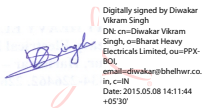
Index
For tender documents (Technical)
Tender no B/4011/2014/5073V1



Based on standard : ASME PTC 6-2004

TECHNICAL SPECIFICATION FOR CALIBRATED FLOW NOZZLES

1.0 GENERAL

This specification calls for supply of calibrated long radius, low beta ratio throat tap flow nozzle assembly(ies) for the accurate determination of primary flow in the Performance Guarantee test on the TG set of the project indicated in sheet-5.

2.0 SCOPE

Supply of calibrated flow nozzle assembly(ies) comprising primary flow element, flow straightener(s), end flanges, gaskets (including one extra set for future use), requisite zinc plated bolts, nuts, upstream and downstream pipe sections and suitable root valves for tap sets. Each of the four pressure tap sets shall be 90° apart and calibrated as per ASME PTC 6-2004.

3.0 TECHNICAL REQUIREMENTS

Long Radius, low beta ratio throat tap flow nozzle assembly is to be designed as per para 4.8.4 to 4.8.11 of "ASME PTC 6-2004", "ASME PTC 19.5 –Flow Measurement" alongwith data in Sheet No. 4. The overall dimensions of the flow meter(s) should match with those indicated in sketch in sheet No.5. Major technical requirements are reproduced as follows:

a) The flow nozzle(s) shall be designed, manufactured and calibrated as per ASME PTC 6-2004.

b) The supplier should calibrate the nozzle(s) preferably by Weigh tank method with Reynolds number, Water Temperature & other flow conditions as close to test conditions as possible. When it is not possible to calibrate at the test Reynolds number, the calibration Reynolds number should be obtained in accordance with para 4.8.16 of ASME PTC 6-2004. While calibrating, the transition region from 1.0 million to 4.0 million should be established .It is recommended that the value of the coefficient be established at the highest Reynolds No. possible, to minimize the effects of the transition region (in accordance with para 4.8.13 of ASME PTC 6-2004). It is recommended that nozzles be sized to produce throat Reynolds Nos. beyond this range if possible to avoid effects of the Transition region as described in para 4.8.17, pg.37 of ASME PTC 6-2004.

c) The supplier should get the flow nozzle calibrated only at a recognized facility having international repute. Calibration should be conducted on all the pairs of taps & preferably consist of at least 20 acceptable points over a wide range of Reynolds Nos. For each set of selected taps, the calibration curve shall be within 0.25% of the reference curve and shall have the same slope. The reference curve is given in fig. 4.10 & table 4.2 on pg. 37 of ASME PTC 6-2004. The calibration of the flow nozzle shall comply with the conditions listed in clause 4-8.14 and 4-8.15 on pg. 36 & 37 of ASME PTC 6-2004.

				नाम NAME	दिनांक एवं हस्ताक्षर SIGNATURE & DATE
TSX	BIHARI CHAUDHARY		अनुवादक TRANSLATED BY	-	-
MEMBER-PSC	VIRENDRA KUMAR		निर्माणकर्ता DRAWN BY	-	-
QAX	S.K. CHAUHAN		जांचकर्ता WORKED BY	PREETAM SINGH	07/10/10
सहमत विभाग AGREED DEPTT.	नाम NAME	दिनांक एवं हस्ताक्षर DATE & SIGNATURE	पर्यवेक्षणकर्ता CHECKED BY	PRABHAT SINGH	07/10/10
			स्वीकृति : APPROVED : S. BHATTACHARYA DGM (STE) 7/10/10		GP No. 2.83
REV.NO. 01			निर्माण : PREPARED : STE	जारी : ISSUED : STE –TC	दिनांक : DATE : 07.10.2010
09/05/11					

11-10-10

P-6404

d) The flow nozzle(s) shall be made from corrosion resistant material with known thermal expansion coefficient. Its surface should be hydraulically smooth and shall be free from all burrs, scratches, imperfections or ripples. For additional requirements on the design and manufacture of the nozzle(s) and its pressure taps, refer paras. 5.1, 5.2, 5.3, 5.4 of ASME PTC 19.5-2004 Flow Measurement & paras 4.8.6 & 4.8.7 of ASME PTC 6-2004.

e)The flow straightener shall be of Perforated or tubed plate design with non uniform hole distribution ***(also called Gallagher Straightener)*** as shown in Fig 4.5 & described in Para 4.8.4 & Table 4.1 on Pg. 30 & 32 of ASME PTC 6-2004.

f) The bidder should confirm that in case the calibration curves are not within the limits prescribed in ASME PTC 6, they will manufacture fresh flow nozzle(s) and calibrate it to achieve the calibration regimes of ASME PTC 6 and supply the new piece(s) without any price / delivery implications.

g) The total length of the flow assembly including flow straighteners; upstream & downstream machined pipe length; flanges of size Nb450 CL400 RF Weld neck type as per ANSI B16.5 etc. is to be exactly as indicated in the sketch in sheet No.6 of this document. For ease of transportation and installation, it is proposed to provide an interlocking flange joint near the center of assembly. This joint to be opened for shipping after calibration.

h) The external surfaces of the assembly shall be suitably painted to avoid rusting due to sea transportation (if applicable) and storage. **The end faces shall be provided with suitable covers and conservation shall be done by filling Nitrogen and blanking the nozzle at the ends to avoid rusting/damage of the pipe internals. The nozzle shall remain filled with nitrogen until installation for Performance Test.** Open ends of upstream and downstream taps should be sealed with covers to prevent damages to thread. The nozzles shall be packed in suitable seaworthy crates to avoid damage during transport and temporary storage before use at site.

i) Serial No. of the nozzle, tag **FP01 should be clearly indicated on a name plate permanently affixed to the assembly. Tap set identification mark(s) shall also be punched as well as painted on the assembly** so that they can be easily identified by the customer at site. **These should also be clearly indicated in the assembly drawing.**

j) The nozzle should be placed in box with name plate facing upward. The box should have arrow mark indicating upper direction and should atleast carry **name of supplier, S.No. Of nozzle ,name of the project, package size, gross weight and net weight.**

4.0 DOCUMENTS TO BE SUBMITTED WITH OFFER

1) A copy of the design calculation for the nozzle(s) indicating clearly the calculation formula & the various correction factors like Buoyancy factor, Density correction, scale expansion etc. the bidder intends to apply in the calculations.
2) A typical flow calibration curve for a flow nozzle supplied earlier as per ASME PTC 6
3) Preliminary drawing of nozzle assembly and nozzle cross sectional drawing.
4) A quality plan on prescribed format.
5) Details of Manufacturing, testing & calibration facilities.
6) Experience list of supply of flow nozzle for similar rating supercritical thermal sets.

5.0 DOCUMENTS TO BE SUBMITTED FOR DESIGN APPROVAL (after Placement of order)

1) Drawings of the flow section with details of different components, material details and dimensions.
2) Final flow calculation as per ASME PTC 6.
3) An assembly drawing showing the location and assembly of all major components including the location of the marks showing tap set Nos.
4) Quality plan.

5.1 INSPECTION & TEST CERTIFICATES

The following minimum tests shall be carried out as per applicable standards. 3 copies of test certificates and 1 reproducible shall be submitted for all the tests listed below **before packing and dispatch of nozzles.**

1) Calibrations on nozzle as per ASME PTC 6. Copies of calibration for each tap set indicating nozzle/pipe diameter and calibration conditions, including curves and calculation data shall be submitted for review and acceptance.
2) Material tests for all major components (i.e.) Nozzle, Steel pipes, Flanges, fittings, etc
3) Magnetic particle or liquid penetrant examination for each pressure taps as per ASME Sect.V.
4) 100 % Radiographic examination of butt welds as per ASME Sect.VIII.
5) Hydrostatic pressure test of complete meter run at 1.5 times of design pressure for minimum 30 minutes with proof of test.
6) Surface finish measurement for Nozzles satisfying the requirements of ASME PTC 6 and ASME PTC 19.5 as stated in para 3(d) above.

PRESCRIBED FORMAT FOR QUALITY PLAN

S. No	COMPONENT OPERATION	CHARACTERISTICS	CLASSIFICATION	TYPE OF CHECK	QUANTUM	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY P | W | V			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13

INSTRUCTIONS FOR FILLING QUALITY PLAN

The quality plan shall include all the quality control measures and check adopted by the vendor to ensure that the material/ components/ assembly/ services supplied by the vendor meet /will meet the requirements as per specifications and good practices. They shall include all stages of operation such as materials, process, assembly, packing & dispatch. The following guidelines for filling the Quality plan may be noted:

Column 1- Serial Number

Column 2- Component / operation. The component and / or operation being checked shall be given here.

Column 3-Characteristics - The characteristic being checked shall be given here (e.g.) Chemical composition, mechanical properties, leak tightness, surface defects, etc.

Column 4- Category CR stands for critical characteristic affecting the safety of equipment and personnel. MA stands for major characteristic affecting performance, reduction in life, large down time.MI stands for minor characteristic affecting appearance.

Column 5-Type of check: like chemical analysis, tensile testing, hydraulic test, visual examination, radiography, etc.

Column 6- Quantum of check such as 100%, 10%, 1 per Heat, etc.

Column 7- Reference documents - Documents such as Technical specifications, drawings, standard specifications (BS, ANSI, ASME, DIN, IS, etc.), procedure etc. according to which the checks are done.

Column 8- Acceptance norms-Standards etc. according to which the acceptability or otherwise of the characteristics being checked is decided.

Column 9- Format of Records - Formats, log sheets, reports, etc. in which the observations are recorded. Standard log sheets, reports, format, etc. of the vendor shall be numbered and such reference numbers shall be included here.

Column 10-12 -Agency - The agency which performs the test/inspection shall be written in the sub-column P. The agency which witnesses the tests shall be written in the sub-column W & the agency which verifies the tests certificates/inspection records shall be written in the sub-column V.

DATA SHEET FOR FLOW MEASURING DEVICE

660 MW THERMAL POWER PLANT

1) SERVICE : CONDENSATE FLOW TO DEAERATOR
2) TAG NO. : FP01
3) QUANTITY : 1 NO.
4) LINE FLUID : CONDENSATE (DM WATER)
5) OPERATING DATA

	100 % LOAD (Design Point)	80 % LOAD	MAXIMUM LOAD
FLOW (T /Hr)	1463.661	1182.861	1610.982
PRESSURE(Kg/cm^2 abs)	12.11	10.03	12.45
TEMPERATURE (°C)	153.8	147.1	154.8

6) PIPE SIZE : O.D. = 457.00 mm
: I.D. = 431.60 mm
: Thickness = 12.70 mm
7) PIPE MATERIAL : SA106 Gr C.
8) PIPE STANDARD : ANSI B 36.10
9) TYPE OF FLOW ELEMENT : LOW BETA RATIO THROAT TAP NOZZLE
10) MATERIAL OF FLOW ELEMENT : 321 SS or Equivalent
11) TYPE OF MOUNTING : Flanged
12) TYPE OF TAPPING : Throat Taps
13) NO.OF TAPPING POINTS : FOUR Pairs
14) TYPE OF FLOW STRAIGHTENER : Perforated or Tubed plate (As per Fig. 4.5, ASME PTC-6-2004)
15) GRADIENT : Horizontal.
16) ALLOWABLE PRESSURE LOSS : Approx 1.0 Kg/cm2 at 100 % load
17) DESIGN & CALCULATIONS : As per ASME PTC-6-2004 & ASME PTC 19.5-2004 Flow Measurement
18) CALIBRATION CURVES & DATA : Required for each pair of tapings. Data indicating Cd $_{theo}$ & Cd $_{practical}$ to be furnished.
19) DIFFERENTIAL AT 100% LOAD : Preferably 1.5 Kg/cm2
20) INSTRUMENT RANGE : 0-2.5 Kg/cm2 Dp transmitter

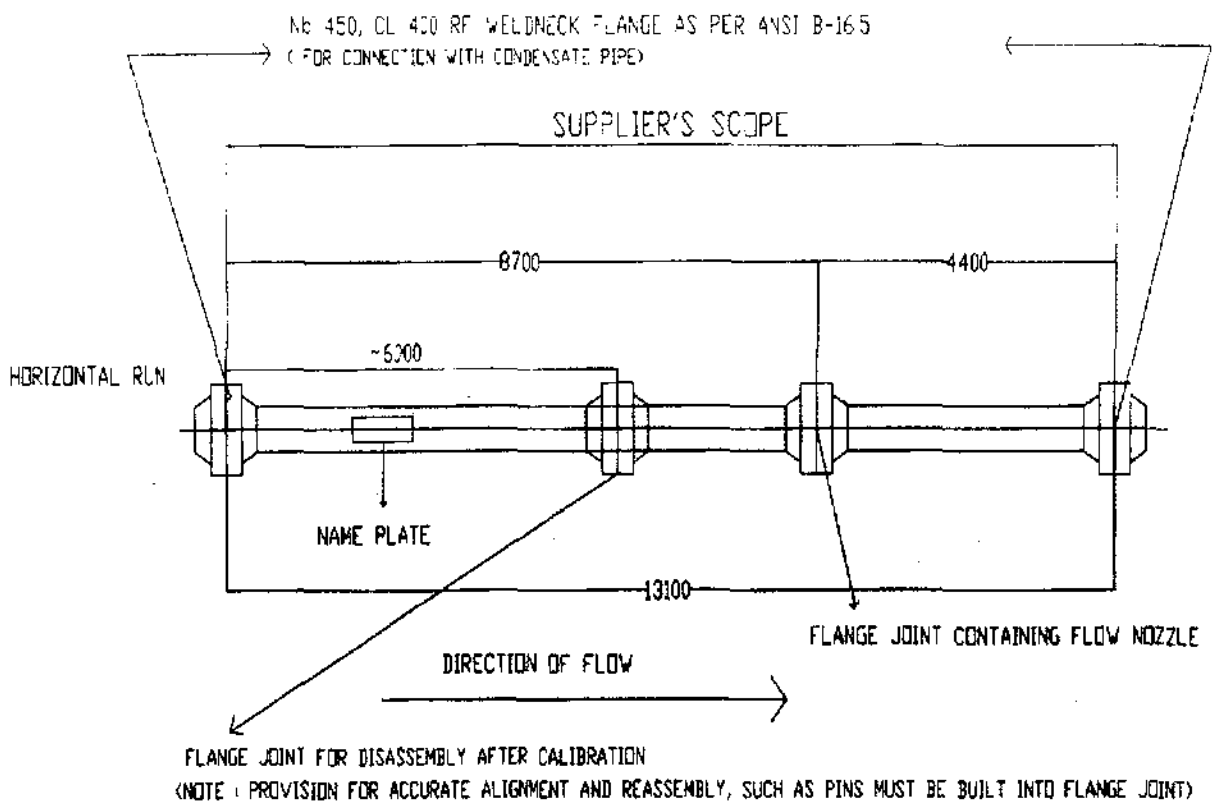
REV. NO. 01			
	अधिकर्ता WORKED BY	PREETAM SINGH	09/05/11
	परीक्षणकर्ता CHECKED BY	PRABHAT SINGH	03/05/11

हस्ताक्षर एवं दिनांक SIGN & DATE 25/5/11

सामग्री सूची संख्या INVENTORY NO. P-6401

SUPERSEDES INVENTORY NO

REV. NO. 01



DESIGN DATA

PIPE O.D.	PIPE THICKNESS	PIPE MATERIAL	DESIGN PRESSURE	TEST PRESSURE	DESIGN TEMP.	DESIGN CODE
457.00	12.70	SA 106 GrC	48 Kg/cm2	72.0 Kg/cm2	160 Deg C	ANSI B36.1

All Dimensions in mm

WORKED BY: PREETAM SINGH

CHECKED BY: PRABHAT SINGH

05/05/11

PRODUCT STANDARD

उत्पाद मानक

ST45008

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MANUFACTURER'S NAME AND ADDRESS		STANDARD QUALITY PLAN		TO BE FILLED BY BHEL	TO BE FILLED BY BHEL
BHEL	VENDOR'S NAME	ITEM	CALIBRATED FLOW NOZZLE	QP.. NO.:	QA/BE/QP/326
				REV. NO.:	03
		DRG. NO.	As Per PO		
		REV. NO.:	As Per PO		
		SPEC NO.:	As Per PO		
		REV. NO.:	As Per PO	Page 1 of 3	

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	D	AGENCY M	AGENCY B	AGENCY N	REMARKS
1	2	3	4	5	6	7	8	9		10			11
1.0	**In Coming Raw Material Inspection:**												
1.1	Flow Nozzle & Flange Adaptors	Chemical & Mechanical Properties	Major	Chemical & Mechanical	100%	BHEL Specification	BHEL Specification / Approved Data Sheet	MTC	√	P/ V	V	-	Correlated Manufacturer Test Certificate (MTC) to be Submitted
1.2	Forgings	Chemical & Mechanical Properties	Major	Chemical & Mechanical	100%	BHEL Specification	BHEL Specification / Approved Data Sheet	Test Certificate	√	P/ V	V	-	
1.3	Stud & Nuts (Zinc plated)	Make & Proove Chemical & Mechanical Properties	Major	Chemical & Mechanical & Zinc coating	100%	BHEL Specification	BHEL Specification / Approved Data Sheet	MTC	√	P	V	-	
1.4	Branches Pipes	Chemical, Mechanical Properties & Hydraulic test	Major	Chemical, Mechanical & Leakage	100%	BHEL Specification	BHEL Specification / Approved Data Sheet	MTC	√	P/ V	V	-	Correlated Manufacturer Test Certificate (MTC) to be Submitted
2.0	**In Process Inspection:**												
2.1	Machining	Visual & Dimensions	Major	Visual & Measurement	100%	Approved Drawing	Approved Drawing	Inspection Report	√	P	V	-	
2.2	Welding	WPS/ PQR/ WPQ	Major	Records	100%	ASME SEC IX	ASME SEC IX	Records	√	P	V	-	
2.2	Welding	NDT Examination	Major	Radiography	100% (On All Butt Weld Joints)	ASME SEC - V	ASME SEC - VIII, DIV – 1 APPENDIX- 4	RT Report	√	P	V	-	Radiographs will be Reviewed
2.3	Welding	NDT Examination	Major	DPT	All Weld Joints	ASME SEC - V	ASME SEC III, DIV – 1 APPENDIX - 8	LPT Report	√	P	W	-	LPT to be Witnessed

		LEGEND:	FOR CUSTOMER USE	
MANUFACTURER/SUBCONTRACTOR		! RECORDS IDENTIFIED WITH 'TICK'(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. M: MANUFACTURER / SUBCONTRACTOR B: BHEL / NOM. INSPECTION AGENCY N: CUSTOMER INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION ALL 'W' INDICATED IN COLUMN 'N' SHALL BE 'CHP' OF CUSTOMER		APPROVED BY

MANUFACTURER'S NAME AND ADDRESS		STANDARD QUALITY PLAN		TO BE FILLED BY BHEL	TO BE FILLED BY BHEL
BHEL	VENDOR'S NAME	ITEM	CALIBRATED FLOW NOZZLE	QP.. NO.:	QA/BE/QP/326
				REV. NO.:	03
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		REV. NO.:	As Per PO	Page 2 of 3	

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	D	AGENCY M	AGENCY B	AGENCY N	REMARKS
1	2	3	4	5	6	7	8	9	D	10			11
3.0	**Final Inspection on Assembly, Identification, Marking & Packing:**												
3.1		Visual & Surface Finish of Flow nozzle	Major	Visual & Measurement	100%	BHEL Specification	BHEL Specification	Inspection Report	√	P	W	-	
3.2		Checking of internal machining of bore of upstream & downstream pipe as per ASME	Major	Measurement	100%	BHEL Specification / ASME PTC-6	Approved Drawing / ASME PTC-6	Inspection Report	√	P	W	-	
3.3		Checking of dimensional measurement of Upstream pipe, downstream pipe and flow nozzle at various locations as per ASME .	Major	Measurement	100%	BHEL Specification / ASME PTC-6	Approved Drawing / ASME PTC-6	Inspection Report	√	P	W	-	
3.4		Hydro Test	Major	Hydraulic	100%	BHEL Specification	No Leakage Allowed	Hydro Test Certificate	√	P	W	-	Hydro test will be Carried Out at 1.5 times of design Pressure for Min. 30 Minutes
3.5		Fixing of Name Plate Stamping of Tap No, Flow Direction	Major	Visual	100%	BHEL Specification	BHEL Specification	Inspection Report	√	P	W	-	
3.6		Painting of Flow Nozzle assembly	Major	Visual	100%	BHEL Specification	BHEL Specification	Inspection Report	√	P	W	-	
3.7		Workmanship	Major	Visual	100%	BHEL Specification	BHEL Specification	Inspection Report	√	P	W	-	

MANUFACTURER/SUBCONTRACTOR		LEGEND: ! RECORDS IDENTIFIED WITH 'TICK'(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. M: MANUFACTURER / SUBCONTRACTOR B: BHEL / NOM. INSPECTION AGENCY N: CUSTOMER INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION ALL 'W' INDICATED IN COLUMN 'N' SHALL BE 'CHP' OF CUSTOMER	FOR CUSTOMER USE	APPROVED BY

MANUFACTURER'S NAME AND ADDRESS		STANDARD QUALITY PLAN		TO BE FILLED BY BHEL	TO BE FILLED BY BHEL
BHEL	VENDOR'S NAME	ITEM	CALIBRATED FLOW NOZZLE	QP.. NO.:	QA/BE/QP/326
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SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	D	AGENCY M	AGENCY B	AGENCY N	REMARKS
1	2	3	4	5	6	7	8	9	D	10			11
3.8		Calibration & Accuracy	Major	Wet Calibrated	100%	ASME PTC-6	ASME PTC-6	Calibration Certificate	√	P	W	-	Calibration at FCRI Palghat
3.9		Final Check	Major	Visual	100%	BHEL Specification	BHEL Specification	Inspection Report	√	P	W	-	
3.10		Preservation after Assembly & Calibration	Major	Visual	100%	BHEL Specification	BHEL Specification	Inspection Report	√	P	W	-	
3.11		Packing of Flow Nozzle Assembly, Root Valves and Gaskets	Major	Visual	100%	BHEL Specification	BHEL Specification	Inspection Report	√	P	W	-	

Note: Calibrated instruments shall be used for measurements & testing.

		LEGEND:	FOR CUSTOMER USE	
MANUFACTURER/SUBCONTRACTOR		! RECORDS IDENTIFIED WITH 'TICK'(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. M: MANUFACTURER / SUBCONTRACTOR B: BHEL / NOM. INSPECTION AGENCY N: CUSTOMER INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION ALL 'W' INDICATED IN COLUMN 'N' SHALL BE 'CHP' OF CUSTOMER		APPROVED BY