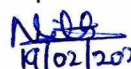
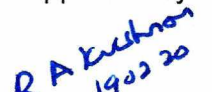


**Advanced Technology Products
High Pressure Boiler Plant
Tiruchirappalli – 620 014**

**Specification for Hemi Spherical Ball Housing Assembly
of Steam Generator's Top Guide Support**

Specification No.: BHEL: 700MWe: Hemi Spherical Ball Housing Assy: 001

Contract :	Nuclear Power Corporation of India Limited (NPCIL)
Project :	Gorakhpur Haryana Anu Vidyut Pariyojna (GHAVP-1&2)
Work Order :	D157 to D160-001-1-93-171

BHEL / ATP - Engineering			NPCIL
Prepared by:  19/02/2020 NITHIN K. KRISHNAN Nithin K. Krishnan Engg. & Advanced Technology Products BHEL, Tiruchirappalli - 620 014.	Reviewed by:  19/02/20 M. LAKSHMINARASIMHAN M Lakshminarasimhan Dy. General Manager Engg., Mktg. & Commercial Advanced Technology Products BHEL, Tiruchirappalli - 620 014	Approved by:  19/02/20 R. Ananthakrishnan R. Ananthakrishnan Dy. General Manager Advanced Technology Products BHEL, TRICHY - 620 014	

REVISIONS			
REVISION No.	DATE	DESCRIPTION	ORIGINATOR
00	01.07.2019	Initial Issue	Nithin K. Krishnan
01	26.11.2019	Revised clause nos. 1.6, 2.0, 3.0, 4.1, 4.3, 4.4.2, 4.10, 4.11, 5.0, 6.2.5, Appendix-A	Nithin K. Krishnan
02	03.02.2020	Revised clause Nos. 3.0 and 4.1	Nithin K. Krishnan

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1.0 INSTRUCTIONS TO SUPPLIER

- 1.1 This specification covers the technical requirements for design, procurement of materials, manufacture/fabrication, inspection, guarantee, packing and supply of self-lubricating hemi spherical ball housing 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 hemi spherical ball housing 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 ASME Sec-III, Sub section-NF, Class-1 supports (Latest Edn.).

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

- DIN EN 10269: Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties or equivalent manufacturing standard.

British Standard

- BS: 970 for Wrought Steel for Mechanical and allied engineering purpose or equivalent manufacturing standard.

- 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 hemi spherical ball housing Set shall include, but is not limited to, the following components.

- Ball Housing
- Hemi Spherical Ball

Important Note:

The configuration of hemi spherical ball housing shall be machined as per BHEL drawing no.: 3-93-171-05470/ latest revision requirements. Details of greasing groove dimensions are suggestive in nature and to be confirmed by the supplier based on his design and experience. Supplier to confirm the overall dimensions and surface finish of hemi spherical ball housing indicated in the drawing. 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 Edn.).

Assemblies shall be supplied as per the following.

- a) Quantity of supply shall be as specified in Tender Specification
- 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 hemi spherical ball housing when they are shipped)

3.0 FUNCTIONAL REQUIREMENT OF HEMI SPHERICAL BALL HOUSING

- 3.1 During site erection, the Steam Generator is supported at the top with the help of Top Guide Supports. The Top Guide Supports will be assembled in such a way that 3-3.5 mm gap (gap on one side only) is maintained between the face of supporting lug of Steam Generator and the flat face of hemi spherical ball housing assembly of top guide supports (Refer Appendix-A for details).
- 3.2 The purpose of the specified hemi spherical ball housing assembly of top guide supports is to act as guide support in horizontal direction (N-S and E-W) and allow the angular movement of steam generator while safely transmitting the forces that arises due to dead weight, thermal expansion, earthquakes and pipe rupture events as specified in design data of section 5.0 from the supporting lug of steam generator to Top Guide Support Arrangement. The hemi spherical ball housing assembly shall be designed to allow movement under specified loads: **Design/Level-A (1000 cycles), Level-B (50 cycles), Level-C/D (10 cycles)** during its lifetime.
- 3.3 The hemi spherical ball housing assembly should be designed for 40 years of effective service life without maintenance and for operation with the rated loads provided in design data of section 5.

4.0 HEMI SPHERICAL BALL HOUSING CONSTRUCTIONAL REQUIREMENT

- 4.1 Material of hemi spherical ball bearing shall be 817M40 (EN 24) or 34CrNiMo6 (DIN EN 10269:1.6582) in forged round condition for the hemi spherical ball with additional material test requirement as required under customer specification PC-M-965 Rev.00 and SA193 Gr. B7 for ball housing as per ASME Sec. II Part A (Latest Edn.). 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, vacuum degassed and shall be fully killed.
- 4.2 Hemi spherical ball housing Chemical properties and Mechanical properties shall comply with 817M40 (EN 24) or 34CrNiMo6 (DIN EN 10269 :1.6582) for hemi spherical ball and SA193 Gr. B7 for ball housing or the equivalent or superior material grade standards.
- 4.3 All material shall be subjected to Non-Destructive examination viz. Visual, Liquid penetrant/ Magnetic particle and 100% Ultrasonic examination as per ASME Sec. III Sub Sec.NF (Latest Edn.).
- 4.4.1 Magnetic Particle or Liquid penetrant examination shall be according to NF-2583.
- 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 mm² 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 calibration amplitude is not acceptable.
- 4.5 Hardness of hemi spherical ball and ball housing shall be suitably different with hardness of ball housing at least 4 HRC higher than hemi spherical ball. The
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hardness test shall be done according to the standard specified in the material specification to confirm the above hardness values.

- 4.6 Heat Treatment of ball housing and hemi spherical ball, if required shall be carried out after proof machining keeping required minimum material on all dimensions.
- 4.7 Final machining shall be carried out after Heat Treatment to meet the final dimension.
- 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 Spherical surface of hemi spherical ball shall be lapped with spherical groove in ball housing ensuring proper bearing of 70-80%. Then, each assembly shall be identified with proper numbering as pair.
- 4.10 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 (Latest Edn.).

4.11 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 Edn.).

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 manufacturing of items.

4.12 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 hemi spherical ball housing.

5.0 DESIGN LOAD DETAILS

Design Conditions			
Loading Conditions	Units	Load in each pair of Ball Housing (T)	
		Horz-1 Load (East-West)	Horz-2 Load (North-South)
Design	tons	2	5
Level- A	tons	11	9
Level B	tons	125	141
Level D	tons	180	190
Level D (Rupture)	tons	1	4
Load to be considered for design of Hemi Spherical Ball Housing Assembly	tons	Level D Conditions (Max. Load condition)	
Operating Conditions			
Temperature of surface in contact	°C	325	
Humidity	%	Max to 100%	
Environment	Radiation: It shall be designed to withstand Gamma and Neutron radiation accumulated dose of 20 MRads over 40 years without degradation in performance.		

6.0 DRAWINGS, DOCUMENTATION & REPORTS

6.1. To be submitted with Quotation

- 6.1.1 The Supplier to provide outline drawings of the hemi spherical ball housing conforming to the drawing provided. 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 for review.
- 6.1.4 Clause to clause acceptance for the specification.

6.2 To be submitted after awarding Contract

- 6.2.1 Detailed engineering drawings of the hemi spherical ball housing 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 hemi spherical ball housing.
- 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 Liquid penetrant/ Magnetic particle 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 **The following documents need to be submitted prior to dispatch clearance**
 - 6.2.6.1. As-built drawing for each hemi spherical ball housing
 - 6.2.6.2. Material test certificates
 - 6.2.6.3. Inspection reports as per quality plans as approved by purchaser or his authorized agency before shipment of the hemi spherical ball housing

7.0 IDENTIFICATION AND PACKAGING

Identification marking and packaging shall be done as specified below:

- 7.1 Each hemi spherical ball housing to be marked by electro etching or by any other suitable permanent marking method with following information as minimum.
 - a) Manufacturer's Name and Year of Manufacture
 - b) Material Specification
 - c) Part Number and / or Serial Number
 - d) Purchaser order / or Work Order number
- 7.2 All surfaces of the hemi spherical ball housing shall be cleaned and shall be free of oil, grease and other impurities before packing. All finish machined surfaces and threaded surfaces shall be protected suitably to avoid any damage during handling, heat treatment or otherwise. Packing must be suitable for tropical conditions and should 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)

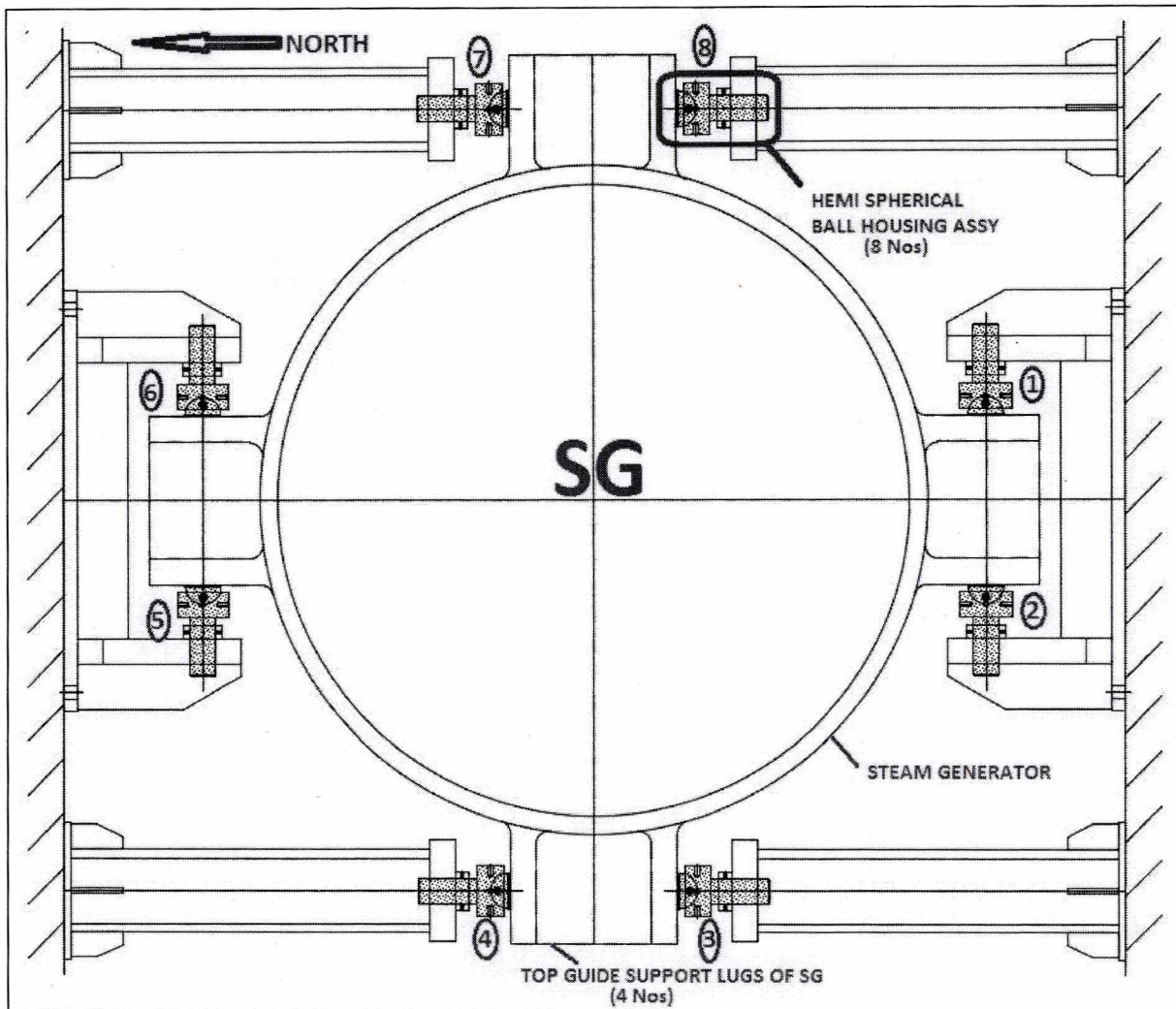
Design & Constructional Data			
Parameter	Units	Value	Remarks
Bearing Constructional Details			
Ball Housing Material			
Ball Housing Material Hardness	HRC		
Hemi Spherical Ball Material			
Hemi Spherical Ball Material Hardness	HRC		
Dimensional Details			
Bearing Area between Ball Housing and Hemi Spherical Ball (70-80% reqd)	%		

Note: Exceptions to the Specification

We have conformed to Sections 1.0 through 7.0 and Drg. no.: 3-93-171-05470/
Latest revision except as specifically noted as follows:

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

Appendix A – Assembly of Hemi Spherical Ball Housing with Steam Generator



The assembly of Hemi Spherical Ball Housing with Steam Generator top guide support lugs is shown pictorially in the top sectional view of steam generator.