Bharat Heavy Electricals Limited
Heavy Plates & Vessels Plant
Visakhapatnam – 530 012
Andhra Pradesh, INDIA
PAN-AAACB4146P, GSTIN-37AAACB4146P7Z8

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INVITATION TO TENDER

Ref.: OS/21-22/2438/Partial Fab/PVLG/33/011 Date: 02.07.2021

Sub: Partial Fabrication of L&T Vessels (with Boots) against S.O. 2438 at HPVP-Lovagarden site, Visakhapatnam

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 subject to the following eligibility criteria:

ELIGIBILITY CRITERIA:

1.1 Bidders must have an experience of executing fabrication of similar works in the past 7 Years as on 30.06.2021. Bidders shall have to enclose Work Order / Purchase Order and Work Completion Certificate / any other relevant document from their customer/s in support of successful and satisfactory completion of the work.

1.3 Similar works means Fabrication of Columns/ Pressure Vessels/ Storage Tanks for Process industries.

1.4 Bidders shall have to enclose the documents of Registration of Firm/ Certification of Incorporation/ Factory License, 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 of the tenderer will only be considered for eligibility criteria.

1. LOCATION OF WORK SPOT:

1.1 The fabrication work is to be carried out at Lovagarden Site (a Sea Front facility of BHEL - HPVP near Hindustan Shipyard Limited - OPF Site), Visakhapatnam, Andhra Pradesh.

2. VENDOR'S SCOPE OF WORK:

2.1 The following are the Vessels having Boots and will be fabricated as separate entities i.e., as Vessel and Boots at our HPVP shops. Vessels and its Boots are to be assembled at Lovagarden site. Details of the Vessels to be Partially fabricated at Lovagarden site for HPCL, Vizag project of M/s LTHE is as follows:

1.	**Closed Blow Down Drum -2**	**- Tag No. 504-V-809**
2.	**Hot Oil Blow Down Drum**	**- Tag No. 504-V-807**
3.	**HOS Product Drum**	**- Tag No. 504-V-201**
4.	**Closed Blow Down Drum -1**	**- Tag No. 504-V-803**
5.	**HP Flare K.O. Drum**	**- Tag No. 504-V-801**

2.2 Partial fabrication of the Vessels includes Assembly, Fit-up, Welding, NDT of Boot assemblies with SR Nozzle / RF Pads as applicable on the Vessels, Local PWHT, Hydro testing of Complete Vessel, Shot blasting and Painting of Complete Vessels as per applicable approved drawings, QAP, WPS, Painting Schedule, Approved Procedures, Specifications & Standards, etc. and it includes the following activities but not limited to the same:

2.2.1 The fabricated vessels, Rolled / Pressed RF Pads, Fabricated Boot assemblies and SR Nozzles shall be issued as FIM to the vendor at HPVP-Lovagarden site. Transportation of the same from BHEL-HPVP shops to Lovagarden site is in the scope of BHEL.

2.2.2 Unloading of the vessels and placing them on the Rollers / supports. BHEL will be deploying one no. of 75 MT Crawler crane and one no. of 300 MT Crawler Crane for handling of the vessels. However, the required manpower for handling shall be arranged by the vendor.

2.2.3 Collection of free issue items like Blind Flanges, Fasteners & Gaskets, Fabricated Saddles required for Hydro-testing of the Vessels, Paints etc., from BHEL-HPVP stores / shops and Transportation of the same to Lovagarden site is in the scope of the vendor.

2.2.4 Assembly, Fit-up and Welding of SR Nozzles / RF Pads of the Boots on Shell including Edge Preparation as per applicable drawings, approved QAP and Specifications.

2.2.5 Assembly, Fit-up and Welding of Boot Shell Assemblies with SR Nozzle / RF Pad & Shell including Edge Preparation as per applicable drawings, approved QAP and Specifications.

2.2.6 NDT requirement as per applicable drawings, approved QAP and specifications.

2.2.7 Local Stress Relieving shall be carried out by engaging specialised agency for the Joints of SR Nozzles / RF Pads to Shell, SR Nozzles / RF Pads to Boot Shell Assemblies as per approved drawings, QAP, Specification and Procedures.

2.2.8 Hardness shall be checked for the joints on Welds / Heat Affected Zone / Parent Metal after PWHT as per approved QAP / NDE procedure.

2.2.9 100% UT on Pressure retaining welds after PWHT as per approved QAP / NDE procedure.

2.2.10 After completion of SR, the vessel shall be loaded on the saddles for conducting Hydro-test. Fabricated saddles shall be provided by HPVP. However, transportation of the same from BHEL-HPVP shop to Lovagarden site is in vendor's scope.

2.2.11 Temporary supporting arrangement for supporting of Nozzles is to be provided for conducting Hydro-test of the vessel. The materials required for fabrication of temporary supports shall be issued by BHEL as FIM which shall be collected and transported from HPVP-stores to Lovagarden site by the vendor.

2.2.12 Arrangement of all the accessories required for the Hydro-test like Filling Pump, Pressurizing Pump, Calibrated Pressure Gauges including fabrication of stems for Fixing of Pressure Gauges, Non-Return Valves etc. Testing of water samples at NABL approved laboratory for its suitability for Hydro-test is in Vendor's scope.

2.2.13 Hydro-testing of Vessel followed by Draining, Drying & Cleaning.

2.2.14 Spot PT after Hydro Testing of Vessels as per approved QAP.

2.2.15 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, Surface Profile Gauge Check, Tape Adhesion Test, Holiday Check, Peel-off Test etc., required as per Project 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 / AIA / LTHE as per approved QAP.

2.2.16 Painting is to be carried out only by Painters qualified by HPVP as per BHEL standard format.

2.2.17 Nitrogen filling of the vessels is to be carried out as per drawings and approved QAP. Nitrogen shall be made available at one point by BHEL-HPVP **as Free Issue**. The arrangement of all accessories required for filling of Nitrogen i.e., laying of necessary piping, valves, manifolds, gauges etc., shall be arranged by the Vendor.

2.2.18 All the Nozzle openings shall be closed with suitable steel blind covers supplied by BHEL as FIM.

2.2.19 Name plate fixing, punching and rub off.

2.2.20 Offering for stage wise / final inspection and obtaining Clearance as per approved QAP from HPVP (QC) / TPIA / AIA / LTHE.

2.2.21 Loading of Finished equipments onto the trailer using the BHEL cranes by providing necessary manpower, Tools & tackles and welding of all temporary supports required for transportation of vessels.

2.2.22 Experienced Site in charge, Technically Qualified Engineers, Safety Supervisors, Quality Control Engineers, NDT Evaluation Engineer (Level-II) & sufficient Supervisors shall be deployed for smooth execution & proper co-ordination of the job.

2.2.23 Welding shall 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.

2.2.24 All consumables like welding electrodes, gases, grinding wheels etc. required for fabrication are in the scope of the Vendor. 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.

2.2.25 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 Vendor.

2.2.26 Sufficient No. of Rollers & Idlers are to be arranged by the vendor.

2.2.27 All the Scaffolding materials like Pipes, Clamps, Jallies etc. for temporary platform works are to be arranged by the Vendor.

2.2.28 Liaisoning & Issue of Gate passes from Visakhapatnam Port Trust for the movement of Manpower, Materials, Machinery, Trailers etc. are to be taken care by the contractor only.

2.2.29 Any modification work due to revision of drawings during fabrication is to be carried out by the vendor without any extra cost.

2.2.30 Vendor shall deploy sufficient no. of calibrated Welding machines, Main Ovens & Portable Ovens required for baking of electrodes etc., at the site. All relevant documents shall also be made available for verification & approval by BHEL - HPVP (QC) / TPIA/ AIA / LTHE.

2.2.31 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.

2.2.32 Equipment details shall be hard stamped by encircling with paint and stencilled in a specific format with details of Project name, Customer No., Work Order No., PGMA No., Weight etc., for identification and dispatch as per the instructions of the outsourcing department.

2.2.33 Vendors shall have to return the Blind Flanges, Fasteners, Fabricated saddles & Temporary supports issued for Hydro testing of the vessels to HPVP Stores / Shops after completion of the job. In case the same are not returned by the vendors, Recovery shall be made as per BHEL Rates plus applicable taxes, prevailing at the time of processing of the final bills.

2.2.34 Though not mentioned specifically, any 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 Standards & Specifications.

3.2 Fabricated vessels, Rolled / Pressed RF Pads, Fabricated Boot assemblies and SR Nozzles and transportation of the same from BHEL-HPVP to Lovagarden site is in the scope of BHEL.

3.3 Blind Flanges, Gaskets & Fasteners, fabricated saddles required for Hydro-test and steel blind covers for all nozzle openings.

3.4 Higher capacity Slings required for handling the vessels.

3.5 All Paints as per requirement.

3.6 Cranes with capacity of 300 MT – 01 No. & 75 MT – 01 No. 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/Helpers required for handling the job shall have to be provided by the vendor.

3.7 Area required for fabrication, site office and Stores at Lovagarden site will be provided free of charge.

3.9 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 bidder's scope. However, Test for Suitability of the Water for carrying out the Hydro Test is to be arranged by vendor at his cost.

3.10 DG set will be provided as a Standby during power breakdown. **However, experienced operator for DG set has to be arranged by the vendor.**

3.11 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 Vendor.

3.12 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 – Vizag / BHEL Authorized Inspection Agency (AIA) / LTHE / PMC / Customer as per approved QAP. Contractor shall have to offer for Stage wise and Final inspection as per 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 / 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.

5. DELIVERY:

5.1 Finished items along with inspection documents and all other certificates are to be handed over to HPVP as per the following schedule:

Within 8 weeks from the date of issue of Fabricated vessels and other fabricated components.

Notes:

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 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. GOODS & SERVICES TAX (GST):

8.1 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 and Sale and GST is required to be paid along with interest 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.

9. REVERSE AUCTION:

9.1 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. Bidder may refer Guidelines for Reverse Auction available on our website, **www.bhel.com** → supplier registra□on → Guidelines for Reverse Auction 2021, before submission of their offer.

9.2 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.

9.3 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.

9.4 Bidders are advised to read the 'Business Rules' (Annexure – V) indicating details of RA event carefully, before reverse auction event.

10. Other Terms & Conditions, whichever applicable, shall be as per Annexure – III enclosed.

11. 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**.**

12. VALIDITY OF OFFER:

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

13. GENERAL:

13.1 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.

13.2 **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 for evaluation**.

13.3 BHEL reserves the right to modify or cancel the tender enquiry at any stage without assigning any reasons thereof.

13.4 The General Terms & Conditions, if any, contradicting with the specific terms & conditions given in the tender, then specific terms & conditions shall only be considered.

14. The following documents shall form part of the tender enquiry:

i) Schedule of Rates : Annexure – I
ii) Details of Vessels to be Partially 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) Approved QAP, Applicable Drawings, Painting Schedule etc., as per Annexure - II (B)
(Drawings, QAP, WPS, Painting Schedule, etc. shall be sent by e-mail to vendor's e-mail address on written request)

15. TENDER SUBMISSION (Through E - Mail):

15.1 Techno-commercial bids along with the tender document duly signed 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 **technicalbid-hpvp@bhel.in**

15.2 **Tentative List of Man Power, Machinery, Tools & Tackles to be engaged by the vendor shall also be attached to the Techno-Commercial Bid.**

15.3 Price bid (i.e., Annexure – I) shall also be sent separately through e-mail to another e-mail ID **pricebid-hpvp@bhel.in**

15.4 Offers completed in all respects along with the supporting documents shall be sent through the above e-mails only **latest by 14.00 Hrs. on 16.07.2021** 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 and time.

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

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

16. TENDER OPENING:

16.1 Techno-commercial Bids will be opened **at 14.00 Hrs** on **16.07.2021.** The bidders may depute their representatives at the time of opening of Technical bids.

16.2 After evaluation of the Techno-commercial Bids, intimation regarding date & procedure of conducting reverse auction shall be given by the service provider to all the eligible techno-commercially qualified bidders through an e-mail in advance at an appropriate time.

For Bharat Heavy Electricals Limited,

02/07/2021

D. N. MURTHY
Dy. Manager (OS)
Bharat Heavy Electricals Ltd.
HPVP, Visakhapatnam-530 012

ANNEXURE - I

SCHEDULE OF RATES

Ref: OS/21-22/2438/Partial Fab/PVLG/33/011 **Date: 02.07.2021**

Sub : Partial Fabrication of L&T Vessels (with Boots) against S.O. 2438 at HPVP-Lovagarden site, Visakhapatnam

Sl. No.	S.O. No.	Description of Work	Unit	Qty.	Unit Rate (Rs.)	Total Amount (Rs.)
		Partial fabrication of the Vessels which includes Assembly, Fit-up, welding, NDT of Boot assemblies with SR Nozzle / RF Pads as applicable on the vessels, Local PWHT, Hydrotesting, Shot blasting & Painting of complete Vessels, Nitrogen Filling of vessels as per applicable drawings, approved QAP, WPS, Painting Schedule, Approved Procedures, Specifications & Standards, etc. at HPVP-Lova Garden site complete in all respects as per the detailed scope of work mentioned in the tender document. (All consumables are in vendor's scope)				
1	**2438**	**Closed Blow Down Drum -2 Tag No. 504-V-809**	**No.**	**1**		
2		**Hot Oil Blow Down Drum Tag No. 504-V-807**	**No.**	**1**		
3		**HOS Product Drum Tag No. 504-V-201**	**No.**	**1**		
4		**Closed Blow Down Drum -1 Tag No. 504-V-803**	**No.**	**1**		
5		**HP Flare K.O. Drum Tag No. 504-V-801**	**No.**	**1**		
		TOTAL				
Total Amount in words:						

Notes :

1) **a) L1 status will be evaluated based on total quoted price.**
   b) Bidder has to quote for all the 5 items.
   c) Part quotation is not acceptable and such bids shall be summarily rejected.
2) 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.
3) The prices shall be fixed & firm without any escalation during the entire period of contract and till completion of work.
4) The quantity / 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.
5) The bidders are advised to go through all the drawings & documents before quoting the tender.
6) The evaluation currency for this tender shall be **INR**.
7) 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

Annexure - II(A)

Ref : OS/21-22/2438/Partial Fab/PVLG/33/011 **Date: 02.07.2021**

Details of Vessels to be Partially fabricated

Sub : Partial Fabrication of L&T Vessels (with Boots) against S.O. 2438 at HPVP-Lovagarden site, Visakhapatnam

Sl. No.	S.O.	PGMA	Vessel Tag No.	Equipment Description	Qty. (No.)	Shell			Boot		Matl. Spec.	Remarks
						ID x Thk (mm)	Length - TL to TL (mm)	Approx. Wt. (MT)	ID x Thk (mm)	Qty. (Nos.)		
1	2438	PV-200	504-V-809	Closed Blow Down Drum -2	**1**	2500 x 28	8500	36	936 x 20	2	SA 516 GR.70	
2	2438	PV-190	504-V-807	Hot Oil Blow Down Drum	**1**	2500 x 28	8500	35	500 x 20	2	SA 516 GR.70	
3	2438	PV-070	504-V-201	HOS Product Drum	**1**	3000 x 16	6000	23	1468 x 16	1	SA 516 GR.70 (NACE+HIC)	
4	2438	PV-160	504-V-803	Closed Blow Down Drum -1	**1**	3000 x 28	8500	39	936 x 20	2	SA 516 GR.70	
5	2438	PV-140	504-V-801	HP Flare K.O. Drum	**1**	5300 x 20	14000	78	572 x 16	1	SA 516 GR.70 (NACE+HIC)	

ANNEXURE - II (B)

Ref: OS/21-22/2438/Partial Fab/PVLG/33/011 **Date: 02.07.2021**

LIST OF REFERENCE DRAWINGS & DOCUMENTS

Sub: Partial Fabrication of L&T Vessels (with Boots) against S.O. 2438 at HPVP-Lovagarden site, Visakhapatnam

Sl. No.	S.O. No.	PGMA	Eqpt. Tag No.	Description of Drawings / Documents	Drawing / Document No.	Rev. No.	No. of Sheets
01	2438	PV-200	504-V-809	General Assembly of Closed Blow Down Drum -2	1-PV-200-U0125	02	01
02		PV-190	504-V-807	General Assembly of Hot Oil Blow Down Drum	1-PV-190-U0123	03	01
03		PV-070	504-V-201	General Assembly of HOS Product Drum	1-PV-070-U0092	04	01
04		PV-160	504-V-803	General Assembly of Closed Blow Down Drum -1	1-PV-160-U0115	01	01
05		PV-140	504-V-801	General Assembly of HP Flare K.O. Drum	1-PV-140-U0107	04	01
06		-	-	QAP for Eqpt. No. 504-V-201, 801, 803, 809 (Code-1)	B016-RUF-LT-504-QC-QD-BHEL(1)-02001	04	18
07		-	-	QAP for Eqpt. No. 504-V-807 (Code-1)	B016-RUF-LT-504-QC-QD-BHEL(1)-02002	03	18
08		-	-	Surface Preparation & Painting Scheme	HPVP-2438-Paint-01	01	02
19	-	-	-	Procedure for Radiographic Examination	BHE-NDT-RT-07023	02	18
17	-	-	-	Procedure For Magnetic Particle Examination	BHE-NDT-MT-07024	02	11
18	-	-	-	Procedure for Ultrasonic Examination	BHE-NDT-UT-07025	02	10
16	-	-	-	Procedure for Liquid Penetrant Examination	BHE-NDT-PT-07026	02	09

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.

ANNEXURE – III

Ref.: OS/21-22/2438/Partial Fab/PVLG/33/011 Date: 02.07.2021

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 ñFree 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 partyôs 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).**

Contd…2

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 Structurals (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 × 250	500 × 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 × 250	500 × 250 & above
6.	SS Structural, Rods, Tubes, Pipes	Below 250	250 & above
7.	Non – ferrous: sheets & plates, rods & tubes	Below 500 × 250 (S & PL), Below 250 (Rods & Tubes)	500 × 250 & above, 250 & above
8.	Big size Scrap	(2500 & above) × (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.

Contd…3

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 vendorôs 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 there of 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 partyôs responsibility to ensure the safety of their workmen and fulfilling the ESI, PF and other relevant statutory regulations.

Contd…4

22. **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. Contractorûs 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.*

23. **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.,

24. **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 menûs 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.

25. **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.

26. 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.

27. 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**.**

28. 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.

Signature of the Bidder with Stamp

Annexure – IV

Ref.: OS/21-22/2438/Partial Fab/PVLG/33/011 Date: 02.07.2021

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

ANNEXURE – V

Ref.: OS/21-22/2438/Partial Fab/PVLG/33/011 Date: 02.07.2021

BUSINESS RULES FOR REVERSE AUCTION (RA)

This has reference to tender no. **OS/21-22/2438/Partial Fab/PVLG/33/011, dated 02.07.2021**. BHEL shall finalize the Rates for **Partial Fabrication of L&T Vessels (with Boots) against S.O. 2438 at HPVP-Lovagarden site, Visakhapatnam** 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/21-22/2438/Partial Fab/PVLG/33/011, dated 02.07.2021**, (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 eligible 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/21-22/2438/Partial Fab/PVLG/33/011, dated 02.07.2021.** 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

Annexure – GST

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/Warrantee 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.

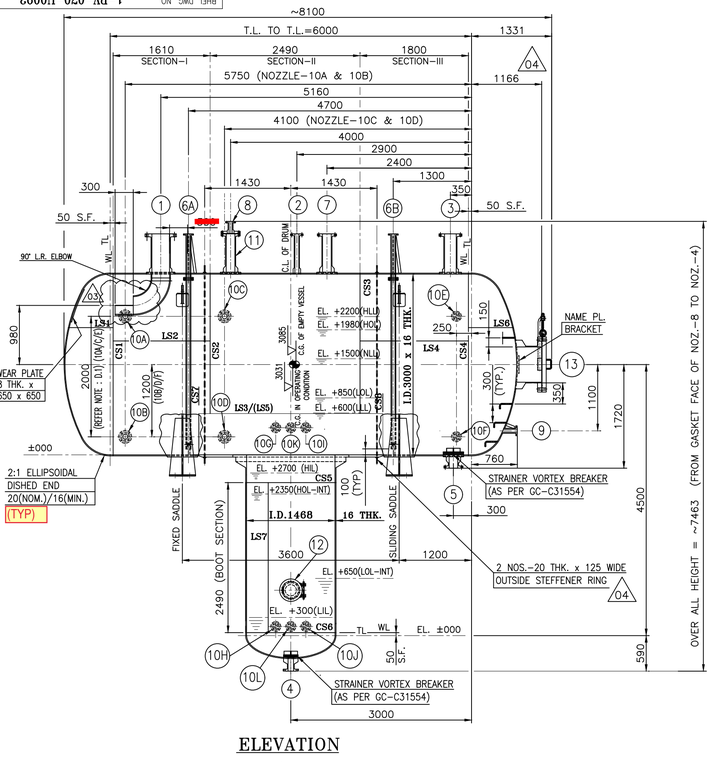
10. That in case vendor delays Declaring such invoice in his return and GST credit availed by BHEL is denied or reversed subsequently as per GST law, GST amount paid by BHEL towards such ITC reversal as per GST law shall be recoverable from vendor/contractor along with interest levied/ leviable on BHEL.

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

Signature of the Bidder with Stamp

BHEL DWG. NO. 1-PV-070-U0092

DWG. NO. B016-RUF-LT-504-MS-GA-BHEL(1)-02201



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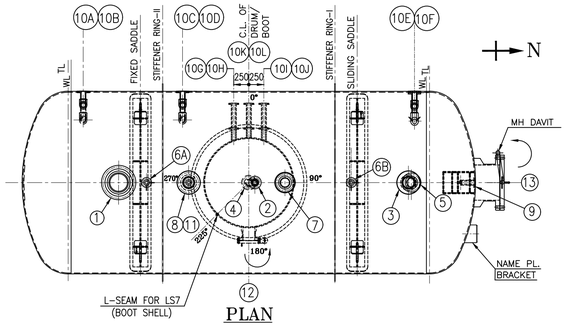
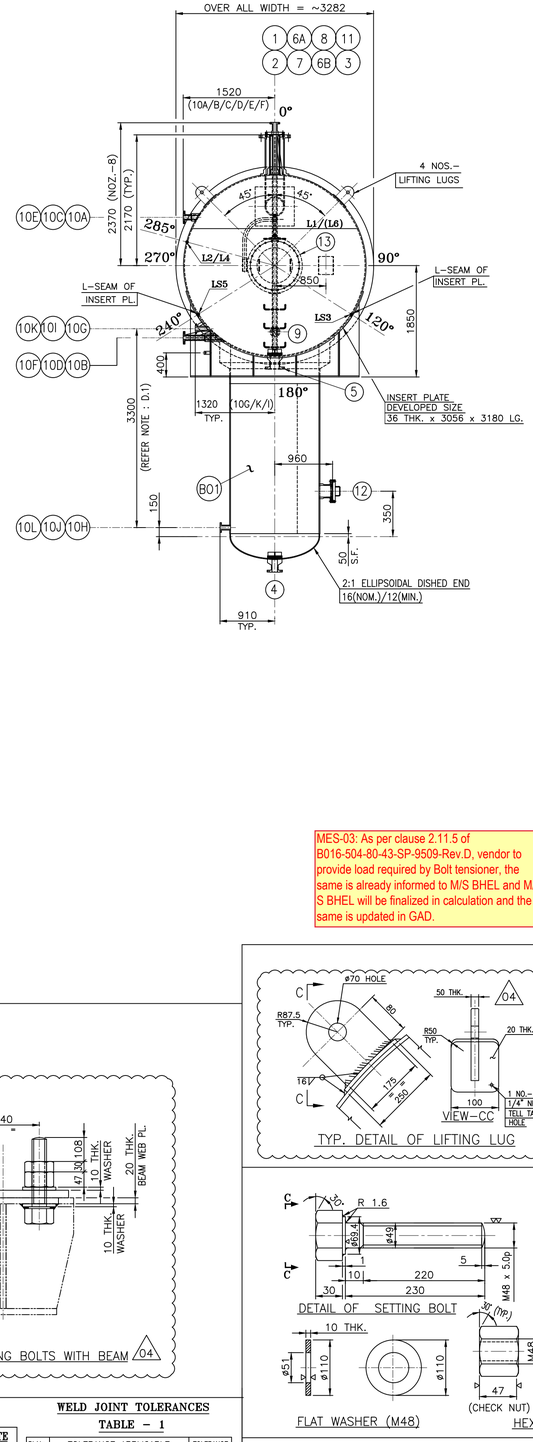


PLAN



$ REFER NOTE B.4. OF GENERAL NOTES.

LIST OF PARTS

SL.NO.	DESCRIPTION	MATERIAL REFERENCE	REFERENCE SPECFICATION
01	SHELL, SHELL D'ENDS, BOOT, BOOT D'END, STIFFENERS	CARBON STEEL	SA 516 GR.70 $
02	NOZZLES (SR/LWN)	CARBON STEEL FORGED NOZZLE	SA 105 $
03	INTERNALS, VORT. BREAKER/ WEAR PLATE	CS / SS	SA 516 GR.70; SA 106 GR.B / SA 240 GR. 304L (UNS S30403)
04	GASKET	SS 316 SPIRAL WOUND GRAFIL FILLED WITH SS 316 INNER RING & C.S. OUTER RING	ASME B16.20
05	INTERNAL BOLTING	STAINLESS STEEL	SS 304 (SA 193 GR.B8 / SA 194 GR.8)
06	PIPE FITTINGS	CARBON STEEL	SA 234 WPB $
07	EXT. ATTACHMENTS/LIFTING LUG/ WRAPPER PLATE	CARBON STEEL	SA 516 GR.70 $
08	SADDLE SUPPORT/EARTHING LUG	CARBON STEEL	IS 2062 E250B/ SA 240 GR. 304/304L
09	SETTING BOLTS/ NUTS/ WASHER	CARBON STEEL	IS 3757 & IS:4000 OF CL. 8.8 (MIN.)/ (HIGH STRENGTH & HOT DIP GAVANISED) HEX. NUT : IS:6623, WASHER : IS:6629
10	EXTERNAL BOLTING	ALLOY STEEL	SA 193 GR.B7M /SA 194 GR.2HM
11	NAME PLATE/ BRACKET	S.S./CARBON STEEL	SA 240 GR 304 / SA 516 GR.70

B01	1	BOOT	–	1500	– 16	–	SRN/–	SEE DRG.	LIP
13	1	MANWAY + B.F. + DAVIT	600 (24")	610	– 16	300	SRN/R.F.	SEE DRG.	LIP
12	1	HAND HOLE+B.F.+HINGE	200 (8")	219.1	– 16	300	SRN/R.F.	SEE DRG.	LIP
11	1	VENTILATION +B.F	150 (6")	168.3	– 14	300	SRN/R.F.	SEE DRG.	LIP
10E–L	8	LEVEL TAPS & DP LT (MAGNETIC)	50 (2")	50.8 (ID)	– 16.6	300	LWN/R.F.	SEE DRG.	–
10A–D	4	LEVEL TAPS (DIAPHRAGM)	80 (3")	ALT TO 150	– 12	300	SRN/R.F.	SEE DRG.	–
9	1	STEAM OUT	50 (2")	50.8 (ID)	– 16.6	300	LWN/R.F.	SEE DRG.	–
8	1	VENT	50 (2")	84.0	– 16.6	300	SRLWN/R.F.	SEE DRG.	–
7	1	PRESSURE RELIEF	150 (6")	168.3	– 14	300	SRN/R.F.	SEE DRG.	LIP
6A–B	2	MINIMUM FLOW	50 (2")	50.8 (ID)	– 16.6	300	LWN/R.F.	SEE DRG.	–
5	1	OIL OUTLET	150 (6")	168.3	– 14	300	SRN/R.F.	SEE DRG.	LIP
4	1	WATER OUTLET	100 (4")	114.3	– 12	300	SRN/R.F.	SEE DRG.	–
3	1	VAPOUR OUTLET	200 (8")	219.1	– 16	300	SRN/R.F.	SEE DRG.	LIP
2	1	LIQUID FEED	80 (3")	88.9	– 12	300	SRN/R.F.	SEE DRG.	–
1	1	FEED INLET	300 (12")	323.8	– 16	300	SRN/R.F.	SEE DRG.	LIP
MARK NO.	QTY.	SERVICE	N.P.S.	O.D.	SCH. THK.	RATING CLASS	TYPE/FACE	PROJECTION	R.F.PAD WIDTH×THK.

TABLE OF NOZZLES AND FLANGES

DESIGN DATA

SERVICE	---		
DESIGN PRESSURE (INTL. | EXTERNAL) MPa (kg/sq.cm)(g)	0.343 (3.50)	0.103 / (FV (1.055)) AT HIGHEST POINT	
MAXIMUM ALLOWABLE WORKING PRESSURE MPa (kg/sq.cm) (g)	0.343 (3.50)		
MAXIMUM ALLOWABLE PRESSURE MPa (kg/sq.cm) (g)	1.461 (14.90)		
MAXIMUM ALLOWABLE EXT. WORKING PRESSURE MPa (kg/sq.cm) (g)	0.157 (1.600)		
MAXIMUM ALLOWABLE CORROSION ALLOWANCE (mm)	1.4 (04)	MDMT AT MAWP : 12.5°C @ 3.5 Kg/sq.cm	
DESIGN TEMPERATURE (°C) (INT. / EXT.)	260/260		
OPERATING PRESSURE MPa (kg/sq.cm) (g)	0.039 (0.40)		
OPERATING TEMPERATURE (°C)	52		
STEAM OUT CONDITON MPa (kg/sq.cm) (g)	0.049 (0.5) @ 170 °C		
LOWEST ALLOWABLE MDMT (°C) = -31.5	COINCIDENT MAXIMUM PRESSURE : 0.343 (3.5)		MPa (kg/sq.cm)(g)
(04) HYD.TEST PRESSURE MPa UG 99(c) (kg/sq.cm) (g)	1.87(19.07) AT 16 °C(MIN)/48°C(MAX)		(AT TOP, AT SHOP)
HYD.TEST PRESSURE MPa UG 99(b) (kg/sq.cm) (g)	0.446(4.55) AT 16 °C (MIN)/48°C(MAX)		(AT TOP, AT SITE)
CORROSION ALLOWANCE mm	6 (INTERNAL & BOOT)		4.5 (SHELL & HEADS)
CAPACITY (cu.m)	54.98	CLAD (cm)	NOT APPLICABLE
RADIOGRAPHY:	SHELL:100% HEAD:100%	DEGREE OF RADIOGRAPHY: RT–1	
JOINT EFFICIENCY	SHELL: 1.0 HEAD: 1.0	EMPTY WEIGHT (Kg.): ~22650	
IMPACT TESTING = EXEMPTED (AS PER UCS–66(c), & NOTE (4) OF FIG UCS–66)		FAB. WEIGHT (Kg.): ~191400 (04)	
OTHER LOADINGS : YES AS PER UG–22(a), (b), (c), (d), (2), (f), (j)		OPERATION WEIGHT (Kg.): ~66479	
INSULATION / FIRE PROOFING	NA / NA	TEST WEIGHT (Kg.) : ~77600	
DENSITY OF FLUID: Kg./ cu.m (LIQUID/WATER)	762 / 982 @53 °C	SPECIAL SERVICE : HIC RESISTANT CRITERIA (SH-3), SUP.DUT-C, E-79-2013	
POST WELD HEAT TREATMENT (AS PER UW–2, UCS–56, UCS–68)	YES (REFER TABLE–1)	CYCLIC SERVICE : NO	
(04) POST FORMING HEAT TREATMENT(HEAD)	NOT REQD. AS PER 4.31 (c) OF 6–12–0002	NATIONAL BOARD REGISTRATION	NOT REQUIRED
CODE STAMP REQUIRED	☒ YES ☐ NO	CONSIGNMENT SIZE : ODC/~~ORDINARY~~	
NB CODE STAMP REQUIRED	☐ YES ☒ NO	POSITION OF VESSEL : HORIZONTAL	
ASME CERTIFICATION MARK : YES WITH U DESIGNATOR	VESSEL SL.NO. : 26664	HYDROTEST POSITION : HORIZONTAL IN SHOP	
CODE: ASME BPVC.VIII.1: ED–2019		INSPECTION: AUTHORISED INSPECTION: M/s TUV + BV (AI)	
NOZZLE LOAD DATA	APPLICABLE	STAGE WISE & THIRD PARTY INSPCTION: YES	
WIND CODE: IS 875, PART:3–2015; WIND ZONE: 6; RISK FACTOR: 1; WIND SPEED: 52 m/sec; TERRAIN CATEGORY: 3; TOPOGRAPHY FACTOR : 1			
SEISMIC CODE: IS 1893(PART 4)–2015& SITE SPECTRA; SEISMIC ZONE : III; IMPORTANCE FACTOR : 2; EQUIPMENT CATEGORY : 1			
LOCATION OF INSTALLATION	M/s. HPCL – VISAKHAPATNAM, A.P, INDIA		

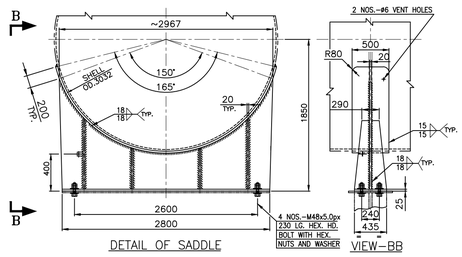
FOR GENERAL NOTES & OTHER APPLICABLE STD. PLEASE REFER DRG. NO.: B016-RUF-LT-504-MS-FD-BHEL(1)-02207/3-PV-070-U0152

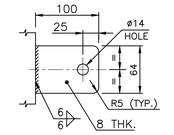
REFERENCE DOCUMENTS/DRAWINGS

4–PV–070–U0052	B016–RUF–LT–504–MS–LS–BHEL(1)–03017	SCHEDULE OF MANDATORY SPARES & COMMISSIONING SPARES (504–V–201)	**
PPPV–2438–PV–070–001	B016–RUF–LT–504–MS–CL–BHEL(1)–02201	MECHANICAL DESIGN OF HOS PRODUCT DRUM (504–V–201)	**
2–PV–070–U0036	B016–RUF–LT–504–MS–FD–BHEL(1)–02208	TRANSPORTATION ARRANGEMENT DETAILS FOR HOS PRODUCT DRUM (504–V–201)	**
3–PV–070–U0152	B016–RUF–LT–504–MS–FD–BHEL(1)–02207	GENERAL NOTES FOR HOS PRODUCT DRUM (504–V–201)	**
3–PV–070–U0151	B016–RUF–LT–504–MS–FD–BHEL(1)–02206	NAME PLATE DETAILS FOR HOD PRODUCT DRUM (504–V–201)	**
3–PV–070–U0150	B016–RUF–LT–504–MS–FD–BHEL(1)–02205	DETAILS OF MANWAY DAVIT FOR HOS PRODUCT DRUM (504–V–201)	**
0–PV–070–U0012	B016–RUF–LT–504–MS–FD–BHEL(1)–02204	SHELL DEVELOPMENT OF HOS PRODUCT DRUM (504–V–201)	**
1–PV–070–U0094	B016–RUF–LT–504–MS–FD–BHEL(1)–02203	EXTERNAL ATTACHMENTSS OF HOS PRODUCT DRUM (504–V–201)	**
1–PV–070–U0093	B016–RUF–LT–504–MS–FD–BHEL(1)–02202	ASSEMBLY DETAILS OF HOS PRODUCT DRUM (504–V–201)	**
BHEL DRAWING NO.	CLIENT DOCUMENT NO.	DRAWING TITLE	** SHALL BE MENTIONED DURING AS–BUILT DRAWING / REV. No.

APPLICABLE STANDARDS :

1. ASME BOILER & PRESSURE VESSEL CODE SEC VIII DIV 1 : ED–2019
2. ASME BOILER & PRESSURE VESSEL CODE SEC II PART A, C & D : ED–2019
3. ASME BOILER & PRESSURE VESSEL CODE SEC V : ED–2019
4. ASME BOILER & PRESSURE VESSEL CODE SEC IX ED–2019
5. ASME B16.5 ED–2013–STANDARD FOR PIPE FLANGES AND FLANGED FITTINGS.
6. ASME B16.11 ED–2016 FORGED STEEL FITTINGS, SOCKET WELDED & THREADED
7. ASME B36.10M ED–2018 WELDED AND SEAMLESS WROUGHT STEEL PIPE
8. ASME B1.20.1 ED2013 PIPE THREADS, GENERAL PURPOSE (INCH)
9. ASME B16.20 ED2017 METALLIC GASKETS FOR PIPE FLANGES

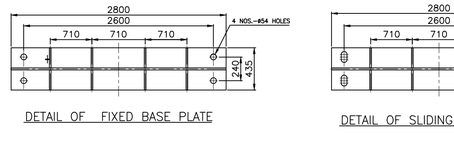




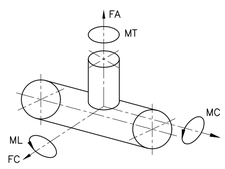
EARTHING LUG (2 NOS.)

NOTE:–DO NOT PAINT THE EARTHING LUGS

MES–03: As per clause 2.11.5 of B016–504–80–43–SP–9509–Rev.D, vendor to provide load required by Bolt tensioner, the same is already informed to M/S BHEL and M/S BHEL will be finalized in calculation and the same is updated in GAD.

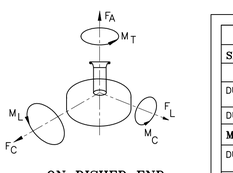


MAX. ALLOWABLE NOZZLE LOAD



ON SHELL

Nozzle Mark	NPS	FA (kgf)	FC (kgf)	FL (kgf)	MT (kgf–m)	ML (kgf–m)	MC (kgf–m)
9	2	200	200	200	50	40	30
7	6	600	600	600	450	360	270
6A–B	2	200	200	200	50	40	30
5	6	600	600	600	450	360	270
4	4	400	400	400	200	160	120
3	8	800	800	800	800	640	480
2	3	300	300	300	112	90	67
1	12	1700	1900	1200	1600	1440	1080



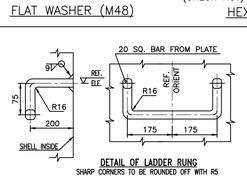
ON DISHED END

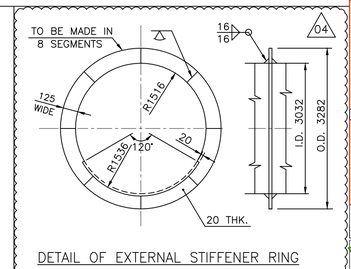
LOAD DATA (04)		
	EMPTY	IN OPERATION
SHEAR AT BASE (KG)		
DUE TO SEISMIC	–	MCE 12922
		DBE 9930
DUE TO WIND	–	4728
MOMENT AT BASE (KG–M)		
DUE TO SEISMIC	–	MCE 23905
		DBE 18371
DUE TO WIND	–	8747

LIST OF HOLDS AS ON DATE

WELD JOINT TOLERANCES TABLE – 1

Sl.No.	TOLERANCE APPLICABLE	TOLERANCE
01.	BEVEL ANGLE / INCLUDING ANGLE	
	a). > 35°	± 5°
	b). 20° – 35°	± 2°
	c). < 20°	± 1°
02.	ROOT GAP	
	a). ≤ 3	± 1
	b). 1 < ROOT GAP < 3	± 0.5
	c). < 1	+ 0.5 –0.0





MES–02: AI (Authorized inspector) review is pending for drawing and calculation for this tag, hence M/s BHEL to take approval on drawings and calculation from AI and comments to be incorporated in drawings/calculation if require before performing HYDROTEST OF VESSESL, the same is M/S BHEL responsibility to ensure consistency between calculation & drawings.

This drawing is also submitted to Client/PMC for approval, and hence LTHE's approval is subjected to PMC approval. PMC comments if any upon receipt will be shared and vendor shall comply to those comments without any cost and time implications.

MES–01: Calculation is not with CODE–1, hence the details of HYDROTEST PRESSURE, MAEWP, MAP, LOWEST ALLOWABLE MDMT, CG, FOUNDATION LOAD DATA, FLANGE RATING etc, to be updated as per CODE–1 calculation if required before performing HYDROTEST OF VESSESL, the same is M/S BHEL responsibility to ensure consistency between calculation & drawings.

HEAT–TREATMENT DETAILS (TABLE–1)

PART	PROCEDURE	LOADING TEMP.	HOLDING TEMP.	HEATING RATE	HOLDING TIME	COOLING RATE	REMARKS
COMPLETE VESSEL	PWHT/STRESS RELIEVING	<400 °C	610 °C ± 15 °C	155 °C/HR	90 MINUTES (MINIMUM)	195 °C/HR	COOLING IN STILL AIR; UNLOADING <400°C

DRG. CATEGORY: (USE TICK MARK) [R] [I]
EIL REVIEW/APPROVAL CODE:
VPTL NO.:
SCH. DATE OF SUBMISSION
DOCUMENT STATUS
STATEMENT OF SUB: [1st] [2nd] [3rd]
☐ FINAL FOR CODE–1 ☐ AS BUILT
ISSUED FOR
☐ AS BUILT ☐ INFORMATION
☐ CONSTRUCTION ☐ REVIEW
SIGN: DATE:

☐ REVIEW CODE 1 – NO COMMENTS PROCEED WITH MANUFACTURE / FABRICATION/ CONSTRUCTION AS PER THE DOCUMENT.
☐ REVIEW CODE 2 – PROCEED WITH MANUFACTURE / FABRICATION / CONSTRUCTION AS PER THE COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED.
☐ REVIEW CODE 3 – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW.
☐ R – DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION
☐ V–VOID

NAME	DICIPLINE	SIGN	DATE

REV.	DESCRIPTION	DRN	CHECKED	APPROVED	REVIEWED	APPROVED	DATE
04	REVISED AS PER L&T & PMC COMMENTS	T.S.S.RAO	D.SATISH	A.N.V.K.K.	---	---	18.01.2021
03	REVISED AS PER L&T & PMC COMMENTS	T.S.S.RAO	D.SATISH	A.N.V.K.K.	---	---	04.12.2020
02	REVISED AS PER L&T & PMC COMMENTS	T.S.S.RAO	D.SATISH	A.N.V.K.K.	---	---	05.09.2020
01	REVISED AS PER L&T COMMENTS	T.S.S.RAO	D.SATISH	A.N.V.K.K.	---	---	07.07.2020
00	ISSUED FOR APPROVAL	T.S.S.RAO	D.SATISH	A.N.V.K.K.	---	---	14.05.2020

OWNER: HINDUSTAN PETROLEUM CORPORATION LIMITED
VISAKH REFINERY MODERNIZATION PROJECT
EPCC–03 PACKAGE FOR RESIDUE UP–GRADATION FACILITY (RUF)

PMC : ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

LSTK CONTRACTOR: L&T Hydrocarbon Engineering

DETAILED ENGINEERING CENTER: L&T – CHIYODA LIMITED

L&T – CHIYODA LIMITED

REVIEW CODE 1 – NO COMMENTS PROCEED WITH MANUFACTURE / FABRICATION/ CONSTRUCTION AS PER THE DOCUMENT.
☐ (W)MINOR COMMENTS FOR AS–BUILT) URE / FABRICATION /CONSTRUCTION AS PER THE COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED.
☐ REVIEW CODE 3 – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW.
☐ R – DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION
☐ V–VOID

PBD	KMD	AG/MS	03/02/21
COMMENTED BY	REVIEWED BY	APPROVED BY	DATE

THIS REVIEW / APPROVAL DOES NOT RELIEVE THE VENDOR / MANUFACTURER OF THE FULL RESPONSIBILITY AS TO DESIGN CORRECTNESS OF DIMENSIONS & COMPLIANCE WITHALL APPLICABLE REGULATIONS AND WITH THE REQUIREMENTS MADE IN PURCHASER SPECIFICATIONS.

VENDOR : Bharat Heavy Electricals Limited
UNIT: HEAVY PLATES & VESSELS PLANT
VISAKHAPATNAM–530012

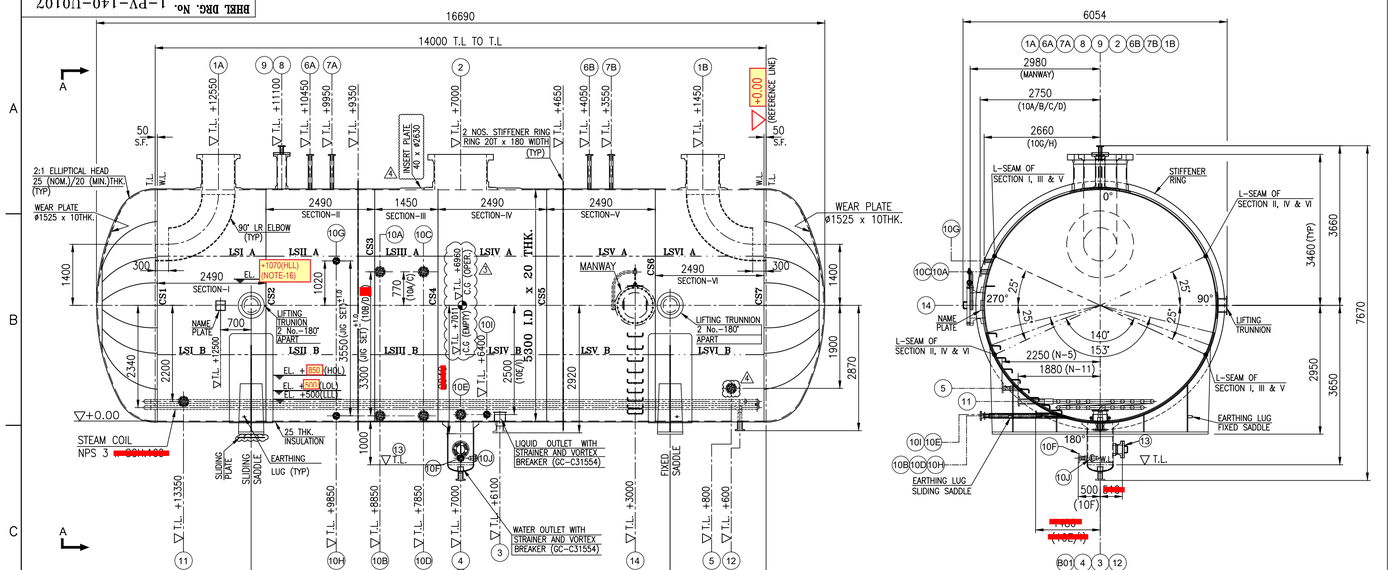
BHEL PO NO: REFINERY / 75000–66912 / NG ; DATE :18.03.2020
BHEL DWG. NO: 1–PV–070–U0092, REV.04

DATE	SCALE	TITLE:
14.05.2020	1 : 50	GENERAL ASSEMBLY OF HOS PRODUCT DRUM (504–V–201)

DEPT:	PROJECT:	DRG. NO.:	SH.
PP ENGG.		B016–RUF–LT–504–MS–GA–BHEL(1)–02201	1 OF 1
DRN BY: T.S.S.RAO			REV. 04
CHK BY: A.N.V.K.K./ D.SATISH	PWO NO.:	–	
APP BY: Y.P.KUMAR	CAD REVISE THIS DRG. USING CAD SYSTEM ONLY	FILE:	

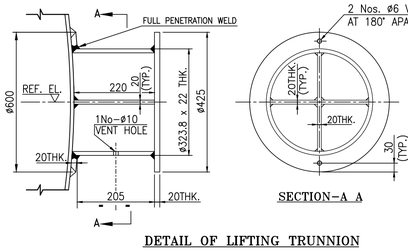
BHEL DRG. No. 1-PV-140-U0107

DWG. NO. B016-RUF-LT-504-MS-CA-BHEL(1)-02451

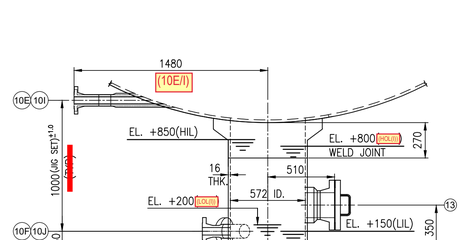


ELEVATION

VIEW A-A



DETAIL OF LIFTING TRUNNION



BOOT DETAIL

DESIGN DATA

MES-01

SERVICE	HYDRO CARBON	
DESIGN PRESSURE (INTL. | EXTERNAL) MPa (kg/cm²)(g)	0.7846 (8.0)	NIL AT HIGHEST POINT
MAXIMUM ALLOWABLE WORKING PRESSURE MPa (kg/cm²)(g)	0.7846 (8.0)	
MAXIMUM ALLOWABLE PRESSURE MPa (kg/cm²)(g)	(1.0787 (11)) ⚠	
MAXIMUM ALLOWABLE EXTERNAL WORKING PRESSURE MPa (kg/cm²)(g)	(0.0860 (0.877)) ⚠	
DESIGN TEMPERATURE (INTERNAL | EXTERNAL) (°C)	260 | NIL	
OPERATING PRESSURE MPa (kg/cm²)(g)	0.509 (5.2)	
OPERATING TEMPERATURE (°C)	AMBIENT TO 104	
STEAM OUT CONDITON MPa (kg/cm²)(g)	0.05 (0.5) @ 170 °C	⚠
STEAM COIL DESIGN PRESSURE (INTL. | EXTERNAL) MPa (kg/cm²)(g)	1.226 (12.5) / (FULL VACUUM)	STEAM COIL AREA (m²):65
STEAM COIL DESIGN TEMPERATURE (INTL. | EXTERNAL)(°C): 300 | 300	STEAM COIL MAWP MPa (kg/cm²)(g): 1.226 (12.5)	
STEAM COIL HYDRO TEST PRESSURE MPa (kg/cm²)(g): 1.594 (16.25)	STEAM COIL MAEWP MPa (kg/cm²)(g): 5.115 (52.162)	
PNEUMATIC TEST PRESSURE MPa (kg/cm²) (g)	–NIL–	
HYD.TEST PRESSURE AS PER UG-99(c) (AT SHOP) MPa (kg/cm²)(g)	1.295 (13.204) AT 16 °C (MIN) / 48 °C(MAX) (AT HIGHEST POINT)	
HYD.TEST PRESSURE AS PER UG-99(b) (AT SITE) MPa (kg/cm²)(g)	1.019 (10.400) AT 16 °C (MIN) / 48 °C(MAX) (AT HIGHEST POINT)	
CORROSION ALLOWANCE mm	6 (FIXED INTERNAL) |3 (REMOVABLE)| 3 (SHELL & HEADS)	
BOOT CORROSION ALLOWANCE mm:	9 (FIXED INTERNAL) |4.5 (REMOVABLE)| 4.5 (SHELL & HEADS)	
MAXIMUM ALLOWABLE CORROSION ALLOWANCE mm ⚠	4.0	
CAPACITY (m³)	348.169	CLADDING (mm) | NOT APPLICABLE
RADIOGRAPHY: (RT1)SHELL: 100% | HEAD: 100% | COIL:100%	JOINT EFFICIENCY	SHELL: 1.0 | HEAD: 1.0 | COIL: 1.0
IMPACT TESTING = EXEMPTED (AS PER UCS-66(d), & NOTE (4) OF FIG UCS-66) = EXEMPTED (AS PER Figure UCS-66 General Notes (c)) = EXEMPTED (AS PER CURVE-B OF UCS-66)	FABRICATED WEIGHT (Kg.) : ~63341	
OTHER LOADINGS : YES AS PER UG-22(a), (b), (c), (d), (2), (f), (j)	EMPTY WEIGHT (Kg.) : ~77733	
INSULATION (THK./TYPE): 25 mm / HOT | FIRE PROOFING: NA	OPERATION WEIGHT (Kg.) : ~248729	
DENSITY OF FLUID: Kg./ m³	758	TEST WEIGHT (Kg.) : ~417378
POST WELD HEAT TREATMENT (AS PER UW-2, UCS-56, UCS-68)	YES ⚠SPECIAL SERVICE: SUPPLIMENT C (REFER NOTE-B1)| CYCLIC SERVICE : NO	
POST FORMING HEAT TREATMENT	YES, AS PER THE CYCLE GIVEN BELOW✻	
MDMT AT MAWP: 12.5 °C AT 8 Kg/cm² (g) ⚠	MANUFACTURER'S SERIAL No : 26673	
LOWEST ALLOWABLE MDMT AT COINCIDENT MAXIMUM PRESSURE: -9°C AT 11 Kg/cm²(g) ⚠		
CODE STAMP REQUIRED	☒ YES ☐ NO	CONSIGNMENT SIZE : ODC/~~ORDINARY~~
NB CODE STAMP REQUIRED	☐ YES ☒ NO	POSITION OF VESSEL : HORIZONTAL
ASME CERTIFICATION MARK : YES WITH 'U' DESIGNATOR	HYDROTEST POSITION : HORIZONTAL IN SHOP	
CODE: ASME BPVC.VIII.1: ED-2019	INSPECTION: AUTHORISED INSPECTION: M/s TUV + BV (AI) ⚠	
NOZZLE LOAD DATA | APPLICABLE	STAGE WISE & THIRD PARTY INSPECTION: YES	
WIND SPEED: 52 M/SEC WIND SPECIFICATION:IS 875, PART-3: 2015 ED	WIND ZONE: 6 | RISK FACTOR : 1 | TERRAIN CATEGORY: 3 | TOPOGRAPHY FACTOR : 1	
EARTHQUAKE SPECIFICATION: IS 1893 (PART 4)-2015 ED	NATIONAL BOARD REGISTRATION | NOT REQUIRED	
EQUIMENT CATEGORY=1 & SITE SPECIFIC SEISMIC SPECTRA	IMPORTANCE FACTOR : 2 | SEISMIC ZONE : III	
LOCATION OF INSTALLATION	M/S HPCL-VISAKHAPATNAM, A.P, INDIA	

✻DISHED ENDS SHALL BE COLD FORMED FOLLOWED BY HEAT TREATMENT CYCLE AS BELOW.

HEAT TREATMENT ⚠

Part	Procedure	Loading Temperature (°C)	Holding Temperature (°C)	Heating Rate (°C/hr)	Holding Time (min)	Cooling Rate (°C/hr	Remarks
DISHED ENDS (SHELL)	STRESS RELIEVING/PFHT	<400°C	610±15°C	210°C/hr	70 minutes	270°C/hr	Unloading at 400°C
DISHED ENDS (BOOT)	STRESS RELIEVING/PFHT	<400°C	610±15°C	210°C/hr	45 minutes	270°C/hr	Unloading at 400°C
COMPLETE EQUIPMENT	STRESS RELIEVING/PWHT	<425°C	630±10°C	110°C/hr	96 minutes	140°C/hr	Unloading at 425°C

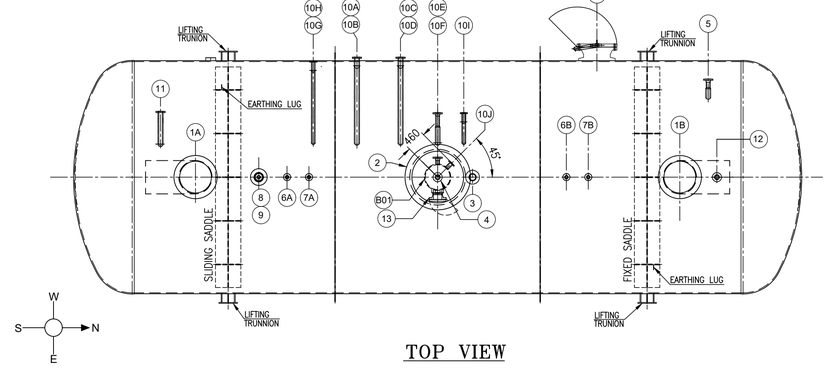
LIST OF PARTS (REFER NOTE B1)

SL.NO	DESCRIPTION	MATERIAL REFERENCE	MATERIAL SPECFICATION
01	SHELL, D'END, BOOT	BQ PLATE CS	SA 516 GR.70
02	NOZZLES WITH INTEGRAL FLANGES	FORGED STEEL	SA 105
03	SADDLE WRAPPER PL., TRUNNION PAD	BQ PLATE (CS)	SA 516 GR.70
04	SADDLE SUPPORT, TRUNNION	CS	IS 2062 E250B
05	VORTEX BREAKER	CS	SA 516 GR.70 / SA 106 GR.B
06	GASKET	SS 316 SPIRAL WOUND GRAFIL FILED WITH SS316 INNER RING & CS OUTER RING	AS PER ASME B16.20
07	BOLTS & NUTS (EXT.)	ALLOY STEEL	SA193 GR.B7M/SA194 GR.2HM
08	BOLTS & NUTS (INT.)	STAINLESS STEEL	SS304L
09	PIPE FITTINGS	CS	SA 234 GR.WPB
10	EXTERNAL ATTACHMENTS	BQ PLATE (CS)	SA 516 GR.70
11	WEAR PLATE	STAINLESS STEEL	SA 240 TYP.304L (UNS S30403)
12	EARTHING LUG, SLIDING PLATE	STAINLESS STEEL	SA 240 TYP.304
13	STEAM COIL	CS	SA 106 GR.B/ SA234 GR. WPB
14	ANCHOR BOLT (LTHE SCOPE)	CS	IS 2062 E250 BR/BO

FOR GENERAL NOTES & OTHER APPLICABLE STD. PLEASE REFER DRG. NO: B016-RUF-LT-504-MS-FD-BHEL(1)-02460

PPPV-2438-PV PV-140-001	B016-RUF-LT-504-MS-CL-BHEL(1)-02451	MECHANICAL DESIGN OF HP FLARE KO DRUM (504-V-801)
2-PV-140-U0043	B016-RUF-LT-504-MS-DW-BHEL(1)-02461	TRANSPORTATION ARRANGEMENT DETAILS FOR HP FLARE KO DRUM (504-V-801)
3-PV-140-U0174	B016-RUF-LT-504-MS-FD-BHEL(1)-02460	GENERAL NOTES FOR HP FLARE KO DRUM (504-V-801)
4-PV-140-U0052	B016-RUF-LT-504-MS-LS-BHEL(1)-03022	SCHEDULE OF MANDATORY SPARES & COMMISSIONING SPARES (504-V-801)
3-PV-140-U0173	B016-RUF-LT-504-MS-FD-BHEL(1)-02459	NAME PLATE DETAILS FOR HP FLARE KO DRUM (504-V-801)
3-PV-140-U0172	B016-RUF-LT-504-MS-FD-BHEL(1)-02458	FOUNDATION TEMPLATE FOR HP FLARE KO DRUM (504-V-801)
3-PV-140-U0171	B016-RUF-LT-504-MS-FD-BHEL(1)-02457	DETAILS OF MANWAY DAVIT FOR HP FLARE KO DRUM (504-V-801)
0-PV-140-U0016	B016-RUF-LT-504-MS-FD-BHEL(1)-02456	SHELL DEVELOPMENT OF HP FLARE KO DRUM (504-V-801)
1-PV-140-U0110	B016-RUF-LT-504-MS-FD-BHEL(1)-02455	INSULATION SUPPORT DETAILS FOR HP FLARE KO DRUM (504-V-801)
1-PV-140-U0109	B016-RUF-LT-504-MS-FD-BHEL(1)-02454	EXTERNAL ATTACHMENTS OF HP FLARE KO DRUM (504-V-801)
1-PV-140-U0108	B016-RUF-LT-504-MS-FD-BHEL(1)-02452	ASSEMBLY DETAILS OF HP FLARE KO DRUM (504-V-801)
BHEL DRAWING NO.	CLIENT DOCUMENT NO.	DRAWING TITLE REV.

THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE ABOVE DRAWINGS



TOP VIEW

APPLICABLE STANDARDS

1. ASME BOILER & PRESSURE VESSEL CODE SEC VIII DIV 1 : ED-2019
2. ASME BOILER & PRESSURE VESSEL CODE SEC II PART A, C & D : ED-2019
3. ASME BOILER & PRESSURE VESSEL CODE SEC V : ED-2019
4. ASME BOILER & PRESSURE VESSEL CODE SEC IX ED-2019
5. ASME B16.5 ED-2017-STANDARD FOR PIPE FLANGES AND FLANGED FITTINGS.
6. ASME B16.47 ED-2017-STANDARD FOR LARGE DIAMETER STANDARD FLANGES
7. ASME B16.11 ED-2016 FORGED STEEL FITTINGS, SOCKET WELDED & THREADED
8. ASME B36.10M ED-2018 WELDED AND SEAMLESS WROUGHT STEEL PIPE
9. ASME B1.20.1 ED2013 PIPE THREADS, GENERAL PURPOSE (INCH)
10. ASME B16.20 ED2017 METALLIC GASKETS FOR PIPE FLANGES
11. ASME B36.19M ED2018 STAINLESS STEEL PIPE

——·——·—— L-SEAM OF SECTION II, IV, & VI

—— - - —— L-SEAM OF SECTION I, III, & V

NO. OF CIRCUFERENTIAL SEAMS: 7

NO. OF LONGITUDINAL SEAMS: 2 PER SECTION

MES-02: AI (Authorized inspector) review is pending for drawing and calculation for this tag, hence M/s BHEL to take approval on drawings and calculation from AI and comments to be incorporated in drawings/calculation if require before performing HYDROTEST OF VESSESL, the same is M/S BHEL responsibility to ensure

MES-03: As per clause 2.11.5 of B016-504-80-43-SP-9509-Rev.D, vendor to provide load required by Bolt tensioner, the same is already informed to M/S BHEL and M/S BHEL will be finalized in calculation and the same is updated in GAD.

MES-01: Calculation is not with CODE-1, hence the details of HYDROTEST PRESSURE, MAEWP, MAP, LOWEST ALLOWABLE MDMT, CG, FOUNDATION LOAD DATA, FLANGE RATING etc, to be updated as per CODE-1 calculation if required before performing HYDROTEST OF VESSESL, the same is M/S BHEL responsibility to ensure consistency between calculation & drawings.

This drawing is also submitted to Client/PMC for approval, and hence LTHE's approval is subjected to PMC approval. PMC comments if any upon receipt will be shared and vendor shall comply to those comments without any cost and time implications.

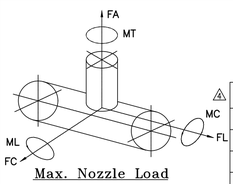
NOTE-16: CORRESPONDING TO MAXIMUM LIQUID RELIEF CASE (350328 KG/HR) HOLD UP REQUIREMENT ID 32.8M3 FOR 5MIN. OF RELIEF. THE VESSEL IS HOWEVER SUITABLE TO ACCOMMODATE 196.6M3 LIQUID FOR 30MINUTES HOLD-UP, CORRESPONDING LIQUID LEVEL IS 2920MM FROM BOTTOM. LEVEL MEASUREMENT SHALL BE SUITABLE FOR ENTIRE LIQUID RANGE.

MARK NO.	QTY.	SERVICE	NB (N.P.S)	O.D.	SCH. THK.	I.D.	R.P.PAD WIDTH x THK.	RATING CLASS	TYPE/ FACE	PROJ. SEE NOTE-3	REMARKS
B01	1	BOOT	I.D.572	–	– 16.0		LIP TYPE	–	–	AS PER DRAWING	
14	1	MANWAY+B.F.+DAVIT	600 (24")	610	– 16.0		LIP TYPE	300	SRWN/R.F.	AS PER DRAWING	
⚠13	1	HANDHOLE+BF+HINGE	200 (8")	219.1	– 14.0		LIP TYPE	300	SRWN/R.F.	AS PER DRAWING	
⚠12	1	CONDENSATE OUTLET	80 (3")	117	– 20.4		––	300	LWN/R.F.	AS PER DRAWING	
11	1	STEAM INLET	80 (3")	117	– 20.4		––	300	LWN/R.F.	AS PER DRAWING	
10G,H, I&J	4	LEVEL TAPS (MAGNETIC)	50 (2")	84	– 16.6	50.8	––	300	LWN/R.F.	AS PER DRAWING	
10B,D, E&F	4	LEVEL TAPS (DIAPHRAGM)	80 (3")	88.9	– 16.0	56.9	––	300	SRWN/R.F.	AS PER DRAWING	
10A,C	2	LEVEL TAPS (DIAPHRAGM)	80 (3")	117	– 20.4	76.2	––	300	LWN/R.F.	AS PER DRAWING	
9	1	VENTILATION	200 (8")	219.1	– 14		LIP TYPE	300	SRWN/R.F.	AS PER DRAWING	WITH BLIND + Noz-8
8	1	VENT	50 (2")	84	– 16.6		––	300	LWN/R.F.	AS PER DRAWING	
7A/7B	2	TEMPERATURE TAPS	50 (2")	84	– 16.6	50.8	––	300	LWN/R.F.	AS PER DRAWING	
6A/6B	2	PRESSURE GAUGE (PT/PI)	50 (2")	84	– 16.6	50.8	––	300	LWN/R.F.	AS PER DRAWING	
5	1	STEAM OUT	80 (3")	88.9	– 12.0		––	300	SRWN/R.F.	AS PER DRAWING	
4	1	WATER OUTLET	80 (3")	117	– 20.4		––	300	LWN/R.F.	AS PER DRAWING	
3	1	OIL OUTLET ⚠	150 (6")	219.1	– 14.0		LIP TYPE	300	SRWN/R.F.	AS PER DRAWING	
2	1	VAPOUR OUTLET	1200 (48")	1227.1	– 30.0		LIP TYPE	300	SRWN/R.F.	AS PER DRAWING	FLANGE AS PER ASME-16.47 SERIES-B
1A & 1B	2	FEED INLET	750 (30")	768.4	– 16.0		LIP TYPE	300	SRWN/R.F.	AS PER DRAWING	FLANGE AS PER ASME-16.47 SERIES-B

TABLE OF NOZZLES AND FLANGES

LIST OF HOLDS AS ON DATE

01. PIPE SUPPORT & PLATFORM SUPPORT CLEATS
02. NOZZLE-3 & NOZZLE-14 ELEVATION.



Max. Nozzle Load

Nozzle Mark	NB	FA (kgf)	FL (kgf)	FC (kgf)	MT (kgf-m)	ML (kgf-m)	MC (kgf-m)
⚠ 4,5,11,12	3"	300	300	300	112	90	67
3	8"	800	800	800	800	640	480
2	48"	9500	4000	6000	15000	19000	16500
1A & 1B	30"	6900	3000	3000	11250	9000	6750

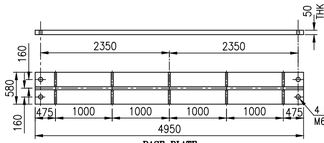
WELD JOINT TOLERANCES

TABLE – 1

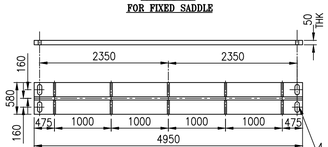
Sl.No.	TOLERANCE APPLICABLE	TOLERANCE
01.	BEVEL ANGLE / INCLUDING ANGLE	
	a). > 35°	± 5°
	b). 20° – 35°	± 2°
	c). < 20°	± 1°
02.	ROOT GAP	
	a). ⩽ 3	± 1
	b). 1 < ROOT GAP < 3	± 0.5
	c). ⩽ 1	+ 0.5 – 0.0

⚠ LOAD DATA

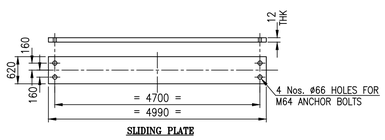
	EMPTY	OPERATING CASE
SHEAR AT BASE (KG)		
DUE TO SEISMIC	–	37114(DBE)/48346(MCE)
DUE TO WIND	–	12517
MOMENT AT BASE (KG-M)		
DUE TO SEISMIC	–	109487(DBE)/142621(MCE)
DUE TO WIND	–	36926



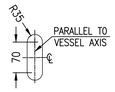
BASE PLATE FOR FIXED SADDLE



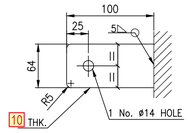
BASE PLATE FOR SLIDING SADDLE



SLIDING PLATE



SLOT DETAIL FOR BASE PLATE OF SLIDING SADDLE (TYP)



EARTHING LUG (DO NOT PAINT)

DRAWING NO. | DRAWING TITLE | REV

REFERENCE DOCUMENTS / DRAWINGS

04	L&T COMMENTS ON REV-02 INCORPORATED	MK	AVR	TK				23.12.20
03	L&T COMMENTS ON REV-02 INCORPORATED	MK	AVR	TK				01.12.20
02	L&T COMMENTS ON REV-01 INCORPORATED	MK	AVR	TK				05.10.20
01	COMMENTS OF L&T INCORPORATED	MK	AVR	TK				25.07.20
00	ISSUED FOR APPROVAL	MK	AVR	TK				09.06.20
REV.	DESCRIPTION	DRN	CHECKED	APPROVED	REVIEWED	APPROVED		DATE

DRG. CATEGORY: (USE TICK MARK) [R] [I] | EIL REVIEW/APPROVAL | VPTL NO.:

SCH. DATE OF SUBMISSION | CODE:

DOCUMENT STATUS
STATEMENT OF SUB: [1st] [2nd] [3rd]
☐ FINAL FOR CODE–1 ☐ AS BUILT

ISSUED FOR
☐ AS BUILT ☐ INFORMATION
☐ CONSTRUCTION ☐ REVIEW

☐ REVIEW CODE 1 – NO COMMENTS PROCEED WITH MANUFACTURE / FABRICATION/ CONSTRUCTION AS PER THE DOCUMENT.
☐ REVIEW CODE 2 – PROCEED WITH MANUFACTURE / FABRICATION / CONSTRUCTION AS PER THE COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED.
☐ REVIEW CODE 3 – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW.
☐ R – DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION
☐ V–VOID

SIGN: | DATE: | NAME | DISCIPLINE | SIGN. | DATE

OWNER: HINDUSTAN PETROLEUM CORPORATION LIMITED
VISAKH REFINERY MODERNIZATION PROJECT
EPCC-03 PACKAGE FOR RESIDUE UP-GRADATION FACILITY (RUF)

PMC : ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

1STK CONTRACTOR: L&T Hydrocarbon Engineering

DETAILED ENGINEERING CENTER: L&T - CHIYODA LIMITED

VENDOR : Bharat Heavy Electricals Limited
UNIT: HEAVY PLATES & VESSELS PLANT
VISAKHAPATNAM–530012

VENDOR PO NO: Refinery/75000–66912/NG; DATE:18.03.2020
VENDOR DWG. NO: 1–PV–140–U0107, REV.04

DATE 09.06.20 | SCALE 1 : 70

TITLE: GENERAL ASSEMBLY OF HP FLARE KO DRUM ITEM NO. 504–V–801

DEPT: HT ENGG.
DRN BY: V. A. RAO
CHK BY: A.V.RAO
APP BY: K.TARAKESH

PROJECT:
DRG. NO.: B016–RUF–LT–504–MS–GA–BHEL(1)–02451 | SH. 01 of 01
PWO NO.: | REV. 04

CAD #DRGE THIS DRG USING CAD SYSTEM ONLY FILE:

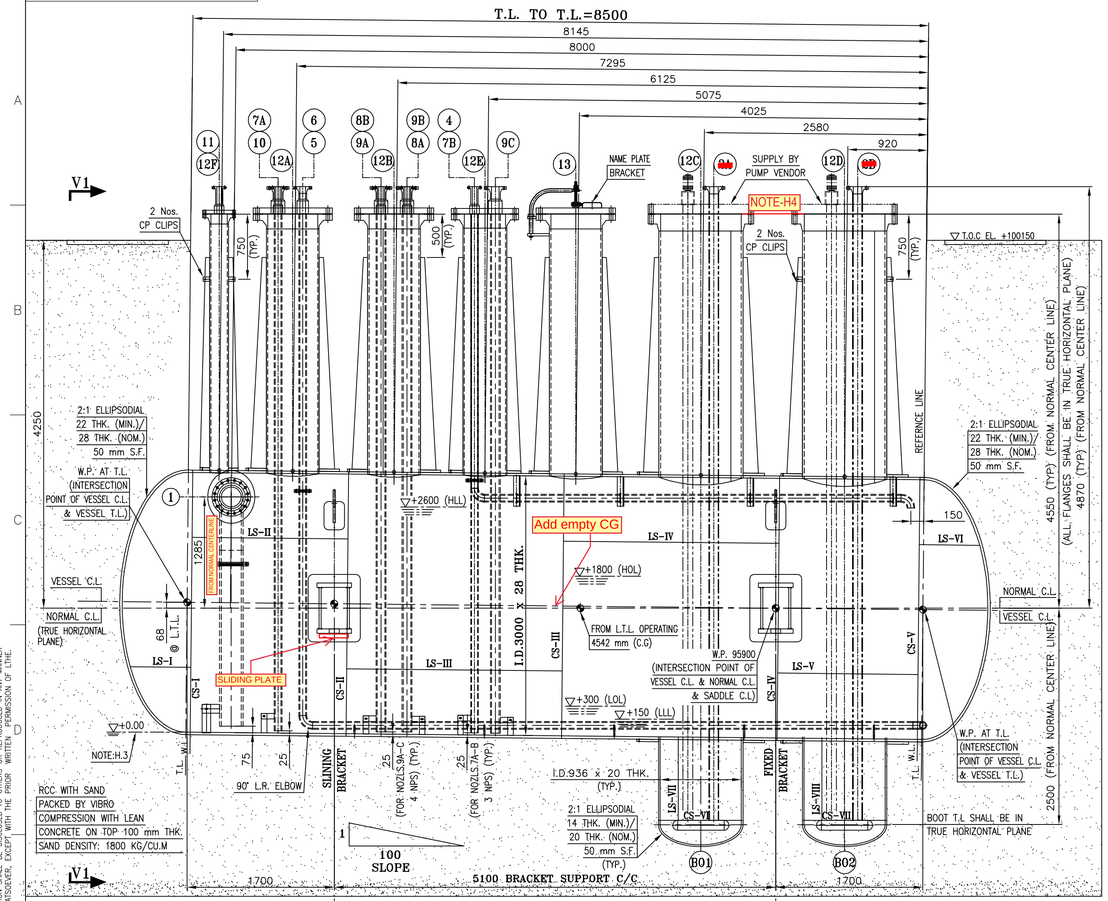
L&T - CHIYODA LIMITED
REVIEW CODE 1 – NO COMMENTS PROCEED WITH MANUFACTURE / FABRICATION/ CONSTRUCTION AS PER THE DOCUMENT.
(W/MINOR COMMENTS FOR AS BUILT)TURE/ FABRICATION /CONSTRUCTION AS PER THE COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED.
☐ REVIEW CODE 3 – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW.
☐ R – DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION
☐ V–VOID

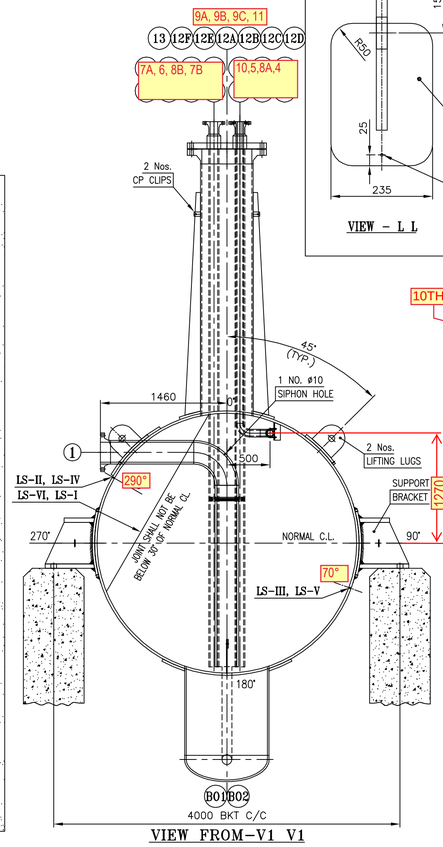
PBD	KMD	AG/MS	13/01/21
COMMENTED BY	REVIEWED BY	APPROVED BY	DATE

THIS REVIEW / APPROVAL DOES NOT RELIEVE THE VENDOR / MANUFACTURER OF THE FULL RESPONSIBILITY AS TO DESIGN CORRECTNESS OF DIMENSIONS & COMPLIANCE WITHALL APPLICABLE REGULATIONS AND WITH THE REQUIREMENTS MADE IN PURCHASER SPECIFICATIONS.

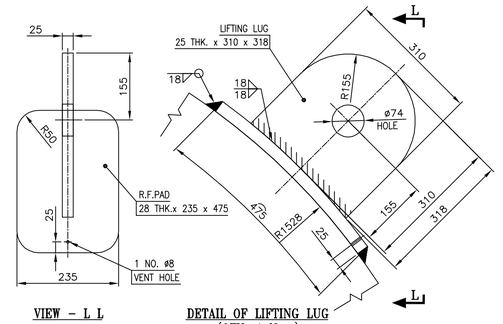
BHEL DWG. NO. 1-PV-160-U0115

DWG. NO. B016-RUF-LT-504-MS-GA-BHEL(1)-02551

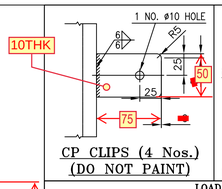




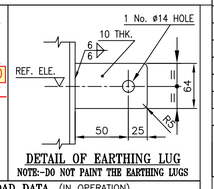
VIEW – L L



DETAIL OF LIFTING LUG (QTY. 4 Nos.)



CP CLIPS (4 Nos.) (DO NOT PAINT)



DETAIL OF EARTHING LUG
NOTE:-DO NOT PAINT THE EARTHING LUGS

VIEW FROM–V1 V1

LOAD DATA (IN OPERATION)

	DBE	MCE
SHEAR AT BASE (KG)		
DUE TO SEISMIC	6585	7766
MOMENT AT BASE (KG-M)		
DUE TO SEISMIC	98758	10588

This drawing is also submitted to Client/PMC for approval, and hence LTHE's approval is subjected to PMC approval. PMC comments if any upon receipt will be shared and vendor shall comply to those comments without any cost and time implications.

MES-02: AI (Authorized inspector) review is pending for drawing and calculation for this tag, hence M/s BHEL to take approval on drawings and calculation from AI and comments to be incorporated in drawings/calculation if require before performing HYDROTEST/PWHT OF VESSESL, the same is M/S BHEL responsibility to ensure consistency between calculation & drawings.

DESIGN DATA

SERVICE			
DESIGN PRESSURE INT/EXT – MPa	(Kg/cm^2g)	0.49 (5) / 0.208 (2.12) @ HIGHEST POINT	
MAXIMUM ALLOWABLE WORKING PRESSURE MPa	(Kg/cm^2g)	0.49 (5)	
MAXIMUM ALLOWABLE PRESSURE MPa	(Kg/cm^2g)	2.4 (24.7) (LIMITED BY D'END)	
MAXIMUM ALLOWABLE EXT. WORKING PRESSURE MPa	(Kg/cm^2g)	0.208 (2.127)	
MAXIMUM ALLOWABLE CORROSION ALLOWANCE	(MM)	7	
DESIGN TEMPERATURE	(INT./EXT.)(°C)	260 / 260	
OPERATING PRESSURE MPa	(Kg/cm^2g)	0.147 (1.5)	
OPERATING TEMPERATURE	(°C)	56	
STEAM OUT CONDITON MPa	(Kg/cm^2g)	0.049 (0.5) @ 170°C	
LOWEST ALLOWABLE MDMT & COINCIDENT MAX. PRESSURE		–48° C @ 5 (Kg/cm^2g)	
HYD.TEST PRESSURE AS PER UG-99(c) MPa	(Kg/cm^2g)	2.56 (26.10) AT SHOP	
HYD.TEST PRESSURE AS PER UG-99(b) MPa	(Kg/cm^2g)	0.64 (6.5) AT SITE	
CORROSION ALLOWANCE (MM)	SHELL, HEADS (INT./EXT.)–3/3 | REMOVABLE INTERNAL	BRACKET SUPPORT–3 | PERMANENT INTERNAL–6	
CAPACITY	M^3 67.404	CLAD (mm)	NIL
RADIOGRAPHY:	SHELL: 100%	HEAD: 100% | (RT–1)	
JOINT EFFICIENCY	SHELL: 1.0	1.0	
IMPACT TESTING	EXEMPTED, AS PER UCS–66(b)(3)	FABRICATED WEIGHT	: ~38500 Kg.
OTHER LOADINGS	YES AS PER UG–22(a), (b), (c), (d), (2), (f)	WEIGHT (EMPTY)	: ~38500 Kg.
INSULATION / FIRE PROOFING	NO	OPERATION WEIGHT	: ~90000 Kg.
DENSITY OF FLUID	(Kg/M^3) 600–1000 (max)	TEST WEIGHT	: ~107000 Kg.
MDMT @ MAWP	(°C)@ (Kg/cm^2) 12.5 @ 5	SPECIAL SERVICE	: SUPPLEMENTARY–A
NB CODE STAMP REQUIRED	☐ YES ☒ NO	CYCLIC SERVICE	: NO
ASME CERTIFICATION MARK	U	VESSEL SL.NO.	: 26675
CODE: ASME SEC. VIII DIV –1 : ED–2019	ASME CODE STAMPED REQUIRED : YES	KT SIZE	: ODC/~~ORDINARY~~
NOZZLE LOAD DATA	APPLICABLE	POSITION OF VESSEL	: HORIZONTAL
WIND SPECIFICATION :	NOT APPLICABLE	HYDROTEST POSITION	: HORIZONTAL IN SHOP
EARTHQUAKE SPECIFICATION : IS 1893 (PART 4)–2015 & SITE SPECTRA		INSPECTION: AUTHORISED INSPECTION: M/s.BV, M/S.TUV	
EQUIPMENT CATEGORY : 1, SOIL TYPE : SOFT		STAGE WISE & THIRD PARTY INSPCTION : YES	
SEISMIC ZONE : III, IMPORTANCE FACTOR : 2		NATIONAL BOARD REGISTRATION : NOT REQUIRED	
POST WELD HEAT TREATMENT	YES, (REFER HEAT TREATMENT TABLE BELOW)		
POST FORMING HEAT TREATMENT	NOT REQUIRED, AS PER 4.3.1. (C) OF 6–12–0002	FOR COLD FORMED HEADS	
LOCATION OF INSTALLATION	M/s.HPCL–VISAKHAPATNAM, AP, INDIA.		
COIL DESIGN PRESSURE (NOZ-5/6) INT./EXT.) (Kg/cm^2g)	8 / 5		
COIL DESIGN TEMPERATURE (NOZ-5/6) INT./EXT.) (°C)	190/260		
COIL DEGREE OF RADIAOGRAPHY	100%		
COIL JOINT EFFICIENCY : 1.0	COIL HYDROTEST PRESSURE : 26.10 (Kg/cm^2g)		

MATERIAL OF CONSTRUCTION

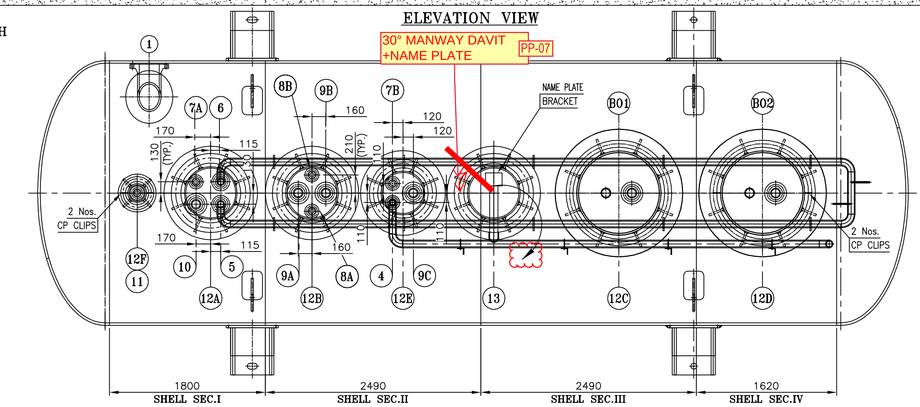
SL.NO.	DESCRIPTION	MATERIAL REFERENCE	MATERIAL SPECIFICATION
01	SHELL / BOOT SHELL	CARBON STEEL	SA 516 GR.70
02	HEADS / BOOT HEADS	CARBON STEEL	SA 516 GR.70
03	SUPPORT	CARBON STEEL	SA 516 GR.70
04	NOZZLE FLANGE	FORGED (CARBON STEEL)	SA 105
05	NOZZLE NECK	CARBON STEEL (FORGED CARBON STEEL)	SA 106 GR.B / SA 516 GR.70/SA 105
06	GASKET (EXTERNAL)	STAINLESS STEEL	SS 316 SPIRAL WOUND GRAFIL FILLED WITH SS 316 INNER RING & C.S. OUTER RING
07	GASKET (INTERNAL)	ALLOY STEEL	CNAF
08	BOLT & NUT (EXTERNAL)	CARBON STEEL	SA 193 GR.B7 / SA 194 GR.2H
09	BOLT & NUT (INTERNAL)	STAINLESS STEEL	SS 304
10	INTERNAL	CARBON STEEL	SA 516 GR.70 / SA 106 GR.B
11	EXTERNAL ATTACHMENT	CARBON STEEL	SA 516 GR.70
12	PIPE FITTINGS	CARBON STEEL	SA 234 GR.WPB
13	EARTHING LUG	STAINLESS STEEL	SA 240 TP 304
14	LIFTING LUG	CARBON STEEL	SA 516 GR.70
15	ANCHOR BOLT	CARBON STEEL	IS 2062 GR.E250 B0/BR
16	CATHODIC PROTECTION CLIP	CARBON STEEL	SA 516 GR.70

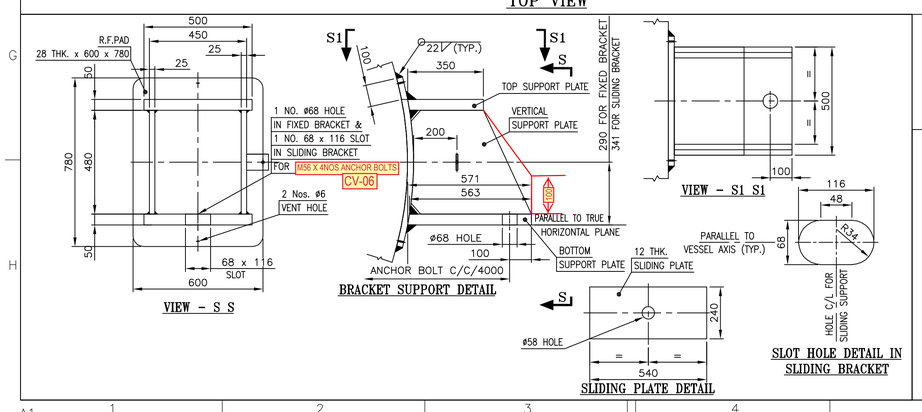
REFERENCE DRAWING LIST

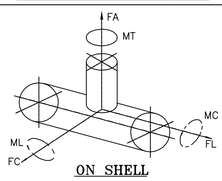
BHEL DOCUMENT NUMBER	CLIENT DOCUMENT NUMBER	DRAWING TITLE
1–PV–160–U0116	B016–RUF–LT–504–MS–FD–BHEL(1)–02552	ASSEMBLY DETAILS OF CLOSED BLOWDOWN DRUM–1 (504–V–803)
0–PV–160–U0018	B016–RUF–LT–504–MS–FD–BHEL(1)–02554	SHELL DEVELOPMENT OF CLOSED BLOWDOWN DRUM–1 (504–V–803)
3–PV–160–U0182	B016–RUF–LT–504–MS–FD–BHEL(1)–02555	DETAILS OF MANWAY DAVIT FOR CLOSED BLOWDOWN DRUM–1 (504–V–803)
3–PV–160–U0180	B016–RUF–LT–504–MS–FD–BHEL(1)–02557	NAME PLATE DETAILS FOR CLOSED BLOWDOWN DRUM–1 (504–V–803)
3–PV–160–U0179	B016–RUF–LT–504–MS–FD–BHEL(1)–02558	GENERAL NOTES FOR CLOSED BLOWDOWN DRUM–1 (504–V–803)
2–PV–160–U0045	B016–RUF–LT–504–MS–DW–BHEL(1)–02559	TRANSPORTATION ARRANGEMENT DETAILS FOR CLOSED BLOWDOWN DRUM–1 (504–V–803)
4–PV–160–U0052	B016–RUF–LT–504–MS–LS–BHEL(1)–03024	SCHEDULE OF MANDATORY SPARES & COMMISSIONING SPARES (504–V–803)
PPPV–2438–PV–160–001	B016–RUF–LT–504–MS–CL–BHEL(1)–02551	MECHNICAL DESIGN OF CLOSED BLOWDOWN DRUM–1 (504–V–803)

LIST OF HOLDS

1. PUMP NOZZLE LOAD+MOMENT FOR 12C/D







WELD JOINT TOLERANCES TABLE – 1

Sl.No.	TOLERANCE APPLICABLE	TOLERANCE
01.	BEVEL ANGLE / INCLUDING ANGLE	
	a). > 35°	± 5°
	b). 20° – 35°	± 2°
	c). < 20°	± 1°
02.	ROOT GAP	
	a). ≤ 3	± 1
	b). 1 < ROOT GAP < 3	± 0.5
	c). ≤ 1	+ 0.5 –0.0

HEAT TREATMENT CYCLE

Part	Procedure	Loading Temperature (°C)	Holding Temperature (°C)	Heating Rate (°C/hr)	Holding Time (min)	Cooling Rate °C/hr	Remarks
BLIND FLG. ASSLY	PWHT	<425	630±10	110	165	140	Unloading at 425°C
COMPLETE EQUIPMENT	PWHT	<425	630±10	110	70	140	Unloading at 425°C

APPLICABLE STANDARDS :

1. ASME BOILER & PRESSURE VESSEL CODE SEC VIII DIV 1 : ED–2019
2. ASME BOILER & PRESSURE VESSEL CODE SEC II PART A, C & D : ED–2019
3. ASME BOILER & PRESSURE VESSEL CODE SEC V : ED–2019
4. ASME BOILER & PRESSURE VESSEL CODE SEC IX ED–2019
5. ASME B16.5 ED–2013–STANDARD FOR PIPE FLANGES AND FLANGED FITTINGS.
6. ASME B16.11 ED–2016 FORGED STEEL FITTINGS, SOCKET WELDED & THREADED
7. ASME B36.10M ED–2018 WELDED AND SEAMLESS WROUGHT STEEL PIPE
8. ASME B16.20 ED2013 METALLIC FLAT GASKET FOR PIPE FLANGES
9. ASME B16.21 ED2011 NON METALLIC FLAT GASKET FOR PIPE FLANGES

MARK NO.	QTY.	SERVICE	NB (N.P.S.)	O.D.	SCH. THK.	RATING CLASS	TYPE/ FACE	PROJECTION	R.F. PAD W x THK.	REMARKS
B01–2	2	BOOT FOR PUMP NOZZLE	I.D.936	–	–	–	–	SEE DRG.	250 x 28	
13	1	MANWAY+B.F.+DAVIT	600 (24")	610.0	20 ~~40~~	300	WN/RF	SEE DRG.	235 x 28	
12F	1	VENTILATION+B.F	200 (8")	219.1	40 ~~100~~	300	WN/RF	SEE DRG.	110 x 28	
12E	1	HOUSING NOZZLE FOR NOZLS.4, 7B & 9C	500 (20")	508.0	60 ~~80~~	300	WN/RF	SEE DRG.	165 x 28	(WITH BLIND)
12C–D	2	PUMP NOZZLE	950 (38")	I.D. 931.6	– 20	300	WN/RF	SEE DRG.	250 x 28	AS PER 16.47 SERIES–B
12B	1	HOUSING NOZZLE FOR NOZLS.8A/B & 9A/B	600 (24")	610.0	40 ~~80~~	300	WN/RF	SEE DRG.	235 x 28	(WITH BLIND)
12A	1	HOUSING NOZZLE FOR NOZLS.5, 6. 7A & 10	600 (24")	610.0	40 ~~47.48~~	300	WN/RF	SEE DRG.	235 x 28	(WITH BLIND)
11	1	VENT	50 (2")	84.0	– 16.6	300	SRLWN/RF	SEE DRG.	–	I.D.50.8
10	1	LP FLARE	100 (4")	114.3	160 ~~223.8~~	300	SRWN/RF	SEE DRG.	–	
9A–C	3	LEVEL TAPS RADAR (NON CONTACT TYPE)	100 (4")	114.3	160 ~~223.8~~	300	SRWN/RF	SEE DRG.	–	(ID 87.32 (WITH PIPE)
8A/B	2	PRESSURE TAPS	50 (2")	84.0	– 16.6	300	SRLWN/RF	SEE DRG.	–	I.D.50.8
7A/B	2	TEMPERATURE TAPS	50 (2")	84.0	– 16.6	300	SRLWN/RF	SEE DRG.	–	I.D.50.8 (WITH PIPE)
6	1	BEARING COOLING WATER RETURN	80 (3")	88.9	160 ~~447~~	300	SRWN/RF	SEE DRG.	–	
5	1	BEARING COOLING WATER SUPPLY	80 (3")	88.9	160 ~~447~~	300	SRWN/RF	SEE DRG.	–	
4	1	STEAM OUT/FG	50 (2")	84.0	– 16.6	300	SRLWN/RF	SEE DRG.	–	(WITH PIPE)
1	1	FEED INLET	250 (10")	273.1	120 ~~219.1~~	300	WN/RF	SEE DRG.	135 x 28	

TABLE OF NOZZLES

Nozzle Mark	NPS	FA (kgf)	FL (kgf)	FC (kgf)	MT (kgf–m)	ML (kgf–m)	MC (kgf–m)
4	2	200	200	200	50	40	30
5, 6	3	300	300	300	112	90	67
10	4	400	400	400	200	160	120
~~12F~~	6	~~540~~	~~800~~	~~800~~	~~800~~	~~640~~	~~480~~
12E	20	2000	2000	2000	5000	4000	3000
12D	38	3800	3800	3800	18050	14440	10830
12C	38	3800	3800	3800	18050	14440	10830
12B	24	2400	2400	2400	7200	5760	4320
12A	24	2400	2400	2400	7200	5760	4320
1	10	1000	1000	1000	1250	1000	750

Max. Nozzle Load

MES-01: Calculation is not with CODE-1, hence the details of HYDROTEST PRESSURE, MAEWP, MAP, LOWEST ALLOWABLE MDMT, CG, FOUNDATION LOAD DATA, FLANGE RATING etc, to be updated as per CODE-1 calculation if required before performing HYDROTEST/PWHT OF VESSESL, the same is M/S BHEL responsibility to ensure consistency between calculation & drawings.

REV.	DESCRIPTION	DRN	CHECKED	APPROVED	REVIEWED	APPROVED	DATE
01	M/s.LTHE COMMENTS INCORPORATED	NPR	SATISH	SATISH	---	---	09.01.21
00	ISSUED FOR SUBMISSION	RPK	SATISH	PKS	---	---	09.06.20

OWNER: HINDUSTAN PETROLEUM CORPORATION LIMITED
VISAKH REFINERY MODERNIZATION PROJECT
EPCC–03 PACKAGE FOR RESIDUE UP–GRADATION FACILITY (RUF)

PMC: इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उद्यम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

LSTK CONTRACTOR: L&T Hydrocarbon Engineering

DETAILED ENGINEERING CENTER: L&T - CHIYODA LIMITED

L&T - CHIYODA LIMITED
☑ REVIEW CODE 1 – NO COMMENTS PROCEED WITH MANUFACTURE / FABRICATION/ CONSTRUCTION AS PER THE DOCUMENT.
☐ (W/MINOR COMMENTS FOR AS-BUILT) FABRICATION /CONSTRUCTION AS PER THE COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED.
☐ REVIEW CODE 3 – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW.
☐ R – DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION
☐ V–VOID
PBD | KMD | AG/MS | 30/01/21
COMMENTED BY | REVIEWED BY | APPROVED BY | DATE
THIS REVIEW / APPROVAL DOES NOT RELIEVE THE VENDOR / MANUFACTURER OF THE FULL RESPONSIBILITY AS TO DESIGN CORRECTNESS OF DIMENSIONS & COMPLIANCE WITH ALL APPLICABLE REGULATIONS AND WITH THE REQUIREMENTS MADE IN PURCHASER SPECIFICATIONS.

VENDOR: Bharat Heavy Electricals Limited UNIT: HEAVY PLATES & VESSELS PLANT VISAKHAPATNAM–530012
VENDOR PO NO: REFINERY/75000–66912/NG DT:18.03.2020
VENDOR DWG. NO: 1–PV–160–U0115, REV–01

DATE	SCALE	TITLE:
23.11.2020	1 : 35	GENERAL ASSEMBLY OF CLOSED BLOWDOWN DRUM–1 (ITEM NO.504–V–803)

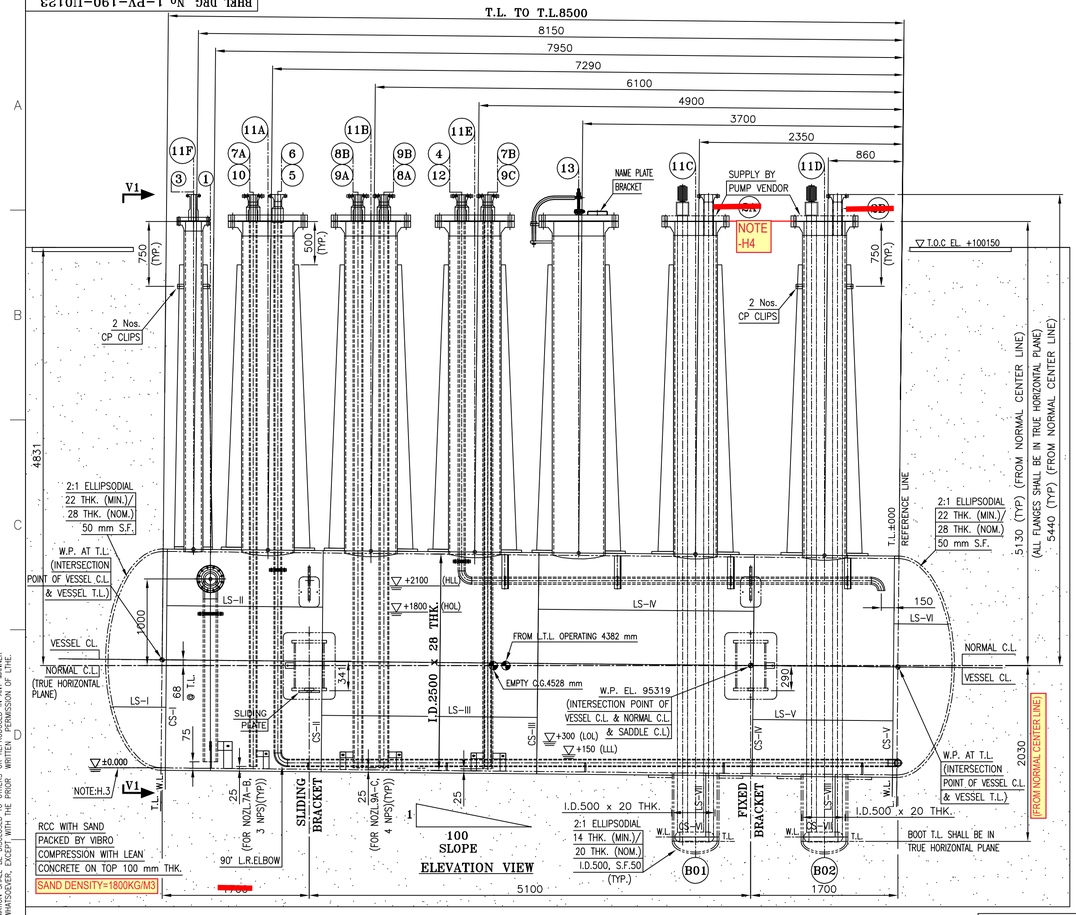
DEPT: HT ENGG.
DRN BY: N.PRAKASH
CHK BY: D.SATISH
APP BY: D.SATISH
PROJECT:
PWO NO.:
DRG. NO.: B016–RUF–LT–504–MS–GA–BHEL(1)–02551
SH. 01 of 01
REV. 01
CAD REVISE THIS DRG. USING CAD SYSTEM ONLY FILE:

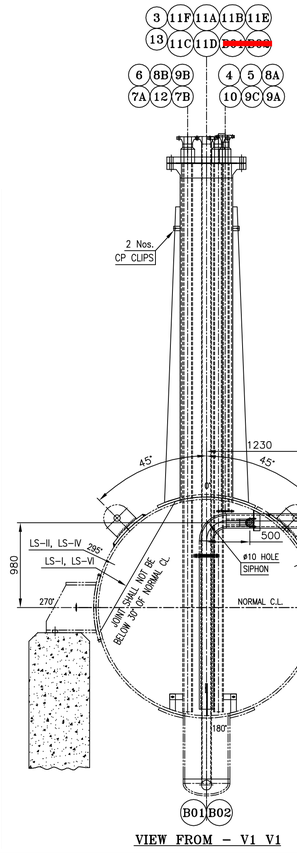
DRG. CATEGORY: (USE TICK MARK) R | I
EIL REVIEW/APPROVAL CODE:
VPTL NO.:
SCH. DATE OF SUBMISSION
DOCUMENT STATUS
STATEMENT OF SUB: 1st 2nd 3rd
☐ FINAL FOR CODE–1 ☐ AS BUILT
ISSUED FOR
☐ AS BUILT ☐ INFORMATION
☐ CONSTRUCTION ☐ REVIEW
SIGN: DATE:
☐ REVIEW CODE 1 – NO COMMENTS PROCEED WITH MANUFACTURE / FABRICATION/ CONSTRUCTION AS PER THE DOCUMENT.
☐ REVIEW CODE 2 – PROCEED WITH MANUFACTURE / FABRICATION / CONSTRUCTION AS PER THE COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED.
☐ REVIEW CODE 3 – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW.
☐ R – DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION
☐ V–VOID

	NAME	DICIPLINE	SIGN.	DATE

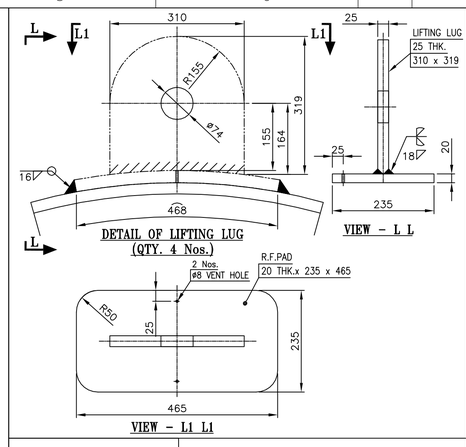
DWG. NO. B016-RUF-LT-504-MS-GA-BHEL(1)-02701

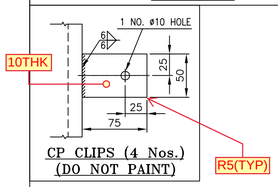
BHEL DRG. No. 1-PV-190-U0123





VIEW FROM – V1 V1





This drawing is also submitted to Client/PMC for approval, and hence LTHE's approval is subjected to PMC approval. PMC comments if any upon receipt will be shared and vendor shall comply to those comments without any cost and time implications.

MES-02: AI (Authorized inspector) review is pending for drawing and calculation for this tag, hence M/s BHEL to take approval on drawings and calculation from AI and comments to be incorporated in drawings/calculation if require before performing HYDROTEST OF VESSESL, the same is M/S BHEL responsibility to ensure consistency between calculation & drawings.

DESIGN DATA

MES-01

SERVICE				
DESIGN PRESSURE INT/EXT – MPa	(Kg/cm^2g)	0.49 (5) / 0.218 (2.23) @ HIGHEST POINT		
MAXIMUM ALLOWABLE WORKING PRESSURE MPa	(Kg/cm^2g)	0.49 (5)		
MAXIMUM ALLOWABLE PRESSURE MPa	(Kg/cm^2g)	1.461 (14.9) (LIMITED BY D'END)		
MAXIMUM ALLOWABLE EXT. WORKING PRESSURE MPa	(Kg/cm^2g)	0.373 (3.8)		
MAXIMUM ALLOWABLE CORROSION ALLOWANCE	(MM)	9.6		
DESIGN TEMPERATURE	(INT./EXT.)(°C)	260 / 260		
OPERATING PRESSURE MPa	(Kg/cm^2g)	0.147 (1.5)		
OPERATING TEMPERATURE	(°C)	40–180		
STEAM OUT CONDITON MPa	(Kg/cm^2g)	0.049 (0.5) @ 170°C		
LOWEST ALLOWABLE MDMT & COINCIDENT MAX. PRESSURE		–48° C @ 5 (Kg/cm^2g)		
HYD.TEST PRESSURE AS PER UG–99(c) MPa	(Kg/cm^2g)	3.09 (31.49) AT SHOP		
HYD.TEST PRESSURE AS PER UG–99(b) MPa	(Kg/cm^2g)	0.64 (6.5) AT SITE		
CORROSION ALLOWANCE (MM)	SHELL, HEADS (INT./EXT.)–3/3	REMOVABLE INTERNAL BRACKET SUPPORT–3	PERMANENT INTERNAL–6	
CAPACITY	(M^3)	46.961	CLAD (mm)	NIL
RADIOGRAPHY:		SHELL: 100%	HEAD: 100%	(RT-1)
JOINT EFFICIENCY		SHELL: 1.0	1.0	
IMPACT TESTING	EXEMPTED, AS PER UCS–66(b)(3)		FABRICATED WEIGHT	: ~35,000 Kg.
OTHER LOADINGS	YES AS PER UG–22(a), (b), (c), (d), (2), (f)		WEIGHT (EMPTY)	: ~35,000 Kg.
INSULATION / FIRE PROOFING	NO		OPERATION WEIGHT	: ~88,000 Kg.
DENSITY OF FLUID	(Kg/M^3)	930–1060 (max)	TEST WEIGHT	: ~81,200 Kg.
MDMT @ MAWP	(°C)@ (Kg/cm^2)	12.5 @ 5	SPECIAL SERVICE	: NO
NB CODE STAMP REQUIRED		☐ YES ☒ NO	CYCLIC SERVICE	: NO
ASME CERTIFICATION MARK		U	VESSEL SL.NO.	: 26678
CODE: ASME SEC. VIII DIV –1 : ED–2019			CONSIGNMENT SIZE	: ODC/~~ORDINARY~~
NOZZLE LOAD DATA		APPLICABLE	POSITION OF VESSEL	: HORIZONTAL
WIND SPECIFICATION :	NOT APPLICABLE		HYDROTEST POSITION	: HORIZONTAL IN SHOP
EARTHQUAKE SPECIFICATION : IS 1893 (PART 4)–2015 & SITE SPECTRA			INSPECTION: AUTHORISED INSPECTION: M/s.BV + M/S TUV	
EQUIPMENT CATEGORY : 1, SOIL TYPE : SOFT			STAGE WISE & THIRD PARTY INSPCTION : YES	
SEISMIC ZONE : III, IMPORTANCE FACTOR : 2			NATIONAL BOARD REGISTRATION : NOT REQUIRED	
POST WELD HEAT TREATMENT	YES, (REFER HEAT TREATMENT TABLE BELOW)			
POST FORMING HEAT TREATMENT	YES, (REFER HEAT TREATMENT TABLE BELOW)			
LOCATION OF INSTALLATION	M/s.HPCL–VISAKHAPATNAM, AP, INDIA.			
COIL DESIGN PRESSURE (NOZ-5/6)	INT./EXT.) (Kg/cm^2g)	8 / 5		
COIL DESIGN TEMPERATURE (NOZ-5/6)	INT./EXT.) (°C)	245/260		
COIL DEGREE OF RADIAOGRAPHY		100%		
COIL JOINT EFFICIENCY : 1.0		COIL HYDROTEST PRESSURE: 31.49 (Kg/cm^2g)		

MATERIAL OF CONSTRUCTION

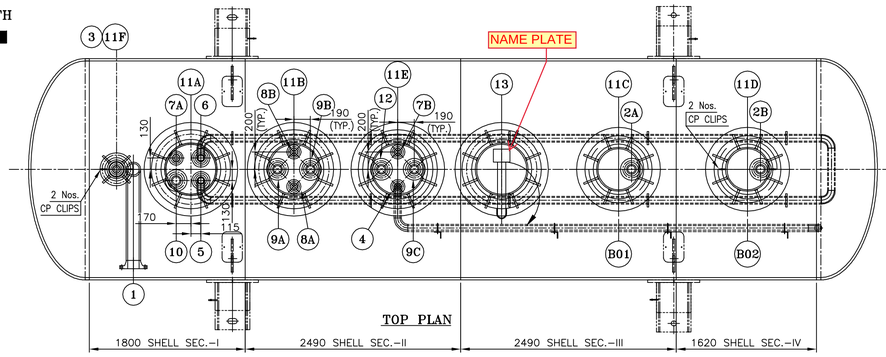
SL.NO.	DESCRIPTION	MATERIAL REFERENCE	MATERIAL SPECIFICATION
01	SHELL / BOOT SHELL	CARBON STEEL	SA 516 GR.70
02	HEADS / BOOT HEADS	CARBON STEEL	SA 516 GR.70
03	SUPPORT	CARBON STEEL	SA 516 GR.70
04	NOZZLE FLANGE	FORGED (CARBON STEEL)	SA 105
05	NOZZLE NECK	CARBON STEEL (FORGED CARBON STEEL)	SA 106 GR.B / SA 516 GR.70/SA 105
06	GASKET (EXTERNAL)	STAINLESS STEEL	SS 316 SPIRAL WOUND GRAFIL FILLED WITH SS 316 INNER RING & C.S. OUTER RING
07	GASKET (INTERNAL)	–	CNAF
08	BOLT & NUT (EXTERNAL)	CARBON STEEL	SA 193 GR.B7 / SA 194 GR.2H
09	BOLT & NUT (INTERNAL)	STAINLESS STEEL	SS 304
10	INTERNAL	CARBON STEEL	SA 516 GR.70 / SA 106 GR.B
11	EXTERNAL ATTACHMENT	CARBON STEEL	SA 516 GR.70
12	PIPE FITTINGS	CARBON STEEL	SA 234 GR.WPB
13	EARTHING LUG	STAINLESS STEEL	SA 240 TP 304
14	LIFTING LUG	CARBON STEEL	SA 516 GR.70
15	ANCHOR BOLT	CARBON STEEL	IS 2062 GR.E250 B0/BR
16	CATHODIC PROTECTION CLIP	CARBON STEEL	SA 516 GR.70

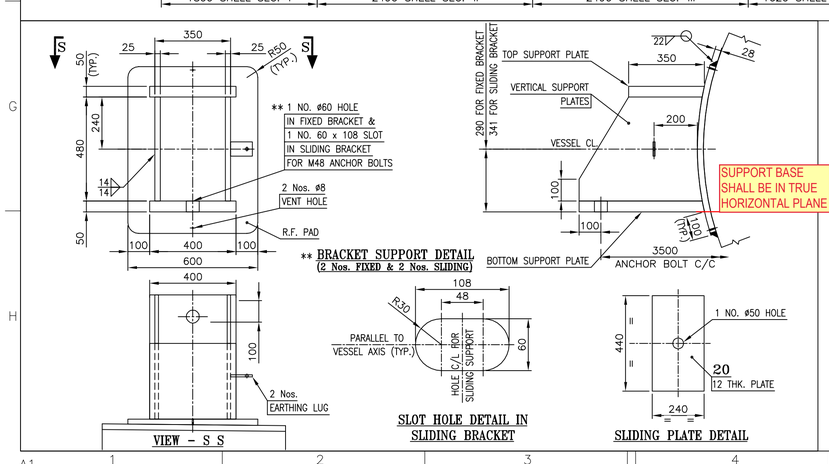
REFERENCE DRAWING LIST

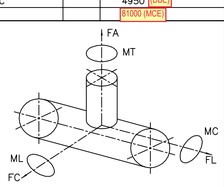
BHEL DOCUMENT NUMBER	CLIENT DOCUMENT NUMBER	DRAWING TITLE
1–PV–190–U0124	B016–RUF–LT–504–MS–FD–BHEL(1)–02702	ASSEMBLY DETAILS OF HOT OIL BLOWDOWN DRUM (504–V–807)
0–PV–190–U0022	B016–RUF–LT–504–MS–FD–BHEL(1)–02704	SHELL DEVELOPMENT OF HOT OIL BLOWDOWN DRUM (504–V–807)
3–PV–190–U0194	B016–RUF–LT–504–MS–FD–BHEL(1)–02705	DETAILS OF MANWAY DAVIT FOR HOT OIL BLOWDOWN DRUM (504–V–807)
3–PV–190–U0192	B016–RUF–LT–504–MS–FD–BHEL(1)–02707	NAME PLATE DETAILS FOR HOT OIL BLOWDOWN DRUM (504–V–807)
3–PV–190–U0191	B016–RUF–LT–504–MS–FD–BHEL(1)–02708	GENERAL NOTES FOR HOT OIL BLOWDOWN DRUM (504–V–807)
2–PV–190–U0049	B016–RUF–LT–504–MS–DW–BHEL(1)–02709	TRANSPORTATION ARRANGEMENT DETAILS FOR HOT OIL BLOWDOWN DRUM (504–V–807)
4–PV–190–U0052	B016–RUF–LT–504–MS–LS–BHEL(1)–03027	SCHEDULE OF MANDATORY SPARES & COMMISSIONING SPARES (504–V–807)
PPV–2438–PV–190–001	B016–RUF–LT–504–MS–CL–BHEL(1)–02701	MECHNICAL DESIGN OF HOT OIL BLOWDOWN DRUM (504–V–807)

LIST OF HOLDS

~~1. PUMP NOZZLE LOAD+MOMENT FOR 11C/D~~







WELD JOINT TOLERANCES

TABLE – 1

Sl.No.	TOLERANCE APPLICABLE	TOLERANCE
01.	BEVEL ANGLE / INCLUDING ANGLE	
	a). > 35°	± 5°
	b). 20° – 35°	± 2°
	c). < 20°	± 1°
02.	ROOT GAP	
	a). ≤ 3	± 1
	b). 1 < ROOT GAP < 3	± 0.5
	c). < 1	+ 0.5 –0.0

LOAD DATA

SHEAR AT BASE (KG)	EMPTY	IN OPERATION
DUE TO SEISMIC		14451 (DBE)
–		19000 (MCE)
MOMENT AT BASE (KG–M)	**EMPTY**	**IN OPERATION**
DUE TO SEISMIC		4950 (DBE)
–		81000 (MCE)

ON SHELL

5,6	3"	300	300	300	112	90	67
4	2"	200	200	200	50	40	30
10/12	4"	400	400	400	200	160	120
11E	24"	2400	2400	2400	7200	5760	4320
11D	20"	2000	2000	2000	5000	4000	3000
11C	20"	2000	2000	2000	5000	4000	3000
11B	24"	2400	2400	2400	7200	5760	4320
11A	24"	2400	2400	2400	7200	5760	4320
1	6"	600	600	600	450	360	270
Nozzle Mark	NB	FA (kgf)	FL (kgf)	FC (kgf)	MT (kgf–m)	ML (kgf–m)	MC (kgf–m)

Max. Nozzle Load

HEAT TREATMENT CYCLE

Part	Procedure	Loading Temperature (°C)	Holding Temperature (°C)	Heating Rate (°C/hr)	Holding Time (min)	Cooling Rate °C/hr	Remarks
BLIND FLG. ASSLY	PWHT	<425	630±10	110	165	140	Unloading at 425°C
D'ENDS OF SHELL & BOOT	PPHT	<425	630±10	110	70	140	Unloading at 425°C

APPLICABLE STANDARDS :

1. ASME BOILER & PRESSURE VESSEL CODE SEC VIII DIV 1 : ED–2019
2. ASME BOILER & PRESSURE VESSEL CODE SEC II PART A, C & D : ED–2019
3. ASME BOILER & PRESSURE VESSEL CODE SEC V : ED–2019
4. ASME BOILER & PRESSURE VESSEL CODE SEC IX ED–2019
5. ASME B16.5 ED–2013–STANDARD FOR PIPE FLANGES AND FLANGED FITTINGS.
6. ASME B16.11 ED–2016 FORGED STEEL FITTINGS, SOCKET WELDED & THREADED
7. ASME B36.10M ED–2018 WELDED AND SEAMLESS WROUGHT STEEL PIPE
8. ASME B16.20 ED2013 METALLIC FLAT GASKET FOR PIPE FLANGES
9. ASME B16.21 ED2011 NON METALLIC FLAT GASKET FOR PIPE FLANGES

TABLE OF NOZZLES

MARK NO.	QTY.	SERVICE	NB (N.P.S.)	O.D.	SCH. THK.	RATING CLASS	TYPE/ FACE	PROJECTION	R.F. PAD W x THK.	REMARKS
B01–2	2	BOOT FOR PUMP NOZZLE	I.D.500	–	–	–	–	SEE DRG.	275 x 28	
13	1	MANWAY+B.F.+DAVIT	600 (24")	610.0	– 20	300	WN/RF	SEE DRG.	235 x 28	
12	1	HOT OIL FROM P–813A/B	100 (4")	114.3	160 13.49	300	SRWN/RF	SEE DRG.	~~110 x 28~~	
11F	1	VENTILATION+B.F	200 (8")	219.1	120 18.26	300	WN/RF	SEE DRG.	110 x 28	
11E	1	HOUSING NOZZLE FOR NOZL.4,7B,9C & 12	600 (24")	610.0	– 20	300	WN/RF	SEE DRG.	235 x 28	(WITH BLIND)
11C–D	2	PUMP NOZZLE	500 (20")	508.0	– 20	300	WN/RF	SEE DRG.	250 x 28	
11B	1	HOUSING NOZZLE FOR NOZL.9A/B & 8A/B	600 (24")	610.0	– 20	300	WN/RF	SEE DRG.	235 x 28	(WITH BLIND)
11A	1	HOUSING NOZZLE FOR NOZL.6,5,10 & 7A	600 (24")	610.0	– 20	300	WN/RF	SEE DRG.	235 x 28	(WITH BLIND)
10	1	LP FLARE	100 (4")	114.3	160 13.49	300	SRWN/RF	SEE DRG.	–	
9A–C	3	LEVEL TAPS (RADAR (NON CONTACT TYPE))	100 (4")	114.3	160 13.49	300	WN/RF	SEE DRG.	–	I.D.87.32 (WITH PIPE)
8A/B	2	PRESSURE TAPS	50 (2")	84.0	– 16.6	300	SRLWN/RF	SEE DRG.	–	I.D.50.8
7A/B	2	TEMPERATURE TAPS	50 (2")	84.0	– 16.6	300	SRLWN/RF	SEE DRG.	–	I.D.50.8 (WITH PIPE)
6	1	BEARING COOLING WATER RETURN	80 (3")	88.9	160 11.13	300	SRWN/RF	SEE DRG.	–	
5	1	BEARING COOLING WATER SUPPLY	80 (3")	88.9	160 11.13	300	SRWN/RF	SEE DRG.	–	
4	1	STEAM OUT/N2	50 (2")	84.0	– 16.6	300	SRLWN/RF	SEE DRG.	–	(WITH PIPE)
3	1	VENT	50 (2")	84.0	– 16.6	300	SRLWN/RF	SEE DRG.	–	
1	1	FEED INLET	150 (6")	168.3	160 18.26	300	WN/RF	SEE DRG.	70 x 28	

MES-01: Calculation is not with CODE–1, hence the details of HYDROTEST PRESSURE, MAEWP, MAP, LOWEST ALLOWABLE MDMT, CG, FOUNDATION LOAD DATA, FLANGE RATING etc, to be updated as per CODE-1 calculation if required before performing HYDROTEST OF VESSESL, the same is M/S BHEL responsibility to ensure consistency between calculation & drawings.

L&T – CHIYODA LIMITED

REVIEW CODE 1 – NO COMMENTS PROCEED WITH MANUFACTURE / FABRICATION/ CONSTRUCTION AS PER THE DOCUMENT.
☐ W/MINOR COMMENTS FOR AS-BUILT/ FABRICATION /CONSTRUCTION AS PER THE COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED.
☐ REVIEW CODE 3 – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW.
☐ R – DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION
☐ V–VOID

PBD	KMD	AG/MS	06/01/21
COMMENTED BY	REVIEWED BY	APPROVED BY	DATE

THIS REVIEW / APPROVAL DOES NOT RELIEVE THE VENDOR / MANUFACTURER OF THE FULL RESPONSIBILITY AS TO DESIGN CORRECTNESS OF DIMENSIONS & COMPLIANCE WITHALL APPLICABLE REGULATIONS AND WITH THE REQUIREMENTS MADE IN PURCHASER SPECIFICATIONS.

DRG. CATEGORY: (USE TICK MARK) R I
SCH. DATE OF SUBMISSION
DOCUMENT STATUS
STATEMENT OF SUB: 1st 2nd 3rd
☐ FINAL FOR CODE–1 ☐ AS BUILT
ISSUED FOR
☐ AS BUILT ☐ INFORMATION
☐ CONSTRUCTION ☐ REVIEW
SIGN: DATE:

EIL REVIEW/APPROVAL VPTL NO.:
CODE:
☐ REVIEW CODE 1 – NO COMMENTS PROCEED WITH MANUFACTURE / FABRICATION/ CONSTRUCTION AS PER THE DOCUMENT.
☐ REVIEW CODE 2 – PROCEED WITH MANUFACTURE / FABRICATION / CONSTRUCTION AS PER THE COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED.
☐ REVIEW CODE 3 – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW.
☐ R – DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION
☐ V–VOID
NAME DICIPLINE SIGN. DATE

REV.	DESCRIPTION	DRN	CHECKED	APPROVED	REVIEWED	APPROVED	DATE
03	M/s.LTHE COMMENTS INCORPORATED	NPR	SATISH	SATISH	----	----	28.12.20
02	M/s.LTHE COMMENTS INCORPORATED	NPR	SATISH	SATISH	----	----	24.11.20
01	M/s.LTHE COMMENTS INCORPORATED	RPK	SATISH	PKS	----	----	08.09.20
00	ISSUED FOR SUBMISSION	RPK	SATISH	PKS	----	----	09.06.20

OWNER: HINDUSTAN PETROLEUM CORPORATION LIMITED
VISAKH REFINERY MODERNIZATION PROJECT
EPCC–03 PACKAGE FOR RESIDUE UP–GRADATION FACILITY (RUF)

PMC: ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

LSTK CONTRACTOR: L&T Hydrocarbon Engineering

DETAILED ENGINEERING CENTER: L&T – CHIYODA LIMITED

VENDOR: Bharat Heavy Electricals Limited
UNIT: HEAVY PLATES & VESSELS PLANT
VISAKHAPATNAM–530012

VENDOR PO NO: REFINERY/75000–66912/NG DT:18.03.2020
VENDOR DWG. NO: 1–PV–190–U0123, REV–03

DATE 23.11.2020 | SCALE 1 : 35
DEPT: HT ENGG.
DRN BY: N.PRAKASH
CHK BY: D.SATISH
APP BY: D.SATISH

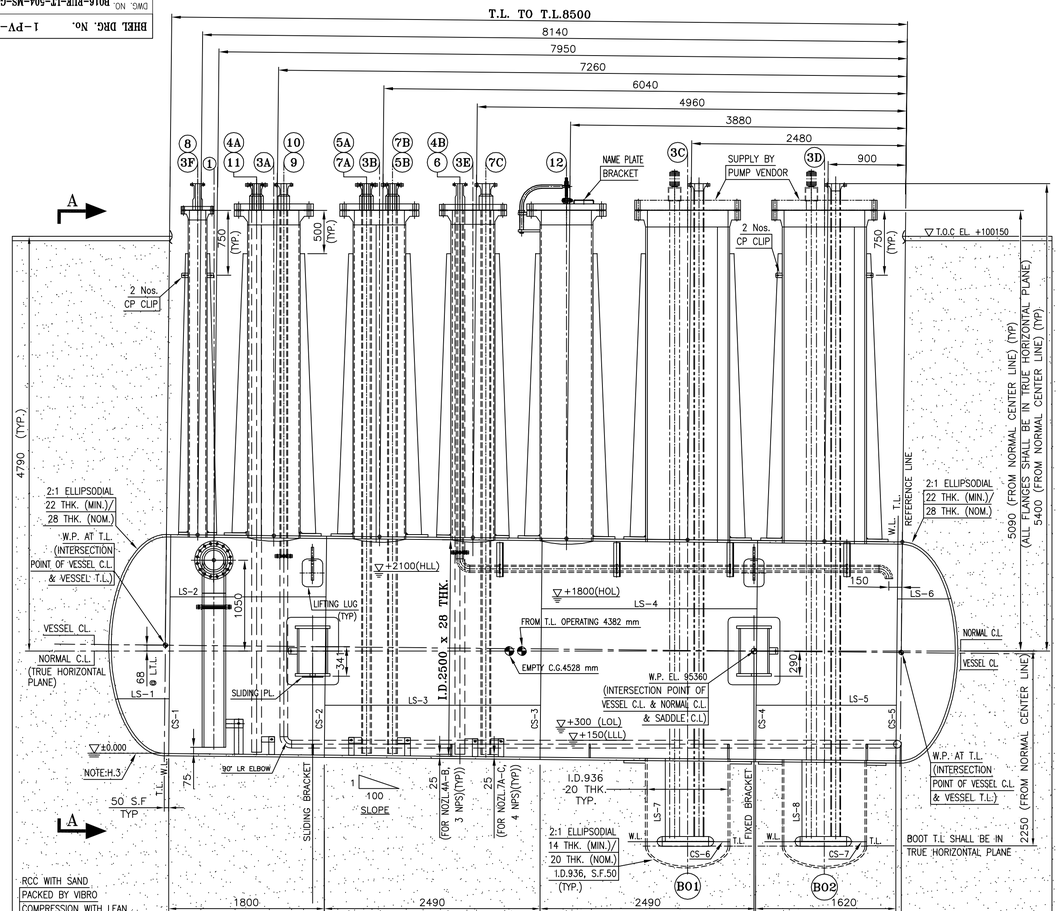
TITLE: GENERAL ASSEMBLY OF HOT OIL BLOWDOWN DRUM (ITEM NO.504–V–807)
PROJECT:
DRG. NO.: B016–RUF–LT–504–MS–GA–BHEL(1)–02701
SH. 01 of 01
PWO NO.:
REV. 03

CAD REVISE THIS DRG. USING CAD SYSTEM ONLY FILE:

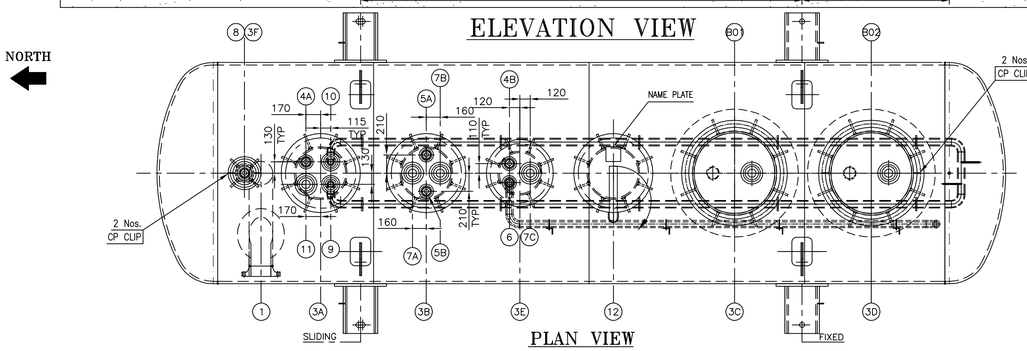
BHEL DRG. NO. 1-PV-200-U0125

DMG. NO. B016-RUF-LT-504-MS-GA-BHEL(1)-02751

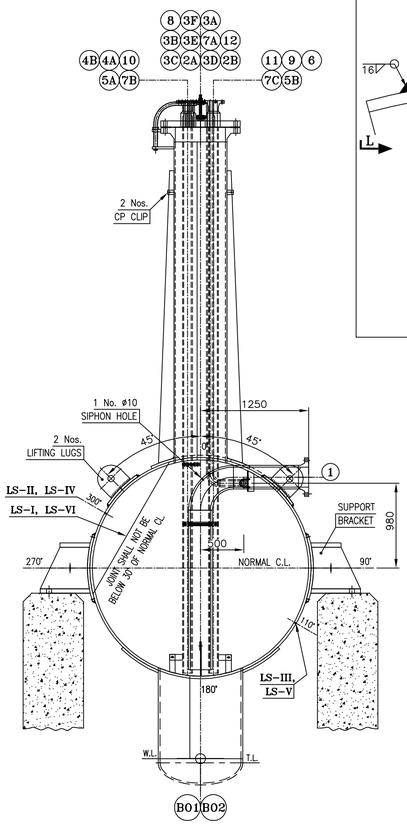
ELEVATION VIEW



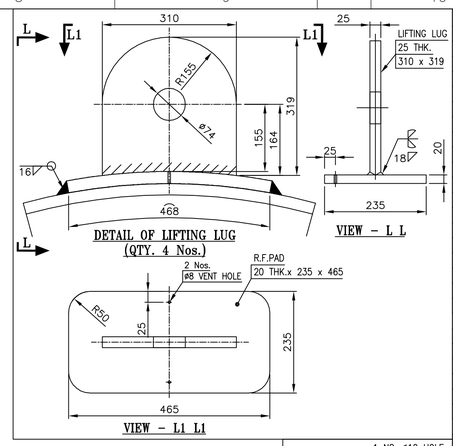
PLAN VIEW

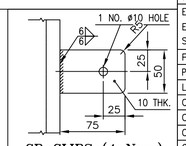


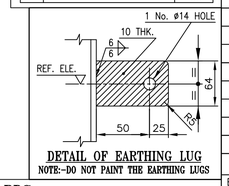
This drawing is also submitted to Client/PMC for approval, and hence LTHE's approval is subjected to PMC approval. PMC comments if any upon receipt will be shared and vendor shall comply to those comments without any cost and time implications.



VIEW FROM A-A







NOTE:-DO NOT PAINT THE EARTHING LUGS

DESIGN DATA

SERVICE			
DESIGN PRESSURE INT/EXT – MPa	(Kg/cm^2g)	0.49 (5) / 0.218 (2.23) @ HEIGHT POINT	
MAXIMUM ALLOWABLE WORKING PRESSURE MPa	(Kg/cm^2g)	0.49 (5)	
MAXIMUM ALLOWABLE PRESSURE MPa	(Kg/cm^2g)	1.461 (14.9) (LIMITED BY D'END)	
MAXIMUM ALLOWABLE EXT. WORKING PRESSURE MPa	(Kg/cm^2g)	0.373 (3.8)	
MAXIMUM ALLOWABLE CORROSION ALLOWANCE	(MM)	9.6	
DESIGN TEMPERATURE INT./EXT.	(°C)	260	
OPERATING PRESSURE MPa	(Kg/cm^2g)	0.147 (1.5)	
OPERATING TEMPERATURE	(°C)	40–180	
STEAM OUT CONDITON MPa	(Kg/cm^2g)	0.049 (0.5) @ 170°C	
LOWEST ALLOWABLE MDMT & COINCIDENT MAX. PRESSURE		–48 °C @ 5 (Kg/cm^2g)	
HYD.TEST PRESSURE AS PER UG–99(c) MPa	(Kg/cm^2g)	3.09 (31.49) AT SHOP	
HYD.TEST PRESSURE AS PER UG–99(b) MPa	(Kg/cm^2g)	0.64 (6.5) AT SITE	
CORROSION ALLOWANCE(MM)	SHELL, HEADS (INT./EXT.)–3/3 | REMOVABLE INTERNAL BRACKET SUPPORT–3 | PERMANENT INTERNAL–6		
CAPACITY	(Kg/M^3)	46,961	CLAD (mm) | NIL
RADIOGRAPHY:		SHELL: 100%	HEAD: 100%
JOINT EFFICIENCY		SHELL: 1.0	HEAD: 1.0
IMPACT TESTING	EXEMPTED, AS PER UCS–66(b)(3)		FABRICATED WEIGHT : ~35,800 Kg.
OTHER LOADINGS	YES AS PER UG–22(a), (b), (c), (d), (2), (f)		EMPTY WEIGHT : ~35,800 Kg.
INSULATION / FIRE PROOFING	NO		OPERATION WEIGHT : ~88,800 Kg.
DENSITY OF FLUID	(Kg/M^3) 600–1000		TEST WEIGHT : ~82,000 Kg.
MDMT @ MAWP	(°C)@(Kg/cm^2) 12.5 @5		SPECIAL SERVICE : SUPPLEMENTARY–A
NB CODE STAMP REQUIRED	☐ YES ☒ NO		CYCLIC SERVICE : NO
ASME CERTIFICATION MARK	U		VESSEL SL.NO. : **26679**
CODE: ASME SEC. VIII DIV –1 : ED–2019			CONSIGNMENT SIZE : ODC/~~ORDINARY~~
NOZZLE LOAD DATA	APPLICABLE		POSITION OF VESSEL : HORIZONTAL
WIND SPECIFICATION :	NOT APPLICABLE		HYDROTEST POSITION : HORIZONTAL IN SHOP
EARTHQUAKE SPECIFICATION : IS 1893 (PART 4)–2015 & SITE SPECTRA			INSPECTION: AUTHORISED INSPECTION: M/s.BV/TUV
EQUIPMENT CATEGORY : 1, SOIL TYPE : SOFT			STAGE WISE & THIRD PARTY INSPCTION : YES
SEISMIC ZONE : III, IMPORTANCE FACTOR : 2			NATIONAL BOARD REGISTRATION : NOT REQUIRED
POST WELD HEAT TREATMENT	YES, (REFER HEAT TREATMENT TABLE BELOW)		
POST FORMING HEAT TREATMENT	NOT REQUIRED, AS PER 4.3.1 (C) OF 6–12–0002		
LOCATION OF INSTALLATION	M/s.HPCL–VISAKHAPATNAM, AP, INDIA.		
COIL DESIGN PRESSURE ((NOZL9 & 10) INT./EXT.)	(Kg/cm^2g)	8 / 5	
COIL DESIGN TEMPERATURE ((NOZL9 & 10) INT./EXT.)	(°C)	245/260	
COIL DEGREE OF RADIAOGRAPHY		100%	
COIL JOINT EFFICIENCY : 1.0		COIL HYDROTEST PRESSURE: 31.49	(Kg/cm^2g)

WELD JOINT TOLERANCES

TABLE – 1

Sl.No.	TOLERANCE APPLICABLE	TOLERANCE
01.	BEVEL ANGLE / INCLUDING ANGLE	
	a). > 35°	± 5°
	b). 20° – 35°	± 2°
	c). < 20°	± 1°
02.	ROOT GAP	
	a). ≤ 3	± 1
	b). 1 < ROOT GAP < 3	± 0.5
	c). < 1	+ 0.5 –0.0

MATERIAL OF CONSTRUCTION

SL.NO.	DESCRIPTION	MATERIAL REFERENCE	MATERIAL SPECIFICATION
01	SHELL / BOOT SHELL	CARBON STEEL	SA 516 GR.70
02	HEADS / BOOT HEADS	CARBON STEEL	SA 516 GR.70
03	SUPPORT	CARBON STEEL	SA 516 GR.70
04	NOZZLE FLANGE	FORGED (CARBON STEEL)	SA 105
05	NOZZLE NECK	CARBON STEEL (FORGED CARBON STEEL)	SA 106 GR.B / SA 516 GR.70/SA 105
06	GASKET (EXTERNAL)	STAINLESS STEEL	SS 316 SPIRAL WOUND GRAFIL FILLED WITH SS 316 INNER RING & C.S. OUTER RING
07	GASKET (INTERNAL)	–	CNAF
08	BOLT & NUT (EXTERNAL)	CARBON STEEL	SA 193 GR.B7 / SA 194 GR.2H
09	BOLT & NUT (INTERNAL)	STAINLESS STEEL	SS 304
10	INTERNAL	CARBON STEEL	SA 516 GR.70 / SA 106 GR.B
11	EXTERNAL ATTACHMENT	CARBON STEEL	SA 516 GR.70
12	PIPE FITTINGS	CARBON STEEL	SA 234 GR.WPB
13	EARTHING LUG	AUSTENITIC STEEL	SA 240 TP 304
14	LIFTING LUG	CARBON STEEL	SA 516 GR.70
15	ANCHOR BOLT	CARBON STEEL	IS 2062 GR.E250 BO/BR
14	CATHODIC PROTECTION CLIP	CARBON STEEL	SA 516 GR.70

REFERENCE DRAWING LIST

BHEL DOCUMENT NUMBER	CLIENT DOCUMENT NUMBER	DRAWING TITLE
1–PV–200–U0126	B016–RUF–LT–504–MS–FD–BHEL(1)–02752	ASSEMBLY DETAILS OF CLOSED BLOWDOWN DRUM–2 (504–V–809)
0–PV–200–U0023	B016–RUF–LT–504–MS–FD–BHEL(1)–02754	SHELL DEVELOPMENT OF CLOSED BLOWDOWN DRUM–2 (504–V–809)
3–PV–200–U0195	B016–RUF–LT–504–MS–FD–BHEL(1)–02755	DETAILS OF MANWAY DAVIT FOR CLOSED BLOWDOWN DRUM–2 (504–V–809)
3–PV–200–U0197	B016–RUF–LT–504–MS–FD–BHEL(1)–02757	NAME PLATE DETAILS FOR CLOSED BLOWDOWN DRUM–2 (504–V–809)
3–PV–200–U0198	B016–RUF–LT–504–MS–FD–BHEL(1)–02758	GENERAL NOTES FOR CLOSED BLOWDOWN DRUM–2 (504–V–809)
2–PV–200–U0050	B016–RUF–LT–504–MS–DW–BHEL(1)–02759	TRANSPORTATION ARRANGEMENT DETAILS FOR CLOSED BLOWDOWN DRUM–2 (504–V–809)
4–PV–200–U0052	B016–RUF–LT–504–MS–LS–BHEL(1)–03028	SCHEDULE OF MANDATORY SPARES & COMMISSIONING SPARES (504–V–809)
PPPV–2438–PV–200–001	B016–RUF–LT–504–MS–CL–BHEL(1)–02751	MECHNICAL DESIGN OF CLOSED BLOWDOWN DRUM–2 (504–V–809)

APPLICABLE STANDARDS :

1. ASME BOILER & PRESSURE VESSEL CODE SEC VIII DIV 1 : ED–2019
2. ASME BOILER & PRESSURE VESSEL CODE SEC II PART A, C & D : ED–2019
3. ASME BOILER & PRESSURE VESSEL CODE SEC V : ED–2019
4. ASME BOILER & PRESSURE VESSEL CODE SEC IX ED–2019
5. ASME B16.5 ED–2013–STANDARD FOR PIPE FLANGES AND FLANGED FITTINGS.
6. ASME B16.11 ED–2016 FORGED STEEL FITTINGS, SOCKET WELDED & THREADED
7. ASME B36.10M ED–2018 WELDED AND SEAMLESS WROUGHT STEEL PIPE
8. ASME B16.20 ED2013 METALLIC FLAT GASKET FOR PIPE FLANGES
9. ASME B16.21 ED2011 NON METALLIC FLAT GASKET FOR PIPE FLANGES

HEAT TREATMENT CYCLE

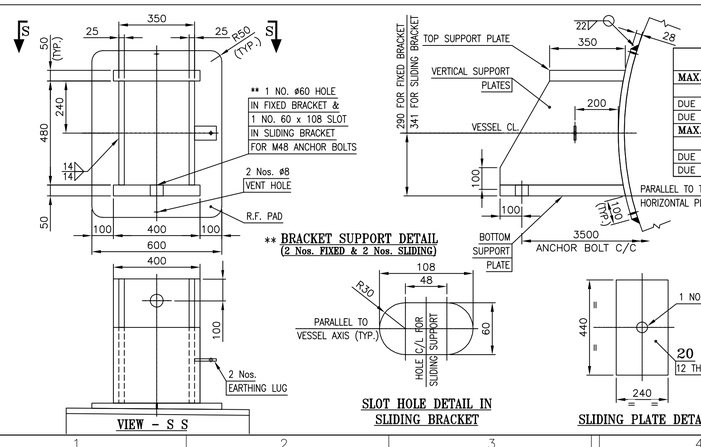
Part	Procedure	Loading Temperature (°C)	Holding Temperature (°C) (min.)	Heating (Max.) Rate (°C/hr)	Holding Time (min)	Cooling(Max.) Rate °C/hr	Remarks
COMPLETE EQUIPMENT	PWHT	<425	610±10	110	70	140	Unloading at 425°C
BLIND FLANGE ASSLY.	PWHT	<425	630±10	110	165	140	Unloading at 425°C

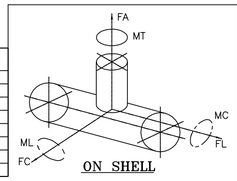
B01–2	2	BOOT FOR PUMP NOZZLE	I.D.936	–	– / 20	–	–	SEE DRG.	255 x 28	
12	1	MANWAY+B.F.+DAVIT	600 (24")	610	40 / 17.48	300	WN/RF	SEE DRG.	255 x 28	
11	1	LP FLARE	100 (4")	114.3	160 / 13.48	300	SRWN/RF	SEE DRG.	–	
10	1	BEARING COOLING WATER RETURN/CONDENSATE	80 (3")	88.9	160 / 11.13	300	SRWN/RF	SEE DRG.	–	
9	1	BEARING COOLING WATER SUPPLY/LP STEEM	80 (3")	88.9	160 / 11.13	300	SRWN/RF	SEE DRG.	–	
8	1	VENT	50 (2")	84.0	– / 16.6	300	SRLWN/RF	SEE DRG.	–	
7A–C	3	LEVEL TAPS (GWR)	100 (4")	114.3	160 / 13.48	300	SRWN/RF	SEE DRG.	–	I.D.87.32 (WITH PIPE)
6	1	STEAM OUT/FG	50 (2")	84.0	– / 16.6	300	SRLWN/RF	SEE DRG.	–	I.D.50.8
5A/B	2	PRESSURE TAPS	50 (2")	84.0	– / 16.6	300	SRLWN/RF	SEE DRG.	–	I.D.50.8
4A/B	2	TEMPERATURE TAPS	50 (2")	84.0	– / 16.6	300	SRLWN/RF	SEE DRG.	–	(WITH PIPE)
3F	1	VENTILATION + B.F.	200 (8")	219.1	120 / 18.26	300	WN/RF	SEE DRG.	110 x 28	WITH BLIND
3E	1	HOUSING NOZZLE FOR NOZLS.4B, 6 & 7C	500 (20")	508.0	60 / 20.62	300	WN/RF	SEE DRG.	165 x 28	WITH BLIND
3C–D	2	PUMP NOZZLE	950 (38")	I.D. 931.6	– / 20	300	WN/RF	SEE DRG.	255 x 28	(B16.47, SERIES–B)
3B	1	HOUSING NOZZLE FOR NOZLS.5A/B & 7A/B	600 (24")	610	– / 20	300	WN/RF	SEE DRG.	255 x 28	WITH BLIND
3A	1	HOUSING NOZZLE FOR NOZLS.4A, 9, 10 & 11	600 (24")	610	– / 20	300	WN/RF	SEE DRG.	255 x 28	WITH BLIND
1	1	FEED INLET	250 (10")	273.1	120 / 21.44	300	WN/RF	SEE DRG.	135 x 28	
MARK NO.	QTY.	SERVICE	NB (N.P.S.)	O.D.	SCH. THK.	RATING CLASS	TYPE/ FACE	PROJECTION	R.F. PAD W x THK.	REMARKS

TABLE OF NOZZLES

LOAD DATA

MAX. SHEAR AT BASE (KG)	EMPTY	IN OPERATION
DUE TO SEISMIC		14688.6
DUE TO WIND		–
MAX. MOMENT AT BASE (KG–M)	**EMPTY**	**IN OPERATION**
DUE TO SEISMIC		5008.8
DUE TO SEISMIC		–





Max. Nozzle Load

Nozzle Mark	NPS	FA (kgf)	FL (kgf)	FC (kgf)	MT (kgf–m)	ML (kgf–m)	MC (kgf–m)
9, 10	3	300	300	300	112	90	67
6	2	200	200	200	50	40	30
11	4	400	400	400	200	160	120
3E	20	2000	2000	2000	5000	4000	3000
3D	38	3800	3800	3800	18050	14440	10830
3C	38	3800	3800	3800	18050	14440	10830
3B	24	2400	2400	2400	7200	5760	4320
3A	24	2400	2400	2400	7200	5760	4320
1	10	1000	1000	1000	1250	1000	750

LIST OF HOLDS

~~1. NOZZLE 3C/3D/LOAD+MOMENT~~

MES-02: AI (Authorized inspector) review is pending for drawing and calculation for this tag, hence M/s BHEL to take approval on drawings and calculation from AI and comments to be incorporated in drawings/calculation if require before performing HYDROTEST OF VESSESL, the same is M/S BHEL responsibility to ensure consistency between calculation & drawinas.

MES-01: Calculation is not with CODE-1, hence the details of HYDROTEST PRESSURE, MAEWP, MAP, LOWEST ALLOWABLE MDMT, CG, FOUNDATION LOAD DATA etc, to be updated as per CODE-1 calculation if required before performing HYDROTEST OF VESSESL, the same is M/S BHEL responsibility to ensure consistency between calculation & drawings.

L&T - CHIYODA LIMITED

☑ REVIEW CODE 1 – NO COMMENTS PROCEED WITH MANUFACTURE / FABRICATION/ CONSTRUCTION AS PER THE DOCUMENT.
☐ REVIEW CODE 2 – PROCEED WITH MINNOR COMMENTS FOR AS–~~BUILT~~ICTURE/ FABRICATION /CONSTRUCTION AS PER THE COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED.
☐ REVIEW CODE 3 – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW.
☐ R – DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION
☐ V–VOID

PBD	KMD	AG/MS	30/12/20
COMMENTED BY	REVIEWED BY	APPROVED BY	DATE

THIS REVIEW / APPROVAL DOES NOT RELIEVE THE VENDOR / MANUFACTURER OF THE FULL RESPONSIBILITY AS TO DESIGN CORRECTNESS OF DIMENSIONS & COMPLIANCE WITHALL APPLICABLE REGULATIONS AND WITH THE REQUIREMENTS MADE IN PURCHASER SPECIFICATIONS.

DRG. CATEGORY: (USE TICK MARK) R I
EIL REVIEW/APPROVAL CODE:
VPTL NO.:
SCH. DATE OF SUBMISSION
DOCUMENT STATUS
STATEMENT OF SUB: 1st 2nd 3rd
☐ FINAL FOR CODE–1 ☐ AS BUILT
ISSUED FOR
☐ AS BUILT ☐ INFORMATION
☐ CONSTRUCTION ☐ REVIEW
SIGN: DATE:

☐ REVIEW CODE 1 – NO COMMENTS PROCEED WITH MANUFACTURE / FABRICATION/ CONSTRUCTION AS PER THE DOCUMENT. REVISED DOCUMENT REQUIRED.
☐ REVIEW CODE 2 – PROCEED WITH MANUFACTURE / FABRICATION / CONSTRUCTION AS PER THE COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED.
☐ REVIEW CODE 3 – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW.
☐ R – DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION
☐ V–VOID

REV.	DESCRIPTION	DRN	CHECKED	APPROVED	REVIEWED	APPROVED	DATE
03	W/s.LTHE COMMENTS INCORPORATED	NPR	SATISH	PKS	---	---	22.12.20
02	W/s.LTHE COMMENTS INCORPORATED	NPR	SATISH	PKS	---	---	04.12.20
01	ISSUED FOR ACTION	RPK	SATISH	PKS	---	---	21.07.20
00	ISSUED FOR INFORMATION	RPK	SATISH	PKS	---	---	12.06.20

NAME DICIPLINE SIGN. DATE

OWNER: HINDUSTAN PETROLEUM CORPORATION LIMITED
VISAKH REFINERY MODERNIZATION PROJECT
EPCC–03 PACKAGE FOR RESIDUE UP–GRADATION FACILITY (RUF)

PMC: इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उद्यम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

LSTK CONTRACTOR: L&T Hydrocarbon Engineering

DETAILED ENGINEERING CENTER: L&T - CHIYODA LIMITED

VENDOR: BHH
Bharat Heavy Electricals Limited
UNIT: HEAVY PLATES & VESSELS PLANT
VISAKHAPATNAM–530012

VENDOR PO NO: REFINERY/75000–66912/NG DT:18.03.2020
VENDOR DWG. NO: 1–PV–200–U0125, REV–02

DATE	SCALE	TITLE:
09.06.2020	1 : 35	GENERAL ASSEMBLY OF CLOSED BLOWDOWN DRUM–2 (ITEM NO.504–V–809)

DEPT:	HT ENGG.	PROJECT:	DRG. NO.:	SH.
DRN BY:	RPK		B016–RUF–LT–504–MS–GA–BHEL(1)–02751	01 of 01
CHK BY:	SATISH	PWO NO.:		REV. 03
APP BY:	PKS	CAD ROUSE THIS DRG. USING CAD SYSTEM ONLY	FILE:	

HP / इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt of India Undertaking)	**Residue Upgradation Facility (RUF)** **EPCC-3 Package for** **Visakh Refinery Modernization Project (VRMP)**	L&T Hydrocarbon Engineering **L&T-CHIYODA LIMITED**
Title: INSPECTION & TEST PLAN (504-V-201, 315, 607 A/B/C, 801, 802, 803, 804, 809) **Doc. No.: B016-RUF-LT-504-QC-QD-BHEL (1)-02001**		**Rev. No.:** 4 **Page :** 1 of 1

OWNER	:	**HINDUSTAN PETROLEUM CORPORATION LIMITED (HPCL)**
PMC	:	**ENGINEERS INDIA LIMITED, NEW DELHI (EIL)**
UNIT	:	**504**
PMC JOB NO.	:	**B016**
EQUIPMENT DESCRIPTION	:	**ODC Vessels (HOS PRODUCT DRUM,SULFIDING CHEMICAL DRUM, CATALYST INVENTORY HOLDING BIN, HP FLARE KO DRUM,LP FLARE KO DRUM, CLOSED BLOW BOWN DRUM, AMINE BLOW DOWN DRUM,CLOSED BLOW DOWN DRUM-2)**
EQUIPMENT TAG	:	**504-V-201, 315, 607 A/B/C, 801, 802, 803, 804, 809**
P. R. NO	:	**B016-RUF-LT-504-MS-PR-0007**
VENDOR NAME	:	**BHARAT HEAVY ELECTRICALS LIMITED**
VENDOR DOCUMENT NO.	:	**CQP 2505**

DOCUMENT SUBMISSION STATUS – LTHE/VENDOR	**1.1.1.1 REVIEW STATUS**	
	LTHE	**EIL**
DOC. CATEGORY: (USE TICK MARK) ☐ A ☐ R ☐ I	☑ **REVIEW CODE 1** – NO COMMENTS. PROCEED WITH MANUFACTURE / FABRICATION / CONSTRUCTION AS PER THE DOCUMENT. ☐ **REVIEW CODE 2** – PROCEED WITH MANUFACTURE/FABRICATION/CONSTRU CTION AS PER COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED. ☐ **REVIEW CODE 3** – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW ☐ **R**– DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION ☐ **V**- VOID	☑ **REVIEW CODE 1** – NO COMMENTS. PROCEED WITH MANUFACTURE / FABRICATION / CONSTRUCTION AS PER THE DOCUMENT. ☐ **REVIEW CODE 2** – PROCEED WITH MANUFACTURE/FABRICATION/CONSTRUCTI ON AS PER COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED. ☐ **REVIEW CODE 3** – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW ☐ **R**– DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION ☐ **V**- VOID
ISSUED FOR ☐ REVIEW ☐ INFORMATION ☐ CONSTRUCTION ☐ AS BUILT ☐	DISCIPLINE: VR (Civil & Arch) / SIGN / DATE: 21/12/2020	DISCIPLINE / SIGN / DATE

Rev.	Description	Prepared By	Reviewed By	Approved By	Approved Date
4	Revised as Commented.	P.G Kishore	A.K Mandal	A.K Mandal	18-12-2020
3	Revised as Commented.	P.G Kishore	A.K Mandal	A.K Mandal	21-11-2020
2	Revised as Commented.	P.G Kishore	A.K Mandal	A.K Mandal	10-11-2020
1	Revised as Commented.	P.G Kishore	A.K Mandal	A.K Mandal	14-10-2020
0	INSPECTION & TEST PLAN	P.G Kishore	A.K Mandal	A.K Mandal	01-10-2020

All PO/AR/Data sheet requirements shall be complied

Reviewed & APPROVED
B.M. Joshi
21-12-2020
(Rashmin Joshi)

Technical Inspection Services TUV 64 TUV India

Approved
21.12.2020
HARISH KUMAR
INSPECTION AUTHORITY

Code of Construction: ASME Section VIII Div.1, Edition 2019 with "U" Stamping.

VESSELS with SKIRT			
Sl. No.	**Item Description**	**Tag Number**	**Special Service**
1.	SULFIDING CHEMICAL DRUM	504-V-315	Nill
2.	CATALYST INVENTORY HOLDING BIN	504-V-607 A/B/C	SUPPLEMENTARY "B"
VESSELS with BOOT and Saddle			
Sl. No.	**Item Description**	**Tag Number**	
1.	HOS PRODUCT DRUM	504-V-201	*HIC+SUPPLEMENT "C"*
2.	HP FLARE KO DRUM	504-V-801	*NACE+SUPPLEMENT "C"*
3.	LP FLARE KO DRUM	504-V-802	*NACE+SUPPLEMENT "C"*
4.	CLOSED BLOWDOWN DRUM	504-V-803	SUPPLEMENTARY "A"
5.	AMINE BLOWDOWN DRUM	504-V-804	*NACE+SUPPLEMENT "C"*
6.	CLOSED BLOWDOWN DRUM-2	504-V-809	SUPPLEMENTARY "A"

P. Gopi Kishore Manager/QA/BHEL	A.K. Mandal AGM/Q & BE/BHEL	21-12-2020 TUV	AI	LTHE	EIL
Prepared By	Reviewed By	Approved			

BHEL	MANUFACTURER'S NAME & ADDRESS **BHEL-VISAKHAPATNAM or Approved Sub Contractor.**	**QUALITY ASSURANCE PLAN** QAP NO: **B016-RUF-LT-504-QC-QD-BHEL (1)-02001** Rev.4 Date : 18-12-2020 Page 2 of 17 BHEL SO: 2438; Internal CQP No: 2505	Purchaser : L & T Hydrocarbon Engineering Ltd (LTHE), Vadodara Project Name: VRMP-Visakh Refinery Modernisation Project Customer : Hindustan Petroleum Corporation Limited- Visakhapatnam PMC : Engineers India Limited (EIL) EIL Job No. : B016-504 L & T Job No.& PO No.: RUFV & REFINERY/75000-66912/NG Dt.18-03-2020

S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
1.0	Design & Drawings approval	Drawings & Design Calculations	ASME Sec VIII Div.1 Ed 2019 & PR Specifications	Drawings & Design Calculations	H	V	R		
2.0	ITP / QAP	Documents & Inspection Stages	ASME Sec VIII Div.1 Ed 2019 & other specifications as per approved General Assembly drawing	QAP	H	H	R		
3.0	**Procedures**								
3.1	Welding Procedure Specification & WPS/PQR/**WPQ**	Compliance to ASME Sec IX	ASME Sec VIII Div.1 & Sec IX and CLG and EIL specifications	WPS/PQR/WPQ	H	R/W	R		TPIA inspection envisaged for any new WPS or WPQ R- for old PQR W-New PQR to be qualified; For Vessel Tag Nos with Supplemental **Requirement –C**, refer to PVM-SU-4750-H Cl. No. 14.3.7.

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
3.2	All Manufacturing, Test Procedures a) NDT (UT/RT/MT/PT) b) NDE Plan c) Surface Preparation & Painting d) Hydro test e) Hardness test f) Heat Treatment	Procedure & Acceptance Criteria	ASME Sec VIII Div.1 Ed 2019 & & other specifications as per approved General Assembly drawing	Procedure	H	R	R		
3.2a	Heat Treatment procedure for Dénd	Procedure & Acceptance Criteria	ASME Sec VIII Div.1 Ed 2019 & PR Specifications	Procedure	H	R	R		
4.0	**Raw Materials**								
4.1	Plates, Pipes, Fittings, Forgings, Fasteners, Gaskets etc., (as applicable) at sourcing locations.	PO., Approved Drawings	ASME Section II A, TDC & other specifications as per PR including NACE, HIC requirements for applicable Tag Nos.	Test Certificates / Check test results	H	R	-		Raw materials will be inspected by BHEL appointed TPIA; For Vessel Tag Nos with Supplemental **Requirement –C**, refer to PVM-SU-4750-H Cl. No. 14.3.1, 14.3.4 & 14.3.5.

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
	Raw Materials after receipt								
4.2 a)	All Pressure parts / Part attached to Pressure part (Plates & Pipes)	PO., Approved Drawings	ASME Section II A, UCS-23 & other specifications as per PR	Manufacturer Test Certificates / Check test results	H	H&	R		&-Material identification for Plates & Pipes (Pressure parts): Review of test certificates, markings, visual & dimensional inspection, identity correlation & transfer of identity for each tag & part no. This is to be followed by TPIA stamping.
4.2 b)	All Pressure parts / Part attached to Pressure part (Nozzle forgings & Flanges)	PO., Approved Drawings	ASME Section II A, UCS-23 & other specifications as per PR	Manufacturer Test Certificates / Check test results	H	W	R		
4.3	Non Pressure parts	PO., Approved Drawings	ASME Section II A & other specifications as per PR	Manufacturer Test Certificates / Check test results	H	R	-		
4.4	Welding Consumables	PO, TDC	ASME Section II C, CLG PVM-SU-4750-H & other specifications as per PR	Manufacturer Test Certificates	H	R	R		
4.5	Fasteners & Gaskets	PO, Drawings	ASME Section II A & other specifications as per PR	Manufacturer Test Certificates	H	W	R		PMI of AS, SS Material as applicable.

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
5.0	**Fabrication of Dished Ends and Tori Cone along with PTC as applicable**								
5.1	Transfer of Marking and Heat Number	Material Spec & Heat Number	Drawing & TDC, Material identification & transfer of marking procedure	Inspection Report	H	W	R		
5.2	Plate Marking, Cutting, Weld Edge Preparation	Dimensions	Drawing	Inspection Report	H	R	R		
5.3	DPT of Weld Edges & Fit Up Clearance for L-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
5.4	Welding of L-Seam along with PTC	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R/W		W by AI, when there is impact test requirement; Refer Note- 3
5.5	100% WFMT for back gouging prior to back welding of L-seam	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
5.6	DPT of Weld Edges & Fit Up Clearance for C-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		C-seam is applicable for Tori cone.
5.7	Welding of C-Seam (in case, C-seam is applicable for Tori cone)	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R		Refer Note-1 & 3

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
5.8	100% WFMT for back gouging prior to back welding of C-seam (in case, C-seam is applicable for Tori cone)	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
5.9	Forming of Dished End and Tori cone (as applicable)	Dimensional & Template check	As per Drawing	Inspection Report	H	R	R		
5.10	Heat Treatment (along with PTC) for applicable Tag Nos.	Time & Temperature	ASME Sec VIII Div.1 & Drawing	HT Chart / Report	H	R	R		HT procedure duly approved to be followed. (if HT is applicable)
5.11	100% PT on Knuckle inside & outside and Tori Cone (as applicable) including welds and WEP after forming & heat treatment	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	W	-		Along with Boot Dish end as per applicable tags
5.12	Weld Visual Inspection before RT	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	H	W		
5.13	100% RT of weld after forming and heat treatment	Detection of flaws	ASME Sec VIII Div.1 & Drawing	RT Films / Records	H	R	R		

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
5.14	Final Dimensions (minimum thickness, profile, roundness, ovality etc.,)	Visual & dimensional	ASME Sec VIII Div.1 & Drawing, UG-80, UG-81	Inspection Report	H	H$	R		Along with Boot Dish end as per applicable tags; $ -Trail Assembly & fit up in case of Crown & Petal construction, Tori cone
5.15	Test Coupon testing for applicable tags	Tensile Strength & Hardness as applicable.	ASME Sec VIII Div.1 & PVM-SU-4750-H Cl.No. 7.6 to 7.8	Test report	H	H	R#		Refer Note-4; R # for AI, if heat treatment is Normalising.
6.0	**Fabrication of Main Shell / Boot along with PTC as applicable**								
6.1	Plate Marking, Cutting, Weld Edge Preparation	Dimensions	Drawing	Inspection Report	H	R	R		
6.2	Shell rolling	Dimensions	Drawing	Inspection Report	H	-	-		
6.3	DPT of Weld Edges & Fit Up Clearance for L-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
6.4	Welding of L-Seam along with PTC	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R/W		W by AI, when there is impact test requirement; Refer Note- 3
6.5	100% WFMT for back gouging prior to back welding of L-seam	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
6.6	Weld Visual Inspection before RT	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	W	W		

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
6.7	100% DPT of Full Weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	R	R		
6.8	RT on L-seam weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		Refer Note-2
7.0	**Shell to Shell Circular Seam fabrication**								
7.1	Weld Edge Preparation	Dimensions	Drawing	Inspection Report	H	R	R		
7.2	DPT of Weld Edges & Fit Up Clearance for C-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
7.3	Welding of C-Seam	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R		
7.4	100% WFMT for back gouging prior to back welding of C-seam	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
7.5	Weld Visual Inspection before RT	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	W	W		
7.6	100% DPT of Full Weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	R	R		
7.7	RT on C-seam weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		Refer Note-2

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
8.0	**Shell to Dished end / Shell to Boot / Boot to Boot Dished end Circular Seam fabrication**								
8.1	Weld Edge Preparation	Dimensions	Drawing	Inspection Report	H	R	R		
8.2	DPT of Weld Edges & Fit Up Clearance for C-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
8.3	Welding of C-Seam	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R		
8.4	100% WFMT for back gouging prior to back welding of C-seam	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
8.5	Weld Visual Inspection before RT	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	W	W		
8.6	100% DPT of Full Weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	R	R		
8.7	RT on C-seam weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		Refer Note-2

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
9.0	**Fabrication of Nozzle Assemblies**								
9.1	Weld Edge Preparation	Dimensions	Drawing	Inspection Report	H	R	R		
9.2	DPT of Weld Edges & Fit Up Clearance for C-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
9.3	Welding of C-Seam of pipes /elbows / flanges / nozzle neck etc	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R		
9.4	100% WFMT prior to back welding of C-seam (In cases where root run is done by GTAW process because of access constraint / limitation in access to weld from both sides, WFMT will be done for root run)	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
9.5	Weld Visual Inspection before RT	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	W	W		
9.6	100% DPT of Full Weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	R	R		
9.7	RT on C-seam weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Reports	H	R	R		
9.8	100% RT for fabricated Nozzles, elbows etc., if made from plate	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
10.0	**Nozzle to Shell / Dished end / Boot / Boot Dished end fabrication**								
10.1	Marking, Cutting, Weld Edge Preparation of Openings for Nozzles on Shell, Dished ends, Boot, Boot Dished ends.	Dimensions	Drawing	Inspection Report	H	R	R		
10.2	DPT of Weld Edges & Fit Up Clearance	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
10.3	Welding of Seam	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R		
10.4	100% WFMT prior to back welding of seam (In cases where root run is done by GTAW process because of access constraint / limitation in access to weld from both sides, WFMT will be done for root run)	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
10.5	Weld Visual Inspection	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	W	W		
10.6	100% DPT of Full Weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	R	R		

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
10.7	100% RT on Lip type nozzle weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		In case where such joint is specified in drawing
10.8	100% UT on Nozzles to Shell, Dished ends, Boot, Boot Dished end welds, before PWHT if applicable	Detection of flaws	Drawing	Inspection Report	H	W	-		
10.9	Pneumatic test on RF pads	Detection of leakage	Drawing	Inspection Report	H	W	-		As applicable
11.0	**Fabrication of Internal & External attachments**								
11.1	Welding of Internal & External attachments including insert plate (where applicable)	Location & Dimensions	Drawing	Inspection Report	H	-	-		
11.2	NDE for Internal & External attachment welds	Detection of flaws	Drawing	Inspection Report	H	-	-		Refer Note-5; For Vessel Tag Nos with Supplemental **Requirement –C**, refer to PVM-SU-4750-H Cl. No. 14.3.9 a) & b) as elaborated under Note-7.

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
11.3	Assembly and Welding of coil to coil joints	Location & Dimensions	Drawing	Inspection Report	H	R	W		Refer Note-8 .
11.4	RT of coil to coil joints	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		Refer Note-8
11.5	Hydro testing of coil assembly followed by drying & cleaning as applicable	No pressure drop or leakage	Drawing	Inspection Report	H	H	H@		Refer Note-8; @ H for AI for Hydrostatic test only.
11.6	Assembly and Welding of coil to nozzle hook-up joint.	Location & Dimensions	Drawing	Inspection Report	H	R	R		Refer Note-8
11.7	RT of coil to nozzle hook-up joint.	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		Refer Note-8
11.8	Assembly and Welding of coil supporting arrangement to Vessel weld joints	Location & Dimensions	Drawing	Inspection Report	H	R	-		Refer Note-8
11.9	NDE of coil supporting arrangement to Vessel weld joints	Detection of flaws	Drawing	Inspection Report	H	-	-		Refer Note-5 & 8; For Vessel Tag Nos with Supplemental **Requirement –C**, refer to PVM-SU-4750-H Cl. No. 14.3.9 a) & b) as elaborated under Note-7.

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
12.0	**Saddle fabrication and Assembly for applicable tag numbers**								
12.1	Fit up and Welding of Saddle, saddle with Vessel	Offset & weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	-		
12.2	100% PT on welds	Detection of flaws	Drawing	Inspection Report	H	R	-		
12.3	Dimensional inspection of Saddle	Dimensions	Drawing	Inspection Report	H	W	-		W-During Final Inspection
	Skirt fabrication and Assembly for applicable tag numbers								
12.4	Fit up and Welding of Skirt, Skirt with Vessel	Offset & weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	-		
12.5	100% PT on welds	Detection of flaws	Drawing	Inspection Report	H	R	-		
12.6	100% UT on skirt-to-vessel welds	Detection of flaws	ASME Sec VIII Div.1 & PVM-SU-4750-H Cl. No. 9.5.1	Inspection Report	H	R	-		Applicable for Tag Nos. 504-V-315 and 504-V-607 A/ B/ C ; Refer Note-6
12.7	Dimensional inspection of Skirt	Dimensions	Drawing	Inspection Report	H	W	-		W-During Final Inspection
13.0	Final Visual & Dimensional inspection before PWHT & clearance for PWHT	Dimensions & orientations	Drawing	Inspection Report	H	H	W		
14.0	PWHT of Equipment along with PTC	Time & Temperature	ASME Sec VIII Div.1 & Drawing	HT Chart / Report	H	R	R		PWHT procedure duly approved to be followed

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MANUFACTURER'S NAME & ADDRESS **BHEL-VISAKHAPATNAM or Approved Sub Contractor.**	**QUALITY ASSURANCE PLAN** QAP NO: **B016-RUF-LT-504-QC-QD-BHEL (1)-02001** Rev.4 Date : 18-12-2020 Page 15 of 17 BHEL SO: 2438; Internal CQP No: 2505	Purchaser : L & T Hydrocarbon Engineering Ltd (LTHE), Vadodara Project Name: VRMP-Visakh Refinery Modernisation Project Customer : Hindustan Petroleum Corporation Limited- Visakhapatnam PMC : Engineers India Limited (EIL) EIL Job No. : B016-504 L & T Job No.& PO No.: RUFV & REFINERY/75000-66912/NG Dt.18-03-2020	

S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
15.0	Test Coupon testing for applicable tags	Tensile Strength & Hardness as applicable. Chemy, micro as applicable	ASME Sec VIII Div.1 & PVM-SU-4750-H Cl.No. 7.6 to 7.8	Test report	H	H	-		Refer Note-4; For Vessel Tag Nos with Supplemental **Requirement –C**, refer to PVM-SU-4750-H Cl. No. 14.3.9 c) & d) as elaborated under Note-7
16.0	100% UT after PWHT on pressure retaining weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	RW	-		
16.1	Hardness test of welds after PWHT	Hardness as applicable.	ASME Sec VIII Div.1 & PVM-SU-4750-H Cl.No. 14.3.9	Test report	H	RW	-		Refer Note-7
17.0	Spot PT /WFMT on internal & External welds	Detection of flaws	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	RW	-		Refer Note-6
18.0	Final Dimensional inspection	Dimensions & orientations	Drawing	Inspection Report	H	H	W		Complete Equipment Visual inspection of both Internal & External
19.0	Hydro static testing followed by drying & cleaning	No pressure drop or leakage	Drawing	Inspection Report	H	H	H@		@ H for AI for Hydrostatic test only.
20.0	Spot PT after Hydro testing	Detection of flaws	Drawing	Inspection Report	H	W	-		

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
21.0	Outside Surface Preparation (Blasted Surface Profile & Salt Contamination Tests)	Surface profile & salt contamination	Drawing & Approved procedure	Inspection Report	H	RW	-		
22.0	Painting Refer Note-9	Visual & DFT etc	Drawing, Approved procedure	Inspection Report	H	RW	-		
23.0	Nozzles blanking & N2 filling (if specified in drawing)	Physical verification	Drawing		H	W	-		
24.0	Verification of Name Plate	Verification as per drawing	Name plate drawing	Name Plate	H	R	H		
24.1	Stamping of ASME certification mark with "U" designation	Verification as per drawing	Name plate drawing	Name Plate	H	R	H		
25.0	Closing of NCRs (if any)	Closure of NCRs	PR, Drawing, Specification	Closure Reports	H	H	H		
26.0	Name plate fixing, punching and rub off	Visual	Drawing	Inspection Report	H	H	H		
27.0	Inspection of Mandatory & Commissioning spares	Physical Verification	Drawing & approved spares list (as applicable)	Inspection Report	H	H	-		
28.0	Manufacturer's Data Report & Final Documentation	Documentation	Drawings & ITP/QAP	MDR	H	R	H		
29.0	Issue of IRN & clearance for dispatch	Completeness	Drawing, Approved procedure	Inspection Release Note	H	H	-		

21/12/2020

21.12.2020

Technical Inspection Services TÜV 64 TÜV India

Order

	MANUFACTURER'S NAME & ADDRESS	QUALITY ASSURANCE PLAN	
	BHEL-VISAKHAPATNAM or Approved Sub Contractor.	QAP NO: **B016-RUF-LT-504-QC-QD-BHEL (1)-02001** Rev.4 Date : 18-12-2020 Page 17 of 17 BHEL SO: 2438; Internal CQP No: 2505	Purchaser : L & T Hydrocarbon Engineering Ltd (LTHE), Vadodara Project Name: VRMP-Visakh Refinery Modernisation Project Customer : Hindustan Petroleum Corporation Limited- Visakhapatnam PMC : Engineers India Limited (EIL) EIL Job No. : B016-504 L & T Job No.& PO No.: RUFV & REFINERY/75000-66912/NG Dt.18-03-2020

S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
	PMI of SS (internal parts) shall be witnessed by TPIA								

Notes:

1) As per CLG Spec. PVM-SU-4750-H Clause No. 9.2, WFMT shall be performed for Category A, B, C & D butt-welded root areas and prior to back welding.
2) Extent of RT shall be in line to the approved drawing.
3) It is to be noted that wherever PTC is applicable, it will be as per Doc: B016-RUF-LT-504-QC-QD-BHEL (1)-02022.
4) As per PVM-SU-4750-H Cl. No. 7. 8: Production (vessel) test plates shall be subjected to the same thermal history expected for the finished vessel, including hot-forming, pre heat and PWHT.
5) As per PVM-SU-4750-H Cl. No. 9.5.2 & 9.5.3: Internal and external attachment welds, including those for lifting attachments when supplied, shall receive WFMT after grinding, if grinding is required. If vessel is subject to heat treatment, WFMT shall be performed after heat treatment. Surfaces from which temporary attachments have been removed shall receive WFMT after grinding.
6) As per PVM-SU-4750-H Cl. No. 9.5.1 b 2) : If impossible or impracticable to design so that UT can be applied, skirt-to-vessel welds shall receive WFMT after the root pass is completed and every third layer thereafter. In such case, finishing attachment welds shall require WFMT (after heat treatment when heat treatment is required).
7) As per PVM-SU-4750-H Cl. No. 14.3.9: Internal welds and HAZs shall be inspected after PWHT as follows:
   a) Internal welds shall undergo WFMT for at least 1 inch (25 mm) on each side of the toe of the weld in accordance with ASME Code, Section V, Article 7.
   b) Acceptance criteria shall be per ASME Code, Division 1, Appendix 6 (Division 2, paragraph 7.5.6).
   c) Fluid-wetted pressure boundary and attachment welds shall be hardness tested and shall not exceed 200 BHN.
   d) One hardness test shall be performed on each weld or each 10 linear feet (3 m) of weld, whichever is more frequent.
8) Applicable only for Tag Nos where Steam Coil / Coil is specified in drawing viz., Tag Nos.504-V-801; 504-V-802 & 504-V-809

9) Coating DFT, Adhesion test and Holiday detection check shall be witnessed by TPIA as per cl. no 12.9 of B016-000-79-41-PLS-01 Rev1

Legends:

P: Perform	Drawing : Approved Drawing	WPS: Welding procedure specification	DFT: Dry film thickness
A-Approval	Spec : Specification	WPQ; Welder performance Qualification	RT: Radiographic testing
W-Witness Point	IRN: Inspection release note issued by TUV	HT Chart: Heat Treatment chart	UT: Ultrasonic testing manual
RW: Random Witness	M-BHEL or BHEL approved sub-contractor	PR: Purchase Requisition	PT: Dye penetrant testing
H: Hold Point (to inform to concerned and proceed ahead only after their approval)	L-Seam: Longitudinal Seam welding, C-Seam: Circumferential Seam welding	TUV: TUV India Pvt Ltd., (Third party inspection agency appointed by M/s LTHE	MPI: Magnetic particle Inspection WFMT: Wet Fluorescent Magnetic Particle Test
V: Verification of reports/Procedures	R: Review Point		MPT: Magnetic particle testing

QA-QC 21/12/2020

B.M.S. Reddy 22-12-2020

Technical Inspection Services TUV 64 TUV India

Approved 29.12.2020

HP / ENGINEERS INDIA LIMITED	**Residue Upgradation Facility (RUF)** **EPCC-3 Package for** **Visakh Refinery Modernization Project (VRMP)**	L&T Hydrocarbon Engineering **L&T- CHIYODA LIMITED**
Title: INSPECTION & TEST PLAN (504-V-703, 504-V-807, 701-T-113 A/B) **Doc. No.: B016-RUF-LT-504-QC-QD-BHEL (1)-02002**		**Rev. No.: 3** **Page : 1 of 1**

OWNER	:	**HINDUSTAN PETROLEUM CORPORATION LIMITED (HPCL)**
PMC	:	**ENGINEERS INDIA LIMITED, NEW DELHI (EIL)**
UNIT	:	**504**
PMC JOB NO.	:	**B016**
EQUIPMENT DESCRIPTION	:	**ODC Vessels (HOT OIL SURGE DRUM, HOT OIL BLOWDOWN DRUM, SOLVENT STORAGE TANK)**
EQUIPMENT TAG	:	**504-V-703, 504-V-807, 701-T-113 A/B**
P. R. NO	:	**B016-RUF-LT-504-MS-PR-0007**
VENDOR NAME	:	**BHARAT HEAVY ELECTRICALS LIMITED**
VENDOR DOCUMENT NO.	:	**CQP 2508**

DOCUMENT SUBMISSION STATUS – LTHE/VENDOR	**1.1.1.1 REVIEW STATUS**	
	LTHE	**EIL**
DOC. CATEGORY: (USE TICK MARK) ☐ A ☐ R ☐ I	☑ **REVIEW CODE 1** – ~~NO~~ COMMENTS. With Minor PROCEED WITH MANUFACTURE / FABRICATION / CONSTRUCTION AS PER THE DOCUMENT.	☐ **REVIEW CODE 1** – NO COMMENTS. PROCEED WITH MANUFACTURE / FABRICATION / CONSTRUCTION AS PER THE DOCUMENT.
ISSUED FOR ☐ REVIEW ☐ INFORMATION ☐ CONSTRUCTION ☐ AS BUILT ☐	☐ **REVIEW CODE 2** – PROCEED WITH MANUFACTURE/FABRICATION/CONSTRUCTION AS PER COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED. ☐ **REVIEW CODE 3** – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW ☐ **R**– DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION ☐ **V**- VOID	☐ **REVIEW CODE 2** – PROCEED WITH MANUFACTURE/FABRICATION/CONSTRUCTION AS PER COMMENTED DOCUMENT. REVISED DOCUMENT REQUIRED. ☐ **REVIEW CODE 3** – DOCUMENT DOES NOT CONFORM TO BASIC REQUIREMENTS AS MARKED. RESUBMIT FOR REVIEW ☐ **R**– DOCUMENT IS RETAINED FOR RECORDS. PROCEED WITH MANUFACTURE / FABRICATION ☐ **V**- VOID
	DISCIPLINE: QA&C / SIGN: QA - QC / DATE: 13/01/2021	DISCIPLINE / SIGN / DATE

Rev.	Description	Prepared By	Reviewed By	Approved By	Approved Date
3	Revised as Commented	P.G Kishore	A.K Mandal	A.K Mandal	30-12-2020
2	Revised as Commented	P.G Kishore	A.K Mandal	A.K Mandal	21-12-2020
1	Revised as Commented	P.G Kishore	A.K Mandal	A.K Mandal	10-11-2020
0	INSPECTION & TEST PLAN	P.G Kishore	A.K Mandal	A.K Mandal	14-10-2020

All PO / PR requirements shall be fully considered

Reviewed & Approved
RASHMIN JOSHI

Reviewed & Approved with minor comments
15-01-2021

Technical Inspection Services TUV 64 TUV India

Approved

हरीश कुमार HARISH KUMAR EIL 159 INSPECTION AUTHORITY निरीक्षण प्राधिकारी
13.01.2021

	MANUFACTURER'S NAME & ADDRESS	QUALITY ASSURANCE PLAN	
	BHEL-VISAKHAPATNAM or Approved Sub Contractor.	QAP NO: **B016-RUF-LT-504-QC-QD-BHEL (1)-02002** Rev.3 Date : 30-12-2020 Page 1 of 17 BHEL SO: 2438; Internal CQP No: 2508	Purchaser : L & T Hydrocarbon Engineering Ltd (LTHE), Vadodara Project Name: VRMP-Visakh Refinery Modernisation Project Customer : Hindustan Petroleum Corporation Limited- Visakhapatnam PMC : Engineers India Limited (EIL) EIL Job No. : B016-504 L & T Job No.& PO No.: RUFV & REFINERY/75000-66912/NG Dt.18-03-2020

Code of Construction: ASME Section VIII Div.1, Edition 2019 with "U" Stamping.

VESSEL with SKIRT		
Sl. No.	**Item Description**	**Tag Number**
1.	**HOT OIL SURGE DRUM**	**504-V-703**
VESSEL with BOOT and Saddle		
Sl. No.	**Item Description**	**Tag Number**
1.	**HOT OIL BLOW DOWN DRUM**	**504-V-807**
VESSEL with Saddle		
Sl. No.	**Item Description**	**Tag Number**
1.	**SOLVENT STORAGE TANK**	**701-T-113 A/B**

P. Gopi Kishore Manager/QA/BHEL	A.K. Mandal AGM/Q & BE/BHEL	15-01-2021 TUV	AI	15/01/2021 LTHE	EIL
Prepared By	Reviewed By	Approved			

MANUFACTURER'S NAME & ADDRESS **BHEL-VISAKHAPATNAM or Approved Sub Contractor.**	**QUALITY ASSURANCE PLAN** QAP NO: **B016-RUF-LT-504-QC-QD-BHEL (1)-02002** Rev.3 Date : 30-12-2020 Page 2 of 17 BHEL SO: 2438; Internal CQP No: 2508	Purchaser : L & T Hydrocarbon Engineering Ltd (LTHE), Vadodara Project Name: VRMP-Visakh Refinery Modernisation Project Customer : Hindustan Petroleum Corporation Limited- Visakhapatnam PMC : Engineers India Limited (EIL) EIL Job No. : B016-504 L & T Job No.& PO No.: RUFV & REFINERY/75000-66912/NG Dt.18-03-2020	

S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
1.0	Design & Drawings approval	Drawings & Design Calculations	ASME Sec VIII Div.1 Ed 2019 & PR Specifications	Drawings & Design Calculations	H	V	R		
2.0	ITP / QAP	Documents & Inspection Stages	ASME Sec VIII Div.1 Ed 2019 & other specifications as per approved General Assembly drawing	QAP	H	H	R		
3.0	**Procedures**								
3.1	Welding Procedure Specification & WPS/PQR/WPQ	Compliance to ASME Sec IX	ASME Sec VIII Div.1 & Sec IX and CLG and EIL specifications	WPS/PQR/WPQ	H	R/W	R		TPIA inspection envisaged for any new WPS or WPQ R- for old PQR W-New PQR to be qualified.

L&T Hydrocarbon Engineering Offshore Projects QA - QC

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
3.2	All Manufacturing, Test Procedures a) NDT (UT/RT/MT/PT) b) NDE Plan c) Surface Preparation & Painting d) Hydro test e) Hardness test f) Heat Treatment	Procedure & Acceptance Criteria	ASME Sec VIII Div.1 Ed 2019 & & other specifications as per approved General Assembly drawing	Procedure	H	R	R *		* Hydro test / NDE and Heat treatment for AI review.
3.2a	Heat Treatment procedure for Dénd & Nozzle Assembly (as applicable)	Procedure & Acceptance Criteria	ASME Sec VIII Div.1 Ed 2019 & PR Specifications	Procedure	H	R	R		
4.0	**Raw Materials**								
4.1	Plates, Pipes, Fittings, Forgings, Fasteners, Gaskets etc., (as applicable) at sourcing locations.	PO., Approved Drawings	ASME Section II A, TDC & other specifications as per PR.	Test Certificates / Check test results	H	R	-		Raw materials will be inspected by BHEL appointed TPIA.

L&T Hydrocarbon Engineering Large Projects QA - QC

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TÜV

MANUFACTURER'S NAME & ADDRESS **BHEL-VISAKHAPATNAM or Approved Sub Contractor.**	**QUALITY ASSURANCE PLAN** QAP NO: **B016-RUF-LT-504-QC-QD-BHEL (1)-02002** Rev.3 Date : 30-12-2020 Page 4 of 17 BHEL SO: 2438; Internal CQP No: 2508	Purchaser : L & T Hydrocarbon Engineering Ltd (LTHE), Vadodara Project Name: VRMP-Visakh Refinery Modernisation Project Customer : Hindustan Petroleum Corporation Limited- Visakhapatnam PMC : Engineers India Limited (EIL) EIL Job No. : B016-504 L & T Job No.& PO No.: RUFV & REFINERY/75000-66912/NG Dt.18-03-2020	

S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
	Raw Materials after receipt								
4.2 a)	All Pressure parts / Part attached to Pressure part (Plates & Pipes)	PO., Approved Drawings	ASME Section II A, UCS-23 & other specifications as per PR	Manufacturer Test Certificates / Check test results	H	H&	R		&-Material identification for Plates & Pipes (Pressure parts): Review of test certificates, markings, visual & dimensional inspection, identity correlation & transfer of identity for each tag & part no. This is to be followed by TPIA stamping.
4.2 b)	All Pressure parts / Part attached to Pressure part (Nozzle forgings & Flanges)	PO., Approved Drawings	ASME Section II A, UCS-23 & other specifications as per PR	Manufacturer Test Certificates / Check test results	H	W	R		
4.3	Non Pressure parts	PO., Approved Drawings	ASME Section II A & other specifications as per PR	Manufacturer Test Certificates / Check test results	H	R	-		
4.4	Welding Consumables	PO, TDC	ASME Section II C, CLG PVM-SU-4750-H & other specifications as per PR	Manufacturer Test Certificates	H	R	R		
4.5	Fasteners & Gaskets	PO, Drawings	ASME Section II A & other specifications as per PR	Manufacturer Test Certificates	H	W	R		PMI of AS, SS Material as applicable.

Hydrocarbon Engineering Offshore Projects QA - QC

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
5.0	**Fabrication of Dished Ends and Tori Cone along with PTC as applicable**								
5.1	Transfer of Marking and Heat Number	Material Spec & Heat Number	Drawing & TDC, Material identification & transfer of marking procedure	Inspection Report	H	W	R		
5.2	Plate Marking, Cutting, Weld Edge Preparation	Dimensions	Drawing	Inspection Report	H	R	R		
5.3	DPT of Weld Edges & Fit Up Clearance for L-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
5.4	Fit up & Welding of L-Seam along with PTC	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R/W		W by AI, when there is impact test requirement; Refer Note- 3
5.5	100% WFMT for back gouging prior to back welding of L-seam	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
5.6	DPT of Weld Edges & Fit Up Clearance for C-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		C-seam is applicable for Tori cone (as applicable)
5.7	Welding of C-Seam (in case, C-seam is applicable for any Tori cone)	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R		Refer Note-1 & 3

L&T Hydrocarbon Engineering QA - QC

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
5.8	100% WFMT for back gouging prior to back welding of C-seam (in case, C-seam is applicable for Tori cone)	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
5.9	Forming of Dished End and Tori cone (as applicable)	Dimensional & Template check	As per Drawing	Inspection Report	H	R	R		
5.10	Heat Treatment (along with PTC) for applicable Tag Nos.	Time & Temperature	ASME Sec VIII Div.1 & Drawing	HT Chart / Report	H	R	R		HT procedure duly approved to be followed.
5.11	100% PT on Knuckle inside & outside and Tori Cone (as applicable) including welds and WEP after forming & heat treatment	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	W	-		Along with Boot Dish end as per applicable tags
5.12	Weld Visual Inspection before RT	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	H	W		
5.13	100% RT of weld after forming and heat treatment	Detection of flaws	ASME Sec VIII Div.1 & Drawing	RT Films / Records	H	R	R		
5.14	Hardness testing of Dénd (Parent Material & Weld area)	Hardness as applicable.	ASME Sec VIII Div.1 & PVM-SU-4750-H Cl. No. 14.3.9 c) & d)	Test report	H	RW	-		

L&T Hydrocarbon Engineering Ltd. Offshore Projects QA - QC

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
5.15	Final Dimensions (minimum thickness, profile, roundness, ovality etc.,)	Visual & dimensional	ASME Sec VIII Div.1 & Drawing, UG-80, UG-81	Inspection Report	H	H$	R		Along with Boot Dish end as per applicable tags; $ -Trail Assembly & fit up in case of Crown & Petal construction, Tori cone
5.16	Test Coupon testing for applicable tags	Tensile Strength & Hardness as applicable.	ASME Sec VIII Div.1 & PVM-SU-4750-H Cl. No. 7.6 to 7.8	Test report	H	H	R#		Refer Note-4; R # for AI, if heat treatment is Normalising.
6.0	**Fabrication of Main Shell / Boot along with PTC as applicable**								
6.1	Plate Marking, Cutting, Weld Edge Preparation	Dimensions	Drawing	Inspection Report	H	R	R		
6.2	Shell rolling	Dimensions	Drawing	Inspection Report	H	-	-		
6.3	DPT of Weld Edges & Fit Up Clearance for L-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
6.4	Fit up & Welding of L-Seam along with PTC	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	RW	R/W		W by AI, when there is impact test requirement; Refer Note- 3
6.5	100% WFMT for back gouging prior to back welding of L-seam	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
6.6	Weld Visual Inspection before RT	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	W	W		

L&T Hydrocarbon Engineering Ltd. Onshore Projects Vadodara

15-01-2021

RASHMIN JOSHI TUV India

S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
6.7	100% DPT of Full Weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	R	R		
6.8	RT on L-seam weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		Refer Note-2
7.0	**Shell to Shell Circular Seam fabrication**								
7.1	Weld Edge Preparation	Dimensions	Drawing	Inspection Report	H	R	R		
7.2	DPT of Weld Edges & Fit Up Clearance for C-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
7.3	Welding of C-Seam	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R		
7.4	100% WFMT for back gouging prior to back welding of C-seam	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
7.5	Weld Visual Inspection before RT	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	W	W		
7.6	100% DPT of Full Weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	R	R		
7.7	RT on C-seam weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		Refer Note-2

L&T Hydrocarbon Engineering Ltd. Onshore Projects Group QA - QC 13/01/2021

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
8.0	**Shell to Dished end / Shell to Boot / Boot Shell to Boot Dished end Circular Seam fabrication**								
8.1	Weld Edge Preparation	Dimensions	Drawing	Inspection Report	H	R	R		
8.2	DPT of Weld Edges & Fit Up Clearance for C-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
8.3	Welding of C-Seam	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R		
8.4	100% WFMT for back gouging prior to back welding of C-seam	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
8.5	Weld Visual Inspection before RT	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	W	W		
8.6	100% DPT of Full Weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	R	R		
8.7	RT on C-seam weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		Refer Note-2

L&T Hydrocarbon Engineering QA-QC BU

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
9.0	**Fabrication of Nozzle Assemblies**								
9.1	Weld Edge Preparation	Dimensions	Drawing	Inspection Report	H	R	R		
9.2	DPT of Weld Edges & Fit Up Clearance for C-seam	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
9.3	Welding of C-Seam of pipes /elbows / flanges / nozzle neck etc	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R		
9.4	100% WFMT prior to back welding of C-seam (In cases where root run is done by GTAW process because of access constraint / limitation in access to weld from both sides, WFMT will be done for root run)	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
9.5	Weld Visual Inspection before RT	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	W	W		
9.6	100% DPT of Full Weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	R	R		
9.7	RT on C-seam weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Reports	H	R	R		
9.8	100% RT for fabricated Nozzles, elbows etc., if made from plate	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		

L&T Hydrocarbon Engineering Offshore Projects QA-QC

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order

S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
10.0	**Nozzle to Shell / Dished end / Boot / Boot Dished end fabrication**								
10.1	Marking, Cutting, Weld Edge Preparation of Openings for Nozzles on Shell, Dished ends, Boot, Boot Dished ends.	Dimensions	Drawing	Inspection Report	H	R	R		
10.2	DPT of Weld Edges & Fit Up Clearance	Detection of flaws & Offset	Drawing	Inspection Report	H	RW	-		
10.3	Welding of Seam	weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	R		
10.4	100% WFMT prior to back welding of seam (In cases where root run is done by GTAW process because of access constraint / limitation in access to weld from both sides, WFMT will be done for root run)	Detection of flaws	ASME Sec VIII Div.1 & Drawing, ASME Sec V Article 7, MPI Procedure	Inspection Report	H	RW	-		Refer Note-1
10.5	Weld Visual Inspection	Weld Visual	ASME Sec VIII Div.1, UW-35	Inspection Report	H	W	W		
10.6	100% DPT of Full Weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, PT Procedure	Inspection Report	H	R	R		

L&T Hydrocarbon Engineering Ltd. Offshore Projects Hazira QA - QC 15/01/2021

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
10.7	100% RT on Lip type nozzle weld	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		In case where such joint is specified in drawing
10.8	100% UT on Nozzles to Shell, Dished ends, Boot, Boot Dished end welds, before PWHT (if applicable)	Detection of flaws	Drawing	Inspection Report	H	W	-		
10.9	Pneumatic test on RF pads	Detection of leakage	Drawing	Inspection Report	H	W	-		As applicable
11.0	**Fabrication of Internal & External attachments**								
11.1	Welding of Internal & External attachments including insert plate (where applicable)	Location & Dimensions	Drawing	Inspection Report	H	-	-		
11.2	NDE for Internal & External attachment welds	Detection of flaws	Drawing	Inspection Report	H	-	-		Refer Note-5

L&T Hydrocarbon Engineering Offshore Projects QA - QC

RASHMIN JOSHI TUV

S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
11.3	Assembly and Welding of coil to coil joints	Location & Dimensions	Drawing	Inspection Report	H	R	W		Refer Note-7 .
11.4	RT of coil to coil joints	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		Refer Note-7
11.5	Hydro testing of coil assembly followed by drying & cleaning as applicable	No pressure drop or leakage	Drawing	Inspection Report	H	H	H@		Refer Note-7; @ H for AI for Hydrostatic test only.
11.6	Assembly and Welding of coil to nozzle hook-up joint.	Location & Dimensions	Drawing	Inspection Report	H	R	R		Refer Note-7
11.7	RT of coil to nozzle hook-up joint.	Detection of flaws	ASME Sec VIII Div.1 & Drawing, UW-51	RT Films & Report	H	R	R		Refer Note-7
11.8	Assembly and Welding of coil supporting arrangement to Vessel weld joints	Location & Dimensions	Drawing	Inspection Report	H	R	-		Refer Note-7
11.9	NDE of coil supporting arrangement to Vessel weld joints	Detection of flaws	Drawing	Inspection Report	H	-	-		Refer Note-5 & 7

L&T Hydrocarbon Engineering Ltd. Offshore Projects

RASHMIN JOSHI TÜV

S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
12.0	**Saddle fabrication and Assembly for applicable tag numbers**								
12.1	Fit up and Welding of Saddle, saddle with Vessel & Lug Supports	Offset & weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	-		As applicable
12.2	100% PT on welds	Detection of flaws	Drawing	Inspection Report	H	R	-		
12.3	Dimensional inspection of Saddle & Lug Supports	Dimensions	Drawing	Inspection Report	H	W	-		W-During Final Inspection
	Skirt fabrication and Assembly for applicable tag numbers								
12.4	Fit up and Welding of Skirt, Skirt with Vessel	Offset & weld geometry	ASME Sec VIII Div.1 & Drawing	Inspection Report	H	R	-		
12.5	100% PT on welds	Detection of flaws	Drawing	Inspection Report	H	R	-		
12.6	100% UT on skirt-to-vessel welds	Detection of flaws	ASME Sec VIII Div.1 & PVM-SU-4750-H Cl. No. 9.5.1	Inspection Report	H	R	-		Applicable for Tag Nos. 504-V-703; Refer Note-6
12.7	Dimensional inspection of Skirt	Dimensions	Drawing	Inspection Report	H	W	-		W-During Final Inspection

L&T Hydrocarbon Engineering Offshore Projects QA - QC

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S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
13.0	Review of PWHT Chart of Blind flange assemblies	Time & Temperature	ASME Sec VIII Div.1 & approved procedure	HT Chart	H	R	R		Applicable for Nozzle No. **11 A, 11 B, 11 C, 11 D, 11 E, 11 F** of Tag No. 504-V-807.
14.0	Final Visual & Dimensional inspection after PWHT of applicable Blind flange assemblies	Dimensions & orientations	Drawing	Inspection Report	H	H	W		
15.0	Hardness testing of blind flange assembly after PWHT	Hardness as applicable.	ASME Sec VIII Div.1 & PVM-SU-4750-H Cl. No. 14.3.9 c) & d)	Test report	H	H	-		
16.0	Final Visual & Dimensional inspection	Dimensions & orientations	Drawing	Inspection Report	H	H	W		Complete Equipment Visual inspection of both Internal & External
17.0	Hydro static testing followed by drying & cleaning	No pressure drop or leakage	Drawing	Inspection Report	H	H	H@		@ H for AI for Hydrostatic test only.
18.0	Spot PT after Hydro testing	Detection of flaws	Drawing	Inspection Report	H	W	-		
19.0	Outside Surface Preparation (Blasted Surface Profile & Salt Contamination Tests)	Surface profile & salt contamination	Drawing & Approved procedure	Inspection Report	H	RW	-		
20.0	Painting	Visual & DFT etc	Drawing, Approved procedure	Inspection Report	H	RW	-		

L&T Hydrocarbon Engineering Shore Project QA - QC

RASHMIN JOSHI TUV

S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		
21.0	Nozzles blanking & N2 filling (if specified in drawing)	Physical verification	Drawing	Inspection Report	H	W	-		
22.0	Verification of Name Plate	Verification as per drawing	Name plate drawing	Name Plate	H	R	H		
22.1	Stamping of ASME certification mar with "U" designation	Verification as per drawing	Name plate drawing	Name Plate	H	R	H		
20.0	Closing of NCRs (if any)	Closure of NCRs	PR, Drawing, Specification	Closure Reports	H	H	H		
21.0	Name plate fixing, punching and rub off	Visual	Drawing	Inspection Report	H	H	H		
22.0	Inspection of Mandatory & Commissioning spares	Physical Verification	Drawing & approved spares list (as applicable)	Inspection Report	H	H	-		
23.0	Manufacturer's Data Report & Final Documentation	Documentation	Drawings & ITP/QAP	MDR	H	R	H		
24.0	Issue of IRN & clearance for dispatch	Completeness	Drawing, Approved procedure	Inspection Release Note	H	H	-		

L&T Hydrocarbon Engineering Onshore Projects QA - QC

RASHMIN JOSHI TUV

	MANUFACTURER'S NAME & ADDRESS	QUALITY ASSURANCE PLAN	Purchaser : L & T Hydrocarbon Engineering Ltd (LTHE), Vadodara
	BHEL-VISAKHAPATNAM or Approved Sub Contractor.	QAP NO: **B016-RUF-LT-504-QC-QD-BHEL (1)-02002** Rev.3 Date : 30-12-2020 Page 17 of 17 BHEL SO: 2438; Internal CQP No: 2508	Project Name: VRMP-Visakh Refinery Modernisation Project Customer : Hindustan Petroleum Corporation Limited- Visakhapatnam PMC : Engineers India Limited (EIL) EIL Job No. : B016-504 L & T Job No.& PO No.: RUFV & REFINERY/75000-66912/NG Dt.18-03-2020

S. No	Description	Type of Checks	Reference Documents and Acceptance Criteria	Format of Record	Inspection			EIL	Remarks
					M	TUV	AI		

DFT, Adhesion test and Holiday detection Check shall be inline with B016-000-79-41-PLS-01 and shall be witnessed by TPIA

Notes:

1) As per CLG Spec. PVM-SU-4750-H Clause No. 9.2, WFMT shall be performed for Category A, B, C & D butt-welded root areas and prior to back welding.
2) Extent of RT shall be in line to the approved drawing and Applicable data sheet
3) It is to be noted that wherever PTC is applicable, it will be as per Doc: B016-RUF-LT-504-QC-QD-BHEL (1)-02022.
4) As per PVM-SU-4750-H Cl. No. 7. 8: Production (vessel) test plates shall be subjected to the same thermal history expected for the finished vessel, including hot-forming, pre heat and PWHT.
5) As per PVM-SU-4750-H Cl. No. 9.5.2 & 9.5.3: Internal and external attachment welds, including those for lifting attachments when supplied, shall receive WFMT after grinding, if grinding is required. If vessel is subject to heat treatment, WFMT shall be performed after heat treatment. Surfaces from which temporary attachments have been removed shall receive WFMT after grinding.
6) As per PVM-SU-4750-H Cl. No. 9.5.1 b 2) : If impossible or impracticable to design so that UT can be applied, skirt-to-vessel welds shall receive WFMT after the root pass is completed and every third layer thereafter.
7) Applicable only for Tag Nos where Steam Coil / Coil is specified in drawing viz., Tag Nos.504-V-807.
8) ~~As per PVM-SU-4750-H Cl. No. 14.3.9: Internal welds and HAZs shall be inspected after PWHT as follows:~~
   - ~~a) Internal welds shall undergo WFMT for at least 1 inch (25 mm) on each side of the toe of the weld in accordance with ASME Code, Section V, Article 7.~~
   - ~~b) Acceptance criteria shall be per ASME Code, Division 1, Appendix 6 (Division 2, paragraph 7.5.6).~~
   - ~~c) Fluid-wetted pressure boundary and attachment welds shall be hardness tested and shall not exceed 200 BHN.~~
   - ~~d) One hardness test shall be performed on each weld or each 10 linear feet (3 m) of weld, whichever is more frequent.~~

Legends:

P: Perform	Drawing : Approved Drawing	WPS: Welding procedure specification	DFT: Dry film thickness
A-Approval	Spec : Specification	WPQ; Welder performance Qualification	RT: Radiographic testing
W-Witness Point	IRN: Inspection release note issued by TUV	HT Chart: Heat Treatment chart	UT: Ultrasonic testing manual
RW: Random Witness	M-BHEL or BHEL approved sub-contractor	PR: Purchase Requisition	PT: Dye penetrant testing
H: Hold Point (to inform to concerned and proceed ahead only after their approval)	L-Seam: Longitudinal Seam welding, C-Seam: Circumferential Seam welding	TUV: TUV India Pvt Ltd., (Third party inspection agency appointed by M/s LTHE	MPI: Magnetic particle Inspection WFMT: Wet Fluorescent Magnetic Particle Test
V: Verification of reports/Procedures	R: Review Point		MPT: Magnetic particle testing

Hydrocarbon Engineering Onshore Projects

RASHMIN JOSHI

15-01-2021

Technical Inspection Services TUV 64 TUV India

Approved

19.01.21

EIL 159

INSPECTION

ISSUE NO. : 2

PROCEDURE FOR RADIOGRAPHIC 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. 3,7,10,12,13,15 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.

Prepared by	Reviewed & Approved by
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TABLE OF CONTENTS

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.

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

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

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 INDICATIORS (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.

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 120^0 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.

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. RADIOGRAPH MAKING TECHNIQUES:

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

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

(Note: When DWDI 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")

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 Type Designation	Essential hole	Wire-type Essential wire	Hole Type Designation	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 Ug are tabulated below

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

$$\text{Exposure Time (Ci minutes)} = \frac{\text{Film factor} * (\text{SFD in Meters})^2 * 2^{(\text{thickness of job/HVT of material})}}{(\text{RHM of Source})} \times 60$$

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.

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.

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

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 to19 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.

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.

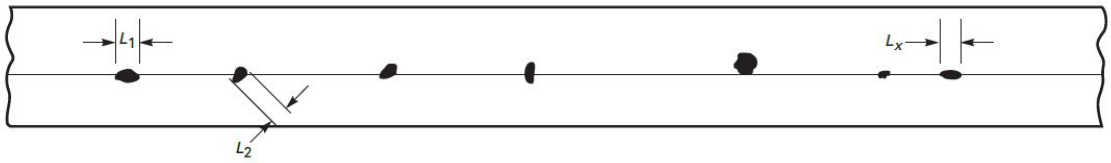
Acceptance Criteria for Rounded Indications

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

SI Units

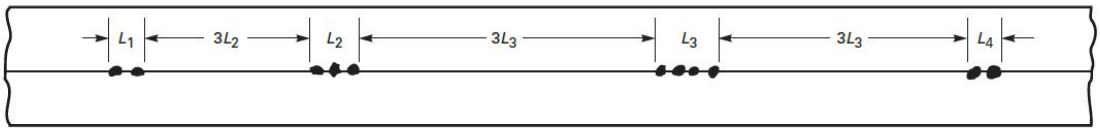
Thickness, t, mm	Maximum Size of Acceptable Rounded Indication, mm		Maximum Size of Nonrelevant Indication, mm
	Random	Isolated	
Less than 3	$\frac{1}{4}\,t$	$\frac{1}{3}\,t$	$\frac{1}{10}\,t$
3	0.79	1.07	0.38
5	1.19	1.60	0.38
6	1.60	2.11	0.38
8	1.98	2.64	0.79
10	2.31	3.18	0.79
11	2.77	3.71	0.79
13	3.18	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 $12t$.

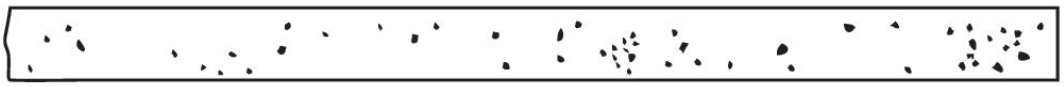
Figure 4-2
Groups of Aligned Rounded Indications



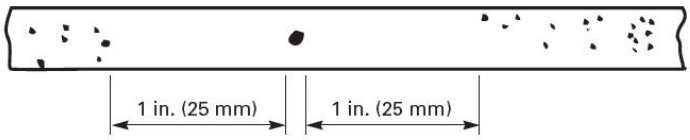
Maximum Group Length	Minimum Group Spacing
L = $^1/_4$ in. (6 mm) for t less than $^3/_4$ in. (19 mm) L = $^1/_3t$ for t $^3/_4$ in. (19 mm) to $2^1/_4$ in. (57 mm) L = $^3/_4$ in. (19 mm) for t greater than $2^1/_4$ in. (57 mm)	$3L$ where L is the length of the longest adjacent group being evaluated

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 $^1/_8$ in. to $^1/_4$ in. (3 mm to 6 mm), Inclusive



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



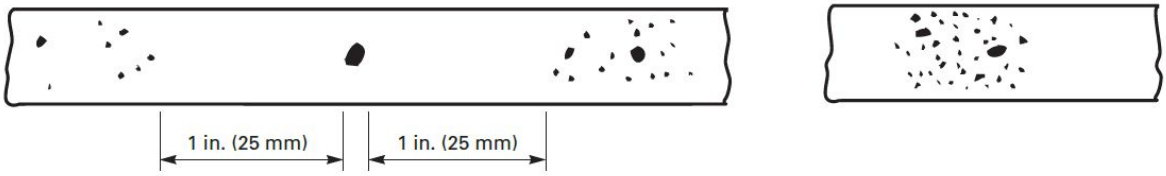
(b) Isolated Indication [See Note (2)]

(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 1/4 in. to 3/8 in. (6 mm to 10 mm), Inclusive

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



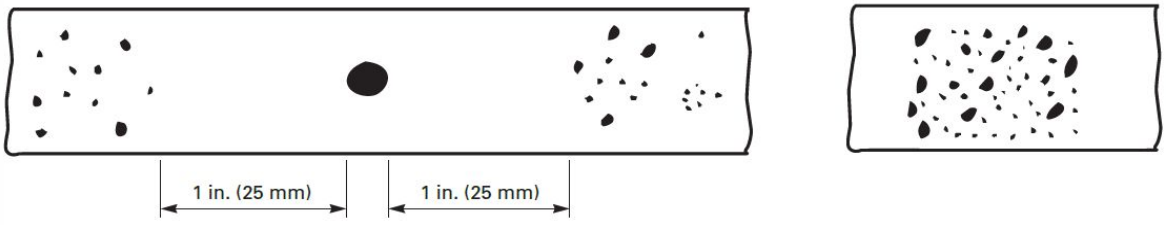
(b) Isolated Indication [See Note (2)]

(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 3/8 in. to 3/4 in. (10 mm to 19 mm), Inclusive

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

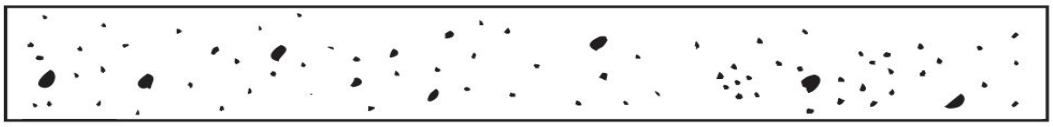


(b) Isolated Indication [See Note (2)]

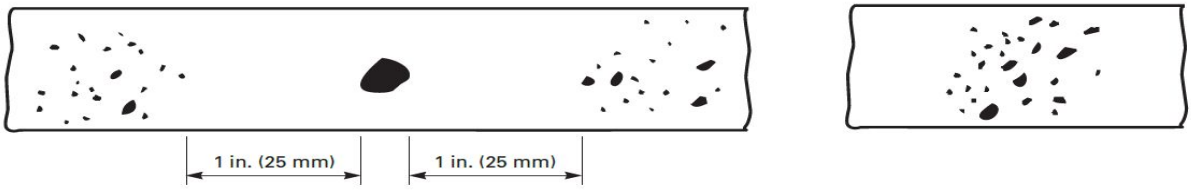
(c) Cluster

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

Figure 4-6
Charts for *t* Over ¾ in. to 2 in. (19 mm to 50 mm), Inclusive



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

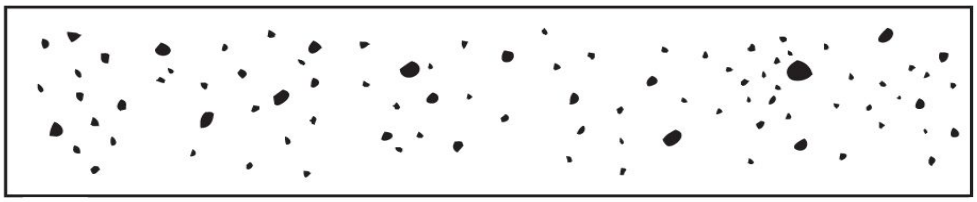


(b) Isolated Indication [See Note (2)]

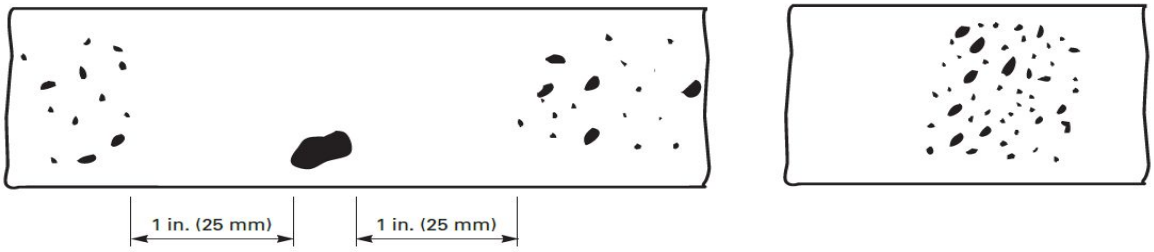
(c) Cluster

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)

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

Prepared by	Reviewed & Approved by
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TABLE OF CONTENTS

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.

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.

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 45º, 60º , 70º 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 45º angle beam and 4T for 60º 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%

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% ± 5% of full screen height. This shall be the primary reference level.

7.4.2. CALIBRATION FOR TECHNIQUE TWO:

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%± 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% ± 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 1½ 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.

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 45º angle beam search unit and ½ DAC for a 60º 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.

- 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.

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.

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.

Prepared by	Reviewed & Approved by
(K. JANAKI RAMULU) NDE LEVEL-II	VENKATA RAVI CHANDRA M. ASNT NDT LEVEL III-RT,UT,MT,PT CERTIFICATE No. 204694 (M.V. RAVI CHANDRA) NDE LEVEL- III

TABLE OF CONTENTS

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.

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 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 ºC to 315 ºC (within maximum temperature specified by the manufacturer of the particles) and wet particles shall be maximum 57 ºC 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.

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.

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.

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/ cm^2 at a distance of 15 inch.

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:

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.

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

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**.**

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)

ISSUE NO.: 2

PROCEDURE FOR LIQUID PENETRANT 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. 3,5,13 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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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.

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.

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 2019Article 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.

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**

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.

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).

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)