

MAIN SUPPLIER'S NAME:

BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL
(A GOVERNMENT OF INDIA UNDERTAKING)



NAME OF SUB-VENDOR: N/A

NPCIL PO NO.: CMM/FTP/10-32-1-1152/e-PO/30447, DTD: 24.01.19

QA REF. NO.:

MAIN VENDOR: ~~QAX-TH-1479~~ 2190191

SUB VENDOR: N/A

CUSTOMER:

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)



PROJECT:

2x700MW GORAKHPUR HARYANA ANU VIDYUT PARIYOJANA
(UNIT 1&2)

EQUIPMENT: MODERATOR HEAT EXCHANGER

DOCUMENT NO.: BHEL / NPCIL / 30447 / SS FORGING / CDE-19-3408

TITLE:

TECHNICAL SPECIFICATION FOR STAINLESS STEEL FORGING

न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
NUCLEAR POWER CORPORATION OF INDIA LTD.

☒ अनुमोदित / APPROVED *with minor comments*
☐ टिप्पणी के अनुसार अनुमोदित / APPROVED AS NOTED
☐ संशोधन को आगे बढ़ाएं / रोके ।
 PROCEED WITH / HOLD FABRICATION
☐ अंतिम ट्रान्सपेरेंसी एवं प्रतियाँ भेजें ।
 SEND FINAL TRANSPARENCIES & PRINTS
☐ संशोधन करें एवं अनुमोदन के लिए पुनः प्रस्तुत करें ।
 REVISE AND RESUBMIT FOR APPROVAL

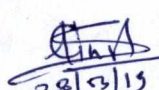
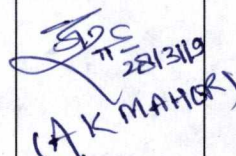
जाँचकर्ता CHECKED BY <i>प्र. व. न. शर्मा</i> 10/4/19	समीक्षकर्ता REVIEWED BY <i>म. वा. हर</i> 10/4/19	अनुमोदन कर्ता APPROVED BY <i>म. व. न.</i> 10/4/19
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किए जानेवाले कार्य का अनुमोदन आपूर्तिकर्ता को विनिर्देशों के अनुसार
आपूर्ति के उत्तरदायित्व से मुक्त नहीं करता ।
The Approval of the work to be done does not relieve the supplier of
responsibility of supply according to specifications.

01	28.03.2019	2+7 = 9	<i>प्र. व. न. शर्मा</i> 28/03/19	<i>म. वा. हर</i> 28/03/19	<i>म. व. न.</i> 28/03/2019
00	08.03.2019	2+7 = 9	-Sd- (DK AUDH)	-Sd- (M WAHAB R)	-Sd- (ASNANI L)
REV NO.	DATE	PAGES	PREPARED BY	CHECKED BY	APPROVED BY

	CONDENSER & HEAT EXCHANGER ENGG. DIVISION BHEL BHOPAL	Document No.
		BHEL / NPCIL / 30447 / SS FORGING / CDE-19-3408
TECHNICAL SPECIFICATION FOR STAINLESS STEEL FORGING		

REVISION CONTROL SHEET

BHEL					
REV. No Date	PAGES	Description of Revision	Prepared By	Checked By	Approved By
00, 08.03.2019	2+7=9	Original submission with correction in sr. nos. of clause no. 3 from cl no. 3.6 onwards.	-Sd- (DK AUDH)	-Sd- (M WAHAB R)	-Sd- (ASNANI L)
01, 28.03.19	2+7=9	Incorporation of following NPCIL comments dtd: 14.03.19 : 1. Cover sheet updated. 2. Annexure-1: Dimensions incorporated in sketch showing Test sample location for forging. 3. Annexure-3: Forging drawing no. of Tubesheet 1-16503-40864. 4. Annexure-4: Forging drawing no. of Channel Flange 1-16503-40833.	 28/03/19	 28/03/19	 28/03/19 (A K MAHAR)

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ANNEXURE 2

SPECIFICATION OF SS FORGINGS

1.0 SCOPE

This specification is for manufacture, inspection, testing, tropical packaging and delivery of stainless steel forgings for heat exchangers. S.S. forgings conforming to ASME-SA-182 F316L (with carbon & Cobalt percentage restricted to 0.03% max.), fully solution annealed, meeting supplementary requirements of S1, S2 and S8 of SA-182, ultrasonic and liquid penetrant examination.

2.0 MATERIAL MANUFACTURING AND TESTING REQUIREMENTS

- 2.1 The material shall conform to requirements SA-182 F 316 L with restriction on carbon & Cobalt content not to exceed 0.03% each.
- 2.2 Supplementary requirements S1, S2 and S8 of SA – 182 shall be met. With reference to S1, the acceptable criteria in respect of E-340 and E-381 would be
 - i) Sub-surface condition S2
 - ii) Random condition R2
 - iii) Centre Segregation C1
 - iv) Flute cracks, gassy appearance, butt tears, splash, flakes, etc. are not acceptable to any degree.
- 2.3 The steel shall be vacuum degassed and refined. The steel shall have very high degree of cleanliness and shall be controlled for cleanliness quality equivalent to :
 - a) Cleanliness according to ASTM-E-45 method D:
 - A smaller or equal to 1
 - B smaller or equal to 2
 - C smaller or equal to 1
 - D smaller or equal to 3
 - b) O₂, H₂ and N₂ shall also be controlled to
 - i) O₂ lower or equal to 80 ppm
 - ii) H₂ lower or equal to 5 ppm
 - iii) N₂ lower or equal to 0.1%
- 2.4 The grain size of finished forgings shall be determined as per ASTM-E-112. The grain size shall be ASTM No.3 or finer. Micrographs shall be attached to test certificates.

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- 2.5 Tube sheets and corresponding test plate forgings shall be from the same heat and shall undergo similar forging reduction ratio and heat treatment so as to get properties in tube sheets and corresponding test plates as close to each other as possible.

Tube sheets and test plates belonging to one heat shall be clearly identified.

A sketch showing plan of tube sheets and test plates from each ingot shall be submitted by the manufacturer.

- 2.6 Hardness measurement shall be done on each piece of forged item. The hardness shall be in the range of RB 86 to RB 95.

- 2.7 Mechanical testing shall be done from specimens from following locations / orientations and shall meet requirements specified in SA-182 and Section III NB 2223.

- 2.7.1 For each tube sheet and channel flange forging, the tension test shall be carried out as follows:

Specimens at location A

- i) One tension test in axial direction,
- ii) One tension test in tangential direction.
- iii) One tension test in radial direction.

Specimens at location B

Similar three additional specimens will be taken at 90° from the location of the specimen at A for carrying out tension test as given above.

Specimens to be taken parallel to the hub from the area close to the hub. Sketches showing the specimen locations are to be submitted by the bidder
Refer Annexure-1 having sketch showing Test sample location for forgings.

- 2.7.2 For each test block, tension test shall be carried out as follows:

- i) One tension test in axial direction,
- ii) One tension test in tangential direction.
- iii) One tension test in transverse direction.

Sketches showing the specimen locations are to be submitted by the bidder.

Refer Annexure-1 having sketch showing Test sample location for forgings.

- 2.8 The forgings shall meet the requirements of intergranular corrosion test as per ASTM-A-262 Practice A /E. One test specimen shall be taken per heat / heat treatment batch for each type of forgings.

- 2.9 Grain size test and macroetch test shall be performed on one test specimen per heat / heat treatment batch for each type of forgings.

- 2.10 Each forgings shall be ultrasonically examined to ASME Section III NB-2542. The extent of test shall be 100%. The scanning shall be done by straight beam in two

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perpendicular direction and also by angle beam examination from two circumferential directions.

The acceptance standards shall be as follows:

For straight beam examination, calibration shall be done to detect indications equivalent to or greater than the indication from 6 mm or smaller flat bottom hole. Defects producing indications equivalent to or greater than the indication from 6 mm or smaller flat bottom hole are unacceptable.

All indications above 20% of reference level shall be recorded.

All recordable indications shall be investigated to confirm that they are parallel to the forging faces and not in transverse direction i.e. in thickness direction. Defect indications exceeding 20% of reference level in thickness direction are not acceptable.

For angle beam examinations, a forging shall be unacceptable if the results of examination show one or more reflectors which produce indications exceeding in amplitude the indication from the appropriate calibration notches as stipulated in SA-745.

The supplier shall establish suitable ultrasonic examination procedure and shall submit for approval of NPCIL.

2.11 Each forging in finished shape shall be examined by liquid penetrant method in accordance with ASTM-E-165 with following additional requirements.

- a) Penetrants, developers and cleaning agents shall not contain more than 25 ppm each of Sulphur and Halogens.
- b) All traces of penetrant and developer shall be thoroughly removed from the job after completion of examination.

Acceptance Standard:

Any indication of any shape and size shall be unacceptable.

2.12 Repairs

Minor surface defects should be smoothly ground and blended without impairing the thickness shown on the drawings.

No other repairs shall be carried out without prior approval of the Purchaser.

3.0 CLEANING

All surfaces shall be degreased and then flushed with clean water. The degreasing agent shall not contain halogens. Final cleaning shall be performed with a hot water

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wash using a household or commercial detergent followed by a hot water rinse. Forging shall be cleaned/pickled free from scale & same shall be passivated.

4.0 DOCUMENTS / PROCEDURES / TEST REPORTS / INFORMATION TO BE SUBMITTED

4.1 Following information/documents are to be submitted.

4.1.1 Name and Address of forging manufacturer and information on various facilities available with him for manufacture and testing of forging and list of references indicating supply of similar quality forgings made earlier.

4.1.2 Manufacturing, testing and shipment plans to meet delivery requirements.

4.1.3 Manufacturing procedure giving sequence of operations right from melting, ingot pouring, forgings, heat treatment, proof machining and testing.

Sketch showing 'As Forged' shape of forgings and locations of test coupons shall be submitted.

Steel making practice proposed to be adopted shall be clearly mentioned.

4.1.4 Heat treatment plan and details such as type of furnace, atmosphere in furnace, rate of heating and cooling, soaking temperature and time, etc.

4.1.5 Non-destructive examination procedure for ultrasonic and liquid penetrant testing.

4.1.6 Metallographic examination procedure.

4.1.7 Intergranular corrosion test procedure.

4.1.8 Any other procedure having a bearing on quality.

4.1.9 Any deviation being taken shall be clearly brought out in the bid. If no deviation is being taken, a specific mention that 'No deviation from tender specifications' shall be made.

4.1.10 Packaging procedure and suggested packing arrangement for long storage.

4.2 Test Reports / Certificates

4.2.1 All material shall be provided with complete test reports / certificates.

All certificates shall be supplied in a bound volume with proper identification and also in soft form with proper indexing.

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Supplier shall keep record of all test reports / certificates for at least five years after completion of the order.

The reports / certificates shall include the following.

- a) Chemical analysis (heat and product analysis).
- b) Forging ratio given during manufacture.
- c) Heat treatment details (heat treatment charts shall be sent after completion of the contract).
- d) Sketch showing actual location of test specimens taken.
- e) Results of mechanical properties.
- f) Hardness value of each forging.
- g) Result of inter-granular corrosion test.
- h) Grain size. Micrographs to be attached.
- i) Results of macroetch test. Photos to be attached.
- j) Results of ultrasonic examination.
- k) Results of liquid penetrant examination.
- l) As built dimension of each forging.
- m) Any other examination / inspection / test done.

5.0 IDENTIFICATION

Each forging shall be marked with following information :

- a) Heat number
- b) Material designation.
- c) P.O. number.
- d) Identification number

Tube sheets and corresponding test plates to be marked in such a manner so that they can be correlated with each other.

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SUGGESTED QUALITY ASSURANCE PLAN FOR SS FORGINGS

Sl. No.	OPERATION	PARAMETER	METHOD	EXTENT OF CHECK	INSPECTION				REMARKS
					P	W	R	H	
01	Raw Material	Ladle analysis	Spectro-scopic	One sample per heat	-	-	2,1	-	-
02	Forging (Bloom)	Dimensions	Measurement	100%	-	-	-	-	-
		Macroetch	Macroscopic	One slice at top	-	2,1	-	-	Photos to be attached.
03	Forging	Dimension as forged	Measurement	100%	-	-	-	-	-
		UT Examination	-	100%	-	2	-	-	-
04	Heat treatment	Solution annealing	-	100%	-	-	2,1	-	-
05	UT	UT Examination	As per specification	100%	-	2	-	1	-
06	Test plate stamping	Stamping	Integral test bar	One per heat and HT batch	-	2	-	1-	-
07	Test plate painting and machining	Painting and machining	-	-	-	-	-	-	-
08	Inspection	Physical testing	Tensile and hardness	As per specification	-	-	2,1	1	-
		LPT	-	-	-	2,1	-	-	-
		Intergranular test	-	One sample / heat / HT batch	-	-	2,1	-	-
		Product analysis	-	One sample / heat / HT batch	-	-	2,1	-	-
		Grain size	Macroscopic	One sample / heat / HT batch	-	-	2,1	-	-
		Hardness	-	100%	-	-	2,1	1	-
		Dimensions	Measurement	100%	-	-	2,1	-	-
09	Documentation & Shipping Release	-	-	-	2	-	-	1	-

P = Prepared by,

R = Reviewed by,

W = Witnessed by

H = Hold by

1 = NPCIL authorized representative.

2 = Prime Contractor

NOTES:

- All test reports, test certificates and inspection reports shall be reviewed by Manufacturer before submitting the same for verification by Purchaser.
- Chemical and mechanical tests on the material shall be performed in laboratories approved by NPCIL.
- Heat treatment shall be carried out in furnaces approved by NPCIL.
- Celibrated instruments shall be used during inspection, examination and testing.
- NPCIL approved chemicals for liquid penetrant examination shall be used.
- Non-destructive examinations shall be carried out by personnel qualified to Level-II of ISNI or ASNT.

Annexure-1 of CDE-19-3408

