√	P	H	R	Refer note-5,6 & 7
<b>4.0</b>	<b>Top Washer :</b>											
4.1	Machining of top washer	Machining	Measurement	100%	As per Approved Drawing		IR	--	P	R	R	
4.2	Turning of spherical face	Turning	Measurement of all dimensions	100%	As per Approved Drawing		IR	--	P	R	R	
4.3	Visual Check examination of top washer spherical face	Visual	Visual	100%	Free from Visual Defects		IR	--	p	H	R	
4.4	MT examination of top washer	Material Integrity	NDE of metal	100%	As per specification & approved MT procedure (procedure indicating the size & shape of the product at the time of NDE will be submitted for review & approval)		RD	√	P	H	R	Refer note-5,6 & 7

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Prepared	Reviewed & Approved	Reviewed & Approved	BHEL	Reviewed & Approved	NPCIL		
<b>SUPPLIER'S NAME: To be filled</b>							

**M. ARUN KUMAR**  
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Supplier's Name and Address		Generic Quality Plan for Plain Thrust Spherical Bearing Assembly				Project: FLEET 700MWe SG						
Supplier's Name and Address		Item: Spherical Thrust Washer	QP No.:	To be filled by Supplier		W.O.: D167 to D178-001-1-93-172						
Supplier's Name and Address		Material: To be specified by supplier	Rev. No.:	To be filled by Supplier		P.O No: To be filled						
Supplier's Name and Address		Sub-system: Steam Generator	Date:	To be filled by Supplier		Dated :						
Supplier's Name and Address		Page No.:	4 of 4									
Sl. No	Component & Operations	Characteristics	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Agency	Remarks			
								M	B	N		
4.5	Hardness check	Hardness measurement	Hardness	100%	As per standard, ASTM A 370 & Specification		IR	✓	P	H	R	Refer note-5
4.6	Dimension check after drilling of Assembly hole	Dimension check	Dimensions as per drawing	100%	As per Approved Drawing		IR	✓	P	H	R	
4.7	MT examination of top washer (after drilling of assembly holes)	Material Integrity	NDE of metal	100%	As per specification & approved MT procedure		RD	✓	P	H	R	Refer note-5,6 & 7
<b>5.0</b>	<b>Assembly of top and bottom washer :</b>											
5.1	Lapping of convex & concave portions of bottom and top washer	Lapping	Visual check, Surface finish & Blue matching	100%	As per specification to meet 90% contact area.		IR	--	P	H	R	Refer note- 9
5.2	Assembly of top & bottom washer	Final Dimension	Height & dimensions	100%	As per Approved Drawing		IR	--	P	H	R	Refer note- 9
<b>6.0</b>	<b>Radiation testing</b>	Performance	Radiation test	1/each melt of forged rod & each HT batch	As per specification to withstand Gamma & Neutron radiation accumulated dose of 20mrads over 40 years		IR	--	P	R	R	
Prepared		Reviewed & Approved	Reviewed & Approved		Reviewed & Approved							
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Supplier's Name and Address		Generic Quality Plan for Plain Thrust Spherical Bearing Assembly					Project: FLEET 700MWe SG				
Supplier's Name and Address		Item: Spherical Thrust Washer Material: To be specified by supplier		QP No.: To be filled by Supplier		W.O.: D167 to D178-001-1-93-172					
Sub-system: Steam Generator		Material: To be specified by supplier		Rev. No.: To be filled by Supplier		P.O No: To be filled					
Sub-system: Steam Generator		Reference Document		Date: To be filled by Supplier		Dated :					
Sub-system: Steam Generator		Page No: 5 of 4		Acceptance Norms		Form of Record					
Sub-system: Steam Generator		Quantum Of check		Reference Document		M B N					
Sub-system: Steam Generator		Type of Check		As per approved procedure		P H R					
Sub-system: Steam Generator		Characteristics		Identification as per specification		P H R					
Sub-system: Steam Generator		Performance		As per approved procedure		P H R					
Sub-system: Steam Generator		Specification, Grade, Melt No, SI No, Supplier's Seal, Inspector Seal		100%		P H R					
Sub-system: Steam Generator		Rigidity		100%		P H R					
Sub-system: Steam Generator		Compilation of documents & issue of release note		100%		P H R					
Sub-system: Steam Generator		Type testing		1/each melt of forged rod & each HT batch		P H R					
Sub-system: Steam Generator		Marking		100%		P H R					
Sub-system: Steam Generator		Packaging		100%		P H R					
Sub-system: Steam Generator		Documentation		100%		P H R					
7.0	Type testing	Performance	Type test	1/each melt of forged rod & each HT batch	As per approved procedure	IR	--	P	H	R	The item subjected to type test, shall not be a part of supply.
8.0	Marking	Specification, Grade, Melt No, SI No, Supplier's Seal, Inspector Seal	Visual & Record verification	100%	Identification as per specification	IR	--	P	H	R	
9.0	Packaging	Rigidity	Verification and Visual	100%	As per approved procedure	IR	--	P	H	R	
10.0	Documentation	Compilation of documents & issue of release note	Verification	100%	As per P.O	HD	--	P	H	R	

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Supplier's LOGO	Supplier's Name and Address		Generic Quality Plan for Plain Thrust Spherical Bearing Assembly		Project: FLEET 700MWe SG
	Item: Spherical Thrust Washer Material: To be specified by supplier Sub-system: Steam Generator		QP No.: To be filled by Supplier	Rev. No.: To be filled by Supplier	W.O.: D167 to D178-001-1-93-172
Supplier's Name and Address		Date: To be filled by Supplier		P.O No: To be filled	
Supplier's Name and Address		Page No: 6 of 4		Dated :	

**Note:**

- The manufacturing process shall be fully killed & vacuum degassed.
- Co-related original material test certificate is acceptable. In the absence of co-related material test certificate, sample per lot (lot means, all material having same heat mark / material specification requirements) for chemical and physical test shall be drawn and witnessed by BHEL. All material verification reports and test reports as per material specification shall be submitted to NPCIL for checking / verification and clearance. The MSTP (Material Sampling and Testing Plan) indicating the orientation, location & size of test specimens for all the applicable tests as per Fig.-2 of EN 10088-3 will be submitted for BHEL & NPCIL approval and testing will be done as per the same.
- Stamping of raw material and stamp transfer shall be done by BHEL.
- Heat treatment shall be carried out in calibrated furnaces. Heat treatment shall be submitted for approval. Also the calibration certificates of recorders, controllers, TCs also will be submitted for review.
- Calibrated instruments shall be used for inspection, examination and testing.
- NPCIL approved consumables for magnetic particle examination shall be used.
- Nondestructive examinations shall be done by qualified personnel as per minimum Level-II of ISNT or ASNT.
- Hardening of bottom washer shall be done, only if the material hardness is outside the range specified. Signed HT Chart shall be submitted in case of heat treatment.
- Axis of both top & bottom part of spherical washer assembly set shall be concentric within 0.2mm. At least 90% bearing contact shall be ensured in each spherical bearing assembly set in final assembly. Also parallelism of both top & bottom washers shall be within 0.2mm as indicated in drawing. Further each assembly shall be identified with proper numbering as pair.
- Stage wise inspection documents shall be concluded/completed with signature of all inspection agencies including NPCIL QS, before taking up and presenting the next stage for inspection.
- It is certified that M/s. BHEL has incorporated all the technical requirements as per P.O., specifications & drawings.

*(Signature)*  
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 Manager  
 Engg & RPD / ATP  
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