A-FORM

FORM NO BP-0021

BHARAT HEAVY ELECTRICALS LIMITED - BHOPAL

MM DEPARTMENT

ESTIMATE SHEET FOR ISSUE OF MATERIAL/COMPONENTS FROM BHEL

CHECKLIST

A-FORM NO : A211B36
REV NO : 0
A-FORM DATE 27-NOV-21
DATE : 27-NOV-21
PAGE : 1 / 1

DEPARTMENT : 211 PROJECT : NPCIL GHAVP UNI PO NO : A211B36 END PRODUCT : DRILLED TUBESHEET

INDENT NO : 221110067 WORK ORDER NO : 18084W04701 PO DATE : DELY REQD : 04042022

INDENT DATE : 12112021 MATERIAL ISSUE DIV : 211 SUPP CODE : SUPP NAME :

DETAILS OF FINISHED GOODS

A-SLNO	PO IT NO	PI IT NO	QUANTITY REQUIRED	UNIT	SHOP NO	DEST CD	COST CD	H.CELL
1	0	1	4.000	NO	211	211		211

DESCRIPTION OF SUB-ASSEMBLY/ITEM & WEIGHT/VOLUME/AREA

DRILLED TUBESHEET AS PER DRG.11650340824 REV. 04

FREE ISSUE MATERIAL PER UNIT OF FINISHED GOODS

MATL CODE	QTY PSL UNIT	PSL UNIT	RATE PSL UNIT	TOTAL MATL TO BE ISSUED	ISSUE UNIT	PSL/ WIP	SMIV/ PPMIV NO	MATERIAL VALUE	TARRIF HEAD	MATL ISSUE QTY
HE4180832011	1.0000	NO	5613500.000	4.00	NO	PSL		22454000.000		1.0000

DESCRIPTION OF FREE ISSUE MATERIAL AND WEIGHT /VOLUME/AREA

CLADDED TUBESHEET TO DRG. 11650340824 REV. 04 (R/M WT. 4650 KG, FINISH WT. 3410 KG. EACH) QTY- 4 NOS.

REMARKS LABOUR BASIS

AFORM TOTAL 22454000.000

TOTAL NO OF CANCEL ITEM 0

1 MATERIAL TO BE ISSUED ON :- FREE ISSUE BASIS

2.TRANSPORT TO BE PROVIDED BY :- BHEL

3.EXCISE DUTY ON ISSUE MATL TO BE BORNE BY :- SUPPLIER

4.SCRAP TO BE RETURNED :- NO

SIGNATURE OF INDENTOR
NAME
DESIGNATION
TELEPHONE

सत्य श्री / SATYA SHRI
बी.एच.ई.एल., भोपाल / BHEL, Bhopal

SIGNATURE OF ASC EXECUTIVE
NAME
DESIGNATION
TELEPHONE

RPT-101

1.0 GENERAL

1.1 This procedure establishes the requirements for the Procedure qualification & Production drilling of Tube sheet and Baffles.

1.2 Production drilling shall be taken up only after successful completion of procedure qualification, duly accepted by NPCIL (QA).

1.3 Tube sheet drilling shall be done on a CNC deep hole drilling machine while baffle drilling can be done on CNC drilling machine

1.4 All measurements shall be recorded in proper formats.

2.0 PROCEDURE QUALIFICATION OF TUBE SHEET DRILLING

2.1. Qualification Block

Following are the requirements for the qualification Block

Item	Requirement
Material	Same as tube sheet material including cladding (if any), heat treatment condition, NDE examinations.
Thickness	Equal to Tube sheet Thickness
Surface Flatness	Shall be within 0.2 mm
Surface Finish	Same as Tube sheet

2.2. Drilling Machine Setting

2.2.1 Channel side (front face) shall face the M/C tool (drill) side, so as to start drilling from the Channel side surface.

2.2.2 Parallelism of entire block face shall be set using precision dial gauges. It shall be within 0.10 mm and actual measurements shall be recorded and verified periodically.

2.3 Drilling

2.3.1 Drilling shall be done as per approved sequence and machine shall be programmed accordingly.

2.3.2 Drawing of test block with holes layout, holes identified with respect to machine, spindles, and spindle combinations, in case of multi spindle machine, shall be prepared prior to drilling and shall be submitted to purchaser for information.

2.4 Nos. of Holes

Minimum 50 holes shall be drilled per spindle as per approved tube lay out by using parameters established during trial drilling. Drilling parameters shall be recorded. Limit of maximum numbers of holes per drill bit to be established during the procedure qualification.

2.5 Examination

Following examinations shall be carried out:

Item	Requirement	Acceptance Standard
Hole Diameter	100% holes at 3mm from the front face, 3mm from the rear face and 3 locations at equal intervals on remaining length in two perpendicular directions by bore dial.	Approved drawing
	Go gauge check for full length & NOGO gauge check for all holes from both ends.	Go gauge should enter and No go gauge should not enter the hole

Ligament	100% ligaments shall be measured at front and rear face sides	Approved drawing
Hole position	100% holes shall be measured at front face.	Approved drawing
Drift	100% holes by optical tooling at rear w.r.t. front side.	Approved drawing
Visual examination	100% holes by Visual and Boroscope examination	Hole surface shall be free from scratch, tool mark etc.
Surface finish measurement	100% holes by Surface finish tester/Replica method at front and rear ends of holes.	Approved drawing

3.0 TUBE-SHEET DRILLING

3.1 Tube Sheet Condition

Just prior to drilling stage, Tube sheet condition shall be as per approved manufacturing procedure / QAP.

3.2 Drilling

3.2.1 Drilling shall be carried out on qualified machine by qualified operators.

3.2.2 Tube sheet shall be set in a position as shown in approved drawing with respect to axis marking and set position shall be recorded and verified.

3.2.3 Suitable measures shall be taken to ensure that Tube sheet setting is not disturbed during drilling.

3.2.4 Drilling sequence and machine setting parameters shall be as per drilling program established during procedure qualification. CNC machine drilling program/sequence shall be checked/verified for hole depth and hole layout before drilling on the job.

3.2.5 One hole shall be drilled on the test block set along with the tube sheet before/after the shift and during the event of any change in conditions (i.e change of drill, change found during in process checks on hole diameter, finish, ligaments by visual examination and go-no-go gauges) and only after ensuring acceptable hole quality, drilling on the production job shall be taken up.

3.2.6 The first hole on the job at the beginning of the shift shall be examined for acceptable quality.

3.2.7 As drilling proceeds, each of the drilled holes shall be checked before drilling the next hole by operator by visual means and using go- nogo gauges at drill entry and exit for hole diameter & ligaments. Records for 100 % tube hole inspection shall be kept by the manufacturer.

3.2.8 In addition, at regular intervals during drilling operation, hole shall be inspected and measurements recorded.

3.2.9 Drill bit shall be replaced as per established holes limit during procedure qualification or as and when limits for hole dimensions are reached during in process inspection, whichever falls earlier. Whenever a drill is replaced, the first hole shall be checked for compliance. Reground tools can also be used. Record

Not for publication /presentation outside NPCIL

shall be kept on the status of each drill (i.e. new, first grinding, second grinding etc.) along with identification of holes drilled, sequence on each spindle.

3.3 Examination

Following examinations shall be carried out on drilled Tube sheet:

Item	Requirement	Acceptance Standard
Hole Diameter	10% of total holes referred as **"Reference Holes",** selected at random by NPCIL (QA). At 3mm from the front face, 3mm from the rear face and 3 locations at equal intervals on remaining length in two perpendicular directions by dial bore gauge.	Approved drawing
	If all the reference holes are within specified limits then remaining holes of Tube sheet shall be checked with GO gauge for full length) & NOGO gauge from both ends.	Go gauge should enter and No go gauge should not enter the hole
Ligament	100% ligaments shall be measured at front and rear face sides	Approved drawing
Hole position	All reference holes at random and all non-conformance holes shall be measured at front face.	Approved drawing

Drift	All reference holes and all non-conformance holes at rear w.r.t front side.	Approved drawing
Visual examination	100% holes by Visual and Boroscope Examination.	Hole surface shall be free from scratch, tool mark etc.
Surface finish measurement	All reference holes and all non-conformance holes by Surface finish tester/Replica method and at front & rear ends of holes.	Approved drawing

Note: **"Reference holes"** to be selected by NPCIL (QA) randomly, but in a manner representing total tube sheet drilling.

3.4 Special Occurrence

If abnormalities like vibration, loosening of clamping, drill breakage etc. are noticed, drilling shall be stopped and the affected hole(s) shall be evaluated. Drilling shall proceed only after a satisfactory drilling of a hole on the test block and NPCIL (QA) clearance.

4.0 PROCEDURE QUALIFICATION OF BAFFLE DRILLING

4.1 Qualification Block

Following are the requirements for the qualification Block:

Item	Requirement
Material	Same as Baffle material including heat treatment condition, NDE examinations, etc.
Thickness	The number of plates, in a stack, used in procedure qualification, shall be the maximum permitted during production drilling
Surface Flatness	Shall be within 0.2 mm
Surface Finish	Same as baffle

The drilling of extra portion of first production baffle set itself may be used for baffle drilling procedure qualification.

4.2 Drilling Machine Setting

4.2.1 Setting of baffle plates on machine and clamping arrangements shall be done suitably to prevent buckling of the baffle plate before/during drilling. Adequacy of clamping and parallelism of baffle plate surface towards the drill side shall be checked by precision dial gauges traversing the entire surface.

4.2.2 Each of the plates in such a stack shall be punch marked suitably with respect to drill side face and plate sequence number in drilling direction, stack identification number so that baffles, from the same stack can be installed in the same sequence and facing, in the heat exchangers such that tubes can be smoothly inserted in the drilling direction. The setting/clamping and marking of plates shall be shown in a sketch.

4.2.3 Parallelism of entire baffle stack face shall be set using precision dial gauges. It shall be within 0.10 mm and actual measurements shall be recorded and verified periodically**.**

4.3 Drilling

Drilling shall be done as per approved sequence and machine shall be programmed accordingly.

4.4 No of holes

Minimum 50 holes shall be drilled per spindle as per approved tube lay out by using parameters established during trial drilling. Drilling parameters shall be recorded. Limit of maximum numbers of holes per drill bit to be established during the procedure qualification.

4.5 Examination

Following examinations shall be carried out:

Item	Requirement	Acceptance Standard
Hole Diameter	100% holes	Approved drawing
	Go gauge check for full length & NOGO gauge check for all holes from both ends.	Go gauge should enter and No go gauge should not enter the hole
Ligament	100% ligaments shall be measured at front and rear face sides	Approved drawing

Item	Requirement	Acceptance Standard
Hole position	100% holes shall be measured preferably by optical tooling at front face.	Approved drawing
Visual examination	100% holes	Hole surface shall be free from scratch, tool mark etc.
Surface finish	All holes shall be visually examined	Scratch Free uniform surface finish.
Bar Gauge Check	The stack shall be clamped and locked with locking pins for a bar gauge of diameter specified by purchaser. Check all holes	Bar Gauge shall pass through all the holes in the stack smoothly.

5.0 BAFFLE DRILLING

5.1 Condition

Just prior to drilling stage, Baffle condition shall be as per approved manufacturing procedure /QAP.

5.2 Drilling

5.2.1 Drilling shall be carried out on a qualified machine by qualified operators.

5.2.2 Baffle Stack or individual baffle shall be set in a position as shown on approved drawing with respect to axis marking and set position shall be recorded and verified.

5.2.3 Dial gauge shall be suitably fixed on periphery of Baffle Stack/Baffle to ensure setting is not disturbed during drilling.

5.2.4 Drilling sequence and machine setting parameters shall be as per drilling program established during procedures qualification. CNC machine drilling program/sequence shall be checked/verified for hole depth and hole layout before drilling on the job.

5.2.5 One hole shall be drilled on the test block set along with the Baffle Stack/Baffle before/after the shift and during the event of any change in conditions (i.e change of drill, change found during in process checks on hole diameter, finish, ligaments by visual examination and go-nogo gauges) and only after ensuring acceptable hole quality, drilling on the production job shall be taken up.

5.2.6 The first hole on the job at the beginning of the shift shall be examined for acceptable quality.

5.2.7 As drilling proceeds each of the drilled holes shall be checked before drilling the next hole by operator by visual means and using go-nogo gauges at drill entry and exit for hole diameter & ligaments.

5.2.8 In addition, at regular intervals during drilling operation, hole shall be inspected and measurements recorded.

5.2.9 Drill bit shall be replaced as per established holes limit during procedure qualification for baffle drilling or as and when limits for hole dimensions are reached during in process inspection, whichever falls earlier. Whenever a drill is replaced, the first hole shall be checked for compliance. Reground tools can also be used. Record shall be kept on the status of each drill (i.e. new, first grinding, second grinding etc.) along with identification of holes drilled, sequence on each spindle.

5.3 Examination

Following examinations shall be carried out on drilled Baffles:

Item	Requirement	Acceptance Standard
Hole Diameter	Diameters of at least 3% of total holes (but not less than 5 holes /baffle) referred as **"Reference holes"** shall be measured and recorded.	Approved drawing
	If all the reference holes are within specified limits then remaining holes shall be checked with GO gauge & NOGO gauge.	Go gauge should enter and No go gauge should not enter the hole
Ligament	At least 3% of total ligaments (per baffle) shall be measured. 100% holes by GO gauge & NOGO gauge.	Approved drawing

Visual examination	100% holes	Hole surface shall be free from scratch, tool mark etc.
Bar Gauge Check	The stack shall be clamped and 1ocked with locking pins for a bar gauge of diameter specified by purchaser. check all holes. After successful bar gauge check, the baffle sequence number and set number shall be marked so that baffles of the same set could be subsequently assembled in the same sequence in the heat exchanger for smooth tube insertion in the drilling direction.	Bar Gauge shall pass through the all the holes in the stack smoothly.
Surface finish	All holes shall be visually examined	Scratch free uniform surface finish.

Note: "Reference Holes" to be selected by NPCIL (QA) randomly, but in a manner-representing total Baffle drilling.

5.4 Special occurrence

If abnormalities like vibration, loosening of clamping, drill breakage etc. are noticed, drilling shall be stopped and the affected holes shall be evaluated and reported for clearance. Drilling shall proceed only after a satisfactory drilling of a hole on test block and purchaser or his authorized agency's clearance.

PRE-QUALIFICATION REQUIREMENT FOR MODERATOR TUBE SHEET

S.No.	DESCRIPTION	Requirement	Bidder's Response
1	Details of past experience in Drilling of jobs of similar nature (Shell and Tube Type Heat Exchangers) including job executed and under progress, in the last five years. Vendor should provide Minimum Qty. 2 Nos of Tube Sheet Drilling PO copy & Job Completion certificate executed for any Central/State Govt. Organization/PSU/Public listed Company. No exceptions shall be given to MSE /Start up enterprises in technical evaluation of PQR.	PO Copy & Job Completion Certificate/any document mentioning completion of Job/mail mentioning Job Completion with Dimension Thickness Minimum 150 mm & Dia. 2000 mm	Vendor to confirm & Provide Documents.
2	In house Facility of CNC Deep Hole Drilling Machine BTA/BTS Type suitable for Drilling of Tube Sheets of hole of dia. 12.76+.05-0.00 x 150 depth (min. or higher) 0.1 drift & Positional Accuracy 0.1 mm.	As mentioned below	Vendor to confirm & Prove during Technical Evaluation and during Visit of BHEL QA & NPCIL QA.
2.1	Make		Vendor to Specify
2.2	Quantity	Minimum 1 No. Machine Required	Vendor to Specify and confirm
2.3	Capacity X Axis	Minimum 3000 mm.	Vendor to Specify & Confirm
2.4	Capacity Y Axis	Minimum 2000 mm.	Vendor to Specify & confirm
2.5	Capacity Z Axis	Minimum 200 mm.	Vendor to Specify & confirm
2.5	Accuracy(Positional & Repetitive)	Valid Calibrated Machine Report required	Vendor to specify and furnish report
3.0	Pre-requisites:		
3.1		CNC deep hole drilling M/c BTA/BTS Type.	Vendor to Specify & confirm
3.2		Fixture for Mounting Alignment Telescope.	Vendor to Specify & confirm
3.3		Three-point micrometer for hole size measurement/Dial Gauge.	Vendor to Specify & confirm
3.4		Go- No-Go gauge.	Vendor to Specify & confirm. BHEL to furnish drawings for the same.
3.5		Ligament gauge	Vendor to Specify & confirm
3.6		Borescope.	Vendor to Specify & confirm
3.7		Surface finish tester.	Vendor to Specify & confirm
3.8		Thread Plug Gauge for Tie ROD Holes	Vendor to Specify & confirm
4.0	Certification.	All machines & instruments used should have valid certification issued by NABL accredited agency.	Vendor to Specify & confirm

सत्य श्री / SATYA SHRI
प्रबंधक / Manager
एच.सी.एम. विभाग / HCM Division
बी.एच.ई.एल., भोपाल / BHEL, Bhopal

27/11/2021
(R. Singhal / Sr. Mgr / HCM)

पंकज / PANKAJ

QUALITY ASSURANCE PLAN

ITEMS: MODERATER HEAT EXCHANGER FOR 700 MW GHAVP UNIT 1&2

CUSTOMER: M/S NUCLEAR POWER CORPORATION

QA PLAN NO.	QAX/TH/1479
Date	29-10-2020
Rev.	04
Page No.	5 of 31

Sr.No.	Component & Operation	Characteristic	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record	Inspection Agency				Remarks
									P	W	R	H	
2.1.7	Machining of Stopper & Trunnion.	OD, length and WEP	Major	Visual and Measurements	100%	As per App Drawing	As per Approved drawing	Inspection report	2	2	1	-	
		LPE Machined surface & WEP	Major	LPE	100%	Approved LPE procedure	Approved LPE procedure	Inspection report	2	2, 1	-	1	
2.1.8	Release of welding consumables	Batch qualification & Approved brand of welding consumables.	Major	Co-relation of Test certificates & verification of Batch no.	100%	Tender Spec/ App. TPS	Tender Spec/ App. TPS	Inspection report	2	2, 1	-	1	
2.1.9	Assembly of Stopper & Trunnion with Tube Sheet.	Fit up Dimension.	Major	Root gap Orientation	100%	Appd. Drawing	Appd. Drawing.	Inspection Report	2	2, 1		1	
		WPS & PQR	Major	Procedure qualification	100%	App WPS	Specification/ PQR	PQR/Weld data sheet.	2	2, 1		1	
2.1.10	Welding of Stopper & Trunnion with Tube Sheet	Welding parameter	Major	verification	100%	Approved specification/procedure/WPS	Approved specification/procedure/WPS	Weld data report	2	2	1		
		Root Run LPE	major	visual, NDE	100%	Approved LPE procedure	Approved LPE procedure	Inspection reports	2	2, 1		1	
		Final weld LPE	major	visual, NDE	100%	Approved LPE procedure	Approved LPE procedure	Inspection reports	2	2, 1		1	
		Final weld UT	major	visual, NDE	100%	Approved UT procedure ,	Approved UT procedure	Inspection reports	2	2, 1		1	
2.1.11	Machining of Stopper & Trunnion	Dimension measurement.	Major	visual/ measurement	100%	App Drawing ,	App Drawing ,	Inspection report	2	2, 1			
		LPE of machined surface	Major	LPE	100%	Approved LPE procedure	Approved LPE procedure	Inspection report	2	2, 1	-	1	
2.1.12	Cleaning & Preservations	Surface Protection	Major	Visual	100%	Approved Procedures	Approved Procedures	Inspection Report	2	2, 1			
2.2	Drilling Procedure Qualification on DQB	Alignment of Block on machine. Tube layout and Reference hole identification	Major	Measurement / Visual	100%	Approved drawing, Approved Drilling Procedure	AS per Approved drawing, Drilling Procedure	Inspection Report	2	2, 1		1	

BHEL

NPCIL

S.B.Dharmadhikari

QUALITY ASSURANCE PLAN

ITEMS: MODERATER HEAT EXCHANGER FOR 700 MW GHAVP UNIT 1&2

CUSTOMER: M/S NUCLEAR POWER CORPORATION

QA PLAN NO.	QAX/TH/1479
Date	29-10-2020
Rev.	04
Page No.	6 of 31

Sr.No	Component & Operation	Characteristic	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record	Inspection Agency				Remarks
									P	W	R	H	
		Hole dia, drift,, surface finish, positional accuracy, pitch, ligament check Drilling machine parameters and tool life	Major	Measurement by optical tooling, Borescope and Visual	100%	As per Approved drawing & Drilling Procedure	As per Approved drawing & Drilling Procedure	Inspection Report	2	2, 1		1	
2.3	**Drilling of Tube sheet**												
2.3.1	Tube sheet drilling with Production Quality Control Block (PQC block). (Equivalent names PQC Block=Mock Up Block=Test Block)	Tube sheet Setting on deep hole drilling machine. Orientation, flatness, Tube layout,	Major	Set up on machine, Measurement / Visual , Line layout	1) 2% of Tube sheet holes. 2) All PQCB holes 3) Drilling sequence	Approved drawing, Drilling Procedure	Approved drawing, Drilling Procedure	Inspection Report	2	2, 1	-	1	1.All control holes (2% of Tube sheet holes) shall be witnessed by NPCIL.
		Hole dia , drift, surface finish, positional accuracy	Major	Dial gauge , Optical tooling , Surface finish tester									
		Ligaments check , Hole dia ,	Major	Go-No go gauging , Visual	100%								
2.3.2	Tie rod holes drilling on **shell side** drilling.	Set up verification Axis matching	Major	Visual & Dimensional	100%	Approved drawing	Approved drawing	Inspection Report	2	2, 1			
2.3.3	Tapping of Tie rod holes on Shell side of T/S	Threads	Major	Gauge Check	100%	Approved drawing	Approved drawing	Inspection Report	2	2, 1		1	
2.3.4	Radius machining of Tube holes on Shell side & de burring	Radius	Major	Dimensions & visual	100%	Approved Drawing/ procedure	Approved Drawing / procedure	Inspection report	2	2 ,1	-	1	2%holes random by NPCIL QS
2.3.5	Tube sheet final machining	channel side & shell side WEP of tube sheet and Trunnion &	Major	Dimensions & visual	100%	Approved Drawing/ procedure	Approved Drawing / procedure	Inspection report	2	2	1	1	

BHEL

NPCIL 13-11-2020 S.B.Dharmadhikari

Sr.No.	Component & Operation	Characteristic	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record	Inspection Agency				Remarks
									P	W	R	H	
		LPE of WEP	Major	LPE	100%	Approved LPE procedure	Approved LPE procedure	Inspection report	2	2, 1	-	1	
2.3.6	Cleaning and Preservation	Cleaning and capping of holes from both side	Major	Visual and Measurements	100%	App Drawing / Approved procedure	App Drawing / Approved procedure	Inspection Report	-	2, 1		1	
2.4	**BAFFLES**												
2.4.1	Material Inspection & Identification of baffle and mock-up (PQC) plates.	Chemical Composition	Major	Co-relation & verification of MTC / Lab TC, all stage-wise records	100%	ASME Sec.II / III, Approved NPCIL specification (TPS) & approved material inspection and testing plan	ASME Sec.II / III, Approved NPCIL specification (TPS) & approved material inspection and testing plan	Inspection Report	2	-	1, 2	1	Identification on item should cover heat no./Lot no./PO no./Material grade /Monogram/ QS stamp Witness for only visual and co-Relation Refer Note 1
		Heat Treatment, IGC, Grain size, Forging ratio							2	-	1, 2	1	
		Mechanical Properties							2	-	1, 2	1	
		UT	Major	UTE	100%	Approved UTE procedure	Approved UTE procedure	Inspection report	2	2, 1	-	1	
2.4.2	Cleaning and Preservation after sizing	Dimensional check , surface quality	Major	Visual and Measurements	100%	App Drawing / Spec	As per Approved drawing	Inspection Report	-	2, 1		1	
2.4.3	Procedure qualification of baffle drilling	Material block thick , flatness, parallelism, hole dia., ligament, hole position, corner radius	Major	Set up on m/c, parallelism measurement bar gauge	100%	Approved drawing , Drilling procedure	Approved drawing , Drilling procedure	Inspection Report	2	2, 1	-	1	
2.4.4	Baffle drilling with production quality control/Mock up block.	Hole dia., ligament, Visual check, Sliding rod hole position, Tube hole layout.	Major	1) Holes Measurement 2)Ligament check 3) Go-No go gauging 4)Bar gauge	1) 3% holes Ref. hole 2) 3% ligaments per baffle 3) 100 % 4)	Approved drawing / Drilling procedure	Approved drawing / Drilling procedure	Inspection Report	2	2, 1	-	1	Visual check 100% holes

BHEL

19/11/2020 NPCIL

13-11-2020 S.B.Dharmadhikari

QUALITY ASSURANCE THERMAL (QTH)

SUB-VENDOR CREDENTIAL-INDEX

DATE:-

NAME OF ORGANISATION: M/S_____

ADDRESS of Organisation:-_____

PRODUCT DESCRIPTION:-_____

CONTACT PERSON : -_____

TELEPHONE (LAND LINE/MOB.) : -_____

E-MAIL :-_____

UDYOG AADHAR MEMORANDUM.: -_____

BHEL REGISTRATION NO. AND DATE:-_Registered (Year_____) / Not registered__

Sl no.	PARAMETER	PAGE NO	REMARK
1	Balance Sheet for last 4 years.		
2	Rating, Range / type etc. of equipment/ item for proposed approval.		
3	Organisational structure including QA/QC inspection dept. with man power & qualification details. QA manual		
4	Machine detail. Valid Calibration Certificate, X, Y, X Travel of the machine.		
5	20 Holes Drilling result (Diameter, hole finish, hole depth, drift etc.)- Report of any previous job drilled.		
6	Machine Operator details		
7	Ring & Plug Gauge , other measuring instruments with calibration report		
8	In house NDE facilities & list of qualified NDE personnel with level of qualification (Minimum Level-II) and facility (DP, MPT & UT).		
9	Experience (Past Track Record) list for last 3 years for Tube Sheets.		
10	Performance certificates issued by other customers if any.		
11	Machines & instruments with valid certification issued by NABL accredited agency.		
12	Capability to manufacture as per Approved technical spec. & fabrication code section 3NB/ND.		

Authorized Signatory

SPECIFICATION FOR SUB-CONTRACTING FOR TUBESHEET DRILLING- MODERATOR HEAT EXCHANGER

1.0 GENERAL:

1.1. This specification gives requirements for Sub-Contracting of Tube Sheet Drilling of 4 Nos Moderator Heat Exchanger on CNC Deep Hole Drilling Machine.

1.2. Deep hole Drilling on Qualification block, Test Block and Actual Job as per Drawing. Quality drilling of Tube sheets meeting specification / approved drawing requirements with respect to drift, positional accuracy, ligament, hole size, surface finish within specified tolerances are very important.

1.3. Setting Jobs will be done in single setting. Approval required for setting by BHEL QA before proceeding any deep hole drilling.

1.4. Machine calibration Report & all related measuring instrument calibration report need to be approved from BHEL QA before start of process.

1.5. The drilling of the Tube Sheet shall be done as per qualified Procedure and also by the same machine used for Procedure qualification.

1.6. All measurements, readings and derived values shall be recorded in proper format.

1.7. Sub-Contracting to Sub-vendor for drilling is not allowed. Only vendors having in house facility for deep hole drilling as per enclosed drawing and Drilling Specifications can submit offer.

2.0 SCOPE OF WORK:

2.1. Establishment of Drilling Parameters & Tool Life.

2.2. Drilling of Qualification block (drilling procedure qualification) prior to start of Tube Sheet Drilling with Minimum 50 Holes per spindle.

2.3. One hole shall be drilled on the Test Block set along with the Tube Sheet before/after the shift and during the event of any change in conditions (i.e. change of drill, change found during in process checks on hole diameter, finish, ligaments by visual examination and go-no-go gauges) and only after ensuring acceptable hole quality, drilling on the production job shall be taken up.

2.4. Production drilling as per layout shall be taken up only after successful completion of Procedure qualification on Drilling Qualification Block(DQB) and duly accepted by BHEL QA & NPCIL QA.

2.5. BTA/BTS tool required for Tube Sheet Drilling.

2.6. Radius of Tube Holes in Shell Side as per Drawing requirement.

2.7. Measuring instruments like Go-NOGO plug Gauges, Ligament Gauges, Dial Bore Gauge, Surface finish testing instrument & borescope for visual Inspection etc.

2.8. Required Skilled manpower for execution of Job.

2.9. Fixture required for Mounting of Optical instrument i.e. Alignment Telescope.

2.10. Drilling & Tapping of Tie Rod Holes.

2.11. Internal Inspection (Namely Hole Diameter, Ligament, hole Position, Drift, Visual Inspection & Surface finish.

2.12. Joint Inspection of BHEL & NPCIL during drilling and final inspection.

3.0 REFERENCE DOCUMENTS

3.1 NPCIL Drilling Specification PC-P-192.

3.2 TUBE SHEET DRILLING PLAN No -11650340824.

4.0 PRE-QUALIFICATION REQUIREMENT: -

S. No.	DESCRIPTION	Requirement	Bidder's Response
1	Details of past experience in Drilling of jobs of similar nature (Shell and Tube Type Heat exchangers) including job executed and under progress, in last five years. Vendor should provide Minimum Qty. 2 Nos of Tube Sheet Drilling PO copy & Job Completion certificate executed for any Govt. Organization, MNC listed in Stock Exchange, & Public Sector Enterprises.	PO Copy & Job Completion Certificate/any document mentioning completion of Job/mail mentioning Job Completion with Dimension Thickness Minimum 150 mm & Dia. 2000 mm	Vendor to confirm & Provide Documents.
2	In house Facility of CNC Deep Hole Drilling Machine BTA/BTS Type for Drilling of Tube Sheets of hole of dia. 12.76+.05-0.00 x 150 depth, 0.1 drift & Positional Accuracy 0.1 mm.	As mentioned below	Vendor to confirm & Prove during Technical Evaluation and during Visit of BHEL QA & NPCIL QA.

2.1	Make		Vendor to Specify
2.2	Qty.	Minimum 1 No Machine Required	Vendor to Specify and confirm
2.3	Capacity X Axis	Minimum 3000 mm	Vendor to Specify & Confirm
2.4	Capacity Y Axis	Minimum 2000 mm	Vendor to Specify & confirm
2.5	Capacity Z Axis	Minimum 200 mm	Vendor to Specify & confirm
2.6	Accuracy(Positional & Repetitive)	Valid Calibrated Machine Report required	Vendor to specify and furnish report

5.0 PRE-REQUISITES:

5.1 CNC deep hole drilling M/c BTA/BTS Type.

5.2 Fixture for Mounting Alignment Telescope

5.3 Two-point micrometer for hole size measurement/Dial Gauge.

5.4 Go- No-Go gauge.

5.5 Ligament gauge.

5.6 Borescope.

5.7 Surface finish tester.

6. JOB DETAILS:

S. No.	Identification	Unit	Moderator Heat Exchanger Tube Sheet Requirement
1	Tube plate thickness	mm	150 mm
2	Outer Tube Limit	mm	2037.8
3	No of tube holes	No	8272
4	Tube hole size	mm	$12.76^{+0.05/-0.0}$
5	Drift	mm	0.1 mm
6	No of Tie Rod holes		32
7	Tie Rod hole size	mm	M12X25 Deep
8	Tube pitch	mm	19 mm triangular as per Detail N of Drg.
9	Hole finish	microns	1.6

10	Shell side holes Radius making on Tube Sheet as per drawing		As per Drawing.
11	**Channel side holes Chamfering/Beveling 0.6 X 45 degree**		**BHEL SCOPE**
12	Quantity of Production Block	Nos	4 (Four)
13	Tentative Weight of Each Tube sheet	Kg	3407
14	Qualification Block Dimension & Qty-1 Nos		800 MM (+2.0/-0.0) MM X 300 MM X (+2.0/-0.0) X 150 MM (+2/-0.0) (WT.= 288 KG EACH)
15	Test Block & Qty.- 4 Nos	Kg	800 MM (+2.0/-0.0) MM X 300 MM X (+2.0/-0.0) X 150 MM (+2/-0.0) (WT.= 288 KG EACH)

7. NOTES: -

7.1 Ensure availability of all types of Tooling & Fixture at your end and confirm.

7.2 BHEL QA presence for witness, customer witness will be ensured by BHEL after your feedback for loading schedule.

7.3 You need to carry out inspection of our raw material supplied at your end for visual, dimensional and machining allowance before starting the process. If any defect or non-conformity found, inform BHEL QA immediately and hold the job. Acceptance will be subjected to BHEL QA Approval.

7.4 In case of rejection and Tube Plugging all the material cost & all processing cost (Decided by BHEL) till date will be recovered from you.

8. GENERAL TERMS FOR INSPECTION OF COMPONENT:

8.1 After drilling & inspection, tube sheet holes shall be cleaned & protected from both sides by Plastic caps.

8.2 After completion of Job in all respect as per the scope of purchase order inspection shall be carried out at your end to confirm conformity of the component.

8.3 Following are Guidelines to fill up the inspection report.

a) Component ID no must be filled in the inspection report.

b) Dimensions must be reported in one more decimal than tolerance decimal.

c) All deviations must be marked by * Marks.

d) Ensure proper packing to avoid any damage during transit.

8.4 Drilling Qualification Requirement:

Item	Requirement	Acceptance Standard
Hole Diameter	All holes at 3mm from the front face,3 mm from the rear face and 3 locations at equal intervals on remaining length in two perpendicular directions by bore dial.	12.76 +0.05/-0.00
	Go gauge check for full length & NO GO gauge check for all holes from both ends. If all the reference holes are within specified limits then remaining holes of tube sheet shall be checked with GO gauge for full length) & NOGO gauge from both ends.	Go gauge should enter and No go gauge should not enter the hole. Go Gauge size 12.76+0.03 and No Go gauge size-12.81+0.03 here
Ligament	100 % ligaments shall be measured at front and rear face side.	Front max= 6.69 mm & min = 5.9 mm. Rear Max=6.64 mm & 5.79 mm
Hole Position	100 % holes shall be measured at front face.	0.2 mm
Drill Drift	100 % holes by optical tooling at rear w.r.t Front Side.	0.1mm max
Visual Examination	100 % Holes By Visual/borescope examination.	Hole surface shall be free from scratch, tool mark etc.
Surface finish measurement	100% holes by Surface finish tester/Replica method at front and rear ends of holes.	1.6 Ra

8.4 Actual Job Inspection Requirement:

Item	Requirement	Acceptance Standard
Hole Diameter	2% of total holes referred as **"Reference Holes",** selected at random by NPCIL (QA). At 3mm from the front face, 3mm from the rear face and 3 locations at equal intervals on remaining length in two perpendicular directions by dial bore gauge.	12.76 +0.05/-0.00
	If all the reference holes are within specified limits then remaining holes of Tube sheet shall be checked with GO gauge for full length & NOGO gauge from both ends.	Go gauge should enter and No go gauge should not enter the hole. Go Gauge size *12.76+0.03* and No Go gauge size- 12.81+0.03 here
Ligament	100 % ligaments shall be measured at front and rear face side.	Front max= 6.69 mm & min = 5.9 mm. Rear Max=6.64 mm & 5.79 mm
Hole Position(Layout)	All reference holes and all non-conformance holes shall be measured at front face	0.2 mm
Drill Drift	All reference holes by optical tooling and all non-conformance holes at rear w.r.t front side.	0.1mm max
Visual Examination	100 % Holes By Visual/borescope examination.	Hole surface shall be free from scratch, tool mark etc.
Surface finish measurement	All reference holes and all nonconformance holes by Surface finish tester/Replica method and at front & rear ends of holes.	1.6 Ra

9. GENERAL INSTRUCTIONS:

9.1 There should be no scratch mark on the surface of the items.

9.2 All the material given for processing should be stored separately and should not come in contact with any other material like MS during storage.

9.3 Our QA stamp & NPCIL QA stamp and numbers should be visible for all the time during processing and in case the stamp is getting removed during drilling, vendor shall inform in advance for stamp transfer on another location.

9.4 All machined components should be free from Dirt, Dust, Oil, Grease or any other foreign particles.

9.5 BHEL will issue the tube sheet welded with Trunnion, Stopper and lugs required to clamp the job vertically on T- Slotted Angle plate. Vendor to submit their holding/ clamping arrangement drawing requirement according BHEL will fitted the lugs before issuing of Tube sheet.

9.6 Drift shall be measure by optical instrument.

9.7 Since tube sheet is having collar projection on both the side, hence vendor is requested to understand the drawing very carefully so that outer tube limit of the hole would not get any obstruction/ foul of drilling head.

9.8 Contact of Tube Sheets with carbon steel shall be avoided to prevent contamination. All clamping and packing arrangement used will be of stainless steel.

9.9 Dimension report dully sealed & signed by BHEL QC along with customer shall be submitted before dispatch of Tube sheet.

9.10 Shipping release note/ document endorsed by BHEL customer i.e. NPCIL that job is made as per drg. and ready to use at BHEL works.

9.11. Lug will be removed at BHEL works, hence under BHEL scope.

9.12 Tube sheet, drilling qualification Block & Production quality control block used shall be properly protected, covered & packed in wooden box before dispatch.

9.13 Vendor has to submit the following document for BHEL

I. Drilling procedure,
II. Sample format dimension report.

9.14 Vendor must confirm machine shall be available & run 24 x 7 dedicatedly on receipt of order for drilling of 4 Nos of Moderator Heat Exchanger.

1.14 Vendor to submit drilling offer inclusive of inspection charges. Vendor to read drawing & NPCIL specification before submitting offer on fixed amount basis for drilling, chamfering (Making Radius on Shell Side) & inspection of job in the machine during drilling and after Unloading.8.16

1.15 Difference in weight of forging & drilled tube plate shall be considered as scrap. Cost of scrap shall be deducted at the prevailing rates which is presently Rs. 74.80/- per kg.

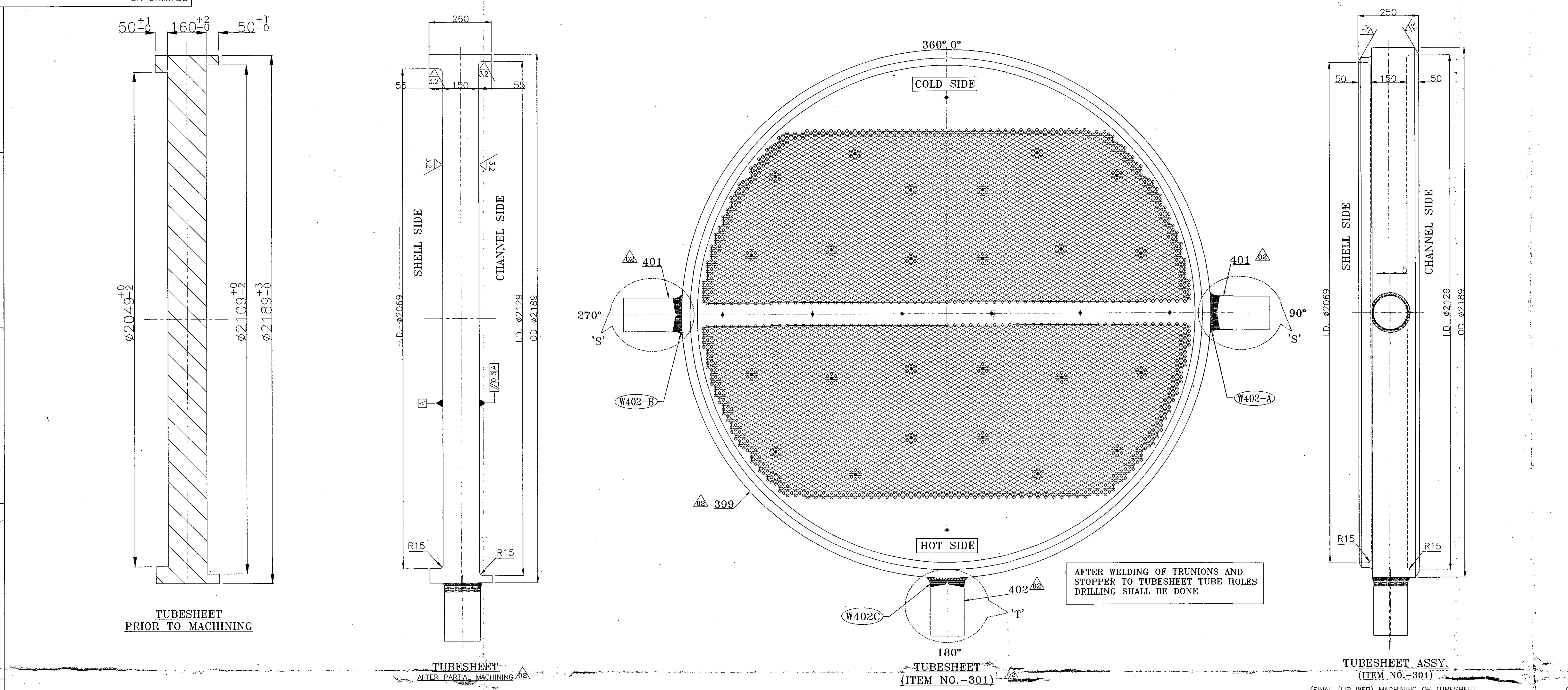
10.0 SPECIAL INSTRUCTIONS:

If at any of the checks of the operator or the Inspector non-conformities are noted, production drilling shall be stopped. Drilling shall proceed only after disposition of the non-conformity. In case of machine malfunction like vibration, loosening of clamping, drill Breakage etc. are noticed during drilling operation, the hole drilled shall be examined immediately for all the characteristics as above. If required, the machine shall be stopped immediately and the affected holes shall be evaluated and reported. Drilling shall proceed only after a satisfactory drilling of a hole on the test block and clearance by NPCIL. Drilling shall be done as per approved drilling procedure.

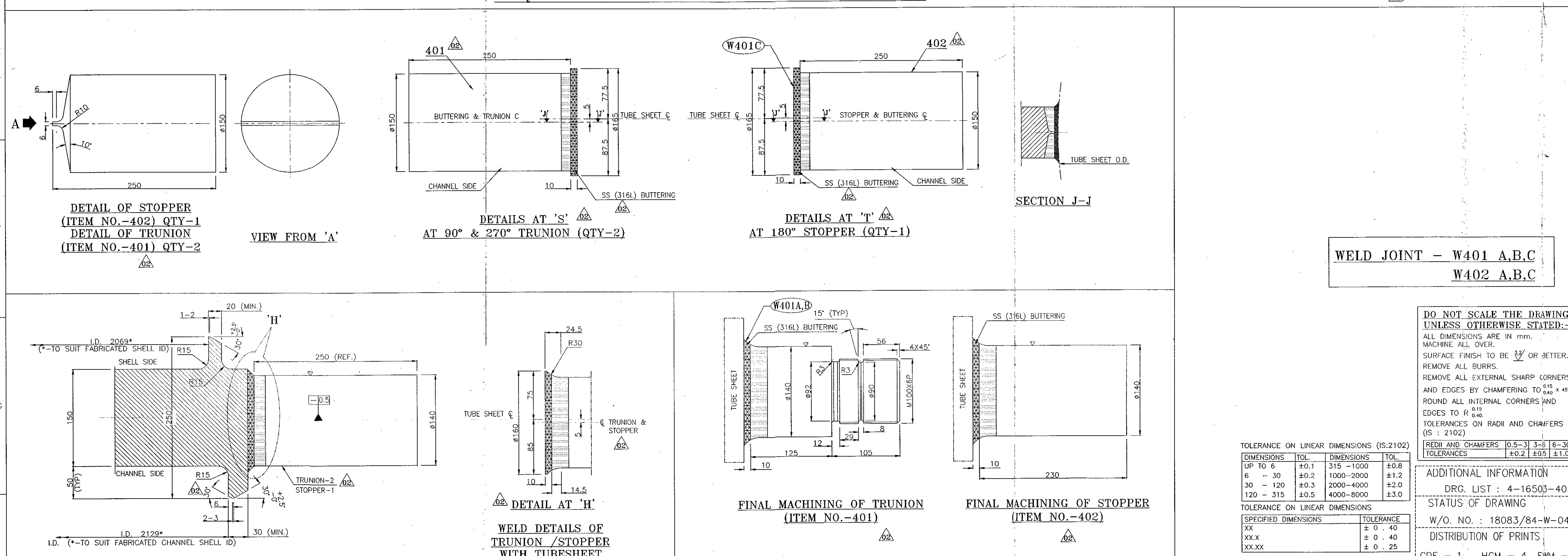
FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING NO. 1-16503-40823



SEQUENCE OF OPERATIONS ON TUBESHEET



WELD JOINT - W401 A,B,C
W402 A,B,C

TECHNICAL REQUIREMENTS (TR):-

1. NO OF 'U' TUBES---------------- 4136
2. NO OF 'U' TUBE HOLES----------- 8272
3. TUBE HOLE PITCH---------------- 19 (TRIANGULAR)
4. TUBE HOLE SIZE---------------- $12.76^{+0.05}_{-0.0}$ (02)
5. DRILL DRIFT------------------- ±0.1(MAX.)
6. MINIMUM LIGAMENT-------------- 5.79
7. TUBE HOLE POSITION ACCURACY------ WITHIN ±0.1 OF TRUE POSITION
8. OUTER TUBE LIMIT (OTL)----------ø2037.8
9. CAUTION: TIE ROD HOLES ARE ON THE SHELL SIDE ONLY.
10. MACHINING & DRILLING, INSPECTION, SURFACE TREATMENT ETC. REQUIREMENTS SHALL BE AS PER APPROVED PROCEDURE.
11. DEBURRING AND CLEANING OF HOLES SHALL BE CARRIED OUT
12. DELETED. (04)
13. TUBESHEET SHALL BE DRILLED FROM CHANNEL SIDE. THE AXIS DERIVED FROM THE TIE ROD HOLE PATTERN ON SHELL SIDE FACE SHALL BE TRANSFERRED TO THE TUBE SIDE FACE WITHIN TOLERANCE OF ±0.5.
14. TUBESHEET FORGING ARE PROCURED CONSIDERING MACHINING ALLOWANCE.
15. UT EXAMINATION OF BUTTERING SHALL BE CARRIED OUT AS PER APPROVED PROCEDURE.
16. UT EXAMINATION OF TRUNION AND STOPPER ASSEMBLY SHALL BE CARRIED OUT AS PER APPROVED PROCEDURE.
17. FOR TUBE SHEET HOLE DRILLING DETAILS REFER SHEET-2 OF THIS DRAWING.
18. TUBE IDENTIFICATIONS NUMBERS ARE MARKED
19. ANY TEMPORARY ATTACHMENT (IF REQUIRED), SHALL BE WELDED WITH BUTTERING TO TUBESHEET (ITEM 399). AFTER REMOVAL OF TEMPORARY ATTACHMENTS, THOSE SURFACES SHALL BE GROUND SMOOTH AND SUBJECTED TO L.P TEST. (02)
20. FOR GENERAL NOTES REFER TR IN GA DRG. No. 11650340822. (02)

QTY	REMARKS	VAR. NO.	ITEM NO.	DESCRIPTION	STD	DRAWING NO.	IT.NO / VAR.	MATL. CODE / MATL. SPCN.	A/C	UNIT	UNIT WT. / QTY.	GS	ZONE
01 (03)	250 LG. ALT. MAT. SA516 GR70* AS PER NPCIL APPROVAL		402	STOPPER ø150				B.O. / IS:2062 GRB0			34.60		
02 (03)	250 LG. ALT. MAT. SA516 GR70* AS PER NPCIL APPROVAL		401	TRUNION ROD ø150				B.O. / IS:2062 GRB0			34.60		
01			399	FORGING FOR TUBE SHEET 2189 OD X 260 TK.				B.O. / SA 182 F316L			3303.00		
√			301	TUBE SHEET ASSEMBLY									

28 → CARD TYPE-3   28 → CARD TYPE-1   28 → CARD TYPE-2

* NCR.

न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
Nuclear Power Corporation of India Limited
अनुमोदित / APPROVED
टिप्पणी के अनुसार अनुमोदित / APPROVED AS NOTED
संविरचना हेतु आगे बढ़ें / रोकें / PROCEED WITH/HOLD FABRICATION
अंतिम ट्रांसपेरेन्सी एवं प्रतियाँ भेजें / SEND FINAL TRANSPARENCIES & PRINTS
संशोधन करें एवं अनुमोदन के लिए पुनः प्रस्तुत करें / REVISE & RESUBMIT FOR APPROVAL
जाँचकर्ता / CHECKED BY — समीक्षाकर्ता / REVIEWED BY — अनुमोदनकर्ता / APPROVED BY
किए जानेवाले कार्य का अनुमोदन आपूर्तिकर्ता संविदाकार को विनिर्देशनों के अनुसार आपूर्ति करने के उत्तरदायित्व से मुक्त नहीं करता है।
This approval of the work to be done does not relieve the supplier of the responsibility of supply according to specifications.

BHEL

DO NOT SCALE THE DRAWING.
UNLESS OTHERWISE STATED:-
ALL DIMENSIONS ARE IN mm.
MACHINE ALL OVER.
SURFACE FINISH TO BE 3.2 OR BETTER.
REMOVE ALL BURRS.
REMOVE ALL EXTERNAL SHARP CORNERS AND EDGES BY CHAMFERING TO $^{0.15}_{0.40}$ x 45°.
ROUND ALL INTERNAL CORNERS AND EDGES TO R $^{0.15}_{0.40}$.
TOLERANCES ON RADII AND CHAMFERS (IS : 2102)

REDII AND CHAMFERS	0.5–3	3–6	6–30
TOLERANCES	±0.2	±0.5	±1.0

TOLERANCE ON LINEAR DIMENSIONS (IS:2102)

DIMENSIONS	TOL.	DIMENSIONS	TOL.
UP TO 6	±0.1	315 –1000	±0.8
6 – 30	±0.2	1000–2000	±1.2
30 – 120	±0.3	2000–4000	±2.0
120 – 315	±0.5	4000–8000	±3.0

TOLERANCE ON LINEAR DIMENSIONS

SPECIFIED DIMENSIONS	TOLERANCE
XX	± 0 . 40
XX.X	± 0 . 40
XX.XX	± 0 . 25

TOLERANCE ON ANGULAR DIMENSIONS : 0°–0.5°

ADDITIONAL INFORMATION
DRG. LIST : 4-16503-40363
STATUS OF DRAWING
W/O. NO. : 18083/84-W-04701
DISTRIBUTION OF PRINTS
CDE - 1 . HCM - 4 FWM - 4

REV.	DATE	ALTERED / CHECKED / APPROVED	ZONE	DESCRIPTION
04	27/11/19	कमलेश गामीत / मो. वहाब रफीक / ललित असनानी		DRAWING REVISED AS MARKED (04) TR.-12 DELETED. ITEM NO. & WELD NOS. MODIFIED.
03	23/10/19	कमलेश गामीत / मो. वहाब रफीक / ललित असनानी		DRG. REVISED BASED ON NPCIL COMMENTS RECEIVED DURING MEETING DTD.17/10/2019. DRAWING REVISED AS MARKED (03) WELD NO FOR BUTTERING ADDED TR.-20 ADDED
02	25/09/19	कमलेश गामीत / मो. वहाब रफीक / ललित असनानी		DRAWING REVISED BASED ON NPCIL COMMENTS DTD. 12/07/2019. ITEM NOS REVISED BOM ADDED DRAWING REVISED AS MARKED (02)
01	29/06/19	कमलेश गामीत / मो. वहाब रफीक / ललित असनानी		DRAWING REVISED BASED ON NPCIL COMMENTS DTD. 12/04/2019.

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
PROJECT : GORAKHPUR HARIYANA ANU VIDHYUT PARIYOJANA 1&2 (700 MWe)
NPCIL PURCHASE ORDER NO. : CMM/FTP/10-32-1-1152/e-PO/30447, DATED 24.01.2019
NPCIL DRAWING NO : GHAVP-1&2/32111/2003/DD REV.01

उत्पाद का प्रकार / TYPE OF PRODUCT: **MODERATOR HEAT EXCHANGER**

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD BHOPAL

	नाम/ NAME	हस्ता./SIGN	दिनांक/DATE
बनाया DRN.	कमलेश गामीत		01/03/2019
जाँचा CKD.	मो. वहाब रफीक	वहाब	05/03/2019
अनुमोदित APPD.	ललित असनानी		05/03/2019

वे रि. की संख्या NO. OF VAR.

विभाग DEPT. कोड CODE	अन.टल. नाप की श्रेणी UNTOL. DIMS. GR.	अनुपात SCALE	भार (कि.ग्रा.) WEIGHT (K.G.)	असे. ड्राइंग का संदर्भ REF. TO ASSY. DRG.	मद क्र. ITEM NO.	मद संख्या NO. OF ITEM
CDE 411	M AA 0230205	–	3407.0	1-16503-40824	–	–

शीर्षक/ TITLE: **DETAIL OF TUBESHEET**

ड्राइंग क्र./DRAWING NO. 1-16503-40824 — पुन./ REV. 04

पृष्ठ क्र./SHT. NO. 01 — पृष्ठों की संख्या/NO. OF SHT. 02

FORMAT SIZE A1