



## TECHNICAL SPECIFICATION OF HYDRO LABYRINTHS


**Specification No.: EMRP-TS-EM-E002, Rev.0**  
**Dt. 27.11.2012**

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TOTAL NO. OF SHEETS = 34  
(INCLUDING COVER SHEET)

IT IS CONFIRMED THAT OUR TECHNICAL OFFER COMPLIES WITH THE SPECIFICATION IN TOTO, & THAT THERE ARE NO TECHNICAL DEVIATIONS AS SUCH & TECHNICAL DEVIATIONS (IF ANY) ARE ENCLOSED SEPARATELY ALONG WITH OFFER.

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BIDDER'S STAMP & SIGNATURE

**SECTION – 'A'**  
**SCOPE OF SUPPLY**

1. Bidder's scope covers the supply of HVOF coated Hydro-labyrinths casting or forging in fully finished basis as per the following table.

Raw material (vendor to specify)	Specification/drawings/technical spec
a) For casting	ASTM A743 CA 6 NM & Product Standard HT-00252
b) For forging	ASTM A 473M TYPE S41500 & Product Standard HT-00012
Machining of forging/casting (the drawings are for finished components with HVOF coating. The required machining dimension is to be calculated by considering the nominal thickness of HVOF coating)	As per drawing Nos 1. 1223017203 upper labyrinth 2. 12230117804 lower labyrinth 3. 22230117801 upper outer stationary labyrinth 4. 22230117802 upper inner stationary labyrinth 5. 22230117803 lower stationary labyrinth As per above drawings and section- 'B' Part – 'A'
HVOF coating application	As per drawing Nos 1. 1223017203 upper labyrinth 2. 12230117804 lower labyrinth 3. 22230117801 upper outer stationary labyrinth 4. 22230117802 upper inner stationary labyrinth 5. 22230117803 lower stationary labyrinth As per above drawings and section- 'B' Part – 'B'

2. It is not the intent to specify herein all the details of design & manufacture. However, the items shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing in continuous commercial operation up to bidder's guarantee.
3. The bidders shall be responsible for and governed by all requirements stipulated hereinafter.
4. Requirements of the specification including the QAP shall be agreed upon for total compliance by bidders without any deviations. Price offers of only those bidders complying with this requirement shall be acceptable.
5. The documents shall be in English language and MKS system of units.
6. Bidder must furnish point wise compliance to technical specification and any deviation must be specifically listed as technical deviations. BHEL reserves the right to accept any deviation based on requirement.

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## SECTION – 'B'

### PART-A

**Note:** *Offer of only those suppliers would be considered who fulfil the requirement asked in vendor qualifying criteria.*

**1. Material:**

a) Stainless Steel casting as per ASTM A 743 CA 6 NM with supplementary requirement as per product standard HT-00252

Or

b) Stainless Steel forging as per ASTM A 473M Type S 41500 with supplementary requirement as per product standard HT-00012

(Vendor to specify a of b)

2. Labyrinths are to be supplied in finish machined condition as per drawings along with individual support fixtures / transport fixture & necessary hardware used in fixture. Vendors have the choice of dispatching the three upper labyrinths (having drawing no. 22230117801, 22230117802 & 12230117803) in one fixture with proper clamping arrangement and similarly the two lower labyrinths (having drawing no. 22230117803 & 12230117804) in one fixture with proper clamping arrangement. Transport fixture should have sufficient strength & provisions to maintain dimensional stability and to prevent damage to HVOF coated surfaces & other machined surfaces during transportation. Supplier to note that, labyrinths will be finally checked & cleared at BHEL Bhopal works and if any deviation found from the specification & drawing (even because of transportation), supplier to do the needful correction to meet the specification & drawing requirements without any price repercussions.

3. Labyrinths are to be supplied in heat treated condition to surface finish & tolerances specified in the drawing.

4. Labyrinths shall be free from defects i.e. cracks, scales, fins, porosity, segregation, hard spots, excessive non-metallic inclusions. No patching or welding will be permitted.

5. Test pieces are to be integrally cast at suitable places and to be removed in presence of BHEL inspector after complete heat treatment cycle for per melt per heat treatment batch. Test piece should be of sufficient size so as to carry out the tests for chemical composition & mechanical properties.


6. Labyrinths are to be examined by NDT as per clause – 4 of product standard HT-00252 in case of castings and product standard HT-00012 in case of forgings after machining.

7. Supplier to furnish the test certificates for chemical composition & mechanical properties.

8. Supplier's offer should be accompanied by a drawing of fixture of the 5 types of labyrinths without which the offer will be rejected.

9. Suppliers to arrange casting for the labyrinths from the M/s SJVN's approved vendors only, refer Annexure - B for list of M/s SJVN's approved vendors. For forging material suppliers can arrange from suggested vendor list as per Annexure – C. (Vendor to specify casting or forging). List of vendors should be approved by BHEL.

10. Labyrinths are to be supplied with **Tungsten Carbide coating with minimum 500 micron thickness by HVOF process** having final dimension & extent of coating as per drawings. HVOF coating to be arranged by the supplier at any of the following parties:

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i) M/s Associated Thermal Spray, Ahmedabad

ii) M/s Industrial Processors and Metallizers (P) Ltd, Delhi

iii) M/s Metallizing Equipment Company Pvt Ltd, Jodhpur

iv) HVOF coating is very critical requirement from M/s SJVN (customer) and for this process any other vendor will be considered only after due acceptance of successful testing of sample piece by M/s SJVN. In this case vendor has to take prior approval from M/s SJVN without any price implication to BHEL.


11. Vendor to take care of the machining before HVOF coating to achieve the final dimension of HVOF coated surface as per drawing with the coating thickness 500 micron minimum.

12. Vendor to submit the pre-machining drawing with the dimensions before HVOF coating for reference before start of manufacturing.

13. Details of HVOF coating to be as follows:

- Application Process : High Velocity Oxygen Fuel (HVOF) spray process / High Pressure High Velocity Oxygen Fuel (HPHVOF) thermal spray of proven quality
- Coating thickness : 500  $\mu$ m (minimum)
- Surface Roughness : 5  $\mu$  Ra (average)
- Coating Material : Tungsten Carbide Cobalt Chrome
- Density : 12.7 g / cm<sup>3</sup> (as sprayed)
- Macro Hardness : Equivalent RC 65 – 70 at 98 N load
- Adhesive Bond Strength : 70 – 100 MPa (tensile test in normal direction to the surface)

14. Supplier to submit their quality plan for BHEL's approval before start of manufacturing.

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**PART-B**  
(For HVOF coating)

**1 DESCRIPTION OF WORK:**

HVOF coating is to be carried out on each labyrinth on surfaces marked in respective drawing.

**2 SCOPE OF WORK:**

2.1 HVOF coating (including grit blasting) on the specified areas as per the attached drawing and the technical specification as detailed below.

2.2 Total coating is to be carried out at any of the three parties mentioned at clause – 10 of Part-A of this annexure. The specified area is to be coated by using liquid fuel (ATF) and Robot only. Entire coating is to be performed in one go without any manual handling of the job. There should not be any overlapping of the coating on the HVOF coated area.

2.3 Before starting the coating, it should be ensured that the area to be coated is free from any defects like scratch marks, tooling marks, serrations, pin holes or any defects revealed after grit blasting etc. and shall be repaired / rectified and ground. It should be thoroughly ensured that the surface finish is adequate prior to start of coating.

2.4 If the labyrinths are dispatched independently such that coated surface is exposed then the coated surfaces should be suitably protected by bubble sheet after coating & placed in suitable fixture by the vendor to avoid any damage to the coated surfaces during transportation.

**3 TECHNICAL SPECIFICATIONS**

**A. Coating Material**

The coating powder of M/s Sulzer Metco make Brand name: WOKA 3652 FC only is acceptable and if any other powder is to be used then approval for the same shall be taken from BHEL's customer, M/s SJVN. The powder shall meet all the requirements as mentioned in the QP for hard coating material (copy attached).

All the quality checks as per the QP shall be adhered to and met.

Vendor to provide document to confirm procurement source of coating powder. The vendor should provide test certificate of chemical composition of coating powder from any Government approved lab


**B. Coating properties requirements:**

- 1) Surface roughness : 5 microns Ra (average)
- 2) Coating Thickness : 500 µm minimum
- 3) Coating hardness : 1250 - 1500 HV
- 4) Bond Strength : Min. 10000 Psi
- 5) Porosity : < 1%
- 6) Micrograph

Note: The coating thickness per pass should be maintained as 15-20 microns from a gun with a velocity of at least 2000 m/s.

**C. Coating parameters**

Vendor to submit the coating parameters prior to start of coating and the same shall be followed during the entire coating of job and samples as well. BHEL / M/s SJVN will verify the parameters at any time during the coating.

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**D. Grit blasting requirement:**

1. Grit : Alumina grit of size 16-24 mesh
2. Surface finish after grit blasting: Ra 10-15 microns

**E. Masking:**

Proper masking should be provided by vendor to protect non-coating areas during grit blasting and HVOF coating.

**F. Inspection:**

In-process and final quality checks shall be strictly as per the QP for HVOF coating. (Copy attached). The expenses for sample testing have to be borne by the vendor only. All the testing has to be carried out by NABL approved lab only as per the QP. The final inspection will be done by M/s SJVN at vendor's works. It is the responsibility of the vendor to get the labyrinths cleared by M/s SJVN before dispatch to BHEL - Bhopal works.

BHEL / M/s SJVN will have the right to cross check the parameters for their own reference and information at any point of time during the coating. BHEL / SJVN's inspector shall have full access to their job during coating operation and can continuously witness the job during coating.

**G. Testing Instrument:**

Vendor should arrange calibrated surface roughness thickness and temperature measuring instruments for measurement.

**4. WITHDRAWAL FROM THE CONTRACT**

In case the vendor withdraws the contract after its acceptance by BHEL or fails to complete the work as per the terms and conditions of contract, BHEL shall be at liberty to cancel the work order and to recover from the vendor the extra cost and other loss incidental to the breach of contract on the part of the vendor


**5. The offer should be unconditional. Any deviation from our requirement leads to rejection.**

**6. PERFORMANCE GUARANTEE**

The vendor shall guarantee that the operating life of hard coating shall be 12 months from the date of operational acceptance / commissioning of the unit. In case the coating done by contractor fails to meet the requirements of technical specification, then, the contractor shall go to the site and do the necessary repairing and satisfy the customer. To ensure this future activity BHEL takes the performance guarantee. Performance guarantee of **10%** of the contract value shall be submitted to BHEL. The performance guarantee will be applicable for 12 months from the date of operational acceptance / commissioning of the unit or 2 years from the date of supply whichever is earlier. The recoating shall be done after doing weld repairing if occurred due to erosion of the HVOF coating on the pre coated parts.

However even if the commissioning of the unit is delayed due to any reason, if any peeling off of coating is reported during a period of 24 months from the date of supply it has to be rectified by the vendor at their cost at the site only.

Note: Peeling off of coating, if any, during / after the coating operation / during handling should be rectified immediately and the required area shall be recoated by the vendor at their own cost. The vendor shall also guarantee that coating shall not peel off during transportation.

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## 7. DELIVERY

1. Delivery of items to be done at CRX/ BHEL Bhopal.
2. Delivery schedule shall be as per the following table

No of lot	No of set	Date of delivery
1	3 sets	Within 1 month from date of PO placement
2	5 sets	Within 2 month from date of PO placement
3	5 sets	Within 3 month from date of PO placement
4	5 sets	Within 4 month from date of PO placement


Note:-

Delivery is not a criterion for rejection of offer; this can be negotiated and mutually agreed upon. Early delivery is also acceptable.

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<b><u>ANNEXURE - 3</u></b>			
<b><u>DRAWING LIST</u></b>			
IT NO	DESCRIPTION	DRAWING NO	
1	UPPER OUTER STATIONARY LABYRINTH	22230117801 REV00	ATTACHED HERewith
2	UPPER INNER STATIONARY LABYRINTH	22230117802 REV00	ATTACHED HERewith
3	LOWER STATIONARY LABYRINTH	22230117803 REV00	ATTACHED HERewith
4	UPPER LABYRINTH	12230117803 REV00	ATTACHED HERewith
5	LOWER LABYRINTH	12230117804 REV00	ATTACHED HERewith



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**ANNEXURE – 4**  
**CUSTOMER APPROVED QAPs (ATTACHED HEREWITH)**

1. Successful vendor to submit their quality plan for BHEL's approval before start of manufacturing. Quality plan has to be prepared by vendor in accordance with the relevant portions of the SJVN (customer) approved QAP attached herewith.