

	TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES
ROS: CPN: R01	

	BHARAT HEAVY ELECTRICALS LIMITED (A GOVT OF INDIA UNDERTAKING)	Water Systems Group, Boiler Auxiliary Plant (BAP), BHEL Ranipet – 632406.
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Technical Specification: C 276 Cladded Carbon Steel Nozzles

SPECIFICATION NUMBER : ROS: CPN: R01
BUYER (EPC) : BHEL, BAP Ranipet
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM

01	03.08.2020	Revision	<i>A. Kumar</i>	<i>J. M. Ramdani</i>	<i>M. Salaimanalan</i>
00	20.07.2020	Fresh Issue	Abhinav Kumar	IMRL Rao	M Salaimanalan
REV No	Date	Description	Prepared	Checked	Approved

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**1.0 INTENT OF SPECIFICATION****Introduction:**

This specification covers the minimum requirements of procurement specifications & inspection requirements for cladded (CS+ Hastelloy C-276) nozzle pipe with flange internally including Raised Face (RF) weld overlaid with Hastelloy C-276 (Note: The CS plate shall not have the raised face) / Cladded plate welded on the flange face. The bidders shall be responsible for complete material, manufacturing, shop inspection, testing at the manufacturer's works, and Inspection of C276 Cladded Carbon Steel backed Flanged Nozzles.

This document shall form an integral part of Enquiry, Purchase order. Third party inspection (TPI) agency shall be appointed to carry out stage-wise inspection as depicted in the following procedure. The TPI shall be BHEL nominated agencies (Details will be shared during contract execution):

The following may be noted:

- a. Bidder shall assume full responsibility for the materials, fabrication craftsmanship, and assembly. Comply strictly with the requirements of this specification, drawings and other referred specifications / attachments as per the Tender enquiry and comply at Ordering stage.
- b. In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (**ANNEXURE- I**)". The reason for seeking deviation shall be explained and documentary evidence shall be provided to substantiate the same. This will facilitate the decision making.
- c. Any deviation, not listed in Annexure - I, though reflected in any other part of the offer, shall not be considered.
- d. BHEL discretion is final in acceptance / rejection of exceptions / deviations listed by Bidders' proposal in Annexure – I. Only written approval by BHEL is valid means of acceptance of deviation / exception.
- e. Bidder shall ensure completeness of the C 276 Cladded Carbon Steel backed Nozzles in all respects and provide all necessary inspection documents after carrying out the same to fulfil requirements within this specification and referred standards to ensure compliant products in line with the specification unless specifically excluded by BHEL.
- f. Metric (SI) units of measurement shall be used throughout the specification and drawings.

Applicable Standards, Codes & Regulations:

Materials selection, Manufacture shall conform to the requirements of applicable codes and regulations of the latest edition. The same shall follow the latest applicable Indian/International (ASME / EN / API / Japanese) Standards and any other standards indicated in this specification. If any other country standard used, then against each standard, equivalent Indian/Internal standard to be indicated against each item. A copy of such standard duly translated in English shall be furnished by vendor.

In general, components shall conform to latest edition of the following standards:

Pipe Material Standard & Specifications: ASTM B 619, ASTM B 622.



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Schedule: As per drawing. Type: Seam less / ERW / Welded / Fabricated

Length: As per drawings provided.

Nozzle Free End: Bevel / Plain (Refer respective drawings)

Flange Material Standard & Specifications: IS 2062 Gr B (Carbon Steel plate)

UNS Code for C276 cladding material: UNS N 10276

API SPEC 5 LD Latest edition

API RP 582 Latest edition

Clad Plate / sheet / Weld Overlay Specification: ASME SA – 265 – specifically C – 276 Alloy.

2.0 PROVENNESS CRITERIA:

The Bidder shall offer only proven products for which the fabrication, manufacturing process, Inspection methods are established and meets the Provenness criteria indicated in the **QR requirement documents**. Necessary documentary evidences as per **QR for qualification** shall be submitted along with the bid. Offers of Bidders without the provenness criteria shall not be considered for evaluation.

Bidders are required to meet the Qualification Requirement (QR) for the supply of the C276 Cladded Nozzles as per **enclosed document & submit Attachment to qualification requirement**

3.0 ORDER OF PRECEDENCE

Any conflict between any requirements specified in this document and the requirements of any other relevant referenced document shall be resolved in the following order of preference.

- 1) The item number description in the enquiry, Purchase requisition or Purchase order.
- 2) This specification
- 3) Other Project specification if any referenced in this document.
- 4) Reference codes and standards.

Deviation to the specified requirements of the enquiry package for material procured shall only be considered explicitly by written approval from BHEL.

4.0 MATERIAL OF CONSTRUCTION

Sl.no	Description of the Item	Material Standard / Specification
A	2" Pipe	Hastelloy C-276
B	Above 2"	
i.	Backing Pipe	ASTM A 106 Gr. B

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	Backing Plate formed into pipe	IS 2062 Gr. B
	Flange	IS 2062 Gr. B
ii.	Lining Sheet	Hastelloy C – 276 as per ASTM A265
	Cladding Metal Electrode	ERNiCrMO4 or ENiCrMO4 (depending on overlay mode/method)
iii.	Welding :	
	Carbon Steel	E 7018 or equivalent
	Carbon Steel to C 276	ERNiCrMO4 or ENiCrMO4 (depending on overlay mode/method)

Bidders offering alternative / equivalent specifications shall submit documents along with proof of equivalency. The same is subject to acceptance & approval to BHEL's discretion. Bidders are advised to obtain a written acceptance from BHEL during the pre-bid stage / technical bid stage, as all other modes are invalid.

5.0 SCOPE OF SUPPLY

Scope for the bidders shall include fabrication, manufacture, Inspection and Supply of the Nozzles. Any Engineering done by Bidder for approval of BHEL shall be intimated immediately on award of contract and shall not exceed a Time frame of 14 calendar days from the date of PO placement. This requirement shall be indicated in the Technical Bid stage itself.

It may be noted that for Inspection and Clearance, BHEL drawings and documents along with referred standards shall be basis of successful execution of work including approved fabrication drawings of Vendor. This includes specific exemptions granted to Bidder during offer evaluation.

GENERAL REQUIREMENTS FOR HASTELLOY C-276 CLADDING/ WELD OVERLAY OF NOZZLE PIPE WITH FLANGE:

The document covers the requirements for CS (IS 2062 Gr. B) + Hastelloy C-276 clad plate for fabricated nozzle pipe.

ASME Boiler & Pressure Vessel code – Section IX and AWS B 2.1 shall be followed for Welding & Brazing qualification and Welding Procedure and Performance Qualification (WP & PQ) respectively. References from standards listed in this specification is also acceptable. Bidders shall specify the applicable standards and corresponding clauses for WP & PQ.

Welders performing the job on subject Nozzles shall be qualified in line with the above and shall have a minimum further 6 to 9 months prior to their requalification tests from the date of PO placement. Successful Bidders shall carryout the WP & PQ within 1 week of order

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placement for witness by BHEL / BHEL appointed TPI agency. Records of the Welders shall be maintained for verification. The same shall be provided along with the Inspection reports for submission to Customer.

Fabrication scope of vendor/contractor includes Supply of plate / Pipe material , fabrication of nozzle cladding / weld overlay with Hastelloy C-276 as per drawing, requisite Non Destructive Testing (NDT), dimensional inspection, Post Weld Heat Treatment (PWHT) after weld overlay (if applicable), cleaning, painting, marking, certification etc. and dispatch.

The Clad plates shall be made either hot rolled or explosion bonded process. Clad plates shall be procured to specifications ASTM A265 and Ultrasonically Tested to meet quality requirements of SA/A 578 or equivalent standards.

All fabrication Drawings shall be prepared based on attached reference drawings and the same shall be approved by BHEL. All fabrication shall be carried out as per approved drawings.

Hastelloy-276 (C – 276) weld overlay shall be carried out using welding consumable ERNiCrMO4, as per ASME Sec II Part-C .The minimum thickness shall be 3.0 mm. Tolerance on thickness of overlay shall be + 1.0/ - 0.0 mm.

Weld overlay shall be carried out with minimum 25% overlap with the previous bead.

Weld overlay shall be carried out in minimum two layers. Single layer weld overlay is not acceptable.

Vendor shall ensure the circularity of ID at the edges of pipe as per ASME Section VIII standard.

Pipe ends shall be supplied as mentioned in drawing.

Vendor shall develop procedure to minimize dilution: maximum value as per prescribed standards shall be maintained. Data shall be provided during technical offer along with proof / evidence in line with referred standards with respect to dilution in Hastelloy C-276 weld overlay at the surface and same shall be demonstrated during Pre-Qualification Requirement (PQR).

Vendor shall develop procedure with low heat input to prevent distortion.

In case of flanges, weld overlay / clad plate welding shall be carried out on the gasket seating face. The raised face (if present in the Flange) shall be machined to accommodate the weld overlay thickness. The weld overlaid gasket seating surface shall be machined to require surface finish 125-250 RMS (3.2 to 6.3 finish)

100% Positive Material Identification (PMI) of final weld overlay shall be carried out at accessible locations & bevel edges.

Weld overlay shall be carried out only with GTAW (Computerized controlled automatic) process. SMAW/ GMAW/FCAW process shall not be permitted to avoid excess dilution.

Weld repair on localized area shall be carried out only with GTAW process and same will be done with the preheating as applicable. PWHT of repaired shall be done only after attending all repairs on weld overlay surface.



All Weld Procedure Qualification for Weld Overlay shall conform to QW-453 of ASME Sec. IX latest edition. Weld overlay is "corrosion resistant" type. The PQR shall be qualified with the same PWHT holding temperature (if applicable) & time required for the production welding. All welders/ welding operators shall be qualified accordingly for the same.

For all other aspects of back cladding using Corrosion Resistant Overlay, QW 217(b) of ASME Sec IX and related / cross referred QW's shall be referred for incorporation of required tests. Figure QW – 462.5(a) shall form the basis of determining the minimum qualified weld overlay thickness.

The specification covers the requirements for CS (IS 2062) + Hastelloy C-276 clad plate and CS Pipe (SA 106 Gr B) with C – 276 weld Over Lay for fabricated nozzle pipe.

NOZZLE FABRICATION

Fabrication shall be in accordance with approved fabrication drawing and applicable codes/standards/recommended good practices.

Welding procedures (WPS and PQR) shall be submitted to BHEL prior to commencement of job for approval

In the selection of the welding parameters, specific care shall be taken to avoid hot cracking

Following requirements apply for weld overlay fabrication:

Required preheating shall be achieved before start of weld overlay & during weld overlay to avoid shrinkage cracking. The minimum temperature shall be as per ASME B31.1 Table 330.1.1

All piping and piping components of P No 1 undergoing weld overlay shall be stress relieved in accordance with paragraph 323.4.3 of ASME B31.3.

Stress relieving shall be done in furnace or by application of heating pads/coils.

Each nozzle shall be tagged for identification before loading into furnace.

In case of furnace PWHT, loading temperature of furnace shall be $< 425^{\circ}\text{C}$. Furnace can be induction heated or gas fired. Rate of rise of temperature shall be $< 150^{\circ}\text{C}/\text{hour}$. Rate of cooling shall be $100^{\circ}\text{C}/\text{hour}$. Temperature of the firebox shall be controlled by automatic controls. Chart shall be made available for each charge.

During PWHT, vendor to ensure the proper internal / external support to avoid distortion / Ovality / warping etc.

After PWHT, the pieces shall be thoroughly cleaned by blasting to remove scales.

Hydro Test shall be performed for all nozzle at 1.5 times of design pressure.

The nozzle pipe shall be fabricated out of clad plate with suitable manufacturing process maintaining OD of the pipe. In case higher thickness back up plate are used for forming, the pipe to meet to minimum thickness of pipe schedule specified, pipe outside dia shall be

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maintained. Alternatively CS Pipe with C-276 Weld Overlay may also be offered with all conditions of manufacture in line with the specification and standards referred to herein.

6.0	INSPECTION AND TESTING
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INSPECTION AND TESTING REQUIREMENTS:

Quality Plan is attached with the specification. Bidders shall submit the Technical Bid along with signed copy of the quality plan.

PQR / WPS for all welding including overlay welding shall be submitted to TPIA for review / approval and for final approval of BHEL.

Throughout the manufacturing processes, a means of identification shall be utilized to maintain strict traceability of all items.

Each clad plate shall be subjected to internal Ultrasonic Testing before taking up for fabrication.

Visual inspection shall be carried out for flatness & deviation for clad plate. Records shall be maintained for review by BHEL / TPIA

Formed components (pipe) shall be Ultrasonically Tested after heat treatment, for de-bond check between clad and base material.

100% RT shall be carried out for butt weld of Pipe fabricated from clad plate.

All NDE shall be carried-out in accordance with the applicable process piping/pressure vessel Code and / or this Specification, as stated in Purchase Orders. Relevant NDE procedures, methods and techniques, shall be submitted to BHEL for approval. Any subsequent revision to the document shall be submitted to BHEL for re-approval. All NDE procedure shall be reviewed by BHEL / BHEL authorised agency prior to commencement of job.

All NDE shall be performed by personnel qualified to a recognized National or International Standard (e.g. PCN, ASNT Level II minimum, etc.). The manufacturer's QC department's representative shall review Certification of NDE personnel periodically.

PWHT charts shall be reviewed by BHEL / BHEL nominated TPIA.

Internal records of PMI check where applicable shall be reviewed by BHEL / BHEL nominated TPIA. 10% PMI shall be witnessed by BHEL / BHEL nominated TPIA.

All machined surfaces (after weld overlay deposits) shall be subjected to Dye Penetrant examination.

Final dimensional inspection record shall be REVIEW point for BHEL / BHEL nominated TPIA.

Surface preparation for painting, visual inspection of the painting and DFT records shall be reviewed by BHEL / BHEL nominated TPIA.



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After all inspection is over BHEL / BHEL nominated TPIA shall issue the "Inspection release note (IRN).

CLEANING AND PAINTING.

All nozzle surfaces shall be cleaned to remove loose scale, rust, grease, dirt, weld spatter and other foreign matter and applied with red oxide primer/ suitable rust preventive.

IDENTIFICATION MARKING:

Following marking shall be indicated on all Nozzles. Marking shall be accomplished by stencilling and / or hard punching / Affixing a TAG in line with the sample as given below.

	BHEL – BAP - Ranipet
Purchase Order No. :	
Manufacturer Name :	
Description of Item : PIPE NOZZLE - Absorber	
Drawing Number :	
Nozzle Size & No : 8" x N5 (A to B)	
Date of Manufacture:	
Date of Inspection :	

CERTIFICATION:

Manufacturer shall submit a complete set of hard copies and soft copies of all the documents pertaining to fabrication and testing of the nozzle viz. PO copy, approved copy of QAP, ITP, WPS/PQR, Bill of material, material test certificates, and stage wise inspection records, final dimensional inspection, PWHT records (if applicable), NDT records, witnessed by TPIA.

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ANNEXURE- I: DEVIATION SHEET

SI No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____

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	BHARAT HEAVY ELECTRICALS LIMITED (A GOVT OF INDIA UNDERTAKING)	Water Systems Group, Boiler Auxiliary Plant (BAP), BHEL Ranipet – 632406.
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Technical Specification: C 276 Cladded Carbon Steel Nozzles

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APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM

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1.0 INTENT OF SPECIFICATION

Introduction:

This specification covers the minimum requirements of procurement specifications & inspection requirements for cladmed (CS+ Hastelloy C-276) nozzle pipe with flange internally including Raised Face (RF) weld overlaid with Hastelloy C-276 (Note: The CS plate shall not have the raised face) / Cladmed plate welded on the flange face. The bidders shall be responsible for complete material, manufacturing, shop inspection, testing at the manufacturer's works, and Inspection of C276 Cladmed Carbon Steel backed Flanged Nozzles.

This document shall form an integral part of Enquiry, Purchase order. Third party inspection (TPI) agency shall be appointed to carry out stage-wise inspection as depicted in the following procedure. The TPI shall be BHEL nominated agencies (Details will be shared during contract execution):

The following may be noted:

- a. Bidder shall assume full responsibility for the materials, fabrication craftsmanship, and assembly. Comply strictly with the requirements of this specification, drawings and other referred specifications / attachments as per the Tender enquiry and comply at Ordering stage.
- b. In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (**ANNEXURE- I**)". The reason for seeking deviation shall be explained and documentary evidence shall be provided to substantiate the same. This will facilitate the decision making.
- c. Any deviation, not listed in Annexure - I, though reflected in any other part of the offer, shall not be considered.
- d. BHEL discretion is final in acceptance / rejection of exceptions / deviations listed by Bidders' proposal in Annexure – I. Only written approval by BHEL is valid means of acceptance of deviation / exception.
- e. Bidder shall ensure completeness of the C 276 Cladmed Carbon Steel backed Nozzles in all respects and provide all necessary inspection documents after carrying out the same to fulfil requirements within this specification and referred standards to ensure compliant products in line with the specification unless specifically excluded by BHEL.
- f. Metric (SI) units of measurement shall be used throughout the specification and drawings.

Applicable Standards, Codes & Regulations:

Materials selection, Manufacture shall conform to the requirements of applicable codes and regulations of the latest edition. The same shall follow the latest applicable Indian/International (ASME / EN / API / Japanese) Standards and any other standards indicated in this specification. If any other country standard used, then against each standard, equivalent Indian/Internal standard to be indicated against each item. A copy of such standard duly translated in English shall be furnished by vendor.

In general, components shall conform to latest edition of the following standards:

Pipe Material Standard & Specifications: ASTM B 619, ASTM B 622.



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Schedule: As per drawing. Type: Seam less / ERW / Welded / Fabricated

Length: As per drawings provided.

Nozzle Free End: Bevel / Plain (Refer respective drawings)

Flange Material Standard & Specifications: IS 2062 Gr B (Carbon Steel plate)

UNS Code for C276 cladding material: UNS N 10276

API SPEC 5 LD Latest edition

API RP 582 Latest edition

Clad Plate / sheet / Weld Overlay Specification: ASME SA – 265 – specifically C – 276 Alloy.

2.0 PROVENNESS CRITERIA:

The Bidder shall offer only proven products for which the fabrication, manufacturing process, Inspection methods are established and meets the Provenness criteria indicated in the **QR requirement documents**. Necessary documentary evidences as per **QR for qualification** shall be submitted along with the bid. Offers of Bidders without the provenness criteria shall not be considered for evaluation.

Bidders are required to meet the Qualification Requirement (QR) for the supply of the C276 Cladded Nozzles as per **enclosed document & submit Attachment to qualification requirement**

3.0 ORDER OF PRECEDENCE

Any conflict between any requirements specified in this document and the requirements of any other relevant referenced document shall be resolved in the following order of preference.

- 1) The item number description in the enquiry, Purchase requisition or Purchase order.
- 2) This specification
- 3) Other Project specification if any referenced in this document.
- 4) Reference codes and standards.

Deviation to the specified requirements of the enquiry package for material procured shall only be considered explicitly by written approval from BHEL.

4.0 MATERIAL OF CONSTRUCTION

Sl.no	Description of the Item	Material Standard / Specification
A	2" Pipe	Hastelloy C-276
B	Above 2"	
i.	Backing Pipe	ASTM A 106 Gr. B

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	Backing Plate formed into pipe	IS 2062 Gr. B
	Flange	IS 2062 Gr. B
ii.	Lining Sheet	Hastelloy C – 276 as per ASTM A265
	Cladding Metal Electrode	ERNiCrMO4 or ENiCrMO4 (depending on overlay mode/method)
iii.	Welding :	
	Carbon Steel	E 7018 or equivalent
	Carbon Steel to C 276	ERNiCrMO4 or ENiCrMO4 (depending on overlay mode/method)

Bidders offering alternative / equivalent specifications shall submit documents along with proof of equivalency. The same is subject to acceptance & approval to BHEL's discretion. Bidders are advised to obtain a written acceptance from BHEL during the pre-bid stage / technical bid stage, as all other modes are invalid.

5.0 SCOPE OF SUPPLY

Scope for the bidders shall include fabrication, manufacture, Inspection and Supply of the Nozzles. Any Engineering done by Bidder for approval of BHEL shall be intimated immediately on award of contract and shall not exceed a Time frame of 14 calendar days from the date of PO placement. This requirement shall be indicated in the Technical Bid stage itself.

It may be noted that for Inspection and Clearance, BHEL drawings and documents along with referred standards shall be basis of successful execution of work including approved fabrication drawings of Vendor. This includes specific exemptions granted to Bidder during offer evaluation.

GENERAL REQUIREMENTS FOR HASTELLOY C-276 CLADDING/ WELD OVERLAY OF NOZZLE PIPE WITH FLANGE:

The document covers the requirements for CS (IS 2062 Gr. B) + Hastelloy C-276 cladded plate for fabricated nozzle pipe.

ASME Boiler & Pressure Vessel code – Section IX and AWS B 2.1 shall be followed for Welding & Brazing qualification and Welding Procedure and Performance Qualification (WP & PQ) respectively. References from standards listed in this specification is also acceptable. Bidders shall specify the applicable standards and corresponding clauses for WP & PQ.

Welders performing the job on subject Nozzles shall be qualified in line with the above and shall have a minimum further 6 to 9 months prior to their requalification tests from the date of PO placement. Successful Bidders shall carryout the WP & PQ within 1 week of order



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placement for witness by BHEL / BHEL appointed TPI agency. Records of the Welders shall be maintained for verification. The same shall be provided along with the Inspection reports for submission to Customer.

Fabrication scope of vendor/contractor includes Supply of plate / Pipe material , fabrication of nozzle cladding / weld overlay with Hastelloy C-276 as per drawing, requisite Non Destructive Testing (NDT), dimensional inspection, Post Weld Heat Treatment (PWHT) after weld overlay (if applicable), cleaning, painting, marking, certification etc. and dispatch.

The Clad plates shall be made either hot rolled or explosion bonded process. Clad plates shall be procured to specifications ASTM A265 and Ultrasonically Tested to meet quality requirements of SA/A 578 or equivalent standards.

All fabrication Drawings shall be prepared based on attached reference drawings and the same shall be approved by BHEL. All fabrication shall be carried out as per approved drawings.

Hastelloy-276 (C – 276) weld overlay shall be carried out using welding consumable ERNiCrMO4, as per ASME Sec II Part-C .The minimum thickness shall be 3.0 mm. Tolerance on thickness of overlay shall be + 1.0/ - 0.0 mm.

Weld overlay shall be carried out with minimum 25% overlap with the previous bead.

Weld overlay shall be carried out in minimum two layers. Single layer weld overlay is not acceptable.

Vendor shall ensure the circularity of ID at the edges of pipe as per ASME Section VIII standard.

Pipe ends shall be supplied as mentioned in drawing.

Vendor shall develop procedure to minimize dilution: maximum value as per prescribed standards shall be maintained. Data shall be provided during technical offer along with proof / evidence in line with referred standards with respect to dilution in Hastelloy C-276 weld overlay at the surface and same shall be demonstrated during Pre-Qualification Requirement (PQR).

Vendor shall develop procedure with low heat input to prevent distortion.

In case of flanges, weld overlay / clad plate welding shall be carried out on the gasket seating face. The raised face (if present in the Flange) shall be machined to accommodate the weld overlay thickness. The weld overlaid gasket seating surface shall be machined to require surface finish 125-250 RMS (3.2 to 6.3 finish)

100% Positive Material Identification (PMI) of final weld overlay shall be carried out at accessible locations & bevel edges.

Weld overlay shall be carried out only with GTAW (Computerized controlled automatic) process. SMAW/ GMAW/FCAW process shall not be permitted to avoid excess dilution.

Weld repair on localized area shall be carried out only with GTAW process and same will be done with the preheating as applicable. PWHT of repaired shall be done only after attending all repairs on weld overlay surface.



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All Weld Procedure Qualification for Weld Overlay shall conform to QW-453 of ASME Sec. IX latest edition. Weld overlay is "corrosion resistant" type. The PQR shall be qualified with the same PWHT holding temperature (if applicable) & time required for the production welding. All welders/ welding operators shall be qualified accordingly for the same.

For all other aspects of back cladding using Corrosion Resistant Overlay, QW 217(b) of ASME Sec IX and related / cross referred QW's shall be referred for incorporation of required tests. Figure QW – 462.5(a) shall form the basis of determining the minimum qualified weld overlay thickness.

The specification covers the requirements for CS (IS 2062) + Hastelloy C-276 clad plate and CS Pipe (SA 106 Gr B) with C – 276 weld Over Lay for fabricated nozzle pipe.

NOZZLE FABRICATION

Fabrication shall be in accordance with approved fabrication drawing and applicable codes/standards/recommended good practices.

Welding procedures (WPS and PQR) shall be submitted to BHEL prior to commencement of job for approval

In the selection of the welding parameters, specific care shall be taken to avoid hot cracking

Following requirements apply for weld overlay fabrication:

Required preheating shall be achieved before start of weld overlay & during weld overlay to avoid shrinkage cracking. The minimum temperature shall be as per ASME B31.1 Table 330.1.1

All piping and piping components of P No 1 undergoing weld overlay shall be stress relieved in accordance with paragraph 323.4.3 of ASME B31.3.

Stress relieving shall be done in furnace or by application of heating pads/coils.

Each nozzle shall be tagged for identification before loading into furnace.

In case of furnace PWHT, loading temperature of furnace shall be $< 425^{\circ}\text{C}$. Furnace can be induction heated or gas fired. Rate of rise of temperature shall be $< 150^{\circ}\text{C}/\text{hour}$. Rate of cooling shall be $100^{\circ}\text{C}/\text{hour}$. Temperature of the firebox shall be controlled by automatic controls. Chart shall be made available for each charge.

During PWHT, vendor to ensure the proper internal / external support to avoid distortion / Ovality / warping etc.

After PWHT, the pieces shall be thoroughly cleaned by blasting to remove scales.

Hydro Test shall be performed for all nozzle at 1.5 times of design pressure.

The nozzle pipe shall be fabricated out of clad plate with suitable manufacturing process maintaining OD of the pipe. In case higher thickness back up plate are used for forming, the pipe to meet to minimum thickness of pipe schedule specified, pipe outside dia shall be



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maintained. Alternatively CS Pipe with C-276 Weld Overlay may also be offered with all conditions of manufacture in line with the specification and standards referred to herein.

6.0

INSPECTION AND TESTING

INSPECTION AND TESTING REQUIREMENTS:

Quality Plan is attached with the specification. Bidders shall submit the Technical Bid along with signed copy of the quality plan.

PQR / WPS for all welding including overlay welding shall be submitted to TPIA for review / approval and for final approval of BHEL.

Throughout the manufacturing processes, a means of identification shall be utilized to maintain strict traceability of all items.

Each clad plate shall be subjected to internal Ultrasonic Testing before taking up for fabrication.

Visual inspection shall be carried out for flatness & deviation for clad plate. Records shall be maintained for review by BHEL / TPIA

Formed components (pipe) shall be Ultrasonically Tested after heat treatment, for de-bond check between clad and base material.

100% RT shall be carried out for butt weld of Pipe fabricated from clad plate.

All NDE shall be carried-out in accordance with the applicable process piping/pressure vessel Code and / or this Specification, as stated in Purchase Orders. Relevant NDE procedures, methods and techniques, shall be submitted to BHEL for approval. Any subsequent revision to the document shall be submitted to BHEL for re-approval. All NDE procedure shall be reviewed by BHEL / BHEL authorised agency prior to commencement of job.

All NDE shall be performed by personnel qualified to a recognized National or International Standard (e.g. PCN, ASNT Level II minimum, etc.). The manufacturer's QC department's representative shall review Certification of NDE personnel periodically.

PWHT charts shall be reviewed by BHEL / BHEL nominated TPIA.

Internal records of PMI check where applicable shall be reviewed by BHEL / BHEL nominated TPIA. 10% PMI shall be witnessed by BHEL / BHEL nominated TPIA.

All machined surfaces (after weld overlay deposits) shall be subjected to Dye Penetrant examination.

Final dimensional inspection record shall be REVIEW point for BHEL / BHEL nominated TPIA.

Surface preparation for painting, visual inspection of the painting and DFT records shall be reviewed by BHEL / BHEL nominated TPIA.

	TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES
ROS: CPN: R01	

After all inspection is over BHEL / BHEL nominated TPIA shall issue the "Inspection release note (IRN).

CLEANING AND PAINTING.

All nozzle surfaces shall be cleaned to remove loose scale, rust, grease, dirt, weld spatter and other foreign matter and applied with red oxide primer/ suitable rust preventive.

IDENTIFICATION MARKING:

Following marking shall be indicated on all Nozzles. Marking shall be accomplished by stencilling and / or hard punching / Affixing a TAG in line with the sample as given below.

	BHEL – BAP - Ranipet
Purchase Order No. :	
Manufacturer Name :	
Description of Item : PIPE NOZZLE - Absorber	
Drawing Number :	
Nozzle Size & No : 8" x N5 (A to B)	
Date of Manufacture:	
Date of Inspection :	

CERTIFICATION:

Manufacturer shall submit a complete set of hard copies and soft copies of all the documents pertaining to fabrication and testing of the nozzle viz. PO copy, approved copy of QAP, ITP, WPS/PQR, Bill of material, material test certificates, and stage wise inspection records, final dimensional inspection, PWHT records (if applicable), NDT records, witnessed by TPIA.

	TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES
ROS: CPN: R01	

ANNEXURE- I: DEVIATION SHEET

SI No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____

Bidder's seal & sign

	TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES
ROS: CPN: R00	

	BHARAT HEAVY ELECTRICALS LIMITED (A GOVT OF INDIA UNDERTAKING)	Water Systems Group, Boiler Auxiliary Plant (BAP), BHEL Ranipet – 632406.
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Technical Specification: C 276 Cladded Carbon Steel Nozzles

SPECIFICATION NUMBER	: ROS: CPN: R00
BUYER (EPC)	: BHEL, BAP Ranipet
APPLICATION	: FLUE GAS DESULPHURIZATION SYSTEM

			<i>A Kumar</i>	<i>A. n. Ramalingam</i>	<i>M Salaimanalan</i>
00	20.07.2020	Fresh Issue	Abhinav Kumar	IMRL Rao	M Salaimanalan
REV No	Date	Description	Prepared	Checked	Approved

This document is meant for the exclusive purpose of bidding against this specification and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued.



TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES

ROS: CPN: R00

CONTENT

1.0	INTENT OF SPECIFICATION -INTRODUCTION -APPLICATION STANDARD, CODES AND REGULATIONS
2.0	PROVENNESS CRITERIA
3.0	ORDER OF PRECEDENCE
4.0	MATERIAL OF CONSTRUCTION
5.0	SCOPE OF SUPPLY - GENERAL REQUIREMENTS FOR HASTELLOY C-276 CLADDING/ WELD OVERLAY OF NOZZLE PIPE WITH FLANGE - NOZZLE FABRICATION
6.0	INSPECTION AND TESTING - INSPECTION AND TESTING REQUIREMENTS - CLEANING AND PAINTING - IDENTIFICATION MARKING - CERTIFICATION
	ANNEXURES
I	DEVIATION SHEET
II	ABSORBER NOZZLE DETAILS DRAWING : 2FW-203-01132 REV:00

**1.0 INTENT OF SPECIFICATION****Introduction:**

This specification covers the minimum requirements of procurement specifications & inspection requirements for cladmed (CS+ Hastelloy C-276) nozzle pipe with flange internally including Raised Face (RF) weld overlaid with Hastelloy C-276 (Note: The CS plate shall not have the raised face) / Cladmed plate welded on the flange face. The bidders shall be responsible for complete material, manufacturing, shop inspection, testing at the manufacturer's works, and Inspection of C276 Cladmed Carbon Steel backed Flanged Nozzles.

This document shall form an integral part of Enquiry, Purchase order. Third party inspection (TPI) agency shall be appointed to carry out stage-wise inspection as depicted in the following procedure. The TPI shall be BHEL nominated agencies (Details will be shared during contract execution):

The following may be noted:

- a. Bidder shall assume full responsibility for the materials, fabrication craftsmanship, and assembly. Comply strictly with the requirements of this specification, drawings and other referred specifications / attachments as per the Tender enquiry and comply at Ordering stage.
- b. In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (**ANNEXURE- I**)". The reason for seeking deviation shall be explained and documentary evidence shall be provided to substantiate the same. This will facilitate the decision making.
- c. Any deviation, not listed in Annexure - I, though reflected in any other part of the offer, shall not be considered.
- d. BHEL discretion is final in acceptance / rejection of exceptions / deviations listed by Bidders' proposal in Annexure – I. Only written approval by BHEL is valid means of acceptance of deviation / exception.
- e. Bidder shall ensure completeness of the C 276 Cladmed Carbon Steel backed Nozzles in all respects and provide all necessary inspection documents after carrying out the same to fulfil requirements within this specification and referred standards to ensure compliant products in line with the specification unless specifically excluded by BHEL.
- f. Metric (SI) units of measurement shall be used throughout the specification and drawings.

Applicable Standards, Codes & Regulations:

Materials selection, Manufacture shall conform to the requirements of applicable codes and regulations of the latest edition. The same shall follow the latest applicable Indian/International (ASME / EN / API / Japanese) Standards and any other standards indicated in this specification. If any other country standard used, then against each standard, equivalent Indian/Internal standard to be indicated against each item. A copy of such standard duly translated in English shall be furnished by vendor.

In general, components shall conform to latest edition of the following standards:



TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES

ROS: CPN: R00

Pipe Material Standard & Specifications: ASTM B 619, ASTM B 622.

Schedule: As per drawing. Type: Seam less / ERW / Welded / Fabricated

Length: As per drawings provided.

Nozzle Free End: Bevel / Plain (Refer respective drawings)

Flange Material Standard & Specifications: IS 2062 Gr B (Carbon Steel plate)

UNS Code for C276 cladding material: UNS N 10276

API SPEC 5 LD Latest edition

API RP 582 Latest edition

Clad Plate / sheet / Weld Overlay Specification: ASME SA – 265 – specifically C – 276 Alloy.

2.0 PROVENNESS CRITERIA:

The Bidder shall offer only proven products for which the fabrication, manufacturing process, Inspection methods are established and meets the Provenness criteria indicated in the **QR requirement documents**. Necessary documentary evidences as per **QR for qualification** shall be submitted along with the bid. Offers of Bidders without the provenness criteria shall not be considered for evaluation.

Bidders are required to meet the Qualification Requirement (QR) for the supply of the C276 Cladded Nozzles as per **enclosed document & submit Attachment to qualification requirement**

3.0 ORDER OF PRECEDENCE

Any conflict between any requirements specified in this document and the requirements of any other relevant referenced document shall be resolved in the following order of preference.

- 1) The item number description in the enquiry, Purchase requisition or Purchase order.
- 2) This specification
- 3) Other Project specification if any referenced in this document.
- 4) Reference codes and standards.

Deviation to the specified requirements of the enquiry package for material procured shall only be considered explicitly by written approval from BHEL.



TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES

ROS: CPN: R00

4.0 MATERIAL OF CONSTRUCTION

Sl.no	Description of the Item	Material Standard / Specification
A	2" Pipe	Hastelloy C-276
B	Above 2"	
i.	Backing Pipe Backing Plate formed into pipe Flange	ASTM A 106 Gr. B IS 2062 Gr. B IS 2062 Gr. B
ii.	Lining Sheet Cladding Metal Electrode	Hastelloy C – 276 as per ASTM A265 ERNiCrMO4 or ENiCrMO4 (depending on overlay mode/method)
iii.	Welding : Carbon Steel Carbon Steel to C 276	E 7018 or equivalent ERNiCrMO4 or ENiCrMO4 (depending on overlay mode/method)

Bidders offering alternative / equivalent specifications shall submit documents along with proof of equivalency. The same is subject to acceptance & approval to BHEL's discretion. Bidders are advised to obtain a written acceptance from BHEL during the pre-bid stage / technical bid stage, as all other modes are invalid.

5.0 SCOPE OF SUPPLY

Scope for the bidders shall include fabrication, manufacture, Inspection and Supply of the Nozzles. Any Engineering done by Bidder for approval of BHEL shall be intimated immediately on award of contract and shall not exceed a Time frame of 14 calendar days from the date of PO placement. This requirement shall be indicated in the Technical Bid stage itself.

It may be noted that for Inspection and Clearance, BHEL drawings and documents along with referred standards shall be basis of successful execution of work including approved fabrication drawings of Vendor. This includes specific exemptions granted to Bidder during offer evaluation.



TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES

ROS: CPN: R00

GENERAL REQUIREMENTS FOR HASTELLOY C-276 CLADDING/ WELD OVERLAY OF NOZZLE PIPE WITH FLANGE:

The document covers the requirements for CS (IS 2062 Gr. B) + Hastelloy C-276 clad plate for fabricated nozzle pipe.

ASME Boiler & Pressure Vessel code – Section IX and AWS B 2.1 shall be followed for Welding & Brazing qualification and Welding Procedure and Performance Qualification (WP & PQ) respectively. References from standards listed in this specification is also acceptable. Bidders shall specify the applicable standards and corresponding clauses for WP & PQ.

Welders performing the job on subject Nozzles shall be qualified in line with the above and shall have a minimum further 6 to 9 months prior to their requalification tests from the date of PO placement. Successful Bidders shall carryout the WP & PQ within 1 week of order placement for witness by BHEL / BHEL appointed TPI agency. Records of the Welders shall be maintained for verification. The same shall be provided along with the Inspection reports for submission to Customer.

Fabrication scope of vendor/contractor includes Supply of plate / Pipe material , fabrication of nozzle cladding / weld overlay with Hastelloy C-276 as per drawing, requisite Non Destructive Testing (NDT), dimensional inspection, Post Weld Heat Treatment (PWHT) after weld overlay (if applicable), cleaning, painting, marking, certification etc. and dispatch.

The Clad plates shall be made either hot rolled or explosion bonded process. Clad plates shall be procured to specifications ASTM A265 and Ultrasonically Tested to meet quality requirements of SA/A 578 or equivalent standards.

All fabrication Drawings shall be prepared based on attached reference drawings and the same shall be approved by BHEL. All fabrication shall be carried out as per approved drawings.

Hastelloy-276 (C – 276) weld overlay shall be carried out using welding consumable ERNiCrMO4, as per ASME Sec II Part-C .The minimum thickness shall be 3.0 mm. Tolerance on thickness of overlay shall be + 1.0/ - 0.0 mm.

Weld overlay shall be carried out with minimum 25% overlap with the previous bead.

Weld overlay shall be carried out in minimum two layers. Single layer weld overlay is not acceptable.

Vendor shall ensure the circularity of ID at the edges of pipe as per ASME Section VIII standard.

Pipe ends shall be supplied as mentioned in drawing.

Vendor shall develop procedure to minimize dilution: maximum value as per prescribed standards shall be maintained. Data shall be provided during technical offer along with proof / evidence in line with referred standards with respect to dilution in Hastelloy C-276 weld overlay at the surface and same shall be demonstrated during Pre-Qualification Requirement (PQR).

Vendor shall develop procedure with low heat input to prevent distortion.



TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES

ROS: CPN: R00

In case of flanges, weld overlay / clad plate welding shall be carried out on the gasket seating face. The raised face (if present in the Flange) shall be machined to accommodate the weld overlay thickness. The weld overlaid gasket seating surface shall be machined to require surface finish 125-250 RMS (3.2 to 6.3 finish)

100% Positive Material Identification (PMI) of final weld overlay shall be carried out at accessible locations & bevel edges.

Weld overlay shall be carried out only with GTAW (Computerized controlled automatic) process. SMAW/ GMAW/FCAW process shall not be permitted to avoid excess dilution.

Weld repair on localized area shall be carried out only with GTAW process and same will be done with the preheating as applicable. PWHT of repaired shall be done only after attending all repairs on weld overlay surface.

All Weld Procedure Qualification for Weld Overlay shall conform to QW-453 of ASME Sec. IX latest edition. Weld overlay is "corrosion resistant" type. The PQR shall be qualified with the same PWHT holding temperature (if applicable) & time required for the production welding. All welders/ welding operators shall be qualified accordingly for the same.

For all other aspects of back cladding using Corrosion Resistant Overlay, QW 217(b) of ASME Sec IX and related / cross referred QW's shall be referred for incorporation of required tests. Figure QW – 462.5(a) shall form the basis of determining the minimum qualified weld overlay thickness.

The specification covers the requirements for CS (IS 2062) + Hastelloy C-276 clad plate and CS Pipe (SA 106 Gr B) with C – 276 weld Over Lay for fabricated nozzle pipe.

NOZZLE FABRICATION

Fabrication shall be in accordance with approved fabrication drawing and applicable codes/standards/recommended good practices.

Welding procedures (WPS and PQR) shall be submitted to BHEL prior to commencement of job for approval

In the selection of the welding parameters, specific care shall be taken to avoid hot cracking

Following requirements apply for weld overlay fabrication:

Required preheating shall be achieved before start of weld overlay & during weld overlay to avoid shrinkage cracking. The minimum temperature shall be as per ASME B31.1 Table 330.1.1

All piping and piping components of P No 1 undergoing weld overlay shall be stress relieved in accordance with paragraph 323.4.3 of ASME B31.3.

Stress relieving shall be done in furnace or by application of heating pads/coils.

Each nozzle shall be tagged for identification before loading into furnace.



TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES

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In case of furnace PWHT, loading temperature of furnace shall be $< 425^{\circ}\text{C}$. Furnace can be induction heated or gas fired. Rate of rise of temperature shall be $< 150^{\circ}\text{C}/\text{hour}$. Rate of cooling shall be $100^{\circ}\text{C}/\text{hour}$. Temperature of the firebox shall be controlled by automatic controls. Chart shall be made available for each charge.

During PWHT, vendor to ensure the proper internal / external support to avoid distortion / Ovality / warping etc.

After PWHT, the pieces shall be thoroughly cleaned by blasting to remove scales.

Hydro Test shall be performed for all nozzle at 1.5 times of design pressure.

The nozzle pipe shall be fabricated out of cladded plate with suitable manufacturing process maintaining OD of the pipe. In case higher thickness back up plate are used for forming, the pipe to meet to minimum thickness of pipe schedule specified, pipe outside dia shall be maintained. Alternatively CS Pipe with C-276 Weld Over lay may also be offered with all conditions of manufacture in line with the specification and standards referred to herein.

6.0

INSPECTION AND TESTING

INSPECTION AND TESTING REQUIREMENTS:

Quality Plan is attached with the specification. Bidders shall submit the Technical Bid along with signed copy of the quality plan.

PQR / WPS for all welding including overlay welding shall be submitted to TPIA for review / approval and for final approval of BHEL.

Throughout the manufacturing processes, a means of identification shall be utilized to maintain strict traceability of all items.

Each cladded plate shall be subjected to internal Ultrasonic Testing before taking up for fabrication.

Visual inspection shall be carried out for flatness & deviation for cladded plate. Records shall be maintained for review by BHEL / TPIA

Formed components (pipe) shall be Ultrasonically Tested after heat treatment, for de-bond check between clad and base material.

100% RT shall be carried out for butt weld of Pipe fabricated from clad plate.

All NDE shall be carried-out in accordance with the applicable process piping/pressure vessel Code and / or this Specification, as stated in Purchase Orders. Relevant NDE procedures, methods and techniques, shall be submitted to BHEL for approval. Any subsequent revision to the document shall be submitted to BHEL for re-approval. All NDE procedure shall be reviewed by BHEL / BHEL authorised agency prior to commencement of job.



TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES

ROS: CPN: R00

All NDE shall be performed by personnel qualified to a recognized National or International Standard (e.g. PCN, ASNT Level II minimum, etc.). The manufacturer's QC department's representative shall review Certification of NDE personnel periodically.

PWHT charts shall be reviewed by BHEL / BHEL nominated TPIA.

Internal records of PMI check where applicable shall be reviewed by BHEL / BHEL nominated TPIA. 10% PMI shall be witnessed by BHEL / BHEL nominated TPIA.

All machined surfaces (after weld overlay deposits) shall be subjected to Dye Penetrant examination.

Final dimensional inspection record shall be REVIEW point for BHEL / BHEL nominated TPIA.

Surface preparation for painting, visual inspection of the painting and DFT records shall be reviewed by BHEL / BHEL nominated TPIA.

After all inspection is over BHEL / BHEL nominated TPIA shall issue the "Inspection release note (IRN).

CLEANING AND PAINTING.

All nozzle surfaces shall be cleaned to remove loose scale, rust, grease, dirt, weld spatter and other foreign matter and applied with red oxide primer/ suitable rust preventive.

IDENTIFICATION MARKING:

Following marking shall be indicated on all Nozzles. Marking shall be accomplished by stencilling and / or hard punching / Affixing a TAG in line with the sample as given below.

	BHEL – BAP - Ranipet
Purchase Order No. :	
Manufacturer Name :	
Description of Item : PIPE NOZZLE - Absorber	
Drawing Number : 2-FW-203-01132/ 00	
Nozzle Size & No : 8" x N5 (A to B)	
Date of Manufacture:	
Date of Inspection :	

CERTIFICATION:

Manufacturer shall submit a complete set of hard copies and soft copies of all the documents pertaining to fabrication and testing of the nozzle viz. PO copy, approved copy of QAP, ITP, WPS/PQR, Bill of material, material test certificates, and stage wise inspection records, final dimensional inspection, PWHT records (if applicable), NDT records, witnessed by TPIA.

	TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES
ROS: CPN: R00	

ANNEXURE- I: DEVIATION SHEET

SI No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____

mkp

	TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES
ROS: CPN: R01	

	BHARAT HEAVY ELECTRICALS LIMITED (A GOVT OF INDIA UNDERTAKING)	Water Systems Group, Boiler Auxiliary Plant (BAP), BHEL Ranipet – 632406.
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Technical Specification: C 276 Cladded Carbon Steel Nozzles

SPECIFICATION NUMBER : ROS: CPN: R01
BUYER (EPC) : BHEL, BAP Ranipet
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM

01	03.08.2020	Revision	<i>Akumar</i>	<i>J. M. Lambiris</i>	<i>M. Salaimanalan</i>
00	20.07.2020	Fresh Issue	Abhinav Kumar	IMRL-Rao	M Salaimanalan
REV No	Date	Description	Prepared	Checked	Approved

This document is meant for the exclusive purpose of bidding against this specification and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued.

	TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES
ROS: CPN: R01	

CONTENT

1.0	INTENT OF SPECIFICATION -INTRODUCTION -APPLICATION STANDARD, CODES AND REGULATIONS
2.0	PROVENNESS CRITERIA
3.0	ORDER OF PRECEDENCE
4.0	MATERIAL OF CONSTRUCTION
5.0	SCOPE OF SUPPLY - GENERAL REQUIREMENTS FOR HASTELLOY C-276 CLADDING/ WELD OVERLAY OF NOZZLE PIPE WITH FLANGE - NOZZLE FABRICATION
6.0	INSPECTION AND TESTING - INSPECTION AND TESTING REQUIREMENTS - CLEANING AND PAINTING - IDENTIFICATION MARKING - CERTIFICATION
	ANNEXURES
I	DEVIATION SHEET
II	ABSORBER NOZZLE DETAILS DRAWING

**1.0 INTENT OF SPECIFICATION****Introduction:**

This specification covers the minimum requirements of procurement specifications & inspection requirements for cladmed (CS+ Hastelloy C-276) nozzle pipe with flange internally including Raised Face (RF) weld overlaid with Hastelloy C-276 (Note: The CS plate shall not have the raised face) / Cladmed plate welded on the flange face. The bidders shall be responsible for complete material, manufacturing, shop inspection, testing at the manufacturer's works, and Inspection of C276 Cladmed Carbon Steel backed Flanged Nozzles.

This document shall form an integral part of Enquiry, Purchase order. Third party inspection (TPI) agency shall be appointed to carry out stage-wise inspection as depicted in the following procedure. The TPI shall be BHEL nominated agencies (Details will be shared during contract execution):

The following may be noted:

- a. Bidder shall assume full responsibility for the materials, fabrication craftsmanship, and assembly. Comply strictly with the requirements of this specification, drawings and other referred specifications / attachments as per the Tender enquiry and comply at Ordering stage.
- b. In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (**ANNEXURE- I**)". The reason for seeking deviation shall be explained and documentary evidence shall be provided to substantiate the same. This will facilitate the decision making.
- c. Any deviation, not listed in Annexure - I, though reflected in any other part of the offer, shall not be considered.
- d. BHEL discretion is final in acceptance / rejection of exceptions / deviations listed by Bidders' proposal in Annexure – I. Only written approval by BHEL is valid means of acceptance of deviation / exception.
- e. Bidder shall ensure completeness of the C 276 Cladmed Carbon Steel backed Nozzles in all respects and provide all necessary inspection documents after carrying out the same to fulfil requirements within this specification and referred standards to ensure compliant products in line with the specification unless specifically excluded by BHEL.
- f. Metric (SI) units of measurement shall be used throughout the specification and drawings.

Applicable Standards, Codes & Regulations:

Materials selection, Manufacture shall conform to the requirements of applicable codes and regulations of the latest edition. The same shall follow the latest applicable Indian/International (ASME / EN / API / Japanese) Standards and any other standards indicated in this specification. If any other country standard used, then against each standard, equivalent Indian/Internal standard to be indicated against each item. A copy of such standard duly translated in English shall be furnished by vendor.

In general, components shall conform to latest edition of the following standards:

Pipe Material Standard & Specifications: ASTM B 619, ASTM B 622.



TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES

ROS: CPN: R01

Schedule: As per drawing. Type: Seam less / ERW / Welded / Fabricated

Length: As per drawings provided.

Nozzle Free End: Bevel / Plain (Refer respective drawings)

Flange Material Standard & Specifications: IS 2062 Gr B (Carbon Steel plate)

UNS Code for C276 cladding material: UNS N 10276

API SPEC 5 LD Latest edition

API RP 582 Latest edition

Clad Plate / sheet / Weld Overlay Specification: ASME SA – 265 – specifically C – 276 Alloy.

2.0 PROVENNESS CRITERIA:

The Bidder shall offer only proven products for which the fabrication, manufacturing process, Inspection methods are established and meets the Provenness criteria indicated in the **QR requirement documents**. Necessary documentary evidences as per **QR for qualification** shall be submitted along with the bid. Offers of Bidders without the provenness criteria shall not be considered for evaluation.

Bidders are required to meet the Qualification Requirement (QR) for the supply of the C276 Cladded Nozzles as per **enclosed document & submit Attachment to qualification requirement**

3.0 ORDER OF PRECEDENCE

Any conflict between any requirements specified in this document and the requirements of any other relevant referenced document shall be resolved in the following order of preference.

- 1) The item number description in the enquiry, Purchase requisition or Purchase order.
- 2) This specification
- 3) Other Project specification if any referenced in this document.
- 4) Reference codes and standards.

Deviation to the specified requirements of the enquiry package for material procured shall only be considered explicitly by written approval from BHEL.

4.0 MATERIAL OF CONSTRUCTION

Sl.no	Description of the Item	Material Standard / Specification
A	2" Pipe	Hastelloy C-276
B	Above 2"	
i.	Backing Pipe	ASTM A 106 Gr. B

**TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES****ROS: CPN: R01**

	Backing Plate formed into pipe	IS 2062 Gr. B
	Flange	IS 2062 Gr. B
ii.	Lining Sheet	Hastelloy C – 276 as per ASTM A265
	Cladding Metal Electrode	ERNiCrMO4 or ENiCrMO4 (depending on overlay mode/method)
iii.	Welding :	
	Carbon Steel	E 7018 or equivalent
	Carbon Steel to C 276	ERNiCrMO4 or ENiCrMO4 (depending on overlay mode/method)

Bidders offering alternative / equivalent specifications shall submit documents along with proof of equivalency. The same is subject to acceptance & approval to BHEL's discretion. Bidders are advised to obtain a written acceptance from BHEL during the pre-bid stage / technical bid stage, as all other modes are invalid.

5.0 SCOPE OF SUPPLY

Scope for the bidders shall include fabrication, manufacture, Inspection and Supply of the Nozzles. Any Engineering done by Bidder for approval of BHEL shall be intimated immediately on award of contract and shall not exceed a Time frame of 14 calendar days from the date of PO placement. This requirement shall be indicated in the Technical Bid stage itself.

It may be noted that for Inspection and Clearance, BHEL drawings and documents along with referred standards shall be basis of successful execution of work including approved fabrication drawings of Vendor. This includes specific exemptions granted to Bidder during offer evaluation.

GENERAL REQUIREMENTS FOR HASTELLOY C-276 CLADDING/ WELD OVERLAY OF NOZZLE PIPE WITH FLANGE:

The document covers the requirements for CS (IS 2062 Gr. B) + Hastelloy C-276 clad plate for fabricated nozzle pipe.

ASME Boiler & Pressure Vessel code – Section IX and AWS B 2.1 shall be followed for Welding & Brazing qualification and Welding Procedure and Performance Qualification (WP & PQ) respectively. References from standards listed in this specification is also acceptable. Bidders shall specify the applicable standards and corresponding clauses for WP & PQ.

Welders performing the job on subject Nozzles shall be qualified in line with the above and shall have a minimum further 6 to 9 months prior to their requalification tests from the date of PO placement. Successful Bidders shall carryout the WP & PQ within 1 week of order



TECHNICAL SPECIFICATION OF C 276 CARBON STEEL NOZZLES

ROS: CPN: R01

placement for witness by BHEL / BHEL appointed TPI agency. Records of the Welders shall be maintained for verification. The same shall be provided along with the Inspection reports for submission to Customer.

Fabrication scope of vendor/contractor includes Supply of plate / Pipe material , fabrication of nozzle cladding / weld overlay with Hastelloy C-276 as per drawing, requisite Non Destructive Testing (NDT), dimensional inspection, Post Weld Heat Treatment (PWHT) after weld overlay (if applicable), cleaning, painting, marking, certification etc. and dispatch.

The Clad plates shall be made either hot rolled or explosion bonded process. Clad plates shall be procured to specifications ASTM A265 and Ultrasonically Tested to meet quality requirements of SA/A 578 or equivalent standards.

All fabrication Drawings shall be prepared based on attached reference drawings and the same shall be approved by BHEL. All fabrication shall be carried out as per approved drawings.

Hastelloy-276 (C – 276) weld overlay shall be carried out using welding consumable ERNiCrMO4, as per ASME Sec II Part-C .The minimum thickness shall be 3.0 mm. Tolerance on thickness of overlay shall be + 1.0/ - 0.0 mm.

Weld overlay shall be carried out with minimum 25% overlap with the previous bead.

Weld overlay shall be carried out in minimum two layers. Single layer weld overlay is not acceptable.

Vendor shall ensure the circularity of ID at the edges of pipe as per ASME Section VIII standard.

Pipe ends shall be supplied as mentioned in drawing.

Vendor shall develop procedure to minimize dilution: maximum value as per prescribed standards shall be maintained. Data shall be provided during technical offer along with proof / evidence in line with referred standards with respect to dilution in Hastelloy C-276 weld overlay at the surface and same shall be demonstrated during Pre-Qualification Requirement (PQR).

Vendor shall develop procedure with low heat input to prevent distortion.

In case of flanges, weld overlay / clad plate welding shall be carried out on the gasket seating face. The raised face (if present in the Flange) shall be machined to accommodate the weld overlay thickness. The weld overlaid gasket seating surface shall be machined to require surface finish 125-250 RMS (3.2 to 6.3 finish)

100% Positive Material Identification (PMI) of final weld overlay shall be carried out at accessible locations & bevel edges.

Weld overlay shall be carried out only with GTAW (Computerized controlled automatic) process. SMAW/ GMAW/FCAW process shall not be permitted to avoid excess dilution.

Weld repair on localized area shall be carried out only with GTAW process and same will be done with the preheating as applicable. PWHT of repaired shall be done only after attending all repairs on weld overlay surface.



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All Weld Procedure Qualification for Weld Overlay shall conform to QW-453 of ASME Sec. IX latest edition. Weld overlay is "corrosion resistant" type. The PQR shall be qualified with the same PWHT holding temperature (if applicable) & time required for the production welding. All welders/ welding operators shall be qualified accordingly for the same.

For all other aspects of back cladding using Corrosion Resistant Overlay, QW 217(b) of ASME Sec IX and related / cross referred QW's shall be referred for incorporation of required tests. Figure QW – 462.5(a) shall form the basis of determining the minimum qualified weld overlay thickness.

The specification covers the requirements for CS (IS 2062) + Hastelloy C-276 clad plate and CS Pipe (SA 106 Gr B) with C – 276 weld Over Lay for fabricated nozzle pipe.

NOZZLE FABRICATION

Fabrication shall be in accordance with approved fabrication drawing and applicable codes/standards/recommended good practices.

Welding procedures (WPS and PQR) shall be submitted to BHEL prior to commencement of job for approval

In the selection of the welding parameters, specific care shall be taken to avoid hot cracking

Following requirements apply for weld overlay fabrication:

Required preheating shall be achieved before start of weld overlay & during weld overlay to avoid shrinkage cracking. The minimum temperature shall be as per ASME B31.1 Table 330.1.1

All piping and piping components of P No 1 undergoing weld overlay shall be stress relieved in accordance with paragraph 323.4.3 of ASME B31.3.

Stress relieving shall be done in furnace or by application of heating pads/coils.

Each nozzle shall be tagged for identification before loading into furnace.

In case of furnace PWHT, loading temperature of furnace shall be $< 425^{\circ}\text{C}$. Furnace can be induction heated or gas fired. Rate of rise of temperature shall be $< 150^{\circ}\text{C}/\text{hour}$. Rate of cooling shall be $100^{\circ}\text{C}/\text{hour}$. Temperature of the firebox shall be controlled by automatic controls. Chart shall be made available for each charge.

During PWHT, vendor to ensure the proper internal / external support to avoid distortion / Ovality / warping etc.

After PWHT, the pieces shall be thoroughly cleaned by blasting to remove scales.

Hydro Test shall be performed for all nozzle at 1.5 times of design pressure.

The nozzle pipe shall be fabricated out of clad plate with suitable manufacturing process maintaining OD of the pipe. In case higher thickness back up plate are used for forming, the pipe to meet to minimum thickness of pipe schedule specified, pipe outside dia shall be

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maintained. Alternatively CS Pipe with C-276 Weld Overlay may also be offered with all conditions of manufacture in line with the specification and standards referred to herein.

6.0	INSPECTION AND TESTING
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INSPECTION AND TESTING REQUIREMENTS:

Quality Plan is attached with the specification. Bidders shall submit the Technical Bid along with signed copy of the quality plan.

PQR / WPS for all welding including overlay welding shall be submitted to TPIA for review / approval and for final approval of BHEL.

Throughout the manufacturing processes, a means of identification shall be utilized to maintain strict traceability of all items.

Each clad plate shall be subjected to internal Ultrasonic Testing before taking up for fabrication.

Visual inspection shall be carried out for flatness & deviation for clad plate. Records shall be maintained for review by BHEL / TPIA

Formed components (pipe) shall be Ultrasonically Tested after heat treatment, for de-bond check between clad and base material.

100% RT shall be carried out for butt weld of Pipe fabricated from clad plate.

All NDE shall be carried-out in accordance with the applicable process piping/pressure vessel Code and / or this Specification, as stated in Purchase Orders. Relevant NDE procedures, methods and techniques, shall be submitted to BHEL for approval. Any subsequent revision to the document shall be submitted to BHEL for re-approval. All NDE procedure shall be reviewed by BHEL / BHEL authorised agency prior to commencement of job.

All NDE shall be performed by personnel qualified to a recognized National or International Standard (e.g. PCN, ASNT Level II minimum, etc.). The manufacturer's QC department's representative shall review Certification of NDE personnel periodically.

PWHT charts shall be reviewed by BHEL / BHEL nominated TPIA.

Internal records of PMI check where applicable shall be reviewed by BHEL / BHEL nominated TPIA. 10% PMI shall be witnessed by BHEL / BHEL nominated TPIA.

All machined surfaces (after weld overlay deposits) shall be subjected to Dye Penetrant examination.

Final dimensional inspection record shall be REVIEW point for BHEL / BHEL nominated TPIA.

Surface preparation for painting, visual inspection of the painting and DFT records shall be reviewed by BHEL / BHEL nominated TPIA.



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After all inspection is over BHEL / BHEL nominated TPIA shall issue the "Inspection release note (IRN).

CLEANING AND PAINTING.

All nozzle surfaces shall be cleaned to remove loose scale, rust, grease, dirt, weld spatter and other foreign matter and applied with red oxide primer/ suitable rust preventive.

IDENTIFICATION MARKING:

Following marking shall be indicated on all Nozzles. Marking shall be accomplished by stencilling and / or hard punching / Affixing a TAG in line with the sample as given below.

	BHEL – BAP - Ranipet
Purchase Order No. :	
Manufacturer Name :	
Description of Item : PIPE NOZZLE - Absorber	
Drawing Number :	
Nozzle Size & No : 8" x N5 (A to B)	
Date of Manufacture:	
Date of Inspection :	

CERTIFICATION:

Manufacturer shall submit a complete set of hard copies and soft copies of all the documents pertaining to fabrication and testing of the nozzle viz. PO copy, approved copy of QAP, ITP, WPS/PQR, Bill of material, material test certificates, and stage wise inspection records, final dimensional inspection, PWHT records (if applicable), NDT records, witnessed by TPIA.

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ANNEXURE- I: DEVIATION SHEET

SI No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____