

**INVITATION TO TENDER**

Ref.: OS/21-22/2439/MFC/05/009

Date: 24.06.2021

Sub: Fabrication of Main Fractionator Column at Lovagarden site of BHEL-HPVP, Visakhapatnam against S.O. 2439

Dear Sir,

Sealed tenders are invited for the subject work in **two part bid** system from Vendors who are experienced in fabrication of similar jobs and fulfil the eligibility criteria specified against clause-1 below. Scope of work and techno-commercial terms and conditions are as follows.

1. ELIGIBILITY CRITERIA:

- 1.1 Average annual turnover of the contractor during the last 3 financial years ending 31st March 2021 should be at least Rs. 150 Lakhs. Bidders shall enclose Turnover Certificate (duly certified by a practitioner CA), IT Returns and other necessary documents in support of the same. In case, financial accounts for FY 20-21 not yet finalized and ITR is not filed, avg. annual turnover of previous 3 financial years will be taken into consideration.
- 1.2 The Contractor should have an experience of executing similar works of Fabrication of Higher Diameter i.e., **≥ 4 Meters** Columns/Pressure Vessels for process industries during the last 7 years ending on 31st May'2021.

Note: Work Order and Work Completion Certificate / any other relevant document from the customer shall be enclosed **in support of successful and satisfactory completion of the work.**

- 1.4 Bidders shall also have to enclose the documents of Registration of Firm/ Factory License/ Certificate of Incorporation, EPF, ESI, PAN, GSTIN, Udyog Aadhar Memorandum / Udyam Registration (if registered with MSME) etc.
- 1.5 The works executed in the own name of individual / firm will only be considered for eligibility criteria.

2. VENDOR'S SCOPE OF WORK: Detailed scope of the fabrication work will be as follows:

Complete Fabrication of Main Fractionator Column (vessel Tag No. 111-C-2101: approx. weight of 700 MT) consisting of CS portion of Top Main Shell & Dished End, LAS with SS Clad portion of Middle & Bottom Main Shell, Toricone, Bottom Dished End, Skirt, Internals & External attachments including NDT, PWHT (Internal firing method), Hydro test, Pickling and Passivation of clad portion of shell & attachments etc. as per the approved drawings, QAP / ITP, WPS, Procedures, Specifications & Standards and cutting of complete column into two sections for transportation purpose after Final completion and loading of the column sections on trailers including deployment of Higher capacity crane..

It may be noted that the weight indicated above is tentative and may vary on both sides due to revision in the drawings, if any.

2.1 LAS with SS Clad Portion of Middle & Bottom Main Shell including Toricone and Bottom Dished End:

- 2.1.1 Collection of all free issue raw materials, rolled shells in segments, fabricated components, BOC's etc., from HPVP Shops / Stores and Transportation to Lovagarden site (A Sea Front facility of BHEL-HPVP near Hindustan Shipyard Limited - OPF Site, Visakhapatnam, Andhra Pradesh) including unloading at the Lovagarden site.
- 2.1.2 Toricone shall be made in Petals and Bottom Dished End of vessel shall be made in Petals & Crown construction by Dished End Vendors. Cold Formed Petals of Toricone after Edge preparation, Trial Assembly,

Match marking, dismantling into loose petals in different sections will be transported to Lovagarden site by the Toricone vendors.

Cold Formed Petals & Crown of Dish ends after Edge preparation, Trial Assembly, Match marking, dismantling into loose Petals & Crown will be transported to Lovagarden site by the dished end vendors.

Unloading of these Loose Petals & Crown at site received from Toricone & Dished End Vendors is in vendor's scope.

- 2.1.3 Forming of Toricone (Section-1 & 2) and Bottom Dished ends which involves assembly of the Petals & Crown segments, Fit-up, Welding, NDT etc. as per approved drawings / standards / specifications along with Production Test Coupons as per approved QAP.
- 2.1.4 100% RT of L-seam Welds & C-seam welds as per approved QAP.
- 2.1.5 Central Hole, if any, on the Dished End shall be plugged followed by 100% RT.
- 2.1.6 100% UT of Complete Dished End as per QAP.
- 2.1.7 Clad overlay over the L-seams and C-seams as per approved QAP.
- 2.1.8 100% PT on chipped back L-seam & C-seam Welds of Dished End, Tori-cone and Shell as per approved QAP.
- 2.1.9 After receipt of LAS clad plates at BHEL-HPVP Lovagarden site, Visakhapatnam, the inspection clearance of the same shall be obtained from HPVP (QC) / TPIA / EIL as per approved QAP.
- 2.1.10 **Rolling / Pressing of (76+4) mm Thick & (128+4) mm Thick Clad plates of Shell sections in suitable segments shall be done by BHEL at HPVP shops including marking, cutting, Edge preparation and Clad removal.** However, collection and Transportation including loading & unloading of these rolled shell plates from HPVP workshop to Lovagarden site is in Vendor's scope.
- 2.1.11 Rolling of LAS clad shell segments less than 50 mm thickness as per approved drawings / approved QAP and Rerolling as per requirement is in Vendor's scope.
- 2.1.12 Marking, Squaring, Cutting, Weld Edge preparation / Beveling of the Clad Shell Plates including removal of clad at edges as per drawings & approved QAP. Test plates of clad material shall be arranged to BHEL-HPVP/Welding Technology Dept. for establishing PQRs to release welding documents during fabrication.
- 2.1.13 Spot UT to check dis-bondment for rolled sections of Clad and Weld Overlay as per approved QAP / Procedures.
- 2.1.14 MPI Test of all Weld Edges as per approved QAP.
- 2.1.15 UT of all Weld Edges shall be carried out prior to welding as per approved QAP / NDE procedures.
- 2.1.16 Profile of the rolled segments shall be maintained by temporary spiders / profile plates.
- 2.1.17 Assembly, Fit-up, welding including Pre-heating, NDT & Intermediate SR of L-seams of Shell sections as per drawings & approved QAP / ITP along with Production Test Coupons. **As MOC of the base shell is LAS Gr. 11 & Gr. 22, continuous preheating up to required temperature as per WPS has to done before start of welding and suitable arrangements for the same are to be made by the Vendor.**
- 2.1.18 Assembly, Fit-up, Welding including Pre-heating, NDT & Intermediate SR of C-seams of Shell to Shell, Shell to Tori-cone & Shell to Bottom Dished end as per drawings & approved QAP / ITP along with Production Test Coupons. **As MOC of the base shell is LAS Gr. 11 & Gr. 22, continuous preheating up to required temperature as per WPS has to done before start of welding and suitable arrangements for the same are to be made by the Vendor.**
- 2.1.19 RT of C-seam Welds, L-seam Welds and Production Test Coupons as per approved QAP. Extent of RT shall be in line with approved drawings.
- 2.1.20 RT of C-seam Welds as per approved QAP. Extent of RT shall be in line with approved drawings.
- 2.1.21 CuSO₄ solution test after clad removal, Chemical Analysis of samples of Clad restoration of Dished End, Main Shell and Shell to Toricone / Dished End as per approved QAP / NDE Procedure.
- 2.1.22 Prior to Weld Overlay, MPT shall be carried out on the surfaces which are to be covered with Weld Overlay as per approved QAP/ Procedures.

- 2.1.23 Clad Restoration on L-seam & C-seam welds and 100% PT on Clad restoration / Weld Overlay of each layer as per approved QAP/ Procedures.
- 2.1.24 Ferrite check of clad overlay with a calibrated equipment as per approved QAP / NDE procedure.
- 2.1.25 Offering the job for stage wise inspection and obtaining stage wise inspection clearance, Final Inspection clearance from HPVP (QC) / TPIA / EIL as per approved QAP.
- 2.1.26 All NDT activities like DPT, MPT, RT, UT, etc., shall be carried out as per approved QAP/ drawings by NDT personnel qualified by BHEL as per BHEL Procedure No. BHEL: NDE: WP01.
- 2.1.27 NDT agency engaged by fabrication contractors shall have to ensure that their NDE personnel are qualified by BHEL in advance before starting of the job.
- 2.1.28 PMI Check for Clad Weld Overlay as per approved QAP / Procedures.
- 2.1.29 Production Test Coupons after RT to be tested as per approved QAP / Procedures.
- 2.1.30 Handing over of Production Test Coupons for PWHT / SR along with the Vessel.

2.2 CS Portion of Top Main Shell including Top Dished End and Skirt:

- 2.2.1 Collection and Transportation of Free Issue materials like CS Plates for Shell & Skirt, Pipes, Pipe Fittings, BOCs, Structural items, Paints etc., from BHEL-HPVP stores/workshop to Lovagarden site including unloading at site.
- 2.2.2 Top Dished End of the Vessel shall be made in Petals & Crown form by the Dished End Vendor. Cold Formed Petals & Crown after Edge preparation, Trial Assembly, Match Marking, Dismantling into Loose Petals & Crown will be transported to Lovagarden site by the Dished End Vendor. Unloading of Loose Petals & Crown at Lovagarden site received from Dished End Vendor is in Vendor's scope.
- 2.2.3 100% PT on root & final weld, chipped back L-seam & C-seam Welds of Shell, Skirt & Dished Ends as per approved QAP / NDE procedure.
- 2.2.4 After receipt of free issue materials at HPVP Lovagarden site, Visakhapatnam, the inspection clearance of the same shall be obtained from HPVP (QC) / TPIA / EIL as per approved QAP.
- 2.2.5 Marking, Squaring, Cutting, Weld Edge preparation / Beveling of Shell & Skirt plates as per drawings & approved QAP.
- 2.2.6 Rolling of CS Shell & Skirt segments as per approved drawings / QAP.
- 2.2.7 Profile of the rolled segments shall be maintained by temporary spiders / profile plates.
- 2.2.8 Assembly, Fit-up & Welding of L-seams of Main Shell and Skirt as per drawings & approved QAP / ITP along with Production Test Coupons.
- 2.2.9 Assembly, Fit-up & Welding of C-seams of Shell to Shell, Shell to Dished End and Skirt to Toricone as per drawings & approved QAP / ITP along with Production Test Coupons wherever required.
- Welding of the skirt with Toricone involves weld build-up using SMAW/SAW which is to be carried out by the vendor as per detail given in the drawing. After the weld build-up is completed, the groove as per radius mentioned in the drawing has to be maintained by Machining/Grinding. A detailed procedure to be submitted by the vendor along with the techno-commercial bid on methodology of carrying out this activity based on which the bid of the vendor will be accepted for further qualification.**
- 2.2.10 RT of L-seam & C-SEam Welds of Shell, Skirt & Dished Ends and Production Test Coupons as per approved QAP. Extent of RT shall be in line with approved drawings.
- 2.2.11 Dimensional inspection as per approved drawing & QAP.
- 2.2.12 Offering the job for stage wise inspection and obtaining stage wise inspection clearance, Final Inspection clearance from HPVP (QC) / TPIA / EIL as per approved QAP.
- 2.2.13 All NDT activities like DPT, MPT, RT, UT, etc., shall be carried out as per approved QAP by NDT personnel qualified by BHEL as per BHEL Procedure No. BHEL: NDE: WP01.
- 2.2.14 NDT agency engaged by fabrication contractors shall have to ensure that their NDE personnel are qualified by BHEL in advance before starting of the job.

2.2.15 Production Test Coupons after RT to be tested as per approved QAP/Procedures.

2.2.16 Handing over of Production Test Coupons to SR agency for PWHT/SR along with the Vessel.

2.3 Internals & External Attachments:

2.3.1 Fabrication, Marking, Cutting, Assembly, Welding and NDT of –

- a) Externals like Compression & Base Rings, Trailing Lugs, Stiffener Rings, Pipe supports, Earthing Lugs, Insulation & Platform Cleats, Fire proofing supports, Ladders, Platforms, Anchor Chairs, Pipe Davit Assembly, Manhole Davit Assembly, Access Door, Lifting Trunnions, Sub-assemblies of Nozzles, Nozzle Internal Connections, Thermocouple Tappings, Instrument Tappings, RF Pads, Insert Plates, Transportation Saddles etc.,
- b) Internals like Vac. Stiffeners, Steam Sparger, Coke Trap, Chimney trays, Support Rings, Tray supports, Pipe supports, Wear Plate etc. as per approved drawings, QAP & NDE Procedures.

2.3.2 Nozzles in LAS+SS Clad portion:

Nozzles formed from Pipes & fittings: For sizes up to 6"dia., Bore cladding of Pipes will be done by BHEL-HPVP. Also, Weld overlay and Machining of Flanges/ Fittings of these Nozzles up to 6"dia. will be done by BHEL-HPVP.

However, for Nozzle sizes greater than 6"dia., Nozzles are to be formed from clad plates including Rolling of the clad plates, L-seam & C-seam welding and welding of the nozzle pipe with flanges along with Weld overlay & Machining on Flanges / fittings are to be done by the Vendor.

2.3.3 **Nozzles formed from Plates:** For plate formed nozzles with dia. less than 6" only, rolling of the plates to form Nozzles will be done in BHEL-HPVP shop. However, fit up, assembly, welding of L-seams & C-seams, NDT etc. are to be carried out by the Vendor.

For Nozzle sizes greater than 6"dia., Nozzles are to be formed from clad plates including Rolling of the clad plates, L-seam & C-seam welding and welding of the nozzle pipe with flanges along with Weld overlay & Machining on Flanges / fittings are to be done by the Vendor.

2.3.4 Fabrication of Nozzle Sub-assemblies involving Fit up & Welding of C-seams of Pipes, Elbows, Flanges, Nozzles including DPT of Weld Edges after root run & final weld, on weld overlay after each layer and RT on C-seam welds, chemical analysis of weld overlay, Ferrite check of weld overlay as per approved drawings & QAP.

2.3.5 100% RT of Insert plate to Shell, Insert Plate to SR Nozzles and SR Nozzle to Shell as per approved QAP/NDE procedure.

2.3.6 100 % UT where attachments are welded directly to the cladding as per approved QAP / NDE procedure.

2.3.7 Marking & Opening of Nozzles and Access/Man way openings on Shell & Dished End as per approved drawings & QAP.

2.3.8 Fit-up & Welding of Nozzles/Sub-Assemblies on Shell & Dished ends including PT on Weld edges, on Root Run & on Final Welds, on chipped back welds, clad restoration on welds, chemical analysis, ferrite check as per approved drawings, QAP/NDE Procedure.

2.3.9 100% UT on the seam of Nozzle to Shell, Pipes & Dished Ends as per approved QAP / NDE Procedure.

2.3.10 Fabrication of RF pads including Rolling/Pressing, Assembly & Welding with the Column and Pneumatic Test as per approved drawings, QAP/NDE Procedure.

2.4 Fabrication of Temporary Saddles for Stress Relieving of column sections, if required, and Transportation Saddles and Stools for Loading & Unloading of Finished column (2 sections) from/on Hydraulic trailers required for transportation of column as per approved drawings.

2.5 PWHT of Column in sections along with Production test coupons has to be carried out by Vendor through a separate Specialized Agency. Specialized agency shall be identified in advance and credentials of agency & procedure for PWHT to be submitted to BHEL for approval. After according of BHEL approval only, the agency is to be engaged for PWHT job. PWHT specifications, SR chart and other documents as required will be furnished by BHEL.

The method of PWHT will be as follows:

- a) Internally by diesel Firing for different sections of suitable length of column and
- b) Local SR of C-seam joints after assembly & welding of different sections of column by Electrical Resistance method.

All assistance required for the Stress Relieving of the Vessels like preparation & fixing of Bulk Heads, Handling, Shifting & Placing the Vessels on Saddles, Rotation of the equipment, Welding of Thermocouples etc. as per the requirements of SR Agency are to be carried out by the vendor.

- 2.6** Production Test Coupons after RT & PWHT shall be handed over to BHEL-QC Laboratory for testing.
- 2.7** Hardness shall be checked for all pressure joints on Welds/Heat Affected Zone/Parent Metal after PWHT as per approved QAP/NDE procedure.
- 2.8** RT on Pressure retaining welds after PWHT as per approved QAP/NDE procedure.
- 2.9** 100% UT on Pressure retaining welds of clad portion of Dished End, Toricone and Hot formed shells after PWHT as per approved QAP/NDE procedure.
- 2.10** 10% UT on Pressure retaining welds of balance clad portion of shells after PWHT as per approved QAP/NDE procedure.
- 2.11** Spot PT on all the internal & external welds after PWHT as per approved QAP/NDE procedure.
- 2.12** PMI check for SS & Alloy steel components, Final Dimensional inspection after PWHT as per approved QAP / NDE procedure.
- 2.13** Hydro-testing of Column at test pressure specified in the drawing followed by Draining, Drying & inside Cleaning. Water will be made available at one point and laying of necessary piping for filling has to be arranged by Vendor. **Water available at Lovagarden site has to be tested at NABL approved laboratory for its suitability for Hydro-test by the Vendor. If available water is not suitable for Hydro-test as per required specifications, Vendor has to arrange suitable water on his own cost for Hydro-test of the vessel.**
- 2.14** MPT inspection of External and Internal surfaces of all welds shall be checked after Hydro-test of the vessel as per QAP/NDE procedure.
- 2.15** Pickling & Passivation of Clad Surface of Shells, dished ends & weldments and Weld Overlays of Nozzles including cleaning & drying as per standards, approved procedure & QAP after Hydro testing of vessel. **An approved specialized agency shall be engaged by the Vendor for the Pickling & Passivation job. Specialized agency shall be identified in advance and credentials of agency & procedure for Pickling & Passivation to be submitted to BHEL for approval. After according of approval only by BHEL, the agency is to be engaged for Pickling & Passivation job.**
- 2.16** Surface preparation by Blast Cleaning to Specification SSPC-SP-10 and Coating of Primer & Finish Paints as per approved Painting Schedule. All tests like Salt Contamination Test, Profile Gauge Check, Tape Adhesion Test, Holiday Check, Peel-off Test etc. required as per Job Specifications and BHEL Painting Procedure No. **SIP:H: PP:22**, Rev.0. shall be carried out by a qualified agency for testing of painting and obtaining stage wise inspection clearance from HPVP (QC) / TPIA / EIL as per approved QAP.
- 2.17** Painting is to be carried out only by Painters qualified by HPVP as per standard format.
- 2.18** All the nozzle openings shall be closed with suitable steel blind covers supplied by BHEL.
- 2.19** Match marking and Cutting of Complete column into two sections for Transportation and weld edge preparation for site weld as per approved drawings and QAP. Profile of the column at the open ends after cutting of the column shall be maintained by providing temporary spiders / profile plates for which raw materials will be provided by BHEL as Free Issue. The open ends of both the vessels are to be closed by welding of plates provided by BHEL as Free issue.
- 2.20** Nitrogen filling is to be carried out in both the sections of the column as per drawings and approved QAP. **Nitrogen shall be made available at one point by BHEL-HPVP as Free Issue.** The filling of Nitrogen by laying of necessary piping, valves, manifolds, gauges etc., shall be arranged by the Vendor.
- 2.21** Letter painting of Dispatch particulars in a prescribed/specified format on the sections of the column.
- 2.22** Vendor to provide all the assistance to Transportation contractor engaged by BHEL Logistics dept. for loading of these two Column sections on the Hydraulic Trailers like placing & fixing steel/wooden saddles, fixing of temporary supports, if required, on the trailer etc. Steel and wooden saddles will be free Issue by BHEL.

For loading of Column sections on the Hydraulic trailers, additional 300 MT capacity crane has to be mobilised in addition to 300 MT crane provided by BHEL and charges for the same are to be borne by the Vendor. Any delay in Mobilisation of crane will attract demurrage charges towards the Hydraulic Trailer deployed by The Transportation contractor and these charges will be deducted from the bills of the Vendor.

2.23 Work Instruction/ Procedures to be followed during fabrication:

- 2.23.1 Welding is to be carried out by ASME qualified welders only. Vendor shall arrange for Qualification of Welders at HPVP under the supervision of BHEL/WT dept. at their own cost. However, Test Coupons shall be provided by BHEL as free issue.
- 2.23.2 **All consumables like welding electrodes, gases, grinding wheels etc. required for fabrication are in the scope of the Vendor.** The Tentative list of required Electrodes are E8018B2, E308L, E309L, ER309L, ER308L, E9018B3, ER80SB2, ER90SB3, ENiCrFe3 etc. The electrodes/filler wire shall be of BHEL/EIL approved makes only and the vendor shall submit the Batch Test Certificates to BHEL for verification before using on the job.
- 2.23.3 Experienced Site in charge and Qualified Engineers & Supervisors shall be deployed for proper co-ordination of the job.
- 2.23.4 Vendors should deploy Experienced & Qualified QC personnel (Min. 2 Nos.) for carrying out the inspection activities in coordination with BHEL QC inspector/TPIA/EIL. **Non-deployment will attract penalty @ rate decided by BHEL and same will be deducted in RA Bills.**
- 2.23.5 Vendors should deploy Qualified NDT personnel (Level III / Level II) (Min. 2 Nos.) at site for carrying out the NDT inspection activities in coordination with BHEL QC –NDT/TPIA/EIL. Vendors shall have to engage sufficient man power for fabrication to meet HPVP delivery schedules. **Non-deployment will attract penalty @rate decided by BHEL and same will be deducted in RA Bills.**
- 2.23.6 Vendor shall deploy sufficient no. of calibrated Welding machines, Main Ovens & Portable Ovens required for baking of electrodes etc., at site. All relevant documents shall also be made available for verification & approval by BHEL - HPVP (QC)/TPIA.
- 2.23.7 Vendor shall deploy all types of suitable Cranes for handling of the raw materials, plates/ shell segments required during the fabrication. **However, for heavy components, BHEL will be deploying one no. of 75 T Crawler crane and one no. of 300 T Crawler Crane for handling of shell sections.**
- 2.23.8 Diesel required for the operation of cranes and DG set will be Free Issue by BHEL. However, transportation of same from BHEL-HPVP to Lovagarden site has to be arranged by the Vendor.
- 2.23.9 Vendor has to provide exclusively 2 Nos. of Helpers i.e., 1 no. for 75 MT Crane and 1 no. for 300 MT DEMAG Crane for regular maintenance and for assistance to Crane operators during the entire contract period. **Non-deployment will attract penalty @rate decided by BHEL and same will be deducted in RA Bills.**
- 2.23.10 Sufficient No. of Rollers & Idlers required for fabrication of Column have to be arranged by the vendor. **Non-deployment in specified time will attract penalty @rate decided by BHEL and same will be deducted in RA Bills.**
- 2.23.11 Required tools & tackles like Measuring instruments like Tape, Fillet & Butt Weld Gauges, Plumb bobs with magnets, Thermal Chalks / Pyrometer, etc. shall be calibrated and valid calibration certificates must be presented, if required.
- 2.23.12 All the Scaffolding materials like Pipes, Clamps, Jallies etc. for temporary platform works are to be arranged by the Vendor.
- 2.23.13 Gate passes for the entry of Manpower, Materials, Cranes, Trailers etc. inside LG site are to be taken care by the contractor.
- 2.23.14 Any modification work due to revision of drawings during fabrication is to be carried out by the vendor without any extra cost.

- 2.23.15 Submission of economic cutting plans for the plate materials and approval shall be obtained from BHEL-HPVP before taking up the same. Wherever fabrication is done without proper approved cutting plans, any loss of materials arising due to the same will be recovered as per BHEL recovery rates.
- 2.23.16 Vendors shall have to return the excess / balance materials including off-cuts and total scrap available with the vendors exclusive of process allowance & invisible wastage to HPVP Stores after material reconciliation but before submission of their final bill. In case the same are not returned by the vendor, Recovery shall be made as per BHEL Rates / MSTC rates plus applicable taxes, prevailing at the time of processing of the final bills.
- 2.23.17 Though not mentioned specifically, any other activity which is required for completion of the work is deemed to be included in the scope of work of vendor.

3. BHEL SCOPE: BHEL – HPVP shall provide the following as free issue:

- 3.1 Drawings, GMS, QAP, WPS, Painting Schedule, applicable Procedures, Standards & Specifications.
- 3.2 Rolling / Pressing of (76+4) mm Thick & (128+4) mm Thick Clad plates for Shell segments & insert plate shall be done by HPVP at shop including marking, cutting, Edge preparation and Clad removal.
- 3.3 Raw materials like Plates (full/off-cuts), Pipes & Tubes, Round Bars, Structural items etc. and BOCs like Pipe Fittings, Nozzles, Flanges, Fasteners, Gaskets etc., as per GMS from HPVP stores/Lovagarden site.
- 3.4 Bore Cladding of Nozzle Pipes up to 6" Dia.
- 3.5 Section bending wherever required.
- 3.6 Blind Flanges, Gaskets and Fasteners required for Hydro-test.
- 3.7 All Paints as per requirement.
- 3.8 Testing of Production Test Coupons in HPVP QC laboratory.
- 3.9 300 MT – 1 No. & 75 MT – 1 No. cranes along with operator will be provided by BHEL free of charge for fabrication. Maintenance of the crane including spares shall also be in the scope of BHEL. **However, Riggers required for handling the job shall have to be provided by the vendor.** DG set will be provided as a Standby during power breakdown. **However, experienced operator for DG set has to be arranged by the vendor.**
- 3.10 Diesel for operation of 300 MT & 75 MT cranes and also for DG set will be Free Issue by BHEL. **However, transportation of same from BHEL-HPVP to Lovagarden site has to be arranged by Vendor.**
- 3.11 Area required for fabrication, Site Office and Stores at Lovagarden site will be provided free of charge. Vendor to mobilize Office container preferably and temporary storage shed for storing their tools and tackles and also pipes, pipe fittings, gaskets, studs, bolts and Nuts etc. which are issued as FIM by BHEL.
- 3.12 Power & Water shall also be provided free of charge at one point inside the fabrication yard but further distribution to the desired location is in vendor's scope.
- 3.13 Vendor's scope shall include arranging Distribution Boards with suitable capacity Switch Fuse units as incomer, all outgoings with necessary safe trips like MCB, ELCB etc., as per the industrial safety norms and their installation, all outgoing cables from Distribution Board, termination at the distribution board, Working Area Lighting.

4. INSPECTION:

- 4.1 Inspection shall be carried out by M/s. BHEL-HPVP, Vizag / BHEL Authorized Inspection Agency (TPIA) / EIL / Customer as per approved QAP. Contractor shall have to offer for Stage wise and Final inspection as per the approved QAP and obtain necessary stage wise & final clearances before proceeding for further operations.
- 4.2 Fabrication Vendor shall be solely responsible for preparation and submission of all Inspection Reports & documents duly certified by Inspection Authority along with the finished equipments.
- 4.3 All the documentation related to inspection clearance of M/s. BHEL/TPI/EIL/Customer, Generation of Inspection Reports, Preparation of Final Documents as per BHEL standard formats etc., are included in the scope of vendor and scanned copy as well as hard copy of the same is to be submitted to BHEL-QA.

Note: QAP enclosed with the tender document is tentative only and may be subject to revision due to incorporation of comments of the approving authority. Hence, the approved QAP issued to the vendor after ordering shall only be followed for execution and inspection of the job.

5. DELIVERY:

5.1 Complete Column along with inspection documents and all other certificates are to be handed over to HPVP **within 8 months from the date of issue of First consignment of free issue materials or 6 weeks from the date of issue of Last consignment of materials, whichever is later.**

Note: In case the delivery period offered by the vendor is more than the tender delivery, Price quoted by the bidder shall be loaded for additional period @1/2 % per week or part thereof for the purpose of evaluation of Bidder Status.

6. SITE MOBILISATION:

6.1 Successful bidders shall have to complete site mobilization **within 15 days from the date of receipt of order or from the date of intimation for the same by Outsourcing dept. whichever is later.**

7. PRICE:

7.1 The price shall be quoted strictly as per the Schedule of Rates enclosed at Annexure – I for the detailed scope of work and the quoted price shall be inclusive of all applicable taxes & duties except GST.

7.2 The prices shall be fixed & firm without any escalation during the entire period of contract and till completion of the work.

7.3 GST shall be reimbursable to the vendor as per applicable guidelines.

7.4 Income tax will be deducted at applicable rates from RA & Final bills.

8. PAYMENT TERMS:

8.1 Payment shall be made against RA Bills for **90% of the order value** for the following stages of supply and fabrication of the equipment:

a)	After Completion of L-Seams of LAS clad portion of shell including NDE	- 15%
b)	After Completion of C-seams of LAS clad portion of shell including NDE	- 20%
c)	After Completion of L-Seams of CS portion of shell including NDE	- 10%
d)	After Completion of C-seams of CS portion of shell including NDE	- 10%
c)	After Completion of fabrication of complete column, PWHT, Hydro-Testing Pickling & Passivation and Painting	- 35 %
d)	After Completion of cutting of column into two sections & Loading for transportation	- 10 %

8.2 Balance 10% payment shall be made after completion of the job in all respects including material reconciliation and handing over of the balance materials & returnable items, if any and submission of total documentation to BHEL (QC/QA).

8.3 The weight indicated in the tender is tentative and may be subject to increase or decrease after completion of detailed engineering. However, payment shall be made for the actual weights executed as per approved engineering drawings and documents with due certification by BHEL-HPVP site in-charge and QC official.

This clause shall be read in conjunction with the clause 17.0 of Annexure – III i.e., General Terms & Conditions.

9. GOODS & SERVICES TAX (GST):

9.1 Bidders shall make a note of the following points of GST before submission of their offer:

a) Vendors shall have to mention their GSTIN no. (15 Digits) in their Technical Bid. If any specific exemption is available, a declaration with due supporting documents need to be furnished for considering the offer.

b) Semi-finished goods are to be delivered by the Vendors in BHEL, HPVP premises within a maximum period of one year from the date of issue of the material, failing which the whole transaction will be considered as Supply & Sale and GST is required to be paid along with interest (calculated @ SBI Base Rate + 6%) along with penalty, if any, from the date of Challan on the whole value of materials. Hence vendors shall have to ensure that materials issued to them are returned within 365 days.

- c) After fabrication, the vendors shall have to deliver the Semi - finished Goods by fulfilling the following formalities:
 - i) GST invoice should be raised by the vendors by paying GST on job work charges at applicable rates and by incorporating the HPVP GSTIN no. in the invoice for availing the reimbursement of GST from HPVP.
 - ii) The vendor shall also have to enter in their GST Return -1 (GSTR-1) the details of invoice raised for payment of GST so as to enable HPVP to avail input credit.

10. REVERSE AUCTION:

- 10.1 BHEL shall be resorting to Reverse Auction (RA) for this tender. RA shall be conducted among the eligible techno-commercially qualified bidders. Business Rules for Reverse Auction are given at Annexure – V and Guidelines for Reverse Auction are available on our website, www.bhel.com → supplier registration → Guidelines for Reverse Auction 2021.
- 10.2 Sealed envelope/Electronic/E-mail Price bids of all the techno-commercially qualified bidders shall be opened and the same shall be considered as initial bids of the bidders in RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their sealed envelope / Electronic price bid along with applicable loading, if any, shall be considered for ranking.
- 10.3 BHEL will inform bidders the details of service provider who will provide business rules, all necessary training and assistance before commencement of online bidding. The bidders participating in the Reverse Auction shall have to necessarily submit '**Process Compliance Form**' (PCF) to the designated Service Provider.
- 10.4 Bidders are advised to read the 'Business Rules' (Annexure – V) indicating details of RA event carefully, before reverse auction event.
- 11. Other Terms & Conditions, whichever applicable, shall be as per Annexure – III enclosed.

12. RISK PURCHASE:

In case the contractor fails to execute the work within the scheduled time or due to any other reasons, BHEL - HPVP reserves the right to get the same completed through some other party at the risk & cost of the contractor and any additional expenditure incurred due to the same shall be charged to the contractor.

13. VALIDITY OF OFFER:

The offer shall be valid for a period of **3 months** from the date of Reverse Auction.

14. GENERAL:

- 14.1 The bidders shall study the Tender documents, Drawings, Quality Documents and all other relevant documents in detail for understanding the scope of work and the processes involved before submission of offer. Bidders shall get clarifications, if any, from concerned officials on the scope of work, clarifications related to welding or any other details of the tender document, over phone between 09:00 AM and 04:00 PM on any working day or through e-mail.
- 14.2 Drawings, QAP, Clarifications related to Welding, other reference documents etc., shall be sent to the bidder's e-mail address upon their written/e-mail request.
- 14.3 **Conditional / Partial Price Bids and any other deviations to the tender terms & conditions are not acceptable** and BHEL reserves the right to reject such offers without further correspondence. Bidders shall confirm their acceptance to all the terms & conditions of the tender enquiry in the Techno-commercial Bids and **any deviations mentioned in the Price Bids shall not be considered.**
- 14.4 BHEL reserves the right to modify or cancel the tender enquiry at any stage without assigning any reasons thereof.
- 14.5 The General Terms & Conditions, if any, contradicting with the specific terms & conditions given in the tender, then specific terms & conditions shall only be considered.

15 The following documents shall form part of the tender enquiry:

- i) Schedule of Rates : Annexure – I
- ii) Details of Vessel to be fabricated : Annexure – II (A)

- iii) List of Reference Drawings & Documents : Annexure – II (B)
- iv) General Terms & Conditions : Annexure – III
- v) Acceptance to tender terms & conditions : Annexure – IV
- vi) Business Rules for Reverse Auction : Annexure – V
- vii) GST Compliance for Indigenous Suppliers : Annexure – GST
- viii) Integrity Pact : Annexure - VI
- ix) Applicable Drawings, Tentative QAP as per Annexure - II (A)

16 TENDER SUBMISSION (Through E - Mail):

- 16.1 Techno-commercial bids along with the tender document duly signed & stamped by the bidder on all pages along with a covering letter on Company's Letter Head addressed to DGM (Outsourcing), BHEL –HPVP, Visakhapatnam shall be sent through an e-mail to the e-mail ID technicalbid-hpvp@bhel.in
- 16.2 **Tentative List of Man Power, Machinery, Tools & Tackles to be engaged by the vendor for the subject job has to be attached to the Techno-Commercial Bid.**
- 16.3 Price bid (i.e., Annexure-I) shall also be sent separately through e-mail to another e-mail ID pricebid-hpvp@bhel.in
- 16.4 Offers completed in all respects along with all the supporting documents shall be sent to the above e-mails only latest by **14.00 Hrs.** on **15.07.2021** duly mentioning the Name of Work, Tender Ref. No. & Date and Technical Bid / Price Bid in the subject of the e-mail.

Note: Don't mark CC and BCC while submitting your offer as the system is designed to reject such mails having more than one recipient. Max. file size of the attachment shall be ≤ 20 MB only. In case, file size is more, bidder can submit their offer through multiple mails within the due date & time.

16.5 TENDERS RECEIVED AFTER THE DUE DATE & TIME ARE NOT ACCEPTABLE.

16.6 OFFERS SENT IN ANY OTHER FORM WILL BE TREATED AS INVALID AND WILL BE SUMMARILY REJECTED.

17. TENDER OPENING:

- 17.1 Techno-commercial bids will be opened **at 14.00 Hrs.** on **15.07.2021**. The bidders may depute their representatives at the time of opening of Technical bids.
- 17.2 After evaluation of the techno-commercial bids, intimation regarding date & procedure of conducting reverse auction shall be given by the service provider to all eligible techno-commercially qualified bidders through an e-mail in advance at an appropriate time.

18. INTEGRITY PACT:

- 18.1 IP is a tool to ensure that activities and transactions between the Company and its Bidders/ Contractors are handled in a fair, transparent and corruption free manner. A panel of Independent External Monitors (IEMs) have been appointed to oversee implementation of IP in BHEL.
The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory who signs in the offer) along with techno-commercial bid. Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words, entering into this Pact would be a preliminary qualification.

Details of IEM for this tender is furnished below:

S.No.	IEM	E-Mail ID
01	Shri Arun Chandra Verma, IPS (Retd.)	acverma1@gmail.com
02	Shri Virendra Bahadur Singh, IPS (Retd.)	vbsinghips@gmail.com

18.2 Please refer Section-8 of IP for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to any of the above IEMs.

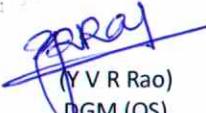
Note:

No routine correspondence shall be addressed to the IEM (phone/ post/ email) regarding the clarifications, time extensions or any other administrative queries, etc on the tender issued. All such clarification/ issues shall be addressed directly to the tender issuing (procurement) department.

For all clarifications/ issues related to the tender, please contact:

Name: Dept.: Address: Phone: (Landline/ Mobile)	1. D N Murthy, Dy. Manager Outsourcing BHEL – HPVP, Visakhapatnam 0891 – 6681359 / 1358	2. Y V R Rao, DGM Outsourcing BHEL – HPVP, Visakhapatnam 0891 – 6681332
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For Bharat Heavy Electricals Limited,



(Y V R Rao)
DGM (OS)

SCHEDULE OF RATES

Ref: OS/21-22/2439/MFC/05/009

Date: 24.06.2021

Sub : **Fabrication of Main Fractionator Column against S.O. no. 2439 at Lovagarden site of BHEL-HPVP, Visakhapatnam.**

Item No.	S.O. No.	Description of Work	Unit	Qty.	Unit Rate (Rs.)	Total Amount (Rs.)
		Fabrication of Main Fractionator Column at Lovagarden site with free issue of raw materials, rolled shell segments of thickness more than 50 mm, fabricated components, Toricone in Petals & Dished Ends in Petals & Crown, BOCs etc., including Rolling of shell segments of thickness less than 50 mm, Assembly, Fit-up, Welding, NDT, PWHT, inspection, Hydrotesting, Pickling & Passivation, Blasting & Painting, cutting of equipment into 2 pieces for transportation purpose, Nitrogen filling etc., as per the approved Drawings, Specifications, QAP, WPS & Painting Schedule and also includes Collection of FIMs from HPVP stores / shops, transportation to Lova Garden site, Loading of equipments onto the trailers etc., completed in all respects as per the detailed scope of work mentioned in the tender document. (All consumables are in vendor's scope)				
1	2439	Main Fractionator Column - Eqpt. Tag No. 111-C-2101 - 1 No.	MT	700		
Total Amount in words:						

Notes :

- 1) The quoted price shall be inclusive of all applicable taxes & duties except GST. Income Tax shall be deducted at applicable rates from RA & Final Bills and GST shall be reimbursable to the vendor as per applicable guidelines.
- 2) The prices shall be fixed & firm without any escalation during the entire period of contract and till completion of work.
- 3) The quantity and weights indicated above are approximate and may vary on both sides subject to revision or addition or deletion of drawings. However, payment shall be made for the actual weights as per the applicable drawings / BOM.
- 4) The bidders are advised to go through all the drawings & documents before quoting the tender.
- 5) The evaluation currency for this tender shall be **INR**.
- 6) Tenderer should quote the amount in figures & words. It may be noted that corrections, overwriting etc. are not allowed. If there is a discrepancy between amount in figures & words, the amount in words shall prevail unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail. If there is an error in the total corresponding to the addition or subtraction of sub-totals, the sub-totals shall prevail and total shall be corrected accordingly.

In case of mismatch between rate and amount in figures, rate in figures shall be taken into consideration for further evaluation and processing.

Signature of the Bidder with Stamp

Details of Vessel to be fabricated

Sub: Fabrication of Main Fractionator Column at Lovagarden site of BHEL-HPVP, Visakhapatnam

Ref: OS/21-22/2439/MFC/05/009

Date: 24.06.2021

Sl. No.	S.O.	PGMA	Equipment No.	Equipment Description	Qty. (No.)	Approx. Wt. (MT)	Eqpt. ID (mm)	Eqpt. Ht. / Overall Length (mm)	Remarks
1	2439	CL-010	111-C-2101	Main Fractionator Column	1	700	8000	58600	
				TOTAL	1	700			

Note : Dimensions & Weights indicated above are purely tentative and may be subject to revisions due to incorporation of comments of the approving authority in the drawings. Hence the approved drawings & documents issued to the vendor after ordering shall only be followed for execution & inspection of the job.

LIST OF REFERENCE DRAWINGS & DOCUMENTS

Sub : Fabrication of Main Fractionator Column at Lovagarden site of BHEL-HPVP, Visakhapatnam against S.O. 2439

Sl. No.	S.O. No.	PGMA	Eqpt. Name	Description of Drawings / Documents	Drawing / Document No.	Rev. No.	No. of Sheets
01	2439	CL-010	Main Fractionator Column (LAS with SS Clad) (Eqpt. Tag No. 111-C-2101)	General Assembly of Main Fractionator	1-CL-010-U0169	A	01
02				General Notes for Main Fractionator	1-CL-010-U0192	00	01
03				Details of Top Dished End	3-CL-010-U0218	A	01
04				Details of Bottom Dished End	3-CL-010-U0219	A	01
05				Details of Toricone	3-CL-010-U0220	A	01
06				Vessel Design data of Main Fractionator Column	B224-111-80-43-DS-3001 Sheet 1 of 7 to 7 of 7	A	07
07				QAP for Main Fractionator Column	CQP 2516 Dtd. 05.02.2021	00	16
08				Procedure for Radiographic Examination	BHE-NDT-RT-07023	02	18
09				Procedure for Ultrasonic Examination	BHE-NDT-UT-07025	02	10
10				Procedure for Magnetic Particle Examination	BHE-NDT-MT-07024	02	13
11				Procedure for Liquid Penetrant Examination	BHE-NDT-PT-07026	02	09
12				Weld Overlay / Cladding Procedure		00	06
13				Weld Details (For reference only)			01

Note: Drawings & Documents indicated above are purely tentative and may be subject to revisions due to incorporation of comments of the approving authority. Hence, the approved drawings and documents issued to the vendor after ordering shall only be followed for execution & inspection of the job.

GENERAL TERMS & CONDITIONS**1. TECHNICAL DELIVERY CONDITIONS:**

The work should conform to the technical data given in our drawings, GMS, Shipping List Specifications, QAP, WPS etc.

2. PARTY'S SCOPE:

The scope of the party shall be as follows: -

- a) All welding equipments, baking oven, tools, jigs and fixtures, measuring instruments duly calibrated, handling facilities, testing facilities etc.
- b) All materials other than those mentioned under "Free Issue Materials", which are required for completion of the work.
- c) All consumables such as electrodes, gases, grinding wheels etc.

Note: Electrodes of specification mentioned in the drawings / WPS and of BHEL approved brands only shall be used and MTCs of the same shall be submitted to BHEL for verification before use.

3. REVISION OF DRAWINGS:

There may be minor changes in the drawings during execution. In such a case, party should accommodate the same without any extra claim.

4. WELDING QUALIFICATION: Qualification of required number of Welders is party's responsibility at their cost.**5. X-RAY:**

All welding shall be of X-ray quality where specified on drawings. Inspection would specify the quantum of X-ray based on drawings / code requirement. Party should strictly follow the WPS and QAP issued by BHEL during welding. Getting the welds radiographed and getting them cleared by inspection is the responsibility of the party.

6. RECTIFICATIONS / REJECTIONS:

Any rectification due to defective work, if required, shall be done by the party free of charge with a suitable technology approved before hand by BHEL in writing. The cost of material, if any used for rectification work / rejection work, will be estimated by BHEL and the same shall be debited to party's account. In case any rectification / rework is to be carried out due to defective material supplied by BHEL, the replacement material and consumables will be supplied by BHEL free of Cost.

7. SECURITY DEPOSIT:

Vendors shall have to submit a Bank Guarantee for **10%** of the order value in case of **HPVP ADM site** or **25%** of the material cost in case of Vendor works towards Security Deposit and safe custody of materials within one week from the date of issue of Order. The BG shall be valid for the contract period with a claim period of 12 months. This Bank Guarantee shall be released to the contractor after completion of work and on acceptance of the same by BHEL / Owner

Bidder agrees to submit performance security required for execution of the contract within the time period mentioned above. In case of delay in submission of performance security, enhanced performance security which would include interest (SBI rate + 6%) for the delayed period, shall be submitted by the bidder. Further, if performance security is not submitted till such time the first bill becomes due, the amount of performance security due shall be recovered as per terms defined in NIT/contract, from the bills along with due interest.

8. PERFORMANCE BANK GUARANTEE:

Vendors shall have to submit Performance Bank Guarantee (claim period of 12 months) for 10% of the order value covering for the defects liability period. If PBG is not submitted, 10% of the order value shall be deducted towards PBG from the final bill and shall be refundable after performance guarantee period, if no defects are found during this period.

9. RAW MATERIALS ISSUE:

Raw materials shall be issued with appropriate processing allowance and invisible wastage over the theoretical requirement of raw materials (**Plates, Sheets, Sections and Pipes**).

10. TRANSFER / RETURN OF LEFT OVER MATERIALS:

Party should maintain proper records for receipt & use of all free issue materials. The left over materials & scrap as per the material accounting statement shall be returned to HPVP stores along with finished job. Material Transfer Vouchers (MTV) from one order to another or from one vendor to another and Material Return Vouchers should be submitted immediately after transfer / return. The material reconciliation statement shall be submitted by the contractor after verification and certification by BHEL along with the final bill **within 30 days from the date of completion of work**. Otherwise, recovery for the balance materials shall be made from any of their pending bills without further intimation.

11. MATERIAL RECONCILIATION:

Orders issued to the vendors have to be completed in all respects including Material Accounting within a maximum of **180 days** from the **date of issue of the first material** from BHEL - HPVP stores.

Maximum of 0.5 % on the requirement of materials (**Plates, Sections and Pipes**) is admitted towards **process allowance and invisible wastage**.

Scrap quantity is permissible up to a **maximum of 1% on Structural (Beams, Channels, Angles, Rods, Pipes etc.), 2% on Sheets, 3% for Plates** on the theoretical requirement of materials.

If wastage and scrap is beyond the above limits, it should be fully justified with cutting diagrams etc. which are to be approved in advance by BHEL. **Otherwise, the cost of raw materials beyond approved limits will be recovered from the contractor as per BHEL recovery rates including applicable taxes & duties.**

Material reconciliation including return of balance materials, off-cuts is to be completed within 20 days from the date of completion of the order. The material reconciliation statement shall be submitted by the contractor after verification and certification by BHEL-HPVP along with the final bill **within 30 days from the date of completion of work**. Otherwise, recovery for the balance materials shall be made from any of their pending bills without further intimation,

Repeated occurrence of inordinate delays in returning and settling the material accounting will entail BHEL the right to terminate the contract forthwith or impose a temporary suspension on further loading at the discretion of BHEL.

12. SCRAP & OFF-CUT NORMS:

Sl. No.	Description	Scrap Size (in mm)	Off-Cut (in MM)
1.	CS/AS Sheets & Plates	Below 500 x 250	500 x 250 & above
2.	Rolled sections Rod, angles etc. (other than -tubes, pipes)	Below 1000	1000 & above
3.	Tubes & Pipes	Below 500	500 & above
4.	Universal column	Below 1000	1000 & Above
5.	SS Sheets & Plates	Below 500 x 250	500 x 250 & above
6.	SS Structural, Rods, Tubes, Pipes	Below 250	250 & above
7.	Non – ferrous: sheets & plates, rods & tubes	Below 500 x 250 (S & PL), Below 250 (Rods & Tubes)	500 x 250 & above, 250 & above
8.	Big size Scrap	(2500 & above) x (150 to 249)	-

13. INSPECTION:

Party shall contact our Quality Control Dept. for stages of inspection before commencement of job and should strictly follow the stages of inspection as per QAP.

14. WORKMANSHIP GUARANTEE:

The vendors should give workmanship guarantee for fabricated items for a period of 18 months from the date of last delivery of the order. Any defects due to incomplete work, faulty workmanship found in the fabricated items after delivery during the defects liability period shall be rectified / replaced by the vendor free of cost. Otherwise, the expenditure incurred towards the same will be recovered from the pending bills of vendors.

15. WORK PROGRESS:

The fabricator shall furnish a weekly report on the progress of work along with the status of availability of free issue materials and requirement of further materials, if any.

Outsourcing dept. personnel will visit vendor's works from time to time to assess and review the work progress. Free access shall be provided to BHEL or its inspection agency at all reasonable times of the day / night.

In case the progress is not satisfactory or supplies are delayed abnormally beyond the contractual delivery date, BHEL-HPVP, Visakhapatnam reserves the right to cancel the order in part or full or get the balance job in as is where is condition completed elsewhere by another agency at the risk and cost of Fabricator. The value of the work carried out by the party will be assessed by BHEL and the same shall be final. No compensation will be given to the fabricator in case of cancellation of order or diversion of balance job even if the jobs have been processed partly.

16. DELIVERY:

Finished items should be handed over to BHEL-HPVP on party's delivery challans along with Job completion certificate / Final Inspection Report from inspection agency / HPVP-QC department.

17. PENALTY:

If delivery exceeds the stipulated delivery schedule, penalty 1/2 % of the total value of order per week or part thereof subject to a maximum of 10% on the total value of the order will be levied. However, time taken for the following will not be considered as delay on the part of the Sub-Contractor.

- 1) Intermediate operations, if any, carried out by BHEL.
- 2) Waiting time for BHEL / Third party Inspection beyond a normal time of 3 days.

18. PAYMENT TERMS:

Payment shall be made against RA Bills within 45 days from the date of submission of Bill.

90% payment will be made after handing over of the finished equipments along with all inspection documents to HPVP shops / Logistics dept. / ADM site / Lova Garden site, duly inspected & cleared by Inspection authority. Balance 10% payment shall be made along with the Final Bill against completion of total order in all respects including documentation.

Vendors shall have to submit the bills in the formats specified by HPVP-Outsourcing and the bills submitted in the specified format along with necessary supporting documents are only admitted for processing. The following documents shall be submitted along with the Final Bill: -

1. No Claim Certificate from the contractor
2. No Dues Certificate from BHEL
3. Work Completion Certificate from BHEL
4. Material Reconciliation Statement submitted by the Contractor and certified by concerned authority of BHEL (if applicable)
5. Workmanship Guarantee certificate from the contractor

19. SECRECY:

All the documents of BHEL inclusive of Drawings, GMS and Standards made available to the fabricator should be kept in strict confidence and under no circumstance be made available to others or allow others to make use of them. Such documents shall be returned to BHEL on demand after completion of the job. This secrecy clause is binding on the employees of the fabricators also. Violation of the same may lead to suspension of business with the vendor and necessary legal action.

20. SUB-LETTING:

In general, sub-letting of jobs will not be permitted. But in special circumstances, this may be allowed. In such case, the party should obtain written approval from BHEL-HPVP, Visakhapatnam before sub-letting.

21. FACTORY RULES AND REGULATIONS:

Party shall abide by all the rules and statutory regulations in force from time to time as per factories act. It shall be party's responsibility to ensure the safety of their workmen and fulfilling the ESI, PF and other relevant statutory regulations.

22. FACTORY RULES AND REGULATIONS:

Party shall abide by all the rules and statutory regulations in force from time to time as per factories act. It shall be party's responsibility to ensure the safety of their workmen and fulfilling the ESI, PF and other relevant statutory regulations.

23. SAFETY:

- a) Contractor shall adhere to safe construction practices, guard against hazardous & unsafe working conditions and shall comply with the safety rules of BHEL and local authorities. He shall maintain First Aid facilities for all his employees and labour. Contractor's responsibility includes supply of welder kit, all safety items such as safety belts, white and colour glasses, goggles, safety helmets, safety shoes etc.
- b) *Contractor and his employees shall follow all fire & safety, security regulations of BHEL.*

24. HOUSE KEEPING:

During execution of work, the contractor at all times keep the working place and storage area clean and free from accumulation of waste materials, rubbish etc.,

25. ACCIDENT / DAMAGE / CONDUCT ETC.:

Contractor will be held responsible for any disorderly conduct / misconduct, indiscipline, theft, smoking etc., on the part of his men. He will ensure summarily eviction of such men from his premises failing which BHEL would remove them from the factory on his responsibility. Any damage to and or loss of equipment, machinery, building etc., to BHEL or BHEL employees, visitors or other contractors resulting from his own or any of his men's negligence shall be liable to be made good by him. Contractor shall be solely responsible for any accident in which you or your men or your equipment may be involved during the execution of contract on account of any reason what so ever.

26. TERMINATION OF CONTRACT:

In the event of any failure on the part of the contractor, BHEL reserves the right to terminate the contract by giving a notice of 2 weeks for any of the following lapses and contractual violations: -

- a) Failure to make labour payments in time as per the rules
- b) Failure to progress the job according to the agreed schedule
- c) Failure to mobilize adequate man power, tools & tackles and consumables in time
- d) Failure to adhere to Quality Standards of BHEL
- e) Refused to co-operate with other agencies working in the same area
- f) Failure to resolve labour disputes like strikes etc., within 7 days of occurrence
- g) Failure to comply with statutory regulations applicable at BHEL

BHEL shall also be free to intervene and take necessary remedial measures. All costs incurred with interest and overheads shall be recovered from contractor by such foreclosing or off-loading any part of the contract work.

27. DISPUTES:

Head of BHEL- HPVP Unit will be the final authority for any disputes arising out of this contract. The disputes / arbitration / settlement of contractual or legal issues shall be under the Jurisdiction of Visakhapatnam Court.

28. For this procurement, Public Procurement (Preference to Make in India), Order 2017 dated 15.06.2017 & 28.05.2018 and subsequent Orders issued by the respective Nodal Ministry shall be applicable even if issued after issue of this NIT but before finalization of Contract / PO / WO against this NIT.

In the event of any Nodal Ministry prescribing higher or lower percentage of purchase preference and / or local content in respect of this procurement, same shall be applicable.

29. The Bidder declares that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s). This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

In case, the Bidder is found having indulged in above activities, suitable action shall be taken by BHEL as per extant policies/ guidelines.

Acceptance to Tender Terms & Conditions

I / We hereby confirm that the Tender documents, Drawings, Quality documents etc. have been studied in detail and we have fully understood the scope of work.

I / We accept to all the Terms and Conditions of the Tender Enquiry and the prices quoted are in accordance with the same.

I / We give our acceptance to participate in reverse auction for this tender.

Tender documents duly signed on all the pages by the Owner / authorized representative of the bidder are attached herewith.

Signature of the Bidder with Stamp

BUSINESS RULES FOR REVERSE AUCTION (RA)

This has reference to tender no. **OS/21-22/2439/MFC/05/009 dated 24.06.2021**. BHEL shall finalize the Rates for **Fabrication of Main Fractionator Column at Lovagarden site of BHEL-HPVP, Visakhapatnam against S.O. 2439** through Reverse Auction mode. BHEL has made arrangement with an authorized Service provider (details will be shared before reverse auction) for conducting RA. Bidders should go through the instructions given below and submit acceptance of the same.

The technical & commercial terms are as per (a) BHEL Tender Enquiry No. **OS/21-22/2439/MFC/05/009 dated 24.06.2021**, (b) Bidders' technical & commercial bid (in case of two-part bid) and (c) subsequent correspondences between BHEL and the bidders, if any.

1. Procedure of Reverse Auctioning:

- i) Price bids of all techno-commercially qualified bidders shall be opened.
- ii) **Reverse Auction:** The 'bid decrement' will be decided by BHEL.
- iii) The lowest bidder in sealed envelope price bid shall be shown as current L1 automatically by the system and no acceptance of that price is required. System shall have the provision to indicate this bid as current L1.
- iv) Bidders by offering a minimum bid decrement or the multiples thereof can displace a standing lowest bid and become "L1" and this continues as an iterative process. However, no bidder shall be allowed to lower its bid below the current L1 by more than 5 decrements at one go.
- v) After the completion of the reverse auction, the Closing Price shall be available for further processing.
- vi) **Wherever the evaluation is done on total cost basis, after Reverse Auction, prices of individual line items shall be reduced on pro-rata basis.**

2. Schedule for reverse auction: The Reverse Auction schedule will be intimated to the techno-commercially qualified bidders at a later stage.**3. Auction extension time:** If a bidder places a bid in the last 5 minutes of closing of the Reverse Auction and if that bid gets accepted, then the auction's duration shall get extended automatically for another 5 minutes, for the entire auction (i.e. for all the items in the auction), from the time that bid comes in. Please note that the auto-extension will take place only if a bid comes in those last 5 minutes and if that bid gets accepted as the lowest bid. If the bid does not get accepted as the lowest bid, the auto-extension will not take place even if that bid might have come in the last 5 minutes. In case, there is no bid in the last 5 minutes of closing of Reverse Auction, the auction shall get closed automatically without any extension. However, bidders are advised not to wait till the last minute or last few seconds to enter their bid during the auto-extension period to avoid complications related with internet connectivity, network problems, system crash down, power failure, etc.

The above process will continue till completion of Reverse Auction.

Complaints/ Grievances, if any, regarding denial of service or any related issue should be given in writing thru e-mail/ fax to M/s. {Service provider} with a copy to BHEL within 15 minutes prior to initial closing time of Reverse Auction.

4. Bid price: The Bidder has to quote the {.....} Price inclusive of Packing & Forwarding charges, all the routine & type tests as per tender scope, taxes, duties, freight and insurance **except GST** as specified in tender document including loading (if indicated by BHEL due to deviations in technical/ commercial terms) for the Items specified. Details are as shown in Excel Sheet for calculation of total cost to BHEL (To be specified by Unit as per NIT conditions).**5. Bidding currency and unit of measurement:** Bidding will be conducted in **Indian Rupees** per **Unit** of the material as per the specifications mentioned in the tender.

In case of foreign currency bids, exchange rate (TT selling rate of State Bank of India) as on scheduled date of tender opening (Part-I bid) shall be considered for conversion in Indian Rupees. If the relevant day happens to be a Bank holiday, then the forex rate as on the previous bank (SBI) working day shall be taken.

6. **Validity of bids:** Price shall be valid for 3 months from the date of reverse auction. These shall not be subjected to any change whatsoever.
7. **Lowest bid of a bidder:** In case the bidder submits more than one bid, the lowest bid at the end of Reverse Auction will be considered as the bidder's final offer to execute the work.
8. Unique user IDs shall be used by bidders during bidding process. All bids made from the Login ID given to the bidders will be deemed to have been made by the bidders/ bidders' company.
9. **Post auction procedure:** BHEL will proceed with the Lowest Bid in the Reverse Auction for further processing.
10. Any commercial/ technical loading shall be separately intimated to respective bidders prior to RA. The excel sheet provided in this regard shall cover all these aspects. Commercial/ technical loading if any, shall be added by the respective bidder in its price during Reverse Auction.
Modalities of loading & de-loading shall be separately intimated to the bidders. The responsibility for correctness of total cost to BHEL shall lie with the bidders.
11. Reverse auction shall be conducted by BHEL (through M/s *{Service Provider}*), on pre-specified date, while the bidders shall be quoting from their own offices/ place of their choice. Internet connectivity shall have to be ensured by bidders themselves.

During the RA process if a bidder is not able to bid and requests for extension of time by FAX/ email/ phone then time extension of additional 15 minutes will be given by the service provider provided such requests come before 5 minutes of auction closing time. However, only one such request per bidder can be entertained.

In order to ward-off contingent situation of connectivity failure bidders are requested to make all the necessary arrangements/ alternatives whatever required so that they are able to circumvent such situation and still be able to participate in the reverse auction successfully. Failure of power or loss of connectivity at the premises of bidders during the Reverse auction cannot be the cause for not participating in the reverse auction. On account of this, the time for the auction cannot be extended and neither BHEL nor M/s. *{Service provider}* is responsible for such eventualities.

12. **Proxy bids:** Proxy bidding feature is a pro-bidder feature to safe guard the bidder's interest of any internet failure or to avoid last minute rush. The proxy feature allows bidders to place an automated bid in the system directly in an auction and bid without having to enter a new amount each time a competing bidder submits a new offer. The bid amount that a bidder enters is the minimum that the bidder is willing to offer. Here the software bids on behalf of the bidder. This obviates the need for the bidder participating in the bidding process until the proxy bid amount is decrementally reached by other bidders. When proxy bid amount is reached, the bidder (who has submitted the proxy bid) has an option to start participating in the bidding process.

The proxy amount is the minimum amount that the bidder is willing to offer. During the course of bidding, the bidder cannot delete or change the amount of a proxy bid.

Bids are submitted in decrements (decreasing bid amounts). The application automates proxy bidding by processing proxy bids automatically, according to the decrement that the auction originator originally established when creating the auction, submitting offers to the next bid decrement each time a competing bidder bids, regardless of the fact whether the competing bids are submitted as proxy or standard bids. However, it may please be noted that if a manual bid and proxy bid are submitted at the same instant manual bid will be recognized as the L1 at that instant.

In case of more than one proxy bid, the system shall bid till it crosses the threshold value of 'each lowest proxy bid' and thereafter allow the competition to decide the final L1 price.

Proxy bids are fed into the system directly by the respective bidders. As such this information is privy only to the respective bidder(s).

13. Bidders are advised to get fully trained and clear all their doubts such as refreshing of Screen, quantity being auctioned, tender value being auctioned etc. from M/s. *{Service provider}*.

- 14.** M/s. {Service provider}, shall arrange to demonstrate/ train the bidder or bidder's nominated person(s), without any cost to bidders. M/s. {Service provider}, shall also explain the bidders, all the business rules related to the Reverse Auction. Bidders are required to submit their acceptance to the terms/ conditions/ modalities before participating in the Reverse Auction in the process compliance form as enclosed. Without this, the bidder will not be eligible to participate in the event.
- 15.** Successful bidder shall be required to submit the final prices (L1) in prescribed format (Annexure – VI) for price breakup, quoted during the Reverse Auction, duly signed and stamped as token of acceptance without any new condition (other than those already agreed to before start of auction), after the completion of auction to M/s. {Service provider} besides BHEL within two working days of Auction without fail.
- 16.** Any variation between the final bid value and that in the confirmatory signed price breakup document will be considered as tampering the tender process and will invite action by BHEL as per extant guidelines for suspension of business dealings (as available on www.bhel.com).
- 17.** Bidders' bid will be taken as an offer to execute the work/ supplies the item as per enquiry no. **OS/21-22/2439/MFC/05/009 dated 24.06.2021**. Bids once made by the bidder, cannot be cancelled/ withdrawn and bidder shall be bound to execute the work as mentioned above at bidder's final bid price. Should bidder back out and not execute the contract as per the rates quoted, BHEL shall take action as per extant guidelines for suspension of business dealings (as available on www.bhel.com).
- 18.** Bidders shall be able to view the following on their screen along with the necessary fields during Reverse Auction:
 - a. Leading (Running Lowest) Bid in the Auction (only total price of package)
 - b. Bid Placed by the bidder
 - c. Start Price
 - d. Decrement value
 - e. Rank of their own bid during bidding as well as at the close of auction.
- 19.** BHEL's decision on award of contract shall be final and binding on all the Bidders.
- 20.** BHEL reserves the right to extend, reschedule or cancel the Reverse Auction process at any time, before ordering, without assigning any reason, with intimation to bidders.
- 21.** BHEL shall not have any liability to bidders for any interruption or delay in access to the site irrespective of the cause. In such cases, the decision of BHEL shall be binding on the bidders.
- 22.** Other terms and conditions shall be as per bidder's techno-commercial offers and other correspondences, if any, till date.
- 23.** If there is any clash between this business document and the FAQ available, if any, in the website of M/s. {Service provider}, the terms & conditions given in this business document will supersede the information contained in the FAQs. Any changes made by BHEL/ service provider (due to unforeseen contingencies) after the first posting shall be deemed to have been accepted if the bidder continues to access the portal after that time.
- 24.** Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party. If the Bidder or any of his representatives are found to be involved in Price manipulation/ cartel formation of any kind, directly or indirectly by communicating with other bidders, action *as per extant BHEL guidelines for suspension of business dealings (as available on www.bhel.com)*, shall be initiated by BHEL.

Signature of the Bidder with Stamp

INTEGRITY PACT

Between

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at "BHEL House", Siri Fort, New Delhi - 110049 (India) hereinafter referred to as "The Principal", which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

and

_____, (description of the party along with address), hereinafter referred to as "The Bidder/ Contractor" which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the OTHER PART

Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for

_____. The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint Independent External Monitor(s), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1- Commitments of the Principal

1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-

- 1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
- 1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.
- 1.1.3 The Principal will exclude from the process all known prejudiced persons.

1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions:

Section 2 - Commitments of the Bidder(s)/ Contractor(s)

- 2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.
 - 2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he/ she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.
 - 2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.
 - 2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant Indian Penal Code (IPC) and Prevention of Corruption Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
 - 2.1.4 Foreign Bidder(s)/ Contractor(s) shall disclose the name and address of agents and representatives in India and Indian Bidder(s)/ Contractor(s) to disclose their foreign principals or associates. The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.
- 2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.
- 2.3 The Bidder(s)/ Contractor(s) shall not approach the Courts while representing the matters to IEMs and will await their decision in the matter.

Section 3 - Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidder(s)/ Contractor(s) from the tender process or take action as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

Section 4 - Compensation for Damages

- 4.1 If the Principal has disqualified the Bidder from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent Earnest Money Deposit/ Bid Security.
- 4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to

demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/ Performance Bank Guarantee, whichever is higher.

Section 5 - Previous Transgression

- 5.1 The Bidder declares that no previous transgressions occurred in the last 3 years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.
- 5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

Section 6 - Equal treatment of all Bidders/ Contractors / Sub-contractors

- 6.1 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors. In case of sub-contracting, the Principal contractor shall be responsible for the adoption of IP by his sub-contractors and shall continue to remain responsible for any default by his sub-contractors.
- 6.2 The Principal will disqualify from the tender process all bidders who do not sign this pact or violate its provisions.

Section 7 - Criminal Charges against violating Bidders/ Contractors /Subcontractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section 8 - Independent External Monitor(s)

- 8.1 The Principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.
- 8.2 The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.
- 8.3 The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all contract documentation of the Principal including that provided by the Bidder(s)/ Contractor(s). The Bidder(s)/ Contractor(s) will grant the monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his contract documentation. The same is applicable to Sub-contractor(s). The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Sub-contractor(s) with confidentiality in line with Non- disclosure agreement.
- 8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.

8.5 The role of IEMs is advisory, would not be legally binding and it is restricted to resolving issues raised by an intending bidder regarding any aspect of the tender which allegedly restricts competition or bias towards some bidders. At the same time, it must be understood that IEMs are not consultants to the Management. Their role is independent in nature and the advice once tendered would not be subject to review at the request of the organization.

8.6 For ensuring the desired transparency and objectivity in dealing with the complaints arising out of any tendering process, the matter should be examined by the full panel of IEMs jointly as far as possible, who would look into the records, conduct an investigation, and submit their joint recommendations to the Management.

8.7 The IEMs would examine all complaints received by them and give their recommendations/ views to CMD, BHEL, at the earliest. They may also send their report directly to the CVO and the Commission, in case of suspicion of serious irregularities requiring legal/ administrative action. IEMs will tender their advice on the complaints within 10 days as far as possible.

8.8 The CMD, BHEL shall decide the compensation to be paid to the Monitor and its terms and conditions.

8.9 IEM should examine the process integrity, they are not expected to concern themselves with fixing of responsibility of officers. Complaints alleging mala fide on the part of any officer of the organization should be looked into by the CVO of the concerned organisation.

8.10 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant Indian Penal Code/ Prevention of Corruption Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

8.11 The number of Independent External Monitor(s) shall be decided by the CMD, BHEL.

8.12 The word 'Monitor' would include both singular and plural.

Section 9 - Pact Duration

9.1 This Pact shall be operative from the date IP is signed by both the parties till the final completion of contract for successful bidder and for all other bidders 6 months after the contract has been awarded. Issues like warranty / guarantee etc. should be outside the purview of IEMs.

9.2 If any claim is made/ lodged during currency of IP, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/ determined by the CMD, BHEL.

Section 10 - Other Provisions

10.1 This agreement is subject to Indian Laws and jurisdiction shall be registered office of the Principal, i.e. New Delhi.

10.2 Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

10.3 If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.

10.4 Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

10.5 Only those bidders / contractors who have entered into this agreement with the Principal would be competent to participate in the bidding. In other words, entering into this agreement would be a preliminary qualification.

[Signature]
 For & On behalf of the Principal
 Dy. Manager (OS)
 Bharat Heavy Electricals Ltd
 HPVP VISAKHAPATNAM-12

(Office Seal)

For & On behalf of the Bidder/
 Contractor

(Office Seal)

Place-----

Date-----

Witness: *[Signature]*

(Name & Address)
 Dy. Manager (OS)
 Bharat Heavy Electricals Ltd.
 HPVP, Visakhapatnam-530 012

Witness: _____

(Name & Address)

GST COMPLIANCE FOR INDIGENOUS SUPPLIERS

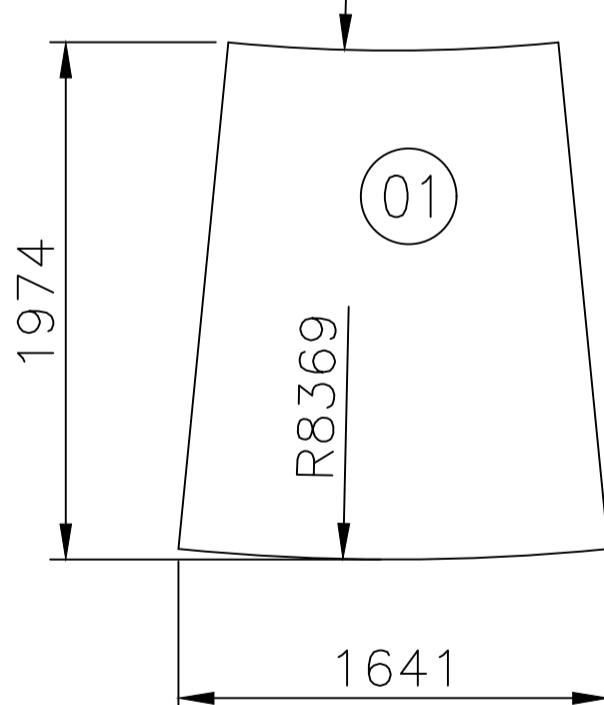
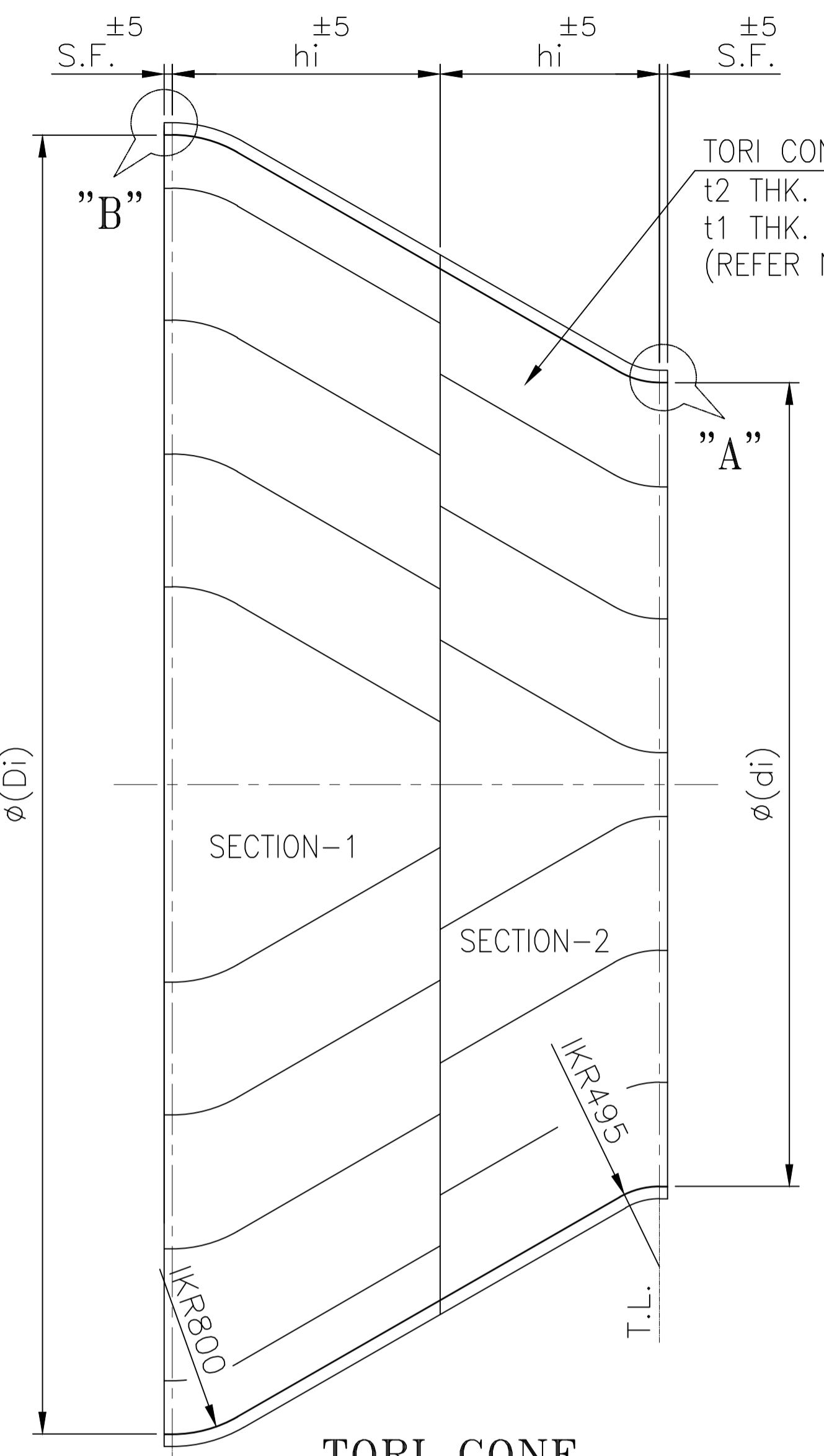
1. In Response to Tenders for Indigenous supplier will be entertained only if the vendor has a valid GSTIN which should be clearly mentioned in the offer. If any specific exemption is available, a declaration with due supporting documents need to be furnished for considering the offer.
2. Supplier shall mention their GSTIN in all their invoices and invoices shall be in the format as specified/prescribed under GST laws. Invoices shall necessarily contain Invoice number (in case of multiple numbering system is being followed for billing like SAP invoice no, commercial invoice no etc., then the Invoice No which is linked/uploaded in GSTN network shall be clearly indicated), item description as per P0, Quantity, Rate, Value, applicable taxes with nomenclature (like IGST, SGST, CGST & UTGST) separately, HSN/ SAC Code, etc.
3. All invoices shall bear the HSN Code for each item separately (Harmonized System of Nomenclature)/ SAC code (Services Accounting Code).
4. A declaration to the effect that all invoice particulars are/were uploaded in the GSTN network/ portal & all tax liability as per GST rules and regulations have been and will be discharged, shall be mentioned in the invoice. If not mentioned in the invoice, a separate declaration shall be submitted as per the requirement of BHEL.
5. All documents like Test Certificate, LR copy, Guarantee/Warranty certificate, work completion certificate, any other document mentioned in PO, shall be sent along with the vehicle/consignment where ever applicable. For all consignments received within the calendar month, input credit will be availed within that month in line with monthly returns filing cycle. In case of any discrepancy in the document or non-submission of documents mentioned in the PO, then BHEL will not be able to accept or account the material, in such case availing of tax credit will be deferred to next month or so.
6. In case of discrepancy in the data uploaded by supplier in the GSTN portal or in case of any shortages or rejection in the supply, then BHEL will not be able to avail the tax credit and will notify the supplier of the same. Supplier has to rectify the data discrepancy in the GSTN portal or issue credit note (details to be uploaded in GSTN portal) for the shortages or rejections in the suppliers, within the calendar month notified by BHEL.
7. For any such delay in availing of tax credit for reasons attributable to supplier (as mentioned above), interest (calculated @ SBI Base Rate + 6%) along with penalty if any will be deducted for the delayed period i.e. from the month of receipt till the month tax credit is availed, from the running bills.
8. Under GST regime, BHEL has to discharge GST liability on LD recovered from suppliers/contractors. Hence applicable GST shall also be recoverable from suppliers/contractors on LD amount. For this Debit note will be issued by BHEL indicating the respective supply invoice number.
9. This is to inform that GST portion of invoice, shall be released only upon Vendor declaring such invoice in his GSTR-1 and receipt of goods and Tax invoice by BHEL and Confirmation of payment of GST thereon by vendor on GSTN portal. Alternatively, BG of appropriate value may be obtained from vendor which shall be valid At least one month after the confirmation of date of payment of GST by vendor on GSTN portal and receipt of Tax invoice and receipt of goods, whichever is later. Above is subject to receipt of goods/service and tax invoice thereof along with vendor declaring invoice in his return and paying GST within timeline prescribed for availing ITC by BHEL.
10. That in case vendor delays Declaring such invoice in his return and GST credit availed by BHEL is denied or reversed subsequently as per GST law, GST amount paid by BHEL towards such ITC reversal as per GST law shall be recoverable from vendor/contractor along with interest levied/ leviable on BHEL.

Note: The above will be followed strictly for processing vendor payments to ensure GST Compliance.

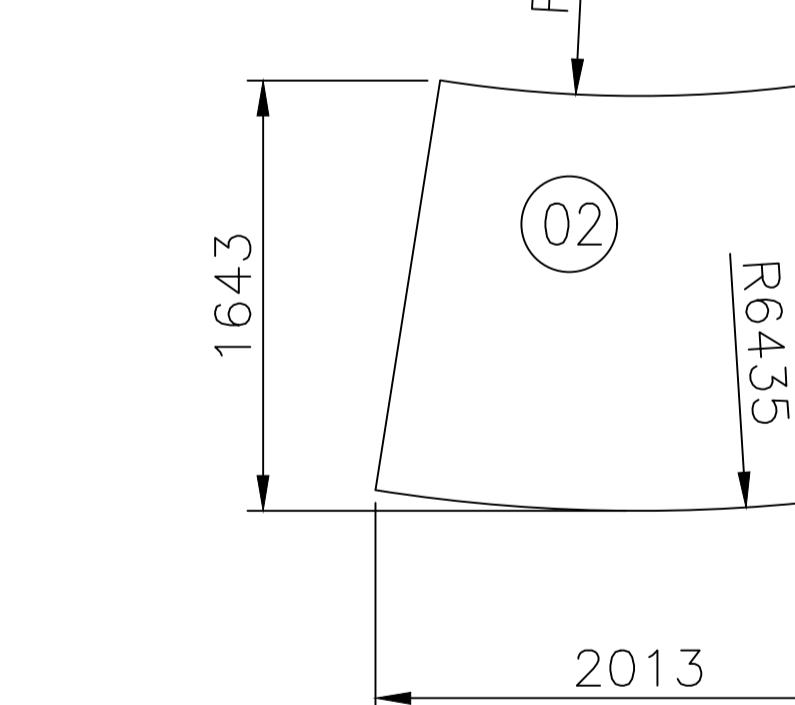
Signature of the Bidder with Stamp

3-CL-010-U0220

DRAWING NO:



SECTION-1 PETAL
QTY.-16 NOS.



SECTION-2 PETAL
QTY.-10 NOS.

WELD DETAIL OF PETAL

02	111-C-2101	6350	4950	1350	60+3	74+3	160	24+3	74+4	20009	1	-	10
01	111-C-2101	8000	6350	1650	60+3	74+3	50	24+3	74+4	31356	1	16	-
SR. NO.	EQUIPMENT NO.	ØDi	Ødi	hi	t1 (MIN.)	t2 (NOM.)	SF	t3	t4	WEIGHT (Kg.)	QTY.	~NO. OF PETALS (SECTION-1)	~NO. OF PETALS (SECTION-2)
							REV	DATE		DESCRIPTION	PPD	CHKD	APPD

REV DATE DESCRIPTION PPD CHKD APPD

NOTES:-

- MATERIAL TO BE SA 387 Gr.22 CL2+3mm CLAD SS304L OF ASME SEC-II PART-A; 2017.
- TORI CONE TO BE PREPARED USING COLD FORMED PETALS WITH FOLLOWING SCOPE OF WORK.
 - AT THE WORKS OF BHEL: PLATE TO BE SUPPLIED TO TORI CONE VENDOR IN RECTANGULAR FORM (SUFFICIENT FOR MAKING THE PETALS).
 - AT THE WORKS OF TORI CONE VENDOR:
 - DETAIL DRAWING SHOWING THE DEVELOPMENT OF EACH PETAL FOR TORI CONE OTHER DETAILS INCLUDING ALL ASSOCIATED DIMENSIONS (MEETING THE END DIMENSION) TO BE FURNISHED TO BHEL FOR APPROVAL BEFORE PROCEEDING FOR MANUFACTURING.
 - SKETCH OF PETAL AS SHOWN HERE IS FOR REFERENCE ONLY. BUT NO. OF PETALS OF TORI CONE TO BE KEPT SAME AS ALREADY SHOWN.
 - PROCEDURE DULY APPROVED BY BHEL TO BE REFERRED FOR MATERIAL HANDLING, MARKING, MATERIAL CUTTING, PROTECTION WHILE FORMATION OF PETALS FOR TORI CONE (IF ANY).
 - CUTTING OF PETALS FROM THE RECTANGULAR PLATES (AS RECEIVED FROM BHEL), FORMING OF PETALS FOR TORI CONE BY COLD FORMING.
 - EDGE PREPARATION OF PETALS SHALL BE DONE AS SPECIFIED IN WLED DETAILS. WELD EDGE SHALL BE DP TESTED.
 - AFTER FORMING, ALL PETALS OF TORI CONE TO BE 100% UT AS PER SA 578 LEVEL-B.
 - TRIAL ASSEMBLY TO CHECK THE FINISHED DIMENSIONS. INSPECTION REPORT SHOULD INDICATE THE PETAL IDENTIFICATION NOS. (SERIAL WISE) FOR TORI CONE ASSEMBLY.
 - AFTER SUCCESSFUL TRIAL ASSEMBLY, EACH PETALS OF TORI CONE TO BE IDENTIFIED WITH UNIQUE IDENTIFICATION NO. SO AS TO AVOID ANY AMBIGUITY AFTER RECEIPT AT BHEL FOR PROCESSING FURTHER (i.e. WELDING OF PETALS) TO MEET THE END DIMENSION.
 - INSPECTION AND NDT SHALL BE CARRIED OUT AS PER APPLICABLE QAP / ITP.
- AT THE WORKS OF BHEL:
 - ARRANGING OF PETALS OF TORI CONE IN SEQUENCE TO MEET THE END DIMENSION.
 - WELDING SHALL BE CARRIED OUT AS PER APPROVED WPS.
 - INSPECTION AND NDT SHALL BE CARRIED OUT AS PER ITP / QAP.
 - PMI TEST SHALL ALSO REQUIRED TO BE CARRIED OUT TO ENSURE CHEMICAL PROPERTIES OF THE WELD.
 - PERFORMING OF HEAT TREATMENT AS PER THE APPROVED PROCEDURE. SEE NOTE-3 BELOW ALSO.
 - COMPLETE TORI CONE TO BE 100% UT AS PER SA 578 LEVEL-B.
 - EDGE PREP. AT SF IS REQUIRED AS PER DETAIL 'A' SHOWN.
 - INSIDE & OUTSIDE OF KNUCKLE AND EDGE PREPARATION TO BE DP TESTED FOLLOWED BY 100% RT FOR WELD SEAM.
- HEAT TREATMENT: (AT VEDNOR WORKS)
 - TORI CONE COMPONENTS (PEALS) SHALL BE STRESS RELIVED AFTER FORMING.
 - UT SHALL BE CARRIED OUT ON TORI CONE COMPONENTS AFTER PFHT.
 - ACTUAL PFHT CYCLE WILL BE PROVIDED DURING DRAWING APPROVAL STAGE.
 - FOR TENDER PURPOSE, PFHT CYCLE SHALL BE CONSIDERED AS PER UCS-56 OF ASME SEC.VIII, DIV.1
- PAINTING AFTER SURFACE CLEANING FOR PETALS & TOP DISHED END: ONE COAT OF RUST PREVENTIVE PAINT ON INSIDE & OUT SIDE SURFACE LEAVING 50 MM FROM EDGE.
- TOLERANCE: i) OVALITY SHOULD NOT EXCEED 10MM OF TORI CONE ID. (DIFFERENCE MAX. & MIN. I.D.).
ii) MEASURED CIRCUMFERENCE SHOULD BE $+6$ OF CALCULATED CIRCUMFERENCE BASED ON I.D. SPECIFIED.
- CODE OF CONSTRUCTION ASME SECTION VIII DIV. 1; 2017.
- INSPECTION BY M/S BHEL / BHEL APPOINTED TPIA AND END CUSTOMER (IF ANY).
- WELDING SHALL BE AS PER APPROVED WPS.
- MATERIAL IDENTIFICATION NO. TO BE MAINTAINED AT END SUPPLIER'S END BEFORE DURING & AFTER FORMING OPERATION.
- TORI CONE SUPPLIER TO FURNISH TEST CERTIFICATES INCLUDING (a) METHOD OF FORMING, CARRIED OUT IF ANY, (c) DIMENSIONAL REPORT INCLUDING MINIMUM THICKNESS, (d) NDE REPORTS & TRIAL ASSEMBLY CHECK. QAP DULY APPROVED BY BHEL SHALL ALSO REQUIRED TO BE REFERRED FOR OTHER DOCUMENTS.
- TORI CONE SUPPLIER SHALL CONFIRM THAT THE TORI CONE (AS SHALL BE SUPPLIED) SHALL MEET THE END DIMENSION AS SHOWN.
- DP TEST & RT ALWAYS SHALL BE CARRIED OUT AS PER APPENDIX-B & UW-51 RESPECTIVELY OF ASME SECTION VIII DIVISION-I; 2017.

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO	MATERIAL CODE	A/C/P	UNIT WEIGHT	D1	QUANTITY	GS
02	74+4	TORI CONE SECTION-2 PETAL	-	156021210000	SA387 Gr.22 CL2+3mm CLAD SS304L	20009	10	156021210000	31356	16	1
		TORI CONE SECTION-1 PETAL									
01	74+4	THK. x 2013 x 1974	-	156021210000	SA387 Gr.22 CL2+3mm CLAD SS304L	20009	10	156021210000	31356	16	1

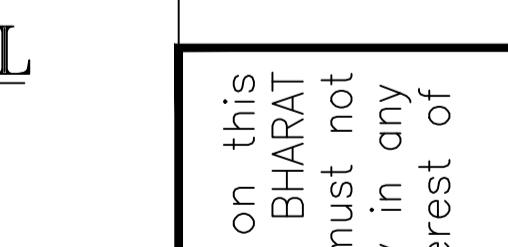
CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

DEPT	ALL DIMENSIONS	PROJECTION	SCALE	WEIGHT (Kg)
PP ENGG	ARE IN MM		1 : 60 & N.T.S	—
CODE 031				REF TO ASSY / OLD DWG

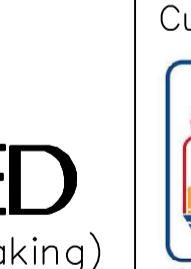
TITLE

DETAIL OF TORI CONE FOR
MAIN FRACTIONATOR (111-C-2101)

DRAWING NO :	REV
3-CL-010-U0220	A



Bharat Heavy Electricals Ltd
UNIT: HEAVY PLATES & VESSELS PLANT
VISAKHAPATNAM-530012



Customer :
HPCL Rajasthan Refinery Limited
Barmer

 ENGINEERS INDIA LIMITED NEW DELHI इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपकरण)	JOB NO: कार्य संख्या	B224	UNIT NO: यूनिट संख्या	111											DESIGN DATA	डिजाइन डाय	DRAWING NUMBER ड्राइंग नंबर	REV
	CLIENT : क्लाइंट	 M/S HRRRL, RAJASTHAN													MAIN FRACTIONATOR ITEM NO. : 111-C-2101	मेन फरैक्शनेटर आइटम नंबर : 111-सी-2101	B224-111-80-43-DS-3001	A
	PLANT : प्लाट	RAJASTHAN REFINERY PROJECT			A	23.08.2019	ISSUED FOR ENGG/BIDS	AKP	NNM/RKM	KJH	REV	DATE	REVISION	BY	CHECKED	APPROVED		

 <p>इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम)</p> <p>NEW DELHI इंजीनियर्स इंडिया लिमिटेड</p>	ENGINEERS INDIA LIMITED	JOB NO: कार्य संख्या	B224	UNIT NO: युनिट संख्या	111								DESIGN DATA	डिजाइन डाटा	DRAWING NUMBER डाइग्राम नम्बर	REV
	CLIENT : कंट्राक्टर	 M/S HRRL, RAJASTHAN											MAIN FRACTIONATOR		मेन फ्रैक्शनेटर	
	PLANT : प्लाट	RAJASTHAN REFINERY PROJECT		A	23.08.2019	ISSUED FOR ENGG/BIDS	AKP	NNM/RKM	KJH						B224-111-80-43-DS-3001	A
		REV	DATE			REVISION	BY	CHECKED	APPROVED				ITEM NO. 111-C-2101		आइटम नम्बर : 111-सी-2101	SHEET 2 OF 7

NOZZLES AND CONNECTIONS (नोजल व कनैक्शन) (2.25 Cr.+1 MO+CLAD ZONE)								GENERAL NOTES (जनरल नोट्स)				SPECIFICATIONS (स्पेसिफिकेशन्स)				DESIGN DATA (डिजाइन डाय)			
MARK	QTY	NOM. DIA (INCH)	SCH./THK.	FLANGES		PROJECTION NOTE-4	PAD WXT	SERVICE	UNLESS STATED OTHERWISE				X DENOTES APPLICABILITY	CODE	ASME SEC.VIII DIV.-1 (LATEST)				
				CLASS	TYPE				FACING	UNLESS STATED OTHERWISE					WORKING PRESSURE (kg/cm²g)	INT. TOP -	BOT. -		
मार्क	क्वान्टिटी	नामिकल डाया (इंच)	शब्दल व विकॉनेस	क्लास	टाईप	फेसिंग	प्रोजेशन	पैड	सर्विस	UNLESS STATED OTHERWISE				GENERAL SPEC. FOR PRESSURE VESSELS	6-12-0001	WORKING PRESSURE (kg/cm²g)	INT. TOP -	BOT. -	
1 A-B	2	REFER SHT.-7				FEED (NOTE-24 & 37)+COMP. FLG.+SPACER/ BLIND		UNLESS STATED OTHERWISE				SUPP. SPEC. FOR CS-VESSELS	6-12-0002	DESIGN PRESSURE (kg/cm²g)	INT. TOP -	BOT. -			
20	1	6	REF. SHT.-7	300	SRWN	RF	REF. SHT.-7	-	QUENCH RETURN	UNLESS STATED OTHERWISE				STD. SPEC. FOR BQCS PLATE	6-12-0011	WORKING TEMPERATURE (°C)	TOP -	BOT. -	
25I	1	24	REF. SHT.-7	300	SRWN	RF	REF. SHT.-7	-	MANHOLE + B.F. + DAVIT	UNLESS STATED OTHERWISE				STD. SPEC. FOR STRUCTURAL QUALITY PLATES	6-12-0014	DESIGN TEMPERATURE (°C)	-	-	
30J-L	3	3 I/D	@	300	SRLWN	RF	REF. SHT.7	-	THERMOWELLS (LIQUID SHIELD)	UNLESS STATED OTHERWISE				STD. SPEC. FOR SHOP & FIELD PAINTING	6-44-0004	MDMT (°C)	15	-	
31H	1	3 I/D	@	300	SRLWN	RF	REF. SHT.7	-	PRESSURE CONNECTION (NOTE-42)	UNLESS STATED OTHERWISE				STANDARDS (स्टैण्डर्ड्स)					
												VESSEL TOLERANCES	7-12-0001	OPERATING MEDIUM					
												SUPPORT FOR HORIZONTAL VESSEL	7-12-0002	SP. GRAVITY					
												WOODEN PILLOWS FOR SADDLE SUPPORT	7-12-0003	WIND SPECIFICATION	15:875				
												SKIRT BASE DETAILS	7-12-0004	EARTH QUAKE SPECIFICATION	IS: 1893 + SITE SPECTRA				
												SKIRT OPENING DETAILS	7-12-0005	CAPACITY (M³)					
												ANGLE LEG SUPPORT	7-12-0006	PAINTING/CLEANING	AS PER SPEC.				
												PIPE LEG SUPPORT	7-12-0007	INSULATION THICKNESS (mm)	<input type="checkbox"/> HOT <input type="checkbox"/> COLD				
												BRACKET SUPPORT FOR VERTICAL VESSEL	7-12-0008	FIRE PROOFING	<input type="checkbox"/> YES <input type="checkbox"/> NO				
												MANHOLE WITH HINGED COVER	7-12-0009	HYDROSTATIC TEST (kg/cm²g)	HORIZONTAL				
												MANHOLE WITH DAVIT	7-12-0010	PRESSURE (NEW & COLD)	VERTICAL (AT TQP)				
												LADDER RUNGS FOR MANHOLE/DEMISTER	7-12-0011	INSPECTION BY	<input type="checkbox"/> EIL <input type="checkbox"/> CIB <input type="checkbox"/> LLOYDS				
												RETAINING PLATE	7-12-0012						
												NOZZLE REINFORCEMENT AND PROJECTION	7-12-0013						
												PAD NOZZLES FOR VESSELS	7-12-0014						
												STANDARD BOLT HOLE ORIENTATION	7-12-0015						
												ALLOY LINER DETAILS	7-12-0016						
												SIGHT GLASSES FOR PRESSURE VESSELS	7-12-0017						
												INTERNAL FLANGES	7-12-0018						
												VORTEX BREAKERS	7-12-0019	SHELL/INSERT PLATE	SA 387 GR.22 CL.2 + SS 304L CLAD				
												INLET DEFLECTOR BAFFLE	7-12-0020	REINFORCEMENT PAD					
												SUPPORT RING AND BOLTING BAR	7-12-0021	TORICONE	SA 387 Gr. 22 CL.2+SS 304L CLAD				
												SUPPORT RING SIZES FOR PACKED TOWERS	7-12-0022	SHELL FLANGES					
												PIPE DAVIT	7-12-0023	NOZZLE FLANGES/LWN	\$\$				
												LIFTING LUG TOP HEAD TYPE	7-12-0024	SELF REINFORCED NOZZLES+NECK EXTENSION	\$\$				
												FIRE PROOFING AND INSULATION SUPPORTS	7-12-0025	NOZZLE NECK ABOVE 80 NB UPTO 150 NB					
												EARTHING LUG	7-12-0026	NOZZLE NECK ABOVE 150 NB	SA 387 Gr.22 CL.2+SS304L CLAD				
												NAME PLATE	7-12-0027	PIPE FITTINGS (SEAMLESS)	SA 234 WP 22+SS304L WELD OVERLAY				
												MANUFACTURER NAME PLATE	7-12-0028	GASKET EXTERNAL	SPIRAL WOUND WITH SS 321H METAL WINDING & GRAFOIL FILLER WITH CS OUTER & SS INNER RING AS PER ASME B16.20				
												BRACKET FOR NAME PLATE	7-12-0029	GASKET INTERNAL					
												NAME PLATE FOR SMALL EQUIPMENT	7-12-0030	EXTERNAL STUDS/BOLTS/NUTS	SA 193 GR.B5 / SA 194 GR.3				
												DETAILS OF FORGED NOZZLES	7-12-0031	INTERNAL STUDS/BOLTS/NUTS	SS 304L				
												SUPPORTS FOR INTERNAL FEED PIPE	7-12-0032	SKIRT/SUPPORT	SA 387 Gr. 11 CL.2				
												HOT INSULATION SUPPORT FOR HORIZONTAL VESSEL	7-12-0033	SKIRT/SUPPORT BASE	SA 516 Gr.70				
												PIPE DAVIT SUPPORT FOR COLD INS. VESSELS	7-12-0034	INTERNAL PARTS (WELDED/BOLTED)	SS 304L				
												TYPE DETAILS OF WIRE MESH DEMISTER SUPPORTS	7-12-0036	SKIRT VENT	SA 335 GR.P11 CL.1				
												S.R. NOZZLE NECK	7-12-0037	SPROLL PIECE FOR NOZZLE 1 & 2	SA 336 GR.11 CL.2 + SS 304L WELD OVERLAY				
												REFERENCE DRAWINGS (रेफरेन्स डाइग)							
												NOZZLE ORIENTATIONS	\$\$ SA 182 GR.F22 CL.3 + SS 304L WELD OVERLAY / SA 336 GR.F22 CL.3 + SS 304L WELD OVERLAY.						
												LADDERS/PLATFORM CLEATS							
												PIPE SUPPORT-CLEATS	#* 2.25 Cr.+1 MO SHALL COMPLY WITH REQUIREMENT FOR STEP COOLING, J FACTOR LESS THAN OR EQUAL TO 100 & X FACTOR LESS THAN OR EQUAL TO 15.						
												TRAY SUPPORT AND BOLTING BARS							
												DEMISTER DATA SHEET							
												STATUTORY REGULATIONS (स्टैचरी रेग्लेशन्स)							
												HOLD UPS (होल्ड अप्स)							
												INDIAN BOILER REGULATIONS (IBR)							
												DEPARTMENT OF EXPLOSIVES, NAGPUR (CCOE)							
												APPROXIMATE WEIGHT (kgs) (PER ITEM) (स्परोक्सिमेट वजन)							
												NOZZLE ORIENTATIONS							
												SIZE OF NOZZLES							
												NOZZLE ELEVATIONS							
												PIPE SUPPORT-CLEATS							
												SUPPORT HEIGHT							
												LADEER/PLATFORM CLEATS							
												DETAILS OF INTERNALS							
												TRAY SUPPORT/BOLTING BARS							
												PIPE DAVIT							
												ERCTION							
												OPERATING							
												HYDROTEST(SHOP)							
												HYDROTEST (FIELD)							
												NUMBER OF ITEMS :							

FILE NAME : B224-111-80-43-DS-3001-A-3	DESIGN DATA				DRAWING NUMBER								
	MAIN FRACTIONATOR				DRAWING NUMBER								
	ITEM NO. 111-C-2101				DRAWING NUMBER								
ENGINEERS INDIA LIMITED NEW DELHI इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपकर)	JOB NO: कार्ट संख्या	B224	UNIT NO: कुनैट संख्या	111	DESIGN DATA				DRAWING NUMBER				
	CLIENT : क्लाइंट	M/S HRRL, RAJASTHAN			MAIN FRACTIONATOR				DRAWING NUMBER				
PLANT : प्लॉट	RAJASTHAN REFINERY PROJECT			ITEM NO. 111-C-2101				DRAWING NUMBER					
A 23.08.2019	ISSUED FOR ENGG/BIDS	AKP	NNM/RKM	KJH	ITEM NO. 111-C-2101				DRAWING NUMBER				
REV	DATE	REVISION	BY	CHECKED	APPROVED	ITEM NO. 111-C-2101				DRAWING NUMBER			
B224-111-80-43-DS-3001													
SHEET 3 OF 7													



ENGINEERS INDIA LIMITED
NEW DELHI

JOB NO. : B224, UNIT NO. : 111
CLIENT : HRRRL, RAJASTHAN
PLANT : RAJASTHAN REFINERY PROJECT

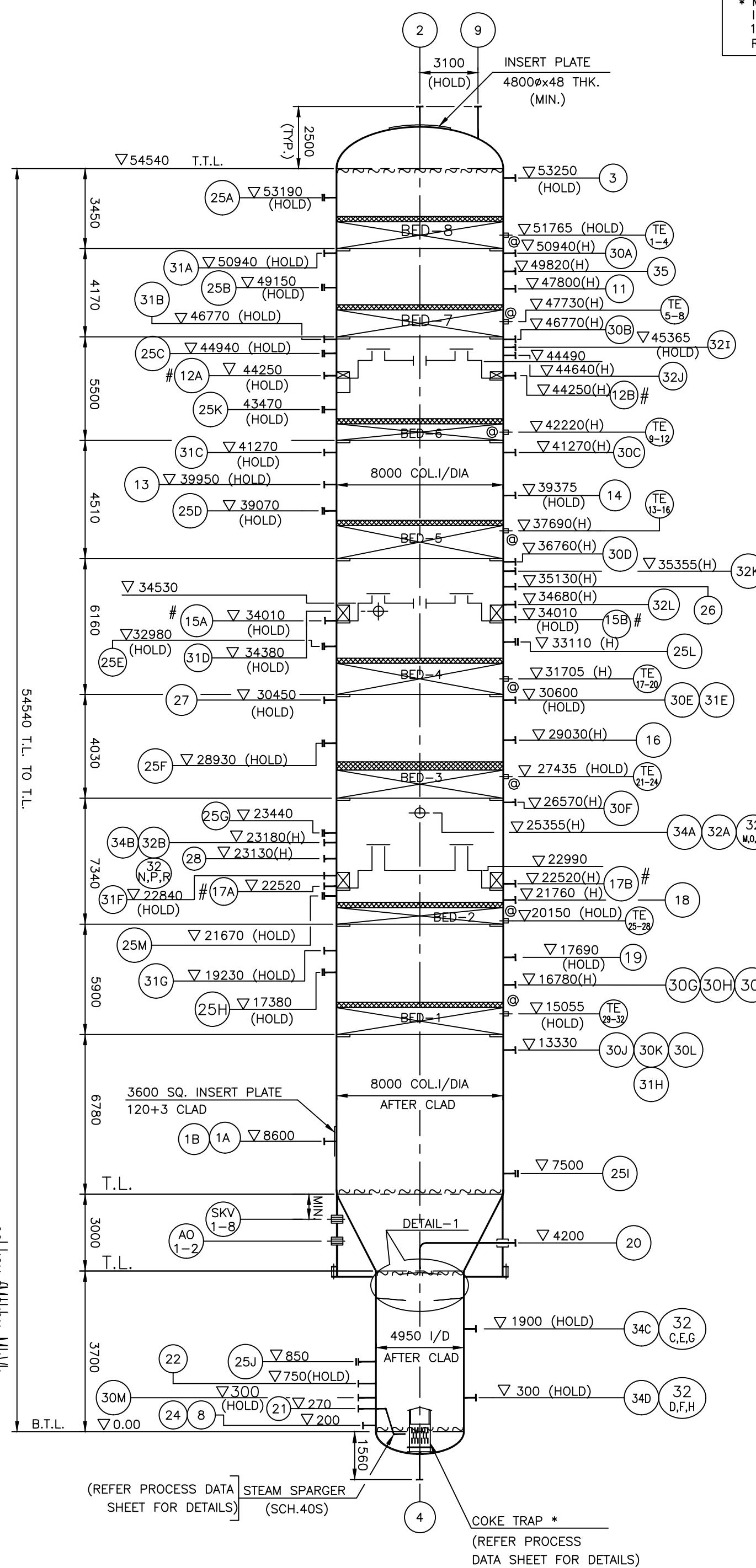
REV. A 23.08.2019
DATE ISSUED FOR ENGG/BIDS
REVISION

VESSEL DESIGN DATA
MAIN FRACTIONATOR
ITEM NO. 111-C-2101

SKV 1-8
AO 1-2
SKV 1-8
AO 1-2

DRAWING NO. B224-111-80-43-DS-3001 A
REV. A-3-42020297

FILE NAME : B224-111-80-43-DS-3001-5-A



(REFER PROCESS DATA SHEET FOR DETAILS) STEAM SPARGER (SCH.40S)
(REFER PROCESS DATA SHEET FOR DETAILS)

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ENGINEERS INDIA LIMITED
NEW DELHI

JOB NO. : B224, UNIT NO. : 111 (C)
CLIENT : HRRRL, RAJASTHAN
PLANT : RAJASTHAN REFINERY PRO

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MAIN				
ITEM				

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FRACTIONATOR
HQ 111 G 2101

मेन फैक्शनेटर B

DRAWING NO. REV. **10**
-111-80-43-DS-3001 A SHEET 6 OF 7

Technical drawing showing a flange assembly with the following dimensions and specifications:

- REF. DET.B** (MOC: SA312T (EDG))
- TEMPORARY DISHED END (CS)**
TO BE CUT AFTER HYDROTEST
THK. TO BE DECIDED
BY VENDOR
- 1:4 TA (INSIDE)**
1768.8
- 30 THK.**
- 260** (W.L.)
200 (W.L.)
FINISHED SPOOL
PIECE LENGTH
- 105** (T.L.)
- 105** (T.L.)
- 105** (T.L.)
- 1875 \varnothing**
1795 \varnothing
- 2140 \varnothing**
2054 BCD
1991 \varnothing
- 1768.8 \varnothing BEFORE OVERLAY**
- 1930.8 \varnothing**
- 30**
- LIFTING LUG (TYP)
25 THK.(HOLD)**
- WELD
DEPOSIT**
- 3THK. GASKET, SPWD
SS316H+GRAFOIL+1/RING & SS316 O/P**
- 1.625 UNC, 72-NOS.
SA193B5/SA194GR.3
STUDS/NUTS**

FLANGE DETAIL FOR NOZZLE- 1A/B (FEE)

(SIZE - 72"NB, MOC : SA 336 F22 CL.3+SS 304L W.V)

(DIMENSIONS INDICATED ARE MINIMUM TO BE FOLLOWED AND SHOULD BE DESIGNED AND FIRMED BY VENDOR)

SKIN THERMOCOUPLE CONNECTION (TE1-TE32) DETAIL

1828

1768.8 ϕ BEFORE OVERLAY

WELD DEPOSIT

REFRACTORY ANCHOR FOR GUNNITE LINING (REFER DETAIL BY VENDOR). REFRACTORY LINING BY OTHERS

RETAINING PLATE (CONTINUOUS RING) 20 THK X 100 WIDE

REFER SHT.-7

VA
AD
EIL

DETAIL FOR NOZZLE- 1 A/B (FEED
(NOZZLE I.D.)

10mm BUTTERING LAYER WITH
ENiCrFe-3 FOLLOWED BY PWHT OF
COMPANION FLANGE. WELD EDGE
BEVEL TO BE DONE AFTER PWHT.

COMPLETE THE JOINT WITH ENiCrFe-3

1:3 TAPER

1:4 TAPER

SS-304L

WELD END PREPARATION
AS PER B16.25 FIG

CORRESPONDING PIPE

WELD OVERLAY

6 THK. INSULATION SUPPORT RING

60 HOLES @ 600 PITCH. ALSO TACK WELD GI BOLTS AS PER EIL STD.

VACUUM STIFFENER RING CAP FOR INS.

75 (TYP)

THIS AREA IS ALSO TO BE FILLED WITH THE INSULATION MAT.

THIS AREA IS ALSO
TO BE FILLED WITH
THE INSULATION MAT

- VACUUM STIFFENERS SHALL BE USED AS INSULATION SUPPORT.
- ADDITIONAL INSULATION SUPPORTS TO BE PROVIDED AS PER
FII STD. WHEREVER REQUIRED.

D.D.

E_C (D)

TEMPORARY DISHED END (CS)
O BE CUT AFTER HYDROTEST
THK. TO BE DECIDED

TEMPORARY DISSED END (CS)
TO BE CUT AFTER HYDROTEST
THK. TO BE DECIDED
BY VENDOR

1:4
(IN)

WELD END
DETAIL HOLD
48 THK. (MOC: SA6772)

250

90

3

1.25 UNC, 88-NOS.
SA193B7M/SA194GR.2HM
STUDS/NUTS

2450 \emptyset

2370 \emptyset

2693 \emptyset

2629 BCD

2594 \emptyset

2342.4 \emptyset

2540 \emptyset

200

T.L.

W.L.

FINISHED LENGTH
OF SPOOL PIECE

3THK. GASKET, SPWD
SS316L+GRAFOIL+1/RING & O/R

COMP. FIG.

DETAIL OF NOZZLE- 2 (O.H. VAPOUR)

(SIZE : 96"NB MOC : SA 266 Gr 4)

(DIMENSIONS INDICATED ARE MINIMUM TO BE FOLLOWED
AND SHALL BE DESIGNED AND FIRMED BY VENDOR)

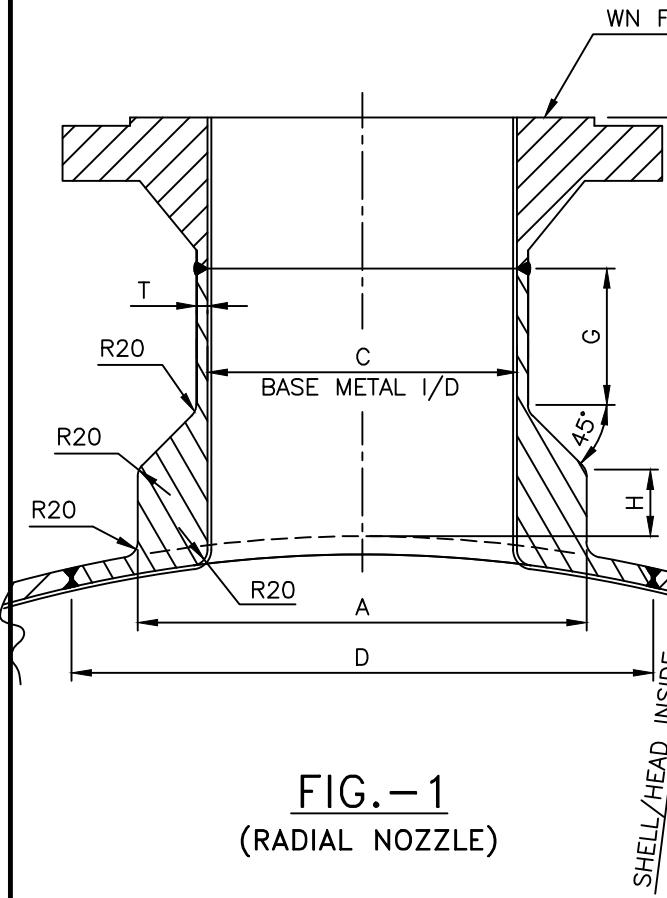


FIG. - 1
(RADIAL NOZZLE)

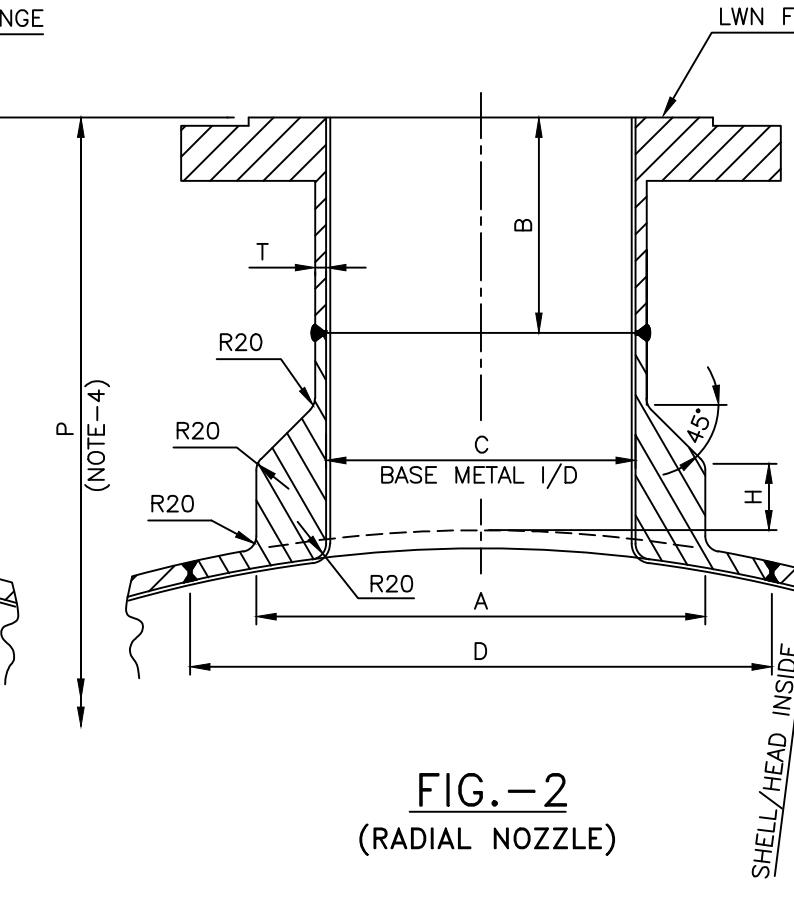


FIG. - 2
(RADIAL NOZZLE)

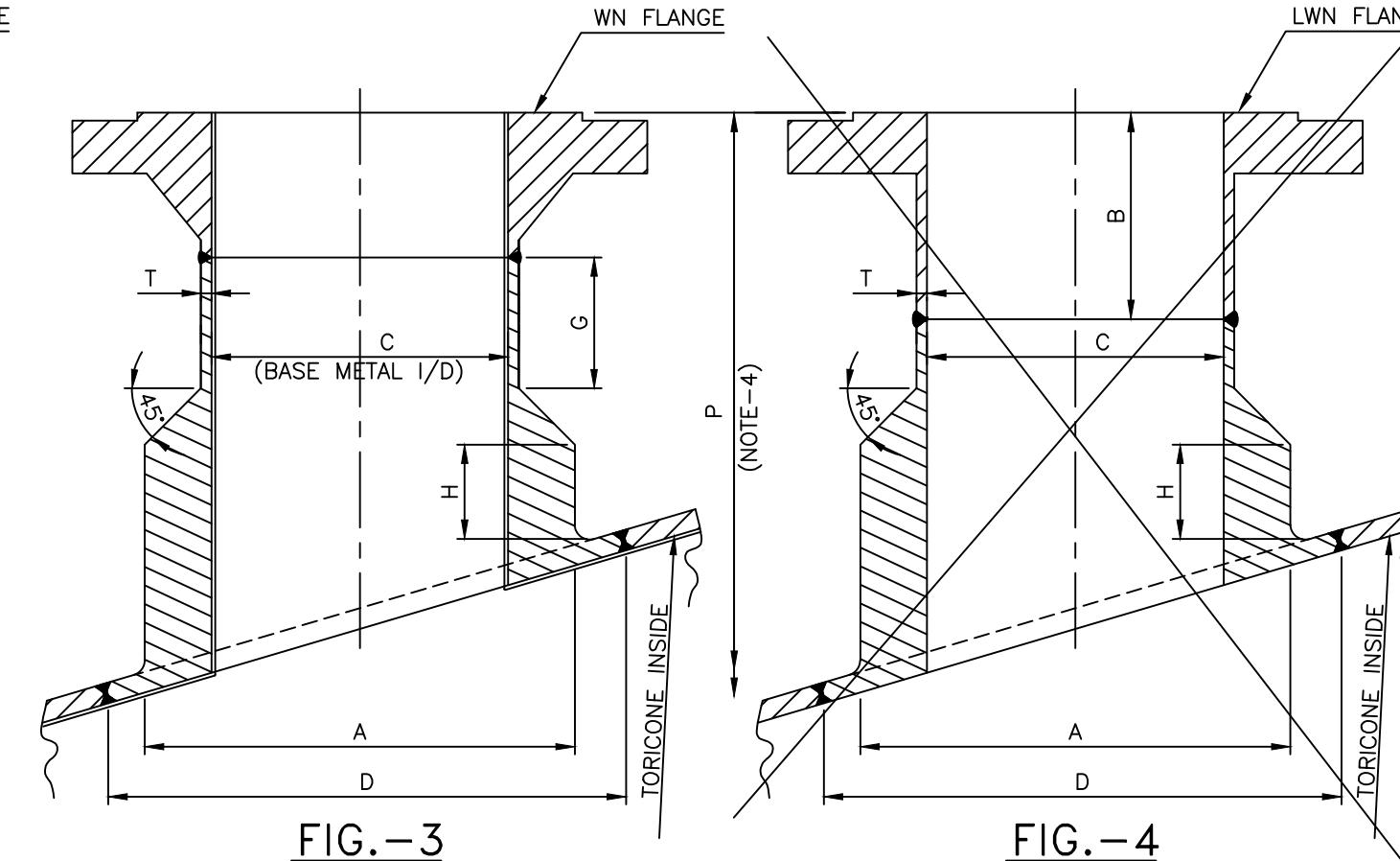


FIG. - 3
(CONE NOZZLES)

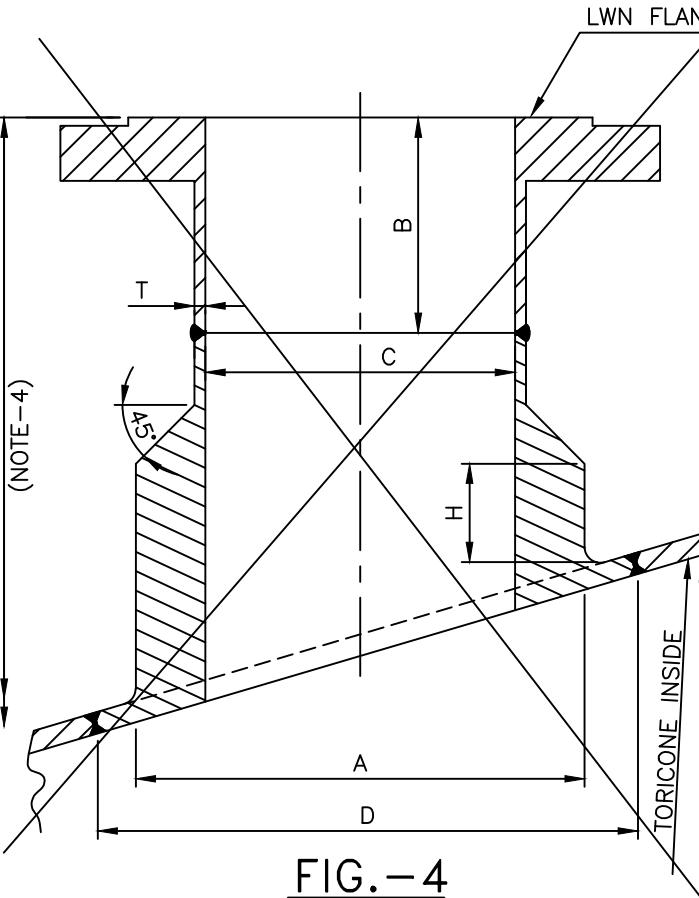
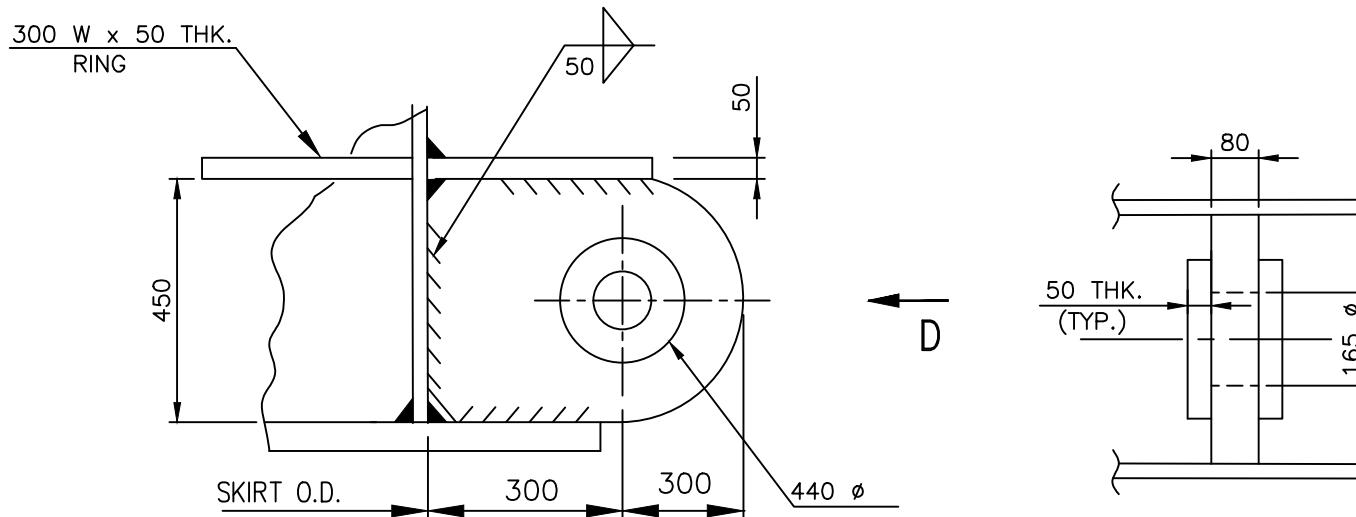


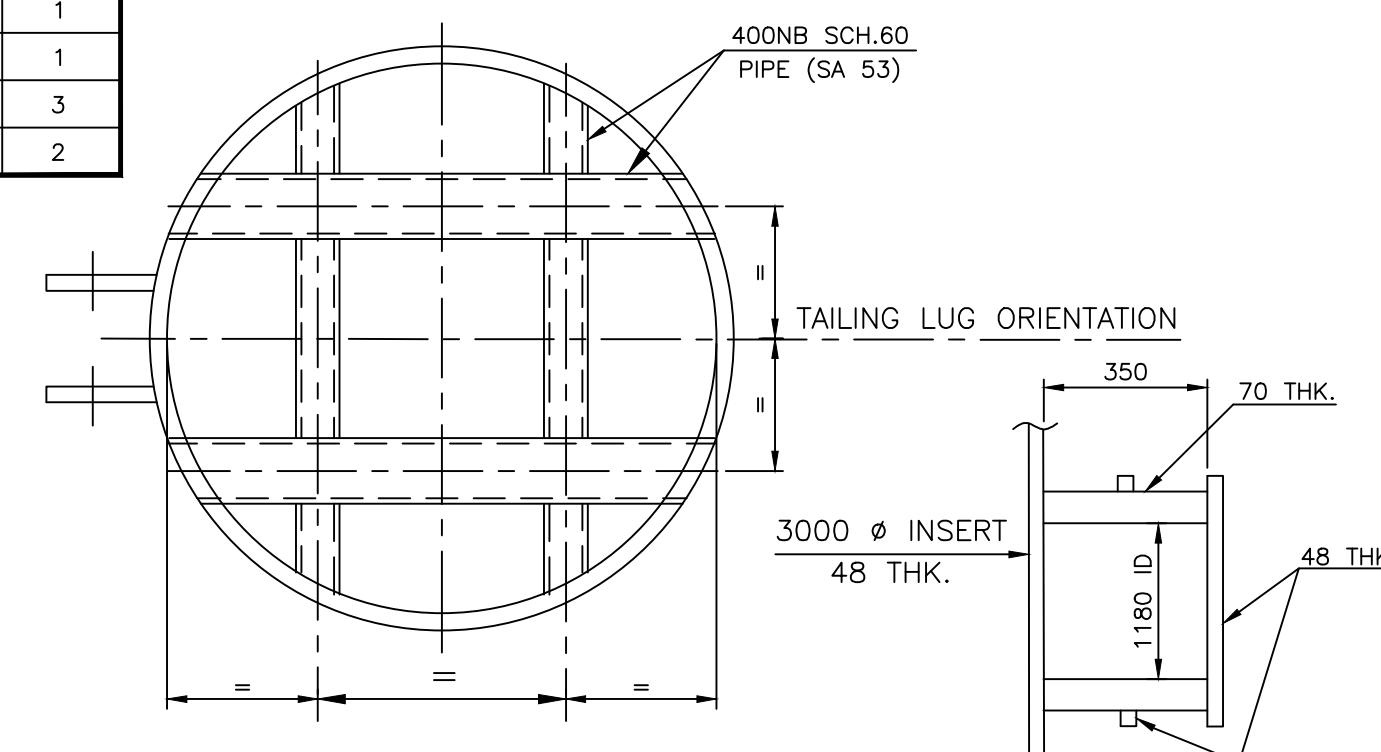
FIG. - 4
(CONE NOZZLES)

NOZZLE MARK	SIZE (INCH)	P (MM)	A (MM)	C (MM)	H (MM)	T (MM)	G (MM) (MIN.)	B (MM) (MIN.)	D (MM)	FIG.
1A/B	72	4800	2270	1768.8	180	30	-	-	2370	1
25 I	24	4600	850	549.6	150	30	-	-	950	1
20	6	4400	230	128.3	100	20	-	-	330	3
31H,30J/K/L	3	4350	200	76.2	50	20.5	-	-	300	2

DETAIL OF SELF REINFORCED NOZZLE



2 NOS OF TAILING LUG DETAIL
(DESIGN BY VENDOR-DIMENSIONS ARE MIN. TO BE FOLLOWED)



STIFFENING DETAIL OF SKIRT
(DESIGN BY VENDOR)

LIFTING TRUNION DETAIL
(DIMENSIONS ARE MINIMUM TO BE FOLLOWED)
(DESIGN BY VENDOR)

OSLKSY fMtkbu MkVK

DRAWING NO.

REV.

मेन फैक्शनेटर

आइटम नम्बर : 111-सी-2101

B224-111-80-43-DS-3001 A

SHEET 7 OF 7



ENGINEERS INDIA LIMITED
NEW DELHI

JOB NO. : B224, UNIT NO. : 111 (FCCU)

CLIENT : HRRL, RAJASTHAN

PLANT : RAJASTHAN REFINERY PROJECT

A 23.08.2019	ISSUED FOR ENGG/BIDS	AKP	NNM/RKM	KJH
REV. DATE	REVISION	BY	CHK	APPROVED

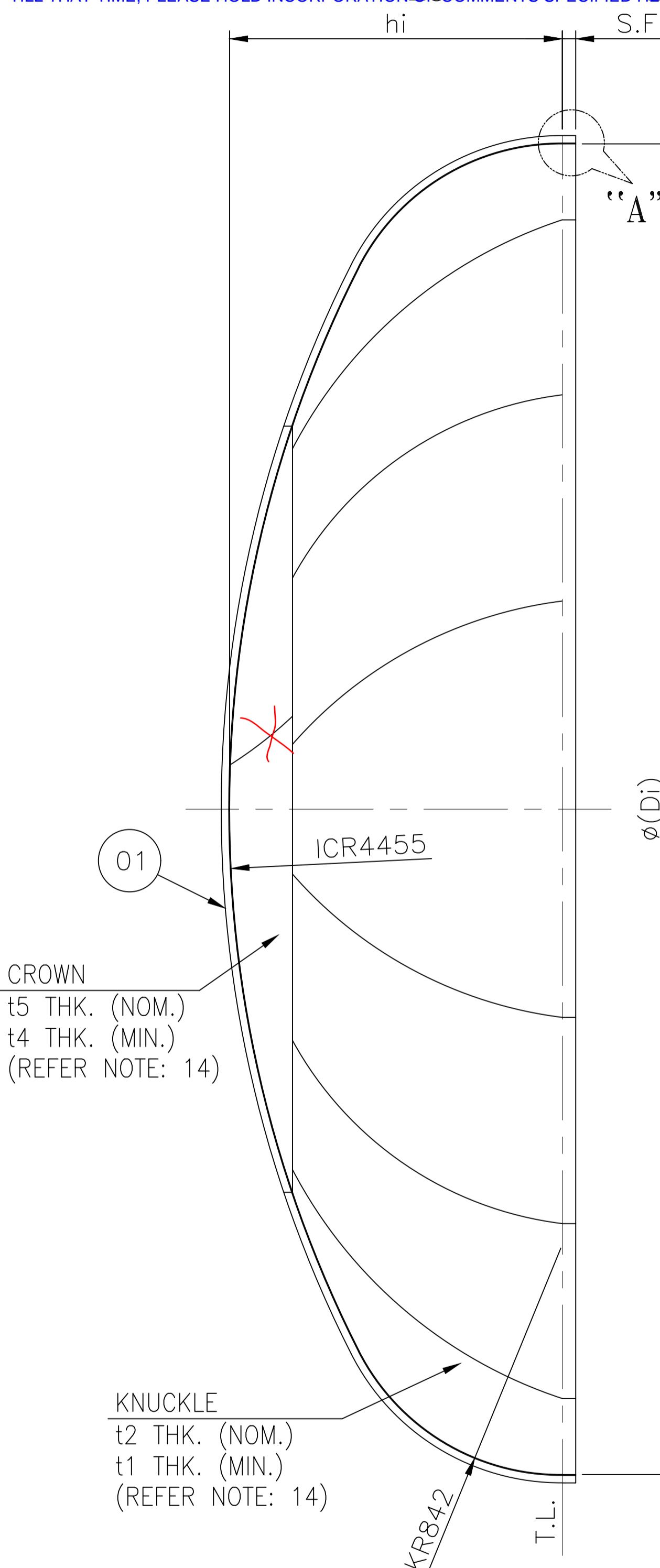
VESSEL DESIGN DATA

MAIN FRACTIONATOR

ITEM NO. 111-C-2101

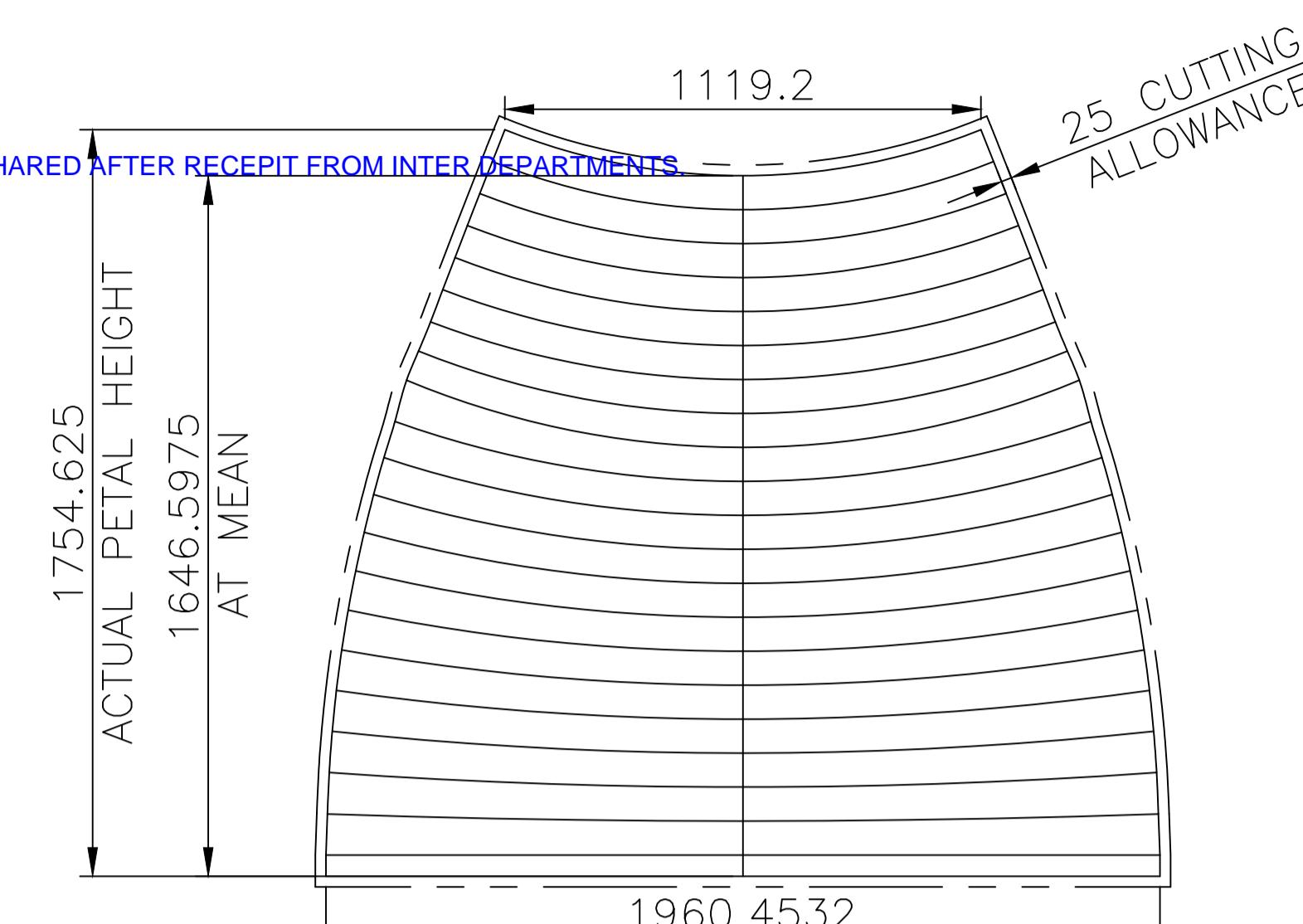
RAWING NO: 3-CL-010-U0219

DRG. IS SHARED TO INTER DEPARTMENTS OF BHEL-HPVP. COMMENTS (IF ANY) TILL THAT TIME, PLEASE HOLD INCORPORATION OF COMMENTS SPECIFIED HEREIN.

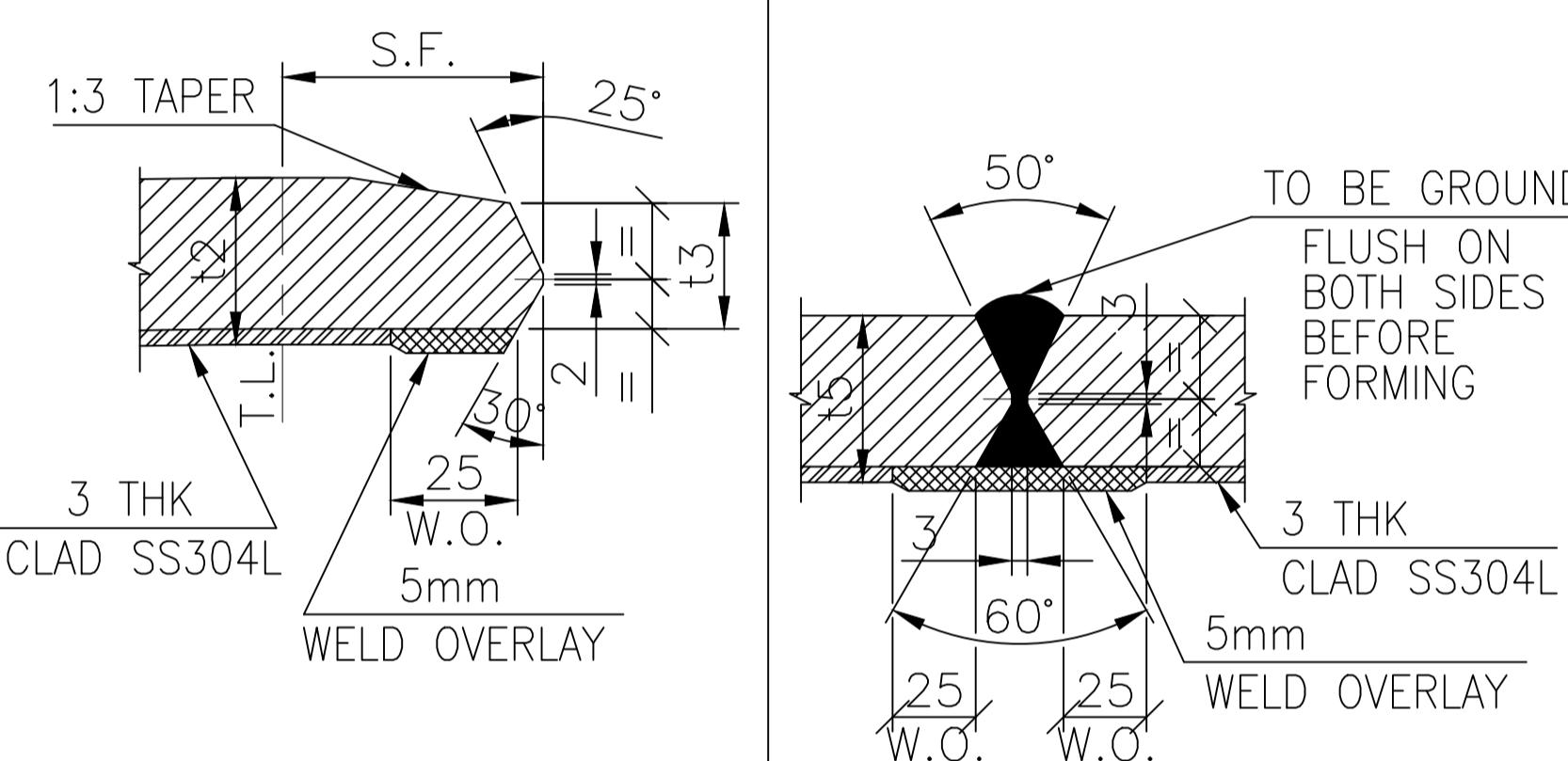


2:1 ELLIPSOIDAL D'ENI

01	111-C-2101	4950	24+3	28+3	50	24+3	-	-	~8702	1	Ø2850	24+3	28+3	8
SR.	EQUIPMENT NO	ØD _i	t ₁	t ₂	SE	t ₃	x ₁	x ₂	WEIGHT	QTY	CROWN	t ₄	t ₅	~NO.OF



DETAIL OF PETAL (8 NOS.) (02)
SCALE - 1:1



DETAIL- "A"

WELD DETAIL FOR

DISH TO SHELL

WELD DETAIL OF PETAL

WELD DETAIL

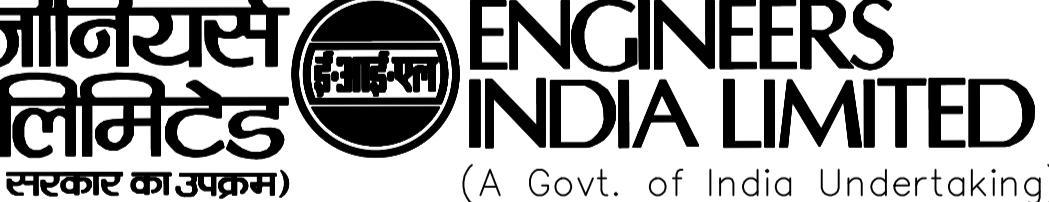
DISH TO CROWN

NOTES:-

1. MATERIAL TO BE SA 387 Gr.11 CL.2+3mm CLAD SS304L OF ASME SEC-II PART-A; 2017.
2. DISHED END TO BE PREPARED USING COLD FORMED PETALS WITH FOLLOWING SCOPE OF WORK.
 - A] AT THE WORKS OF BHEL: PLATE TO BE SUPPLIED TO DISHED END VENDOR IN RECTANGULAR FORM (SUFFICIENT FOR MAKING THE PETALS.). BLANK IN CIRCULAR FORM (INCLUDING WELDING IF ANY) FOR MAKING THE BOTTOM DISH (i.e. CROWN) ALSO TO BE SUPPLIED TO DISHED END VENDOR.
 - B] AT THE WORKS OF DISHED END VENDOR:
 - a) DETAIL DRAWING SHOWING THE DEVELOPMENT OF EACH PETAL, BOTTOM DISH AND OTHER DETAILS INCLUDING ALL ASSOCIATED DIMENSIONS (MEETING THE END DIMENSION) TO BE FURNISHED TO BHEL FOR APPROVAL BEFORE PROCEEDING FOR MANUFACTURING.
SKETCH OF PETAL AS SHOWN HERE IS FOR REFERENCE ONLY. BUT NO. OF PETALS AND CROWN DIA OF BOTTOM DISHED END TO BE KEPT SAME AS ALREADY SHOWN.
 - b) PROCEDURE DULY APPROVED BY BHEL TO BE REFERRED FOR MATERIAL HANDLING, MARKING, MATERIAL CUTTING, PROTECTION WHILE FORMATION OF PETALS / DISH (IF ANY).
 - c) CUTTING OF PETALS FROM THE RECTANGULAR PLATES (AS RECEIVED FROM BHEL), FORMING OF PETALS & BOTTOM DISH BY COLD FORMING.
 - d) EDGE PREPARATION OF PETALS, CROWN SHALL BE DONE AS SPECIFIED IN WLED DETAILS. WELD EDGE SHALL BE DP TESTED.
 - e) AFTER FORMING, ALL PETALS & BOTTOM DISH TO BE 100% UT AS PER SA 578 LEVEL-B.
 - f) TRIAL ASSEMBLY TO CHECK THE FINISHED DIMENSIONS. INSPECTION REPORT SHOULD INDICATE THE PETAL IDENTIFICATION NOS. (SERIAL WISE) INCLUDING BOTTOM DISH FOR A PARTICULAR DISHED END.
 - g) AFTER SUCCESSFUL TRIAL ASSEMBLY, EACH PETALS & BOTTOM DISH TO BE IDENTIFIED WITH UNIQUE IDENTIFICATION NO. SO AS TO AVOID ANY AMBIGUITY AFTER RECEIPT AT BHEL FOR PROCESSING FURTHER (i.e. WELDING OF PETALS) TO MEET THE END DIMENSION.
 - h) INSPECTION AND NDT SHALL BE CARRIED OUT AS PER APPLICABLE QAP / ITP.
 - C] AT THE WORKS OF BHEL:
 - a) ARRANGING OF PETALS IN SEQUENCE INCLUSIVE OF BOTTOM DISH TO MEET THE END DIMENSION.
 - b) WELDING SHALL BE CARRIED OUT AS PER APPROVED WPS.
 - c) INSPECTION AND NDT SHALL BE CARRIED OUT AS PER ITP / QAP.
 - d) PMI TEST SHALL ALSO REQUIRED TO BE CARRIED OUT TO ENSURE CHEMICAL PROPERTIES OF THE WELD.
 - e) PERFORMING OF HEAT TREATMENT AS PER THE APPROVED PROCEDURE. SEE NOTE-3 BELOW ALSO.
 - f) COMPLETE DISHED END TO BE 100% UT AS PER SA 578 LEVEL-B.
 - g) EDGE PREP. AT SF IS REQUIRED AS PER DETAIL 'A' SHOWN.
 - h) INSIDE & OUTSIDE OF KNUCKLE AND EDGE PREPARATION TO BE DP TESTED FOLLOWED BY 100% RT FOR WELD SEAM.
3. HEAT TREATMENT: (AT VEDNOR WORKS)
 - a) DISHED COMPONENTS (PEALS & CROWN) SHALL BE STRESS RELIVED AFTER FORMING.
 - b) UT SHALL BE CARRIED OUT ON DISHED COMPONENTS AFTER PFHT.
 - c) ACTUAL PFHT CYCLE WILL BE PROVIDED DURING DRAWING APPROVAL STAGE.
 - d) FOR TENDER PURPOSE, PFHT CYCLE SHALL BE CONSIDERED AS PER UCS-56 OF ASME SEC.VIII, DIV.1
4. CENTER HOLE IF ANY ON DISHED END TO BE PLUGGED FOLLOWED BY 100% RT (TO BE DONE BY BHEL).
5. PAINTING AFTER SURFACE CLEANING FOR PETALS & TOP DISHED END: ONE COAT OF RUST PREVENTIVE PAINT ON INSIDE & OUT SIDE SURFACE LEAVING 50 MM FROM EDGE.
6. TOLERANCE: I) OVALITY SHOULD NOT EXCEED 10MM OF DISHED END ID. (DIFFERENCE MAX. & MIN. I.D.).
II) MEASURED CIRCUMFERENCE SHOULD BE -0 OF CALCULATED CIRCUMFERENCE BASED ON I.D. SPECIFIED.
7. CODE OF CONSTRUCTION ASME SECTION VIII DIV. 1; 2017⁺⁶
8. INSPECTION BY M/S BHEL / BHEL APPOINTED TPIA AND END CUSTOMER (IF ANY).
9. WELDING SHALL BE AS PER APPROVED WPS:
10. MATERIAL IDENTIFICATION NO. TO BE MAINTAINED AT D'END SUPPLIER'S END BEFORE DURING & AFTER FORMING OPERATION.
11. DISHED END SUPPLIER TO FURNISH TEST CERTIFICATES INCLUDING (a) METHOD OF FORMING.
CARRIED OUT IF ANY, (c) DIMENSIONAL REPORT INCLUDING MINIMUM THICKNESS, (d) NDE REPORTS & TRIAL ASSEMBLY CHECK. QAP DULY APPROVED BY BHEL SHALL ALSO REQUIRED TO BE REFERRED FOR OTHER DOCUMENTS.
12. D'END SUPPLIER SHALL CONFIRM THAT THE PETALS AND THE BOTTOM DISHED (AS SHALL BE SUPPLIED) SHALL MEET THE END DIMENSION AS SHOWN.
13. $hi = Di / 4$.
14. DP TEST & RT ALWAYS SHALL BE CARRIED OUT AS PER APPENDIX-B & UW-51 RESPECTIVELY OF ASME SECTION VIII DIVISION-I; 2017.

NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO VAR NO	1560 2117 0000	KG	7090	UNIT	UNIT WEIGHT	S
						SA387 Gr.11 CL.2+3mm CLAD SS304L					
	02	BOTTOM DISHED END KNUCKLE PETAL 28+3 THK.(CLAD) x 1812 x 2010		—		1560 2117 0000	KG	7090	UNIT	UNIT WEIGHT	S
		SA387 Gr.11 CL.2+3mm CLAD SS304L				NOS					
	01	BOTTOM DISHED END CROWN PL. 28+3 THK.(CLAD) x B.D. 2900		—		1560 2117 0000	KG	1612	UNIT	UNIT WEIGHT	S
		SA387 Gr.11 CL.2+3mm CLAD SS304L				NOS					

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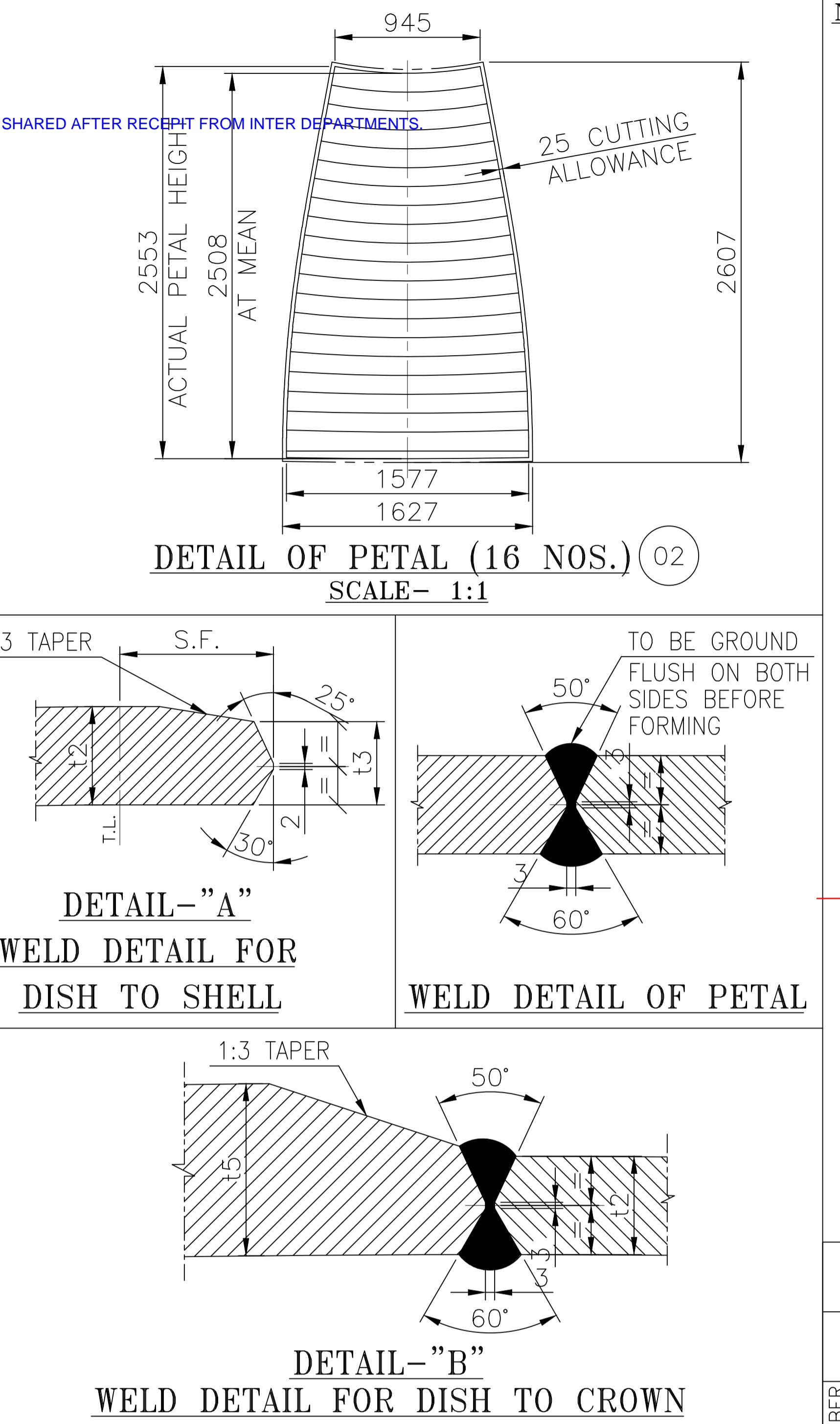
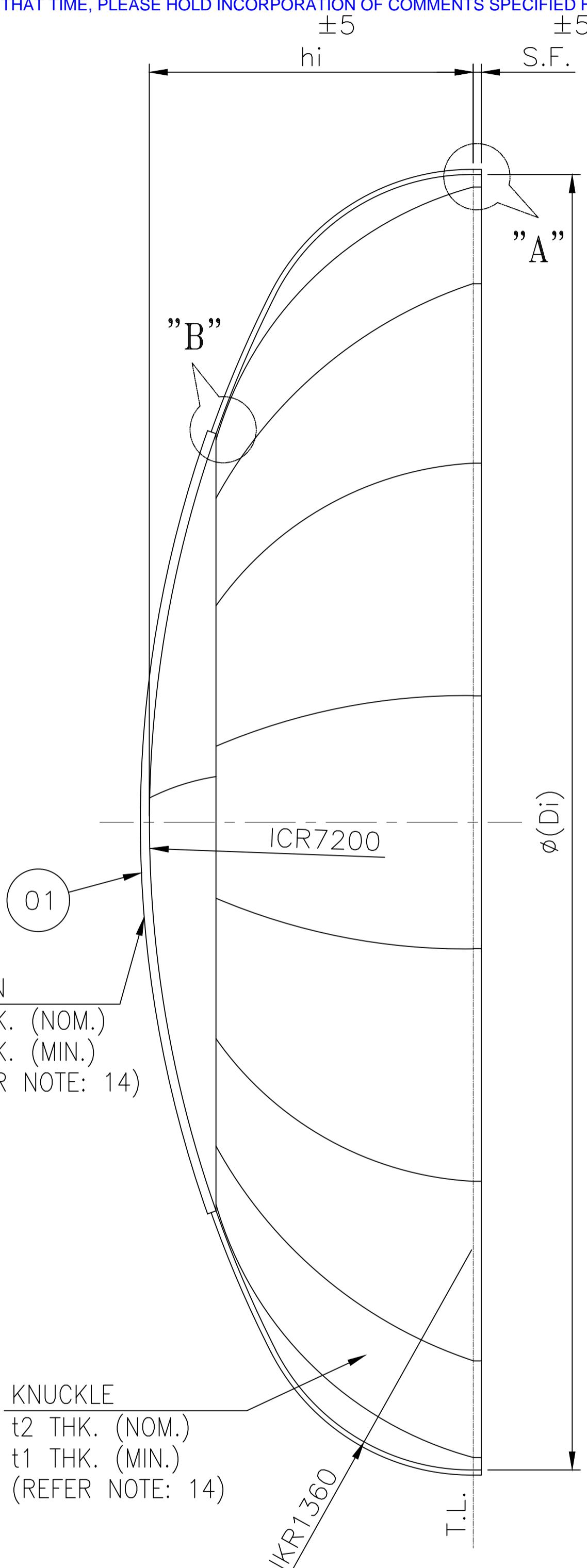


Customer

HPCL Rajasthan Refinery Limited Barmer

 <p>Bharat Heavy Electricals Ltd UNIT: HEAVY PLATES & VESSELS PLANT VISAKHAPATNAM-530012</p>						DRN	NAME	DATE
						CHD	GS.ENC	30.03.2
						APPD	D.SATISH	30.03.2
							D.SATISH	30.03.2
DEPT PP ENGG	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE 1 : 30 & N.T.S	WEIGHT (Kg)		REF TO ASSY / OLD DWG		
CODE 031			—		—			
TITLE <u>DETAIL OF BOTTOM D'END FOR</u> <u>MAIN FRACTIONATOR (111-C-2101)</u>						DRAWING NO : 3-CL-010-U0219		REV A

DRG. IS SHARED TO INTER DEPARTMENTS OF BHEL-HPVP. COMMENTS (IF ANY) WILL BE SHARED AFTER RECEIPT FROM INTER DEPARTMENTS.
TILL THAT TIME, PLEASE HOLD INCORPORATION OF COMMENTS SPECIFIED HERE.



01	111-C-2101	8000	26	32	50	25	-	-	~25386	1	Ø4800	48	56	16	
SR. NO.	EQUIPMENT NO.	ØDi	t1 (MIN.)	t2 (NOM.)	SF	t3	X1	X2	WEIGHT (Kg.)	QTY.	CROWN ~ I.D.	t4 (MIN.)	t5 (NOM.)	~NO.OF PETALS	
		REV	DATE	DESCRIPTION			PPD	CHKD	APPD						

NOTES:-

1. MATERIAL TO BE SA 516 GR.60 (HIC+NACE) OF ASME SEC-II PART-A; 2017.
2. DISHED END TO BE PREPARED USING COLD FORMED PETALS WITH FOLLOWING SCOPE OF WORK.
 - A] AT THE WORKS OF BHEL: PLATE TO BE SUPPLIED TO DISHED END VENDOR IN RECTANGULAR FORM (SUFFICIENT FOR MAKING THE PETALS). BLANK IN CIRCULAR FORM (INCLUDING WELDING IF ANY) FOR MAKING THE TOP DISH (i.e. CROWN) ALSO TO BE SUPPLIED TO DISHED END VENDOR.
 - B] AT THE WORKS OF DISHED END VENDOR:
 - DETAIL DRAWING SHOWING THE DEVELOPMENT OF EACH PETAL, TOP DISH AND OTHER DETAILS INCLUDING ALL ASSOCIATED DIMENSIONS (MEETING THE END DIMENSION) TO BE FURNISHED TO BHEL FOR APPROVAL BEFORE PROCEEDING FOR MANUFACTURING.
 - SKETCH OF PETAL AS SHOWN HERE IS FOR REFERENCE ONLY. BUT NO. OF PETALS AND CROWN DIA OF TOP DISHED END TO BE KEPT SAME AS ALREADY SHOWN.
 - PROCEDURE DULY APPROVED BY BHEL TO BE REFERRED FOR MATERIAL HANDLING, MARKING, MATERIAL CUTTING, PROTECTION WHILE FORMATION OF PETALS / DISH (IF ANY).
 - CUTTING OF PETALS FROM THE RECTANGULAR PLATES (AS RECEIVED FROM BHEL), FORMING OF PETALS & TOP DISH BY COLD FORMING.
 - EDGE PREPARATION OF PETALS, CROWN SHALL BE DONE AS SPECIFIED IN WELD DETAILS. WELD EDGE SHALL BE DP TESTED.
 - AFTER FORMING, ALL PETALS & TOP DISH TO BE 100% UT AS PER SA 578 LEVEL-B.
 - TRIAL ASSEMBLY TO CHECK THE FINISHED DIMENSIONS. INSPECTION REPORT SHOULD INDICATE THE PETAL IDENTIFICATION NOS. (SERIAL WISE) INCLUDING TOP DISH FOR A PARTICULAR DISHED END.
 - AFTER SUCCESSFUL TRIAL ASSEMBLY, EACH PETALS & TOP DISH TO BE IDENTIFIED WITH UNIQUE IDENTIFICATION NO. SO AS TO AVOID ANY AMBIGUITY AFTER RECEIPT AT BHEL FOR PROCESSING FURTHER (i.e. WELDING OF PETALS) TO MEET THE END DIMENSION.
 - INSPECTION AND NDT SHALL BE CARRIED OUT AS PER APPLICABLE QAP / ITP.
 - C] AT THE WORKS OF BHEL:
 - ARRANGING OF PETALS IN SEQUENCE INCLUSIVE OF TOP DISH TO MEET THE END DIMENSION.
 - WELDING SHALL BE CARRIED OUT AS PER APPROVED WPS.
 - INSPECTION AND NDT SHALL BE CARRIED OUT AS PER ITP / QAP.
 - PMI TEST SHALL ALSO REQUIRED TO BE CARRIED OUT TO ENSURE CHEMICAL PROPERTIES OF THE WELD.
 - PERFORMING OF HEAT TREATMENT AS PER THE APPROVED PROCEDURE. SEE NOTE-3 BELOW ALSO.
 - COMPLETE DISHED END TO BE 100% UT AS PER SA 578 LEVEL-B.
 - EDGE PREP. AT SF IS REQUIRED AS PER DETAIL 'A' SHOWN.
 - INSIDE & OUTSIDE OF KNUCKLE AND EDGE PREPARATION TO BE DP TESTED FOLLOWED BY 100% RT FOR WELD SEAM.
 3. HEAT TREATMENT: (AT VENDOR WORKS)
 - DISHED COMPONENTS (PEALS & CROWN) SHALL BE STRESS RELIEVED AFTER FORMING.
 - UT SHALL BE CARRIED OUT ON DISHED COMPONENTS AFTER PFHT.
 - ACTUAL PFHT CYCLE WILL BE PROVIDED DURING DRAWING APPROVAL STAGE.
 - FOR TENDER PURPOSE, PFHT CYCLE SHALL BE CONSIDERED AS PER UCS-56 OF ASME SEC.VIII, DIV.1
 4. CENTER HOLE IF ANY ON DISHED END TO BE PLUGGED FOLLOWED BY 100% RT (TO BE DONE BY BHEL).
 5. PAINTING AFTER SURFACE CLEANING FOR PETALS & TOP DISHED END: ONE COAT OF RUST PREVENTIVE PAINT ON INSIDE & OUTSIDE SURFACE LEAVING 50 MM FROM EDGE.
 6. TOLERANCE: I) OVALITY SHOULD NOT EXCEED 16MM OF DISHED END ID. (DIFFERENCE MAX. & MIN. I.D.). II) MEASURED CIRCUMFERENCE SHOULD BE ± 10 OF CALCULATED CIRCUMFERENCE BASED ON I.D. SPECIFIED.
 7. CODE OF CONSTRUCTION ASME SECTION VIII DIV. 1; 2017.
 8. INSPECTION BY M/S BHEL / BHEL APPOINTED TPIA AND END CUSTOMER (IF ANY).
 9. WELDING SHALL BE AS PER APPROVED WPS:
 10. MATERIAL IDENTIFICATION NO. TO BE MAINTAINED AT D'END SUPPLIER'S END BEFORE DURING & AFTER FORMING OPERATION.
 11. DISHED END SUPPLIER TO FURNISH TEST CERTIFICATES INCLUDING (a) METHOD OF FORMING. CARRIED OUT IF ANY, (c) DIMENSIONAL REPORT INCLUDING MINIMUM THICKNESS, (d) NDE REPORTS & TRIAL ASSEMBLY CHECK. QAP DULY APPROVED BY BHEL SHALL ALSO REQUIRED TO BE REFERRED FOR OTHER DOCUMENTS.
 12. D'END SUPPLIER SHALL CONFIRM THAT THE PETALS AND THE TOP DISHED (AS SHALL BE SUPPLIED) SHALL MEET THE END DIMENSION AS SHOWN.
 13. hi = Di / 4.
 14. DP TEST & RT ALWAYS SHALL BE CARRIED OUT AS PER APPENDIX-B & UW-51 RESPECTIVELY OF ASME SECTION VIII DIVISION-I; 2017.

NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO	MATERIAL CODE	UNIT	UNIT WEIGHT	GS
02		TOP DISHED END KNUCKLE PETAL 32 THK. x 1627 x 2600	—		156021230000	KG	17048		
					SA 516 GR.60 (HIC + NACE)	NOS	16		
01		TOP DISHED END CROWN PL. 56 THK. x B.D. 4913	—		1560 2122 0000	KG	8338		
					SA 516 GR.60 (HIC + NACE)	NOS	1		

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Bharat Heavy Electricals Ltd
UNIT: HEAVY PLATES & VESSELS PLANT
VISAKHAPATNAM-530012

Customer :
इंजीनियर्स
इंडिया लिमिटेड
(भारत सरकार का उपकरण)
ENGINEERS
INDIA LIMITED
A Govt. of India Undertaking
HPCL Rajasthan Refinery Limited
Barmer

DEPT	ALL DIMENSIONS	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
PP ENGG	ARE IN MM		1 : 50 & N.T.S	—	—
CODE 031					
TITLE	DETAIL OF TOP D'END FOR MAIN FRACTIONATOR (111-C-2101)				
DRAWING NO : 3-CL-010-U0218					REV A



MANUFACTURER'S
NAME
& ADDRESS
BHEL-
VISAKHAPATNAM OR
APPROVED SUB-
CONTRACTORS

QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN

Item: Main Fractionator Column

QAP No: CQP 2516 Rev 0

Date: 05.02.2021

Page 1 of 16

Project: Rajasthan Refinery Project (RRP)

Customer: HPCL Rajasthan Refinery Limited
(HRRL), Barmer.

Consultant: Engineers India Limited(EIL)

BHEL Sale Order No: 2439

Customer LOA Ref: HRRL/LOA/2020/25

Dt:29.09.2020

Code of Construction: ASME Section VIII Div.1, Edition 2017

Sl. No.	Item Description	Tag Number
1.	Main Fractionator Column	111-C-2101

To be resubmitted
with resolution
of comments

P. Gopi Kishore/Mgr/QA/BHEL

A.K. Mandal/AGM/Q & BE /BHEL



Prepared By

Reviewed By

Approved by

 MANUFACTURER'S NAME & ADDRESS :BHEL- VISAKHAPATNAM OR APPROVED SUB- CONTRACTORS	QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN					Customer: HPCL Rajasthan Refinery Limited (HRRL), Barmer. Consultant: Engineers India Limited(EIL) BHEL Sale Order No: 2439 Customer LOA Ref: HRRL/LOA/2020/25 Dt:29.09.2020			
	Item: Main Fractionator Column Project: Rajasthan Refinery Project (RRP)		QAP No: CQP 2516 Rev 0 Date: 05.02.2021 Page 2 of 16						
SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISTIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		
1.0	Design & Drawings approval	ASME Sec VIII Div.1 Ed 2017, MDS	Approved Drawings & Calculations	ASME Sec VIII Div.1 Ed 2017	Approved Drawings	-	H	R	
2.0	Inspection & Test Plan	ASME Sec VIII Div.1 Ed 2017 & Approved Drawings, PR	Documents & inspection stages	ASME Sec VIII Div.1 Ed 2017 & Approved Drg & PR	ITP	-	H	R	
3.0	Review of Procedures								
3.1	All Manufacturing, Test procedures (NDE, Surface Preparation & Painting, Forming & Heat Treatment)	ASME SEC.V, ASME Sec IX & Sec VIII Div.1 1 Ed 2017, PR, APPROVED DRAWING, PR Specifications.	Compliance to ASME CODES & PR	ASME SEC.V, ASME Sec IX & Sec VIII Div.1 1 Ed 2017, PR, APPROVED DRAWING	Procedures	-	H	R	To be submitted for information
3.2	Welding Process	WPS/PQR/WPQ (shall be within 5 years)	Compliance to ASME CODES & PR.	ASME SEC.V, ASME Sec IX & Sec VIII Div.1 1 Ed 2017, PR, APPROVED DRAWING	WPS/PQR/W PQ	-	H	R / W	R-for existing; W-for New.
4.0	Raw materials								
4.1	Plates, Pipes & Forgings at sourcing locations	Approved Drawings & Purchase Order, PR	As per PR and ASME Sec IIA Ed 2017	As per PR and ASME Sec IIA Ed 2017	Test Certificates	-	H	*	*Refer Note -9

All CS materials shall meet the requirements of EIL Specification, 6-12-0011, 6-79-0013. Plates shall be procured with HIC test as per TM-02-84 and shall meet the requirements of specification

All Low alloy steel materials shall meet the requirements 6-12-0017, 6-12-0018,clad plates 6-12-0015, stain less steel plates 6-12-0020 with respect to C, CE,Composition, NDT, Simulation HT, hardness, impact, mechanical properties etc

 BHEL VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS	MANUFACTURER'S NAME & ADDRESS :BHEL-VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS	QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN				Customer: HPCL Rajasthan Refinery Limited (HRRL), Barmer. Consultant: Engineers India Limited(EIL) BHEL Sale Order No: 2439 Customer LOA Ref: HRRL/LOA/2020/25 Dt:29.09.2020			
		Item: Main Fractionator Column Project: Rajasthan Refinery Project (RRP)		QAP No: CQP 2516 Rev 0 Date: 05.02.2021 Page 3 of 16					
SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISTIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		

4.2 Raw materials after receipt									
4.2.1	Plates for shells, PTC and dished ends, All parts welded to Pr parts + All process wetted parts	Approved Drawings & Purchase Order, PR	As per PR and ASME Sec IIA Ed 2017	As per PR and ASME Sec IIA Ed 2017	Test Certificates	-	H	H	
4.2.2	Nozzles, forgings, pipes & flanges, and Fittings.	Approved Drawings & Purchase Order	As per TDC and ASME Sec IIA Ed 2017 & PR	As per TDC and ASME Sec IIA Ed 2017 & PR	Test Certificates	-	H	H	
4.2.3	Non-Pressure parts	Approved Drawings & Purchase Order	As per material specification	As per material specification	Test Certificates	-	H	R	
4.2.4	Welding consumables	Purchase Order	As per ASME Sec IIC Ed 2017 & PR	As per ASME Sec IIC Ed 2017 & PR	Test Certificates	-	H	R	
4.2.5	Fasteners and Gaskets	Approved Drawings & Purchase Order	As per TDC and ASME Sec IIA Ed 2017	As per TDC and ASME Sec IIA Ed 2017	Test Certificates	-	H	R	
4.2.6	Base Ring Template	Approved Drawings & Purchase Order	As per TDC and ASME Sec IIA Ed 2017	As per TDC and ASME Sec IIA Ed 2017	Test Certificates	P	H	R	.

 ભારતીય હાઇન્ડ ઇન્ડસ્ટ્રીયરીસ BHEL VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS	MANUFACTURER'S NAME & ADDRESS :BHEL-VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS	QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN				Customer: HPCL Rajasthan Refinery Limited (HRRL), Barmer. Consultant: Engineers India Limited(EIL) BHEL Sale Order No: 2439 Customer LOA Ref: HRRL/LOA/2020/25 Dt:29.09.2020			
		Item: Main Fractionator Column Project: Rajasthan Refinery Project (RRP)		QAP No: CQP 2516 Rev 0 Date: 05.02.2021 Page 4 of 16					
SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISTIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		

Fabrication of Dished ends									
5.1	Transfer of marking and heat number	As per Material test certificates	Heat no and material specification	Approved drawing	-	P	H	W	
5.2	Fit up & welding of long seam	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	W	
5.3	100 % PT on root & final weld, chipped back LS weld, Cu SO4 solution test after clad removal \$ (typ)	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
5.4	100 % RT of completed LS weld	Approved Drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	
5.5	Clad restoration on Long seam \$	Approved Drawings	Parameters as per WPS, Welder Qualification	WPS	-	P	H	-	
5.6	100 % PT on clad restoration after each pass \$	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
5.7	Chemical analysis of clad (2 samples) per seam \$	ASME Sec IIC & Clad procedure	As per specification	As per specification	Analysis report (Note-3)	-	H	R	Per WPS/ Welder basis

 ભારતીય હાઇન્ડ ઇન્ડસ્ટ્રીયર્સ BHEL VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS	MANUFACTURER'S NAME & ADDRESS :BHEL-VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS	QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN				Customer: HPCL Rajasthan Refinery Limited (HRRL), Barmer. Consultant: Engineers India Limited(EIL) BHEL Sale Order No: 2439 Customer LOA Ref: HRRL/LOA/2020/25 Dt:29.09.2020			
		Item: Main Fractionator Column		QAP No: CQP 2516 Rev 0 Date: 05.02.2021		Project: Rajasthan Refinery Project (RRP)		Page 5 of 16	
SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISTIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		

5.8	Forming of dished end	Approved Drawings ASME Sec VIII Div. 1	Visual & Dimensional check, Template check	Approved Drawings	Dimension Report	P	H	-	
5.9	100 % PT of knuckle area (Note-2)	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	W	
5.10	100% UT on Crown , Knuckle, WEP and straight face	Approved procedures	Thickness measurement & Dis-bondment check \$	Approved Drawing, procedures	UT report	P	H	W	
5.11	Visual & Final Dimensions including Dished end profile checking with Template	Approved Drawing ASME Sec VIII Div. 1	Dimensions	Approved Drawing	Dimension Report	P	H	W #	# Trial Assembly & fit-up in case of Crown & Petal construction
6.0	Fabrication of Main shell along with PTC								
6.1	Plate marking & cutting	Approved drawing & cutting plan	Dimensions	Approved Drawings	-	P	-	-	Refer Note-6
6.2	Shell rolling	Approved drawing & cutting plan	Dimensions	Approved Drawings	-	P	H	-	
6.3	Long seam fit up & welding along with test coupon	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	W	

 MANUFACTURER'S NAME & ADDRESS :BHEL- VISAKHAPATNAM OR APPROVED SUB- CONTRACTORS	QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN					Customer: HPCL Rajasthan Refinery Limited (HRRL), Barmer. Consultant: Engineers India Limited(EIL) BHEL Sale Order No: 2439 Customer LOA Ref: HRRL/LOA/2020/25 Dt:29.09.2020			
	Item: Main Fractionator Column Project: Rajasthan Refinery Project (RRP)		QAP No: CQP 2516 Rev 0 Date: 05.02.2021 Page 6 of 16						
SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISTIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		

6.4	100 % PT on root & final weld ,chipped back LS weld	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	
6.5	RT of completed LS weld & test coupon	Approved drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	
6.6	Clad restoration on Long seam & test coupon \$	Approved Drawings	Parameters as per WPS	WPS	-	P	-	-	
6.7	100 % PT on clad restoration each layer \$	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
6.8	Chemical analysis of clad (2 samples) per seam \$	ASME Sec IIC & Clad procedure	As per specification & PR	As per specification & PR	Analysis report (Note-3)	-	H	W	Per welder / WPS/ shell course basis
6.9	Ferrite check of clad overlay (2 spots per seam) \$	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW	
6.10	UT on Rolled sections of clad and weld overlay \$	Approved procedures	Disbondment	Approved procedures,	UT report	P	H	W	
6.11	Testing of test coupon	ASME Sec VIII Div.1 Ed 2017	Tensile & Hardness	ASME Sec VIII Div.1 Ed 2017	Test reports	-	H	RW	

 BHEL VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS	MANUFACTURER'S NAME & ADDRESS :BHEL-VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS	QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN				Customer: HPCL Rajasthan Refinery Limited (HRRL), Barmer. Consultant: Engineers India Limited(EIL) BHEL Sale Order No: 2439 Customer LOA Ref: HRRL/LOA/2020/25 Dt:29.09.2020			
		Item: Main Fractionator Column Project: Rajasthan Refinery Project (RRP)		QAP No: CQP 2516 Rev 0 Date: 05.02.2021 Page 7 of 16					
SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISTIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		

Shell to Shell to Circular seam fabrication									
7.1	CS fit up & welding	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	W	
7.2	100 % PT on root & final weld, chipped back CS weld	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	
7.3	RT of completed CS weld	Approved drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	
7.4	Clad restoration on C- seam \$	Approved Drawings	Parameters as per WPS	WPS	-	P	-	-	
7.5	100 % PT on clad restoration after each pass \$	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
7.6	Chemical analysis of clad (2 samples) per seam \$	ASME Sec IIC & Clad procedure	As per specification & PR	As per specification & PR	Analysis report (Note-3)	-	H	RW	
7.7	Ferrite check of clad overlay (2 spots per seam) \$	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW	

 MANUFACTURER'S NAME & ADDRESS :BHEL- VISAKHAPATNAM OR APPROVED SUB- CONTRACTORS	QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN				Customer: HPCL Rajasthan Refinery Limited (HRRL), Barmer. Consultant: Engineers India Limited(EIL) BHEL Sale Order No: 2439 Customer LOA Ref: HRRL/LOA/2020/25 Dt:29.09.2020				
	Item: Main Fractionator Column Project: Rajasthan Refinery Project (RRP)		QAP No: CQP 2516 Rev 0 Date: 05.02.2021 Page 8 of 16						
SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISTIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		

8.0	Shell to Dished end circular seam fabrication							
8.1	CS fit up & welding	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	W
8.2	100 % PT on root & final weld, chipped back CS weld	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R
8.3	RT of completed CS weld	Approved Drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R
8.4	Clad restoration on C- seam \$	Approved Drawings	Parameters as per WPS	WPS	-	P	H	-
8.5	100 % PT on clad restoration after each pass \$	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW
8.6	Chemical analysis of clad (2 samples) per seam \$	ASME Sec IIC & Clad procedure	As per specification & PR	As per specification & PR	Analysis report (Note-3)	-	H	RW
8.7	Ferrite check of clad overlay (2 spots per seam) \$	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW

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						Prod	Qua		

Weld overlay of Nozzles, Pipes, Elbows and blind flanges									
9.0									
9.1	Weld overlay \$	Approved drawings	Welding parameters	Adherence to WPS	-	P	-	-	
9.2	Weld overlay thickness from inside the nozzles \$	Approved drawings	Thickness	Approved drawings	Inspection Report	-	H	W	
9.3	Chemical analysis of weld overlay (1 sample per size representing manual weld overlays of Nozzles, Pipes, Fittings) per seam \$	ASME Sec IIC & Clad procedure	As per specification	As per specification	Analysis report (Note-3)	-	H	RW	RW-by TPIA is applicable during sample collection only.
9.4	Ferrite check of weld overlay(2 spots per weld overlay) (1 sample per size representing manual weld overlays of Nozzles, Pipes, Fittings) \$	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW	
9.5	100 % PT of weld overlay after each pass \$	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	

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Fabrication of Nozzle Assemblies									
10.1	Fit up & welding of C-seams of pipes/ elbows/ flanges / nozzle neck, internal pipes	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	R	Functional test for Davit.
10.2	RT of completed CS weld & L-seam of rolled nozzles	Approved Drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	
10.3	Clad restoration on C-seam \$	Approved Drawings	Parameters as per WPS	WPS	-	P	-	-	
10.4	100 % PT of weld overlay after each pass \$, nozzle to flange root welds	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
10.5	Chemical analysis of weld overlay(2 samples) per seam \$	ASME Sec IIC & Clad procedure	As per specification	As per specification	Analysis report (Note-3)	-	H	RW	RW-by TPIA is applicable during sample collection only.
10.6	Ferrite check of weld overlay (2 spots per seam (1 sample per size representing Nozzles, Pipes, Fittings) \$	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW	

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Nozzle to shell/dished end fabrication									
11.1	Marking and openings of nozzles on shells	Approved Drawings	Location and orientation	Approved Drawings	-	P	H	R	
11.2	PT on gas cut edges	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	
11.3	Fit up & welding of nozzles on shells or dished ends	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	RW	
11.3.1	Pneumatic test on RF Pads	Approved Drawing	Detection of leakage	Approved Drawing	Approved Drawing	P	H	RW	
11.4	100 % PT on chipped back CS weld	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	
11.5	Clad restoration on welds \$	Approved Drawings	Parameters as per WPS	WPS	-	P	-	-	
11.6	100 % PT of weld overlay after each pass \$	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
11.7	Chemical analysis of weld overlay(2 samples) per seam \$	ASME Sec IIC & Clad procedure	As per specification	As per specification	Analysis report (Note-3)	-	H	RW	RW-by TPIA is applicable during sample collection only.
11.8	Ferrite check of weld overlay (2 spots per seam) \$	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW	
11.9	100 % UT for nozzle to shells and nozzle to pipe	Approved Drawings	Detection of flaws	Approved UT Procedure	UT Report	P	H	W	

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Skirt fabrication, assembly and Final Inspection									
12.0									
12.1	Fit up & welding of Skirt, Skirt with Vessel	Approved Drawings	Dimensions & weld geometry	Approved drawing & WPS	Fit up report	P	H	W	
12.2	RT of C-seam & L-seam	Approved Drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	
12.3	100 % PT of welds (including root and final welds as applicable)	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	W	
12.4	Dimensional inspection of Skirt	Approved Drawings	Dimensions	Approved Drawings	Report	P	H	W	
12.5	Marking of Internal and external cleats, supports	Approved Drawings	Dimensions	Approved Drawings	Report	P	H	R	
13.0	100% UT of attachments welded directly to cladding	Approved procedures	Detection of flaws	Approved procedures	UT report	P	H	R	Refer Note-12
14.0	Pneumatic test on RF Pads	Approved Drawing	Detection of leakage	Approved Drawing	Approved Drawing	P	H	RW	
15.0	Visual & Final dimensional inspection before PWHT including internals	Approved Drawings	Dimensions, orientations	Approved Drawings	Dimensional report	P	H	H	

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15.1	Internals inside the column	Approved Drawings	Dimension, Orientation and 1) Ovality in Column ID 2) Support Ring Levelness	Approved Drawings, & EIL Standard 7-12-0001	Dimensional report	P	H	H	
16.0	PWHT of equipment along with PTC	PWHT procedure	Calibration of thermocouples/ Recorders	PWHT procedure	HT Chart review	P	H	H for release	
17.0	Testing of test coupons (PTC)	ASME Sec VIII Div. 1Ed 2017 <i>See comment 1</i>	Tensile & Hardness <i>See comment 2</i>	ASME Sec VIII Div. 1Ed 2017	Test Reports	P	H	W	
18.0	NDE after PWHT 100% UT on pressure retaining weld	Approved Drawings <i>See comment 3</i>	Detection of flaws	Approved UT Procedures	UT Report	P	H	W	
19.0	Spot PT on internal & external welds.	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	W	
20.0	Hardness check of all pressure part joints on weld / HAZ / PM	ASME Sec VIII Div. 1Ed 2017 <i>6-12-0003, 6-12-0002 6-12-0007 MR-01-03,6-79-0013</i>	Hardness	ASME Sec VIII Div. 1Ed 2017 & PR	Test report	P	H	RW	
21.0	Final dimensional inspection after PWHT	Approved Drawings	Dimensions, orientations	Approved Drawings	Dimensional report	P	H	H	

Comment 1: 6-12-0002 para 4.4, 6-12-0003 para 7, 6-12-0007 para 6.5

Comment 2:Tensile,side bend, hardness, macro/ micro, IGC tests

Comment 3: (a)Radiography required after PWHT. (b) UT in lieu of Radiography requires PMC approval ref. para 5.4.8 of 6-12-0001(c)Clad dished end, toricone, hot formed shells require 100% UT, 10% rest clad for bond integrity

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22.0	PMI Check (only for SS , Alloy Steels)	PR Specification	As per ASME Sec IIC Ed 2017	ASME Sec IIA Ed 2017.	PMI report	P	H	RW	
23.0	Shop Hydro test & Draining, drying, inside cleaning.	Approved Drawings	No pressure drop or leaks	Approved hydro test procedure; draining & drying procedure	Test report	P	H	H	Chloride content in hydro testing water to be as specified in PR
	MPI Inspection of all welds as per 5.4.3 of 6-12-0003								
24.0	Pickling & passivation of weld overlay of nozzles, clad surface of shells, dished ends and further cleaning and drying	Approved Drawings	Visual examination	Approved Drawings & PR	Report	P	H	RW	
25.0	Surface preparation & Primer painting,	Approved Drawings	Visual examination & DFT check	Approved Drawings	Report	P	H	RW	
26.0	Primer Paint application	Approved Drawings	Visual & DFT	Approved Drawings	Report	P	H	R	
27.0	Cutting of Complete Vessel into sections & Weld edge preparation for site weld	Approved drawing / cutting plan	Dimensions	Approved Drawings	-	P	H	W	Refer Note-6
28.0	Trial assembly of cut sections, match marking	Approved drawing / cutting plan	Dimensions	Approved Drawings	-	P	H	W	
29.0	Issue of IRN & clearance for dispatch	Approved drawings	All stages as per this approved ITP	-	Release Note	-	-	H	

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Site fabrication									
30.1	Weld edge, CS fit up & welding	Approved Drawings	Visual, Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	W	
30.2	100 % PT on root & final weld, chipped back CS weld	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	
30.3	RT of completed CS weld	approved drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	For site weld in Pressure part
30.4	Local PWHT for the column	PWHT procedure	Calibration of thermocouples/ Recorders	PWHT procedure	HT Chart review	P	H	H for release	
30.5	Local Box Type Hydro test (as specified in drawing)	Approved Drawings	No pressure drop or leaks	Approved hydro test procedure; draining & drying procedure	Test report	P	H	H	
30.6	Surface preparation & Primer painting	Approved Drawings	Visual examination & DFT check	Approved Drawings	Report	P	H	RW	Only where touch up is applicable
30.7	Issue of site IRN	Approved drawings	All stages as per this approved ITP	-	Release Note	-	-	H	
30.8	Manufacturer's Data Report & Final documentation	Approved drawings & this ITP	Completeness	Approved drawings & this ITP	Reports	-	H	H	QAP sign off by TPIA

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Notes:

- 1) For qualification any new WPS, or new WPQ, witness of TPIA is envisaged.
- 2) In case, the bevel edges are made with gas cutting, the edges shall be 100 % PT tested.
- 3) Wherever chemical analysis of weld metal overlay shall be measured, it shall be at a depth of 2/3rd of the cladding thickness from top of the finished overlay surface.
- 4) Weld over lay thickness cannot be more than 3 mm over and above the required clad thickness.
- 5) All specifications as available in drawings shall be complied.
- 6) In case site weld is required to be done in line to drawing, suitable extra dimensions are to be provided such that complete equipment after shop hydro test is cut into pieces and transported to site followed by seam welding at site.
- 7) All requirements as per PR (Purchase Requisition) shall be met.
- 8) For weld overlay, electrode for barrier layer E309MoL shall be used in line with EIL Spec. No. 6-12-0007.
- 9) Witness by TPIA for indigenous clad plates during explosion bonding activity of base plate with stainless steel plate followed by identification. Witness by TPIA for imported plate material.
- 10) Extent of RT will be in line to approved drawings.
- 11) EIL Spec 6-12-0007 Rev 5 Cl. No. 5.1.5: For welding of clad piping components such as pipe to pipe / pipe fitting from single side where approach from clad side is not accessible, shall be done with a welding consumable matching the clad material followed by an intermediate layer of pure iron (ARMCO/KARDO Iron) welding filler material and then by a welding consumable matching the base material.
- 12) EIL Spec 6-12-0007 Rev 5 Cl. No. 6.1.4: 100% UT shall be carried out of areas where attachments are to be welded directly to the cladding. The above areas shall include 50mm width of adjacent areas on both sides of attachment.
- 13) \$ These stages are applicable for Clad zone only.

Legends:

P: Perform	WPS: Welding procedure specification	DFT: Dry film thickness	LS: Longitudinal Seam welding
R: Review	WPQ: Welder performance Qualification	HT Chart: Heat Treatment chart	CS-Circular Seam welding
H: Hold	RT: Radiographic testing	PR-Purchase Requisition	
W: Witness	UT: Ultrasonic testing	Prod: Production	
RW: Random Witness	PT: Dye penetrant testing	Qua: Quality	
	MPT: Magnetic particle testing	IRN: Inspection release note issued by TPIA	



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MAIN FRACTIONATOR COLUMN FOR PFCC UNIT

(BHEL-HPVP-DEPARTMENT OF WELDING TECHNOLOGY)



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VIZAG

Title: WELD OVERLAY / CLADDING PROCEDURE

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1.0 SCOPE This document describes the Automatic Weld Overlay/Cladding procedure for deposition over ID of Nozzles and Manual Overlay procedure on surfaces.

2.0 REFERENCE DOCUMENTS

ASME SEC IX Codes and Standards for qualification of procedures for weld overlay.

3.0 WELD OVERLAY METHODS

The weld overlay is being carried by either Automatic (or) Manual method.

2.1 Automatic Weld Overlay Method:

This method uses GTAW Automatic welding process and is called as Internal Pipe Cladding (IPC) method and is used for overlaying on inside diameter of nozzle sizes 2 inches to 6 Inches.

For small bore pipe weld overlay demo (validation of process) shall be performed before carrying out actual job.

2.2 Manual Weld Overlay Method:

This method uses SMAW/GTAW manual welding process and is used for overlaying on surfaces.

4.0 AUTOMATIC WELD OVERLAY PROCEDURE (IPC PROCEDURE)

- 4.1 The Automatic Weld Overlay/Internal pipe cladding using GTAW process shall be of the required chemical composition and shall be free from weld defects. The minimum effective cladding/overlay thickness of undiluted weld metal shall be in line with approved fabrication drawings.
- 4.2 The automatic weld overlay/cladding shall be deposited on fresh and clean machined surface as shown in figure 1.
- 4.3 Generally, the internal pipe cladding is applied using a two (or) more layers technique. The filler wires shall be selected for barrier and remaining final layers based on relevant Welding Procedure Specification (WPS) and are listed below -

Base Material	Welding Process	Barrier Layer	Remaining/Final Layers
Gr.11	GTAW (AUTOMATIC) with Filler Wire	ER309L	ER308L



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	addition.		
Gr.22	GTAW (AUTOMATIC) with Filler Wire addition.	ERNiCr3	ER308L

4.4 The qualified internal pipe cladding procedure only to be considered for use on the production jobs. The internal pipe cladding for procedure qualification and production shall be identical in all respects i.e., surface preparation, cleanliness, welding processes, welding parameters, weld layers, PWHT, inspection, etc.

4.5 The automatic weld overlay/cladding shall be done using qualified welding operator using welding consumables meeting ASME SECII Part C requirements.

4.6 The approved WPS (welding procedure specification) to be followed and the basic welding parameters to be used are given below –

Thermal history	Gr.11	Gr.22
Preheat temperature	150 deg. C (minimum)	205 deg. C (minimum)
Interpass temperature	200 deg. C(maximum)	250 deg. C(maximum)
Post Weld Heat Treatment	670 ± 10 deg. C	690 ± 10 deg. C

4.7 The minimum thickness of overlaying/cladding, in the as welded condition, shall be 3mm (minimum) as measured from the original surface without considering the depth of fusion.

4.8 Weld overlay shall be made with minimum two pass (Layers).

AUTOMATIC GTAW Weld Overlay/CLADDING Sequence (For NOZZLES ≤6INCHES)



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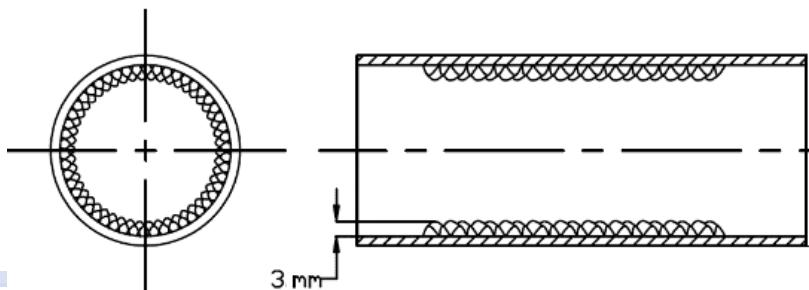


Figure 1: Sketchmatic representation of IPC sequence

- 4.9 The weld overlay parameters shall be followed such that the undiluted weld metal composition shall meet as per ASME SEC II Part C requirements at depth of 2/3rd of the cladding thickness from the finish surface.
- 4.10 The Automatic weld overlaying/cladding shall be free from all types of defects and shall pass the Non Destructive Examinations as per Quality Assurance Plan (QAP).

5.0 MANUAL WELD OVERLAY PROCEDURE

- 5.1 The Manual Weld Overlay using SMAW (or) GTAW + SMAW processes shall be of the required chemical composition and shall be free from weld defects. The minimum effective cladding/overlay thickness of undiluted weld metal (after final machining/grinding) shall be in line with approved fabrication drawings.
- 5.2 The manual weld overlay shall be deposited on fresh and clean machined surface.
- 5.3 Generally, the weld overlay is applied using a two (or) more layers' technique. The electrodes/filler wires shall be selected for barrier and remaining final layers based on relevant Welding Procedure Specification (WPS).
- 5.4 The qualified Weld Overlay procedure only to be considered for use on the production jobs. The weld overlay for procedure qualification and production shall be identical in all respects i.e., surface preparation, cleanliness, welding processes, welding parameters, weld layers, PWHT, inspection, etc.
- 5.5 The Manual weld overlay shall be done using qualified welders using welding consumables meeting ASME SECII Part C requirements.
- 5.6 The relevant WPS (welding procedure specification) to be followed and the basic welding parameters to be used are given below –

Thermal history	For Gr.11 Materials	For Gr.22 Materials
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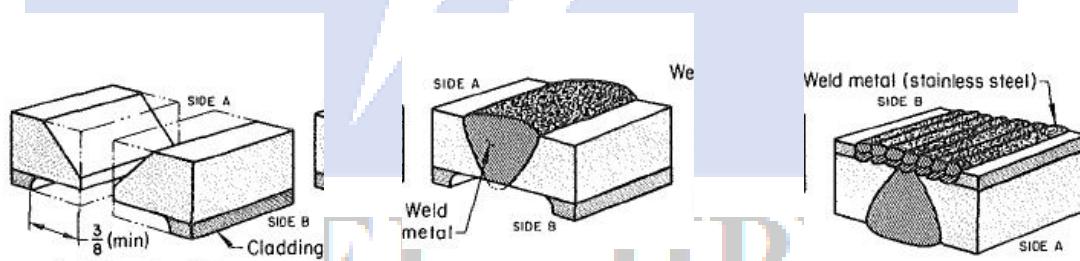
Preheat temperature	150 deg. C (minimum)	205 deg. C (minimum)
Interpass temperature	200 deg. C(maximum)	250 deg. C(maximum)
Post Weld Heat Treatment	670 ± 10 deg. C	690 ± 10 deg. C

5.7 All electrodes prior to use shall be properly baked/dried as per manufacturer's recommendation.

5.8 The minimum thickness of overlaying, after final machining/grinding condition shall be 3mm (minimum) as measured from the original surface without considering the depth of fusion.

5.9 The weld overlay parameters shall be followed such that the undiluted weld metal composition shall meet as per ASME SEC II Part C requirements at depth of 2/3rd of the cladding thickness from the finish surface.

Manual Weld Overlay Sequence (For L/S & C/S, WELD OVERLAY ON NOZZLES >8INCHES, ALL FLANGES



(a) Faces bevelled and cladding stripped

(b) Welded from Side A, weld ground flush on side B

(c) Surfaced from side B

Figure 2: Procedure for Joining Stainless Clad – Carbon steel Plate (sketch is to represent weld overlay sequence only and not represent weld joint design configuration)



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Base Material	Welding Processes	Barrier Layer	Remaining/Final Layers
SA387Gr.11 CL2 + SS304L CLAD	SMAW	E309L	E308L
SA387Gr.22 CL2 + SS304L CLAD	SMAW	ENiCrFe3	E308L

The sequence involves for replacing portions of the stainless steel cladding removed before welding the carbon steel side.

- The Joint is prepared by beveling side A and removing a portion of the stainless steel cladding from Side B to a minimum width of 9.5mm from each side of the joint as shown in figure 2 (a).
- The Joint is fitted up with root gap of 2- 3mm in position for welding
- Carbon steel electrode is deposited and the root of the weld is ground flush with the underside of the carbon steel plate as shown in figure 2 (b).
- The area from which cladding was removed is surfaced with atleast two layers of stainless steel electrodes of E309L/ENiCrFe3 & E308L as barrier & final/remaining layers as shown in figure 2 (c).
- Copper sulphate test shall be carried out on L/S & C/Seams after barrier layer deposition and depth grinding and before starting of deposition of remaining layers.

Manual Weld Overlay Sequence (For ELBOW + NOZZLES/FLANGES)

The sequence involves for single side groove / full penetration welding with GTAW (ER308L) and followed by SMAW (E309L) followed by SMAW of carbon steel portion by using matching electrodes as shown in figure 3.

Base Material	Welding Processes	Root & Subsequent Layers (SS portion)	1 or 2 Subsequent Layers (for SS portion)	Remaining/Fin al Layers (for LAS portion)
SA387Gr.11cl2 / SA387Gr.22 cl2 + SS304L CLAD	GTAW + SMAW	ER308L	E309L	E8018B2 (FOR GR.11) E9018B3 (FOR GR.22)



एचपीएल राजस्थान रिफार्फारी लिमिटेड
HPCL Rajasthan Refinery Limited



इंजीनियर्स इंडिया लिमिटेड
ENGINEERS INDIA LIMITED
(A Govt. of India Undertaking)

MAIN FRACTIONATOR COLUMN FOR PFCC UNIT

(BHEL-HPVP-DEPARTMENT OF WELDING TECHNOLOGY)



BHEL-HPVP
VIZAG

Title: WELD OVERLAY / CLADDING PROCEDURE

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5.10 The Manual weld overlaying shall be free from all types of defects and shall pass the Non Destructive Examinations as per approved ITP. NDE & Sampling for thickness verification and chemistry check shall be as per ITP.

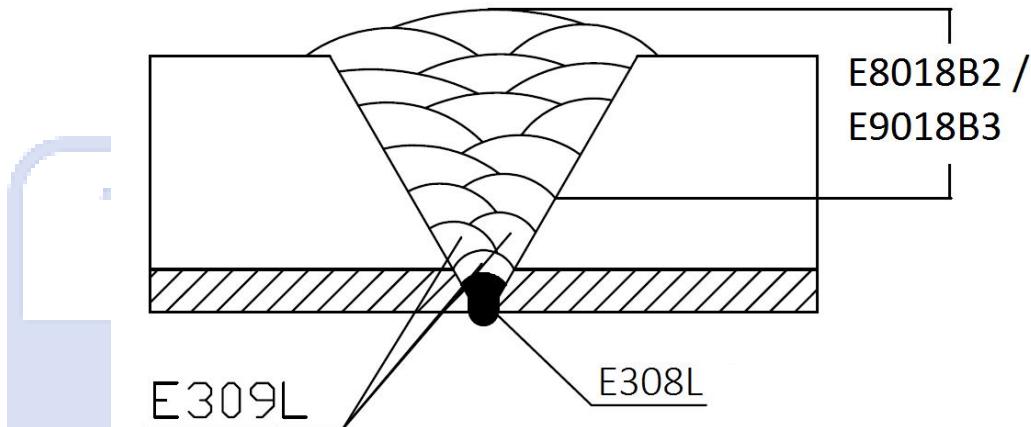


Figure 3: Procedure for Full Penetration welding for Stainless Clad – LAS steel Plates



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ISSUE NO. : 2

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Issue No	Rev No	Date of Revision	Brief Records of Revision
1	0	02-02-2015	First Edition
1	1	11-04-2017	Cl. no. 3,7,10,12,13,15 revised as per ASME Sec V Edition 2015
2	1	25-04-2018	Cl. no. 3,14,15,18 revised as per ASME Sec V Edition 2017
2	2	15-05-2020	Cl. no. 3.1,3.2,9.2,11,12.1,12.4,16.5 revised; Cl. no.1,5,6,9,14,15,16.2 Modified.



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All NDT procedures shall meet the requirements of applicable codes and specifications, PR Scope and extent , acceptance criteria shall be as per applicable drawing and specifications



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1. SCOPE

This procedure specifies the requirement for radiographic examination of butt welded joints in steel(Carbon Steel, Alloy Steel, Stainless Steel etc.) and non-ferrous materials using x-rays or gamma rays as a source of radiation for detecting and evaluating flaws within the weld and HAZ (heat affected zone). It applies to the welded joints in pressure vessels, heat exchangers, columns and pipes etc. Radiographic technique used to demonstrate that required IQI sensitivity and density requirements are achieved.

2. POLICY

- 2.1.** The radiographic examination be carried out either as or one of the procedures enumerated in the following pages which are verified and found to be in accordance with latest ASME SEC V or as per any other applicable referencing code sections and specifications.
- 2.2.** Only personnel qualified in accordance with BHEL HPVP NDE Written Practice shall carry out any radiographic examination.

3. APPLICABLE STANDARDS

- 3.1.** ASME SEC V Edition 2019.
- 3.2.** Construction code sections ASME Sec I, ASME Sec VIII Div 1, ASME Sec VIII Div 2 Edition 2019, ASME B31.1 Edition 2016, NBIC NB 23 Edition 2019, SNT-TC-1A Edition 2016 & ASME SEC V Edition 2019 Art.1.

4. SYSTEM

All radiographic examination procedures be amended and approved as required by NDE level III taking into consideration of

- 4.1.** Experience gained in various examination procedures.
- 4.2.** Recommendations of audit teams.
- 4.3.** Referencing code sections.



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Each page of the document be independently controlled and revision status be indicated on the title page.

5. SURFACE PREPARATION:

The weld ripples or weld surface irregularities on both inside(where accessible) and outside shall be removed by any suitable process to such a degree that the images of surface irregularities cannot mask or be confused with the image of any discontinuity on the resulting radiograph.

The finished surface of all butt-welded joints may be flush with the base material or may have reasonably uniform crones, with reinforcement not to exceed that specified in the referencing code section.

Welds be visually examined to ensure free from surface irregularities which can mask or cause difficulty in detecting discontinuities. If required surface be ground and surface imperfections removed.

6. REINFORCEMENT

The thickness of reinforcement on each side of all butt welded longitudinal and circumferential joints not exceed the limits as given below:

As per ASME Sec-VIII Div 1:

Material thickness (Nominal) (mm)	Permitted Maximum Reinforcement	
	Cat B& C Butt welds (mm)	Other welds (mm)
< 2.4	2.4	0.8
2.4 to 4.8	3.0	1.5
>4.8 to 13	4.0	2.5
>13 to 25	5.0	2.5
>25 to 51	6.0	3.0
>51 to 76	6.0	4.0
>76 to 102	6.0	5.5
>102 to 127	6.0	6.0
>127	8.0	8.0



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As per ASME Sec-VIII Div 2:

Material thickness (Nominal) (mm)	Permitted Maximum Reinforcement	
	Circumferential welds in Pipes & Tubes (mm)	Other welds (mm)
< 2.5	2.5	0.8
≥ 2.5 to < 5.0	2.5	1.5
≥ 5.0 to < 13.0	3.0	2.5
≥ 13.0 to < 25.0	4.0	2.5
≥ 25.0 to < 50.0	4.0	3.0
≥ 50.0 to < 76.0	4.0	4.0
≥ 76.0 to < 100.0	5.5	5.5
≥ 100.0 to < 125.0	6.0	6.0
≥ 125.0	8.0	8.0

As per ASME Sec-I:

Material thickness (Nominal) (mm)	Permitted Maximum Reinforcement	
	Circumferential welds in Pipes & Tubes (mm)	Other welds (mm)
< 3.0	2.5	2.5
3.0 to 5.0	3.0	2.5
>5.0 to 13.0	4.0	2.5
>13.0 to 25.0	5.0	2.5
>25.0 to 50.0	6.0	3.0
>50.0 to 75.0	The greater of 6 mm or 1/8 times the width of the Weld (in mm).	4.0
>75.0 to 100.0		5.5
>100.0 to 125.0		6.0
>125.0		8.0

7. SELECTION OF RADIOGRAPH

Either Agfa D4/D7 or Fuji IX 50/100 brand radiographs be used



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8. INTENSIFYING SCREENS

For Iridium 192, X-ray (150 KV – 200 KV) 0.15 mm thick, Co-60 0.25 mm thick front and back Lead intensifying screens shall be used.

9. IMAGE QUALITY INDICATORS (IQI)

9.1. SELECTION :

9.1.1. MATERIAL:

IQI shall be selected from either the same alloy material group or grade as identified in SE-747 for ASTM wire type or SE-1025 for hole type IQI or grade with less radiation absorption than the material being radiographed.

9.1.2. SIZE:

Nominal single wall Thickness of the base metal (thickness of the thinner incase dissimilar thickness base metals are joined) including the estimated allowed weld reinforcement both in ID and OD be considered for IQI selection. The values used for the estimated weld reinforcement thicknesses shall be representative of the weld conditions and shall not exceed the maximums permitted by the referencing code section. Physical measurement of the actual weld reinforcements not required. Backing rings or strips shall not be considered as part of the thickness in IQI selection. Refer Clause. 14 below for the selection of IQI designation.

9.2. PLACEMENT:

IQI(s) be placed on source side of the object unless hand placing of IQI is not feasible. In such case, the IQI be placed on radiograph side of weld with a letter 'F' placed adjacent to the IQI.

Wire type IQI's be placed on the weld so that the lengths of the wires are transverse to the longitudinal axis of the weld and Hole type IQI's be placed adjacent and parallel to the weld axis, one at each end of the radiography spot..

When weld reinforcement or backing strip is not removed, a shim of material radiographically similar to weld metal be kept under the hole type IQI.



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9.3. NUMBER OF IQI's:

For unidirectional exposures, at least one IQI image appears on each radiograph where one or more radiograph holders are used for an exposure. If the density of the radiograph varies by more than -15% or +30% from the density through the body of hole type IQI, or adjacent to the required wire, an additional IQI be used for each exceptional area or areas and the radiograph is retaken.

For cylindrical components where the source is placed on the axis of the component for a single exposure at least three IQI's be placed approximately 120° apart.

10. RADIATION ENERGY SELECTION (SOURSE SELECTION):

The selection be such that required IQI sensitivity and density are achieved.

The recommended source for radiography of objects is as below.

Applicable ranges shall be as per provisions in Article 22 SE 94

- a) Iridium 192 – with thickness from 6 to 65 mm.
- b) Co-60 – for thickness above 35 mm.
- c) X-ray equipments (100 KV – 200 KV) may be used for thickness 12 mm and below to achieve higher sensitivity, if required.

11. BACK-SCATTER RADIATION

A lead symbol 'B' shall be placed within the area of radiograph with minimum dimensions of 11 mm height and 1.5 mm thick be attached on the back side of each radiograph holder to determine if back-scatter radiation is exposing the radiograph.



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12. SYSTEM OF IDENTIFICATION:

Each radiograph must be identified uniquely so that there is a permanent correlation between the part radiographed and the radiograph.

A system of permanent identification of the radiograph be provided with the following minimum details.

- 12.1.** HPVP Manufacturer Symbol/Name and NDE Subcontractor's Symbol/Name.
- 12.2.** Work Order Number.
- 12.3.** SAP generated RT number if requisition raised through SAP.
- 12.4.** Welder No. and Part Number for Non SAP Requisitions.
- 12.5.** Equipment number, if any.
- 12.6.** Weld seam number, if any.
- 12.7.** Segment number (location marker).
- 12.8.** Date of radiography.
- 12.9.** Letter 'R1, R2' to indicate first repair, second repair etc. when required.
- 12.10.** Letter 'RT' to indicate retaken radiograph when required.

13. RADIOPHOTOGRAPHY MAKING TECHNIQUES:

Normally a single wall single image (SWSI) radiography technique be used.

For test objects with external diameter less than 89 mm (DWI) double wall double image Elliptical technique or (DWSI) double wall single image technique or Super imposition technique be used.

(Note: When DWI technique is used, one exposure be taken unless otherwise specified. The source position be such that two weld images are clearly separated. The maximum separation between two weld images / distance between two weld images be one weld width. IQI be placed on the source side.

In case of DWSI or Super imposition techniques sufficient number of radiography shots ensuring full coverage of the weld seam be used. The IQI be placed close to the radiograph with a lead letter "F")



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14. IQI SELECTION: As per Table T-276 of ASME Sec V Edition 2019

Weld thickness (base metal thickness + Estimated allowed reinforcement) (mm)	Source side			Radiograph side		
	Hole Designation	Type Essential hole	Wire- type Essential wire	Hole Designation	Type Essential hole	Wire type Essential wire
Upto 6.4	12	2T	5	10	2T	4
Over 6.4 to9.5	15	2T	6	12	2T	5
Over 9.5 to12.7	17	2T	7	15	2T	6
Over12.7 to19.0	20	2T	8	17	2T	7
Over 19.0 to25.4	25	2T	9	20	2T	8
Over 25.4 to38.1	30	2T	10	25	2T	9
Over 38.1 to50.8	35	2T	11	30	2T	10
Over 50.8to 63.5	40	2T	12	35	2T	11
Over 63.5to 101.6	50	2T	13	40	2T	12
Over 101.6 to 152.4	60	2T	14	50	2T	13

15. GEOMETRIC UNSHARPNESS:

Recommended maximum values of U_g are tabulated below

Material	Thickness (mm)	U_g Maximum (mm)
Under 50		0.51
50-75		0.76
75-100		1.01
>100		1.78

$$\text{Film factor}^* (\text{SFD in Meters})^2 * 2^{(\text{thickness of job/HVT of material})}$$

Exposure Time (Ci minutes) = ----- X 60
(RHM of Source)



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General requirements:

- Persons working in radiation areas be provided with Personnel monitoring device (TLDs) and Radiation area monitoring devices (Survey meters).
- Personnel Qualification: The minimum qualification of radiography operator be BARC qualified and certified radiographer.
- The minimum Qualification of Radiography Evaluation personnel be ASNT / ISNT Level II.
- Extent of Examination: As per Applicable Drawing / QA plan / NDE plan.
- Marking and identification of the radiograph: Work order no., Joint No., Spot No(s). be permanently marked on the job by stamping. Where stamping is not permitted by code / specification (< 6mm for ferrous plates) sketches be prepared to identify weld joints and radiography spots.
- Location of weld in the radiograph: Set of Markers (arrows or V's) be placed on both sides of the weld at least 5 mm from the edge of the weld. At least two such sets be placed at each end of the radiography spot.
- Alignment of radiation beam: be directed to the centre of the area being radiographed and shall be perpendicular to the object surface at that point.
- Over lap of radiographs: When multiple radiographs are used to cover entire length of weld seams adjacent radiographs overlap at least 25 mm.
- Radiation Exposure times: Exposure charts indicating thickness vs exposure time (Gamma ray-Ir-192) or thickness vs milli Ampere minutes(mA-mts) (X-ray) prepared exclusively for a particular brand / type industrial x-ray radiograph shall be used.



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16. EVALUATION:

16.1. FACILITIES FOR RADIOGRAPH VIEWING:

Radiographs shall be viewed in a room with subdued light after dark adaptation of eyes (minimum 5 minutes) using an illuminator of sufficient illumination. The illuminator shall have facility to adjust the illumination level required for the particular radiograph.

16.2. QUALITY OF RADIOGRAPHS:

All radiographs be free from mechanical, chemical or other blemishes to the extent that they cannot mask or be confused with the image of any discontinuity in the area of interest including:

- i. Fogging
- ii. Processing marks such as streaks, chemical stains, water marks, air bubble marks
- iii. Handling marks such as scratches, finger marks, nail marks, static marks, marks due to dirt on lead intensifying screens.
- iv. False indications due to defective screens.

16.3. RADIOGRAPHIC DENSITY:

Density estimation / measurement: The Density be estimated either with a calibrated densitometer or with a step wedge comparison radiograph.

Density of a radiograph at adjacent to essential hole/ wire and area of interest shall be from 1.8 minimum for single film viewing with X-Ray and 2.0(minimum) for Gamma Rays. For composite viewing of multiple film exposures, each film of the composite set shall have a minimum density of 1.3. The maximum density shall be 4.0 for single or composite viewing.

The density anywhere through the area of interest be within – 15% and +30% of that density obtained through the body of the hole type IQI adjacent to the essential hole or adjacent to the essential wire of wire-type IQI.

A tolerance of 0.05 in density is allowed for variation between densitometer readings.



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When shims are used with hole type IQI(s) the +30% restriction may be exceeded, and the minimum density requirements mentioned above do not apply provided required IQI sensitivity is met.

16.4. EXCESSIVE BACKSCATTER

If a white image of a letter 'B' appears against a darker background, protection from back scatter radiation is needed and the radiograph be retaken by keeping a lead sheet of 1/16" thick at the back of the radiograph cassette.

16.5. IQI SENSITIVITY:

Essential Hole or Essential wire as referred above in "Clause 14" IQI selection be visible. For wire type IQI's the essential wire shall be visible within the area of interest representing the thickness used for determining the essential wire, inclusive of the allowable density variations described in Clause 16.3.

17. DISPOSITION OF WELDS:

Radiography review form shown in Exhibit 1 be used for recording, reporting evaluation and disposition details.

The indications shown on the radiographs which are unacceptable after interpretation and evaluation be repaired by grinding, welding or gouging. Repair welding be performed using qualified procedure and in a manner acceptable to the inspector. The weld repaired areas be re radiographed in accordance with written procedure.

18. PRESERVATION OF RADIOGRAPHS & EVALUATION REPORTS

The complete set of radiographs and radiography evaluation reports be preserved as per the following.

ASME Sec I & B 31.1 5 Years
ASME Sec VIII Div 1	Radiographs-- Till Data Reports are signed by AI RT Reports – 3 Years
ASME Sec VIII Div 2 3 Years
NBIC Part 3 5 Years



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RADIOGRAPHY ACCEPTANCE LEVELS

Ref : ASME SEC I, ASME SEC VIII Div 1, ASME SEC VIII Div 2 Edition 2019.

Full Radiography

Imperfection	Maximum permitted size / length
Any indication characterized as a crack or zone of incomplete fusion or penetration	Unacceptable
Elongated indications (also see notes 1. & 2. Below)	(a) 6 mm for t up to 19 mm (b) $1/3t$ for t from 19 mm to 57 mm (c) 19 mm for t over 57 mm Where t is the thickness of the weld excluding any allowable reinforcement
Rounded indications	As specified by the acceptance standards given in pages 13 to 16.

Note:

1. For a butt weld joining two members having different thicknesses at the weld, t is the thinner of these two thicknesses. If a full penetration weld includes a fillet weld, the thickness of the throat of the fillet be included in t .
2. Any group of aligned indications that have an aggregate length greater than t in a length of $12t$, except when the distance between the successive imperfections exceeds $6L$ where L is the length of the longest imperfection in the group.



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Spot Radiography

Imperfection	Maximum permitted size / length
any indication characterized as a crack or zone of incomplete fusion or penetration	Unacceptable
slag inclusions or cavities	$2/3t$ where t is the thickness of the weld excluding any allowable reinforcement.
Rounded indications	Not a factor in the acceptability of welds not required to be fully radiographed.

Note:

- If a full penetration weld includes a fillet weld, the thickness of the throat of the fillet be included in t .
- If several indications within the above limitations exist in line, the welds be judged acceptable if the sum of the longest dimensions of all such indications is not more than t in a length of $6t$ (or proportionately for radiographs shorter than $6t$) and if the longest indications considered are separated by at least $3L$ of acceptable weld metal where L is the length of the longest indication. The maximum length of acceptable indications be $3/4$ in. (19 mm). Any such indications shorter than $1/4$ in. (6 mm) be acceptable for any plate thickness.



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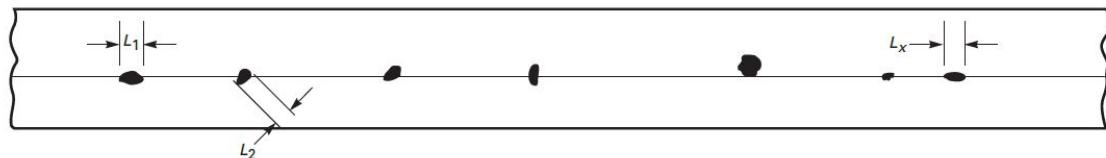
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Acceptance Criteria for Rounded Indications

(Ref: Mandatory Appendix 4 ASME SEC I, SEC VIII DIV I Edition 2019)

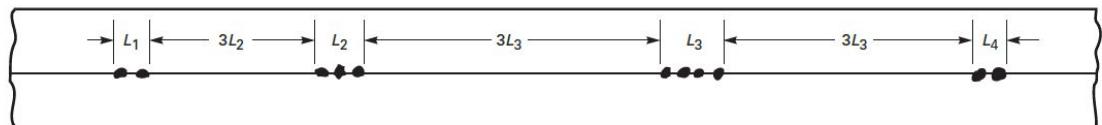
SI Units			
Thickness, t, mm	Maximum Size of Acceptable Rounded Indication, mm		Maximum Size of Nonrelevant Indication, mm
	Random	Isolated	
Less than 3	$\frac{1}{4} t$	$\frac{1}{3} t$	$\frac{1}{10} t$
3	0.79	1.07	0.38
5	1.19	1.60	0.38
6	1.60	2.11	0.38
8	1.98	2.64	0.79
10	2.31	3.18	0.79
11	2.77	3.71	0.79
13	3.18	4.27	0.79
14	3.61	4.78	0.79
16	3.96	5.33	0.79
17	3.96	5.84	0.79
19.0 to 50, incl.	3.96	6.35	0.79
Over 50	3.96	9.53	1.60

**Figure 4-1
Aligned Rounded Indications**



GENERAL NOTE: Sum of L_1 to L_x shall be less than t in a length of $12t$.

Figure 4-2
Groups of Aligned Rounded Indications



Maximum Group Length

$L = \frac{1}{4}$ in. (6 mm) for t less than $\frac{3}{4}$ in. (19 mm)
 $L = \frac{1}{3}t$ for $t^{\frac{3}{4}}$ in. (19 mm) to $2\frac{1}{4}$ in. (57 mm)
 $L = \frac{3}{4}$ in. (19 mm) for t greater than $2\frac{1}{4}$ in. (57 mm)

Minimum Group Spacing

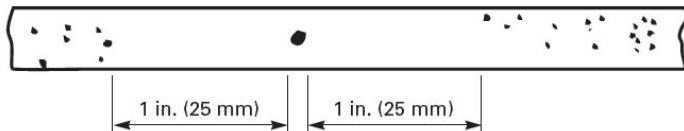
$3L$ where L is the length of the longest adjacent group being evaluated

GENERAL NOTE: Sum of the group lengths shall be less than t in a length of $12t$.

Figure 4-3
Charts for t Equal to $\frac{1}{8}$ in. to $\frac{1}{4}$ in. (3 mm to 6 mm), Inclusive



(a) Random Rounded Indications [See Note (1)]



(b) Isolated Indication [See Note (2)]



(c) Cluster

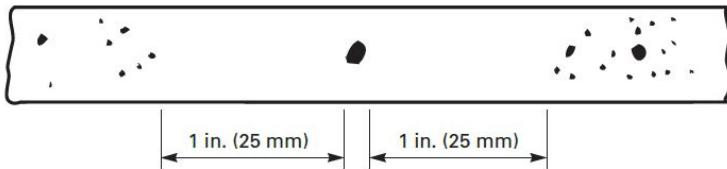
NOTES:

(1) Typical concentration and size permitted in any 6 in. (150 mm) length of weld.
(2) Maximum size per Table 4-1.

Figure 4-4
 Charts for t Over $\frac{1}{4}$ in. to $\frac{3}{8}$ in. (6 mm to 10 mm), Inclusive



(a) Random Rounded Indications [See Note (1)]



(b) Isolated Indication [See Note (2)]

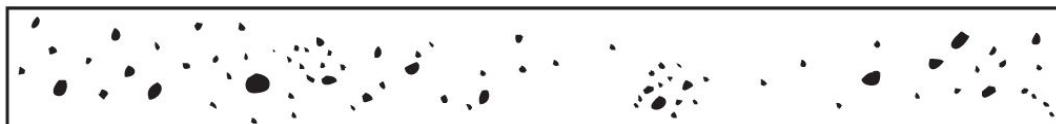


(c) Cluster

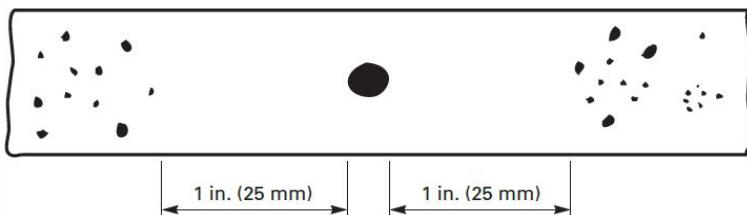
NOTES:

- (1) Typical concentration and size permitted in any 6 in. (150 mm) length of weld.
- (2) Maximum size per [Table 4-1](#).

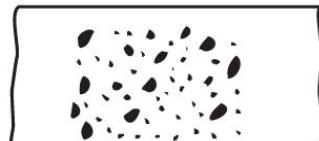
Figure 4-5
 Charts for t Over $\frac{3}{8}$ in. to $\frac{3}{4}$ in. (10 mm to 19 mm), Inclusive



(a) Random Rounded Indications [See Note (1)]



(b) Isolated Indication [See Note (2)]



(c) Cluster

NOTES:

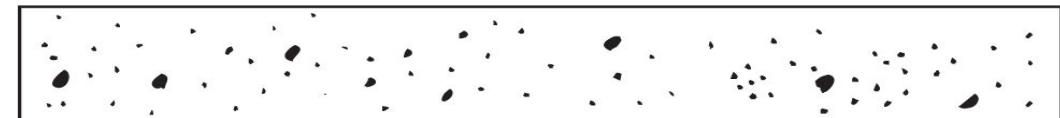
- (1) Typical concentration and size permitted in any 6 in. (150 mm) length of weld.
- (2) Maximum size per [Table 4-1](#).



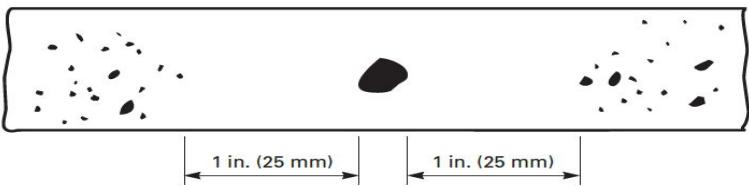
PROCEDURE FOR RADIOGRAPHIC EXAMINATION

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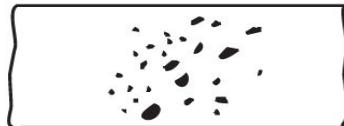
Figure 4-6
Charts for t Over $\frac{3}{4}$ in. to 2 in. (19 mm to 50 mm), Inclusive



(a) Random Rounded Indications [See Note (1)]



(b) Isolated Indication [See Note (2)]



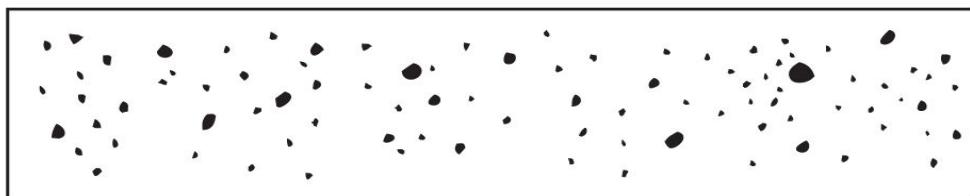
(c) Cluster

NOTES:

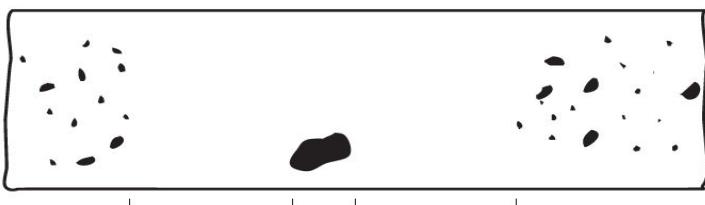
(1) Typical concentration and size permitted in any 6 in. (150 mm) length of weld.

(2) Maximum size per [Table 4-1](#).

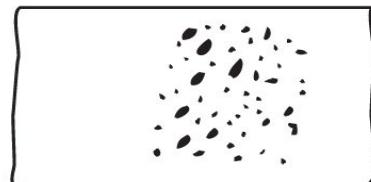
Figure 4-7
Charts for t Over 2 in. to 4 in. (50 mm to 100 mm), Inclusive



(a) Random Rounded Indications [See Note (1)]



(b) Isolated Indication [See Note (2)]



(c) Cluster

NOTES:

(1) Typical concentration and size permitted in any 6 in. (150 mm) length of weld.

(2) Maximum size per [Table 4-1](#).

(For other Codes such as ASME B31.1, NBIC NB23 refer respective current Edition)



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ULTRASONIC EXAMINATION**

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ISSUE NO.2

**PROCEDURE FOR
ULTRASONIC EXAMINATION**

Issue No	Rev No	Date of Revision	Brief Records of Revision
1	0	02-02-2015	First Edition
1	1	11-04-2017	Cl no. 2,3,12,13 revised as per ASME Sec V Edition 2015
2	1	25-04-2018	Cl no. 2,3,12,13 revised as per ASME Sec V Edition 2017
2	2	15-05-2020	Cl no. 1,5,7,12 Modified and Cl no. 2.2,2.3,3,12 Revised as per ASME Sec V Edition 2019



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**PROCEDURE FOR
ULTRASONIC EXAMINATION**

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PROCEDURE FOR ULTRASONIC EXAMINATION

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1. SCOPE:

This procedure covers Ultrasonic Examination for Ferritic welds (Carbon or Alloy steels) and Claddings by Manual, A-Scan, pulse-echo direct contact method of testing for detection of inclusions(slag) and planar discontinuities (cracks, non-fusion, etc.) and thickness measurement as

- a) Full penetration butt welds (double V, single V type), Full penetration corner welded nozzle joints for boiler and pressure vessels of equal to or greater than 10mm thickness.
- b) Butt joints in pipes with thickness equal to or greater than 10mm thickness.
- c) Claddings.
- d) Direct thickness read out by manual Ultrasonic Pulse echo contact method.

2. SYSTEM:

2.1 EXAMINATION PROCEDURE AND APPLICABLE STANDARDS:

All Ultrasonic Examination procedures shall be prepared in accordance with ASME SEC V Edition 2019 by at least NDE Level II and reviewed and approved by NDE Level III.

2.2 REFERENCING CODE SECTION FOR ACCEPTANCE CRITERIA:

ASME SEC I, ASME SEC VIII Div 1, ASME SEC VIII Div 2 Edition 2019, ASME B31.1 Edition 2018 & NBIC NB 23 Edition 2019, SNT-TC-1A Edition 2016 & ASME SEC V Edition 2019 Art.1.

2.3 EXAMINATION PERSONNEL AND APPLICABLE STANDARDS:

All NDE Level – I, NDE Level – II and NDE Level III personnel are qualified in accordance with NDE written practice (Based on SNT-TC-1A 2016& ASME Sec V Edition 2019 Art.1) and appearing in Latest List of Qualified NDE Personnel shall carry out any Ultrasonic Examination.

At the appropriate stage, the Ultrasonic Examination shall be carried out as per the requisitions from production shops endorsed by concerned Quality Controls.

3. WRITTEN PROCEDURE REQUIREMENTS:

This procedure based on T-421 of ASME SEC V Edition 2019 shall contain the requirements listed in the Table below of this procedure.



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Table T-421
Requirements of an Ultrasonic Examination Procedure

Requirement	Essential Variable	Nonessential Variable
Weld configurations to be examined, including thickness dimensions and base material product form (pipe, plate, etc)	X	...
The surfaces from which the examination shall be performed	X	...
Technique(s) (straight beam, angle beam, contact, and/or immersion)	X	...
Angle(s) and mode(s) of wave propagation in the material	X	...
Search unit type(s), frequency(ies), and element size(s)/shape(s)	X	...
Special search units, wedges, shoes, or saddles, when used	X	...
Ultrasonic instrument(s)	X	...
Calibration [calibration block(s) and technique(s)]	X	...
Directions and extent of scanning	X	...
Scanning (manual vs. automatic)	X	...
Method for discriminating geometric from flaw indications	X	...
Method for sizing indications	X	...
Computer enhanced data acquisition, when used	X	...
Scan overlap (decrease only)	X	...
Personnel performance requirements, when required	X	...
Personnel qualification requirements	...	X
Surface condition (examination surface, calibration block)	...	X
Couplant: brand name or type	...	X
Post-examination cleaning technique	...	X
Automatic alarm and/or recording equipment, when applicable	...	X
Records, including minimum calibration data to be recorded (e.g., instrument settings)	...	X

It shall establish a single value, or range of values for each requirement. When required performance shall be demonstrated to the inspector. Any change in specified value or range of values of the essential variables mentioned above shall require requalification of the written procedure.

4. SURFACE CONDITION :

4.1 BASE MATERIAL, WELD, CALIBRATION BLOCK:

The base material and weld surface shall be prepared by grinding and sandering. The scanning surfaces of the basic calibration block shall be done by sandering.

4.2 TEMPERATURE DIFFERENCE:(examination surface vs calibration block)

The temperature difference between examination surfaces and the calibration block shall be within +/- 14 deg C (25 deg F) .

5. EQUIPMENT:

5.1 INSTRUMENT:

A Pulse-echo-type of ultrasonic instrument appearing in current list of NDE equipments under calibration and capable of operation at frequencies over the range of 2-4 MHz equipped with 2dB stepped gain control shall be used.



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5.2 SEARCH UNITS:

Longitudinal wave Straight beam probe of size 10 mm to 24 mm Ø, 2 - 4 MHz ; Transverse wave angled beam probes 45°, 60°, 70° of nominal size (miniature size) 8 x 9 mm² ; make Modsonic / Olympus / GE with suitable 2mtr long probe cables shall be used.

5.3 COUPLANT:

SAE 30 Hylube machine oil or grease oil mixture shall be used. Calibration shall be carried out using the same couplant to be used in examination of welds.

6. TECHNIQUE (S):

Manual, A-Scan, pulse-echo direct contact using either single or dual element straight beam and angle beam search units.

7. CALIBRATION:

7.1 EQUIPMENT CALIBRATION:

The screen height linearity and amplitude control linearity shall be performed in accordance with Procedure No. 07013 (latest revision) at the beginning of each period of extended use or every 3 months.

7.2 TECHNIQUES FOR STRAIGHT BEAM AND ANGLE BEAM CALIBRATION:

7.2.1. SWEEP RANGE CALIBRATION:

The sweep range shall be adjusted to minimum 2T for straight beam, 3T for 45° angle beam and 4T for 60° using an IIW - V1 or V2 reference block.

7.2.2. SENSITIVITY CALIBRATION:

DAC curve plotted on the CRT screen Using Flat basic calibration block 1.5 inch ASME Block for Both Straight beam and Angle beam.

7.2.3. CALIBRATION VERIFICATION FREQUENCY:

Sweep range and DAC curve shall be calibrated at the beginning of each test and shall be verified at the end of each test,

- Whenever any component of test system is changed,
- Whenever operator is changed,
- At intervals of 4 hours during continuous testing.

7.2.4. CONFIRMATION ACCEPTANCE VALUES:

- If the deviation in distance range points exceeds 10% of the distance reading or 5% of full sweep which ever is greater, correct the distance range calibration, reexamine areas since last calibration and record.
- If the sensitivity decreases by 20% or 2dB of its amplitude correct the sensitivity and reexamine areas since last calibration and record. If the sensitivity increases by 20%



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or 2dB of its amplitude correct the sensitivity correct the data sheets since last valid calibration. If the sensitivity varies beyond 20% or 2dB of its amplitude recalibrate and reexamine areas since last valid calibration and record.

7.3 WELD METAL OVERLAY CLADDING CALIBRATION BLOCKS

7.3.1. CALIBRATION BLOCKS FOR TECHNIQUE ONE:

The basic calibration block configuration and reflectors shall be as shown in figure T-434.4.1 of ASME Sec V Article 4. Either a side-drilled hole or flat bottom hole may be used. The thickness of the weld metal overlay cladding shall be at least as thick as that to be examined. The thickness of the base material shall be at least twice the thickness of the weld metal overlay cladding.

7.3.2. ALTERNATE CALIBRATION BLOCKS FOR TECHNIQUE ONE:

Alternately, calibration blocks as shown in figure T-434.4.2.1. or figure T-434.4.2.2. of ASME Sec V Article 4 may be used. The thickness of the weld metal overlay cladding shall be at least as thick as that to be examined. The thickness of the base material shall be at least twice the thickness of the weld metal overlay cladding.

7.3.3. CALIBRATION BLOCK FOR TECHNIQUE TWO:

The basic calibration block configuration and reflectors shall be as shown in the figure T-434.4.3 of ASME Sec V Article 4. A flat bottom hole drilled to the weld/base metal interface shall be used. This hole may be drilled from the base material or weld metal overlay cladding side. The thickness of the weld metal overlay cladding shall be at least as thick as that to be examined. The thickness of the base metal shall be within 1 in. (25mm) of the calibration block thickness when the examination is performed from the base material surface. The thickness of the base material on the calibration block shall be at least twice the thickness of the weld metal overlay cladding when the examination is performed from the weld metal overlay cladding surface.

7.4 CALIBRATION FOR WELD METAL OVERLAY CLADDING

Dished end of clad plates shall be Ultrasonically examined after final heat treatment for lack of bond. 100% UT examination shall be carried out on areas where attachments are to be welded directly to the cladding. Above areas shall include 50mm of adjacent areas on both sides of attachment.

7.4.1. CALIBRATION FOR TECHNIQUE ONE:

Calibrations shall be performed utilizing the calibration block shown in figure T-432.4.1 of ASME Sec V Article 4. The search unit shall be positioned for the maximum response from the calibration reflector. When a side-drilled hole is used for calibration, the plane separating the elements search unit shall be positioned parallel to the axis of the hole. The gain control shall be set so that this response is $80\% \pm 5\%$ of full screen height. This shall be the primary reference level.

7.4.2. CALIBRATION FOR TECHNIQUE TWO:



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Calibrations shall be performed utilizing the calibration block shown in figure T-434.4.3 of ASME Sec V Article 4. The search unit shall be positioned for the maximum response of the first resolvable indication from the bottom of the calibration reflector. The gain shall be set so that this response is $80\% \pm 5\%$ of full screen height. This shall be the primary reference level.

7.4.3. ALTERNATE CALIBRATION FOR TECHNIQUE ONE:

Calibration shall be performed utilizing the calibration blocks shown in figure T-434.4.2.1. or figure T-434.4.2.2 of ASME Sec V Article 4. The calibration shall be performed as follows;

- (a) The search unit shall be positioned for the maximum response from the reflector, which gives the highest amplitude.
- (b) When the block shown in the figure T-434.4.2.2 is used, the plane separating the elements of the dual elements search unit shall be positioned parallel to the axis of the hole.
- (c) The gain shall be set so that this response is $80\% \pm 5\%$ of full screen height. This shall be the primary reference level. Mark the peak of the indication on the screen.
- (d) Without changing the instrument settings, position the search unit for maximum response from each of the other reflectors and mark their peaks on the screen.
- (e) Connect the screen marks for each reflector to provide a DAC curve.

Note: When examination for lack of bond and weld metal overlay cladding flaw indications is required, Technique One shall be used. When examination for lack of bond only is required, Technique Two may be used.

8. SCANNING:

8.1 GENERAL:

8.1.1. EXAMINATION SURFACE:

Examination shall be carried out from identity-punched surface.

8.1.2. COVERAGE:

Shall be on both sides of the weld from 0 to $1\frac{1}{2}$ skip.

8.1.3. SCAN OVERLAP:

Each pass of the search unit shall overlap a minimum of 10% of the active transducer (piezoelectric element) dimension perpendicular to the direction of the scan.

8.1.4. SPEED AND SENSITIVITY:

The weld shall be scanned at a speed not exceeding 6" per second at a scanning sensitivity 6 dB above the DAC or primary Reference Level (PRL).

8.2 BASE MATERIAL:

Prior to angle beam examination of weld, adjacent parent material up to a width of 4T on both sides of the weld shall be scanned with a straight beam search unit to find discontinuities that could interfere with interpretation of indications obtained during subsequent angle beam scanning.

Any discontinuity found by straight beam search unit shall be investigated and not be a cause of rejection of element.



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8.3 WELD:

Weld shall be scanned with two different angles beam search units for detection of Longitudinal and transverse discontinuities

8.3.1. DIRECTION AND EXTENT OF SCANNING:

8.3.1.1. REFLECTORS PARALLEL TO THE WELD SEAM:

The angle beam shall be directed at approximate right angles to the weld axis from both side of the weld (i.e., is from 2 directions) on the same surface when possible and probe manipulated so as to pass ultrasonic energy thro' the required volume of the weld and adjacent base material.

8.3.1.2. REFLECTORS TRANSVERSE TO THE WELD:

The angle beam shall be directed essentially parallel to the weld axis. The search unit shall be manipulated so that the ultrasonic energy passes thro' the required volume of weld and adjacent base material. Search unit shall be rotated 180 ° and the examination repeated.

9. SIZING:

9.1 METHOD OF SIZING INDICATIONS:

Length dimension of indications shall be measured by half maximum amplitude method.

9.2 CALIBRATION CORRECTION:

The surface finish difference between calibration block & scanning surface shall be compensated by using Transfer Correction.

Calibration correction due to Mode conversion and redirection for planar reflectors perpendicular to the examination surface at or near the opposite surface is carried out as per the following.

Position the search unit for maximum amplitude from the notch on the opposite surface of the basic calibration block and mark the position of peak of the indication on the screen

The opposite surface notch may give an indication 2 to 1 above DAC for a 45° angle beam search unit and $\frac{1}{2}$ DAC for a 60° search unit. Therefore, the indications from the notch must be considered when evaluating reflectors at the opposite surface

10. EVALUATION :

It shall be carried out by at least NDE Level II personnel as per the following.

- All indications exceeding 20% of DAC shall be scanned for their nature and location and recorded. The gain shall be increased an additional amount so that no calibration reflector indication is less than 40% FSH during evaluation.



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- The identity, maximum amplitude, location and extent of reflector causing a geometric indication(s) (segregates in the heat-affected zone, surface conditions such as weld root geometry) shall be recorded.
- Following shall be considered for Classifying an indication as geometric or not.
 - Plot and verify the reflector coordinates. Prepare a cross-sectional sketch showing the reflector position and surface discontinuities such as root and counter bore.
 - Review fabrication or weld preparation drawing. Other ultrasonic techniques or nondestructive examination methods may be helpful in determining a reflector's true position, size, and orientation.

11. RECORDING AND REPORTING:

11.1 METHOD OF RECORDING:

- Test data shall be recorded manually in the Proforma appended in exhibit-1 Annexed and reported and Direct thickness read out by manual Ultrasonic pulse echo contact method is recorded in exhibit-2.
- As a minimum all rejectable indications, type of indications (Crack, non-fusion, slag etc.), location and extent (length), depth below surface shall be recorded.
- Non-rejectable indications exceeding 50% of DAC shall be recorded

Report shall contain the following in addition to those mentioned in the table appended next page.

- Procedure identification and revision.
- Instrument reference level gain and, if used, damping and reject settings(s).
- Calibration data (including reference reflector(s) indication amplitude(s), and distance reading(s)).
- Identification and location of weld or volume scanned.
- Map or record of rejectable indications detected or areas cleared.
- Areas of restricted access or inaccessible welds;
- Examination personnel identity and, when required by referencing code section qualification level.
- Date of examination.

12. ACCEPTANCE STANDARDS:

As per ASME SEC I, ASME SEC VIII Div 1, ASME SEC VIII Div 2 Edition 2019, ASME B31.1, NBIC NB 23 Latest Edition.

UT on clad plate (Dished ends) shall be performed as per ASME A 578.

ACCEPTANCE-REJECTION STANDARDS:

(Ref: ASME SEC I, ASME SEC VIII Div 1, ASME SEC VIII DIV 2 Edition 2019)

Imperfections recorded as per para 10 above shall be evaluated as below.

1. Indications characterized as cracks, lack of fusion or incomplete penetration are unacceptable regardless of length.



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2. Other imperfections are unacceptable if the indications exceed the reference level amplitude and have lengths which exceed $1/3 T$ - (weld thickness(T) excluding any allowable reinforcement) or 6 mm whichever is greater.

Notes: Butt welds joining two different thicknesses at the weld, T is the thinner of these two thicknesses.

(For other Codes such as ASME B31.1, NBIC NB23 refer respective current Edition)

13. PRESERVATION OF DATA REPORTS:

All the reports of ultrasonic test shall be preserved till MDR signed.



**PROCEDURE FOR
MAGNETIC PARTICLE
EXAMINATION**

PROC No : BHE-NDT-MT-07024
REVISION : 2
SHEET : 1 OF 11

ISSUE NO.2

**PROCEDURE FOR
MAGNETIC PARTICLE EXAMINATION**

Issue No	Rev No	Date of Revision	Brief Records of Revision
1	0	02-02-2015	First Edition
1	1	11-04-2017	Cl no. 3,5,8,6,9,14 revised as per ASME Sec V Edition 2015
2	1	25-04-2018	Cl no. 3,5,8,2,19,14 revised as per ASME Sec V Edition 2017
2	2	15-05-2020	Cl. no. 1,6,7.1,7.2 Modified; 13,14,15,16,17,18 renumbered; Cl. no. 3,4,9,2,18 revised; Cl.no.8,10,11,12 added.



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**PROCEDURE FOR
MAGNETIC PARTICLE
EXAMINATION**

PROC No : BHE-NDT-MT-07024
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PROCEDURE FOR MAGNETIC PARTICLE EXAMINATION

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1. SCOPE :

This Procedure shall be applied for detecting of surface and near surface discontinuities in Butt welds, fillet welds, partial penetration welds, Back Gouging welds, Full penetration butt and corner welds, Nozzles of Boiler components, pressure vessels, heat exchangers, power piping and Non pressure parts welds, plates, forgings, etc. of Ferro Magnetic Materials to detect surface and subsurface discontinuities using visible Dry & wet particle Continuous Prod or Yoke technique and Fluorescent Wet Prod or Yoke Techniques.

2. POLICY:

- 2.1 The Magnetic Particle Examination shall be carried out either as per one of the procedures enumerated in the following pages which are verified and found to be in accordance with ASME SEC V or as per any other applicable referencing code sections and specifications.
- 2.2 Only personnel qualified to MT NDE Level II / MT NDE Level III in accordance with NDE written practice shall carry out any Magnetic Particle Examination.

3. APPLICABLE STANDARDS:

- 3.1 ASME SEC V Edition 2019
- 3.2 Construction code sections ASME Sec I, ASME Sec VIII Div 1, ASME Sec VIII Div 2 Edition 2019, ASME B31.1 Edition 2018, NBIC NB 23 Edition 2019, SNT-TC-1A Edition 2016 & ASME SEC V Edition 2019 Art.1.

4. SYSTEM:

All Magnetic particle examination procedures shall be amended and approved as required by NDE level III taking into consideration of

- 4.1 Experience gained in various examination procedures
- 4.2 Recommendation of Audit Teams
- 4.3 Referencing Code sections.



PROCEDURE FOR MAGNETIC PARTICLE EXAMINATION

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5. WRITTEN PROCEDURE REQUIREMENTS:

This procedure based on Table T-721 of ASME SEC V Edition 2019 shall contain the requirements listed in the Table below.

It shall establish a single value, or range of values for each requirement. When required performance shall be demonstrated to the inspector. Any change in specified value or range of values of the essential variables mentioned in Table shall require requalification of the written procedure.

Table T-721
Requirements of a Magnetic Particle Examination Procedure

Requirement	Essential Variable	Nonessential Variable
Magnetizing technique	X	...
Magnetizing current type or amperage outside range specified by this Article or as previously qualified	X	...
Surface preparation	X	...
Magnetic particles (fluorescent/ visible, color, particle size, wet/ dry)	X	...
Method of particle application	X	...
Method of excess particle removal	X	...
Minimum light intensity	X	...
Existing coatings, greater than the thickness demonstrated	X	...
Nonmagnetic surface contrast enhancement, when utilized	X	...
Performance demonstration, when required	X	...
Examination part surface temperature outside of the temperature range recommended by the manufacturer of the particles or as previously qualified	X	...
Shape or size of the examination object	...	X
Equipment of the same type	...	X
Temperature (within those specified by manufacturer or as previously qualified)	...	X
Demagnetizing technique	...	X
Post-examination cleaning technique	...	X
Personnel qualification requirements	...	X

6. SURFACE CONDITIONING :

6.1 SURFACE PREPARATION:

6.1.1. Prior to Magnetic Particle Examination, the surface to be examined and all adjacent areas within at least 1" shall be dry and free of all dirt, grease, lint, scale, welding flux & spatter, oil and other extraneous matter that could interfere with examination.

6.1.2. As welded, ground, Machined and Back Gouged conditions are preferable. However, Surface preparation by grinding or machining may be necessary where surface irregularities could mask indications due to discontinuities. This



PROCEDURE FOR MAGNETIC PARTICLE EXAMINATION

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procedure does not address the testing of parts covered with coatings and / or non magnetic surface contrast enhancement.

6.1.3. The surfaces which are to be examined by Magnetic particle testing shall be free from any external Nonmagnetic coatings. If any nonmagnetic coatings are present, it shall be demonstrated that indications can be detected through the existing maximum coating thickness applied.

6.1.4. Nonmagnetic Surface Contrast Enhancement:

Nonmagnetic surface contrasts may be applied by the examiner to uncoated surfaces, only in amounts sufficient to enhance particle contrast. When nonmagnetic surface contrasts are used, it shall be demonstrated that indications can be detected through the enhancement. Thickness measurement of surface contract enhancement is not required.

6.2 TEMPERATURE OF PART SURFACE:

The surface temperature of the part examined with dry particles shall be within the range of 17 °C to 315 °C (within maximum temperature specified by the manufacturer of the particles) and wet particles shall be maximum 57 °C or temperature specified by the manufacturer of the particles.

7. EQUIPMENT:

7.1 TYPE OF EQUIPMENT:

7.1.1. Portable magnetic particle testing equipments appearing in the current list of NDE Equipments under calibration (230V, single phase, open circuit voltage <25V) provided with stepped / continuous current control, remote control switch for momentarily switching on / off, prods for application of current and capable of generating max 1000A HWDC shall be used for magnetization.

7.1.2. Direct/Alternating current electromagnetic yokes shall be used to detect discontinuities that are open to the surface of the part by longitudinal magnetization method and to examine the surfaces where arcing is not permitted or prod method is not practicable.



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7.2 CALIBRATION OF EQUIPMENT:

- 7.2.1. Each magnetizing equipment with an ammeter shall be calibrated at least once a year, or whenever the equipment has been subjected to major electric repair, periodic overhaul, or damage.
- 7.2.2. The magnetizing power of yokes shall be verified prior to use on every day the yoke is used. The magnetizing power of yokes shall be verified whenever the yoke has been damaged or repaired.
- 7.2.3. Each alternating current electromagnetic yoke shall have a lifting power of at least 4.5 kg at the maximum pole spacing that will be used with contact similar to what will be used during the examination.
- 7.2.4. Each direct current or permanent magnetic yoke shall have a lifting power of at least 18 kg at the maximum pole spacing that will be used with contact similar to what will be used during the examination.
- 7.2.5. Each weight shall be weighed with a scale from a reputable manufacturer and stencilled with the applicable nominal weight prior to first use. Weight need only be verified again if damaged in a manner that could have caused potential loss of material.

8. EXAMINATION MEDIUM:

8.1 DRY PARTICLES:

Finely divided ferromagnetic dry particles (non-fluorescent free flowing dry particles of colors either red or grey.) supplied by M/s Arora / M/s Pradeep with brand name Automag RD-7 Red or M/s Ferrochem with Brand names Ferrochem grey and Ferrochem Red shall be used.

8.2 WET PARTICLES:

8.2.1. WET PARTICLE CONCENTRATION:

Non fluorescent or fluorescent wet particles will be black or reddish brown in color that provide adequate contrast with the surface being examined.



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Wet particles shall be suspended in kerosene or water for application to the test surface by flowing or spraying. Suitable conditioning agents shall be added to the water to provide proper wetting and corrosion protection for the parts being examined.

The bath concentration shall be determined by measuring the settling volume through the use of pear-shaped centrifuge tube with a 1-mL stem (0.05-mL divisions) for fluorescent particle suspensions or a 1.5-mL stem (0.1-mL divisions) for non-fluorescent suspensions. The suspension shall be mixed thoroughly or shall be run through the re-circulating system for at least 30 minutes to ensure thorough mixing of all particles. Take a 100-mL portion of the suspension from the hose or nozzle, demagnetize and allow it to settle for 30 minutes' minimum with water based suspension or 60 minutes' minimum with petroleum distillate suspension before taking the reading.

For fluorescent particles, the required settling volume is from 0.1 mL to 0.4 mL in a 100-mL bath sample and from 1.2 mL to 2.4 mL per 100 mL of vehicle for non-fluorescent particles or as recommended by the manufacturer. Concentration checks shall be made at least every eight hours.

8.2.2. WET PARTICLE CONTAMINATION:

Both fluorescent and non-fluorescent suspensions shall be checked periodically for contaminants such as dirt, scale, oil, lint, loose fluorescent pigment, water (in the case of oil suspensions), and particle agglomerates which can adversely affect the performance of the magnetic particle examination process. The test for contamination shall be performed at least once per week.

8.2.2.1. Carrier Contamination:

For fluorescent baths, the liquid directly above the precipitate should be examined with fluorescent excitation light. The liquid will have a little fluorescence. Its color can be compared with a freshly made-up sample using the same materials or with an unused sample from the original bath that was retained for this purpose. If the "used" sample is noticeably more fluorescent than the comparison standard, the bath shall be replaced.



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8.2.2.2. Particle Contamination.

The graduated portion of the tube shall be examined under fluorescent excitation light if the bath is fluorescent and under visible light (for both fluorescent and non-fluorescent particles) for striations or bands, differences in color or appearance. Bands or striations may indicate contamination. If the total volume of the contaminates, including bands or striations exceeds 30% of the volume magnetic particles, or if the liquid is noticeably fluorescent, the bath shall be replaced.

Note: In any case, color of particles used shall have adequate contrast with the surface being examined.

9. EXAMINATION:

9.1 EXAMINATION COVERAGE:

All examinations shall be conducted with sufficient field overlap to ensure 100% coverage at the required sensitivity.

9.2 MINIMUM LIGHT INTENSITY:

9.2.1. Visible Light Intensity

9.2.1.1. The examination area and the accumulation of magnetic particles shall be observed under adequate lighting. An intensity of 1076 lux is adequate. The minimum light intensity shall be 100 fc (1076 lux). The light intensity, natural or supplemental white light source, shall be measured with a white light meter prior to the evaluation of indications or a verified light source shall be used. Verification of light sources is required to be demonstrated only one time, documented, and maintained on file.

All following activity shall be done under the illumination of 100 watt 230V incandescent bulb at a minimum distance of 25 cms from test part for ensuring 1076 Lux light intensity at test part surface.

9.2.2. Black Light (UV-A Light)

9.2.2.1. Black light intensity at the examination surface shall be not less than 1000 micro watt/ cm² at a distance of 15 inch.



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- 9.2.2.2. The black light intensity shall be measured at least once in every 8 hrs. and whenever the work station is changed. The UV-A and White Light Meter should be calibrated once in One year.
- 9.2.2.3. With fluorescent particles, the examination is performed in a darkened area. The Intensity of Ambient visible light in the darkened area shall not exceed 2 fc or 21.5 lux.
- 9.2.2.4. The examiner shall be in the darkened area for at least 5 minutes prior to performing the examination for eye adaptation. The examiner shall not wear glasses with permanent Tint or Photo Chromic (light sensitive) lenses which change colour in Sunlight.
- 9.2.2.5. The black light shall be warmed up for a minimum period of 5 minutes prior to use or measurement of the intensity.

Lux meter/Light meter shall be calibrated at least once a year or whenever a meter has been repaired. If meters have not been in use for one year or more, calibration shall be done before being used.

For selection of other light sources vs maximum distances permitted refer Exhibit 1.

9.3 DIRECTION OF MAGNETIZATION:

Two separate examinations shall be performed on each area. During second examination, the lines of magnetic flux shall be approximately perpendicular to those used in the first examination.

10. METHOD OF EXAMINATION:

Examination shall be made by continuous method.

10.1 Dry continuous magnetization method:

The magnetizing current remains on while the examination medium (Brick red Dry particle) is being applied and while the excess of the examination medium is being removed.

10.2 Wet continuous magnetization method:



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The magnetizing current shall be turned on after the particles have been applied. Flow of particles shall stop with the application of current. Wet particles applied from aerosol spray cans/pump sprayers may be applied before and/or during magnetizing current application.

11. TECHNIQUES:

11.1 PROD TECHNIQUE:

11.1.1. Magnetizing Procedure:

The prod electrodes are pressed firmly against the surface in the area to be examined. In order to avoid arcing, a remote control switch shall be built into the prod handles, to permit the current to be turned on after the prods have been properly positioned and to be turned off before they are removed. The prods tips shall be kept dressed and cleaned to make satisfactory electrical contact.

11.1.2. Magnetizing Current and Prod Spacing:

Single-phase (half-wave rectified) current HWDC shall be used. The current shall be 100 to 125amps per inch of prod spacing for sections 0.75 inch thick or greater. For sections less than 0.75 inch thick the current shall be 90 to 110 amps per inch of prod spacing. Prod spacing shall not exceed 8 inches and shall not be less than 3 inches.

11.2 YOKE TECHNIQUE:

11.2.1. This technique is primarily intended to cover the region between the poles. The pole spacing shall be between 100 mm to 150 mm. In order to ensure that the region of interest gets 100 % coverage, every region (or segment of the test area, divided according to the pole spacing), shall be tested twice such that the pole space displacements are mutually perpendicular in the former and later cases. For example, in the case of the weld, the pole space orientation can be 45 Deg. and 135 Deg. Respectively with respect to the weld center line orientation, in the first and second attempts.

11.2.2. Pie-Shaped Magnetic Particle Field Indicator shall be used to ensure field adequacy as well as direction of field. It shall be positioned on the surface to be examined with copper-plated side away from the inspected surface.



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Suitable field strength is indicated by formation of clearly defined lines of magnetic particles across the copper face of the indicator when the magnetic particles are applied simultaneously with the magnetizing force. When a clearly defined line of particles are not formed in the desired direction, the magnetizing technique shall be changed as needed.

11.3 For inspection of components of Gr 91 material including Gr C12A, prod technique shall not be used. This shall be inspected by Yoke technique using Dry or Wet method.

12. METHOD OF PARTICLE APPLICATION AND EXCESS PARTICLE REMOVAL:

12.1 DRY PARTICLES:

- 12.1.1. The dry particles shall be applied in such a manner that a light uniform dust-like coating settles on the surface of the area being examined. The application technique shall be such that the particles are suspended in air and reaches the examination surface in a uniform cloud with a minimum force, using hand powder applicators (squeeze bulb) or specially designed mechanical blower or by a spray nozzle.
- 12.1.2. Dry particles shall not be applied to a wet surface nor when there is excessive wind. The particles shall not be applied by pouring, throwing, or spreading with fingers.
- 12.1.3. Any excess powder shall be removed while the magnetization current is on and shall be with a gentle air stream by a blower or squeeze bulb without removing or disturbing particles attracted by a leakage field that may prove to be a relevant indication.

12.2 WET PARTICLES:

- 12.2.1. The application of wet particles involves the bathing of the area to be examined, by spraying or flowing during the application of magnetizing current.
- 12.2.2. Two or more shots shall be applied, but the last shot shall be applied while the bath still remains on the area to be examined and after the particle flow has been stopped. Care shall be taken to cut off the bath application before



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removing the magnetic field, to prevent high-velocity particle flow that may wash away or remove fine or weakly held indications.

13. INTERPRETATION AND EVALUATION :

- (a) All indications shall be evaluated in terms of the acceptance standards of the referencing Code Section.
- (b) Discontinuities on or near the surface are indicated by retention of the examination medium. However, localized surface irregularities due to machining marks or other surface conditions may produce false indications.
- (c) Broad areas of particle accumulation, which might mask indications from discontinuities, are prohibited, and such areas shall be cleaned and reexamined.

All indications shall be evaluated by a NDE Level II or NDE Level III in terms of the acceptance standard of ASME SEC VIII DIV 1, ASME SEC VIII DIV 2, ASME SEC I, ASME B31.1, NBIC NB 23 current Edition.

14. REPORTING :

Interpretation and evaluation shall be reported in the Proforma appended in Exhibit-2.

15. POST-EXAMINATION CLEANING :

The examination surface shall be wiped clean using cloth / cotton waste.

16. DEMAGNETIZATION :

No demagnetization is required unless specifically required by customer. When required one of the following methods (ref. SE-709-95 for detail techniques) shall be used.

- Withdrawing from AC coil.
- Decreasing alternating current.
- Demagnetizing with yokes.

17. RECORDS :

All the reports of Magnetic particle test shall be preserved till MDR signed.



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18. ACCEPTANCE STANDARDS:

(Ref: ASME SEC I, ASME SEC VIII Div 1 & Div 2 Edition 2019)

All surfaces to be examined shall be free of

- Relevant Linear indications
- Relevant rounded indications greater than 5 mm.
- Four or more relevant rounded indications in a line separated by 1.5 mm or less edge to edge.

Notes: Any indication believed to be non relevant shall be confirmed by re-examination using same method or other non destructive examination method and/or by surface conditioning.

1. **Relevant indications:** Indications having any dimension greater than 1.5 mm.
2. **Linear indications:** Relevant Indications having length greater than three times the width.
3. **Rounded indications:** Relevant indications having circular or elliptical shape with a length equal to or less than three times its width.

(For other Codes such as ASME B31.1, NBIC NB23 refer respective current Edition)



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ISSUE NO.: 2

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Issue No	Rev No	Date of Revision	Brief Records of Revision
1	0	02-02-2015	First Edition
1	1	11-04-2017	Cl no. 3,5,13 revised as per ASME Sec V Edition 2015
2	1	25-04-2018	Cl no. 3,5,6.2,6.4,6.6,7.2.4,7.3,10,15 revised as per ASME Sec V Edition 2017
2	2	15-05-2020	Cl no. 3.1,3.2,6.2,14 revised and Cl no.1,6.1,6.4,8 modified as per ASME Sec V Edition 2019.



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LIGHT LEVEL VERIFICATION RECORD	Exhibit 1
LIQUID PENETRANT EXAMINATION TECHNIQUE SHEET CUM REPORT FORMAT	Exhibit 2

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1. SCOPE:

This Procedure shall be used for the detection of open surface discontinuities in welds, plates, and forgings etc., used in Pressure Vessels., Heat Exchangers, Boilers and parts thereof by visible Liquid Penetrant Examination using solvent removable process for ferrous and non-ferrous materials.

2. POLICY:

- 2.1. The Liquid Penetrant Examination shall be carried out either as per one of the procedures enumerated in the following pages which are verified and found to be in accordance with ASME SEC V or as per any other applicable referencing code sections and specifications.
- 2.2. Only personnel qualified in accordance with BHEL HPVP NDE Written Practice shall carry out any Liquid Penetrant examination.

3. APPLICABLE STANDARDS:

- 3.1 ASME SEC V Edition 2019.
- 3.2 Construction code sections ASME Sec I, ASME Sec VIII Div 1, ASME Sec VIII Div 2 Edition 2019, ASME B31.1 Edition 2018, NBIC NB 23 Edition 2019, SNT-TC-1A Edition 2016 & ASME SEC V Edition 2019 Art.1.

4. SYSTEM:

All Liquid Penetrant Examination procedures shall be amended and approved as required by NDE Level III taking into consideration of

- 4.1. Experience gained in various examination procedures.
- 4.2. Recommendation of Audit Teams.
- 4.3. Referencing Code sections.



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5. WRITTEN PROCEDURE REQUIREMENTS: (As per ASME Sec V Article 6 T-621)

Liquid Penetrant examination shall be performed in accordance with a written procedure, which shall as a minimum contain the essential and non-essential variable as mentioned in the table below. The written procedure shall establish a single value, or range of values, for requirement.

Table T-621.1
Requirements of a Liquid Penetrant Examination Procedure

Requirement	Essential Variable	Nonessential Variable
Identification of and any change in type or family group of penetrant materials including developers, emulsifiers, etc.	X	...
Surface preparation (finishing and cleaning, including type of cleaning solvent)	X	...
Method of applying penetrant	X	...
Method of removing excess surface penetrant	X	...
Hydrophilic or lipophilic emulsifier concentration and dwell time in dip tanks and agitation time for hydrophilic emulsifiers	X	...
Hydrophilic emulsifier concentration in spray applications	X	...
Method of applying developer	X	...
Minimum and maximum time periods between steps and drying aids	X	...
Decrease in penetrant dwell time	X	...
Increase in developer dwell time (Interpretation Time)	X	...
Minimum light intensity	X	...
Surface temperature outside 40°F to 125°F (5°C to 52°C) or as previously qualified	X	...
Performance demonstration, when required	X	...
Personnel qualification requirements	...	X
Materials, shapes, or sizes to be examined and the extent of examination	...	X
Post-examination cleaning technique	...	X

Any change of requirement specified as an essential variable mentioned above shall require requalification of the written procedure.

6. METHOD OF EXAMINATION:

6.1. IDENTIFICATION OF PENETRANT EXAMINATION MATERIALS:

6.1.1. PRADEEP/PMC/MAGNAFLUX brands of PT chemicals be used. Other brands may also be used with the approval of NDE Level-III.

6.1.2. Refer certification of contaminant content for all liquid penetrant materials used.

6.1.3. Ensure manufacturers batch numbers, on the penetrant material containers and Certificate mentioned above are same.

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6.2. MINIMUM LIGHT INTENSITY:

All following activity shall be done under the illumination of 100 watt 230V incandescent bulb at a maximum distance of 25 cms from test part for ensuring 1076 Lux light intensity at test part surface.

6.3. SURFACE PREPARATION (FINISHING AND CLEANING, INCLUDING TYPE OF CLEANING SOLVENT) (As per ASME Sec V Edition 2019 Article 6 T-642)

This procedure applies to below mentioned surface preparations.

- 6.3.1. As welded
- 6.3.2. As ground
- 6.3.3. As machined /As Forged/As Plates

6.3.4. SURFACE CLEANING:

- 6.3.4.1. Ensure Surface examined and all adjacent areas within 1" shall be free of scale, welding flux, weld spatter.
- 6.3.4.2. Use Organic solvent - Cleaner mentioned above to remove oil, and other extraneous matter.
- 6.3.4.3. Wait for a minimum of 3 minutes for evaporation of cleaning solvent used above.

6.4. SURFACE TEMPERATURE (As per ASME Sec V Edition 2019 Article 6 T-652)

Ensure that the temperature of the penetrant and the surface of the part to be subjected to penetrant testing is between 5 to 52 deg centigrade. For examination between 5- 10 deg Centigrade, the minimum Penetrant dwell time shall be two times than that established for testing between 10 to 52 deg Centigrade.

6.5. METHOD OF APPLYING PENETRANT

Use brush or spray for application of penetrant to the surface of the part.

6.6. PENETRATION (DWELL) TIME

- 6.6.1. Allow penetrant on the weld surface for minimum 5 minutes and maximum 10 for welds & Casts.



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6.6.2. Allow penetrant on the surface for minimum 10 minutes and maximum 15 minutes and for plates & forgings.

Note: Ensure that penetrant is not dried during dwell time.

6.7. METHOD OF REMOVING EXCESS SURFACE PENETRANT

6.7.1. After completion of penetration (dwell) time remove any penetrant remaining on the surface using clean, dry, and lint free cloth.

6.7.2. Remove the remaining traces of penetrant on the weld surface by wiping the surface with clean, lint-free material lightly moistened with the solvent remover. Complete this step within 10 minutes after start of excess penetrant removal.

6.7.3. Do not flush the weld surface with cleaning solvent for removal of excess penetrant.

6.8. DRYING AFTER EXCESS PENETRANT REMOVAL (AS PER ASME SEC V ARTICLE 6 T-674)

Wait for a maximum of 2 minutes for evaporation of cleaning solvent used above for Excess Penetrant Removal.

6.9. METHOD OF APPLYING DEVELOPER

Apply Developer using aerosol can spray after above step. (i.e. Drying After Excess Penetrant Removal). Maximum time for Developer application is 5 min.

6.10. DEVELOPER DWELL TIME (INTERPRETATION TIME)

6.10.1. Developing time for final interpretation begins immediately after developer coating is dry.

6.10.2. Wait for a minimum of 2 minutes after developer spray for developer coating to dry.

6.10.3. Observe closely during application of developer to aid in characterization of indications developed.

6.10.4. Final interpretation shall be made within 10 to 20 min after developer coating is dry.

6.11. MINIMUM AND MAXIMUM TIME PERIODS BETWEEN STEPS AND DRYING AIDS



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6.11.1. Minimum time between surface cleaning and application of penetrant 3 minutes. Maximum No limit.

6.11.2. Minimum/Maximum time between application of penetrant and start of excess Penetrant removal 5/10 minutes for welds and 10/15 minutes for plates and forgings.

6.11.3. Maximum time between excess penetrant removal and application of Developer 10 minutes.

6.11.4. Final interpretation time minimum 10 and maximum 20 minutes after developer coating is dry.

7. PERSONNEL QUALIFICATION REQUIREMENTS

Personnel qualified and certified to NDE Level III in PT shall demonstrate this procedure to the satisfaction of AI. Application of this procedure on jobs shall be by personnel qualified and certified to NDE Level II / NDE Level III in PT as per the Written Practice.

8. MATERIALS, SHAPES, OR SIZES TO BE EXAMINED AND THE EXTENT OF EXAMINATION

This procedure is applicable to welds, plates, forgings of all shapes and sizes for ferrous and non ferrous materials. The extent of examination shall be as per referred specification or test plan.

9. POST EXAMINATION CLEANING TECHNIQUE:

Using cloth or cotton waste Post-examination cleaning shall be done as soon as practical after Evaluation and Documentation.



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10. GENERAL REQUIREMENTS:

- 10.1. If the surface to be examined is large enough to complete examination within the above established times the examination shall be performed in increments.
- 10.2. Ensure bleed-out from large indications does not alter the examination results during interpretation time.
- 10.3. Any change of requirement specified as an essential variable in para 5 shall require requalification of this written procedure.

11. EVALUATION:

All indications shall be evaluated in terms of the acceptance standards Referred below.

12. DOCUMENTATION (AS PER ASME SEC V EDITION 2019ARTICLE 6 T-690):

Recording of Indications shall be done in Liquid Penetrant Examination Requisition cum report format referred in Exhibit 2.

- 12.1. Non rejectable Indications: Non rejectable indications shall be recorded as specified by the referencing Code Section.
- 12.2. Rejectable Indications: Rejectable indications shall be recorded.
As a minimum, the type of indications (linear or rounded), location and extent (length or diameter or aligned) shall be recorded.

13. RECORDS:

All the reports of Liquid Penetrant Examination shall be preserved till MDR signed.

14. ACCEPTANCE STANDARDS FOR LIQUID PENETRANT EXAMINATION:

REF: ASME SEC I, ASME SEC VIII Div 1 & Div 2 Edition 2019.

All surfaces to be examined shall be free of

1. Relevant linear indications.
2. Relevant rounded indications greater than 3/16 inch (5mm).



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3. Four or more relevant rounded indications in a line separated 1/16 inch (1.5mm) or less (edge to edge).

Notes:

- Only indications with major dimensions greater than 1/16 inch (1.5 mm) shall be considered relevant.
- A linear indication is one having a length greater than three times the width.
- A rounded indication is one of circular or elliptical shape with the lengthy equal to or less than three times the width.
- Any questionable or doubtful indications shall be reexamined to determine whether or not they are relevant.

(For other Codes such as ASME B31.1, NBIC NB23 refer respective current Edition)