MTC / REPORT / 01

REPORT NO. 33 / 2013

IFFCO

# KALOL UNIT

# PLAN TURNAROUND REPORT

## (MARCH – APRIL – 2013)

**INDIAN FARMERS FERTILISER CO – OPERATIVE LIMITED**

# INDEX

# PREFACE

The Annual Plant Turnaround for the year 2013 was taken from 29th of March, 2013 to 10th of April, 2013 for carrying out Preventive maintenance of Static & Rotary equipments, Statutory IBR inspection, Preventive maintenance of Electrical & Instrument systems, Civil related jobs and for attending jobs which were pending for Shut down.

This was SHORTEST Annual Turnaround since inception of plant and was possible only due to whole hearted sincere efforts of whole IFFCO Kalol team.

After ensuring availability of all the required material for shutdown and awarding contracts for various shutdown jobs, it was decided to stop Ammonia Plant and Urea Plant on 29th March 2013. This shutdown report contains Plant wise and section wise details of the jobs carried out. Ammonia plant was re started and regular production was lined up at 11.00 Hrs. on 10th April, 2013. Similarly Urea plant also restarted and production was resumed at 17.00 Hrs. on 10th April, 2013.

Major jobs like overhauling of 101- Air compressor LP case, 101JT Turbine, 115-J pump and preventive maintenance of other rotary equipment was carried out in Ammonia Plant. Heat exchanger 110 CA/CB were replaced with new exchangers. In Urea plant all tubes of 2nd inter stage cooler (H-1812) of Hitachi compressor train were replaced with duplex tubes (SAF 2205). In LP Carbamate condenser (H-1205) IRIS inspection was carried out. 5 nos. of tubes were plugged as per Inspection report (Total 93 nos. plugged till date). In Offsite/Utility plants, IBR inspection of BHEL Boiler (GT-2068) was done.

The Turnaround was carried out smoothly due to meticulous planning of all activities like planning of manpower, material and other resources. Due to exemplary efforts put in by all Personnel at all levels, turnaround jobs could be completed before the scheduled period for Ammonia Plant and Urea Plant.

Safety was one of the major aspects, which was given top most priority during the execution of various jobs. All the jobs were carried out considering all safety aspects and the use of safety equipments was ensured during execution of jobs. Necessary training for safe working in the Plant was given to the Manpower employed by all Contractors and strict vigilance was kept by Fire & Safety section during execution of Critical jobs.

Major jobs carried out during shutdown are as under.

## MECHANICAL

### ❖ AMMONIA

- Major overhauling of Air Compressor LP case, its drive turbine 101-JT was carried out.
- Major overhauling of semi lean solution pump drive turbine, 115-JAT was carried out.
- New triple offset butterfly valves were installed on exhaust of 115-JAT & 115-JBT
- Major overhauling of BFW Pump drive turbine, 104-JAT was carried out.

- New electronic trip system was installed on BFW pump drive turbine , 104-JAT
- Major overhauling of Re-cycle gas compressor, 117-J was carried.
- 26 No of damaged Burner Blocks of Primary Reformer were replaced by new upgraded burner blocks.
- The damaged common inlet 12" piping of 116-JA & 116-JB was replaced by new one.
- New inlet valve was installed for BFW pump drive turbine 104-JT
- Boilers 101-F was inspected by the Boiler Inspector and got approval of CIB Gujarat.

❖ **UREA**

- Major overhauling of LP Case ( K-1801-1 ) & HP case ( K-1801-2 ) of CO2 compressor, and minor overhauling of drive turbine ( Q-1801 ) Siemens make, and Gear box ( M-1801) of Hitachi CO2 compressor.
- Routine inspection of Autoclave (V-1201) & Eddy current testing of tubes of H-1201 & H-1202.
- IRIS inspection of LP Carbamate condenser (H-1205).
- IBR inspection of 4 ata steam drum V-1501
- All tubes of 2nd inter stage cooler (H-1812) of Hitachi compressor train were replaced with duplex tubes (SAF 2205).
- In Recirculation heater H-1204, all orifice plugs of bottom tube sheet were replaced with perforated SS sheet to ease in maintenance and proper cleaning in tubes through hydro jetting
- Replacement of off gas line (PR-1208-4"-X1 & P-1206-4"-X1) of V-1201 due to the thickness reduction except RVs station (RV-1201 A/B/C).
- LP Vessels inspection and necessary repairs as per inspection findings.

❖ **OFFSITE & UTILITY**

- IBR inspection of BHEL Boiler (GT-2068)
- Removal of Boiler steam drum Rear side Eye Hye level gauge.(with IBR permission)
- Replacement of 40 ata Header RV Nozzle as it was in bend condition.
- Removal of unused 60 ata common header on top of Mech. Shift office building.
- Overhauling of BFW Turbine Q-5111
- Inspection & Repairing of 52'' inch CW interconnection tunnel.
- Repairing of structural members of cooling towers.
- Replaced Corroded CW Return Header segment in front of Mech. shift office.

**Pre Shutdown Activities**

Following jobs were carried out during Pre-shutdown activities:

- **Maintenance of Air Compressors**
  - .K-5302, Overhauling.
  - K-5401, Overhauling.

- **Maintenance of Cooling Water Turbine & pump (Q-4401/B & P-4401/B)**
  - Complete overhauling of Triveni CW Pump Turbine Train Q-4401/B

- **Preventive Maintenance of Cooling Tower Fans**
  - Preventive maintenance of all Cooling tower fans were carried out.

❖ **B&MH**

- Preventive Maintenance of all Conveyor and Drive Gear boxes and packer machines.

## INSTRUMENTATION

❖ **AMMONIA**

- The existing "Kent Introl Ltd." Make control valves FICV-485 and LCV-490 were replaced with the same make with improved body material ASTM 217 WC6 and modified Trim material SS 420 to protect against high temperature and high D P BFW service. The new valves were taken in line and functioning well.
- LI-101A: New Guided Wave Radar (GWR) Level Transmitters for $CO_2$ Stripper level measurement was installed and successfully taken into the DCS system.
- AC Power cable from PDB to digital cabinets, 24 volt DC Power cable to DCS Cabinets, Auxiliary Consoles and Emergency Shutdown System were replaced by new cables. The old signal cables from field to control room and old junction boxes were replaced with new ones. This has improved reliability and reduced the transmission error in measurement.
- Instrumentation jobs related to 104JA modifications as part of EWR/suggestion schemes/committee recommendations were successfully completed.
- AMC services of DCS/PLC systems/Analyzers/UPSS were carried out with the help of supplier's service engineers.
- Calibration of all quality affecting instruments.

❖ **UREA**

- CO2 Compressor's vibration data were made continuously available on line to Inspection Section by installing "TDXNET" Modules and other hardware in Vibration monitoring cabinet. The vibration monitoring systems put to "Off" condition just before the plant shutdown to check whether the power failure will initiate false trip. It was observed that power failure do not initiate a false tripping.
- Preventive maintenance of Nucleonic gauges was carried out.
- FS-1101(Old FS) Micro motion Ammonia mass flow meter was removed and sent for calibration and it was installed back after calibration and taken in service.

- Control valves LRCV-1201, LICV-1501, and LICV-1502B were replaced with new control valves.
- AMC jobs of servicing of DCS/PLC system for plant and Hitachi compressor were carried out by suppliers' engineers.
- Servicing and overhauling of the Control valves.

❖ **OFFSITE & UTILITY**

Capital job of replacing old control valves PICV-3102 and PICV-5154 with M/s "Dresser" make new valves was completed.

Maintenance of important control valves in all the area was done.

AMC jobs of servicing of DCS/PLC system for Boiler & DM Plant and new 2x60 KVA UPSS were carried out by suppliers' engineers.

❖ **B & MH**

Road Weigh Bridges and weighing machines were overhauled and calibrated.

## ELECTRICAL

Following Electrical preventive maintenance jobs and modification jobs were carried out.

- All the feeders of MCC panels were thoroughly cleaned. Burnt out / damaged components of feeder were replaced. Tightness of connectors was checked.
- Replacement of MCC-2F Sec A was carried out.
- Erection, testing and commissioning of flooded lead acid tubular batteries (OPzS 200P) of 200 AH was carried out in place of Ni-Cd batteries in new MPSS (11 KV Sub-Station).
- Preventive maintenance of all the transformers was carried out. Marshaling boxes were checked. Insulation resistance between HV to earth, LV to earth and Between HV and LV windings were checked and recorded. Oil having low BDV values in transformers was filtered.
- Servicing of the Jyoti make HT VCBs and LT TMG make ACBs was carried out. Closing and tripping time of all the VCBs were checked and calibrated.
- All the critical motors installed at various locations in plants were overhauled.
- All the MOVs were thoroughly checked in various plants and Preventive maintenance of actuators of all MOVs was carried out:
- Old heating elements of PGR Heater were replaced.
- Servicing of 66 KV BHEL make Minimum oil circuit breakers installed at switchyard was carried out.
- Servicing of Chabhi make Battery charger in 11 KV MPSS was carried out.
- Installation of Flameproof & Weatherproof telephone instruments was carried out.

## TECHNICAL

The annual turnaround of about 10 days, provide opportunity to Technical Department to undertake execution of jobs related to EWRs and various modification schemes which require isolation.

### ❖ AMMONIA

- Modification in Jacket water system of Secondary Reformer (103-D) and Waste Heat Boiler (101-CA/CB)
- Performance improvement of turbine (101-JT) gland condensers..
- Vacuum improvement of surface condenser (101-JCA)
- Reformer ID Fan Stack 4" Size Tappings ( 04 Nos ) at 29.5 mtr Height.
- Reliability improvement of LO & SO pumps's operation for 103 J / JT
- Corrosion coupons in CO2 Removal Section of Ammonia Plant
- DM water supply line for cooling of Start up heater panel ( S 50)
- Operational safety Improvement of Deaerator(101-U) and CO2 Stripper (102-E)
- To provide separate line for sending process condensate to cooling tower or to provide NRV to condensate outlet line to cooling tower.

### ❖ UREA PLANT

- Provision of condensate flushing point at outlet of Lean Carbamate Pump Vessel (V-1200).
- Laying of 1-1/2 inch cooling water supply and return headers and to reduce the bends in CW supply line for CCS-II pump bearing/ seal.

### ❖ UTILITY PLANT

- Installation of Chlorine Leak Handling System in New CT area.

### ❖ BAGGING PLANT

- Re-Routing of lines passing under conveyor M-2110 for ease of maintenance.

Emphasis was also laid on cost savings in all possible ways as under -

- The jobs which were big and critical have been executed by SOR contractor in place of shut down contractor to save cost.
- More and more Piping materials and valves etc. were used out of our existing stocks.
- Piping were so designed, so as to use material out of our stocks in most cases thereby minimizing Procurements, by meeting the requirements with in-house availability.

## PLANT TURNAROUND MARCH - APRIL - 2013

## GENERAL - DETAILS

| SR. NO. | CATEGORY | QUANTITY |
|---|---|---|
| (A) | **EQUIPMENT UTILIZED :** | |
| | **IFFCO :** | |
| | 135 T Kobelco | 01 No |
| | 55 T HM Crane | 01 No |
| | 55 T TIL RT-760 Tyre mounted mobile Crane | 01 No |
| | 15 T Coles Crane | 01 No |
| | 18 T Tata Crane | 01 No |
| | 10 T Escort Lift-N-Shift | 01 No |
| | 14 T Escort Lift-N-Shift | 01 No |
| | 03 T Forklift | 03 Nos. |
| | 05 T Forklift | 01 Nos. |
| | 909 Tata (Mini Truck) | 01 No |

**(B) MANPOWER UTILIZED :**

**(I) IFFCO MANPOWER :**

| | | | |
|---|---|---|---|
| 1 | Mechanical | } | |
| 2 | Mechanical Services | } | Existing |
| 3 | Electrical | } | strength |
| 4 | Instrument | } | |

**(II) HIRED - CONTRACT MANPOWER :**

| Sr. No. | Category | Man days |
|---|---|---|
| 1 | General Fitter | 719 |
| 3 | Rigger | 827 |
| 4 | S.S. Rigger | 1987 |
| 5 | Fabricator | 118 |
| 6 | Grinder | 156 |
| 7 | Gas Cutter | 72 |
| 8 | IBR Welder | 26 |
| 9 | Non-IBR Welder | 160 |
| 10 | Carpenter | 48 |
| 11 | Mason | 48 |
| 12 | Machinist | 60 |

# THE PLANT TURNAROUNDS AT A GLANCE

| SR. NO. | YEAR | PERIOD FROM PRODUCTION TO PRODUCTION | | | | | | | | REASON IF ANY |
|---|---|---|---|---|---|---|---|---|---|---|
| | | AMMONIA PLANT | | | | UREA PLANT | | | | |
| | | FROM | TO | DOWN TIME | | FROM | TO | DOWN TIME | | |
| | | | | DAYS | HRS | | | DAYS | HRS | |
| 01 | 1975 | 06-05-75 | 21-05-75 | 16.00 | - | 06-05-75 | 21-05-75 | 16.00 | - | Planned |
| 02 | 1976 | 26-03-76 | 20-04-76 | 26.00 | - | 26-03-76 | 20-04-76 | 26.00 | - | Planned |
| 03 | 76-77 | 05-12-76 | 22-01-77 | 49.00 | - | 05-12-76 | 24-02-77 | 51.00 | - | 101-JT B/D |
| 04 | 1978 | 21-02-78 | 15-03-78 | 23.00 | - | 21-02-78 | 25-03-78 | 31.00 | - | 101-BJ B/D |
| 05 | 1979 | 21-05-79 | 30-06-79 | 41.00 | - | 10-05-79 | 01-08-79 | 82.00 | - | K-1101/2, 3rd Stage Cylinder |
| 06 | 1981 | 12-04-81 | 10-05-81 | 29.00 | - | 08-04-81 | 12-05-81 | 35.00 | - | 101-B Headers Planned |
| 07 | 1984 | 01-01-84 | 25-01-84 | 25.00 | - | 01-01-84 | 25-01-84 | 25.00 | - | Planned |
| 08 | 1986 | 19-03-86 | 03-05-86 | 45.00 | - | 04-03-86 | 01-05-86 | 59.00 | - | Reformer Revamping / HP Scrubber B/D |
| 09 | 1987 | 12-04-87 | 03-05-87 | 21.00 | - | 12-04-87 | 02-05-87 | 20.00 | - | Planned |
| 10 | 1988 | 18-04-88 | 14-05-88 | 27.00 | - | 18-04-88 | 13-05-88 | 26.00 | - | Planned |
| 11 | 1990 | 05-02-90 | 05-03-90 | 29.00 | 688.67 | 31-01-90 | 07-03-90 | 35.00 | 829.00 | Planned |
| 12 | 1991 | 24-02-91 | 13-03-91 | 18.00 | 429.08 | 23-02-91 | 14-03-91 | 20.00 | 459.25 | Planned |
| 13 | 1992 | 03-11-92 | 03-12-92 | 30.60 | 734.91 | 03-11-92 | 04-12-92 | 31.00 | 744.75 | Planned |
| 14 | 1993 | 12-09-93 | 23-10-93 | 42.00 | 986.50 | 12-09-93 | 29-10-93 | 47.00 | 1120.58 | Revamp-II |
| 15 | 1995 | 14-01-95 | 27-01-95 | 14.00 | 311.34 | 11-01-95 | 26-01-95 | 16.00 | 352.18 | Scrubber H-1203 -B/D |
| 16 | 1996 | 14-06-96 | 13-07-96 | 30.00 | 712.00 | 13-06-96 | 13-07-96 | 30.00 | 694.25 | Autoclave V-1201 Leakage |
| 17 | 1997 | 12-05-97 | 17-06-97 | 35.60 | 875.00 | 12-05-97 | 17-06-97 | 36.20 | 870.50 | Planned |
| 18 | 1998 | 22-04-98 | 19-05-98 | 27.50 | 660.00 | 20-04-98 | 19-05-98 | 30.00 | 720.00 | Planned |
| 19 | 1999 | 12-04-99 | 30-04-99 | 18.00 | 434.50 | 11-04-99 | 28-04-99 | 17.00 | 409.75 | Planned |
| 20 | 2000 | 03-04-00 | 27-04-00 | 24.42 | 586.25 | 03-04-00 | 28-04-00 | 25.43 | 610.50 | Planned |
| 21 | 2001 | 25-03-01 | 14-04-01 | 20.90 | 501.50 | 25-03-01 | 15-04-01 | 21.26 | 510.25 | Planned |
| 22 | 2002 | 20-03-02 | 22-04-02 | 33.40 | 801.58 | 20-03-02 | 23-04-02 | 34.31 | 823.50 | Planned |
| 23 | 2003 | 28-05-03 | 25-06-03 | 28.04 | 673.00 | 28-05-03 | 25-06-03 | 28.33 | 679.83 | Planned |
| 24 | 2004 | 20-05-04 | 09-06-04 | 20.00 | 495.17 | 20-05-04 | 09-06-04 | 20.00 | 480.25 | Planned |
| 25 | 2005 | 22-05-05 | 29-06-05 | 38.75 | 930..50 | 22-05-05 | 24-06-05 | 33.85 | 812.50 | Planned |
| 26 | 2006 | 31-03-06 | 06-05-06 | 35.93 | 862.42 | 29-03-06 | 06-05-06 | 37.06 | 889.50 | Planned |
| 27 | 2007 | 14-04-07 | 08-05-07 | 23.72 | 569.25 | 14-04-07 | 05-05-07 | 21.38 | 513.0 | Planned |
| 28 | 2008 | 24-03-08 | 14-04-08 | 20.26 | 486.25 | 24-03-08 | 14-04-08 | 20.40 | 489.50 | Planned |
| 29 | 2009 | 16-03-09 | 10-04-09 | 25.31 | 607.33 | 16-03-09 | 09-04-09 | 24.63 | 591.00 | Planned |
| 30 | 2010 | 21.03.10 | 05-04-10 | 15.07 | 361.50 | 21-03-10 | 05-04-10 | 15.25 | 366.00 | Planned |
| 31 | 2011 | 25-03-11 | 07-04-11 | 13.25 | 318.00 | 25-03-11 | 07-04-11 | 13.12 | 314.92 | Planned |
| 32 | 2012 | 28-03-12 | 13-04-12 | 16.33 | 392.00 | 28-03-12 | 12-04-12 | 15.34 | 368.25 | Planned |
| **33** | **2013** | **29-03-13** | **10-04-13** | **11.88** | **285** | **29-03-13** | **10-04-13** | **11.91** | **285.92** | **Planned** |

## SHUT DOWN RELATED CONTRACTS

| SR. NO. | PLANT | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME |
|---|---|---|---|---|
| 1 | MECH. AMMONIA | 201004131193 04/02/2013 | Major overhauling and preventive maintenance of various rotating equipment. | BVL Power Systems ,Hyderabad |
| 2 | MECH. AMMONIA | 201004131214 08/02/2013 | Services of Scaffolding & Blinding / De-blinding jobs during Annual Shutdown | RAM BAHADUR & CO., Allahabad |
| 3 | MECH. AMMONIA | 201004130996 08/12/2012 | Overhauling of Re-cycle gas compressor 117-J | MALHAN ENTERPRISES PVT. LTD., Ahmedabad. |
| 4 | MECH. AMMONIA | 201004120551 17/03/2012 | Up-gradation of Over speed Trip Mechanism of 104-JAT | Emersion Process, Chennai |
| 5 | MECH. UREA | 201004131228 & 31/01/2013 | Insitu Retubing of Second Stage Intercooler, H-1812 of Urea Plant | M/s S R Engineering, Vadodara |
| 6 | MECH. UREA | 201004131297 & 13-02-2013 | Modification Job in Recirculation Heater ( H-1204 ) | M/s A M Erectors, Ahmedabad |
| 7 | MECH. OFFSITE | Order to Be Placed | Services for In-situ gland re-packing of valves | M/s Mekaster Engg. Halol |
| 8 | MECH. OFFSITE | 201004131237 Dt 08/02/2013 | Specialised services for Repair & Maintenance of Cooling Towers | M/s Paharpur, Vadodara |
| 9 | MECH. OFFSITE | 201004131369 Dt 28/02/2013 | Replacement of suction and Discharge Rubber Expansion Bellow of Cooling Water Pump | M/s General Engineering, Bharuch |
| 10 | MECH. OFFSITE | 201004131151 Dt. 16/01/2013 | Various Fabrication Jobs during S/D | M/s J & J Engineers |
| 11 | B&MH | 201001130380 | Rectification of M-2112 conveyor belt | |
| 12 | B&MH | 201001131145 | Oil resistance conveyor belt for M-2112 | Dynamic rubber pvt ltd |
| 13 | INSPECTION | 20110550 Dt 27/09/11 | NDT Teams for Dye Penetrant Testing Work | Engg. Insp. Services, Mumbai |
| 14 | INSPECTION | 20110554 Dt 23/09/2011 | NDT Teams for UFD Work | Engg. Insp. Services, Mumbai |

| SR. NO. | PLANT | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME |
|---|---|---|---|---|
| 15 | INSPECTION | 20110542 Dt 16/09/11 | NDT Team for MPI Work | Engg. Insp. Services, Mumbai |
| 16 | INSPECTION | 20110604 Dt 08/10/11 | NDT Teams for Ultrasonic Thickness measurement work | Engg. Insp. Services, Mumbai |
| 17 | INSPECTION | 201004130740 Dt 25/10/12 | ECT of HP Stripper, HP Condenser | Testex NDT(I) Pvt. Ltd., Mumbai |
| 18 | INSPECTION | 201004130854 Dt 02/11/12 | Insitu-Metallography Work | TCR Advaced Engg., Vadodara |
| 19 | INSPECTION | 20091032 Dt 01/01/10 | Radiography Work | NDT Services , Ahmedabad 079-25431845 |
| 20 | INSPECTION | 201004130900 Dt 21/11/12 | IRIS Inspection of H-1205 | Testex NDT(I) Pvt. Ltd., Mumbai |
| 21 | INSPECTION | 201004130791 Dt 25/10/12 | AUS of Reformer Tubes | PDIL, SINDRI |
| 22 | INSTRUMENT | WO. No.: 201004131153 Dt.: 21 -Jan-13 | Preventive Maint. / checking of Ammonia Plant FUJI make UPSS | M/s Instrumentation Ltd., Kota |
| 23 | INSTRUMENT | WO. No.: 201004131327 Dt.: 25-Feb-13 | AMC for servicing of ABB make Analyzers | M/s ABB Ltd , Ahmedabad |
| 24 | INSTRUMENT | 201001120366 Dtd. 16-Feb 12 | Maintenance of Control Valves | M/s Amrutha Engineering, New Panvel (Maharastra) |
| 25 | INSTRUMENT | 201004130589 Dt.: 03- Sep12 | Petty Maintenance Jobs | M/s Bajrang & Co., Kalol |
| 26 | INSTRUMENT | 201004120637 Dtd. 27-Mar-12 | AMC for Preventive Maintenance of plants DCS | M/s Yokogawa India Ltd., Vadodara |
| 27 | INSTRUMENT | 201004131190 Date: 08-FEB-13 | AMC for Autoclave / Stripper level Measuring System | "Berthold" Technologies (India) Pvt Ltd,59/115, Padmanabh Nagar 5th Street,Chennai - 600020 |
| 28 | INSTRUMENT | 201004131055 Date:19-DEC-12 | Hiring of Skilled Instrument Manpower | A-Z Instrument Services 8 First Floor Maruti Complex, New Chhani Road, Nizampura,Vdodra - 390002 |
| 29 | INSTRUMENT | 201004131112 Date:05-Jan12 | Replacement of Stripper inlet valve trim parts | Keytech Engineering Mumbai |
| 30 | INSTRUMENT | 201004130813 | AMCO MAKE BATTERY Preventive Maint / checking of Battery | Syntech power systems Vadodara |
| 31 | INSTRUMENT | 201004130937 | Preventive Maint / Checking of Emerson make UPS | Emerson Network power India Pvt Ltd |
| 32 | INSTRUMENT | 201004130127 | Servising of Beltweigher System | EMTICI Engg Ltd V.V.Nagar |

| SR. NO. | PLANT | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME |
|---|---|---|---|---|
| 33 | INSTRUMENT | 201004131332 Dt. 21/02/2013 | Servising of Weigh bridge (40ton, Main Gate) | Ashbee systems Pvt Ltd. |
| 34 | INSTRUMENT | 201004131153 Dt.: 21 -Jan-13 | Preventive Maint. / Checking of Ammonia Plant FUJI make UPSS | M/s Instrumentation Ltd., Kota |
| 35 | ELECTRICAL | 201001130676 20/09/2012 | Servicing of TMG make LT air circuit breakers. | HEATEX ELECTRICALS, MUMBAI |
| 36 | ELECTRICAL | 201001130679 15/09/2012 | Servicing of Jyoti make 11 KV vacuum circuit breakers. | JYOTI LTD, VADODARA-1 |
| 37 | ELECTRICAL | 201001130681 15/09/2012 | Servicing of BHEL make Minimum Oil circuit breakers. | M/S SUN GENTECH PVT LTD, SECUNDERABAD |
| 38 | ELECTRICAL | 201001130706 17/09/2012 | Maintenance/Painting of Transformers at Plant and Township. | UNIQUE TRANSFORMER SERVICE ,AHMEDABAD |
| 39 | ELECTRICAL | 201001130777 | Servicing of Rotork make Valve Actuators. | ROTORK CONTROLS (INDIA) PVT LTD, MUMBAI |
| 40 | ELECTRICAL | 201001130722 | Contract for services of electricians for shutdown jobs | A N ELECTRICALS, GANDHIDHAM |
| 41 | ELECTRICAL | 201001130345 23/07/2012 | Supply and replacement of specified section of motor control centre-2F | SIEMENS LTD, VADODARA-1 |
| 42 | ELECTRICAL | | | SIEMENS LTD, VADODARA-1 |
| 43 | ELECTRICAL | 201001130790 17/10/2012 | Supply and application of anticorrosive paint on electrical equipments | SHREE RAMDEV PAINTS & CONTRACT, AHMEDABAD |
| 44 | ELECTRICAL | 201001130431 20/09/2012 | Supply and supervision of erection,testing and commissioning of battery charger along with battery bank | UNIVERSAL INDUSTRIAL PRODUCTS, MUMBAI |
| 45 | ELECTRICAL | 201001130729 24/09/2012 | Calibration of Power Analyser | ELECTRONICS & QUALITY DEVELOPMENT ,GANDHINAGAR |
| 46 | ELECTRICAL | 201001131170 22-01-2013 | Servicing of Chhabi make battery charger | |
| 47 | PLANNING | 201004131192 Dtd.25/01/2013 | ARC for Petty Maintenance job | M/S J & J Engg.Co, Shertha |

| SR. NO. | PLANT | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME |
|---|---|---|---|---|
| 48 | PLANNING | 201004120253 | ARC for Painting (for urea &B&MH ) | M/s P.M.Patel & Co,Ahmedabad |
| 49 | PLANNING | 201004130560 | ARC for Painting (for Ammonia & Off sites) | M/s Shree Ramdev Paints and Co,Ahmedabad |
| 50 | PLANNING | 20101165 15/3/11 | ARC for Fabrication (For Urea & B&MH) | M/s Smitha Engrs, Kalol |
| 51 | PLANNING | 201004120537, 16/03/2012 | ARC for Hot/Cold insulation (for Ammonia & Offsites) | M/s Balaji insulations Pvt.Ltd. |
| 52 | PLANNING | 201004120538 16/03/2012. | ARC for Hot/Cold insulation (for Urea & B&MH) | M/s Khandelwal insulations(I) Pvt.Ltd. |
| 53 | PLANNING | 201004131342 | Opening and box up of HeatExchangers during shutdown | M/s General Engg. Works, Bharuch |
| 54 | PLANNING | 201004131350, 05/03/2013 | Assisting IFFCO during shutdown | M/s General Engg. Works, Bharuch |
| 55 | PLANNING | 201004131349, 05/03/2013 | Assisting IFFCO during shutdown | M/s RamBahdur & Co, Pali Babugang |
| 56 | PLANNING | 2010041311367 | ARC for Hydro jet cleaning of Heat Exchangers | M/s Deluxe Hydro Blasting Services, Mumbai |
| 57 | PLANNING | 201004131127313 .02.2013 | Overhauling and Testing of R.V (Critical) | M/s Flotec Engg.Services, Surat |
| 58 | PLANNING | 201004131126813 .02.2013 | Overhauling and Testing of R.V (Non-Critical) | M/s Flotec Engg.Services, Surat |
| 59 | CIVIL | 201001130950 | Maintenance of damaged water proof plywood sheet in cooling tower deck . | M/s Roshni construction |
| 60 | CIVIL | 201001130951 | Providing and applying IP net protective coating on RCC structures of Silo, B & MH plant area, Conveyor Gallery, Prill-Tower and others area in plant. | M/s KRISHNA CONCHEM |
| 61 | CIVIL | 201001130952 | Repair of bitumastic work in DM plant and other area to provide / repair acid / akali proof brick in strong / week effluent tanks . | M/s INDOCHEM ENGG CO |

| SR. NO. | PLANT | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME |
|---|---|---|---|---|
| 62 | CIVIL | 201001130954 | Providing and applying epoxy monolithic plaster at B & MH building and Conveyor gallery at silo. | M/s Tex-Sell Engg cor. |
| 63 | CIVIL | 201001130955 | Providing and applying Epoxy painting & White wash to RCC structure of Bagging Plant and Urea Plant | M/s B.Chauhan & Co. |
| 64 | CIVIL | 201001130956 | Repairing of Refractory lining work for Primary Reformer, Auxiliary and BHEL boiler area. | Department |
| 65 | CIVIL | 201001130957 | Maintenance of Damaged AC sheet in various location in plant. | M/s Roshni construction |
| 66 | CIVIL | 201001130959 | Supply of Tractor with trolley for shifting of debris in various location in plant . | M/s Roshni construction |
| 67 | CIVIL | 201001130962 | Miscellaneous Civil work in various location in plant during shutdown-2013. | M/sGayarti construction & Co |
| 68 | CIVIL | 201001130969 | Repair of Floor at B & MH plant by providing Kota stone tiles during plant turnaround 2013 | M/s Rakesh S Prajapati |

# MECHANICAL

# AMMONIA PLANT

(MECHANICAL)

## AIR COMPRESSOR TRAIN (101-J)

### 101-JT, Air Compressor Drive Turbine:

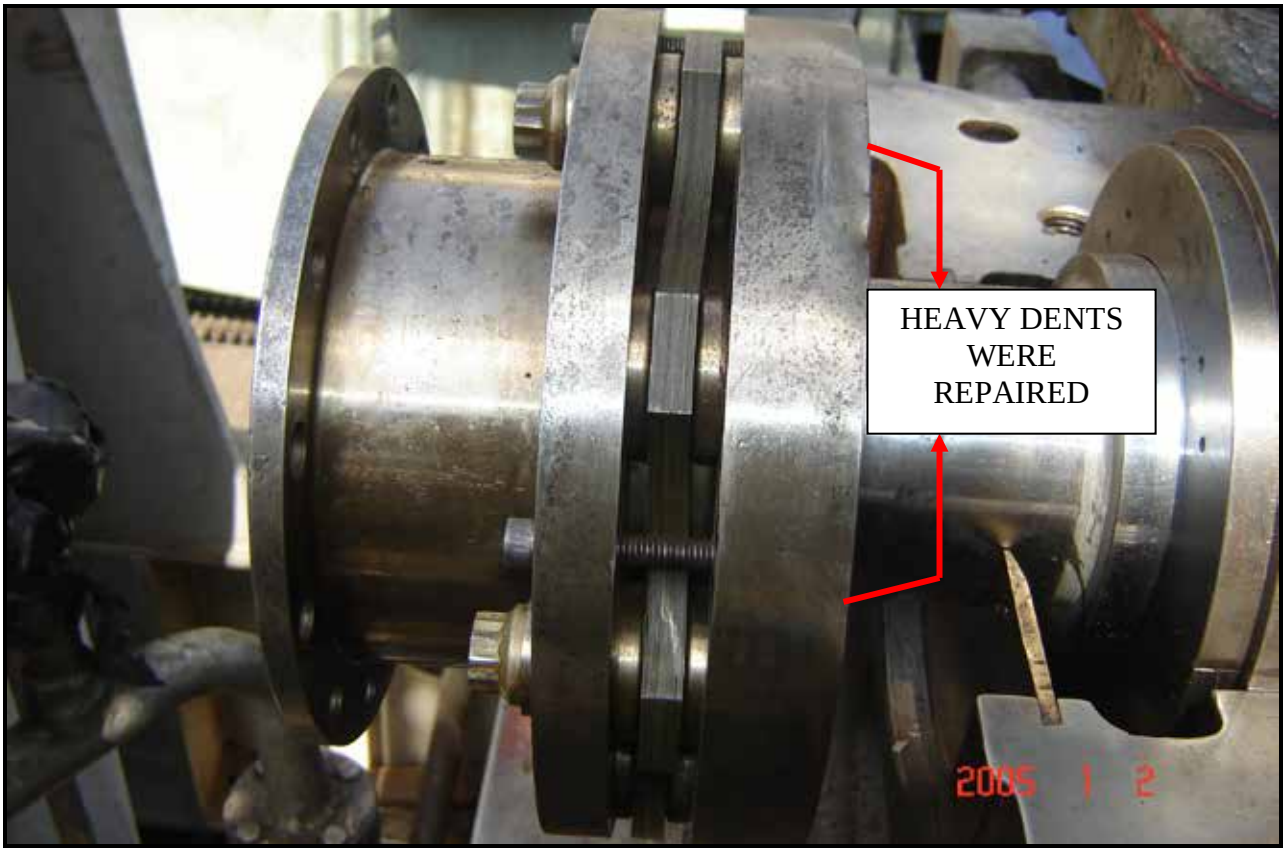
The turbine was taken for complete overhauling after a span of three years to attend heavy gland leak at the steam inlet end. Turbine was decoupled and exhaust pipings were removed. The top casing was removed and all internal radial as well as axial clearances were noted. The bearing clearances were measured and removed for inspection. The rotor was removed and cleaned by sand blasting. The coupling hub rear flange was found to be having a number of bends which may have occurred during rotor float /thrust measurement. These bends were repaired. The top and bottom diaphragms were removed and cleaned by sand blasting. Sand used for cleaning was Kurunda Sand having negligible magnetism level of 0.01 gauss. Heavy erosion was found at the welding joint of one of the reinforcement rods for the diaphragm holders in the bottom casing. This was repaired by welding.

All the inter stage labyrinth clearances were found on higher side and hence were replaced by new ones. Both ends Journal bearings and Thrust bearings were taken for inspection. One of the active side thrust bearing pads (having thermocouple) was found with 70 % white metal removed. Hence the complete set of active thrust pads was replaced by new one. Magnetism level of all major components was found within limit. All drain pipes were cleaned and drain valve roused. The governor end bearings and gear drives were visually inspected and found in good condition. The movement of the OST plunger inside the shaft was checked and found to be satisfactory. The diaphragms were reinstalled and the rotor was placed inside the bottom casing. All internal radial as well as axial clearances were measured and found to be satisfactory. The top casing was reinstalled and the bearing clearances were measured along with rotor free float and trip plunger clearances. The Governor was reinstalled and all linkages were greased. The coupling's flexible elements were locked and the turbine was taken for OST. The turbine tripped in a single attempt at 7460 RPM


**101-JT ROTOR BEFORE CLEANING**

**101-JT ROTOR AFTER CLEANING**


**101-JT BOTTOM CASING DIAPHRAGM HOLDER REINFORCEMENT**




**101-JT COUPLING HUB**

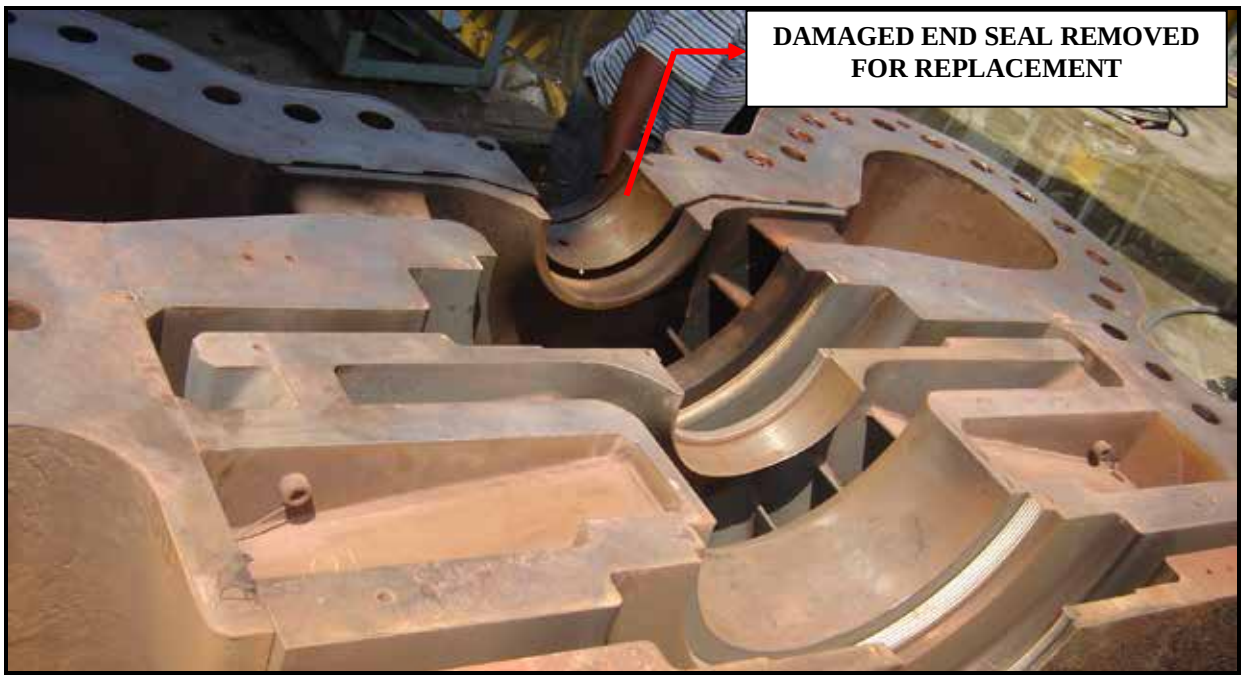
## 101-JLP, Air Compressor:

The compressor was taken for major overhauling after a span of six years. The compressor was decoupled and the piping removed. The top casing was removed and various axial and radial clearances were measured and noted. The rotor assembly was

lifted and taken for cleaning & inspection. Thick depositions were found on the vanes of the 1st & 2nd stage impellers. The complete rotor assembly was cleaned by sand blasting and dye penetration test was performed and no defects were observed. The top and bottom casing were cleaned thoroughly.

The journal bearing clearances were measured on mandrel and found within the design range. The journal & thrust bearing pads and their base rings were dye penetration checked and no defects were found. Magnetism level of complete rotor assembly as well as the bearings was under limit.

The rotor assembly was lifted and placed inside the bottom casing with bearing in place. The axial and diametrical clearances were measured and noted. The clearances of the end seals (CF 2041 V) were found to be on higher side and hence were replaced by new ones. The top casing was boxed up and the rotor end float, bearing clearances were measured and found within limit.




**101-JLP BOTTOM CASING**

**101-JR, Gear Box:**

101-JR was decoupled at both ends. All the bearings were inspected and found in good condition. Both the gear as well as Pinion were inspected and found to be O.K. Gauss measurement of gear shaft and bearings carried out and found within limit. Bearing clearances were taken and found within the design range.

**101-JHP, Air Compressor:**

101-JHP was decoupled from both ends. Journal bearings and Thrust bearings were visually inspected and dye penetration tested and found in good condition. Gauss reading of the bearing pads and base rings were measured and found within limits. Bearing clearances were taken and found within the design range.

All couplings were visually inspected. No damage in flexible elements was observed all the hubs were found to be in their position intact.

# IFFCO - KALOL

## DIAMETRICAL CLEARANCES - 101 JT

| REF. | CLEARANCE - INCHES | BETWEEN | REF. | CLEARANCE - INCHES | BETWEEN |
|---|---|---|---|---|---|
| A | 0,002 TO 0,004 | SEAL RING (THR. BRG.) TO SHAFT / NUT | D | 0,077 TO 0,109 | GUARD TO SHAFT |
| B | 0,007 TO 0,009 | JOURNAL BEARING TO SHAFT | E | 0,013 TO 0,019 | LABYRINTH RING RO SHAFT |
| C | 0.015 TO 0.021 | OIL GUARD TO SHAFT | G | 0.058 TO 0.097 | OIL GUARD TO SHAFT |

| AFTER | BEFORE | | BEFORE | AFTER |
|---|---|---|---|---|
| 0.0019" | 0.0019" | OIL GUARD - A | 0.0019" | 0.0019" |
| 0.0019" | 0.0019" | THRUST BRG. / OIL GUARD - A | 0.0019" | 0.0019" |
| X | X | JR. BRG. B | 0,0078" | 0,0078" |
| 0.009" | 0.009" | OIL GUARD - C | 0.009" | 0.009" |
| 0,051" | 0,052" | RING - D | 0,041" | 0,043" |
| 0.010" | 0.012" | E | 0.009" | 0.007" |
| 0.004" | 0.006" | E | 0.014" | 0.012" |
| 0,006" | 0,007" | E | 0,012" | 0,011" |
| 0.013" | 0.014" | E | 0.007" | 0.004" |
| 0.004" | 0.006" | E | 0.012" | 0.012" |
| 0,006" | 0,007" | E | 0,012" | 0,010" |
| 0.004" | 0.005" | WHEEL - 1 / E | 0.013" | 0.011" |
| 0,004" | 0,006" | WHEEL - 2 / E | 0,013" | 0,012" |
| 0.004" | 0.006" | WHEEL - 3 / E | 0,014" | 0,012" |
| 0.004" | 0.005" | WHEEL - 4 / E | 0.014" | 0.011" |
| 0,004" | 0,006" | WHEEL - 5 / E | 0,014" | 0,010" |
| 0.004" | 0.005" | WHEEL - 6 / E | 0.014" | 0.011" |
| 0.004" | 0.006" | WHEEL - 7 / E | 0.013" | 0.011" |
| 0,004" | 0,006" | WHEEL - 8 A / E | 0,012" | 0,011" |
| 0.004" | 0.006" | E | 0.013" | 0.012" |
| 0,004" | 0,005" | WHEEL - 8 B | 0,014" | 0,011" |
| 0,004" | 0,006" | E | 0,013" | 0,010" |
| 0.004" | 0.005" | E | 0.013" | 0.011" |
| 0,004" | 0,006" | E | 0,0013" | 0,060" |
| 0,0042" | 0,0042" | E | 0,062" | 0,060" |
| 0,009" | 0,009" | RING - D | 0,009" | 0,009" |
| X | X | OIL GUARD - C / JR. BRG. B | 0.007" | 0.007" |
| 0,070" | 0,072" | OIL GUARD - G | 0.030" | 0.030" |

SOUTH (THRUST END)

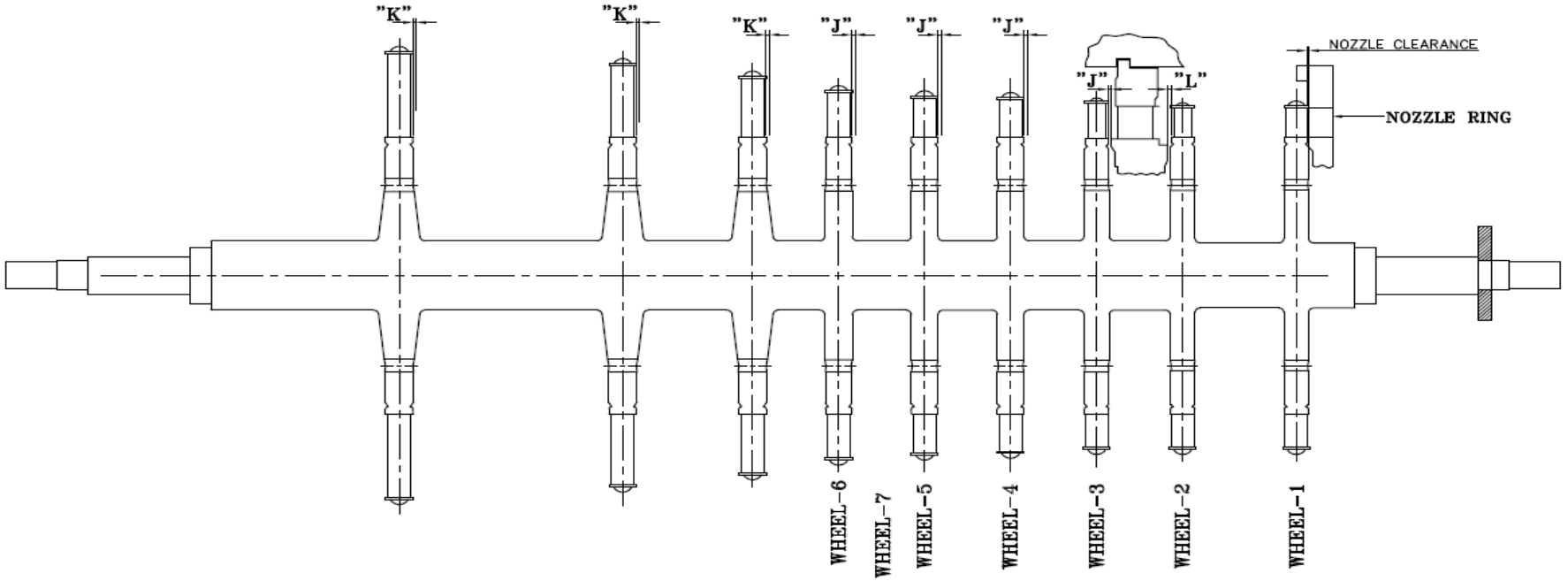
NORTH (OPP. THRUST END)

COUPLING

TOTAL FLOAT - 0,18"
RND THRVST - (0,008"-0,012")-0,008

| | |
|---|---|
| IFFCO :- | |
| PARTY :- | |
| Date :- | |

DATE :- .




| CLEARANCE | | WHEEL–1 | WHEEL–2 | | WHEEL–3 | WHEEL–4 | WHEEL–5 | WHEEL–6 | WHEEL–7 | WHEEL–8A | WHEEL–8B |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NOZZLE CLEARANCE | J | L | J | J | J | J | K | K | K |
| DESIGN | | 0.055"–0.065" | 0.055"–0.065" | 0.115"–0.125" | 0.055"–0.065" | 0.055"–0.065" | 0.055"–0.065" | 0.055"–0.065" | 0.110"–0.120" | 0.110"–0.120" | 0.110"–0.120" |
| MEASURED | SILO SIDE [WEST] | 0.053" | 0.072" | 0.013" | 0.050" | 0.064" | 0.055" | 0.055" | 0.108" | 0.112" | 0.116" |
| | COOLING TOWER SIDE [EAST] | 0.058" | 0.057" | 0.019" | 0.057" | 0.059" | 0.051" | 0.062" | 0.098" | 0.114" | 0.108" |

# IFFCO - KALOL

## WHEEL TO DIAPHRAGM CLEARANCE (101-JT)

PLANT : AMMONIA

# IFFCO - KALOL

## DIAMETRICAL CLEARANCES - 101 JLP

| REF. | CLEARANCE - INCHES | BETWEEN | REF. | CLEARANCE - INCHES | BETWEEN |
|---|---|---|---|---|---|
| A | 0.010 TO 0.014 | BALANCING RING TO BALANCING DRUM | A1 | 0.021 TO 0.027 | OIL GUARD TO SHAFT |
| B | 0.026 TO 0.030 | IMPELLER TO LABYRINTH | C1 | 0.013 TO 0.015 | BEARING HOUSING TO SHAFT |
| C | 0.020 TO 0.024 | IMPELLER TO LABYRINTH | D1 | 0.005 TO 0.008 | BEARING PAD TO SHAFT |
| D | 0.020 TO 0.225 | SLEEVE TO RING | M1 | 0.002 TO 0.004 | OIL GUARD TO SHAFT |
| E | 0.010 TO 0.014 | SHAFT TO RING | S1 | 0.002 TO 0.004 | OIL GUARD TO NUT |
| F | 0.022 TO 0.0245 | SLEEVE TO LABYRINTH | | | |

| AFTER | BEFORE | | BEFORE | AFTER |
|---|---|---|---|---|
| 0.010" | 0.011" | OIL GUARD - A1 | 0.011" | 0.011" |
| 0.002" | 0.002" | OIL GUARD - M1 | 0.002" | 0.002" |
| 0.002" | 0.002" | THRUST BRG. | 0.002" | 0.002" |
| | | OIL GUARD - S1 | | |
| 0.006" | 0.006" | | 0.007" | 0.006" |
| 0.004" | 0.004" | JR. BRG. C1 D1 C1 | 0.003" | 0.003" |
| 0.006" | 0.006" | | 0.006" | 0.006" |
| 0.012" | 0.013" | OIL GUARD - A1 | 0.011" | 0.012" |
| 0.005" | 0.008" | RING - E | 0.007" | 0.004" |
| 0.014" | 0.013" | | 0.013" | 0.013" |
| 0.009" | 0.009" | WHEEL - 1 B D | 0.010" | 0.009" |
| 0.013" | 0.014" | | 0.014" | 0.013" |
| 0.010" | 0.011" | WHEEL - 2 B F | 0.013" | 0.012" |
| 0.010" | 0.012" | | 0.011" | 0.012" |
| 0.010" | 0.011" | WHEEL - 3 C D | 0.011" | 0.012" |
| 0.011" | 0.012" | | 0.011" | 0.012" |
| 0.013" | 0.010" | WHEEL - 4 C D | 0.011" | 0.009" |
| 0.009" | 0.010" | | 0.010" | 0.010" |
| | | WHEEL - 5 C | | |
| 0.005" | 0.004" | BALANCING DRUM A | 0.005" | 0.005" |
| 0.005" | 0.008" | RING - E | 0.008" | 0.004" |
| 0.010" | 0.011" | OIL GUARD - A1 | 0.010" | 0.011" |
| 0.006" | 0.006" | | 0.006" | 0.006" |
| 0.004" | 0.004" | JR. BRG. C1 D1 C1 | 0.004" | 0.004" |
| 0.006" | 0.006" | | 0.006" | 0.006" |
| 0.009" | 0.011" | OIL GUARD - A1 | 0.010" | 0.011" |
| | | COUPLING | | |

NORTH

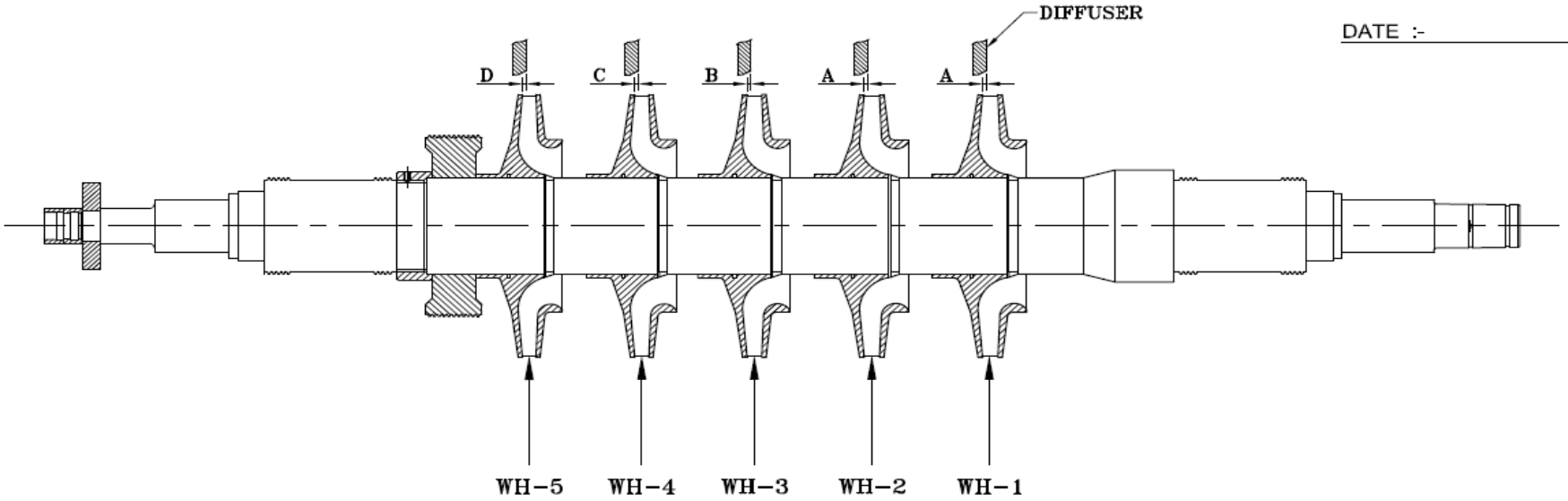
SOUTH

TOTAL END PLAY (0.011"-0.015")- 0.011"

NOTE :-
* A, B, C, D, E, F AS PER REVAMPED
A1, C1, D1, M1, S1 AS PER ORIGINAL DRG.

| | |
|---|---|
| IFFCO | :- |
| PARTY | :- |
| Date | :- |

DATE :- _____ .




| CLEARANCE | | WH-1 | WH-2 | WH-3 | WH-4 | WH-5 |
|---|---|---|---|---|---|---|
| | | A | A | B | C | D |
| DESIGN | | 0.187" | 0.187" | 0.125" | 0.065" | 0.079" |
| MEASURED | SILO SIDE [WEST] | 0.019" | 0.018" | 0.0130" | 0.067" | 0.070" |
| | COOLING TOWER SIDE [EAST] | 0.018" | 0.018" | 0.012" | 0.070" | 0.081" |

**IFFCO - KALOL**

WHEEL POSITION W.R.T. DIFFUSER FOR 101-JLP

PLANT : AMMONIA

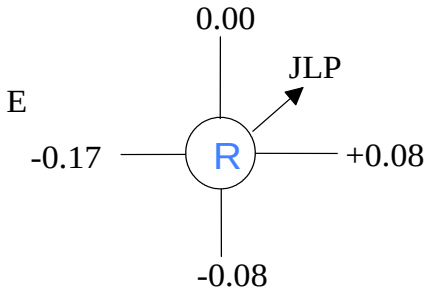
## CLEARANCE CHART - 101-JR

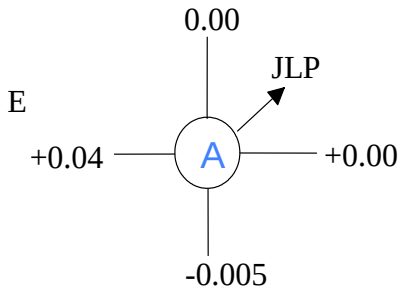
| Description | Position | Design Clearances (Inch) | Before (Inch) | After (Inch) |
|---|---|---|---|---|
| **Journal Bearing** (Low Speed drive gear ) | North | 0.008-0.010 | 0.011 | 0.011 |
| | South | 0.008-0.010 | 0.010 | 0.010 |
| **Axial Thrust** | --- | 0.014-0.024 | 0.017 | 0.017 |
| **Journal Bearing** ( High Speed driven Pinion ) | North | 0.009-0.011 | 0.009 | 0.009 |
| | South | 0.009-0.011 | 0.009 | 0.009 |
| **Backlash** | --- | --- | | 0.017 |

## CLEARANCE RECORDS – 101JHP

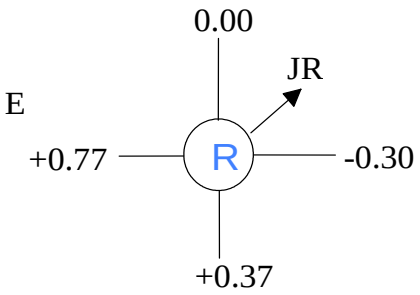
| Description | Position | Design Clearances (Inch) | Before (Inch) | After (Inch) |
|---|---|---|---|---|
| **GB End** | | | | |
| **Journal Bearing Clearance** | Mandrel | 0.004-0.007 | 0.007 | 0.007 |
| **Oil Guard** ( For Journal Bearing ) | North | 0.013-0.016 | 0.010 | 0.010 |
| | South | 0.013-0.016 | 0.010 | 0.010 |
| **Oil Guard** ( For Top Housing ) | North | 0.015-0.022 | 0.016 | 0.016 |
| | South | 0.015-0.022 | 0.016 | 0.016 |
| **Non Drive End** | | | | |
| **Journal Bearing Clearance** | Mandrel | 0.004-0.007 | 0.007 | 0.007 |
| **Oil Guard** ( For Journal Bearing ) | North | 0.013-0.016 | 0.021 | 0.021 |
| | South | 0.013-0.016 | 0.010 | 0.010 |
| **Oil Guard** ( For Thrust bearing ) | North | 0.002-0.004 | 0.002 | 0.002 |
| | South | 0.002-0.04 | 0.002 | 0.002 |
| **Oil Guard** ( For Top Housing ) | North | *** | *** | *** |
| | South | 0.015-0.022 | 0.016 | 0.016 |
| **Axial Thrust** | With Top Housing | 0.008 - 0.012 | 0.012 | 0.012 |

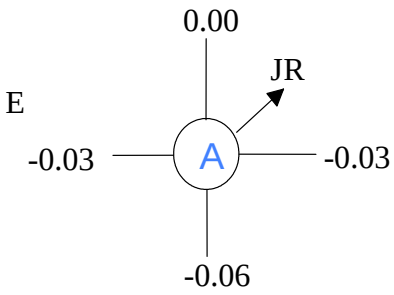
## Alignment (in mm): 101-JT to 101-JLP after Overhauling



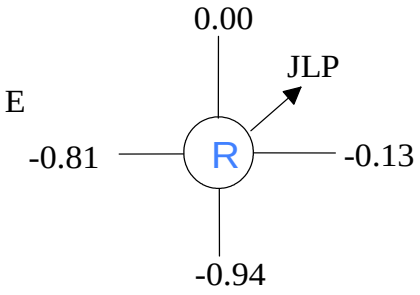



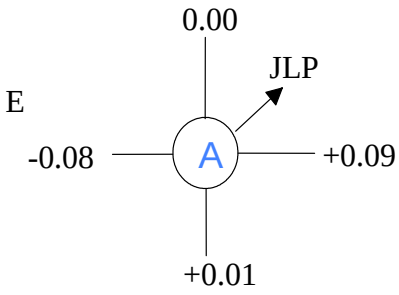
**Alignment (in mm): 101-JLP to 101-JR after Overhauling**




**Alignment (in mm): 101-JR to 101-JHP - After Preventive Maintenance (mm)**




## SYNTHESIS GAS COMPRESSOR TRAIN, 103-J:

### 103-JBT, Condensing turbine:

The turbine was decoupled and thrust bearing and both end Journal bearing were visually inspected and found O.K. Magnetism level of both end journal bearing pad and base ring, shaft journal area, thrust bearing and thrust collar was measured and found within limit. All pads were Dye Penetration tested and no cracks were found. The governor linkages were greased.

### 103-JAT, Backpressure turbine:

The turbine was decoupled and thrust bearing and both end Journal bearing were inspected and found O.K Magnetism level of both end journal bearing pad and base ring, shaft journal area, thrust bearing and thrust collar was measured and found within limit. All pads were Dye Penetration tested and no cracks were found. The governor linkages were grease

All couplings were visually inspected. No damage in flexible elements was observed all the hubs were found to be in their position intact. The lube oil console of the complete train was cleaned after removing all the oil. New oil was charged.

### 103-JLP, Synthesis Gas Compressor:

The non thrust end journal bearing was removed and the clearance was measured and found to be within limit. Both ends journal bearing pads were inspected and found to be satisfactory. Magnetism level check of the removed bearings was carried out and found to be satisfactory. Dye penetration test was performed and the result was found to be OK.

**103-JHP, Synthesis Gas Compressor:**

The compressor was decoupled and thrust bearing and both ends Journal bearing which were visually inspected and found O.K. The active end thrust bearing pads which were showing high metal temperature were found to be having thick oxide deposition. These deposits were cleaned. One of the non active pad thermocouple was not working and hence it was replaced by new one. Magnetism level of the bearings were checked and found within limit. All pads were Dye Penetration tested and found to be OK.


**THICK BLACK DEPOSITS ON BEARING PADS OF 103-JHP**

**PREVENTIVE MAINTENANCE RECORDS: 103 – JBT**

| Description | Position | Clr. Chart Ref | Design Clearances (Inch) | Before (inch) | After (inch) |
|---|---|---|---|---|---|
| **JAT End** | | | | | |
| **Journal Bearing** | Mandrel | A | 0.010-0.012 | 0.011 | 0.011 |
| **Oil Guard** ( For Jr. Brg Housing ) | South | C | 0.008-0.014 | 0.008 | 0.008 |
| **Governor End** | | | | | |
| **Journal Bearing** | Mandrel | A | 0.010-0.012 | 0.010 | 0.010 |
| **Oil Guard** (For Brg. Housing | North | C | 0.008-0.014 | 0.008 | 0.008 |
| **Axial Thrust.** | With Top Housing | | 0.008-0.012 | 0.009 | 0.009 |

**PREVENTIVE MAINTENANCE RECORDS: 103 - JAT**

| Description | Position | Clr.Chart Ref | Design Clearances (Inch) | Before (Inch) | After (Inch) |
|---|---|---|---|---|---|
| **JLP End** | | | | | |
| **Journal Bearing** | Mandrel | N | 0.006-0.008 | 0.007 | 0.007 |
| **Oil Guard** ( For Jr. Brg Housing ) | South | C | 0.015-0.021 | 0.015 | 0.015 |
| **JBT End** | | | | | |
| **Journal Bearing** | Mandrel | B | 0.010-0.012 | 0.010 | 0.010 |
| **Oil Guard** (For Brg. Housing | North | C | 0.015-0.021 | 0.015 | 0.015 |
| **Axial Thrust.** | With Top Housing | --- | 0.008-0.012 | 0.012 | 0.012 |
| **Oil Guard** (For Thrust Bearing) | North | A | 0.002-0.004 | 0.003 | 0.003 |
| | South | A | 0.002-0.004 | 0.004 | 0.004 |

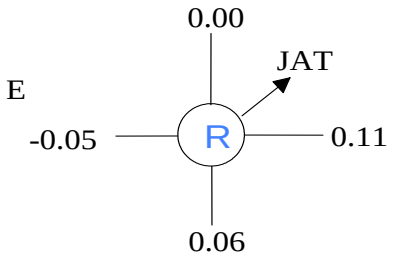
**PREVENTIVE MAINTENANCE RECORDS: 103 – JLP**

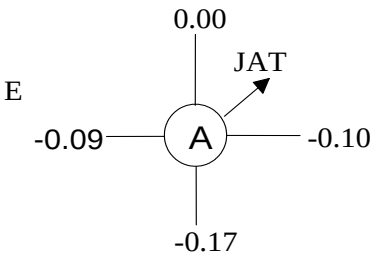
| Description | Position | Clr.Chart Ref. | Design Clearances (Inch) | Before (Inch) | After (Inch) |
|---|---|---|---|---|---|
| **NON THRUST END** | | | | | |
| **Journal Bearing Clearance** | Mandrill | C1 | 0.002”-0.004” | 0.004 | 0.004 |
| **Oil Guard** ( For Journal Bearing ) | North | C2 | 0.008”-0.013” | 0.013 | 0.013 |
| | South | C2 | 0.008”-0.013” | 0.012 | 0.012 |
| **THRUST END** | | | | | |
| **Journal Bearing Clearance** | Mandrill | C1 | 0.002”-0.004” | 0.005 | 0.005 |
| **Axial Thrust** | With Top Housing | | 0.015”- 0.022” | 0.016 | 0.016 |

**PREVENTIVE MAINTENANCE RECORDS: 103 – JHP**

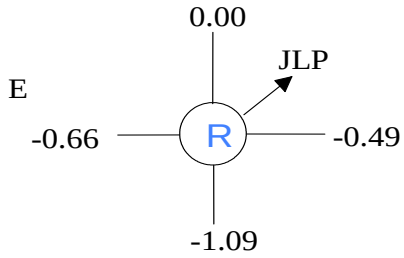
| Description | Position | Clr.Chart Ref. | Design Clearances (Inch) | Before (Inch) | After (Inch) |
|---|---|---|---|---|---|
| **NON THRUST END** | | | | | |
| **Journal Bearing Clearance** | Mandrill | A1 | 0.0023”-.0.0033” | 0.003 | 0.003 |
| **Oil Guard** ( For Journal Bearing ) | North | A2 | 0.0085”-0.0115” | 0.011 | 0.011 |
| | South | A2 | 0.0085”- 0.0115” | 0.011 | 0.011 |
| **THRUST END** | | | | | |
| **Journal Bearing Clearance** | Mandrill | A1 | 0.0023”-0.0033” | 0.003 | 0.003 |
| **Axial Thrust** | With Top Housing | | 0.015” - 0.022” | 0.017 | 0.017 |

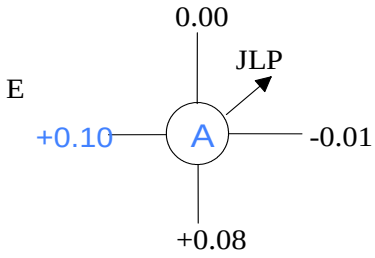
**Alignment: 103-JBT to 103-JAT - After Preventive Maintenance (mm)**



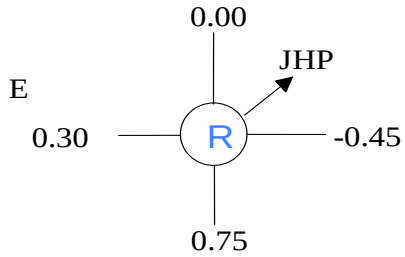



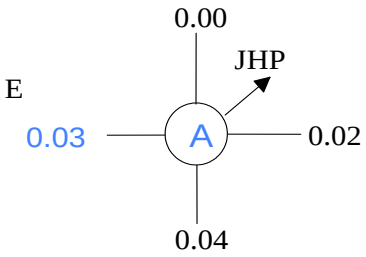

**Alignment: 103-JAT to 103-JLP - After Preventive Maintenance (mm)**




**Alignment: 103-JLP to 103-JHP - After Preventive Maintenance (mm)**




## REFRIGERATION COMPRESSOR TRAIN 105-J:

### 105-JT, Refrigeration Compressor Drive Turbine Preventive Maintenence

Turbine was decoupled and both ends Journal bearings and Thrust bearings were taken for inspection. Gauss readings of the bearing pads were measured and found within limits. The pads were visually inspected as well as dye penetration tested and found OK. Bearing clearances were taken and found within the design range. The governor drive gear assembly and bearings were also inspected and found OK.

### 105-JLP Refrigeration Compressor:

101-JLP, gear box end was decoupled. Journal bearings clearances were measured and found within limit.

### 105-JR Gear Box:

After decoupling the top cover was removed. All the bearings were inspected and found in good condition. Both the gear as well as Pinion were inspected and found to be O.K. Magnetism level of gear/pinion shaft and their bearings was carried out and found within limit. Bearing clearances were taken and found within the design range.

**105-JHP Refrigeration Compressor Preventive Maintenance:**

101-JHP, gear box end was decoupled. Journal bearings clearances were measured and found within limit.

All couplings were visually inspected. No damage in flexible elements was observed all the hubs were found to be in their position intact.

**105-JT CLEARANCES**

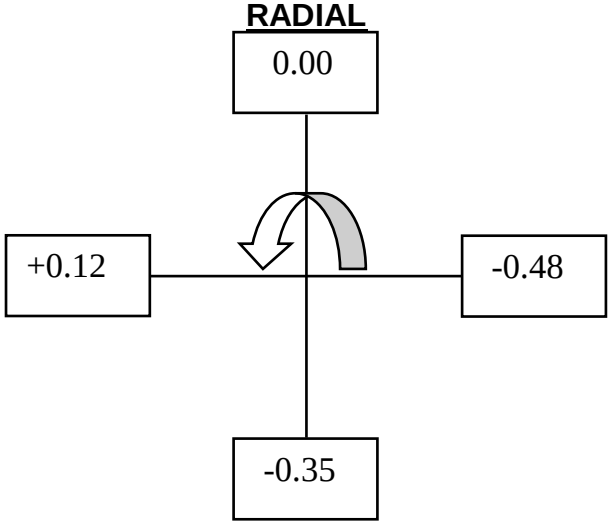
| Description | Position | Design clearance | Actual Clearance |
|---|---|---|---|
| **JLP End** | | | |
| **Journal Bearing** | Lead wire | 0.07”-0.009” | 0.0084 |
| **Oil Guard** (For Jr. Brg Housing**)** | South | 0.015”-0.021” | 0.0086 |
| | North | 0.058”-0.097” | 0.0017 |
| **Oil Guard** (For Seal Housing**)** | *** | 0.077-0.109 | 0.0018 |
| **Governor End** | | | |
| **Journal Bearing** | Lead wire | 0.07”-0.009” | 0.0086 |
| **Oil Guard** (For Jr. Brg Housing**)** | South | *** | *** |
| | North | 0.015”-0.021” | 0.0018 |
| **Oil Guard** (For Thrust Brg.**)** | South | 0.002”-0.04” | 0.0021 |
| | North | 0.002”-0.04” | 0.0022 |
| **Oil Guard** (For Seal Housing**)** | *** | 0.077-0.109 | *** |
| **Axial thrust** | With Top Housing | 0.008-0.012 | 0.0099 |
| **Nozzle Clearance.** | - | 0.055-0.065 | 0.054 |
| **Shim Thickness.** | North | *** | 0.116 |
| **(Nz. Cl. Adjusting** | South | *** | 0.112 |
| **Trip Lever - Plunger** | | 0.120-0.130 | 0.122 |
| **CASING BOLT CLEARANCES** | | | |
| NO 1 | 0.0039 | 0.0043 | |
| NO 2 | 0.0040 | 0.0043 | |

**105-JR CLEARANCES**

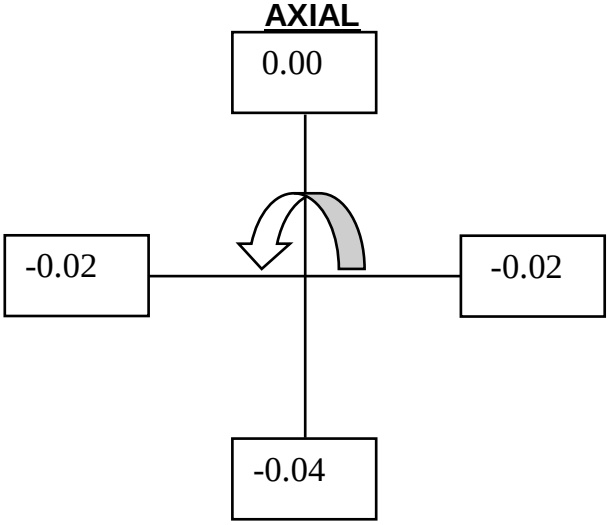
| Description | Position | Design clearance | Actual Clearance |
|---|---|---|---|
| **Journal Bearing** | North | 0.014-0.016 | 0.0141 |
| | South | -do- | 0.0141 |
| **Axial thrust** | | 0.014-0.024 | 0.0141 |
| **Journal Bearing** | North | 0.013 | 0.015 |
| | South | -do- | 0.014 |
| **Free Float** | | -- | 0.060 |
| **Backlash** | | -- | 0.020 |
| **Shaft diameter** | North | -- | 5.031 |
| | South | -- | 5.031 |
| **Shaft diameter** | North | -- | 4.493 |
| | South | -- | 4.493 |
| **Thrust Float.** | | -- | 0.013 |

**ALIGNMENT VALUES - 105-JT TO 105-JLP**

**RADIAL**



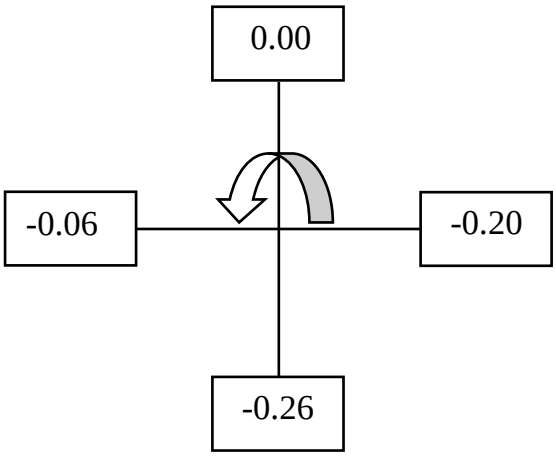

**AXIAL**



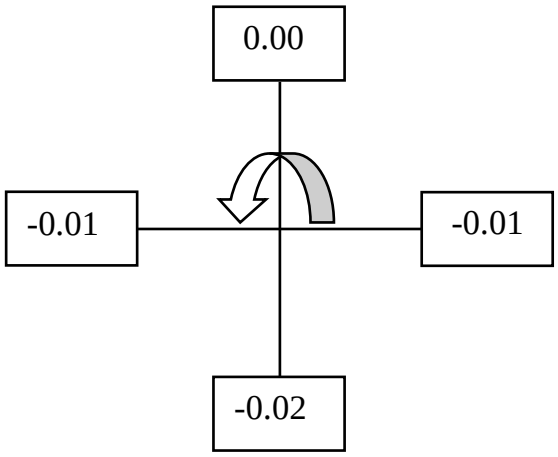

Note: Fixture mounted on Turbine Rotor, Dial reading on JLP. , All Readings are in mm.

**ALIGNMENT VALUE - 105-JLP TO 105-JR:**

**RADIAL**



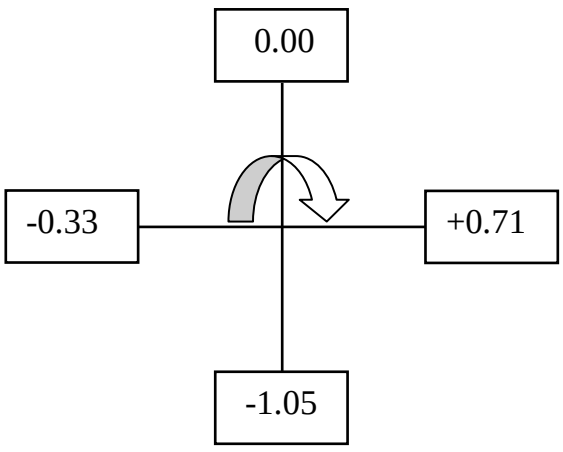

**AXIAL**



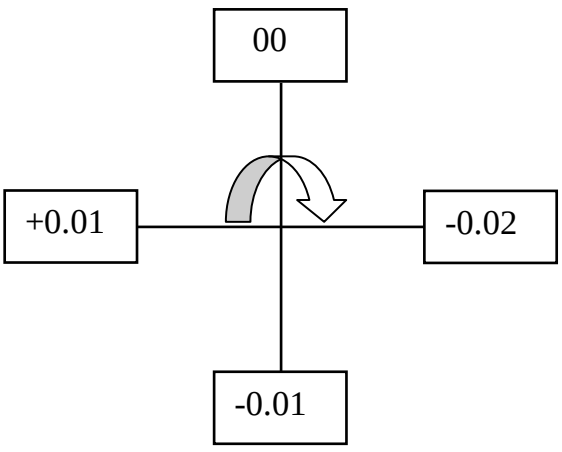

Note: Fixture mounted on LP Rotor. , Dial reading on JR., All Readings are in mm.

**ALIGNMENT VALUE - 105-JR TO 101-JHP:**

**RADIAL**




**AXIAL**




Note: Fixture mounted on JR, Dial reading JHP. , All Readings are in mm.

**INDUCED DRAFT FAN 101-BJ TRAIN:**

**101- BJT Drive Turbine Overhauling:**

The turbine was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. The PGPL actuator oil was flushed. The auxiliary lube oil cooler was showing problem of oil leakage. Hence the same was replaced by spare refurbished one.

**101- BJ Fan:**

Journal bearings and thrust bearings were inspected and found O.K. Gauss reading was taken and found below maximum allowable limit. All the bearing pads were Dye Penetration tested and no cracks were found Bearing clearances were taken and found within the design range. Cooling water line inlet nipple was damaged and hence the same was replaced. Water was circulated in lines and no leaks were observed. The final bearing clearance was measured and found within design range. Dust seal of CT side bearing was replaced since the same was damaged.

**101-BJR Gear box:**

The gear box was taken for major overhauling as abnormal noise was reported during plant operation. The top cover as well as gear and pinion were removed. The bearings were dye penetraton inspected and no defects were observed. Gauss measurement for the bearings was also carried out and found within limit. Gear backlash and bearing clearance was measured and found within limit.

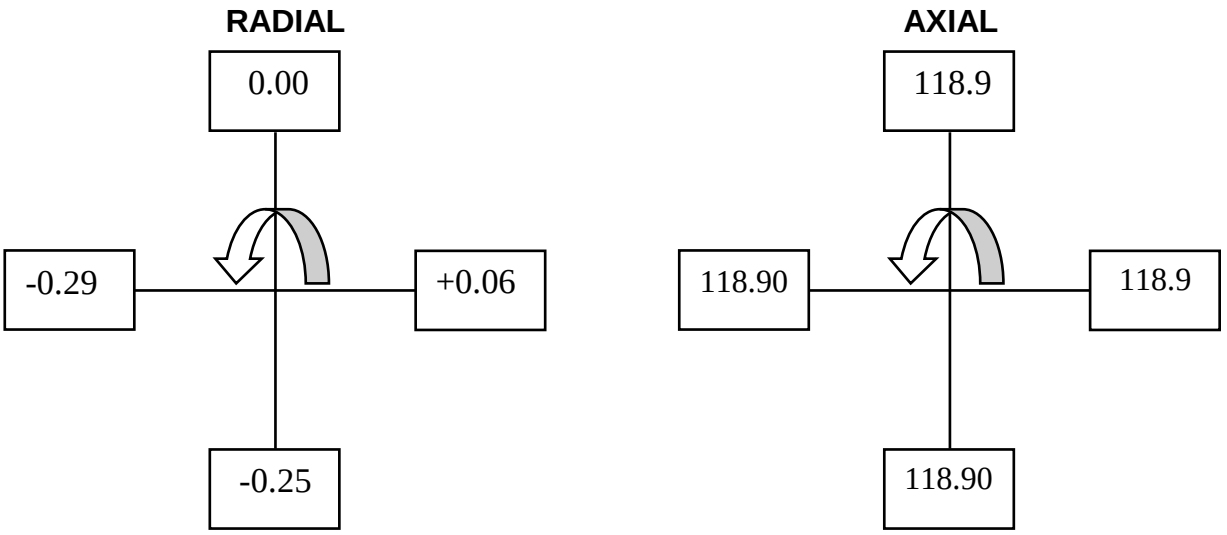
All couplings were visually inspected. One of the flexible element assemblies was having cracked elements and hence the same was replaced by new one. All the hubs were found to be in their position intact.

**BEARING CLEARANCES: 101-BJT**

| Description | Position | Design clearance | Actual Clearance |
|---|---|---|---|
| **Gear Box End-BJT** | | | |
| **Journal Bearing** | Lead wire | 0.07”-0.0010” | 0.011 |
| **Oil Guard** (For Jr. Brg Housing**)** | CT Side | 0.015”-0.0195” | 0.0018 |
| | SILO Side | 0.015”-0.0195” | 0.0018 |
| **Governor End-BJT** | | | |
| **Journal Bearing** | *** | 0.07”-0.0010” | 0.012 |
| **Oil Guard** (For Jr. Brg Housing**)** | *** | 0.015”-0.0195” | 0.016 |
| | *** | *** | ** |
| **Axial Thrust.** | *** | 0.014” | 0.015” |
| **BJR** | | | |
| **Journal Bearing (**High Speed drive Pinion**)** | CT Side | 0.005”-0.008” | 0.011” |
| | SILO Side | 0.005”-0.008” | 0.007” |
| **Axial Thrust.** | | | 0.014” |
| **Journal Bearing (**Low | CT Side | 0.005”-0.008” | 0.010” |

| | | | |
|---|---|---|---|
| Speed drive Gear**)** | SILO Side | 0.005”-0.008” | 0.008” |
| **Backlash** | *** | 0.013”-0.017” | 0.016” |
| **Shaft Diameter** (High Speed drive Pinion) | CT Side | *** | 4.494” |
| | SILO Side | *** | 4.494” |
| **Gear Box End-BJ** | | | |
| **Journal Bearing** | Lead wire | 0.008”-0.012” | 0.0128” |
| **Shaft Diameter** | Jr.Brg | *** | 6.999” |
| **Free End-BJ** | | | |
| **Journal Bearing** | Lead wire | 0.008”-0.012” | 0.0126” |
| **Shaft Diameter** | Jr.Brg | | 6.996” |

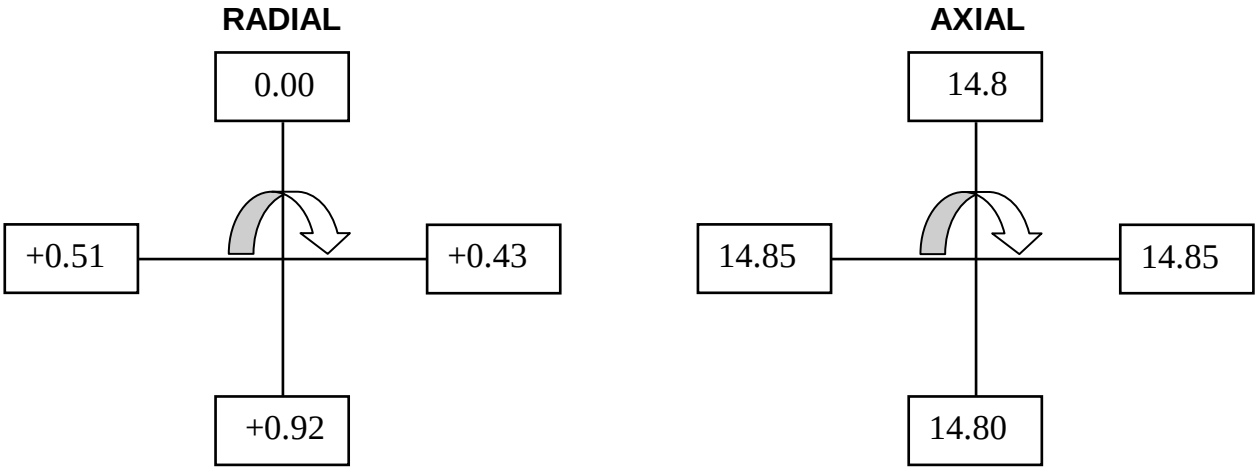
**ALIGNMENT VALUES - 101-BJT TO 101-BJR**




(By using inside micrometer)

Note: Fixture mounted on Turbine, Dial reading on Gear box, All Readings in mm.

**ALINGMENT READING - 101-BJR TO 101-BJ**




(By using, slip gauge)

Note: Fixture mounted on G.B., Dial reading on Fan. All Readings are in mm.

## SEMILEAN SOLUTION PUMP115-JA TRAIN:

### 115- JAT Major overhauling

The turbine was decoupled and exhaust line was removed. The top casing was removed and all axial as well as radial clearances were measured. The bearings were removed for inspection. Rotor assembly was taken out and it's cleaning done by sand blasting. All diaphragms were taken out for cleaning. The bearing pads were visually inspected and DP check carried out and found satisfactory. The magnetism level of the bearings and rotor assembly was checked and found within acceptable limit.

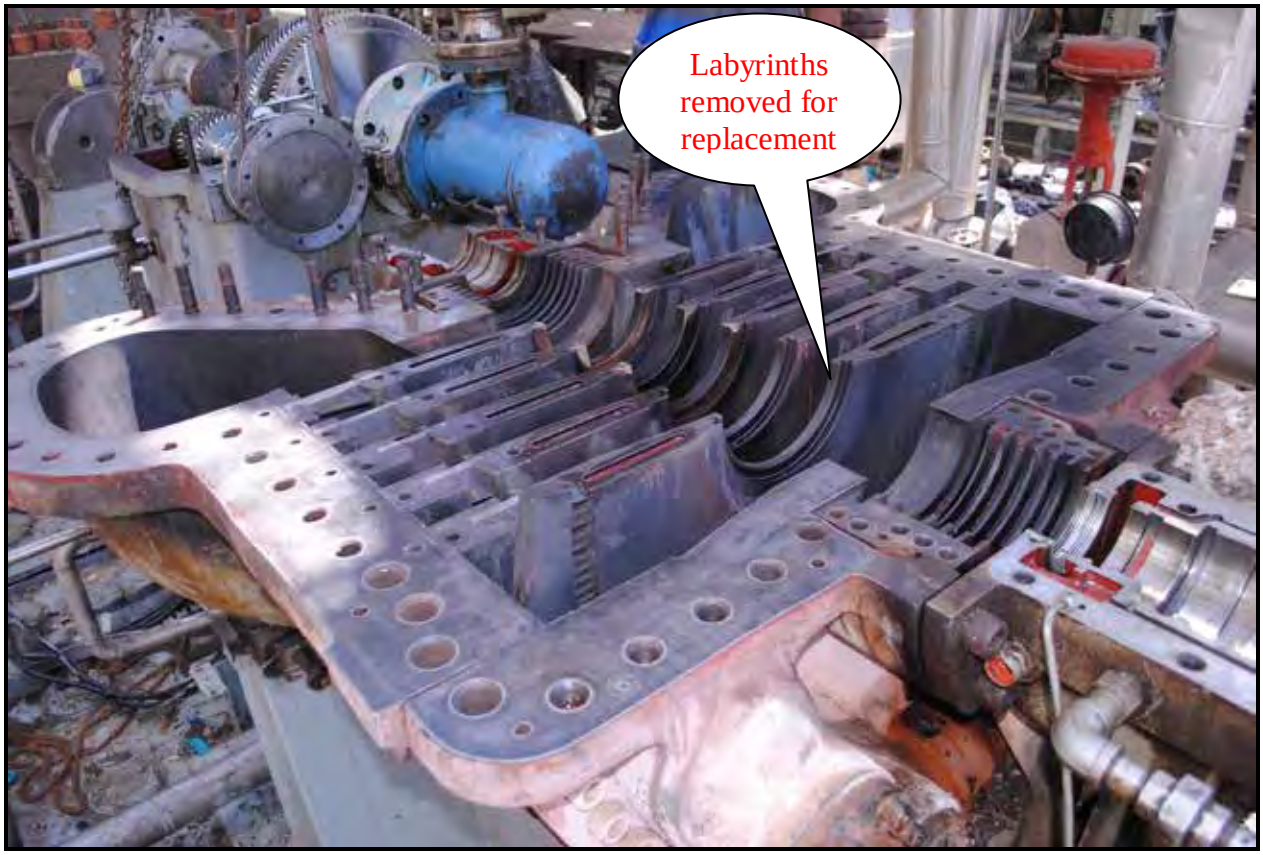
All inter-stage labyrinths were also taken out and new labyrinths were installed. While removing the inter-stage labyrinths some of them were broken as they had got stuck in the diaphragm. The diaphragms had to be machined to remove the stuck portions of the labyrinths.

The rotor was reinstalled & all axial as well as radial clearances were measured. New carbon rings installed. Bearing clearances were measure and found within limit.Steam inlet pipe, exhaust pipe and all other related piping were boxed up.

The TG13 E actuator was removed and replaced by new one as there was problem of hunting. The coupling sleeve was also replaced by new one.

The governing valve was removed for inspection and it was observed that the spindle was having bend as a result of which there was no free movement of the valve. The governing valve and spindle assembly was replaced by new one.

The turbine was taken for a slow roll. The speed was increased by 1000 RPM, maintained for 5-10 min. Then reduced by 500 RPM and maintained for 5-10 min. This procedure ensured proper lapping of the carbon rings. The turbine tripped at 5881 RPM.




**115-JAT BOTTOM HALF CASING**

**115-JA Semi lean Solution Pump:**

The pump was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. The suction strainer was cleaned.

**115-JAR Gear Box:**

All the bearings were inspected and found O.K. Both the gear as well as Pinion were inspected and found to be O.K. Gauss measurement of gear shaft and bearings carried out and found within limit. Bearing clearances and backlash were measured and found within the design range. The main oil pump drive coupling was inspected and found in good condition.

**Hydraulic Turbine 115-HT:**

The hydraulic coupling was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. Non drive end mechanical seal was replaced by new one.

**COLD CLEARANCE TOLERANCES – 115-JAT**

| Sr. No | DESCRIPTION | DESIGN | | ACTUAL | |
|---|---|---|---|---|---|
| | | MIN | MAX | | |
| 1. | RADIAL DIAFRAM SEAL STAGE 2 | .0148 | 0.0165 | 0.015 | |
| 2. | RADIAL DIAFRAM SEAL STAGE 3 | .0148 | 0.0165 | 0.015 | |
| 3. | RADIAL DIAFRAM SEAL STAGE 4 | .0148 | 0.0165 | 0.015 | |
| 4. | RADIAL DIAFRAM SEAL STAGE 5 | .0148 | 0.0165 | 0.015 | |
| 5. | RADIAL DIAFRAM SEAL STAGE 6 | .0148 | 0.0165 | 0.015 | |
| 6. | CARBON RING DIAMETRAL | .0070 | 0.0085 | STM. END | EXT. END |
| | | | | 0.007 | 0.007 |
| 7. | JOURNAL BEARING DIAMETRAL | .0035 | .0080 | STM. END | EXT. END |
| | | | | 0.010 | 0.011 |
| 8. | TRIP PIN/ PLUNGER | .0620 | .0650 | 0.062 | |
| 9. | AXIAL BEARING HOUSING SEAL, STEAM END | .0300 | .0400 | 0.004 | |
| 10 | AXIAL BEARING HOUSING SEAL, EXHAUST END INBOARD | .0400 | .0500 | 0.004 | |
| 11. | AXIAL BEARING HOUSING SEAL, EXHAUST END OUTBOARD | .0800 | .0900 | 0.008 | |
| 12. | NOZZLE RING, AXIAL | .0500 | .0720 | 0.065 | |
| 13. | BUCKET HOLDER, AXIAL (INLET) | .0500 | .0900 | 0.078 | |
| 14. | BUCKET HOLDER , AXIAL (OUTLET) | .0700 | .1050 | 0.097 | |
| 15. | RADIAL , DISK (ROW 6 ) | .0580 | .0680 | 0.061 | |
| 16. | DIAFRAM , AXIAL (ROW 6 ) | .0840 | .1140 | 0.101 | |

| | | | | |
|---|---|---|---|---|
| 17. | DIAFRAM , AXIAL (ROW 2) | .0520 | .0820 | 0.007 |
| 18. | DIAFRAM , AXIAL (ROW 3) | .0520 | .0820 | 0.006 |
| 19. | DIAFRAM , AXIAL (ROW 4) | .0520 | .0820 | 0.007 |
| 20. | DIAFRAM , AXIAL (ROW 5) | .0520 | .0820 | 0.007 |
| 21. | MAGNETIC IMPULSE SPEED PICK – UP AIR GAP | 0.0200 | .0250 | **** |
| 22. | END THRUST | 0.010 | 0.012 | 0.010 |

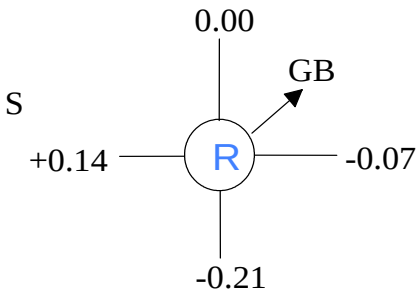
**CLEARANCE RECORD: 115-JA**

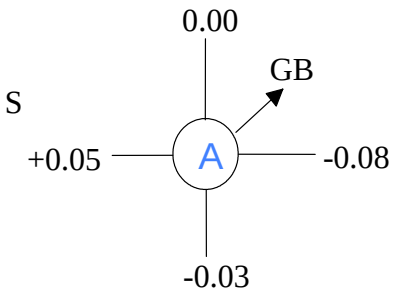
| Description | Design Clearances ( Inch ) | Before ( Inch ) | After ( Inch ) |
|---|---|---|---|
| **Journal bearing** (Thrust end ) | 0.005-0.0098 | 0.0078 | 0.0078 |
| **Journal bearing** (Non thrust end ) | 0.005-0.0098 | 0.0074 | 0.0074 |
| **Axial Thrust** | 0.013 – 0.015 ( 0.35 - 0.40 mm) | 0.010 | 0.010 |

**CLEARANCE CHART: 115-HT**

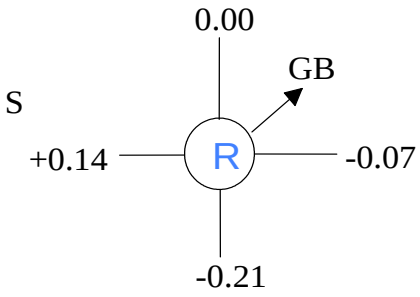
| Description | Design Clearances ( Inch ) | Before ( Inch ) | After ( Inch ) |
|---|---|---|---|
| Thrust end bearing | 0.0048-0.0058 | 0.006 | 0.006 |
| Opp Thrust end bearing | 0.0048-0.0058 | 0.006 | 0.006 |
| Axial Thrust | 0.010-0.011 | 0.012 | 0.011 |

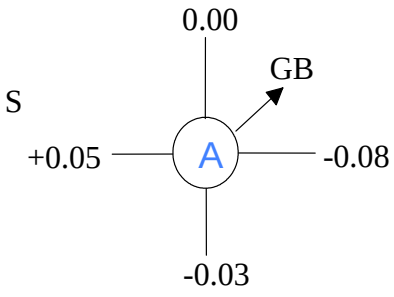
**Alignment: 115-JAT to 115-GB (BEFORE) in mm**



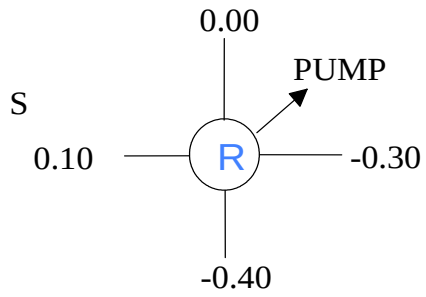



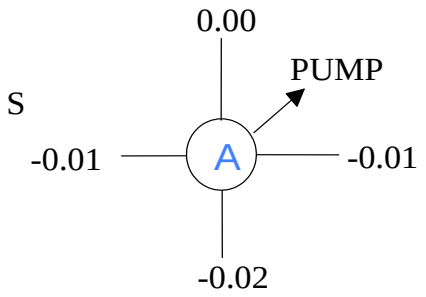

**Alignment: 115-JAT to 115-GB (AFTER) in mm**



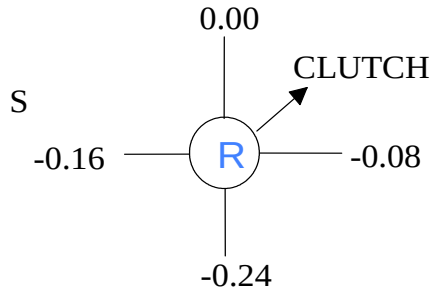



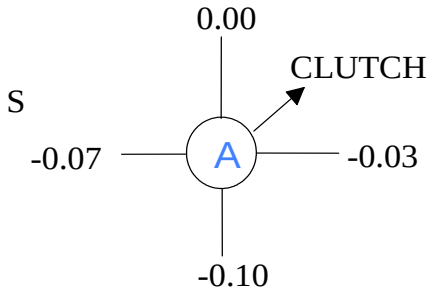
**Alignment: 115-GB to 115-JA in "mm"**



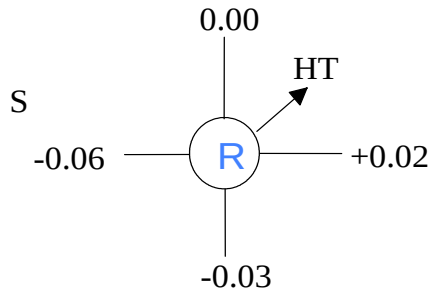



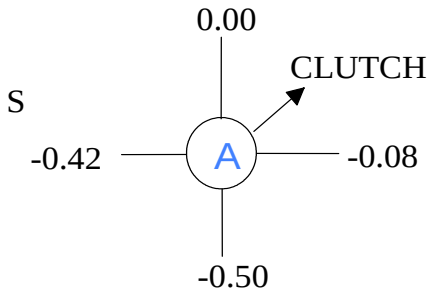

**Alignment: 115-JA to CLUTCH in "mm"**




**Alignment: CLUTCH to 115-HT in "mm"**




**SEMILEAN SOLUTION PUMP115-JB TRAIN:**

**PREVENTIVE MAINTENANCE of SEMILEAN PUMP 115-JB**

The pump was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. The suction strainer was cleaned. The mechanical seal flushing line strainer was cleaned.

**115-JBT Drive Steam Turbine:**

The turbine was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. The TG 13E actuator was opened and flushed with oil. The actuators coupling sleeve whose MOC is EPDM was found to be having cracks. Hence this was replaced by new one. The filter was cleaned and boxed up. New oil SERVO ULTRA 40 was filled.

**115-JBR Gear Box:**

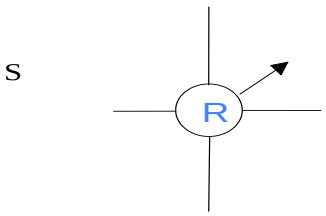
All the bearings were inspected and found O.K. Both the gear as well as Pinion were inspected and found to be O.K. Gauss measurement of gear shaft and bearings carried

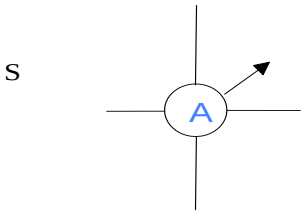
out and found within limit. Bearing clearances and backlash were measured and found within the design range. The main oil pump drive coupling was inspected and found in god condition

| CLEARANCE RECORDS – 115-JB | | | |
|---|---|---|---|
| **Description** | **Design Clearances ( Inch )** | **Before** | **After** |
| Thrust end bearing | 0.005-0.0098 (0.217-0.249mm) | 0.007 | 0.007 |
| Opp Thrust end bearing | --- do--- | 0.008 | 0.008 |
| Axial Thrust | 0.013 – 0.015 ( 0.35 - 0.40 mm) | 0.015 | 0.015 |

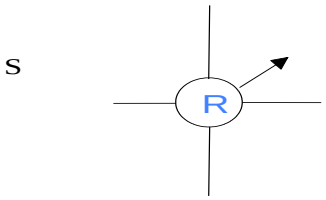
| CLEARANCE RECORDS – 115-JBT | | | | |
|---|---|---|---|---|
| Axial Thrust | | 0.010 – 0.012 | 0.011 | 0.011 |
| Coupling side bearing | | 0.0055-0.008 | 0.007 | 0.008 |
| Governor side bearing | | -- do -- | 0.008 | 0.008 |
| **Oil Guard** Coupling side (inboard) | Radial | 0.0100-0.0125 | 0.01 | 0.01 |
| | Axial | 0.040-0.050 | 0.06 | 0.05 |
| **Oil Guard** Coupling side (outboard) | Radial | 0.0100-0.0125 | 0.013 | 0.012 |
| | Axial | 0.080-0.090 | 0.09 | 0.09 |
| **Oil Guard** Governor side | Radial | 0.0100-0.0125 | 0.013 | 0.013 |
| | Axial | 0.030-0.040 | 0.04 | 0.04 |

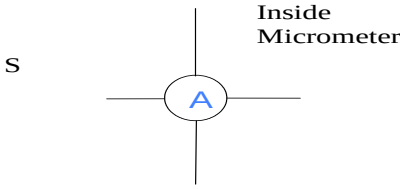
**ALIGNMENT READINGS - 115-JBT to 115-GB**




**ALIGNMENT READINGS - 115-GB to 115-JB**




**BOILER FEED WATER PUMP, TRAIN 104-JA:**

**104-JA Boiler Feed Water Pump:**

Both ends journal bearing sleeves were visually inspected and dye penetration tested and found OK. The bearing clearance were measured and found within design range. Magnetism level of the bearings was carried out and found within desired value. The main oil console and its console along with the filters were cleaned and installed. The seal flushing fluid coolers and strainers were cleaned. Spare refurbished ARV/NRV was

installed. The coupling end mechanical seal was having leakage and hence the same was replaced by new one.

**104-JAT Drive Turbine:**

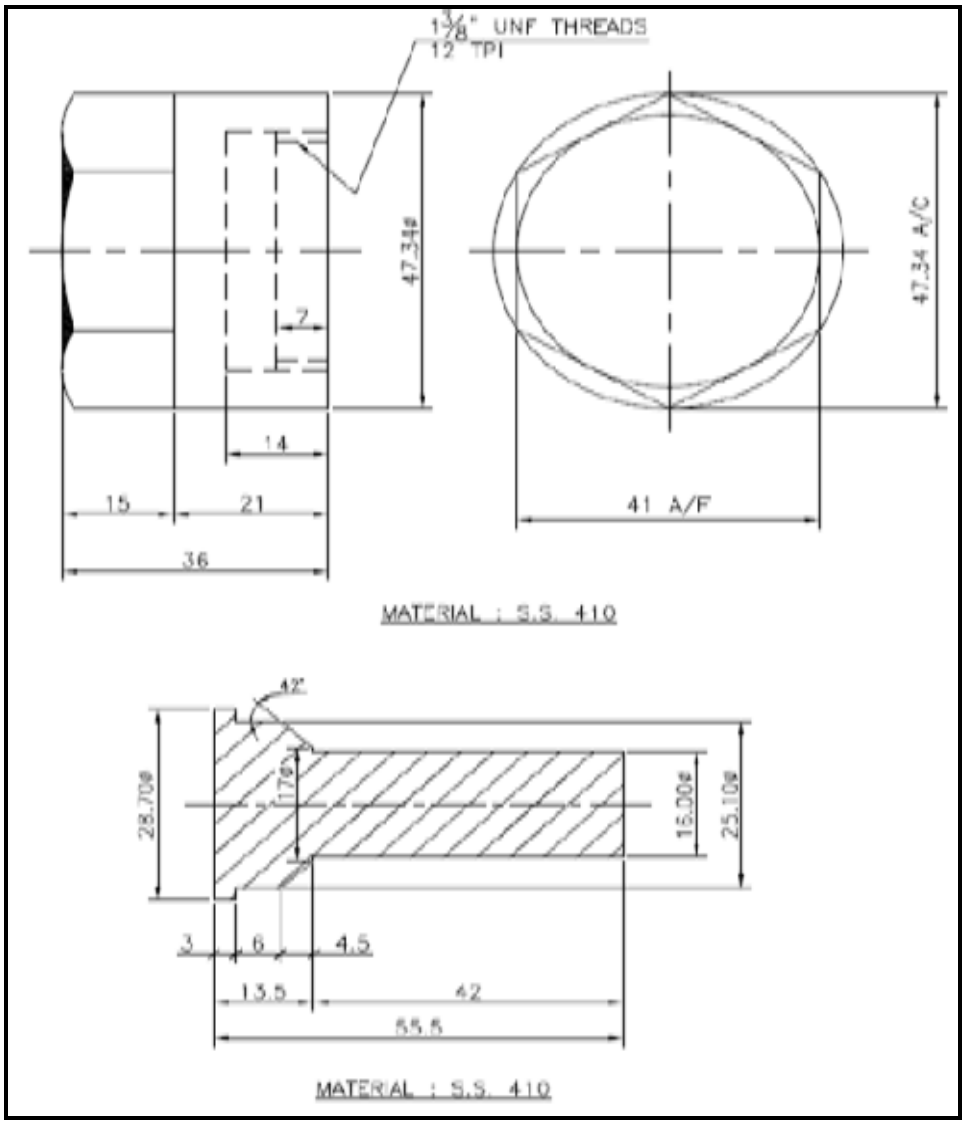
The turbine was taken for preventive maintenance and installation of new electronic trip system.

Removal of existing system: The following components of the old trip system were removed

Dwg. No 88953 E : Valve Butterfly (94) Plate spring Adj. (101), Pin cotter (102), Spindle emergency valve (95), Pin taper (100), Spring emergency valve (99), Ring, Emergency trip (97), Lever, Emergency Reset(98), Box stuffing(87), Packing QP(89), Follower packing nut(90), Nut packing(91) Screw ring bearing (96), Bracket emergency valve (92) Screw Fillister HD (93) Rod connecting (151), Latch, Dump valve (150), Spring Conn. Rod. (152) , Lock nut (153) , Nut Dump valve (147) , Spring latch (148), Bushing dump valve (145), Pin valve lever (149), Spring dump valve (144), Extention valve (143), Body dump valve (141), Stem dump valve (142),Valve dump (146)

Dwg. NO 85739D: All components

Plugging: The opening created due to removal of the spindle emergenmcy was plugged by in-house manufactured gland follower cum dummy spindle and nut as shown below:



## GLAND FOLLOWER CUM DUMMY SPINDLE NUT

Installation of new Trip Mechanism: The new Trip mechanism procured against PO NO. 201004120551 was installed on the inlet flange of the turbine as shown in the sketch:


**OLD SYSTEM**


**NEW SYSTEM**

One No toothed wheel was installed behind the coupling hub and bracket for MPU were installed on the bearing housing. The new trip valve, MPUs were hooked up with the DCS and programmed for tripping of the turbine with low lube oil pressure, over speed, Remote Panel & Local trip.

During start up, when over speed trip check was being carried out, the turbine accelerated at a very high rate and the vibration level increased to a very high level. Hence it was decided to check the bearings before restarting. The bearings were reopened and inspected and found to be satisfactory. The turbine was taken for slow roll, but noise from the turbine was heard. Hence it was decided to stop the turbine and open the turbine for overhauling.

The exhaust piping was locked using crane and the exhaust bellow was removed. The top casing was removed and the following were the observations:

- The top diaphragms were found loose.
- The 1st stage wheel had become free (Thermal shock) on the rotor.
- The inter stage labyrinth clearances were on higher side of the allowable range.
- The diaphragms were of Triveni make.

Spare diaphragms (OEM) were issued from the store and they were also found to be in very bad condition. Spare labyrinths (OEM) were issued from the store, but, they were not interchangeable with that of the Triveni make diaphragms. Hence it was decided to use the same Triveni make diaphragms and labyrinths after proper cleaning.

The rotor was removed and spare refurbished rotor was issued from store. The spare rotor was dimensionally checked and discrepancies were observed in the position of the thrust collar with respect to the first wheel. As a result of this the end thrust and the nozzle clearance s could not be achieved.

Hence another spare refurbished rotror was issued from the store and cleaned with condensate. The above problem was also found with this rotor. But it was decided to use this rotor as its condition was found to be in comparative good condition.

The inboard side thrust collar position was maintained at a distance of 7.126” from the first wheel by placing a washer of desired thickness in between the thrust collar and the deflector. The distance between the two collars was maintained at 3.874” by providing shims in between. The bottom diaphragms were installed inside the casing. The rotor was placed and the nozzle clearance, total float and the end thrust were measured and found to be satisfactory. The same bearings were used and new carbon rings were installed. The top diaphragms were placed inside and the top casing was installed and tightened. The exhaust bellow was installed and the exhaust piping was unlocked.

The turbine was taken for a slow roll by opening the steam inlet bypass valve. The speed was increased by 1000 RPM and maintained for 5-10 min. Then reduced by 500 RPM and maintained for 5-10 min. This procedure ensured proper lapping of the carbon rings. The turbine tripped at 4140 RPM.

The coupling flexible elements were found to be damaged and hence the same were replaced by new one. The DBSE was adjusted as per the drawing while installing the coupling hubs.

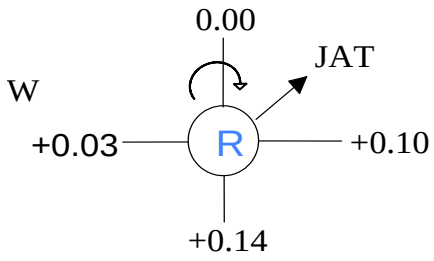
**FINAL CLEARANCES: 104-JAT**

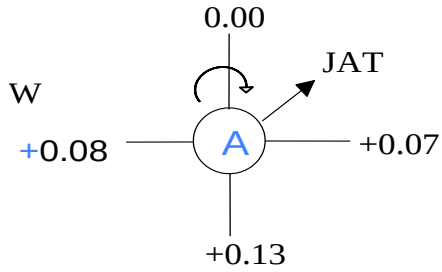
- DE Journal bearing Clearance: 0.16 mm
- NDE Journal bearing Clearance: 0.20 mm
- Axial thrust: 0.35 mm
- Total float: 3.0 mm
- Nozzle clearance: 1.35 mm

**CLEARANCE CHART: 104-JA**

| Description | Design Clearance (Inch) | Before PM (Inch) | After PM (Inch) |
|---|---|---|---|
| **104 JA** | | | |
| **Journal bearing** (Thrust end bearing) | 0.006 - 0.008 | 0.005 | 0.006 |
| **Journal bearing** (Opposite thrust end ) | 0.006 - 0.008 | 0.006 | 0.006 |
| Axial Thrust | 0.014 | 0.009 | 0.010 |

**ALIGNMENT: 104-JAT to 104-JA**




**a-MDEA PUMP 107-J Train:**

**107-JT Drive Turbine:**

The turbine was decoupled and the coupling was inspected and DBSE were noted. Turbine (107-JT) front, rear bearings and thrust pads were thoroughly polished & dimensionally checked and found to be within limits. DP tests were carried out and no damages found. Magnetism level of all bearings was found to be within limit. Clearances were measure and found to be within limit.

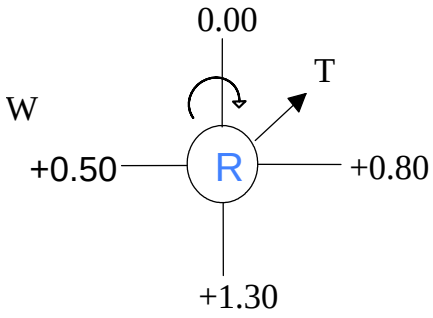
**107-J aMDEA Pump:**

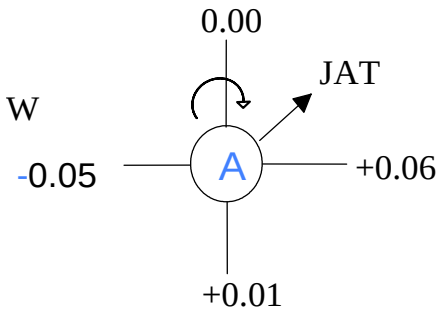
Pump was taken to replace the broken oil ring of the coupling end bearing. It was also decided to replace the mechanical seal mating rings and their packing. The pumps coupling hub was removed bay heating with gas torch up to 180 Deg. C. The bearing and its housing removed after supporting the shaft. The oil ring was found to be having a crack and hence the same was replaced by new one. New bearing was installed. The mechanical seals mating rings and their packing along with packing of the gland plate were also replaced by new one. Coupling hub was reinstalled by heating up to 180 Deg. C in oil bath. Alignment between Turbine & Pump done and turbine was coupled with pump.

**CLEARANCE CHART: 107-JT (MURRY TURBINE)**

| Description | Design Clearance (Inch) | Before PM (Inch) | After PM (Inch) |
|---|---|---|---|
| **Journal bearing** Thrust end | 0.004 – 0.006 | 0.060 | 0.060 |
| **Oil Guard** Thrust end - Inboard | 0.011” – 0.017” | 0.009 | 0.010 |
| **Journal bearing** Opposite thrust end | 0.004 – 0.006 | 0.007 | 0.007 |
| **Oil Guard** Opposite thrust end - Inboard | 0.011” – 0.017” | 0.013 | 0.013 |
| **Axial Thrust** | 0.007 – 0.013 | 0.011 | 0.011 |

**107-JT to 107-J (After PM) in "mm"**




**116-JAT Drive Steam Turbine:**

The turbine was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. The TG 13E actuator was opened and flushed with oil. The actuators coupling sleeve was replaced by new one. The actuator filter was cleaned and boxed up. New oil SERVO ULTRA 40 was filled. The non drive end bottom bearing white metal lining had peeled off and hence the complete bearing was replaced by new one

| LOCATION | DESCRIPTION | DESIGN (INCH) | ACTUAL (INCH) |
|---|---|---|---|
| **DE** | Journal Bearing clearance - Diametrical | 0.006-0.009 | 0.009 |
| **NDE** | Journal Bearing clearance - Diametrical | 0.006-0.009 | 0.008 |
| **F** | Trip pin – Plunger clearance | 0.062 | 0.062 |

**RECIPROCATING $CO_2$ GAS COMPRESSOR TRAIN (117-J)**

**LP Cylinders Overhauling:**

The end clearance at TDC and BDC were measured and opened the head of both cylinders to remove the piston assembly. The cylinder liners were inspected and found OK. The same piston assembly of both the cylinders was reinstalled after replacing the seal rings. Spare refurbished gas packings were reinstalled on both the cylinders. All the valve assemblies were reconditioned.

**HP Cylinders Overhauling:**

The end clearance at TDC and BDC were measured and opened the head of both cylinders to remove the piston assembly. The Kalol side cylinder assembly was replaced just before the shutdown; the same was reinstalled with new seal rings. New gas packing was installed for this cylinder. The Ahmedabad side piston rod assembly was replaced by new one but the same gas packing was reinstalled since the same had been replaced just before shutdown. All the suction and discharge valves were replaced by spare refurbished valves. The Ahmedabad side cylinger jacket cooling water tapping threads were damaged. Hence the nipple was removed and new nipple was provided and welding was carried out.

**Crank case assembly overhauling:**

Crank case cover was opened for the inspection of the bearings and other internals. Clearances of all the big end bearings were found on higher side and the white metal lining had worn out. These bearings were replaced by new ones. All other components

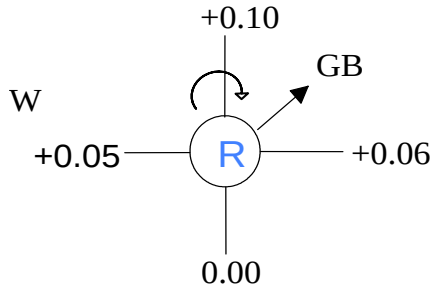
were visually inspected and found OK. All the clearances were measured and found within limit. All critical nuts were tightened at respective design torque. The AOP was run and oil flow inside the crank case was checked and found OK. The oil scrapper rings were replaced by new one.

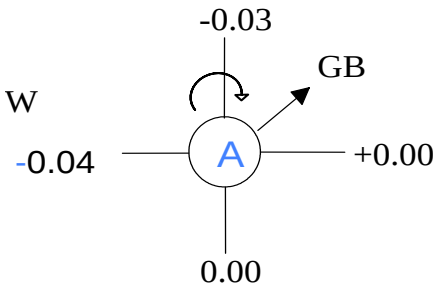
The tube bundle of the interstage cooler was pulled out and cleaned by hydro jetting. The LP and HP flow dampener were checked and found OK. The lube oil strainers were cleaned and reinstalled.

**CLEARANCE CHART: 117-J TRAIN**

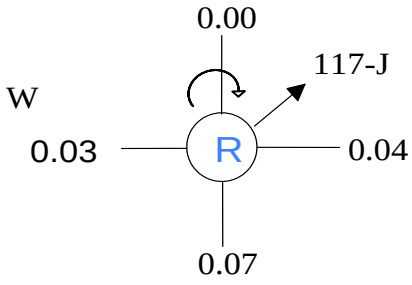
| Description | Position | | Design clearance(mm) | Before (mm) | After (mm) |
|---|---|---|---|---|---|
| **Piston end clr.** (Front /**TDC**) | LP | Urea side | 2 | 2.64 | 2.78 |
| | | Ammonia side | -- do -- | 2.40 | 2.7 |
| | HP | Urea side | -- do -- | 2.40 | 2.41 |
| | | Ammonia side | -- do -- | 2.30 | 2.40 |
| **Piston end clr.** (Intermediate /**BDC**) | LP | Urea side | 1.5 | 1.12 | 1.91 |
| | | Ammonia side | -- do -- | 1.00 | 1.90 |
| | HP | Urea side | -- do -- | 1.40 | 1.60 |
| | | Ammonia side | -- do -- | 1.30 | 1.71 |
| **Main bearing** | I | Urea side to Ammonia side | 0.08-0.15 (0.3 MAX) | | 0.14 |
| | II | | -- do -- | | 0.14 |
| | III | | -- do -- | | 0.15 |
| | IV | | -- do -- | | 0.14 |
| | V | | -- do -- | | 0.16 |
| **Big end bearing** | LP | Urea side | 0.07-0.13 (0.3 MAX) | | 0.13 |
| | | Ammonia side | -- do -- | | 0.14 |
| | HP | Urea side | -- do -- | | 0.14 |
| | | Ammonia side | -- do -- | | 0.14 |
| **Small end bearing** | LP | Urea side | 0.05-0.10 (0.2 MAX) | | 0.08 |
| | | Ammonia side | -- do -- | | 0.08 |
| | HP | Urea side | -- do -- | | 0.08 |
| | | Ammonia side | -- do -- | | 0.08 |
| **Cross head guide** | LP | Urea side | 0.18-0.26 (0.6 MAX) | | 0.20 |
| | | Ammonia side | -- do -- | | 0.20 |
| | HP | Urea side | -- do -- | | 0.20 |
| | | Ammonia side | -- do -- | | 0.20 |
| **Side clearance** (Crank shaft) | ---- | Crank shaft | 0.45-0.60 (0.9 MAX) | | 0.50 |
| **Side clearance** (Connecting rod big end) | LP | Urea side | 0.33-0.42 (0.6 MAX) | | 0.35 |
| | | Ammonia side | -- do -- | | 0.35 |
| | HP | Urea side | -- do -- | | 0.35 |
| | | Ammonia side | -- do -- | | 0.35 |

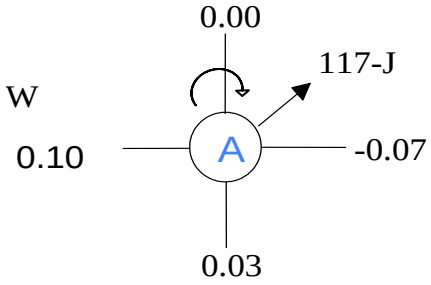
**117-JM to Gear Box - (After PM) in “mm”**




**Gear Box to 117-J - (After PM) in “mm”**




**COPPUS TURBINES:**

**103-JLOPT:**

The lube/seal oil pump drive turbines, 103-JLOPT was taken for replacement of bearings. The radial bearing i.e. deep groove ball bearing as well as the thrust bearing i.e. angular contact ball bearing were replaced by new one. The cooling water lines were flushed. The bearing oil cooler was opened and cleaned. This cooler was of typical design and hence its drawing was prepared for future action. The trip valve spindle was made free for smooth start up of the turbine.

**101/105-JLOPT:**

The lube oil pump drive turbines, was taken for replacement of bearings. The radial bearing i.e. deep groove ball bearing as well as the thrust bearing i.e angular contact ball bearing were replaced by new one. The carbon rings were replaced by new ones. The cooling water lines were flushed. The bearing oil cooling water jackets were cleaned. The trip valve spindle was made free for smooth start up of the turbine.

**112-JAT:**

The lube oil pump drive turbines, was taken for replacement of bearings. The radial bearing i.e. deep groove ball bearing as well as the thrust bearing i.e angular contact ball bearing were replaced by new one. The cooling water lines were flushed. The bearing oil cooling water jackets were cleaned. The trip valve spindle was made free for smooth start up of the turbine. All the carbon rings were replaced. The steam inlet end carbon ring housing was having cracks and hence the same were replaced.

**PRIMARY REFORMER, AUX. BOILER, TRANSFER LINE & SECONDARY REFORMER JOBS.**

In **Primary Reformer radiant section**, the following major jobs were carried out:

**The Primary Reformer Radiant Zone’s**

Burner blocks were inspected and twenty six damaged burner blocks were replaced by new indegenised, Unifrax make, Model: Moldafrax BBM 15 burner blocks at following location.

| Row No. | Burner Nos. |
|---|---|
| 1 | 102, 105, 108, 109, 111,113 |
| 2 | 202, 204, 207, 208, 209 |
| 3 | 305, 306, 313 |
| 4 | 412, 413 |
| 5 | 507,511 |
| 6 | 603 |
| 7 | 711 |
| 8 | 804, 810, 814 |
| 9 | 903, 910, 913 |

The roof insulations were inspected and damaged ones were replaced by new ones.

Gaps in side wall Z-module were observed at several locations at peephole elevation and the same were rectified/repaired. However, side wall insulation at other location was intact & in satisfactory condition.

Damaged header insulation were replaced/ repaired.

AUS of reformer tubes were carried out by Inspection section through M/s PDIL.

Damaged manhole cover frame (silo side) was repaired & new refractory casting of the same was done.

All burners air resistors were checked for free operation.

Preventive maintenance of all Tunnel Burners was carried out.


**NEW BURNER BLOCKS**

**<u>The Primary Reformer Convection Zone's</u>**

"Cercoat ZL" coating which was applied on eroded surface of Z section modules during Annual Turnaround-2012 was found intact.

New ceramic Z section modules were found to be having erosion on the protective coating. New layer of "Cercoat ZL" was provided on damaged areas by the Civil Section using brush.

The LT and HT end panel walls were opened for external cleaning of the coils.

Damaged bottom panel cover of HT section was repaired. HT coils & LT coils were cleaned by air & hydrojetting respectively. HT & LT panels were boxed up with new gasket.

The transfer line end cover was opened for inspection and the line's cooling water jacket leak was repaired.

**The Aux. Boiler**

Burners were taken for preventive maintenance. All burners' oil was flushed. The air resistors were made free.

The man hole was opened for inspection/repair of the refractory.

Damaged refractory was repaired.

Silo side, one of the panels, which was showing hot spot, was removed after removing the external sparger pipes. Its refractory was re-casted and the panel was reinstalled.

**The Secondary Reformer**

Bottom cover was opened for inspection. Minor damage of refractory was observed and the same was repaired. Refractory material lying in pipe line towards 101-CA side was removed (partially up to the approachable distance). Bottom cover boxed up with new gasket.

Top cover with Air distributer was opened & removed. Refractory of Air distributer was found peeled off. Also, erosion/corrosion was observed (shown in fig.) in the Air distributer nozzle. Air distributer was replaced by spare distributer. Damaged refractory (Cracks & peeled off) was repaired. Top cover with Air distributer boxed up with new gasket.

**103-D NOZZLE**

## HEAT EXCHANGERS AND COOLER JOBS

### 110-CA/CB Replacement:

110CA/CB were replaced by new complete AISI SS 316 exchanger. This exchanger was procured from M/s Aerotherm Pvt. Ltd, Ahmedabad vide PO No 20110603. As part of the pre shutdown activity, all flange bolts had been individually roused to facilitate removal of the exchanger during the shutdown. All connecting pipings were supported by new reinforcements before shutdown. The following activities were carried out for the replacement during shutdown.

- Removed shell side inlet line after cutting the common 30" SS line by grinding.
- Removed other pipes connected to the exchangers.
- Removed both exchangers from its position by using Crane.
- New exchanges were installed in their position
- Nozzles of new exchangers were not matching with the existing piping. Therefore, minor modifications were carried out in Gas outlet, cooling water outlet & interconnecting piping to match the respective nozzles of the new exchangers.
- Shell side inlet line was fixed back in position and welded by TIG welding.

### 112-C North side channel cover leak:

The channel cover was removed and minor dents were observed on the shell flange. The same were repaired by welding/grinding/filing. Heavy damage was observed on the channel flange. Hence the same was taken to M/s Ambica Udyog, Odhav, Kathwada, and Ahmedabad where it was machined to remove the damages. New gasket was installed and the channel cover was boxed up. New fasteners were used.
New insulation was provided on complete exchanger after external cleaning and painting.

### 103-C East side channel cover leak:

East side channel cover was opened & removed. Gasket seating areas of channel cover & shell were cleaned properly and boxed up with new 5-Cr, 1/2 Mo jacketed grafoil gasket.

### 114-C North side channel cover leak

North side channel cover was opened & removed. Gasket seating areas of channel cover & shell were cleaned properly and boxed up with new gasket & complete set of new fasteners.

### 116-C South side channel cover leak

South side channel cover was opened & removed. Gasket seating areas of channel cover & shell were cleaned properly and boxed up with new gasket.

### 171-C Channel cover leak

Channel cover of 107C leaked during start-up. Tube Bundle was pulled out for gasket replacement. It was observed that about 75% gasket seating area of shell side flange was corroded. Corroded flange was repaired by welding & grinding. Shell as well as common outlet header was filled with rasching rings, catalyst & other foreign material.

These materials were removed from shell as well as common discharge header. Tube bundle was boxed up with new gasket.

## OTHER EXCHANGERS

| EQP TAG | | TUBE SIDE (Hydro-jetting) | SHELL SIDE (Tube bundle pull out) | HYDRO TEST PR. |
|---|---|---|---|---|
| 101-BJT | LUBE OIL COOLER | **P** | | |
| 101-BJT | ACTU OIL COOLER | **P** | | |
| 101-JCA | | **P** | | |
| 101-JCA | I/A COOLER | **P** | | |
| 101-JCB | | **P** | | |
| 101-JCB | I/A COOLER | **P** | | |
| 101-JLC1 | LUBE OIL COOLER | **P** | | |
| 101-JLC2 | LUBE OIL COOLER | **P** | | |
| 101-JLC3 | LUBE OIL COOLER | **P** | | |
| 103-JLC1 | LUBE OIL COOLER | **P** | | |
| 103-JLC2 | LUBE OIL COOLER | **P** | | |
| 103-JBT | GLAND CONDENSER | **P** | **P** | **P** |
| 104-J | LUBE OIL COOLER | **P** | | |
| 104-JT | LUBE OIL COOLER | **P** | | |
| 104-JT | GOV OIL COOLER | **P** | | |
| 104-JA | LUBE OIL COOLER | **P** | | |
| 104-JAT | LUBE OIL COOLER | **P** | | |
| 104-JAT | ACTU OIL COOLER | **P** | | |
| 105-JT | GLAND CONDENSER | **P** | | |
| 105-CA | | **P** | | Water fill up only |
| 105-CB | | **P** | | |
| 107-JT | LUBE OIL COOLER | **P** | | |
| 107-JAT | LUBE OIL COOLER | **P** | | |
| 108-C1A | | **P** | | **P** |
| 108-C2A | | **P** | | **P** |
| 109-C1A | SILO SIDE | **P** | | |
| 109-C2A | SILO SIDE | **P** | | |
| 115-C | | **P** | **P** | **P** |
| 115-JALC1 | LUBE OIL COOLER | **P** | | |
| 115-JALC2 | LUBE OIL COOLER | **P** | | |
| 115-JBLC1 | LUBE OIL COOLER | **P** | | |
| 115-JBLC2 | LUBE OIL COOLER | **P** | | |
| 116-C | | | **P** | |
| 117-J | INTERCOOLER | **P** | **P** | **P** |
| 117-J | 1st STAGE COOLER | **P** | | |
| 127-CA | | **P** | | **P** |
| 127-CB | | **P** | | **P** |
| 128-C | | **P** | | |
| 129-JC | 101-J INTERCOOLER | **P** | | |
| 130-JC | 101-J INTERCOOLER | **P** | | |
| 131-JC | 101-J INTERCOOLER | **P** | **P** | |
| 173-C | | **P** | | |
| 180-C | | **P** | | |
| HE-2 | PGR | **P** | | |
| HE-4 | PGR | **P** | | |

**RELIEF VALVES OVERHAULING:**

**SAFETY RELIEF VALVES OVERHAULING & SERVICING:**

The following RVs were overhauled and serviced and tested on test bench:

| Sr. No. | RV Tag NO | Valve Size | Set Pressure ($kg/cm^2$) g |
|---|---|---|---|
| 1 | RV-101-F 1 | 2.5 x 6 (2.545) | 118.84 |
| 2 | RV-101-F 2 | 2.5 x 6 (2.545) | 117.00 |
| 3 | RV-101-F 3 | 2.5 x 6 (2.545) | 115.33 |
| 4 | RV-101-B | 3 x (3.6) x 6 | 111.8 |
| 5 | PSV-986 (107-C) | 4 x L x 6 | 45.00 |
| 6 | PSV-987 (107-C) | 4 x L x 6 | 46.3 |
| 7 | RV-104-D2 | 1.5 XF X 2 | 34.1 |
| 8 | RV-103-J | 3 x K x 4 | 158.9 |
| 9 | 103-JAT(Exhaust) | 1 G1 2 | 46.4 |
| 10 | RV-105-D | 3” x 4” | 152.9 |
| 11 | RV-105-D-A | 3 J 4 | 152.9 |
| 12 | RV-106-F | 1.5” x 2” | 158 |
| 13 | RV-102-F | 6 x R x 8 | 28.9 |
| 14 | RV-123-CA | 3 J 6 | 122.00 |
| 15 | RV-123-CB | 3 J 6 | 122.00 |
| 16 | RV-MS-9 | 4 P 6 | 43.00 |
| 17 | RV-BFW-1 | 1 1/2 G 2 1/2 | 92.2 |
| 18 | RV-112-CA | 1 1/2 H 3 | 10.5 |
| 19 | RV-112-CB | 1 1/2 H 3 | 10.5 |
| 20 | RV-170-C (Shell side) | 3 K 4 | 5.7 |
| 21 | RV-170-C (Tube side) | ¾” X 1” | 30.6 |
| 22 | RV-109-F | 6 Q 8 | 19.00 |
| 23 | RV-110-F (N) | 3 L 4 | 7.00 |
| 24 | RV-110-F (N) | 3 L 4 | 7.00 |
| 25 | RV-111-F | 4 P 6 | 6.3 |
| 26 | RV-112-F | 4 M 6 | 6.3 |
| 27 | RV 101-J | 4 M 6 | 37.00 |
| 28 | PSV-954 (115-JBT) | 8 T 10 | 0.7 |
| 29 | PSV-951 (115-JAT) | 8 T 10 | 0.7 |
| 30 | PSV-983 | 6-8 | 7.00 |
| 31 | PSV-910 | 1.5 G 3 | |
| 32 | RV-101D | 3 K 4 | 43.9 |
| 33 | RV-102-D | 3 K 4 | 43.9 |
| 34 | 2005 U inlet RV | 3 L 4 | 8.7 |

**BOILER:**

Open inspections as well as hydro test of the following boilers were successfully executed in presence of IBR inspector.

| Sr. No | Tag No. | Identification No. | Hydro test Pressure ($Kg/CM^2$ ) |
|---|---|---|---|
| 1 | 112-C | Boiler NO GT-1631 | 15.0 |
| 2 | 101-F | Boiler No. GT-1632 | 146.0 |
| 3 | 107-C | Boiler No.GT-5217 | 67.5 |

**VESSEL INSPECTION / REPAIR JOBS:**

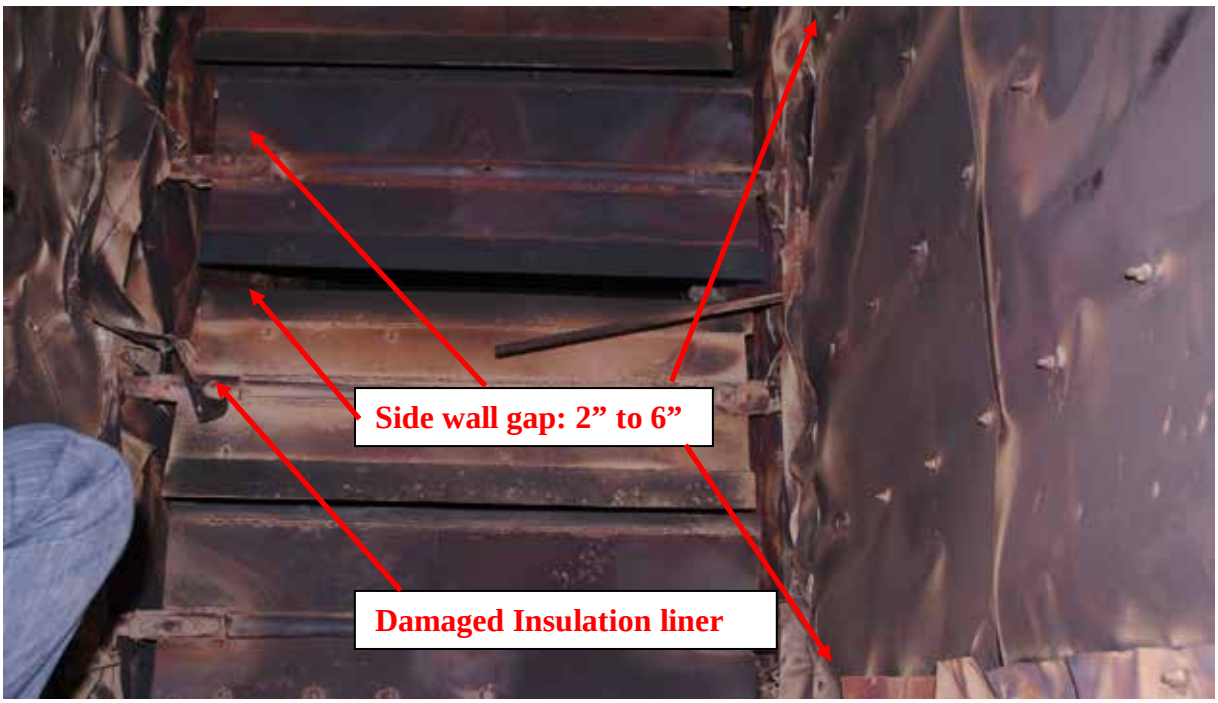
- 102F & 103-F manhole opened and boxed up for inspection. No repair was carried out.
- LP flash inspection was done & no remarkable damages were found.
- 102-EB top manhole opened and boxed up for inspection. Distributer clamp was tightened and new fasteners were provided in place of missing fasteners. Repair carried out in demister pad support strip and rod. Loose bolts were tightened. Manhole boxed up with new gasket after proper cleaning.
- 107-D end cover opened and boxed up for inspection. No repair was carried out.

**FABRICATION JOBS**

- PRC-23 damper repair :

  Presence of excess air was reported in exhaust flue gas with PRC-23 damper in almost 100% closed condition.

  Manhole cover of PRC-23 was opened for the inspection of damper. Both side wall gaps were found more and varying from 4" to 6". These gaps were reduced ( 1.5"- North side, 2"- South side) by welding 6mm thk Incolloy plate. Stiffeners were also welded behind the new plate for strengthening as the existing blade thickness is 20 mm.
- Damper nearby Incolloy liner of side wall insulation was found detached & bend the same were repaired.




**PRC-23 DAMPER**

- Modification in aMDEA line from 107-J discharge to 115-J/HT mechanical seal flushing fluid.
- 104-JAT lube oil cooler was of under capacity as a result of which oil outlet temperature remained high at 60 deg. C. Hence this cooler was replaced by new higher capacity cooler (P-1102- A/B -WORTHINGTON).
- 101-CA/CB & 103-D cooling water jacket inlet line piston type check valves were damaged and hence were replaced by new swing type check valves.
- The 8" X 600 # BW, 104-JT inlet valve was replaced by new 8" X 900 # Flanged End valve. 1 ½" bypass line was also provided. Blowing of the line was carried out before final installation.
- The threaded bonnet type ¾" X 1500 # drain valve of 120-C was replaced by new welded bonnet gate valve.
- 101-U overflow line control valve was not having any isolation valve. A new 8" X 150 # FE isolation valve was provided.
- A portion of 116-JA/JB suction line ( from reducer to Pump's suction ) having 12" NB X Sch.20 ERW pipe was replaced by new 12"NB X Sch.20, ASTM A 105 seamless pipe. This was done since seepage of aMDEA was observed at various locations during the running plant.
- 115-JAT/JBT common exhaust valve (24" X 150 # rubber lined butterfly valve, FE) was removed along with the flanges and spool piece was provided.
- 103-D cooling water jacket was cut (1 m X 1m) on north side for inspection of the shell. Post inspection the cut portion was re-welded.
- MICV 12 bypass valves (1-1/2" X 1500#- 02 Nos) were passing and hence were replaced by new one and a fig 8 blind was also provided as per production dept. requirement.
- The corroded portion of the B-4 outlet tailgas line of PGR was replaced by new one.
- 107-J/JA train CW lines in-between pump/turbine & monorail were obstructing during removal of the equipments and hence they were rerouted to top of monorail.
- Stripper 102-EB's rupture disc downstream line was extended to avoid unsafe spillage of aMDEA.
- Hanging arrangement for 110/111/112 F manhole were provided for easy removal and reinstallation of the manhole covers.
- FRC-2 block valve platform was corroded and hence repaired.
- 101/105-J TTV leak-off line to drain was extended to ground level.
- Beam was provided for easy removal and reinstallation of PC-2A/B.
- Corroded pipings over condensate drain pot near 101-C, were replaced by new ones.
- Modification of monkey ladder of HE-2 platform was carried out to make it safe to work on the platform.
- 101-JCA Radar type level bottom inlet re-routing was done as per production dept. requirement.
- A portion of pipe having pin hole leak at the down stream of LC-3A was replaced.

- A portion of pipe having pin hole leak on 101-F CBD line to 156-F, near PO4 dosing tank was replaced.
- 105-JT exhaust RV downstream spool piece having pin hole was repaired.
- 115-JA Pump flushing fluid (D.M. water) line leak from weld joint.
- Lean aMDEA to absorber welding pin hole leak.
- Dead line of NG near PIC-1A above ground level to be removed.
- B3A new modified BFW line pin hole leak
- The following passing traps and valves which had less than 2" NB and had problems like gland leak, passing, bonnet leak etc were replaced by new ones.
  - Ø 11 ata. atomizing steam line vent isolation valve.
  - Ø Steam to ARU TX HP tapping root isolation valve.
  - Ø PRC-18 down stream PI root isolation valve.
  - Ø Plant air line near 136-C pillar service point valve.
  - Ø PIC-006B upstream isolation valve.
  - Ø E-2 upstream separator drain 1$^{st}$ & 2$^{nd}$ isolation valve.
  - Ø 107-JAT steam inlet line trap.
  - Ø 105-JT exhaust RV downstream spool piece hole to be repaired.
  - Ø 170-C bypass line isolation valve down stream pipe replacement (Thickness reduced) 4" line.
  - Ø 115-JAT steam inlet line drain valve
  - Ø 101-U new tapping for level troll.
  - Ø 102-D Inlet isolation downstream drain valve.
  - Ø 103-JAT inlet drain valve.
  - Ø 107-C BFW inlet line vent valve.
  - Ø 117-J discharge line drain valve.
  - Ø 101-BJT inlets drain valve.
  - Ø PRC-18 down stream PI isolation valve.
  - Ø Steam to ARV TX HP tapping root inlet valve.
  - Ø FR-501 TX LP tapping root isolation valve.
  - Ø 11 ata atomizing steam line vent isolation valve.
  - Ø 11 kg steam header new steam trap isolation valve above 108-J.
  - Ø MIC-22 jump over line HS side drain valve.
  - Ø FR-501 TX LP tapping root isolation valve.
  - Ø 173-C trap.
  - Ø 103-JLJT isolation drain valve.

## VALVE GLAND REPACKING JOBS:

The following valve's gland packings were replaced by new ones.

- 107-C low level switch top isolation valve.
- 102-D local vent valve.
- USV-933 bypass valve.
- Receiving ammonia valve to 107-F.
- 102-F to 104-E flow meter down stream isolation valve.
- LSL-487 switch top isolation valve.
- MIV-8 bypass isolation valve.
- Utility BFW coil inlet isolation bypass valve.
- Utility BFW inlet line drain second isolation valve.
- PIC-14 u/s isolation valve.
- Raw water utility point isolation valve near 108-J.
- 171-C steam inlet isolation valve.
- 17-C LS inlet line 2nd isolation valve.
- Isolation valve at PIC-14 DOWN STREAM line above 108-JA.
- PIC-002 bypass isolation valve.
- 104-JAT steam inlet bypass valve.
- 101-B 3.5 kg utility header drain valve.
- 115-JAT steam inlet isolation valve.
- 170-CA/CB condensate outlet 1st isolation valve.

## MISCELENOUS JOBS

- 115-JAT & 115-JBT, 24"X150# rubber lined butterfly type exhaust valve's rubber lining had peeled off and hence was replaced by triple eccentric metal seated butterfly valve.
- 101-J to 103-D air inlet check valve gasket was replaced.
- FRC-2 NRV top cover was opened as high noise was observed. The hinge was found to be loose. The same was repaired.
- 101-D gas inlet valve (6"X300# Flange End) was passing and hence was replaced by new valve.
- LTS outlet 2nd isolation valve (10"X300# Flange End) was passing and hence was replaced.
- LV-503 bypass globe valve which was passing was replaced.
- 172-F LT root isolation valve down stream diaphragm valve was replaced.
- 170-J mechanical seal cooling water line's chocking was removed.
- VS-102 upstream plug valve was passing and was repaired.
- 107-JAT exhaust relief valve cooling water line broken nipple was replaced by new one.

- 107-C CBD Isolation upstream flange gasket was replaced.
- 115-JBT steam inlet 1st isolation valve up stream flange gasket was replaced.
- 115-JA discharge upstream valve drain cap leak was attended.
- FIC14 transmitter orifice HP tapping thread leak.
- Raw water isolation valve near 105-J was replaced.
- HICV 11 flange leak was attended.
- 153-C gas inlet valve u/s and down stream gasket replaced
- Urea 4 ata steam to 170-C line check valve top flange gasket replaced.
- 103-L lube oil filters were replaced.
- 101-J lube oil filters were replaced.
- C-2 vessel RV upstream flange gasket was replaced.
- C-1 vent drain choking was removed.
- 102-C chemical dosing flange gasket replacement.
- PIC-3 u/s isolation valve down stream leaking flange's gasket was replaced
- LT guard bypass valve bonnet was leaking and hence bonnet gasket was replaced.

# UREA PLANT
(MECHANICAL)

## ROTATING EQUIPMENT

In Annual Turnaround 2013, Overhauling of CO2 Compressor LP Compressor (2MCH607) & HP Compressor (2BCH306/A) (K-1801-1 & 2), Gear Box (M-1801) & Preventive Maintenance of Steam Turbine (Q-1801) was carried out in 10 Days (from 30/03/2013 to 08/04/2013) by M/s. BVL POWER SYSTEMS PVT LTD, Hyderabad against WO No. 201004131193 dated 04/02/2013.

## OVERHAULING OF $CO_2$ COMPRESSOR LP CASE (K-1801-1)

- Casing of LP Compressor was locked. Spring washer provided at all 4 nos. foundation bolts were replaced by solid washer one by one before dismantling.
- Temperature elements & Vibration probes were either disconnected or removed.
- All Nozzles disconnected from Oil supply & return headers, Seal gas supply & return headers, Vent header & piping were removed.
- Decoupled the LP casing from Turbine & Gear Box.

  Loosened the expansion joint & then removed the gasket.

  Removed upper coupling cover

  Removed all the Coupling Bolts & Nuts.

  Removed the shim liner

  Removed the spacer
- Coupling Hub face to face distance was measured with an inside micrometer & recorded. Found 737.43 mm (TB side) & 673.86 mm (OTB side) respectively.
- Alignment of LP compressor with Turbine and with Gear box was checked & recorded before dismantling.
- Removed the top bearing covers. (TB side – POS 470.01 & OTB side – POS 470.05)
- Removed the sensors by unscrewing the sensor holding bracket from bearing housing.
- Thrust Bearing End Play of rotor was measured & recorded before bearing disassembly.
- Rotor position was checked by measuring the distance between rotor end face & bearing cover end face through vernier caliper & found 91.48mm (TB side).
- Removed 4 nos. bolts & then raised the bearing shell (POS 411.03), ensuring that upper bearing housing not lifted together.
- Removed the Thrust bearing housing.

  Removed the upper oil control ring.

  Rotated the upper case ring by $45^0$ to make the split face horizontally.

  Removed the three shoes, then take out the upper base ring.

Rotated the lower base ring by 180 degrees, then removed the remaining three shoes and took out lower base ring.

Removed the remaining thrust bearing as same procedure mentioned above.

Removed the lower oil control ring.

- Removed the thrust bearing liner.
- Rotated the lower thrust bearing housing by 180 degrees, and then removed it.
- Measurement of Rotor Float was carried out.

  Axial Float of Rotor (Opposite Thrust Bearing side) without Thrust bearing pads = 2.46 mm

  Axial Float of Rotor (Thrust Bearing side) without Thrust bearing pads = 2.46 mm

  Total Float = 4.92 mm
- Disassembly of Journal bearing were carried out one by one i.e. thrust bearing side & Opposite thrust bearing side.

  Removed 4 nos. bolts & then raised the bearing shell (POS 411.04), ensuring that upper bearing housing not lifted together.

  Removed upper journal bearing housing (POS 633.00 & POS 633.04).

  Set the dial indicator on the shaft.

  Installed the eyebolt into the shaft end and lifted the shaft slowly by 0.15-0.20 mm to prevent labyrinth fins damage.

  Turned the lower bearing housing by $180^0$ & took it out.
- Unscrewed all the 12 nos. Allen bolts (Size: M12 X 35mm) of Gas seal labyrinth (POS 554.09) installed at both sides (i.e. TB side & OTB side) to make rotor free from casing top & bottom halves.
- Disassembly of Horizontal split casing was carried out as per following procedure:

  Numbering was done on all studs, circular nuts & check nuts (i.e. R1 to R24 & L1 to L24) & then check nuts removed with a 70mm size wrench & hammer from all studs.

  Applied Molybdenum to the thread part of stud and set the jacking tool assembly as per Fig A & Fig B.

  Put a spacer at the top of stud & tightened the tension rod on stud to keep the clearance between the circular nut & tension rod more than 5 mm. Placed Foot & Hydraulic Jack respectively over the tension rod. Tightened the Tension nut by the bar & after that turned back this nut by $15^0$. Then, Hydraulic Pump was operated by 5-7 Kg/cm2g air and increased the oil pressure slowly in the range of 670 – 700 Kg/cm2g. Clearance was adjusted between the piston & cylinder tube within 2-3 mm as Fig. C2. Turned back the circular nut by the help of long bar as Fig. C3.

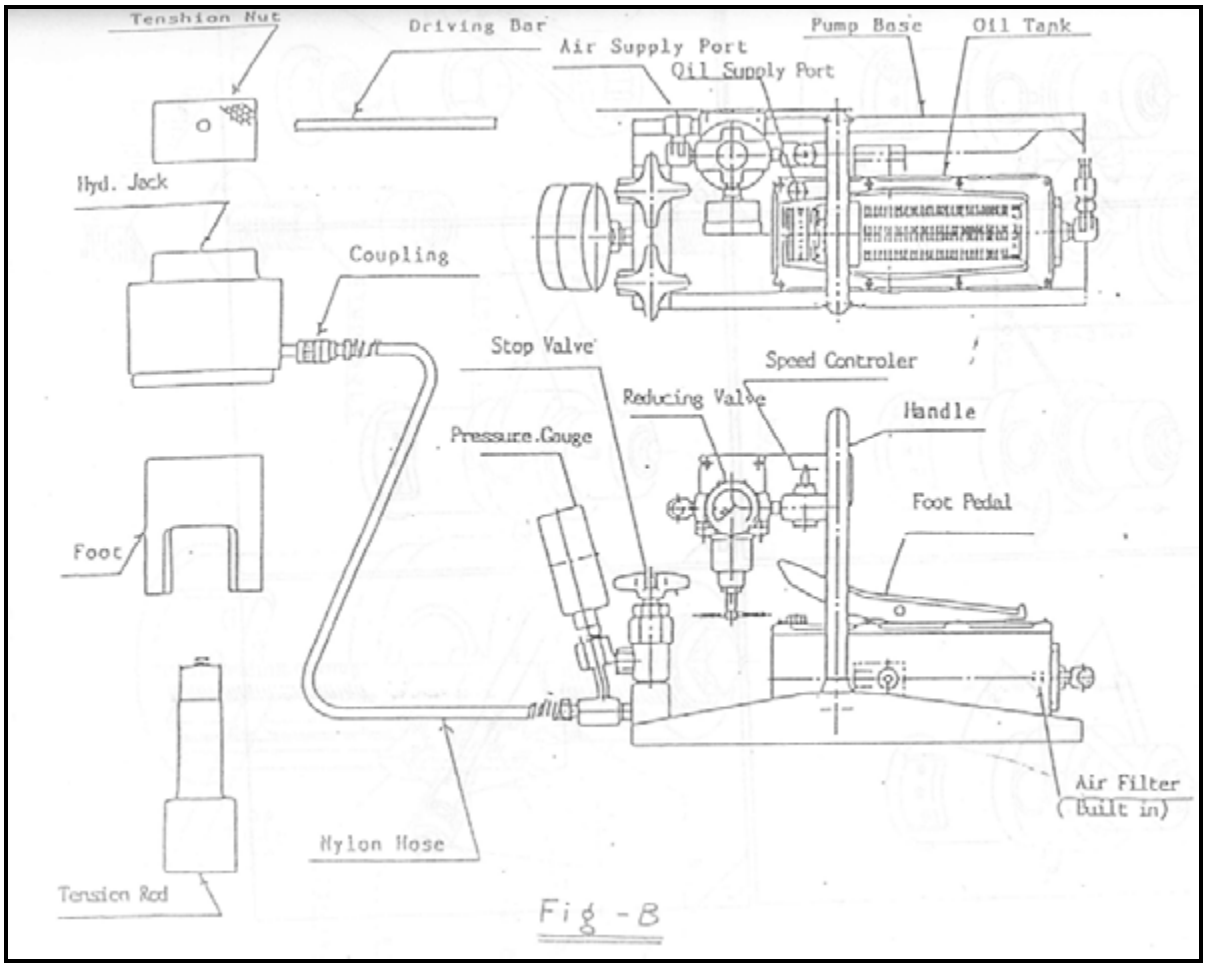
  After then stopped the hydraulic Pump & released the oil pressure slowly. Tightened the tension nut & kept zero clearance between the piston & push. Removed the Jacking Tool & set it on the next stud.

  5 Ton chain block, 10 ton slings, D-shackles used for lifting casing top half.

  Set the guide bolts over studs as specified in the sketch.

  4nos. Jack bolts inserted & tightened equally to make equal gap between top & bottom half casing.

Casing top half was lifted by the 15 tonne crane & placed properly at the ground over slippers & then reversed casing top half for cleaning.




**Lifting arrangement of top caing of LP case -1**

Lifting arrangement of top caing of LP case - 2

Lifting of top casing of LP case

- Removed top half of Gas Seal Labyrinths (POS 554.01 & POS 554.05), Oil Seal Labyrinth (POS 554.12) & Balance Labyrinth (POS 553.01).
- Run out of the Rotor was measured & found 0.01-0.04mm.
- Dismounting of both Coupling Hubs (ST side as well as GB side) were carried out.

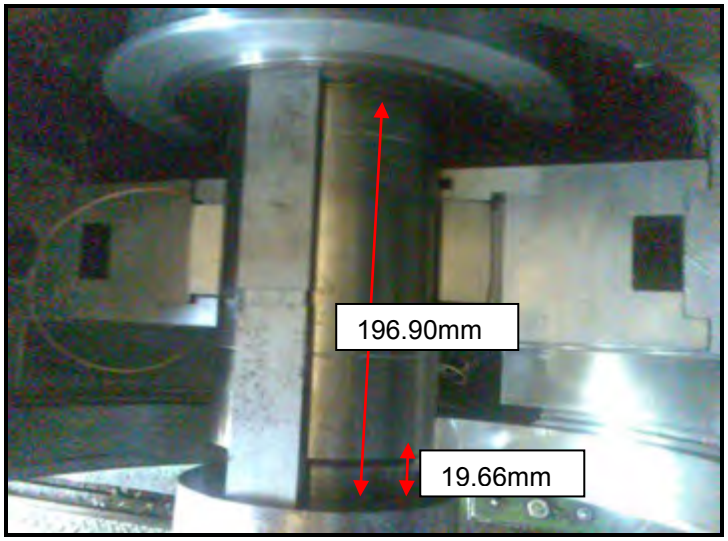
  Coupling Hubs reference position was measured by slip gauge & recorded before hub dismounting. (ST side – 19.66mm & 196.50mm, GB side – 18.75mm)

  Coupling Hub Lock Nuts (POS 110.08 & POS 110.09) removed.

  The Hydraulic Thrust Jig (Guide and Sleeve) was installed into the shaft & the Nipple Joint was tightened into the shaft slowly & firmly.

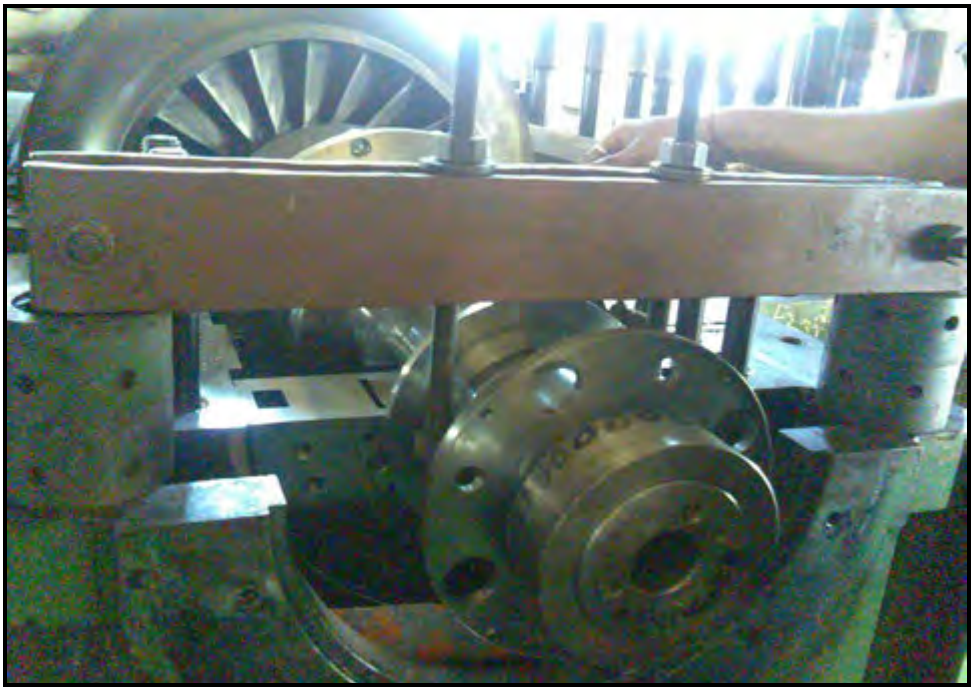
  Connected the hand operated Oil Pump Assy. to nipple joint by flexible pipe with ball nipples & tightened the flexible pipe firmly.

  Applied the expansion pressure by hand operating the oil pump & coupling hub get removed as the expansion pressure reached at 25000PSI (ST Side) & 20000PSI (GB Side).




Reference position of coupling hub ( ST side )

- Dismantled the jig & removed the coupling hubs.
- Rotor was lifted out of the casing bottom half & placed on the rotor stand.
- Removed Thrust Relay Disc (POS 110.10) by unscrewing through C Spanner & then Thrust Collar (POS 631.05) after removing Lock Nut (POS 110.07).
- Gas Seal Labyrinths removed from both sides after lifting rotor from stand slightly.
- Labyrinth clearance of bottom half was taken by inserting feeler gauge between labyrinth & rotor. (Refer Clearance sheet for readings). Clearances were found OK.
- All the Labyrinth fins were removed from casing top & bottom halves, cleaned it properly & checked its condition. No any fin damage or abnormal wear was found.
- Removed bottom half of Gas Seal Labyrinths (POS 554.01 & POS 554.05), Oil Seal Labyrinth (POS 554.12) & Balance Labyrinth (POS 553.01). Cleaned it properly & checked its condition. No any fin damage or abnormal wear was found. Dimensions taken. (Refer Clearance sheet for readings). Clearances were found OK.
- Unscrewed the Diaphragm Locking bolts & all diaphragms removed one by one by the help of chain block from casing top & bottom halves.
- Cleaning of Casing & diaphragms were carried out by Emery paper & cleaner.
- Journal bearings & Thrust bearing dismantled, cleaned properly & thickness of pads & Bearing shell ID measured.
- Measured journal dia. & calculated journal bearing clearance & recorded in clearance sheet. Clearances found within range.
- Assembled Journal bearings & Thrust Bearing.
- DP testing of all bearing pads were carried out & found no any defect.
- Gauss measurement of Casing, Diaphragms, Rotor journal dia., Journal Bearings, Thrust bearing pads & Thrust Collar was carried out & found within limit.

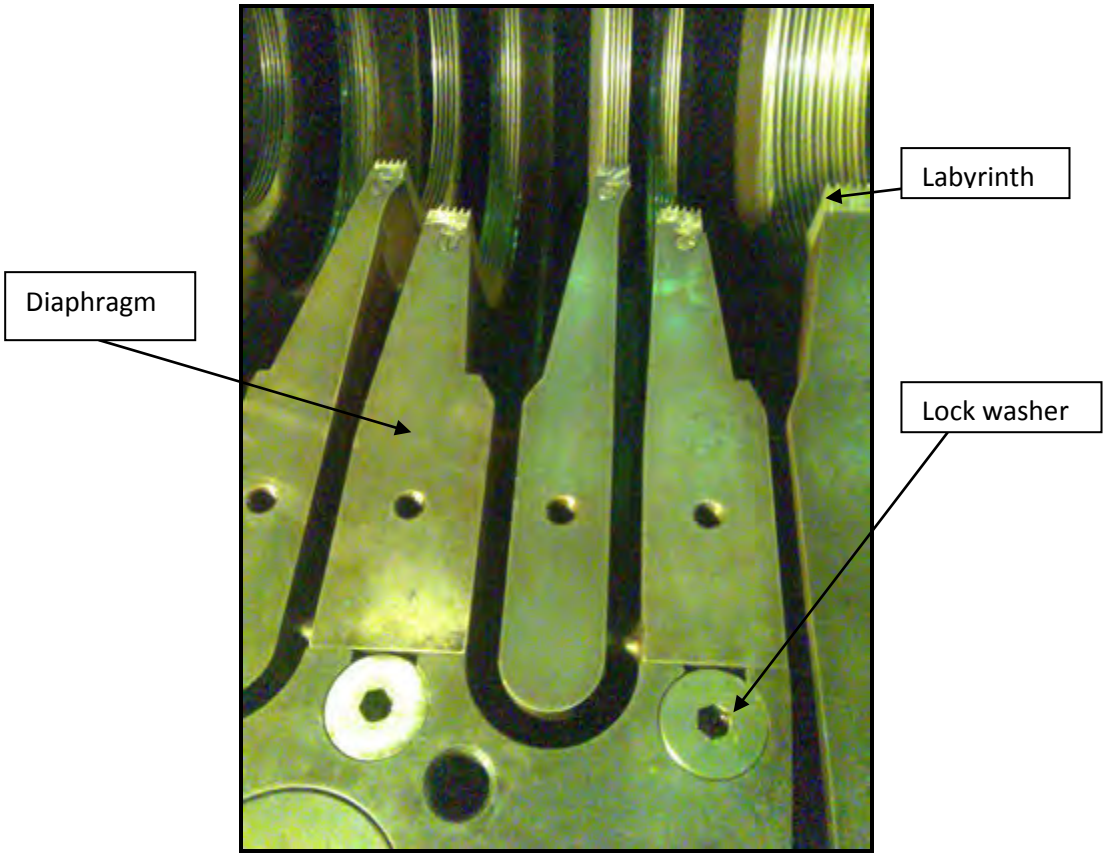


**LP Case – Gear Box Side**

**Reassembly of LP Compressor**

- Installed lower half diaphragms in the lower half casing & inserted lower half labyrinths in the grooves.
- Installed lower half bearing housings & put rotor into the lower half casing.
- Checked Labyrinth clearance again from both sides by feeler gauge. (Refer clearance sheet)

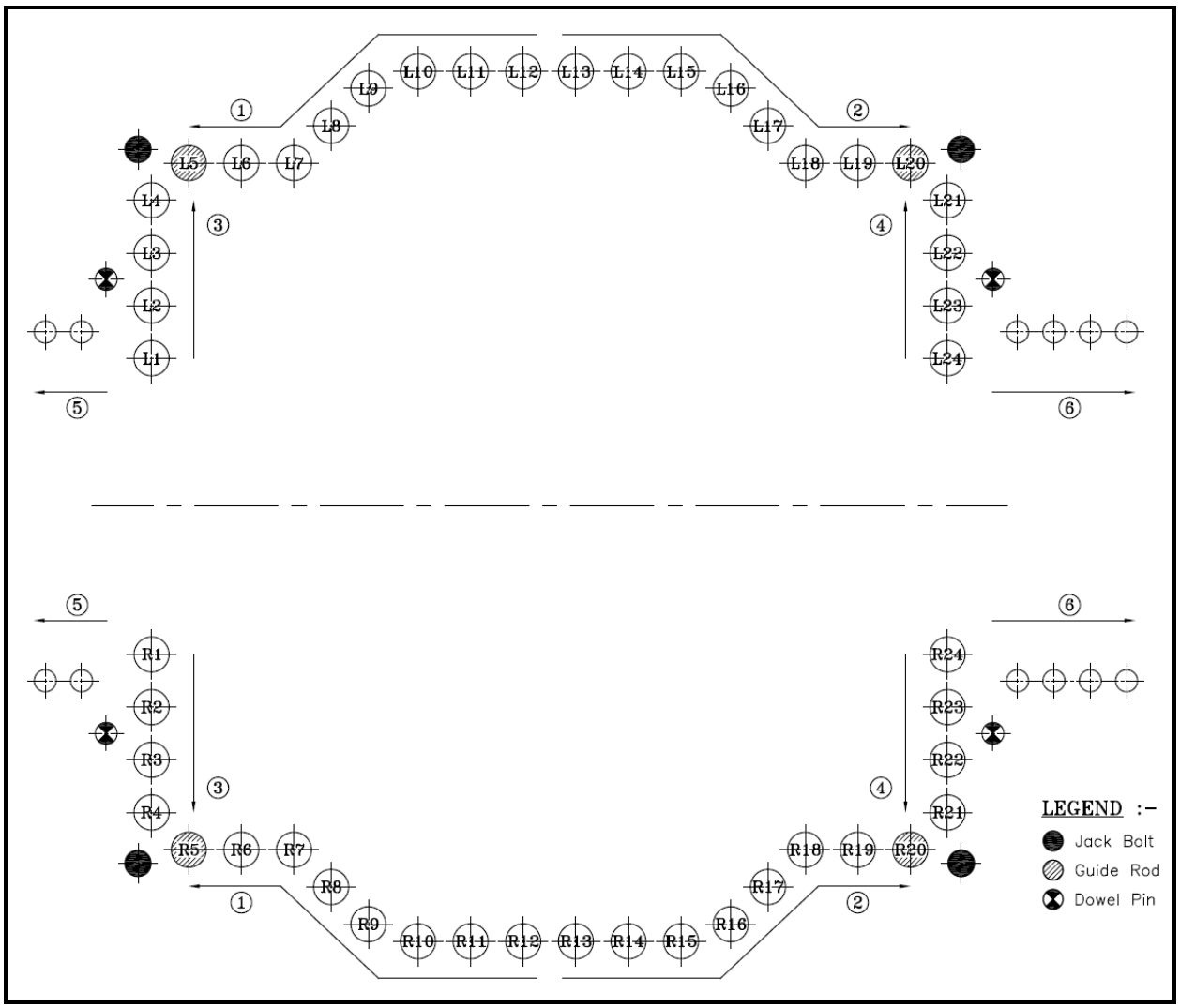
  Rotor was lifted & placed 0.75 mm dia. lead wire at the bottommost position over all the labyrinths & then put the rotor into lower casing half & after that again rotor was lifted & removed all lead wires. Thickness measured.
- Removed all lower half labyrinths from grooves & inserted upper half labyrinths into grooves of lower half casing diaphragms & then checked Labyrinth clearance from both sides by feeler gauge after putting rotor into lower half casing. (Refer clearance sheet).
- Removed rotor from lower half casing & put on rotor stand & also removed upper half labyrinths from the grooves.
- Installed lower half diaphragms & lower half labyrinths in the lower half casing. Also installed upper half diaphragms & upper half labyrinths in the upper half casing & fixed with dowel bolts.




**Bottom half of LP case**

- Inserted New Gas Seal Labyrinth (POS 554.09) on both sides of the rotor after lifting it from stand.
- Thrust bearing collar was inserted by sliding over key & then tightened threaded Lock nut which was locked by Grub screw (5/32”).

- Thrust Relay Disc was inserted & tightened by C spanner & locked by 2 nos. Grub screw (5/32").
- Gas seal Labyrinths (POS 554.01 & POS 554.05) & balance labyrinth lower half portion was fitted on lower half casing & then rotor assembly was put into lower half casing.
- Installed 4 guide bolts in the lower half casing.
- Reversed Upper half casing on the ground & then shifted it to over lower half casing.
- Confirmed the cleanliness & no cracks on mating surface of lower & upper half casing. Then applied birkosit compound on the mating surface of lower half casing.
- Lowered the upper half casing through guide bolts slowly and set the position of the upper & lower half casing using taper dowel pins.
- Removed the guide bolts & tightened both casings with studs & nuts as per Tightening Procedure for Horizontal Split Casing".
- Applied molybdenum on the thread part of stud.
- Set the Jacking Tool as previously done, raise the pressure upto 650 bar & tightened the Circular Nut by the help of long bar.
- The order of tightening is shown in sketch below.



- Retightening round was taken in the same manner at same pressure after completing first round.
- After tightening, installed case nuts on studs.
- Installed the journal bearings & thrust bearing assembly.
- Rotor axial thrust was checked, found within range.
- Coupling hub mounting was carried out as per the sketch & procedure attached.
- Both side Bearing interference and Rotor optimum position were checked and readings are enclosed.
- Both side top covers boxed up.
- Alignment checked & correction done.
- Replaced solid washer by spring washer at all the legs & tightened base bolts.
- Coupling spacer fixed & coupling bolts tightened by torque wrench.
- Installed the expansion joint and coupling cover with new gasket.
- All pipings & instrument fittings fixed

**Installation of Coupling Half**

**Tightening arrangement**

**After overhauling of LP case**

- ❖ LPC Rotor to Turbine Rotor DBFF (Hub face to Hub Face) : 737.43 mm
- ❖ LPC Rotor to Turbine Rotor DBSE : 698.48 mm
- ❖ LPC Rotor to Gear box DBFF (Hub face to Hub Face) : 673.86 mm

**COUPLING HUB REFERENCE DIMENSION:**

| Parameters Measured | Thrust Bearing Side | Opposite Thrust Bearing Side |
|---|---|---|
| Rotor Coupling hub face to pedestal face | 36.40 mm | 91.48 mm |
| Gap between Coupling hub to Rotor face | 18.75 mm | 19.66 mm / 196.5 mm |
| Coupling hub size (Taper 1:20) | Ø79.84 mm | Ø99.75 mm |

**Coupling Hub Dismounting:**

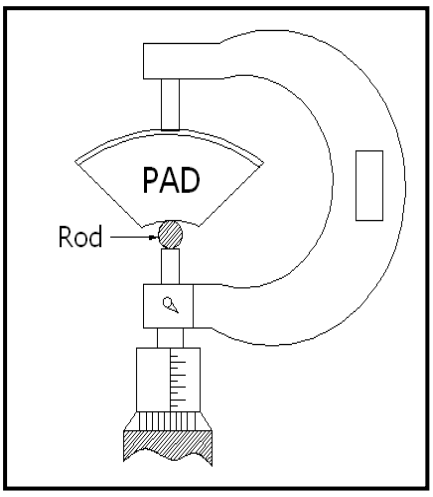
| Rotor Coupling hub removal oil pressure (Expander) | Thrust Bearing Side | Opposite Thrust Bearing Side |
|---|---|---|
| | 20000 psi | 27000 psi |

**Coupling Hub Mounting:**

| Description | Thrust bearing side | | Opposite Thrust bearing side | |
|---|---|---|---|---|
| | Design | Actual | Design | Actual |
| Travel, mm | 3.20 / 3.40 | 3.75 | 5.00 / 5.20 | 5.00 |
| Expansion diametrical, mm | 0.101 / 0.106 | ----- | 0.161 / 0.167 | 0.10 |
| Expander oil pressure, psi | 17952 / 18855 | ----- | 21859 / 22739 | 22000 |
| Axial oil pressure, psi | 6512 | ----- | 9975 | 6000 |

**TILTING PAD JOURNAL BEARING CLEARANCES:**

| Sr. No. | Description | Front | Rear |
|---|---|---|---|
| 1 | Journal Diameter | Ø119.99 | Ø119.99 |
| 2 | Bearing Shell ID | Ø185.00 | Ø185.0 |
| 3 | Tilting Pad thickness | 32.44X2 | 32.44X2 |
| 4 | Bearing Bore | Ø120.12 | Ø120.12 |
| 5 | Actual Clearances | 0.12/13 | 0.13 |




Note: All readings are in mm

Journal Bearing Clearance = Bearing shell ID – Tilting Pad thickness X 2 – Journal Dia.

| Description | Design Value (mm) | Actual Value (mm) | |
|---|---|---|---|
| | | Before PM | After PM |
| Journal bearing clearance on ST side | 0.11 to 0.15 | 0.12/0.13 | 0.12/0.13 |
| Journal bearing clearance on GB side | 0.11 to 0.15 | 0.13 | 0.13 |
| Thrust bearing clearance | 0.28 to 0.38 | 0.38 | 0.38 |
| Journal Bearing Interference on ST side | 0.03-0.08 | - | 0.09 |
| Journal Bearing Interference on GB side | 0.03-0.08 | - | 0.10 |

**THRUST BEARING PAD THICKNESS:**

| PAD NO. | ACTIVE | PAD NO. | Non ACTIVE |
|---|---|---|---|
| 1-1 | 19.81 | 2-1 | 19.83 |
| 1-2 | 19.81 | 2-2 | 19.83 |
| 1-3 | 19.82 | 2-3 | 19.83 |
| 1-4 | 19.81 | 2-4 | 19.82 |
| 1-5 | 19.81 | 2-5 | 19.83 |
| 1-6 | 19.81 | 2-6 | 19.83 |
| 1-7 | 19.81 | 2-7 | 19.83 |
| 1-8 | 19.81 | 2-8 | 19.82 |
| 1-9 | 19.82 | 2-9 | 19.81 |
| 1-10 | 19.81 | 2-10 | 19.82 |
| 1-11 | 19.83 | 2-11 | 19.82 |
| 1-12 | 19.81 | 2-12 | 19.81 |
| **Spacer Thickness** | 4.92 | --- | 10.43 |

**ROTOR OPTIMUM POSITION:**

Thrust Bearing Side = 2.46 mm
Opposite Thrust Bearing side = 2.46 mm

**BOTTOM DIAPHRAGM LABYRINTH SEALS CLEARANCES:**

Diaphragm & Impeller Labyrinth Seals Clearances were measured by feeler gauges.

| Sr. No. | Diaphragm Position No. | Diaphragm Seals | | | | |
|---|---|---|---|---|---|---|
| | | Design value, mm | Before O/H | | After O/H | |
| | | | Left, mm | Right, mm | Left, mm | Right, mm |
| 1 | H | 0.21-0.52 | 0.25/0.30 | 0.20 | 0.25 | 0.25 |
| 2 | I | 0.21-0.53 | 0.30/0.35 | 0.20 | 0.15 | 0.40 |
| 3 | --- | -- | -- | -- | -- | -- |
| 4 | J | 0.15-0.38 | 0.20 | 0.25 | 0.20 | 0.25 |
| 5 | K | 0.15-0.38 | 0.05/0.10 | 0.15 | 0.10 | 0.10 |
| 6 | L | 0.15-0.40 | 0.05/0.10 | 0.15 | 0.10 | 0.10 |
| 7 | ---- | ---- | ---- | ---- | ---- | ---- |
| 8 | Balance drum seal, M | 0.13/0.43 | 0.15/25 | 0.10 | 0.05/0.15 | 0.05/0.15 |
| 9 | End gas seal (TB side), N | 0.13/0.37 | 0.15 | 0.10 | 0.15 | 0.05 |
| 10 | End gas seal (OTB side), N | 0.13/0.37 | 0.15 | 0.10 | 0.20 | 0.10 |
| 11 | End gas seal gas side (TB side), O | 0.26/ 0.74 | ---- | ---- | 0.41 | 0.41 |
| 12 | End gas seal gas side (OTB side), O | 0.26/ 0.74 | ---- | ---- | 0.43 | 0.43 |
| 13 | End gas seal oil side (TB side), P | 0.26/ 0.70 | ---- | ---- | 0.40 | 0.40 |
| 14 | End gas seal oil side (OTB side), P | 0.26/ 0.70 | ---- | ---- | 0.40 | 0.40 |
| 15 | Thrust bearing oil seal, Q | 0.15/ 0.24 | ---- | ---- | 0.10 | 0.10 |

**BOTTOM IMPELLER LABYRINTH SEALS CLEARANCES:**

| Sr. No. | Diaphragm Position No. | Impeller Seals | | | | |
|---|---|---|---|---|---|---|
| | | Design value, mm | Before O/H | | After O/H | |
| | | | Left, mm | Right, mm | Left, mm | Right, mm |
| 1 | A | 0.57-0.86 | 0.65 | 0.50/0.55 | 0.60 | 0.60 |
| 2 | B | 0.49-0.67 | 0.50/0.55 | 0.50/0.55 | 0.50/0.60 | 0.50 |
| 3 | C | 0.48-0.66 | 0.50/0.55 | 0.50/0.45 | 0.30/0.40 | 0.50 |
| 4 | D | 0.32-0.48 | 0.30/0.35 | 0.30/0.35 | 0.30 | 0.30/0.40 |
| 5 | E | 0.33-0.48 | 0.25/0.30 | 0.30 | 0.25 | 0.30 |
| 6 | F | 0.27-0.41 | 0.20/0.30 | 0.20/0.25 | 0.15/0.25 | 0.25/0.30 |
| 7 | G | 0.26-0.40 | 0.25/0.35 | 0.30 | 0.25 | 0.25/0.30 |

**BOTTOM DIAPHRAGM SEALS CLEARANCES WITH LEAD WIRE AFTER OVERHAUL:**

| Sr. No. | Diaphragm No. | Diaphragm Seals | |
|---|---|---|---|
| | | Left, mm | Right, mm |
| 1 | H | 0.50 | 0.55 |
| 2 | I | 0.40 | 0.45 |
| 3 | ---- | ---- | ---- |
| 4 | J | ---- | ---- |
| 5 | K | ---- | ---- |
| 6 | L | 0.40 | ---- |
| 7 | ---- | ---- | ---- |
| 8 | Balance drum seal, M | 0.45 | 0.50 |
| 9 | End gas seal (TB side), N | 0.25 | 0.30 |
| 10 | End gas seal (OTB side), N | 0.40 | 0.40 |

**BOTTOM IMPELLER SEALS CLEARANCES WITH LEAD WIRE AFTER OVERHAUL:**

| Sr. No. | Diaphragm position No. | Impeller Seals | |
|---|---|---|---|
| | | Left, mm | Right, mm |
| 1 | A | 0.60 | 0.60 |
| 2 | B | 0.50 | 0.55 |
| 3 | C | 0.55 | 0.60 |
| 4 | D | 0.40 | 0.50 |
| 5 | E | 0.50 | ---- |
| 6 | F | 0.45 | ---- |
| 7 | G | 0.50 | 0.55 |

**END GAS SEAL RING CLEARANCES (NEW):**

| Description | Thrust Bearing side | Opposite Thrust Bearing side |
|---|---|---|
| Seal bore, mm | Ø180.56 | Ø180.56 |
| Journal diameter, mm | Ø180.16 | Ø180.16 |
| Oil side Clearances (P), mm | 0.40 | 0.40 |
| Design clearances, mm | 0.26-0.70 | |

| Description | Thrust Bearing side | Opposite Thrust Bearing side |
|---|---|---|
| Seal bore, mm | Ø199.60 | Ø199.60 |
| Journal diameter, mm | Ø199.19 | Ø199.17 |
| Gas side Clearances (O), mm | 0.41 | 0.43 |
| Design clearances, mm | 0.26-0.74 | |

**END GAS SEAL RING CLEARANCES (OLD):**

| Description | Thrust Bearing side | Opposite Thrust Bearing side |
|---|---|---|
| Seal bore, mm | Ø180.64 | Ø180.65 |
| Journal diameter, mm | Ø180.16 | Ø180.16 |
| Oil side Clearances (P), mm | 0.48 | 0.49 |
| Design clearances, mm | 0.26-0.70 | |

| Description | Thrust Bearing side | Opposite Thrust Bearing side |
|---|---|---|
| Seal bore, mm | Ø199.60 | Ø199.65 |
| Journal diameter, mm | Ø199.19 | Ø199.17 |
| Gas side Clearances (O), mm | 0.41 | 0.48 |
| Design clearances, mm | 0.26-0.74 | |

**ROTOR RUN OUT:**

1. Coupling hub (TB side) : 0.02 mm
2. Journal bearing : 0.00 mm
3. End Gas seal : 0.03 mm
4. 2nd stage impeller : 0.04 mm
5. 3rd stage impeller : 0.03 mm
6. 5th stage impeller : 0.02 mm
7. End gas seal : 0.02 mm
8. Journal bearing : 0.00 mm
9. Coupling hub (OTB side) : 0.02 mm

- LP Comp. Casing parting plane stud tightening oil pr. (1-48Nos) = 650 kg/ cm2g
- LP Comp. Casing parting plane stud tightening hydraulic pump air pr. = 5.0 atg
- LP Compressor Casing parting plane stud actual elongation (1-48Nos) = 0.80 mm

**SPARES USED**

LP Compressor End gas seal ring (single piece) : 2 Nos.

LP Compressor End gas seal ring Allen bolts : 24Nos.

**OVERHAULING OF $CO_2$ COMPRESSOR HP CASE (K-1801-2)**

- Casing of HP Compressor was locked. Spring washer provided at all 4 nos. foundation bolts was replaced by solid washer one by one before dismantling.
- Temperature elements & Vibration probes was either disconnected or removed.
- All Nozzles disconnected from Oil supply & return headers, Seal gas supply & return headers, Vent header & piping were removed.

- Decoupled the HP casing from Gear Box.
- Coupling Hub face to face distance was measured with an inside micrometer & recorded. (Found 337.58 mm, DBSE = 311.07 mm respectively).
- Alignment of HP compressor with Gear box was checked & recorded before dismantling.
- Removed the top bearing covers.

- Thrust Bearing End Play of rotor was measured & recorded before bearing disassembly.
- Removed 4 nos. bolts & then raised the bearing shell horizontally, ensuring that upper bearing housing not lifted together.
- Removed the Thrust bearing housing.
- Rotor position was measured & recorded.

- Journal bearings Top halves were removed.
- Measurement of Rotor Float was carried out.

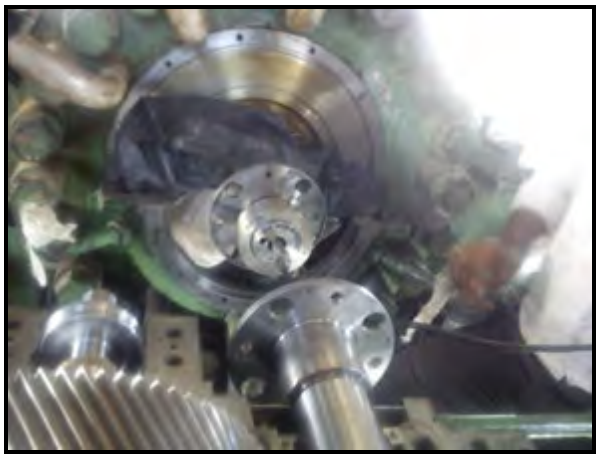
  Axial Float of Rotor (Opposite Thrust Bearing side) without Thrust bearing pads = 2.48 mm

  Axial Float of Rotor (Thrust Bearing side) without Thrust bearing pads = 2.78 mm

  Total Float = 5.26 mm
- Dismounting of Coupling Hub was carried out.

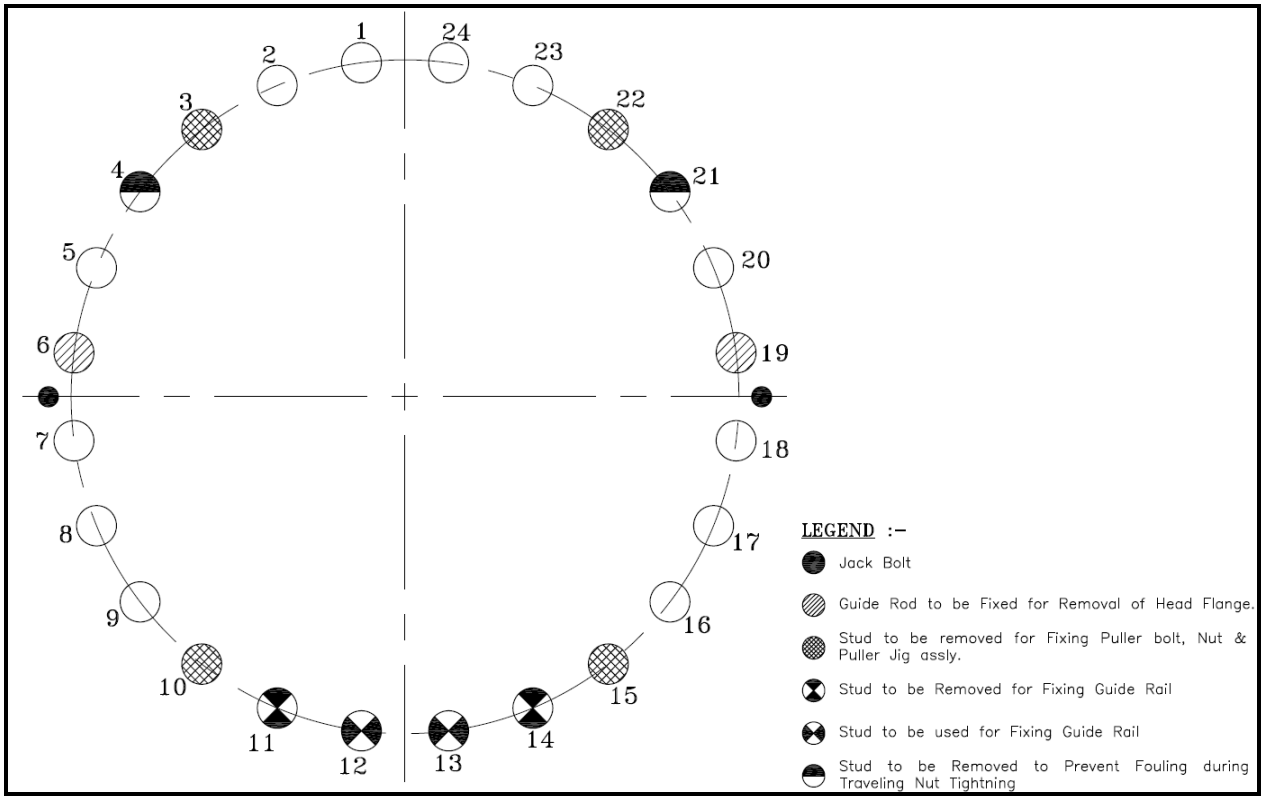
Coupling hub reference position (14.45 mm) was measured by slip gauge. Removed Lock Nut of the Coupling Hub & then installed the hydraulic thrust jig into shaft & connected it with hand operated Oil pump through nipple & flexible pipe.

Applied expansion pressure upto 22000 PSI until hub got removed from shaft.



- Journal bearings Bottom halves were removed.
- Thrust collar was removed.
- End Gas Seal (labyrinth type) of Thrust Bearing side was removed by jacking it with jack bolts.
- Disassembly of Head flange casing (Thrust Bearing side) was carried out.

  All the box nuts were removed. Set the two guide bolts. Attached the two eye bolts on the head flange casing & also attached the four jack bolts in the head flange casing after applying the Molycoat on the threads. Head flange casing was lifted by suitable chain block & wire sling & held it at its position on load & then disassembled by uniformly tightening jack bolts. Removed the O-Ring and/or back-up rings.



- Jig arrangement fixed for removal of inner casing.

  Guide rail was installed, leveling done & then fixed it to the outer casing with box nut.

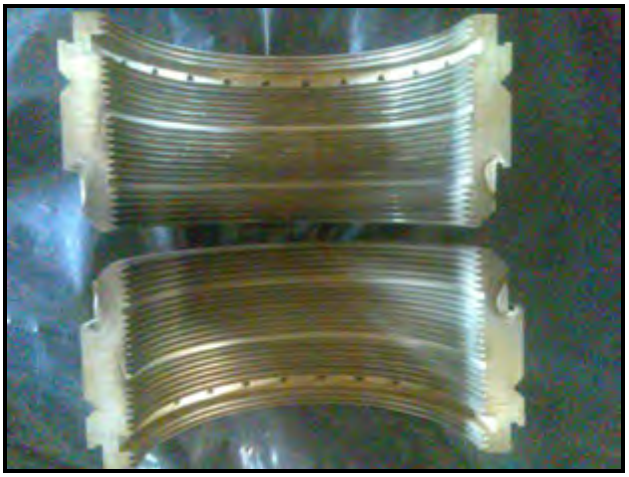
  Four puller bolts assembled with travelling nuts were attached to the inner casing assembly & then inserted puller jig over studs & attached with inner casing by 4 bolts.

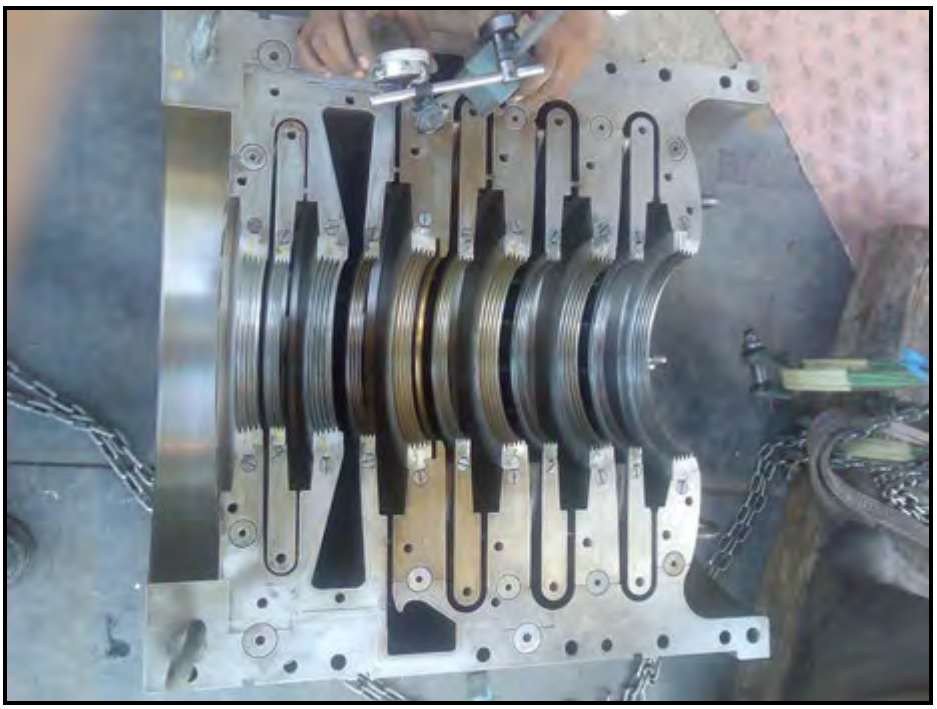
- The inner casing assembly was removed by turning the travelling nuts equally until it clears the outer casing assembly.
- Disassembly of inner casing assembly into two halves was carried out after shifting it from guide rail by unscrewing its parting plane bolts.
- All the Labyrinths were removed from casing top & bottom halves, cleaned it properly & checked its condition. No any fin damage or abnormal wear was found.
- Unscrewed the Diaphragm Locking bolts & all diaphragms removed one by one by the help of chain block from casing top & bottom halves.
- Cleaning of Casing & Diaphragms was carried out by Emery paper & cleaner.
- Journal bearings & Thrust bearing was dismantled, cleaned properly & thickness of pads & Bearing shell ID measured.
- Measured journal dia. & calculated journal bearing clearance & recorded in clearance sheet. Clearances found within range.
- Assembled Journal bearings & Thrust Bearing.
- DP testing of all bearing pads were carried out & found no any defect.
- Gauss measurement of Casing, Diaphragms, Rotor journal dia., Journal Bearings, Thrust bearing pads & Thrust Collar was carried out & found within limit.
- Labyrinth Clearances were measured & recorded.

**Reassembly of HP Compressor**

- Installed diaphragm halves in the lower & upper half casing. Inserted lower half labyrinths in the grooves of lower half diaphragms.
- Put rotor into the lower half casing & supported at both ends by stands having flexibility of horizontal & vertical movement. Rotor centering was done by using two dial gauges for measuring labyrinth clearance.
- Checked Labyrinth clearance of lower half from both sides by feeler gauge.
- Removed all lower half labyrinths from grooves & inserted upper half labyrinths into grooves of lower half casing diaphragms & then checked Labyrinth clearance from both sides by feeler gauge after putting rotor into lower half casing. Clearances were found OK.
- Erosion was found on Balancing Drum Labyrinth seal near parting plane at the face towards impeller. Replaced the seal.

- Rotor run out was measured & found 0.00 - 0.02mm.
- Upper half diaphragms & labyrinths were locked by securing screws.
- Checked the flatness of diaphragms with casing at parting plane by the dial gauge.





- Rotor was placed into the inner casing lower half & rotor centering done by the help of dial indicators.

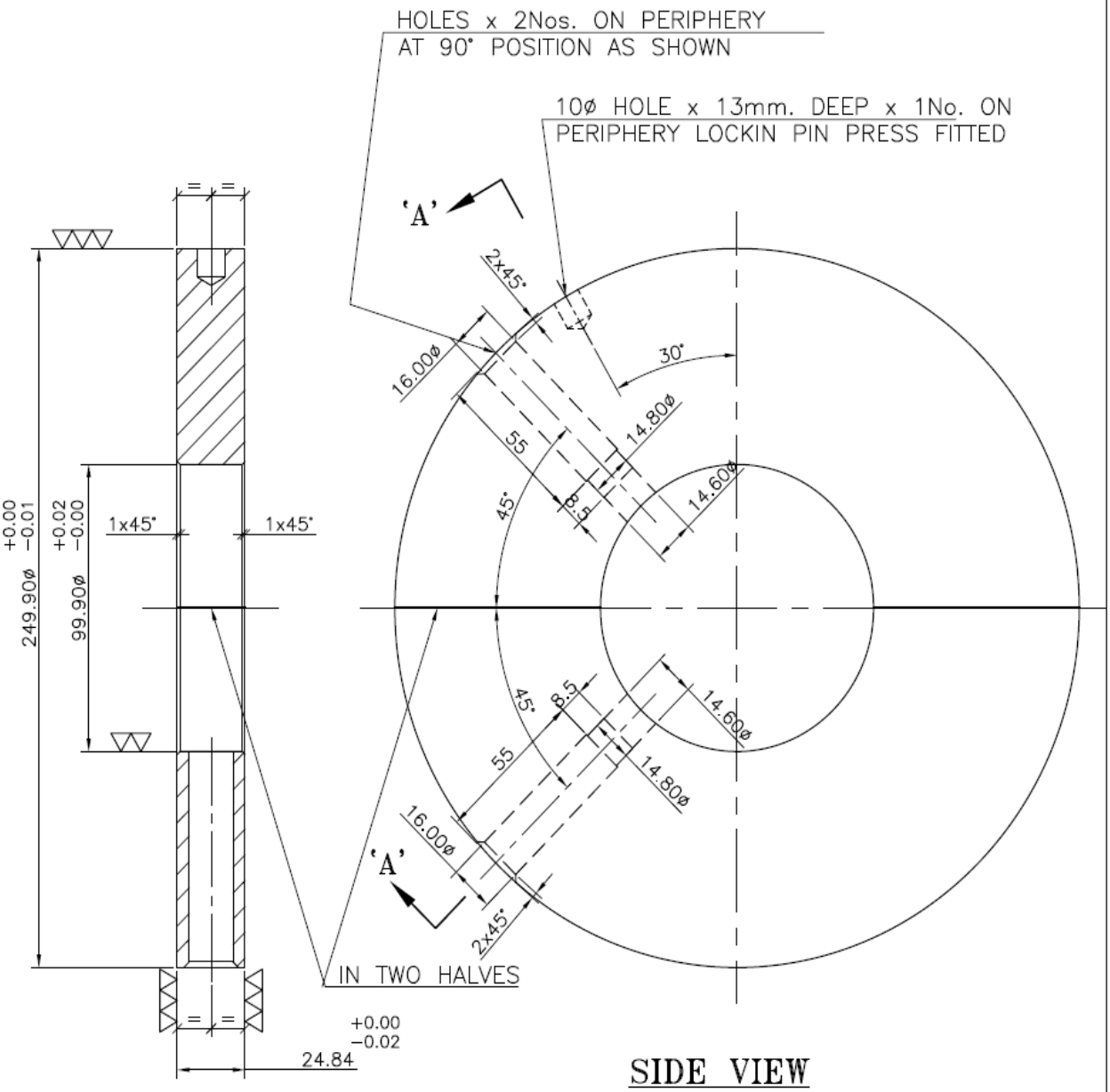
- Inserted Teflon gasket of 2.6 mm dia. X 1000mm long into the groves of lower half casing parting plane & applied Birkosit compound.

- Upper half of inner casing was placed over lower half casing slowly & equally after inserting 4 nos. dowel pins when the two halves were 3-5 mm apart. Tightened all the 12 nos. (M10 Allen bolts) casing bolts uniformly.
- Eyebolt fixed at the centre of shaft & rotor was lifted using chain block & noted the dial indicator reading (TB side = 0.20mm & OTB side = 0.24mm).
- Teflon O-Rings & Back-up Rings (3nos. each) fixed over outer surface of inner casing assembly.

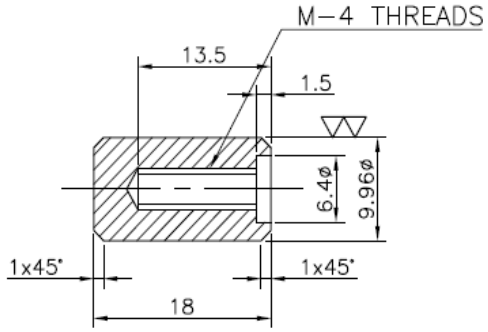
- Installed balance labyrinth from inside outer casing into the driver side Head Flange Casing & then fixed holder by Allen bolt to retain labyrinth at its position.
- Attached gas seal labyrinth assembly into driver side Head Flange Casing.
- Cleaned all the nozzles & drain points connected with casing by pressurized air.
- Applied grease all over the outer surface of inner casing & inner surface of outer casing.
- Jig arrangement fixed for installation of inner casing.
- Guide rail was installed, leveling done & then fixed it to the outer casing with box nut.
- Attached four puller bolts to the inner casing assembly, inserted puller jig over studs & attached with inner casing & then travelling nuts inserted over studs.
- The inner casing assembly was inserted inside the outer casing steadily by turning the travelling nuts equally.
- Removed the jig arrangement.
- Installed new O-rings & backup ring.
- Attached the guide bolts to the casing & tightened studs on the body of casing.
- Head flange was lifted & adjusted the center by keeping the concentricity between the casing studs & the guide bolts. Pushed the head flange steadily & carefully preventing labyrinth fins from getting damaged.
- Installed 4 box nuts to the studs equally spaced. Tightened the box nuts maintaining equal gap between contact faces by caliper.
- Removed the guide bolts. Installed & tightened all the box nuts.
- Attached the gas seal labyrinth assembly into Thrust bearing side Head Flange Casing.
- Assembled all tilting pads of journal bearings into the bearing housing as per the match mark.
- After confirming no any scratches or dents on the journals, applied lubricant oil on the journals & lifted the rotor by 0.3-0.4 mm with care to prevent damage of labyrinth fins & installed the lower half bearing housing on both ends..
- Lowered the rotor.
- Installed the key & thrust collar was slid over the rotor by tapping all around the circumference of collar by nylon hammer & tightened the lock nut by special ‘C’ spanner & locked by grub screw.
- Installed the upper half journal bearing housing.
- Installed the thrust bearing assembly & Thrust bearing cover (632.09)
- **Rotor axial thrust was checked, found out of range (0.43mm). It was corrected by installing new thrust bearing liner (632.15) of increased thickness 24.84mm from 24.72mm (old thrust brg. liner thickness).**

IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL

DATE : 07.04.2013



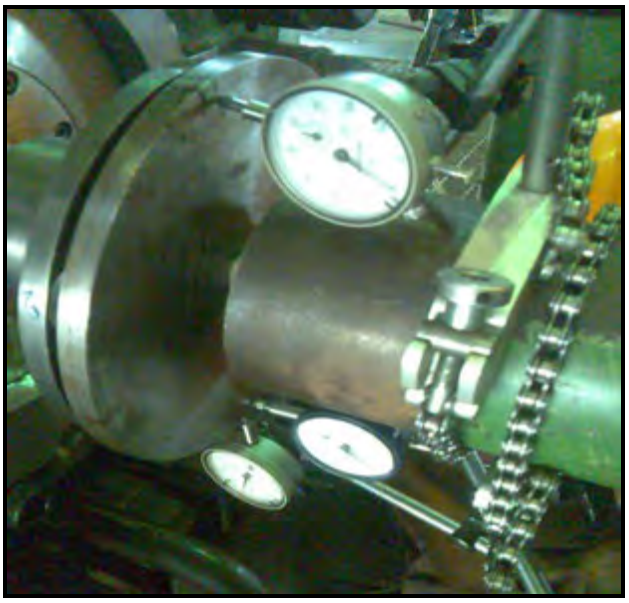

SECTION : 'A-A'




MATERIAL : C.S.

| | NAME | DATE | TITLE – THRUST COLLAR FOR HITACHI COMPRESSOR (HP CASE) S/D-2013 | | EWR No. | |
|---|---|---|---|---|---|---|
| DRN | N.V. PANCHAL | 07.04.2013 | | | SCALE : 1 : 2.25 | |
| CHD | | | DRAWING No. | PLANT FROM NUMBER | SHEET OF | REV. |
| APD | | | CODE UREA-000 | P 2 E S 0 7 P P P | 1 OF 1 | 0 |

- Coupling hub mounting was carried out as per the sketch & procedure attached
- Both side Bearing interference and Rotor optimum position were checked and readings noted down.
- Both side top covers boxed up.
- Alignment checked & correction done.
- Replaced solid washer by spring washer at all the legs & tightened base bolts.
- All pipings & instrument fittings fixed.



- ❖ Gear box to HP Compressor DBSE: 314.33 mm (Lock nut to Lock nut face)
- ❖ Gear box to HP Compressor DBSE: 311.07 mm
- ❖ Gear box to HP Compressor DBFF: 337.55 mm

**COUPLING HUB REFERENCE DIMENSION:**

| Parameters Measured | Opposite Thrust Bearing Side |
|---|---|
| Rotor Coupling hub face to pedestal face | 25.52 mm |
| Gap between Coupling hub to Rotor face | 14.45 mm |
| Coupling hub size (Taper 1:20) | Ø65.00 mm |

**Coupling Hub Dismounting:**

| Rotor Coupling hub removal oil pressure (Expander) | Opposite Thrust Bearing Side |
|---|---|
| | 22000 psi |

**Coupling Hub Mounting:**

| Description | Opposite Thrust bearing side | |
|---|---|---|
| | Design | Actual |
| Travel, mm | 1.95/2.15 | 2.30 |
| Expansion diametrical, mm | 0.06/0.068 | ----- |
| Expander oil pressure, psi | 14060/15939 | 11000 |
| Axial oil pressure, psi | 9042 | 5600 |

**ROTOR AXIAL FLOAT**

Rotor thrust float (Design) : 0.25-0.35 mm

Rotor thrust float (Actual) : 0.25 mm

**ROTOR OPTIMUM POSTION**

Thrust Bearing Side : 2.75 mm

Opposite Thrust Bearing side : 2.48 mm

**BOTTOM HALF DIAPHRAGM LABYRINTH SEALS CLEARANCES AFTER OVERHAUL:**

| Sr. No. | Diaphragm No. | Design value, mm | Diaphragm Seals, mm | | |
|---|---|---|---|---|---|
| | | | Left | Bottom | Right |
| 1 | G | 0.20-0.44 | 0.15 | 0.25 | 0.25 |
| 2 | H | 0.20-0.44 | 0.10 | 0.15 | 0.15 |
| 3 | I | 0.20-0.44 | 0.10 | 0.10 | 0.10 |
| 4 | J | 0.20-0.44 | 0.15 | 0.15 | 0.15 |
| 5 | K | 0.20-0.42 | 0.25 | 0.25 | 0.25 |

**BOTTOM HALF IMPELLER LABYRINTH SEALS CLEARANCES AFTER OVERHAUL:**

| Sr. No. | Diaphragm No. | Design value, mm | Impeller Seals, mm | | |
|---|---|---|---|---|---|
| | | | Left | Bottom | Right |
| 1 | A | 0.72-0.96 | 0.25 | 0.40 | 0.40 |
| 2 | B | 0.72-0.94 | 0.25 | 0.30 | 0.30 |
| 3 | C | 0.72-0.94 | 0.15/0.30 | 0.30 | 0.30 |
| 4 | D | 0.72-0.94 | 0.15/0.25 | 0.20/0.35 | 0.20 |
| 5 | E | 1.02-1.26 | 0.30 | 0.30 | 0.35 |
| 6 | F | 1.02-1.26 | 0.45 | 0.45 | 0.40 |

**TOP HALF IMPELLER LABYRINTH SEALS CLEARANCES AFTER OVERHAUL:**

| Sr. No. | Diaphragm No. | Design value, mm | Impeller Seals, mm | | |
|---|---|---|---|---|---|
| | | | Left | Bottom | Right |
| 1 | A | 0.72-0.96 | 0.30 | 0.40 | 0.40 |
| 2 | B | 0.72-0.94 | 0.20 | 0.20/0.25 | 0.20/0.25 |
| 3 | C | 0.72-0.94 | 0.20/0.30 | 0.15/0.25 | 0.15/0.25 |
| 4 | D | 0.72-0.94 | 0.15/0.25 | 0.15/0.25 | 0.15/0.25 |
| 5 | E | 1.02-1.26 | 0.45 | 0.45 | 0.45 |
| 6 | F | 1.02-1.26 | 0.45 | 0.45 | 0.45 |

**TOP HALF DIAPHRAGM LABYRINTH SEALS CLEARANCES AFTER OVERHAUL:**

| Sr. No. | Diaphragm No. | Design value, mm | Diaphragm Seals, mm | | |
|---|---|---|---|---|---|
| | | | Left | Bottom | Right |
| 1 | G | 0.20-0.44 | 0.15 | 0.10 | 0.15 |
| 2 | H | 0.20-0.44 | 0.10 | 0.10 | 0.10 |
| 3 | I | 0.20-0.44 | 0.10 | 0.10 | 0.10 |
| 4 | J | 0.20-0.44 | 0.15 | 0.15 | 0.10 |
| 5 | K | 0.20-0.42 | 0.15 | 0.15 | 0.15 |

**BALANCING SEAL RING (NEW)**

| Stage no. | Journal OD, mm | Seal ID, mm | Clearances, mm |
|---|---|---|---|
| 1 | Ø189.07 | Ø189.30 | 0.23 |
| 2 | Ø187.05 | Ø187.30 | 0.25 |
| 3 | Ø185.00 | Ø185.40 | 0.40 |
| Design value (L) | 0.20/ 0.44 mm | | |

**BALANCING SEAL RING (OLD)**

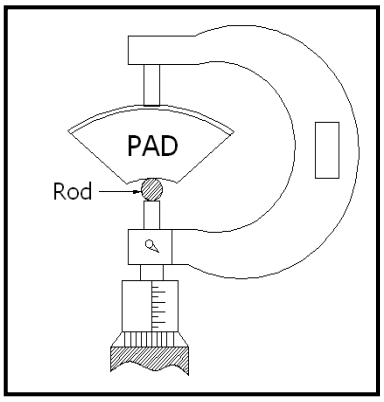
| Stage no. | Journal OD, mm | Seal ID, mm | Clearances, mm |
|---|---|---|---|
| 3 | 185.00 | 185.45 | 0.45 |

**END GAS SEAL RING:**

| Description | Thrust bearing side | Opposite thrust bearing side |
|---|---|---|
| Seal bore, mm | Ø105.32/Ø105.45 | Ø105.27/Ø105.35 |
| Journal OD, mm | Ø104.97 | Ø104.97 |
| Clearance, mm | 0.35/0.45 | 0.30/0.38 |
| Design value (M), mm | 0.30/ 0.48 | |

**TILTING PAD BEARING CLEARANCES:**

| Sr. No. | Description | Front | Rear |
|---|---|---|---|
| 1 | Journal Diameter | Ø79.99 | Ø79.99 |
| 2 | Bearing Shell ID | Ø132.00 | Ø132.00 |
| 3 | Tilting Pad thickness | 25.93/94x2 | 25.93x2 |
| 4 | Bearing Bore | Ø80.12 | Ø80.12 |
| 5 | Actual Clearances | 0.12 | 0.12 |




Note: All readings are in mm

Journal Bearing Clearance = Bearing shell ID – Tilting Pad thickness X 2 – Journal Dia.

| Description | Design Value (mm) | Actual Value (mm) | |
|---|---|---|---|
| | | Before PM | After PM |
| Journal bearing clearance on ST side | 0.11 to 0.14 | 0.12 | 0.12 |
| Journal bearing clearance on GB side | 0.11 to 0.14 | 0.12 | 0.12 |
| Thrust bearing clearance | 0.25 to 0.35 | 0.43 | 0.26 |
| Journal Bearing Interference on ST side | 0.03-0.08 | - | 0.09 |
| Journal Bearing Interference on GB side | 0.03-0.08 | - | 0.09 |

**THRUST BEARING PAD THICKNESS:**

| PAD No. | Non ACTIVE, mm | PAD No. | ACTIVE, mm |
|---|---|---|---|
| 1-1 | 22.19 | 2-1 | 22.20 |
| 1-2 | 22.20 | 2-2 | 22.19 |
| 1-3 | 22.20 | 2-3 | 22.19 |
| 1-4 | 22.20 | 2-4 | 22.20 |
| 1-5 | 22.19 | 2-5 | 22.19 |
| 1-6 | 22.20 | 2-6 | 22.19 |

HP Compressor Thrust collar thickness : 31.82 mm

**ROTOR RUN OUT:**

| | | |
|---|---|---|
| Thrust collar end portion | : | 0.01 mm |
| Journal bearing (TB side) | : | 0.00 mm |
| End gas seal | : | 0.01 mm |
| 1st stage impeller | : | 0.02 mm |
| 2nd stage impeller | : | 0.01 mm |
| 3rd stage impeller | : | 0.01 mm |
| Balancing seal drum | : | 0.01 mm |
| End gas seal | : | 0.00 mm |
| Journal bearing (OTB side) | : | 0.00 mm |

**BOTTOM CASING PARTING PLANE LEVEL**

**DIAPHRAGM TO INNER CASING**

| Stage no. | Left, mm | Right, mm |
|---|---|---|
| 1 | -0.04 | -0.05 |
| 2 | -0.12 | +0.02 |
| 3 | -0.10 | +0.04 |
| 4 | +0.04 | +0.06 |
| 5 | -0.02 | +0.06 |

**DIAPHRAGM TO INNER CASING**

| Stage no. | Left, mm | Right, mm |
|---|---|---|
| 1 | -0.10 | +0.01 |
| 2 | -0.09 | -0.05 |

**TOP CASING PARTING PLANE LEVEL**

**DIAPHRAGM TO INNER CASING**

| Stage no. | Left, mm | Right, mm |
|---|---|---|
| 1 | -0.05 | +0.01 |
| 2 | -0.05 | -0.01 |

**DIAPHRAGM TO INNER CASING**

| Stage no. | Left, mm | Right, mm |
|---|---|---|
| 1 | -0.01 | -0.01 |
| 2 | 0.00 | -0.09 |
| 3 | -0.05 | -0.01 |
| 4 | -0.02 | -0.07 |
| 5 | +0.01 | +0.03 |

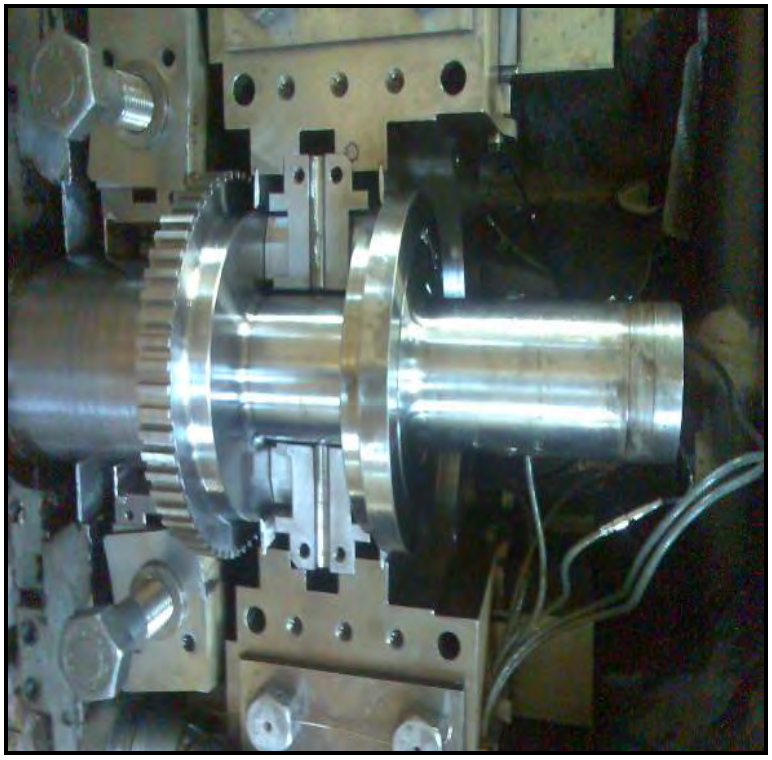
**PREVENTIVE MAINTENANCE OF $CO_2$ COMPRESSOR DRIVE TURBINE (Q-1801)**

Turbine was taken up for Preventive Maintenance & following activities were carried out:

- Removed all instrument probes & connected pipings.
- Decoupled the Turbine from LP case.
- Alignment of Turbine and LP case was checked & recorded.

- Axial Thrust of turbine rotor was measured & recorded before bearing disassembly.
- Removed Top cover of free end bearing pedestal.

**Earthing brush was found worn out completely & made a step at contact area on the rotor.**

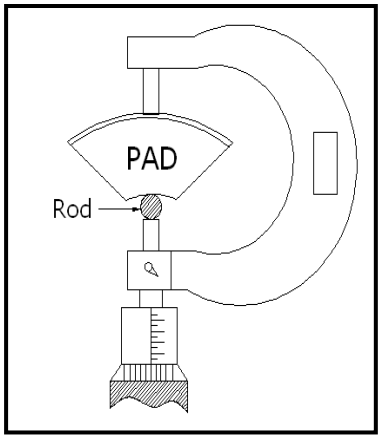


- Journal bearing pads on free end & LP case side were opened for inspection. Dimensions measured & Found clearance values within acceptable limit. (Ref Table-1).
- Thrust bearing was opened for inspection. Thickness of the thrust pad was checked and found within acceptable limits.
- Gauss measurement of Thrust collar, Journal shaft & Bearing housing was carried out by Inspection section and found within acceptable limit.
- DP testing of Pads, Thrust collar and Journal shaft was done and the same were found acceptable.

- Assembled LP Case side & Free end side Journal Bearings & Thrust bearing.
- Interference of Journal bearings were checked, found 0.06mm on free end side & 0.09mm on LP case side.
- Final alignment readings were taken and recorded. Alignment correction was done.

**TILTING PAD JOURNAL BEARING CLEARANCES:**

| Sr. No. | Description | Front | Rear |
|---|---|---|---|
| 1 | Journal Diameter | Ø124.81 | Ø159.73 |
| 2 | Bearing Shell ID | Ø160.00 | Ø205.00 |
| 3 | Tilting Pad thickness | 17.46x2 | 22.49x2 |
| 4 | Bearing Bore | Ø125.08 | Ø160.02 |
| 5 | Actual Clearances | 0.27 | 0.29 |




Note: All readings are in mm

Journal Bearing Clearance = Bearing shell ID – Tilting Pad thickness X 2 – Journal Dia.

| Description | Design Value (mm) | Actual Value (mm) | |
|---|---|---|---|
| | | Before PM | After PM |
| Journal bearing clearance on Front side | 0.18 to 0.31 | 0.27 | 0.27 |
| Journal bearing clearance on Rear side | 0.24 to 0.35 | 0.29 | 0.29 |
| Thrust bearing clearance | 0.25 to 0.35 | 0.35 | 0.21 |
| Journal Bearing Interference on Front side | | - | 0.06 |
| Journal Bearing Interference on Rear side | | - | 0.02 |

Note: All readings are in mm

**THRUST BEARING PAD THICKNESS:**

| PAD NO. | ACTIVE | PAD NO. | NON ACTIVE |
|---|---|---|---|
| 1-1 | 19.96 | 2-1 | 20.15 |
| 1-2 | 19.96 | 2-2 | 20.15 |
| 1-3 | 19.96 | 2-3 | 20.15 |
| 1-4 | 19.96 | 2-4 | 20.15 |
| 1-5 | 19.96 | 2-5 | 20.15 |
| 1-6 | 19.96 | 2-6 | 20.15 |
| 1-7 | 19.95 | 2-7 | 20.14 |
| 1-8 | 19.96 | 2-8 | 20.15 |

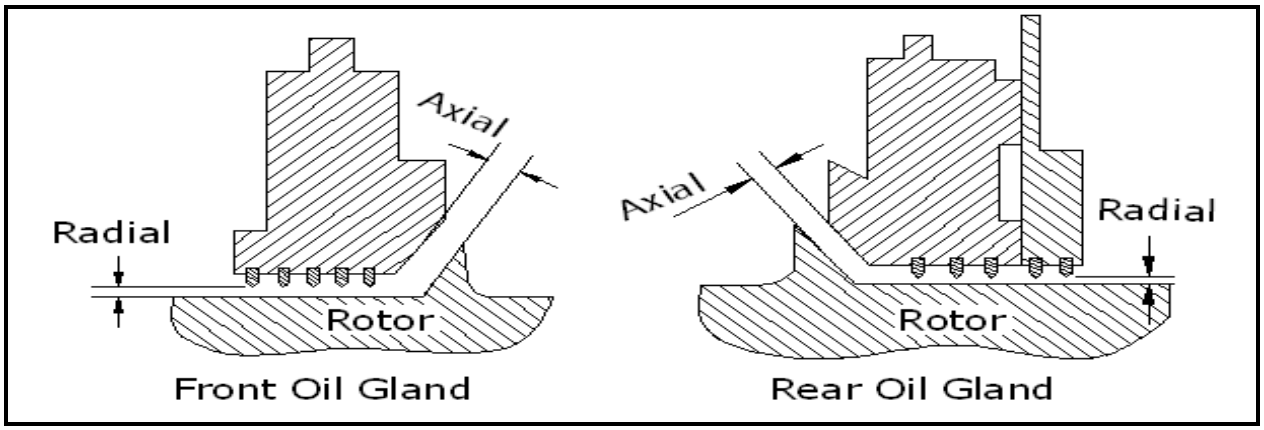
**ROTOR AXIAL FLOAT:**

Rotor Actual thrust float, mm = Rotor total Float, mm - Housing float, mm
(0.21=0.35-0.14)

Rotor thrust float (Design value) = 0.25/0.35 mm

Rotor thrust float (Actual value) = 0.21 mm

**OIL GLAND RADIAL & AXIAL CLEARANCES:**

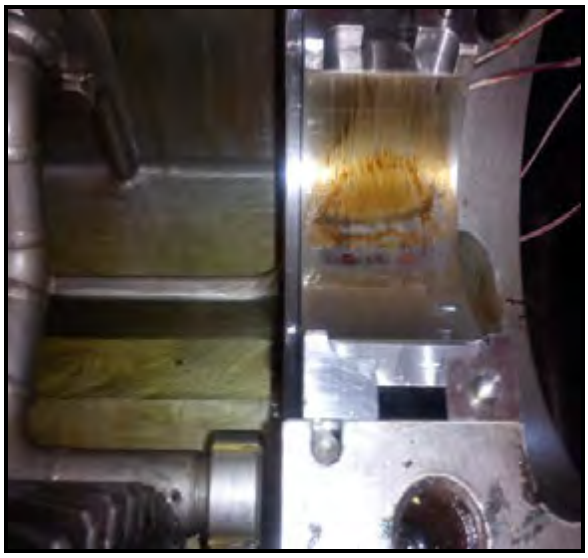


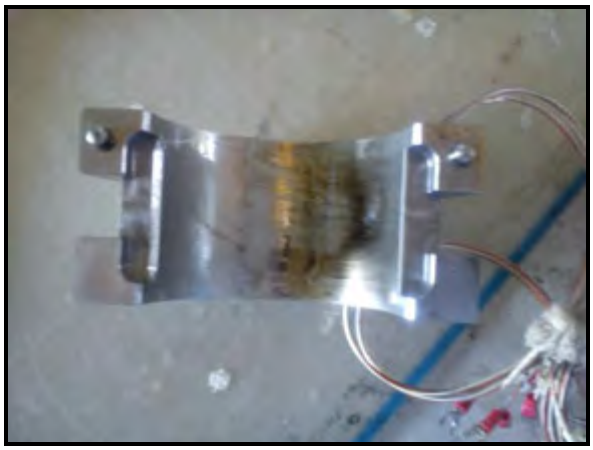

| Description | Radial, mm | | Axial, mm | |
|---|---|---|---|---|
| | Left | Right | Left | Right |
| Front | 0.10 | 0.30 | 2.60 | 2.60 |
| Rear | 0.05 | 0.25 | 4.40 | 4.40 |

Trip Lever Clearances (Radial) : 1.10mm

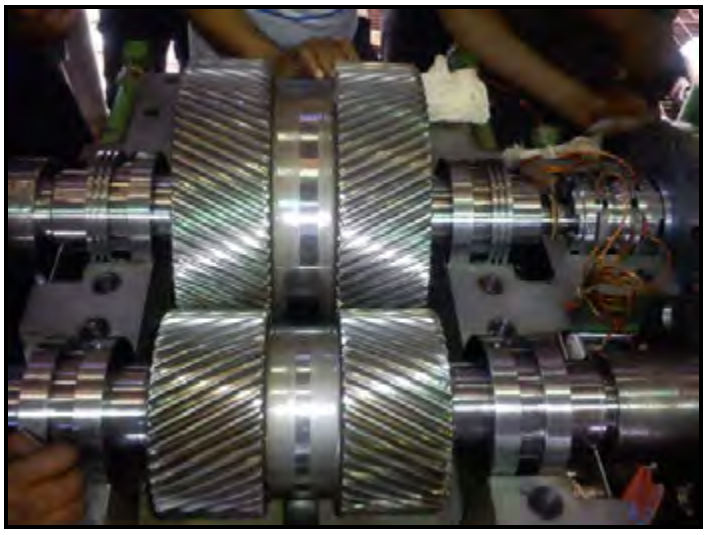
**GEAR BOX MAJOR OVERHAULING ACTIVITIES:**

- Both LP & HP side couplings were decoupled.
- Gear Box top cover was opened.
- All the bearing top halves were removed and also high speed shaft & Low speed shaft were removed by lifting through chain block.
- Deposits were found in the lower half of both journal bearings of high speed shaft.





- All the Pinion & Gear wheel journal bearings were thoroughly cleaned and DP test was conducted found ok. Clearances were checked & assembled back the same.
- Gear wheel thrust bearings pads were thoroughly cleaned and DP test was conducted found ok. Clearances were checked & assembled back the same.
- Backlash between Pinion & Gear wheel was checked and found to ok.
- Alignment between Gear Box & HP Compressor was checked and corrected as per protocol values.



**JOURNAL BEARING CLEARANCES:**

Journal Bearings Clearance was measured by lead wire

| Description | Position | Design clearance, mm | Actual Clearance, mm | |
|---|---|---|---|---|
| | | | Before OH | After OH |
| Journal Bearing **(Low speed)** | Front | 0.125/0.185 | 0.15 | 0.15 |
| | Rear | 0.125/0.185 | 0.15 | 0.15 |
| LSS side Axial Thrust clearances | ---- | 0.38-0.610 | 0.48 | 0.48 |
| Journal Bearing **(High speed)** | Front | 0.15/0.21 | 0.18/0.21 | 0.18/0.21 |
| | Rear | 0.15/0.21 | 0.19/0.21 | 0.19/0.21 |
| GW Backlash | ---- | 0.383-0.608 | 0.46 | 0.42 |

Gear wheel thrust collar thickness : 25.98 mm

Pinion Gear bearing journal diameter : Ø84.85/Ø84.86 mm

Gear wheel bearing journal diameter : Ø99.88 mm

**THRUST BEARING PADS THICKNESS:**

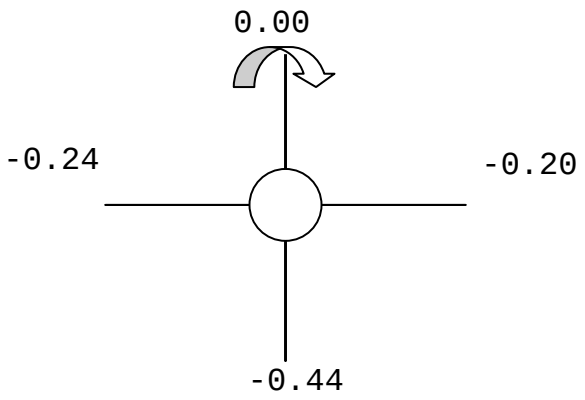
| PAD NO. | ACTIVE, mm | PAD NO. | Non ACTIVE, mm |
|---|---|---|---|
| 1-1 | 12.60 | 2-1 | 12.46 |
| 1-2 | 12.69 | 2-2 | 12.70 |
| 1-3 | 12.69 | 2-3 | 12.71 |
| 1-4 | 12.68 | 2-4 | 12.28 |
| 1-5 | 12.69 | 2-5 | 12.69 |
| 1-6 | 12.68 | 2-6 | 12.69 |

**ALIGNMENT READINGS: TURBINE TO LP COMPRESSOR:**

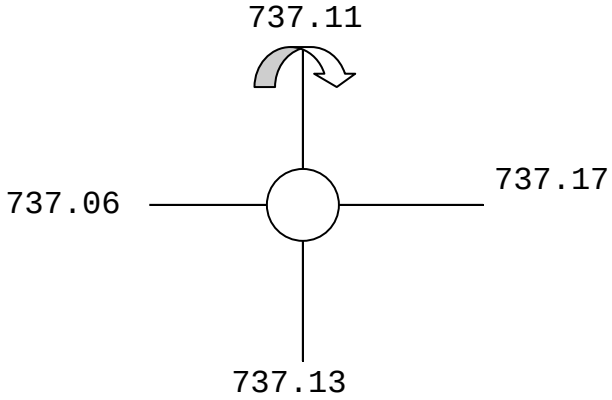
1. View from Turbine Front side
2. Dial put on LP Compressor Rotor.
3. Axial readings (Before PM) were taken with inside micrometer.
4. All Readings are in mm.

**Before PM**

**RADIAL**

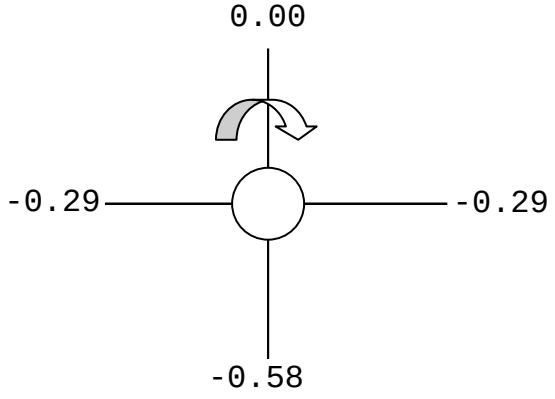



**AXIAL**

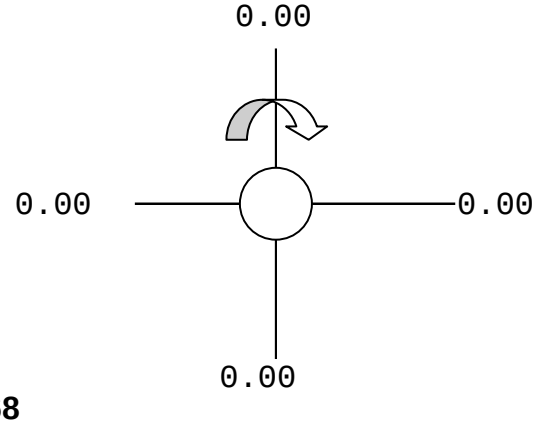



**Protocol Values**

**RADIAL**

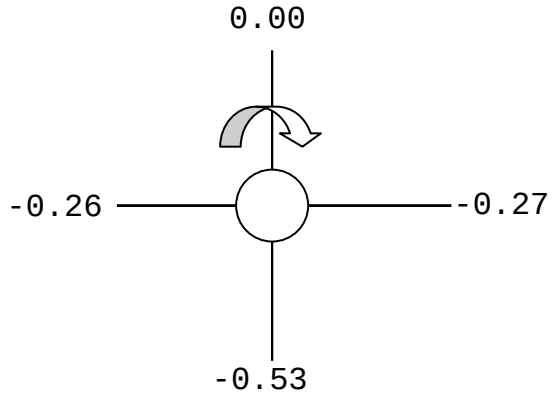



**AXIAL**

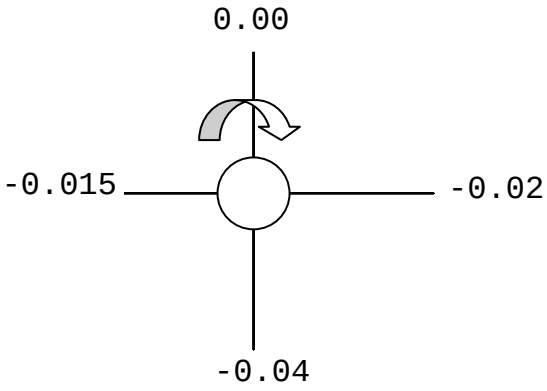


**After PM**

**RADIAL**




**AXIAL**

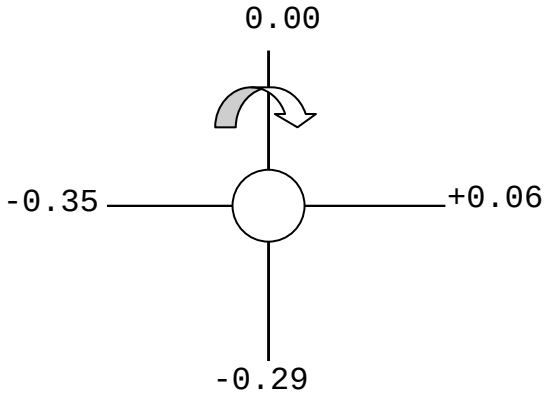



**ALIGNMENT READINGS: GEAR BOX TO LP COMPRESSOR:**

1. View from Turbine Front side
2. Dial put on LP Compressor Rotor.
3. Axial readings (Before PM) were taken with inside micrometer.
4. All Readings are in mm.

**Before PM:**

**RADIAL**

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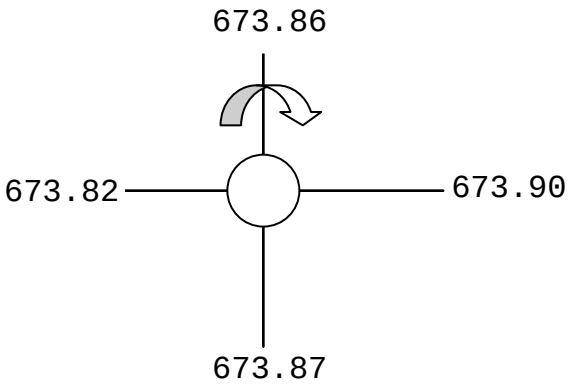


**Protocol Value**

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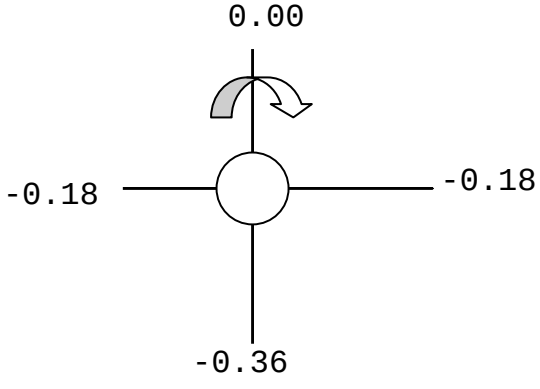


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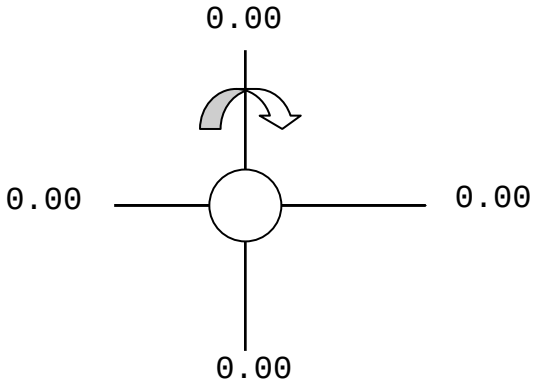
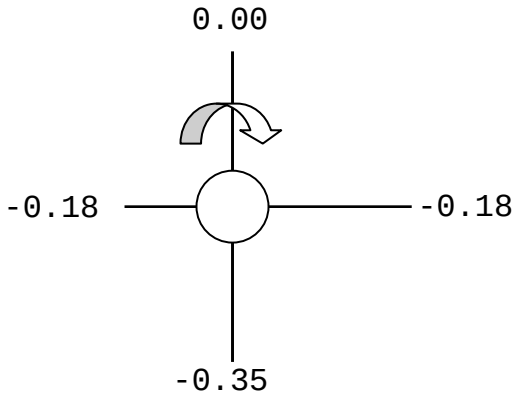


**After PM**

**RADIAL**

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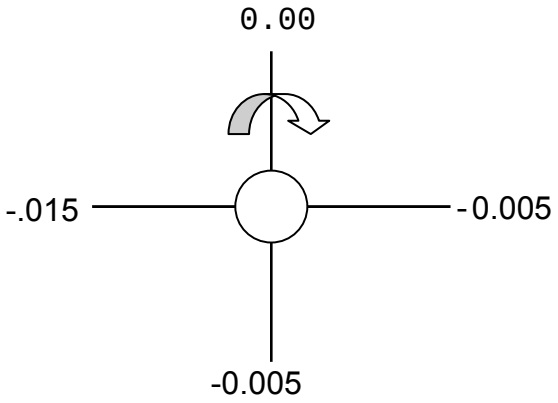
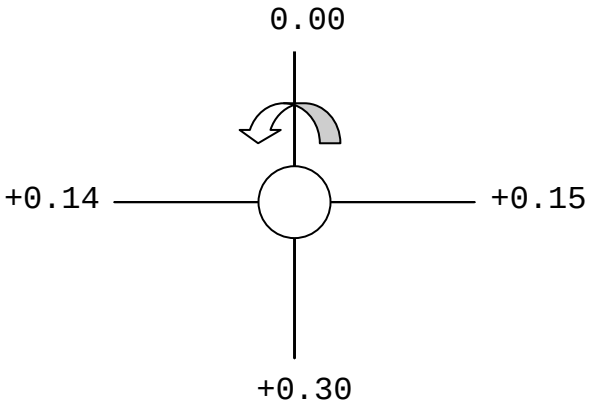



**ALIGNMENT READINGS: GEAR BOX TO HP COMPRESSOR:**

1. View from Turbine Front side
2. Dial put on HP Compressor Rotor.
3. Axial readings (Before PM) were taken with inside micrometer.
4. All Readings are in mm.

**Before PM**

**RADIAL**

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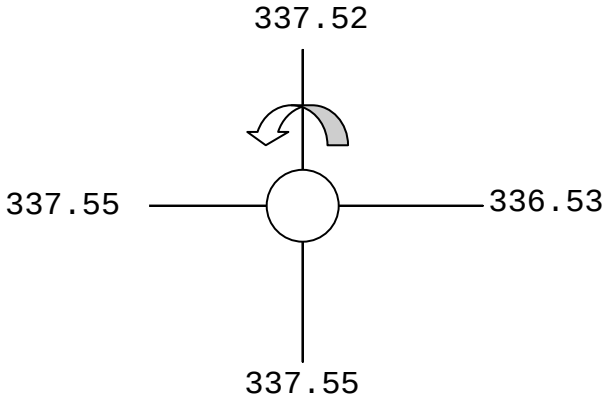


**Protocol Value**

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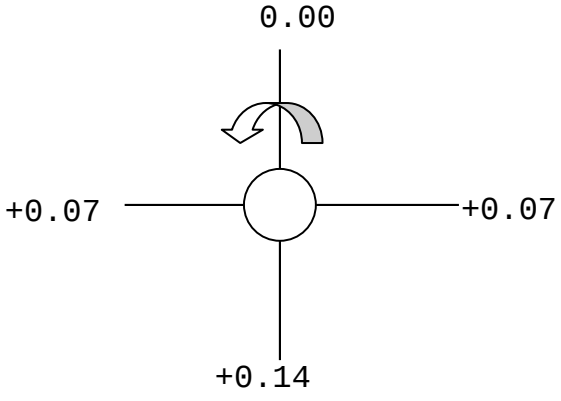


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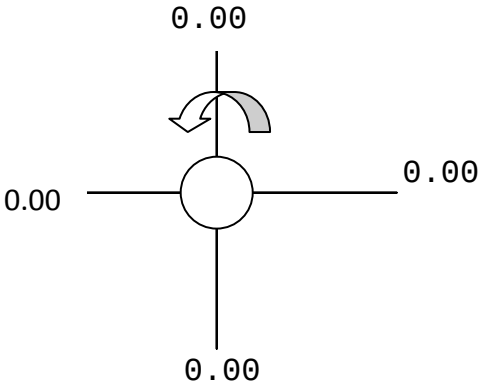
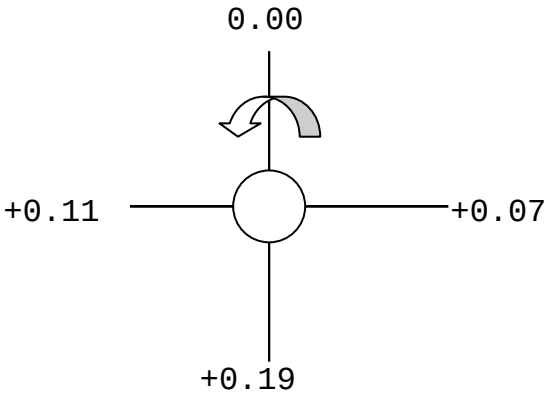
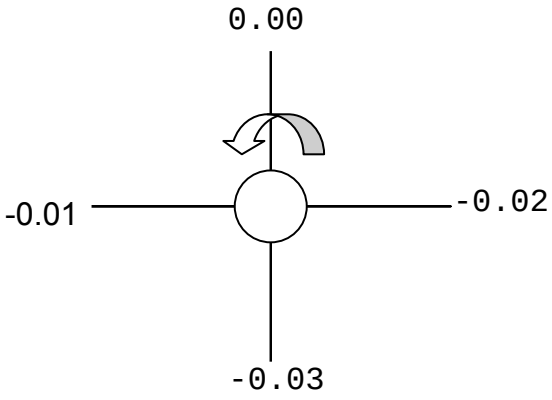


**After PM**

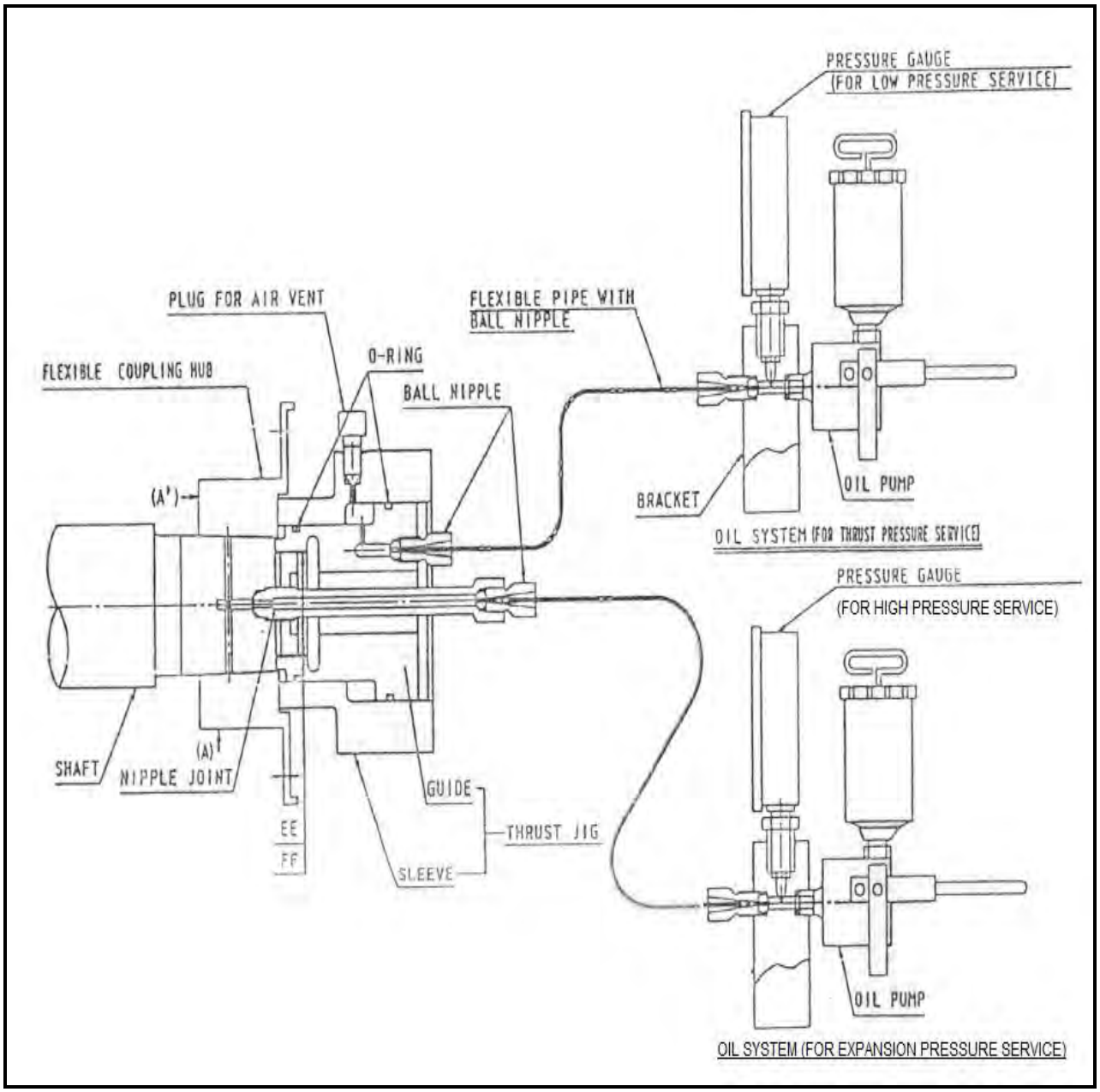
**RADIAL**




**AXIAL**




**Coupling Hub Removal & Mounting Procedure**



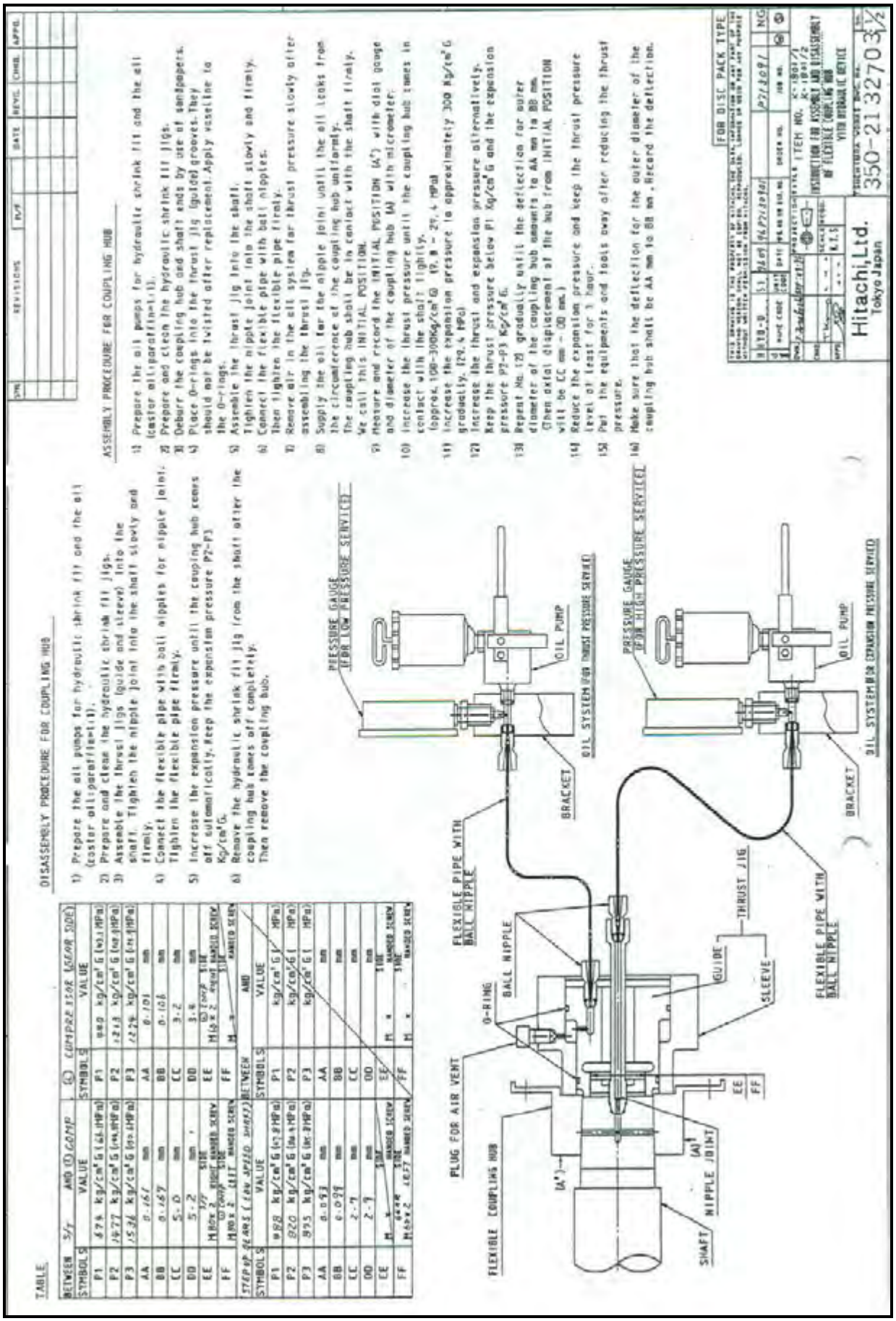
## DISASSEMBLY PROCEDURE FOR COUPLING HUB

- Prepare the Oil Pumps for hydraulic shrink fit and the oil (castor oil: paraffin=1:1).
- Prepare and clean the hydraulic shrink fit jigs.
- Assemble the thrust jig (Guide and Sleeve) into the shaft. Tighten the nipple joint into the shaft slowly & firmly.
- Connect the flexible pipe with ball nipples for nipple joint. Then tighten the flexible pipe firmly.
- Increase the expansion pressure until the coupling hub comes off automatically. Keep the expansion pressure P2-P3 Kg/cm2g.
- Remove the hydraulic shrink fit jig from the shaft after the coupling hub comes off completely. Then remove the coupling hub.

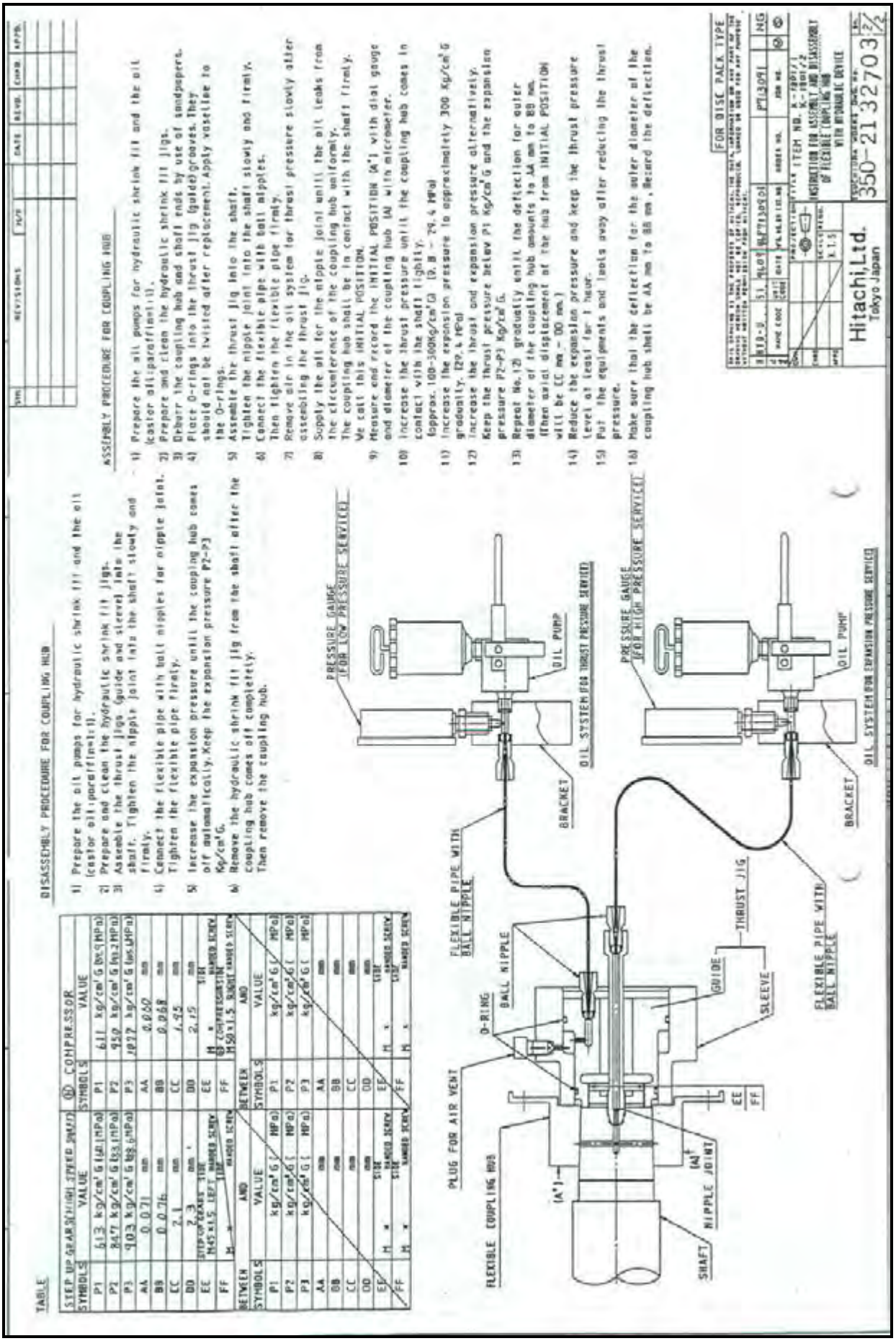
## ASSEMBLY PROCEDURE FOR COUPLING HUB

- Prepare the Oil Pumps for hydraulic shrink fit and the oil (castor oil: paraffin=1:1).
- Prepare and clean the hydraulic shrink fit jigs.
- Deburr the coupling hub and shaft ends by use of sandpapers.
- Place O-rings into the thrust jig (guide) grooves. They should not be twisted after replacement. Apply grease to the O-rings.
- Assemble the thrust jig into the shaft. Tighten the nipple joint into the shaft slowly & firmly.
- Connect the flexible pipe with ball nipples. Then tighten the flexible pipe firmly.
- Remove air in the oil system for thrust pressure slowly after assembling the thrust jig.
- Supply the oil for the nipple joint until the oil leaks from the circumference of the coupling hub uniformly. The coupling hub shall be in contact with the shaft firmly. We call this initial position.
- Measure and record the initial position (A') with dial gauge and diameter of the coupling hub (A) with micrometer.
- Increase the thrust pressure until the coupling hub comes in contact with the shaft tightly. (approx. 100-300 Kg/cm2g) (9.8 - 29.4 Mpa)
- Increase the expansion pressure to approximately 300 Kg/cm2g gradually. (29.4 Mpa)
- Increase the thrust and expansion pressure alternatively. Keep the thrust pressure below P1 Kg/cm2g and the expansion pressure P2-P3 Kg/cm2g.
- Repeat step no. 12 gradually until the deflection for outer diameter of the coupling hub amounts to AA mm to BB mm. (Then axial displacement of the hub from initial position will be CC mm - DD mm)
- Reduce the expansion pressure and keep the thrust pressure level at least for 1 hour.
- Put the equipments and tools away after reducing the thrust pressure.
- Make sure that the deflection for the outer diameter of the coupling hub shall be AA mm to BB mm. Record the deflection.

## Coupling Disassembly - Assembly Pprocedure for Stem Turbine - LP Case and LP Case - Gear Box



## Coupling Disassembly - Assembly Procedure for LP Case - Gear Box



## HP VESSELS

### HP Stripper (H-1201)

### Bottom Dome

- Bottom cover was removed using bolt tensioner at 900 kg/cm2.
- The bottom cover was lowered onto the wooden sleepers.
- After inspection, the bottom cover was boxed up.

### Repairing jobs as per Inspection Report

- Repairing was done at 3 locations inside the bottom at repairs /rectifications were required to be carried out.

### Top Dome

- Top cover studs were opened using bolt tensioner at 900 kg/cm2.
- The top cover was shifted below the platform using monorail hoist and chain blocks.
- Ferrules were removed from position. Ferrules were thoroughly cleaned by Production department.
- Hard thick oxide depositions were removed by chiseling.
- Eddy current testing was carried out by Inspection Department. No repair work was required to be carried out.
- $\Delta$P of all ferrules were checked and 31 nos. ferrules changed.
- The ferrules were fixed in position with new PTFE gaskets (2600 nos).
- After the bottom cover was boxed up, pressure drop measurement was carried out by production department for each tube and the same was found within limit.
- Exchanger was thoroughly cleaned with compressed air and then with DM water.
- Top and bottom cover were boxed up with reconditioned “Kempchen” gasket (839 mm OD x 800 mm ID x 4 mm thick) with new 0.5 mm thick Teflon envelope.
- Tightening pressure for top and bottom cover.

| | |
|---|---|
| 1st tightening round | 300 kg/cm2 |
| 2nd tightening round | 600 kg/cm2 |
| 3rd tightening round | 900 kg/cm2 |
| Final tightening round /checking round | 900 kg/cm2 |

### Autoclave V-1201

Studs holding Top cover were loosened using bolt tensioner at 700 kg/cm2 & then Top cover shifted using a 3 ton chain block.

To facilitate entry of personnel in Autoclave for performing inspection & repair work, dismantling of one no. tray segment (corner side) of 11 nos. sieve trays & after completion of inspection & repair work, Re-fixing of removed tray segment was carried out by M/s. General Engineering against WO No. 201004131342 dated 08/03/2013.

Each tray segment (corner side) has 16 nos. M12 X 30 bolts and 04 nos. M16 J Type holding bolts.

### Repairing jobs as per Inspection Report

The following repairing jobs were carried out departmentally as per Inspection report:

**Compartment No.1 (Top Compartment)**

- Loose fasteners of tray segments were tightened and 2 nos. new tray segment bolts provided in place of missing bolts & 1no. new "J" bolt provided in place of missing bolt just below down comer funnel at north side.
- Pits/Localized erosion of 2mm depth, 10 -12 mm long, 3-4mm wide on Manway liner was repaired by weld deposition.

**Compartment No.2**

- Pits/Localized erosion of 2mm depth, 10-12 mm long, 4mm wide found on Manway Liner and 2mm depth, 10-12 mm long found in Shell liner South West corner, 2" above C-seam near tray clit were repaired by weld deposition.

**Compartment No.4**

- Corrosion/Erosion Pits of 1.5 mm depth, 4-5mm dia. observed at North side in shell liner and Pits/Localized erosion of 1.5mm depth, 4-5 mm dia. found on Manway liner were repaired by weld deposition.

**Compartment No.5**

- Minor corrosion at East side long seam near top "Tee" joint C-Seam welding and Near that Corrosion/Erosion Pits of 1.5 mm depth, 4-5mm dia. observed in shell liner were repaired by weld deposition.

**Compartment No.6**

- Pits/Localized erosion of 2mm depth, 3"long, and 6-7 mm wide found on Manway Liner and two minor pits of 1.5-2 mm deep, 4-5mm dia. observed at South side liner just below C-Seam were repaired by weld deposition.

  No repair work was required in other remaining compartments. All repairing jobs were done using TIG welding method and 25-22-2 L Mn filler wires. Repaired areas were passivated by 10% HNO3 and washed with DM water.

  During removal of ladder and lightening arrangement from V-1201, all tray segment bolts & tray holding 'J' bolts were checked & tightened. After taking clearance from Production, top cover was boxed up with new Kempchen make gasket (839 mm OD x 800 mm ID x 4 mm thick) with new 0.5 mm thick Teflon envelop.

  - Tightening pressure for top cover.

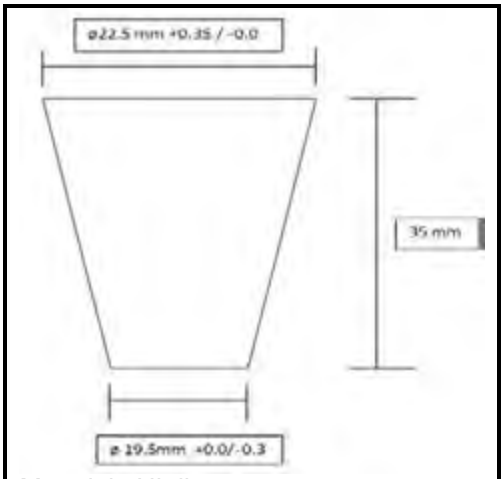
| | |
|---|---|
| 1st tightening round | 300 kg/cm2 |
| 2nd tightening round | 500 kg/cm2 |
| 3rd tightening round | 700 kg/cm2 |
| Final tightening round /checking round | 700 kg/cm2 |

**HP Condenser (H-1202)**

Increasing trend in the conductivity of 4 ata steam **(Shell side of H-1202)** was observed in Nov-Dec, 2012. It was tried to maintain conductivity level below 100 ppm by continuous draining of condensate until it was confirmed that leakage was from HP condenser & ultimately short shutdown was taken from 9-12 January, 2013 to attend the tube leakage in H-1202. Hydrotest was carried out to find out the leaky tube & one no. leaky tube (29th Row, 20th tube) found in hydrotest was plugged. After startup conductivity in condensate went down upto 25-30 ppm but not vanished completely.

Therefore, it was decided to perform the air leak test in the vessel during annual shutdown.

- HPCC was isolated by blinding the inlet & outlet nozzles at appropriate locations as per list & disconnected flanges of off gas line from Nozzle C1A at top & HPCC liquid outlet to Autoclave pipe line flange from Nozzle C3 at bottom & lowered it by the help of chain blocks.
- Fasteners of Top cover and bottom cover were loosened using bolt tensioner at 700 kg/cm$^2$. Bottom cover was shifted using 2 nos. of 3 ton capacity chain block and top cover was shifted using 1 no. of 5 ton chain block.
- Internals (i.e. cover plates, Rasching rings, Bucket & 4 nos. trays) from the top were removed.
- Rubber Plugs as per sketch were fixed on all the tubes at bottom tubesheet.




Material : Nitrile
Hardness : 65-70 Shore-A

**Rubber plug**

- Air connection was given at shell drain nozzle C8 (Size: 1") & started pressurizing the vessel. Soap solution was applied on Top tubesheet.
- One no. tube (29$^{th}$ row, 27$^{th}$ tube) having leakage was found at 4.2 Kg/cm2g air pressure & same was plugged in top & bottom tubesheet by TIG Welding using 25 22 2 LMn filler wire of 2.0mm dia. DP check and ferrite check of root weld & final weld was done & found satisfactory. Tube layout drawing for showing the plugged tube location is attached in shutdown report of inspection. After welding, Passivation was done using 10% HNO3 solution and rinsing with DM water.
- In Top channel head, 01 no. crevice cavity observed on the Circumferential weld seam patch plate in South direction & 01 no. cavity observed on C-Seam HAZ area in West direction were repaired by weld deposition.
- Confirmation Hydro test of Shell side was carried out at 11 kg/cm$^2$.
- After inspection, internals were placed on top portion. Top and bottom cover Boxed up with new Kempchen make gasket (839 mm OD x 800 mm ID x 4 mm thick) with 0.5 mm thick Teflon envelop.
- Tightening pressure for top and bottom cover

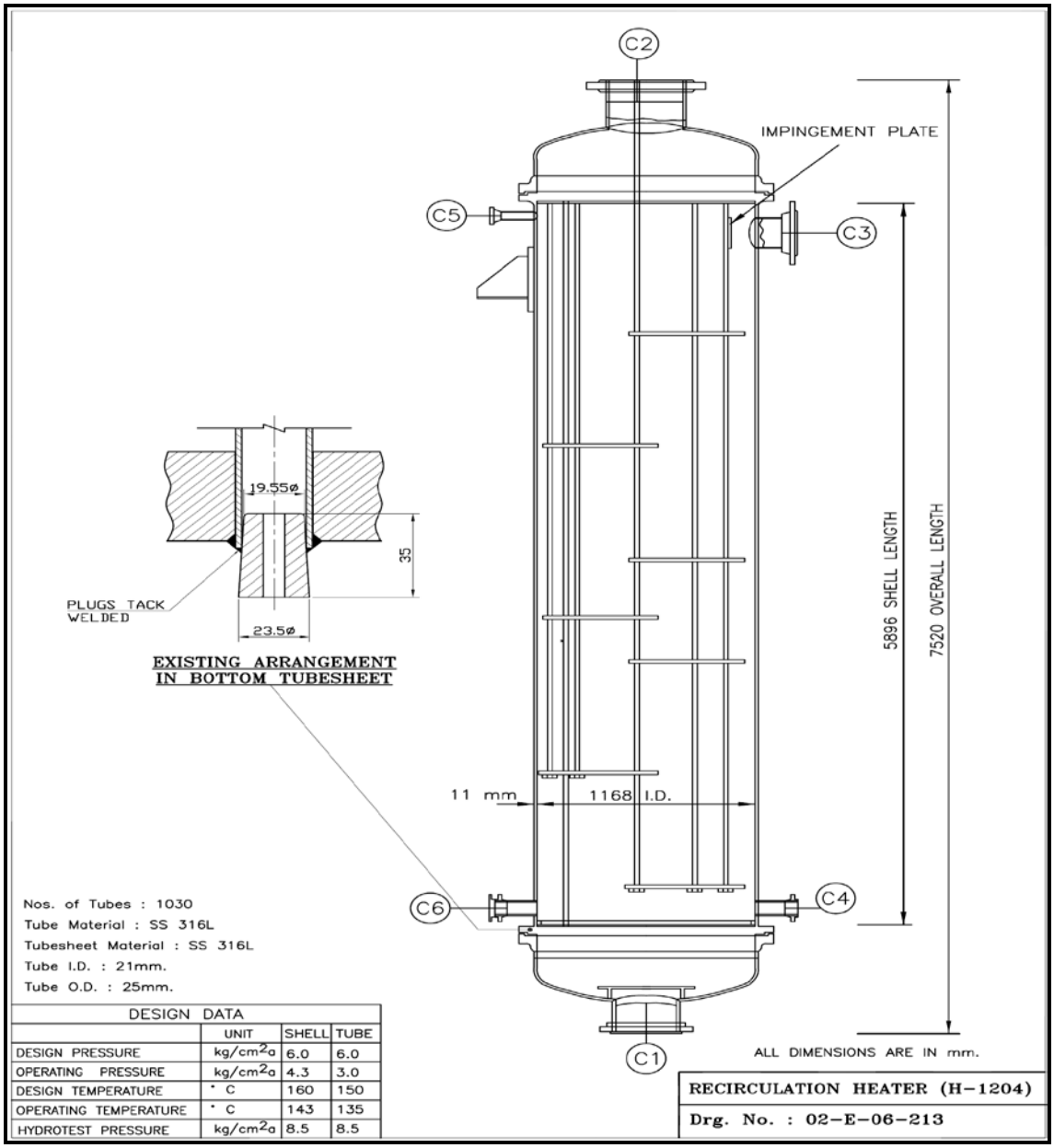
| | |
|---|---|
| 1$^{st}$ tightening round | 300 kg/cm2 |
| 2$^{nd}$ tightening round | 500 kg/cm2 |
| 3$^{rd}$ tightening round | 700 kg/cm2 |
| Final tightening round /checking round | 700 kg/cm2 |

## Recirculation Heater (H-1204)

### Modification Job at Bottom Tube Sheet of Recirculation Heater

The recirculation heater is a shell and tube type heat exchanger, carbamate solution passes in the tubes and LP steam on the shell side. The technical details of H-1204 are given as under.

| | | |
|---|---|---|
| No. of tubes | : | 1030 |
| Tube material | : | SS 316L |
| Tube sheet material | : | SS 316L |
| Tube I. D. | : | 21 mm |
| Tube O.D. | : | 25 mm |
| Tube length | : | 6096 mm |
| Shell I.D. | : | 1168 mm |
| Heat transfer surface | : | 478 $m^2$ |
| Shell material | : | A285 Gr. C- Carbon Steel |




| DESIGN DATA | | | |
|---|---|---|---|
| | UNIT | SHELL | TUBE |
| DESIGN PRESSURE | $kg/cm^2a$ | 6.0 | 6.0 |
| OPERATING PRESSURE | $kg/cm^2a$ | 4.3 | 3.0 |
| DESIGN TEMPERATURE | ° C | 160 | 150 |
| OPERATING TEMPERATURE | ° C | 143 | 135 |
| HYDROTEST PRESSURE | $kg/cm^2a$ | 8.5 | 8.5 |

The 7.0 mm orifice plugs are provided at bottom of all tubes of recirculation heater to increase the rate of heat transfer. These orifice plugs are tack welded with tube and bottom tube sheet. Tubes were not getting cleaned completely by hydro jetting resulting into drop in efficiency. Therefore, it is proposed to remove all 1030 nos. of orifice plugs and to install SS plate with Teflon sheet at bottom tube sheet.

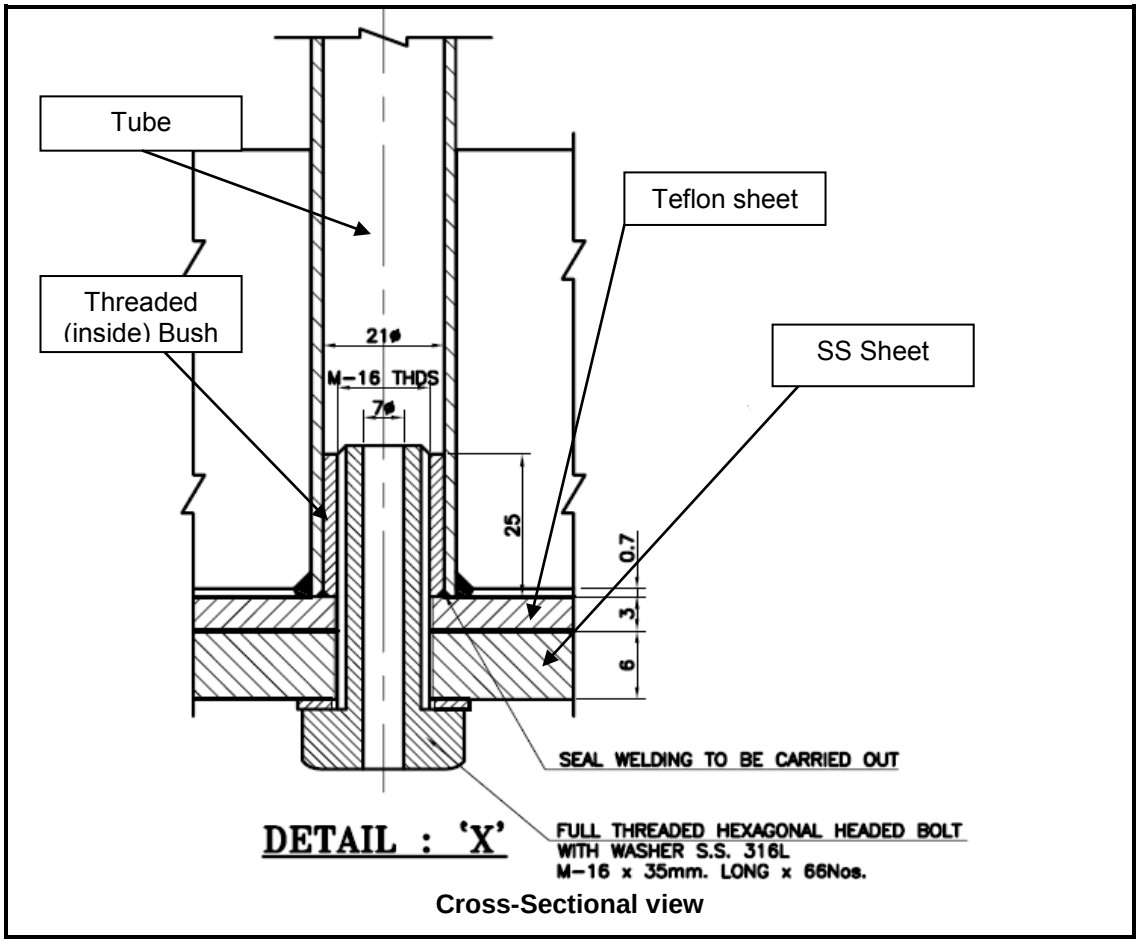
Job was carried out by M/s. A.M. Erectors, Ahmedabad against WO no. 201004131297 dated 13/02/2013.

- Precut SS plate (6mm thick) & Teflon sheet (3mm thick) of 1160mm OD was procured & drilled holes on them at the workshop. Inside threaded bushes of size 21mm OD X 25mm long having M16 thread at ID were made at workshop & 7mm dia. & also, through hole drilled at the centre of M16 X 35mm long Full threaded hexagonal bolts of material SS316L bolts as per drg. No. P2-CS-04093 Sheet 1/1 Rev. 0.
- Disconnected pipelines connected with flanged nozzles C1 & C2 & then removed Top & Bottom cover.
- Tack welding of all 1030 nos. orifice plug were cut from tube one by one by grinding & removed them by pulling as shown in photograph.
- After removal of plug, tube stub end of 0.7 mm long from tubesheet face were maintained by grinding.
- DP Test of tube to tubesheet was carried out.
- Applied blue on Teflon sheet and fixed it on bottom tube sheet with SS plate to check the flatness of stub end face of all tubes.
- Ground the high points of tube end showing blue color and tube end face made flat.
- Hydro jetting of tubes was carried out & also mechanical cleaning of tubes was done from bottom.
- 4 nos. holes of M12 X 25mm size were drilled and tapped and 66 Nos of inside threaded bush were TIG welded with tube & tubesheet by using **25-22-2LMn filler wire size - 2.4 mm dia** as per drg. No. P2-CS-04093 Sheet 1/1 Rev. 0 in bottom tube sheet for holding perforated SS plate and Teflon sheet with bottom tube sheet.
- Ferrite content checked at regular interval. **Max 0.6 % ferrite is acceptable.**
- Cleaned and passivated the weld by washing with 10 % $HNO_3$ and rinse with plenty of DM water.
- Blinding of steam inlet nozzle C3 (8" x 150#, RF) and condensate outlet nozzle C4 (2" x 150#, RF) was done for hydrotest. Water was filled in shell side of vessel through nozzle C6 (1"X 150#) & nozzle C5 was used for venting air & pressurized it after connecting hand operated pump at nozzle C6.
- Hydrotest was carried out at 8.5 kg/cm2g in shell side to check the tube to tube sheet joint leakage. No leakage was found.
- Fitted perforated SS plate & Teflon sheet by SS fasteners.
- Boxed up Top & Bottom dome cover & connected pipelines.

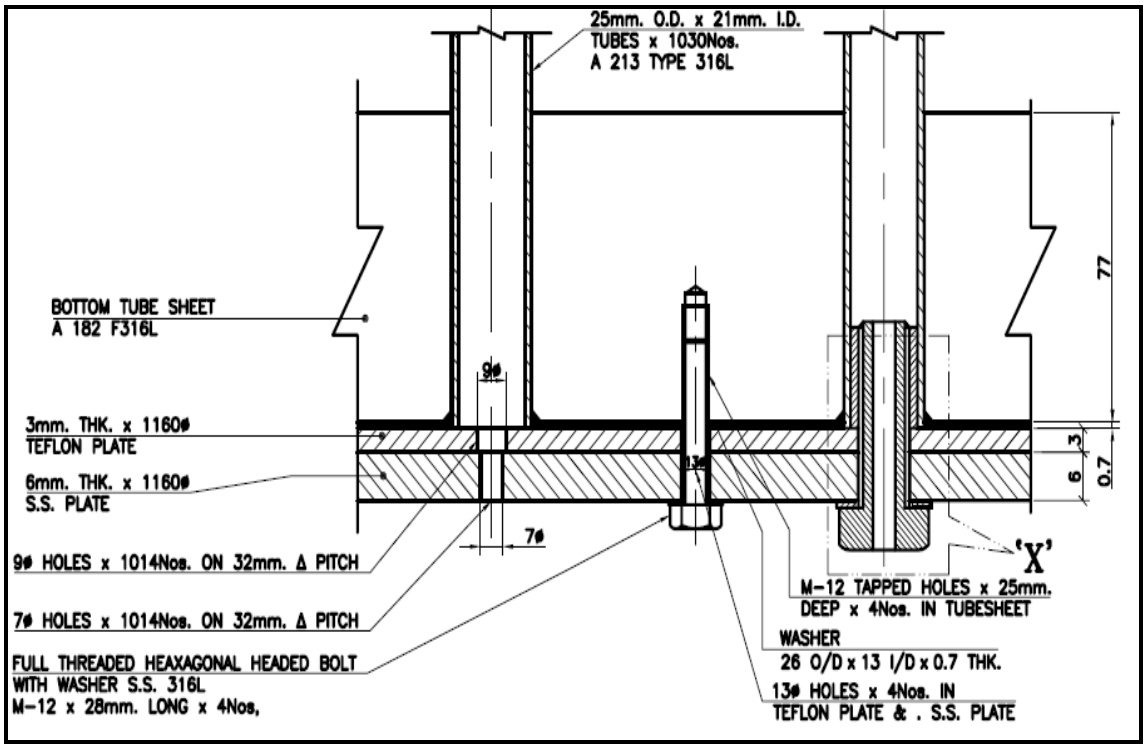
**Orifice plugs in bottom tube sheet**

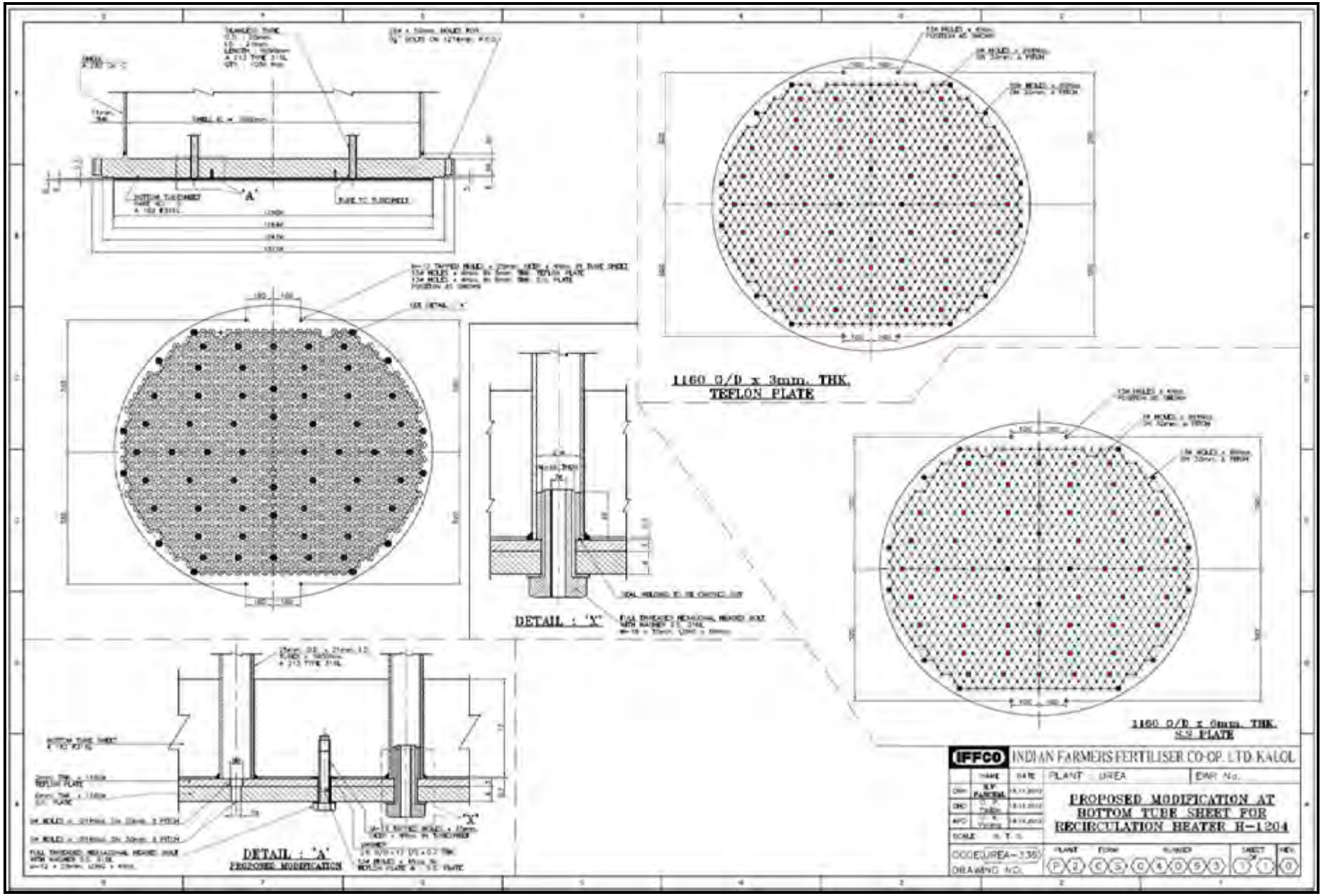

**Removal of orifice plugs from bottom tube sheet**

**Assembly of perforated plate with Teflon sheet**




**Cross-Sectional view**




'A'
1160 O/D x 3mm. THK.
TEFLON PLATE
DETAIL : 'Y'
1160 O/D x 6mm. THK.
S.S PLATE
DETAIL : 'A'
PROPOSED MODIFICATION
'X'
IFFCO
INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL
PLANT : UREA
PROPOSED MODIFICATION AT BOTTOM TUBE SHEET FOR RECIRCULATION HEATER H-1204
CODE UREA-336
DRAWING NO. PJ CS 04093 11 0

## LP Carbamate Condenser (H-1205)

### IRIS inspection and Hydro test:

Condensate inlet and outlet lines were removed by Kobelco crane. Dome cover was removed by monorail. IRIS inspection of tubes was carried out by inspection department after cleaning of tubes by hydojetting using DM water. 5 nos. of tubes were plugged having thickness reduction more than 55% as per inspection report. Total 93 nos. of tubes has been plugged till date.

After tube plugging, Test ring & following blinds were provided.

- NH3/CO2/H2O inlet (C1) : 18" x 150#, RF
- Carbamate solution inlet ( C2) : 8" x 150#, RF
- Discharge from P-1352 A/B & P-1302 C/D : 3" x 150# , RF (End blind flange was used for blinding the nozzle)
- From P-1201 A/B/C , Carbamate inlet (C5) : 2" x 1500#, WNRJT
- Carbamate solution outlet ( C8) : 8" x 150#, RF

Pump and Pressure gauge was provided at C3 Nozzle (1.5" X 150#). Water was filled in shell side through the hose. Shell vent (C11) was used to remove air. Hydrotest pressure was kept at 11.0 kg /cm2g for 30 minutes. No leakage was observed.

Heat exchanger was boxed up after removal of test ring and deblinding was done.

Tube Layout drg. In Inspection – Urea report.

### Modification of Condensate Inlet & outlet line:

Modification was carried out in Condensate inlet and outlet lines to avoid the delay due to non-availability of crane & minimize dependency on crane.

Extra provision of flange connection of size: 14" X 150# was made near elbow in both Condensate inlet & outlet lines to avoid requirement of crane for removal of long pipeline. Job was carried out by M/s. Smitha Engineers.

**Retubing of 2nd inter stage cooler of Hitachi CO2 Compressor (H-1812) with duplex tubes (SAF2205)**

To prevent frequent tube failure due to stress corrosion cracking in the presence of high CO2 gas temperature (tube side) and chloride presence in cooling water (shell side), it was decided to replace the tubes of SS 304L with the duplex tubes (SAF2205) in all inter stage coolers. Retubing of 1st & 3rd inter stage cooler of Hitachi CO2 Compressor (H-1812) with duplex tubes (SAF2205) had been carried out in annual SD-2012.

Retubing of remaining 2nd inter stage cooler of Hitachi CO2 Compressor (H-1812) with duplex tubes (SAF2205) was carried out by M/s. S.R. Engineering, Vadodara against WO No. 201004131228 dated 31/01/2013.

**DETAILS OF EQUIPMENT**

| | | |
|---|---|---|
| Name of Equipment | : | Second Stage Gas Cooler (H-1812) |
| Tube size | : | 19.05 OD X 1.24 thick X 5500 mm long |
| Total no of Tubes | : | 431 |
| No. of tubes to be replaced | : | 431 |
| Material of existing tubes | : | A213 TP 304L |
| Material of new tubes | : | Sandvik make SAF 2205 (Duplex stainless steel) |
| Tubesheet Thickness | : | 75 mm having 2 grooves of 3 mm wide |
| Tube to Tubesheet Joint | : | Tube to be rolled upto 72 mm length for tubesheet at channel side (North end) and 77 mm for tubesheet at other end (South end) |
| Service, Shell Side | : | Cooling Water |
| Service, Tube Side | : | Carbon dioxide at 20.49 $Kg/cm^2$ (a) |
| Hydro test, Shell Side | : | 12 $Kg/cm^2$ (g) |

**Following activities were carried out:**

- Removed the equipment from its position with the help of Hitachi monorail after loosening all flanges.
- Tube bundle was pulled out from the shell.
- Tubes were cleaned by hydojetting from the outside.
- Due to corrosion in outer surface, tubes were unable to pull out from the tube sheet.
- It was decided to cut the tubes with the help of cut rods.
- All tubes were cut with the help of cut rod. Both tube sheets were sent to central workshop to remove the expanded stub tubes from the tube sheet with the help of drilling.
- Replaced the existing CS tie rod with new SS tie rods.
- New tubes of duplex material were inserted in to the both tube sheet one by one.
- Tubes were expanded from 8% to 10% into the tube sheet. Measured Tube ID after expansion: 16.96 mm to 16.98mm.

***Note: Calculation for tube expansion:***

Tube OD: 19.05mm, Thickness: 1.24mm (MWT), Tube ID: 16.57mm,
Tube sheet ID: 19.25mm

Clearance between tube and tube sheet: 19.25 – 19.05 = 0.20mm

Required Expansion: 8% to 10%

8% of tube expansion: (8/100) x 2.48 = 0.19mm

After expansion tube ID: **16.96mm** (16.57 + 0.19 + 0.20)

10% of tube expansion: (10/100) x 2.48 = 0.24mm

After expansion tube ID: **17.01mm** (16.57 + 0.24 + 0.20)

- Inserted the tube sheet into the shell.
- Checked the leak from tube to tube sheet joint, Hydrotest was carried out at 12 kg/cm2 g from the shell side. After hydrotest, minor leakage was observed through tube OD. Those tubes were expanded again. Confirmation hydrotest was done. No tube leakage was found.
- Heat exchanger was kept on the foundation & boxed up.

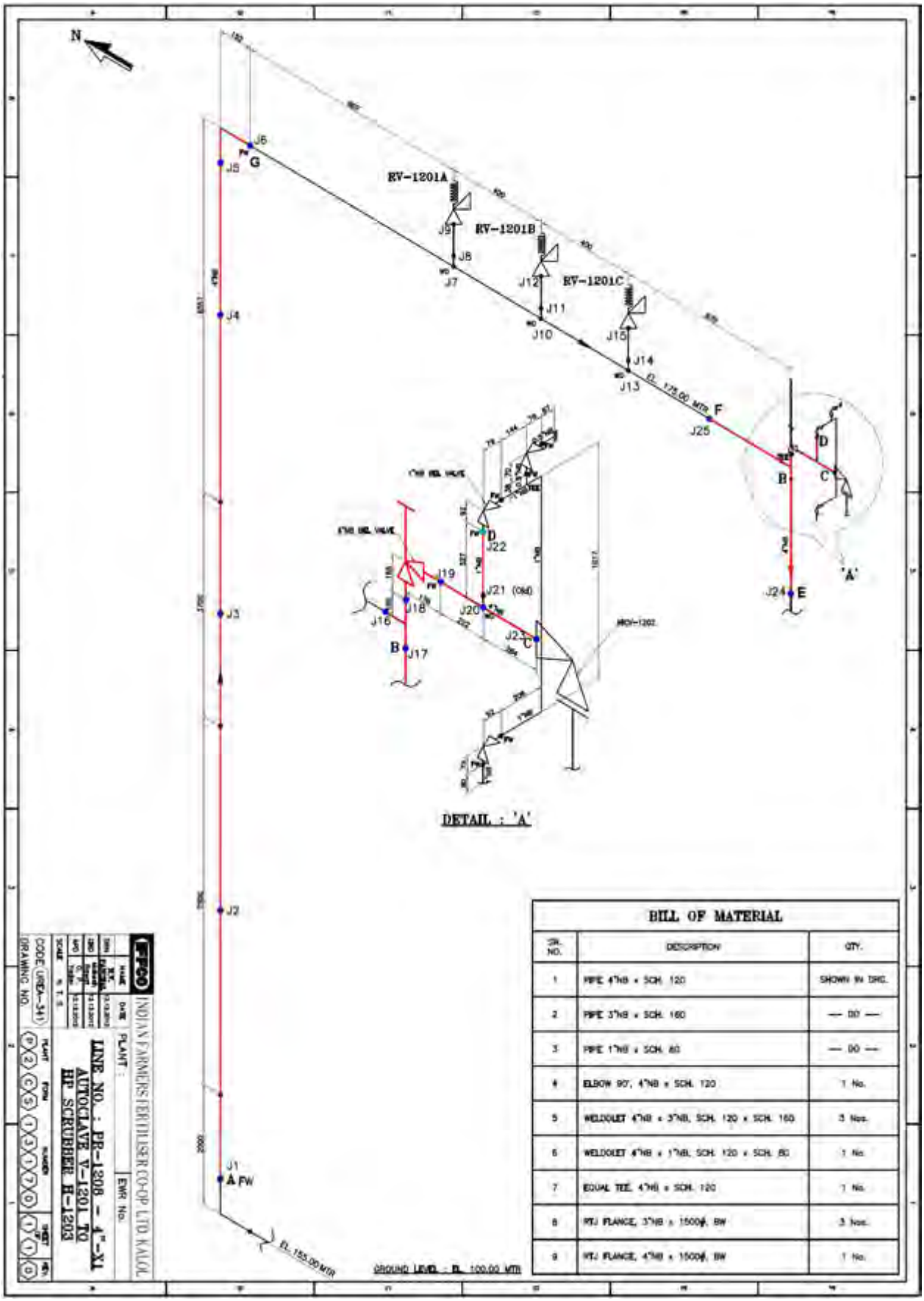
**Replacement of Offgas line of V-1201:**

Fabrication job to replace the offgas line of Autoclave (PR-1206-4”-X1, shown by red color in drawing) were awarded to M/s A.M. Erectors, Ahmedabad against WO 201004131414.

Following activities were carried out:

- Existing piping was cut by grinding at marked A, B, C, D, E, and F & G as shown in attached Drg. No. P2-CS-13170 Sheet 1 of 1 Rev. 0 & removed cut pipe along with fittings.
- Prefabrication of pipe portion from joint J2 to joint J5 was carried out at workshop.
- Insulation was done over the piping before erection & then by the help of Kobelco crane it was erected at site.
- Due to delay in the supply of Pipe fittings required for replacement of portion from joint J6 to joint J25, this portion was left as it is & to be replaced in next Shutdown.
- Edge preparation of field joints were done for carrying out welding.
- Root and final welding of all joints i.e. J1, J6, J16, J17, J18, J19, J23, J24 & J25 of 4” size, J20 and J22 of 1” size were carried out at site by GTAW using 25-22-2LMn filler wire – 2.4mm dia.
- Stage wise Inspection of all weld joints i.e. Weld edge DP, Root weld & final weld DP and 100% radiography (except flange joint) was carried out to maintain quality of welding.

- Approx. 25.0 meter long pipe ( 4” x 160 Sch, SS 316L Urea Grade) , pipe ( 1” x 80 Sch, SS 316L Urea Grade), 1 no. of elbow ( 4” x 160 Sch, 90 Deg. SS 316L Urea Grade ), 1 no. of equal tee ( 4” x 160 Sch, SS 316L Urea Grade ) and 1 no. 4” Bel valve were consumed.




| BILL OF MATERIAL | | |
|---|---|---|
| SR. NO. | DESCRIPTION | QTY. |
| 1 | PIPE 4"NB x SCH. 120 | SHOWN IN DRG. |
| 2 | PIPE 3"NB x SCH. 160 | — DO — |
| 3 | PIPE 1"NB x SCH. 80 | — DO — |
| 4 | ELBOW 90°, 4"NB x SCH. 120 | 1 No. |
| 5 | WELDOLET 4"NB x 3"NB, SCH. 120 x SCH. 160 | 3 Nos. |
| 6 | WELDOLET 4"NB x 1"NB, SCH. 120 x SCH. 80 | 1 No. |
| 7 | EQUAL TEE, 4"NB x SCH. 120 | 1 No. |
| 8 | RTJ FLANGE, 3"NB x 1500#, BW | 3 Nos. |
| 9 | RTJ FLANGE, 4"NB x 1500#, BW | 1 No. |

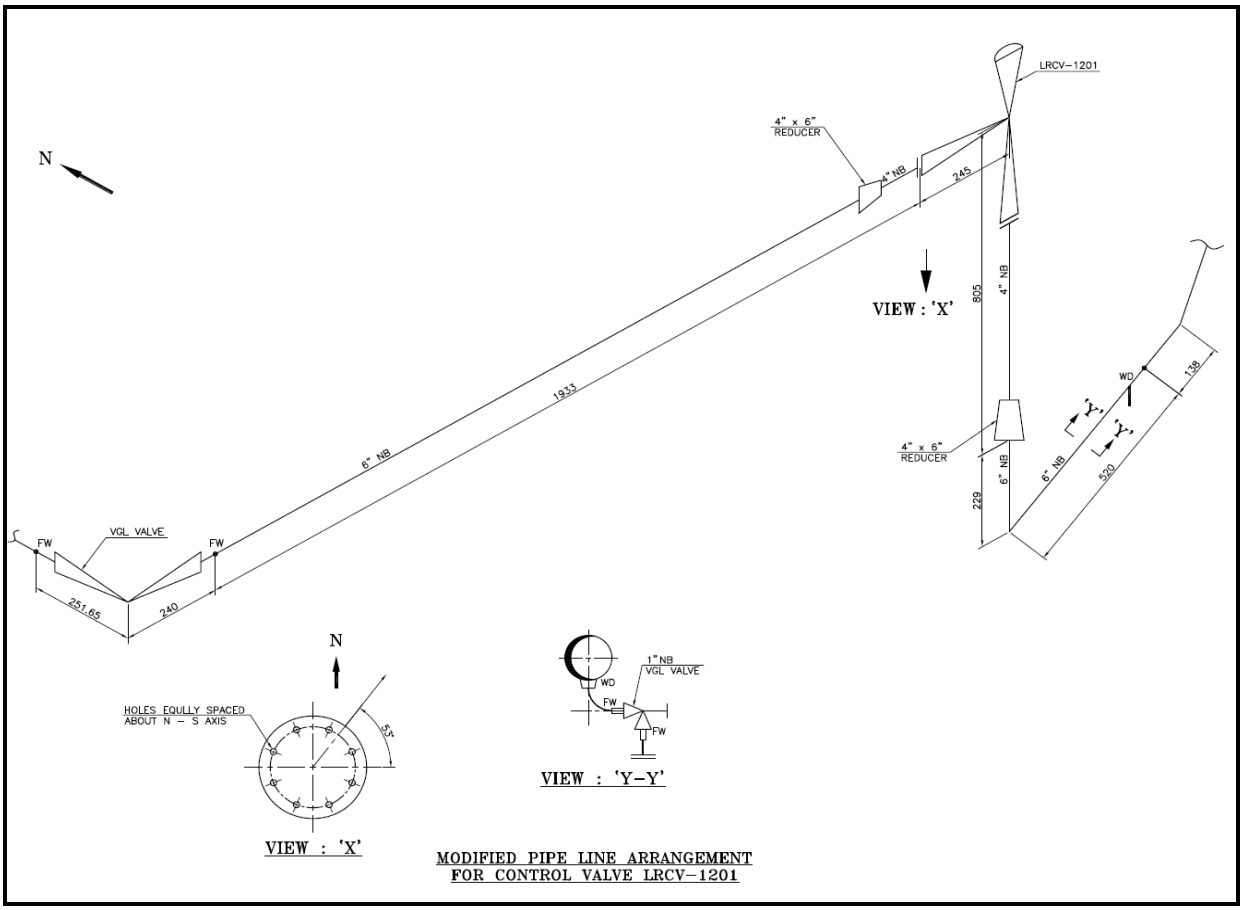
IFFCO INDIAN FARMERS FERTILISER CO-OP LTD KALOL
LINE NO. : PR-1208 - 4"-X1
AUTOCLAVE V-1201 TO HP SCRUBBER H-1203
DRAWING NO. CODE (AREA-34)

**Modification of Pipe Loop for Replacement of LRCV-1201**

Modification in the orientation of pipe loop was required for installation of newly procured LRCV-1201 in place of existing one. Fabrication Job involved in replacement of LRCV-1201 was carried out by M/s. A.M. Erectors against WO No. 201004131414.

Following activities were carried out:

- Existing control valve LRCV-1201 was removed.
- Existing piping was cut by grinding & removed cut pipe along with fittings.
- Due to delay in supply of material, Old fittings such as Elbow 90 degree, 6" x Sch 120 - 2 nos., Reducer, 6" x 4" Sch 120 x Sch 120 - 2 nos. were reclaimed & reused it after proper inspection. Reduced thickness was found in the reducer of inlet line which was maintained by weld deposition. New SS 316L Pipe, 4" x Sch 120 & Pipe, 6" x Sch 120 of required length was used.
- Edge preparation was done for carrying out welding of joints.
- Fitment of modified line was carried out.
- Root and final welding of all joints was done by GTAW using 25-22-2LMn filler wire – 2.4mm dia.
- Stage wise Inspection of all weld joints i.e. Weld edge DP, Root weld & final weld DP and 100% radiography (except flange joint) was carried out to maintain quality of welding.
- Installed new control valve LRCV-1201 along with gasket in the modified line.




## Prill Cooling System

### Inlet Air Fan (K-1701):

- Visual inspection of both bearing was done. Oil flushing of both bearing was done.
- Strengthening of motor base frame was done.
- Alignment of both pulleys was done, Belt replaced by new one and guard was provided.

### Exhaust Air Fan (K-1702):

- Visual inspection of both bearing was done. Drive End side bearing lock nut & lock washer found loose. Bearing checked but no damage was found hence, tightened back the lock nut & washer. Oil flushing of both bearing was done.
- Alignment of both pulleys was done, Belt replaced by new one and guard was provided

### Conveyor System:

### Prill Tower Conveyors (M-1403-12/3):

### M-1403-1 conveyor:

- All damaged carrying rollers and return rollers were replaced with reconditioned ones.
- Head pulley was replaced by modified pulley having provision of coupling drive along with chain drive.
- Gear box oil was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.

**M-1403-2 conveyor:**

- Existing belt was replaced with new HRT2 grade belt.
- All damaged carrying rollers and return rollers were replaced with reconditioned ones.
- Gear box oil was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.

**M-1403-3 conveyor:**

- All damaged carrying rollers and return rollers were replaced with reconditioned ones.
- Gear box oil was flushed. New coupling bush was provided.
- Alignment was done between gear box to motor and from gearbox to pulley.

**Link Conveyor (M-1419):**

- All damaged carrying rollers and return rollers were replaced with reconditioned ones.
- Head Pulley both bearings were replaced.
- Gear box oil was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.

**Prill Cooling System Link Conveyor (M-1421):**

- All damaged carrying rollers and return rollers were replaced with reconditioned ones.
- Head pulley with bearings was replaced with new one as shaft was found worn out at bearing portion. Also both bearings of Tail Pulley were replaced.
- Gear box oil was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.

**Dust Conveyor System (M-1702):**

- All damaged carrying rollers and return rollers were replaced with reconditioned ones.
- Gear box oil was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.

**Prill Tower Scraper (M-1402-1/2):**

**Scraper (M-1402)**

Scraper oil was flushed.

**Fluid Coupling**

- Existing Fluid Coupling M-1402-1 was replaced with pembril make Fluid coupling & oil of M-1402-2 was flushed.
- Alignment of motor and coupling was done.

**Gear Box of Scraper, M-1402-1/2**

- Oil flushed.

**Prill Tower ID Fan K-1401-1/2/3/4**

**K-1401-1**

- Belts were replaced with newly procured green belt. Alignment of motor and fan pulley was corrected.

**K-1401-2**

- Belts were replaced with newly procured green belt. Alignment of motor and fan pulley was corrected.

**K-1401-3**

- Modified Fan Pulley of smaller size 315 mm dia PCD (325 mm OD) was installed at Prill Tower ID Fan (K-1401/2) in place of 355 mm dia PCD (365 mm OD) fan pulley as per the scheme approved by competent authority vide approval note dated 14/07/2012.

**Before Modification**

**After Modification**

- Top bearing was replaced due to damage found in the lock of bearing half.
- Belts were replaced with newly procured green belt. Alignment of motor and fan pulley was corrected.

**K-1401-4**

- Belts were replaced with newly procured green belt. Alignment of motor and fan pulley was corrected.

**Repairing was done in following equipments after manhole opening:**

**V-1101 (CO2 KNOCK OUT DRUM)**

Inside the CO2 Knockout Drum, Painting by Epoxy paint was done.

**V-1102 (NH3 SUCTION FILTER)**

Replaced filter cloth of Ammonia Suction Fillter

**V-1202 (RECTIFYING COLUMN)**

Holes in Spray breaker trays (4 nos.) for holding bolts found elongated, therefore, all the trays were replaced by repaired one.

**V-1423 (1st Stage Evaporator Scrubber)**

Loosened & damaged demister pads were repaired & fixed properly. All loose J- bolts were tightened.

**V-1501 (4 ATA STEAM DRUM) (GT-1664)**

- Open inspection and hydro test carried out at 10.1 Kg/Cm2g in presence of Boiler Inspector.
- Minimum measured thickness of 6.92mm against Nominal thickness of 12.70 mm was found in 4" X 4" area on elbow of 3rd no. riser as per sketch (second riser from ammonia side towards Ahmadabad side). Patch of approx. 6"X 6" size was prepared & welded.

**H-1424 (2nd Stage Evaporator)**

In short shutdown 9-12 January, 2013 during cleaning of H-1424 vessel, choking was observed in suction pipeline of P-1408 pump connected with the H-1424 nozzle. It was tried to clear the choking by rod poking & flushing by hot condensate but not succeeded. When the steam jacketed Pump suction line 1st segment connected to H-1424 nozzle (Flange size: 12" X 150#) above sight glass was removed, it was found completely collapsed & steam jacket found choked badly by urea solution.

Then, it was replaced by temporarily fabricated segment of SS 304L without jacket.

Material consumed in segment fabrication:

Pipe size: 12" X Sch 10

Reducer: 12" X 6" Sch 10 - old reducer reclaimed

Elbow: 22.5 Deg & 45 Deg.12" X Sch 10

Flange: 12" X 150# - 1 no. & 6" X 150# - 1 No.

Same temporarily fabricated segment of SS 304L was replaced by newly fabricated segment utilizing following material:

Pipe size: 12" X Sch 40

Reducer: 12" X 6" Sch 40

Elbow: 22.5 Deg & 45 Deg.12" X Sch 10

Flange: 12" X 150# - 1 no. & 6" X 150# - 1 No.

- Repairing of bend sparger supports nearby manhole and its sheared "U" clamps was carried out.

**RELIEF VALVE OVERHAULING AND TESTING**

Overhauling and testing of RV was done by M/s Flotec Engineering Services, Surat against W. O. No. **20110831** dated 26-11-2011. The testing was done on new RV test bench.

Following RV's were removed, overhauled and tested on valve test bench:

| Sr. No. | RV No. | Description | Test Medium | Set Pressure Kg/cm2g | Reset Pressure Kg/cm2g | Remarks |
|---|---|---|---|---|---|---|
| 1 | RV-1201 A | V-1201 off gas line | Nitrogen | 165 | 150 | |
| 2 | RV-1201 B | V-1201 off gas line | Nitrogen | 165 | 150 | |
| 3 | RV-1201 C | V-1201 off gas line | Nitrogen | 165 | 148 | Nozzle, Disc & Seat replaced |
| 4 | RV-1205 | P-1201 A discharge | Water | 165 | 148 | |
| 5 | RV-1206 | P-1201 B discharge | Water | 165 | 148 | |
| 6 | RV-1208 | P-1201 C discharge | Water | 170 | 148 | |
| 7 | RV-1103 A | P-1102 A discharge | Water | 150 | 135 | |
| 8 | RV-1103 B | P-1102 B discharge | Water | 150 | 135 | |
| 9 | RV-1103 C | P-1102 C discharge | Water | 150 | 135 | |
| 10 | RV-1181 | K-1801 final discharge | Nitrogen | 177 | 159 | |
| 11 | RV-1903 | K-1801 3rd stage discharge | Nitrogen | 111 | 100 | |
| 12 | RV-1202A | V-1202 off gas line LP System | Nitrogen | 6 | 5.5 | |
| 13 | RV-1202B | V-1202 off gas line LP System | Nitrogen | 6 | 5.5 | |
| 14 | RV-1202C | V-1202 off gas line LP System | Nitrogen | 6 | 5.5 | |
| 15 | PSV-1201A | P-1201 A Suction line | Water | 8.5 | 7.5 | |
| 16 | PSV-1201B | P-1201 B Suction line | Water | 8.5 | 7.5 | |
| 17 | PSV-1201C | P-1201 C Suction line | Water | 8.5 | 7.5 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 18 | RV-1101A | Liquid ammonia line from H-1102 to V-1102 | Water | 31 | 29 | |
| 19 | RV-1101B | Liquid ammonia line from H-1102 to V-1102 | Water | 31 | 29 | |
| 20 | RV-1102 A | Ammonia Suc. Vessel (V-1103 ) | Water | 31 | 29 | |
| 21 | RV-1102 B | Ammonia Suc. Vessel (V-1103 ) | Water | 31 | 29 | |
| 22 | RV-1107 A | Liquid anmmonia line(hot) before ammonia filter | Water | 31 | 29 | |
| 23 | RV-1107 B | Liquid anmmonia line(hot) before ammonia filter | Water | 31 | 29 | |
| 24 | RV-1901 | 1st stage discharge of K-1801. | Nitrogen | 7 | 6.7 | |
| 25 | RV-1902 | 2nd stage discharge of K-1801 | Nitrogen | 27 | 25.1 | |
| 26 | RV-1503 | 23 ata Steam | Nitrogen | 25 | 23.8 | |
| 27 | RV-1504 | 9 ata Steam Drum | Nitrogen | 12 | 11 | |
| 28 | RV-1129 A | 4 ata Steam Header | Nitrogen | 6 | 5.4 | |
| 29 | RV-1129 B | 4 ata Steam Header | Nitrogen | 6 | 5.4 | |
| 30 | RV-1501 | 4 ata Steam Drum | Nitrogen | 7.5 | 6.8 | |
| 31 | RV-1502 | 4 ata Steam Drum | Nitrogen | 7.5 | 6.6 | |
| 32 | RV-1506 | 4 ata Steam Main | Nitrogen | 6 | 5.4 | |
| 33 | RV-1209 | V-1203 Vessel | Nitrogen | 10 | 9 | |
| 34 | RV-1351 | RV of V-1351 | Nitrogen | 24 | 23 | |
| 35 | RV-1352 | RV of V-1352 | Water | 6 | 5.4 | |
| 36 | RV-1301 | RV of V-1301 | Nitrogen | 6 | 5.9 | |
| 37 | RV-1184 (CCS-I) | H-1102 outlet NH3 outlet | Water | 6 | 5.5 | |
| 38 | RV-1221 (CCS-II) | P-1204 disch. To H-1203 | Water | 16.5 | 15 | |
| 39 | RV-1913 | Ejector system of Q-1801 | Nitrogen | 0.20 | 0.20 | |
| 40 | RV-1914 | Ejector system of Q-1801 | Nitrogen | 0.20 | 0.20 | |
| 41 | RV-1916 | 23 ata Steam extraction | Nitrogen | 28 | 26 | |
| 42 | RV-1917 | 4 ata Steam exhaust | Nitrogen | 4 | 3.6 | |
| 43 | RV-1351 A | RV of P-1351 A | Water | 10 | 9 | |
| 44 | RV-1351 B | RV of P-1351 B | Water | 10 | 9 | |
| 45 | RV-1130 | 24 ata steam header | Nitrogen | 26 | 22.5 | |
| 46 | RV-1904 | H-1811 1st stage gas cooler | Water | 7 | 6 | |
| 47 | RV-1905 | H-1812 2nd stage gas cooler | Water | 7 | 6 | |
| 48 | RV-1906 | H-1813 3rd stage gas cooler | Water | 7 | 6 | |
| 49 | RV-1224 | C.W from utilities | Water | 6 | 5.4 | |

**CLEANING AND HYDROJETTING OF HEAT EXCHANGERS:**

The Hydro jetting job was awarded to M/s. Deluxe Hydro blasting Services, Mumbai vide W.O. No. 201004120248 dated 24/01/2012. Following heat exchangers were opened for cleaning by hydro jetting. After cleaning, exchangers were boxed up with new gaskets.

- Surface Condenser (H-1815)
- Main Lube Oil Coolers (H-1814-A/B)
- Condenser Pre-evaporator (H-1419)
- First Evaporator (H-1422) with DM water.
- First Evaporator Condenser (H-1423)
- Second Evaporator (H-1424) with D.M. water
- Flash Tank Condenser (H-1421)
- Second Evaporator I Condenser (H-1425)
- Second Evaporator II Condenser (H-1426)
- First Evaporator Final Condenser (H-1420)
- Recirculation Heater (H-1204) with D.M. Water
- L.O. Coolers of P-1102-A/B/C
- L.O. Coolers of P-1201-A/B
- Reflux Condenser (H-1352)
- CCS - II cooler (H-1207)

**NRV Inspection**

Following NRVs in Urea Plant were opened, inspected and boxed up.

- $CO_2$ to H-1201
- $NH_3$ to H-1202
- $NH_3$ to V-1201
- Carbamate to H-1202
- Carbamate to H-1203
- $CO_2$ to H-1203
- 4 ata steam to V-1352
- 23 ata steam to V-1351
- Condensate to melt return line
- 9 ata steam injection to offgas line of V-1203/V-1207
- 9 ata steam injection to off gas line of V-1205
- $NH_3$ water to V-1352
- $CO_2$ to 1$^{st}$ Desorber V-1352
- P-1351 A/B discharge
- K-1801 discharge
- K-1801 3$^{rd}$ suction

## Fabrication Jobs

| Sr. No. | Job Description | Floor Location | Tag No. | Action Taken |
|---|---|---|---|---|
| **Steam and Condensate Jobs:** | | | | |
| 1 | 60 ata header to 40 ata, PT-1145 I/V Gland leak | 1st Floor in front of C R | 8 | Valve replaced 3/4" X 1500# GlV - 1 |
| 2 | PIC-1130 bypass I/V passing | 1st Floor near C R | 7 | Valve replaced 3/4" X 800# GV - 1 |
| 3 | FIC-1302 4 Ata Steam I/V GR (bush broken) | 2nd floor | 95 | Valve replaced 3/4" X 800# GV - 2 |
| 4 | Steam Tracing line trap not working | 2nd floor | 94 | Valve replaced 3/4" X 800# GV - 1 |
| 5 | V-1503 top CCS-II jacket steam I/V(Red Color) GR | 3rd floor | 116 | Valve replaced 1-1/2" X 800# GlV - 1 |
| 6 | PICV-1502A D/S vent I/V to be replaced( furmanite job) | 3rd floor | 123 | Valve replaced 3/4" X 800# GV - 1 |
| 7 | V-1205 steam tracing I/V Gland leak & Union leak | 3rd floor | 108/109 & 117 | Valve replaced 1/2" X 800# GV - 1 |
| 8 | 9 ata I/V CCS-II Jacket | 3rd floor | 116 | Valve replaced 1-1/2" X 800# GlV - 1 |
| 9 | 9 ata condensate line | 3rd floor | 113 | Valve replaced 3/4" X 800# GV - 1 |
| 10 | 9 ata condensate near Lt tap valve passing | 3rd floor | 124 | Valve replaced 1" X 800# GV - 1 |
| 11 | V-1503 LP tapping Root I/V passing | 3rd floor | | Valve replaced 1"X 1500# SW GV - 1 |
| 12 | 23 ata vent between two bypass I/V of MOV & I/V | Compressor Floor | 24 | Valve replaced 1-1/2" X 800# GV - 1 |
| 13 | 23ata header drain I/V & Bypass passing | G Floor | 22 | Valves replaced 3/4" X 800# GV - 1 No.1"X800# GV-1 No. |
| 14 | Q-1801 Extraction header drain I/V (near QC NRV) bush broken. | G Floor | 14 | Valves replaced 3/4" X 800# GV - 1No. |
| 15 | 23 ata header trap, near H-1815, I/V and bypass I/V passing. | G Floor | 12 | Valve replaced 1" X 800# GV - 2 No |
| 16 | 60 ata main header I/V U/S drain passing | G Floor | 15 | Valves replaced 1" X 800# GV - 2 No. |
| 17 | PICV-1128 U/S drain both I/V passing | G Floor | 2 | Valve replaced 3/4" X 1500# GlV - 1 3/4" X 1500# GV - 1 |
| 18 | 60 ata B/L drain I/V passing | G Floor | 3 | Valve replaced 2" X 1500# GlV - 1 |
| 19 | Steam trap behind operator cabin is passing. | G Floor | 9 | Valve replaced 1/2" X 800# GV - 2 |
| 20 | 60 ata trap ( near PDI-1717 boiler side) is passing | G Floor | 18 | Valve replaced 1" X 800# GV – 2 |

| | | | | |
|---|---|---|---|---|
| 21 | 23 ata vent outside CR near stair case. | In front of control room | 67 | Valve replaced 3/4" X 800# GV - 1 |
| 22 | 23 ata near turbine drain trap bypass is passing | Near H-1815 | 13 | Valve replaced 1" X 800# GV - 1No |
| 23 | T-1814 23 ata Inlet I/V | | 17 | Valve replaced 3/4" X 800# GV - 1 |
| **Compressor Section:** | | | | |
| 24 | PIC-1810 Tracing drains to be replaced. | G Floor | 18 | Tracing line with Valve replaced 1" X 800# GV - 1 |
| 25 | 23 ata Header Drain I/V passing | G Floor | 22 | Valves replaced 3/4" X 800# GV - 1, 1" X 800# GV - 1 |
| 26 | PAHH-1838 root I/V to be replaced | Near H-1815 | 19, 20, 21 | Valve replaced 3/4" X 800# GV - 3 |
| **Synthesis Section:** | | | | |
| 27 | P-1201/A 2nd discharge I/V passing | 1st floor | 126 | Valve replaced 3" BEL Valve |
| 28 | H-1207 CW strainer, drain I/V to be rerouted. | 2nd floor | 54 | Drain line with Valves replaced, 1" X 800# GV - 2 |
| 29 | H-1205 O/L line steam tracing I/V not operatable | 2nd floor | 148 | 1/2" new Line provided |
| 30 | Service station condensate I/V passing control room side | 2nd floor | 69 | Valves replaced 3/4" X 800# GV - 2 |
| 31 | TICV-1201 steam line trap I/V not operatable | 2nd floor | 83 | Valves replaced 1/2" X 800# GV - 2 |
| 32 | CCS-II inlet to H-1207(at H-1207 top) line vent I/V and its drain I/V not operatable | 2nd floor | 87 | Valves replaced, 3/4" X 800# GV – 1 & 1" X 800# GV - 1 |
| 33 | P-1201/B Suction drain I/V passing | G floor | 37 | Valve replaced, 3/4" X 150# GlV SS316-1 |
| 34 | H-1201 sample point 1st I/V passing | G Floor | 38 | Valve replaced, 1/2" Bel Valve |
| 35 | P-1102B discharge line PT tapping PI-1102B I/V wheel free | G floor | 44 | Valve replaced, 1/2" X 1500# GV - 1 |
| 36 | P-1102A drains line between both dishes. I/V, I/V wheel is free | G floor | 45 | Valve replaced, 3/4" X 800# GV - 1 |
| 37 | Near P-1102C suction I/V instrument air service line I/V wheel is missing | G floor | 46 | Valve replaced, 3/4" X 800# GV - 1 |
| 38 | FT-1502 root I/V leakage | G Floor | 49 | Valve replaced, 3/4" X 800# GV - 1 |
| 39 | LRCV-1201 d/s drain hard to operate | G Floor | 52 | Valve replaced, 3/4" X 800# GV - 1 |
| 40 | P-1102A/B/C close drain line vent I/V wheel missing | Near MIC 1102B | 47 | Valve replaced, 3/4" X 800# GV - 1 |
| 41 | CO2 to H-1203(FIC-1202) D/S drain I/V is passing | PT Top | 151 | Valve replaced, 1" Bel Valve - 1 |

| | | | | |
|---|---|---|---|---|
| **Evaporation and Prilling:** | | | | |
| 42 | Lute drains steam tracing I/V not operable. | 1st floor | 144 | Valve replaced 3/4" X 1500# GIV - 1 |
| 43 | FI-1435 I/V Flange Joint Leakage | 1st floor | 71 | Attended |
| 44 | Steam tracing behind H-1424 | 2nd floor | 84, 88, 91 | Tracing line with valves replaced, 1/2" X 800# GV - 3 |
| 45 | H-1424 shell side I/V U/S Leak | 2nd floor | 93 | Valve replaced 1" X 800# GV - 1 |
| 46 | H-1424 steam tracing I/V at 2nd floor is hard to operate. | 2nd floor | 92 | Valve replaced 1/2" X 800# GV - 1 |
| 47 | P-1408 jacket steam trap not working | G Floor | 56 | Trap replaced, 1/2" Trap - 1 |
| 48 | P-1408 tracing line 3rd I/V not operatable | G Floor | 55 | Valve replaced 3/4" X 800# GV - 2 |
| 49 | P-1408 casing jacket I/V G/L | Near P/1408 | 55 | Valve replaced,1/2" X 800# GV SS316 - 1 |
| 50 | Steam injection to melt return line I/V wheel broken & not operable | PT Top | 172 | Valves replaced, 1/2" X 800# GV - 1, 3/4" X 800# GV - 1 |
| 51 | HICV-1401 bypass I/V bush broken | PT Top | 145 | Valve replaced, 3/4" X 800# GV - 1 |
| 52 | P-1401 AB Common suction tracing I/V G/L | G Floor | 53 | Valve replaced, 3/4" X 800# GV - 1 |
| 53 | H-1421 drain line pinhole leak and its I/V is passing | | | 1/2" line & ½" SW GV replaced |
| **PCS Section:** | | | | |
| 54 | Steam trap of PCS tank is not working | G Floor | 61, 62, 78, 96 | Trap & Valves replaced, 1/2" X 800# GV - 1, 1/2" Trap SPM - 2, 1/2" Trap Ball Float - 2 |

## Gland Repacking Jobs:

Gland packing in following jobs was replaced by new one.

| Sr. No. | Job Description | Floor Location | Tag No. | Remarks |
|---|---|---|---|---|
| **Steam and Condensate Jobs:** | | | | |
| 1 | 60 ata bypass I/V at compressor floor G/L | Compressor Floor | 5, 23 | |
| 2 | H-1419 drain I/V Gland leak | 2nd floor | 97 | |
| 3 | 23ata to 9ata Line vent I/V G/L (near PICV-1502A) | 3rd floor | 123 | |
| 4 | H-1424 steam tracing I/V. 23 ata to 9 ata main I/V G/L | 3rd floor | 121 | |
| 5 | 60 ata main B/L I/V bypass I/V G/L | G Floor | 5 | |
| 6 | H-1303 Surface Condenser common inlet both I/V G/L | | 108/11 | |

| | | | | |
|---|---|---|---|---|
| **Synthesis Section:** | | | | |
| 7 | V-1202 LT LP tapping condensate flushing I/V (Furmanite job) | 1st floor | 68 | 1-1/2" X 150# Flanged GlV |
| 8 | 4 ata header near V-1409 filter | 1st floor | 125 | |
| 9 | Ammonia to H-1202 I/V G/L. MOV-1202 Gland leak. | 3.5 floor | 127 | |
| 10 | 4 ata to V-1202 off gas I/V G/L | 3rd floor | 104 | |
| 11 | 9 ata to 4 ata to H-1202 I/V gland no margin | 3rd floor | 105 | |
| 12 | P-1302 C dish. I/V passing | G Floor | 48 | |
| 13 | NH3/ H2O flushing inlet I/V to P-1201C to be replaced as no margin gland left. | G Floor | 50 | |
| 14 | P-1305A dish. I/V gland to be repacked. | G Floor | 30 | |
| 15 | P-1202A dish. I/V gland no margin | G Floor | 51 | |
| 16 | PRCV-1504 U/S I/V gland no margin | G Floor | | |
| 17 | P-1102 A 1st and 2nd suction I/V gland no margin | G Floor | 42 | |
| 18 | V-1103 1st I/V Gland Leak | G floor | 122 | |
| 19 | P-1102B dish. 1st I/V gland no margin | G Floor | 43 | 4" X 900# |
| 20 | Hydrolyser to H-1205 I/V Gland Leak | | 64 | |
| 21 | LICV-1422 1st outlet Gland Leak | | 85 | |
| 22 | P-1201-A/B/C steam tracing I/V Gland Leak | | 119 | 1/2" X 150# GV Flanged - 1 |
| 23 | V-1205 Condensate Flushing I/V Gland Leak | | 82 | |
| **Evaporation and Prilling:** | | | | |
| 24 | P-1401 AB Common suction tracing I/V G/L. | G Floor | 53 | 3/4" X 800# GV - 1 |
| 25 | P-1304C dish I/V Gland leak. | 1st floor | 63, 66, 70, 74, 110 | |
| 26 | FI-1436 d/s I/V Gland leak | 1st floor | 59, 73, 79 | |
| 27 | H-1426 outlet I/V Gland leak. | 1st floor | 65, 77, 118 | |
| 28 | H-1427 cooler Ammonical water I/V G/L | 1st floor | 73, 79 | |
| 29 | H-1419 Gland leakage | 2nd floor | 90 | 1" X 800# SS316 |
| 30 | TRCV-1422 U/S I/V Gland leak | 3rd floor | 106/107 | |
| 31 | H-1425 condensate flushing 2nd I/V Gland leak and no margin left to tight. | 3rd floor | 111 | |
| 32 | H-1422 condensate flushing I/V is passing | 3rd floor | 115 | |
| 33 | T-1301 suction I/V near TR-1427 Gland leak and no margin left to tight. | G Floor | 28 | |

| | | | | |
|---|---|---|---|---|
| 34 | P-1426B dish. I/V gland no margin | G Floor | 30 | |
| 35 | P-1302 C recycle I/V Gland leak and no margin left to tight. | G Floor | 29 | |
| 36 | P-1302C & D dish. Interconnection I/V Gland leak and no margin left to tight. | G Floor | 31 | |
| 37 | V-1409 A/B suction & discharge I/V's Gland leak | Ist floor | 80/81 | |
| **PCS Section:** | | | | |
| 38 | P-1701 discharge to T -1401 PCS batch transfer line ball valve leak at 1st floor (behind P-1304) to be replaced/attended | 1st Floor | 75 | |
| 39 | TICV-1701 A/B discharge I/V & bypass I/V G/L | G Floor | 57 | |
| 40 | P-1701A dish I/V Gland leak. | G Floor | 58 | |
| 41 | P-1701-A Suction I/V Gland leak | G Floor | 60 | |
| **Hydrolyser Section:** | | | | |
| 42 | TICV-1353 Bypass I/V Gland leakage | 1st floor | 141 | |
| 43 | LICV-1352 both I/V Gland leakage | 2nd floor | 142/143 | |
| 44 | P-1351/A Dish I/V G/L. | G floor | 34 | |
| 45 | P-1351 A dish I/V G/L | G Floor | 34 | |
| 46 | T-1301 outlet I/V to P1305 Gland leak. | G Floor | 27 | |
| 47 | P-1302A suction I/V Gland leak. | G Floor | 32 | |
| 48 | P-1351-B Discharge & recycle line Gland leakage | G Floor | 36 | |

## Other Process Jobs:

| Sr. No. | Job Description | Floor Location | Tag No. | Action Taken |
|---|---|---|---|---|
| **Steam and Condensate Jobs:** | | | | |
| 1 | 4 ata vent between two I/V is passing | Compressor Floor | 26 | Replaced, 2" X 1500# Flanged GlV- 1 |
| 2 | 4 ata steam drain near H-1815 CW outlet, passing | G Floor | 16 | Replaced, 1" X 800# Threaded GV - 1 |
| **Compressor Section:** | | | | |
| 3 | 4 ata admission CV oil leakage | Compressor Floor | 25 | Union leakage attended |
| **Synthesis Section:** | | | | |
| 4 | N/C Ratio Meter inlet I/V wheel broken | 1st floor | 76 | 1/2" Bel Valve bonnet assy. replaced |
| 5 | Carbamate density meter inlet I/V is passing, to be replaced / attended | 2nd floor | 86 | Replaced 1" X 150# Flanged GV SS316L-1no. |

| | | | | |
|---|---|---|---|---|
| 6 | V-1201 bottom seal I/V bonnet leak | 3rd floor | 100, 101, 102, 103 | 2" Bel Valve bonnet assy. replaced |
| 7 | V-1201 9 ata injection I/V bonnet leak | 3rd floor | 101 | 2" Bel Valve bonnet assy. replaced |
| 8 | V-1201 bottom seal I/V bonnet leak, to be attend | 3rd floor | 103 | 2" Bel Valve bonnet assy. replaced |
| 9 | V-1501 PI top root I/V passing | 4th floor | | |
| 10 | P-1102/C both recycle I/V for passing | G Floor | 39 | Replaced 4" X 900# Flanged GlV – 1 no. |
| 11 | Autoclave unloading line near LRCV-1201 HPF I/V gland no margin | G Floor | 41 | 1/2" Bel Valve bonnet assy. replaced & flanged Japanese Valve replaced |
| 12 | H-1208 bypass I/V Wheel not Operatable | G floor | | Wheel made free |
| 13 | HPF at PT top bleeder I/V passing | PT top | | 1/2" Bel Valve bonnet assy. replaced |
| 14 | CO2 to H-1203 (FIC-1202) U/S drain is not operatable | PT top near | 147 | 1/2" Bel Valve bonnet assy. replaced |
| **Evaporation and Prilling:** | | | | |
| 15 | Steam I/V to Ejector not working | Bucket room | 170 | Overhauling done |
| 16 | H-1419 CW inlet I/V not closing 100% | 2nd floor | 89 | O/H of geared actuator of valve done |
| 17 | H-1422 1st stage evaporator top PT tapping ball I/V is broken | 3rd floor | | Attended |
| 18 | H-1424 Off gas steam injection line flange leak. | 3rd floor | | Flange gasket replaced |
| 19 | Prill bucket assembly hard to rotate. Needs servicing. | PT top | 155 | Overhauling of Prill Bucket assy. Done. |
| **Hydrolyser Section:** | | | | |
| 20 | V-1351 23 ata Steam NRV leak (fermaniting. job) | G Floor | 35 | 3" X 150# NRV O/H done |
| 21 | V-1351 O/L Line drain I/V U/S Flange Leak (H-1351 A Bottom) | G Floor | 33 | Gasket replaced |
| 22 | P-1302 Discharge to V-1352 Flange leak (Fermanited) | 1st floor | 171 | 4" X 150# gasket replaced |
| 23 | Ammonical water to V-1352 inlet line NRV D/S flange leak(furmanite job) | 1st floor | 171 | 4" X 150# gasket replaced |

## PREVENTIVE MAINTENANCE OF ROTARY EQUIPMENTS

### COOLING WATER PUMP (P-4401/A)

Following activities were carried out:

- Take the alignment between Gear box to pump
- Both the Top covers of the pump are removed
- Bearings are removed on both the sides
- Cleaning of journal on both sides of the pump
- Gland packing on both sides of the pump is removed
- Cleaning of bearings is carried out
- Cleaning of bearings covers is carried out
- Pump Gland packing are replaced with new ones 25mm
- Bearing clearances are measured using lead wire
- Bearings are assembled back
- Bearing covers are assembled back
- Check the final alignment & readings are enclosed

| Bearing | Clearance by lead wire | Interference |
|---|---|---|
| Pump Front Bearing | 0.28 to 0.29 | 0.05 |
| Pump Rear Bearing | 0.20 to 0.22 | 0.04 |

Note: All Readings are in mm.

- Pump total float is measured and found **0.60 mm**
- Coupling float was measured and recorded = 10 mm

### ELLIOTT TURBINE (Q-4411) FOR CW PUMP, P-4401/A

During Preventive maintenance following activities were carried out:

- Gear box top cover removed.
- All the bearing top half's were removed.
- Cleaning of journal on both gear wheel & pinion wheels.
- Cleaning of bearings is carried out.
- Cleaning of bearings covers is carried out.
- Bearing clearances are measured using lead wire.
- Bearings are assembled back.
- Top covers are assembled back.
- Check the final alignment & readings are enclosed

**Clearance Readings**

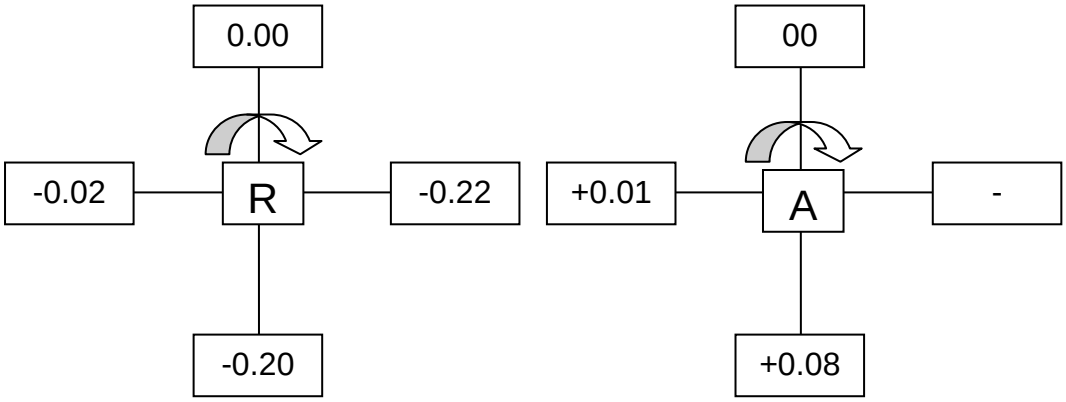
| Bearing | Clearance by lead wire |
|---|---|
| Pinion Front Bearing | 0.19 to 0.21 |
| Pinion Rear Bearing | 0.18 to 0.20 |
| Gear Wheel Front Bearing | 0.26 to 0.28 |
| Gear Wheel Rear Bearing | 0.27 to 0.28 |

Thrust float : 0.54mm

Back lash : 0.55mm

Note: All Readings are in mm.

**Final Alignment Reading between Turbine to Gear Box**

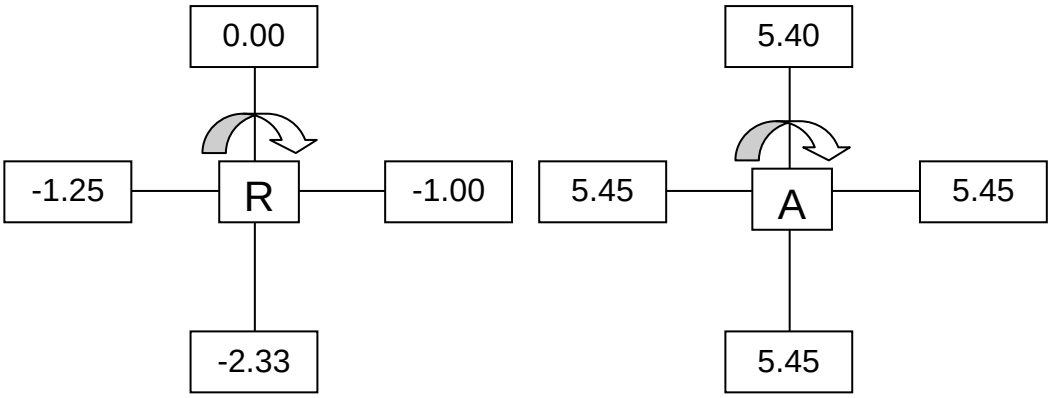



Note:1) Dial on Gear Box.

2) View from Turbine Front Side

3) All Readings are in mm.

**Final Alignment Reading between Gear Box To Pump**




Note: 1) Dial on Pump

2) View from Turbine Front Side

3) All Readings are in mm

Note: All Readings are in mm.

**TRIVENI TURBINE (Q-4401/B) FOR COOLING WATER PUMP P- 4401/B OVERHAULING**

- After overhauling readings are as under:
- Turbine
- Bearing clearance 0.17 to 0.24 (rear side ) interference is 0.00
  0.23 to 0.27 (front side) clearance is 0.05mm
- So put a 0.1mm seam on bearing top and then checked bearing clearance as 0.17 to 0.22
- Thrust Clearance : Before 0.32mm , After 0.38mm
- Total float 3.50 mm (without labyrinth)

| | Adm side | Ammonia side |
|---|---|---|
| • Active side nozzle clearance | 2.38mm | 2.40mm |
| 1st rotor rear side | 3.35mm | 3.35mm |
| 2nd rotor diaphragm clearance | 2.20mm | 2.20mm |
| • Non Active side nozzle clearance | 2.05mm | 2.10mm |
| 1st rotor rear side | 3.50mm | 3.50mm |
| 2nd rotor diaphragm clearance | 2.00mm | 2.00mm |

- Replaced all carbon seal.
- **Carbon seal clearance**
- **Inlet side**

| | O.D. | Clearance | Total Diameter |
|---|---|---|---|
| 1 | 106.88 | 0.26 | 107.14 |
| 2 | 106.91 | 0.26 | 107.17 |
| 3 | 106.90 | 0.22 | 107.12 |
| 4 | 106.91 | 0.22 | 107.13 |
| 5 | 106.90 | 0.16 | 107.06 |
| 6 | 96.81 | 0.15 | 96.96 |
| 7 | 96.84 | 0.15 | 96.99 |

- **Exhaust side**

| | O.D. | Clearance | Total Diameter |
|---|---|---|---|
| 1 | 106.90 | 0.22 | 107.12 |
| 2 | 106.90 | 0.22 | 107.12 |
| 3 | 106.91 | 0.18 | 107.09 |
| 4 | 106.90 | 0.18 | 107.08 |
| 5 | 106.90 | 0.15 | 107.05 |
| 6 | 96.84 | 0.12 | 96.96 |
| 7 | 96.86 | 0.12 | 96.98 |

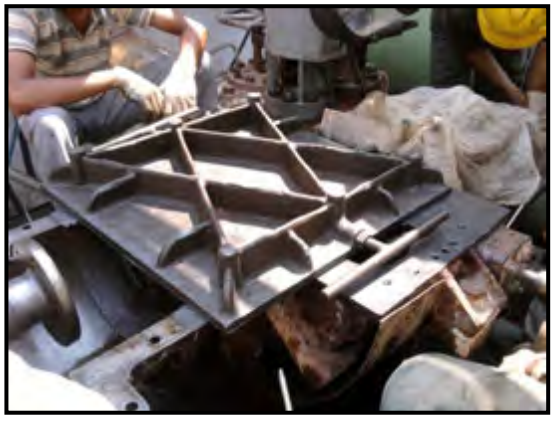
- Governor worm wheel backlash checked as 0.12 mm.
- Turbine OST carried out at 6200 RPM

## Photographs of Triveni Turbine

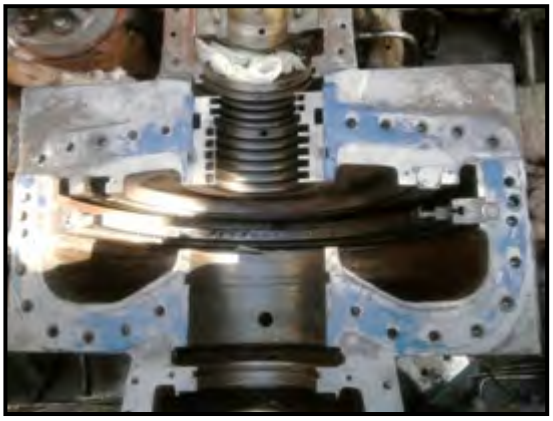
**Turbine Bottom Casing**

**Trip Assembly of Turbine**

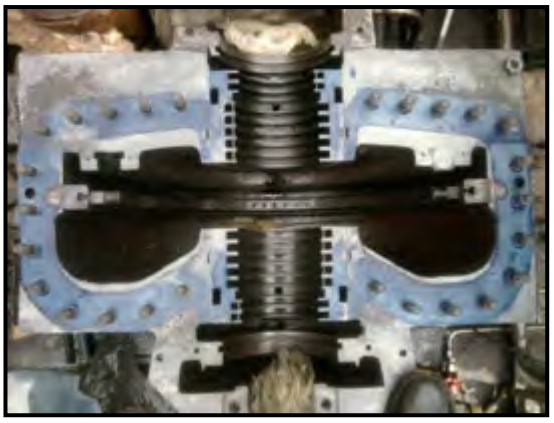
**Scoring on Thrust Collar of Turbine**



**Lapping of parting Plane of Turbine**



**Blue Matching of Parting Plane**

**Blue Matching of Parting Plane**


**Cleaned Turbine Rotor**

## Gear box

- Low speed gear 0.17 to 0.20mm (Turbine side)
- Change a bearing because found a white metal layer is damage
- 0.17 to 0.23mm (pump side)
- Low speed gear thrust is 0.15
- High speed gear 0.12mm (Turbine side)
  0.12mm (Pump side)
- High speed gear thrust is 0.85 mm
- Gear back less 0.45mm

## COOLING WATER PUMP (P-4401/B)

Pump was taken in maintenance and following activities were carried out:

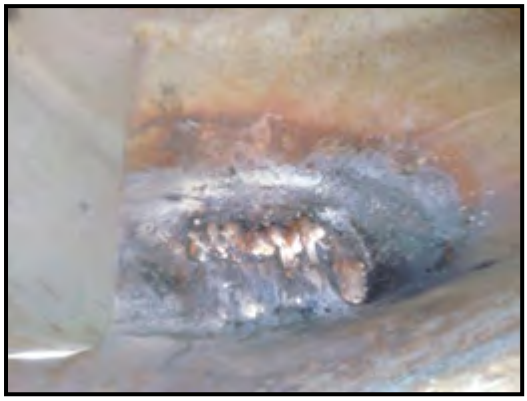
- Corroded portion of impeller was repaired with welding.
- During removal of impeller one side neck ring was broken, so both side neck rings were replaced.
- Neck Ring clearance was maintained as 0.35 to 0.5mm by machining.
- After installation of impeller and final box up bearing clearance were checked.
- Bearing clearance : 0.18 to 0.20 (coupling side )
  0.18 to 0.20 (free end side)
- Pump Thrust float was measured as 0.45 mm

- Thrust ball bearing No. SKF 6318
- Finally alignment was done and readings are as under:

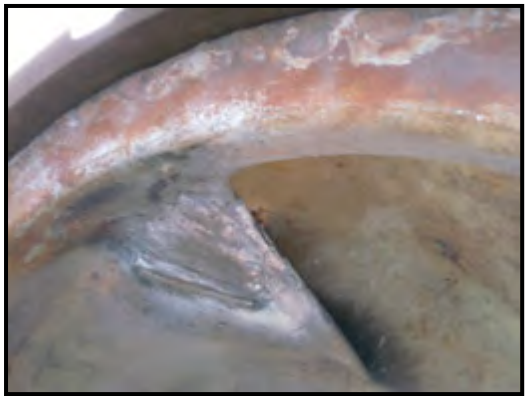
**Photographs of Cooling Water Pump**


**Corroded Cooling water Pump Impeller**

**Corroded Wane**



**Repaired wane by welding**



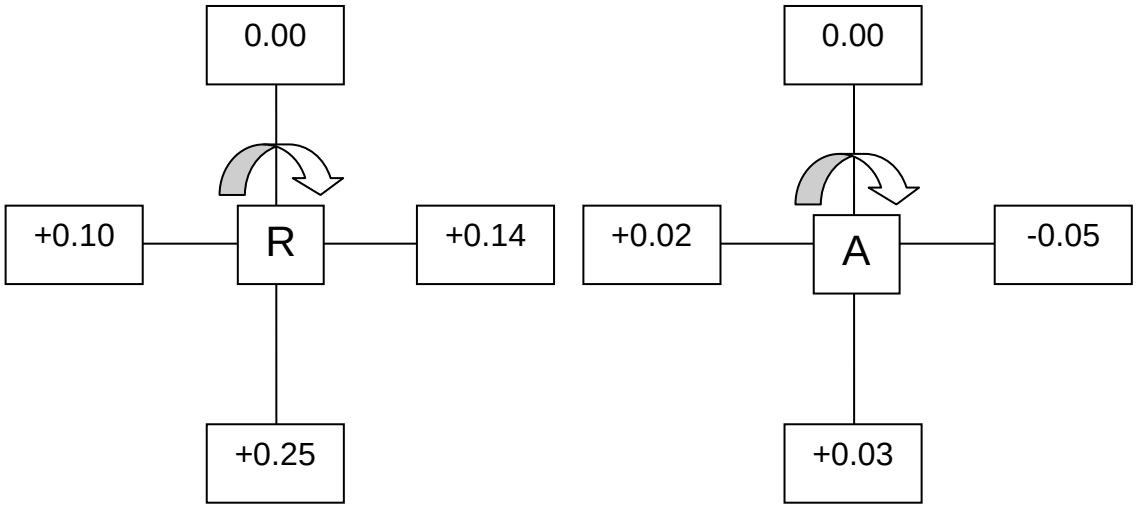
**Repaired wane by welding**

**Inside Painting of Top Housing**

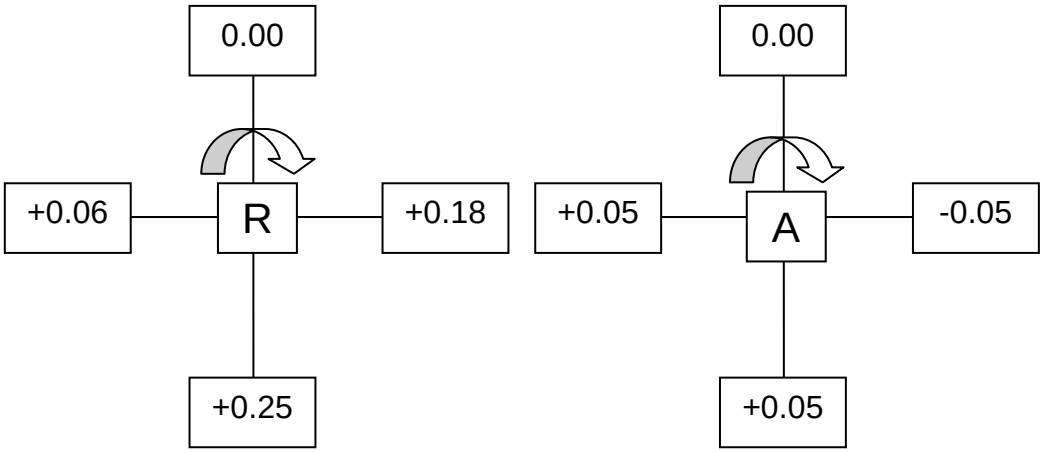

**Repaired and painted Cooling water Pump Impeller**

**Alignment reading** (turbine to gearbox) dial on gear box

**Before**




**After**




**Cooling water pump P-4402**

During Preventive following activities were carried out

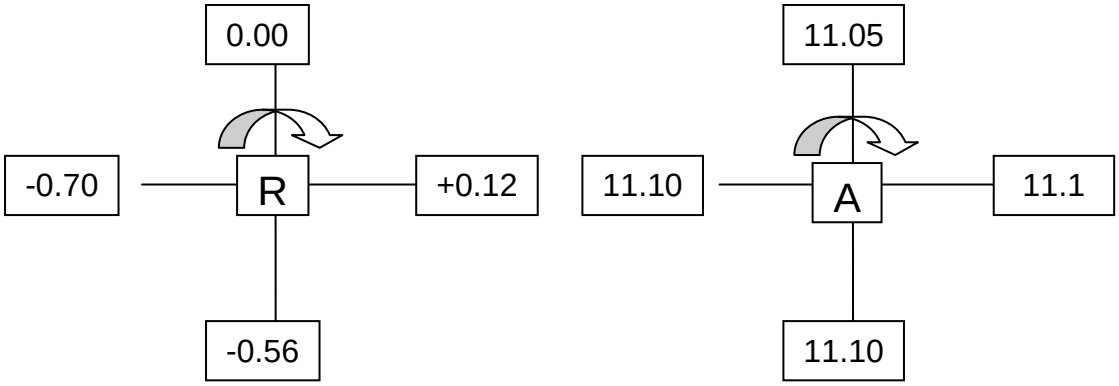
- Take the alignment between motor to pump
- Both the Top covers of the pump are removed
- Bearings are removed on both the sides
- Cleaning of journal on both sides of the pump
- Gland packing on both sides of the pump is removed
- Cleaning of bearings is carried out
- Cleaning of bearings covers is carried out
- Pump Gland packing are replaced with new ones
- Bearing clearances are measured using lead wire
- Bearings are assembled back
- Bearing covers are assembled back
- Check the final alignment.

Final Bearing Clearances

| Bearing | Clearance by lead wire | Interference |
|---|---|---|
| Pump Front Bearing | 0.17 to 0.20 | 0.04 |
| Pump Rear Bearing | 0.18 to 0.20 | 0.06 |

Note: All Readings are in mm.

**Final Alignment Reading between Motor To Pump**




**Note:** 1) Dial on Pump
2) View from Motor Front
3) All Readings are in mm
4) Axial reading noted by filler gauge.

**COOLING WATER PUMP, P-4401/C**

**OBSERVATIONS**

Pump gland packing was found to be damaged condition.

Preventive Maint. Activities

- Take the alignment between motor to pump
- Both the Top covers of the pump are removed
- Bearings are removed on both the sides
- Cleaning of journal on both sides of the pump
- Cleaning of bearings is carried out.
- Cleaning of bearings covers is carried out
- Pump Gland packing are replaced with new ones
- Bearing clearances are measured using lead wire
- Bearings are assembled back
- Bearing covers are assembled back

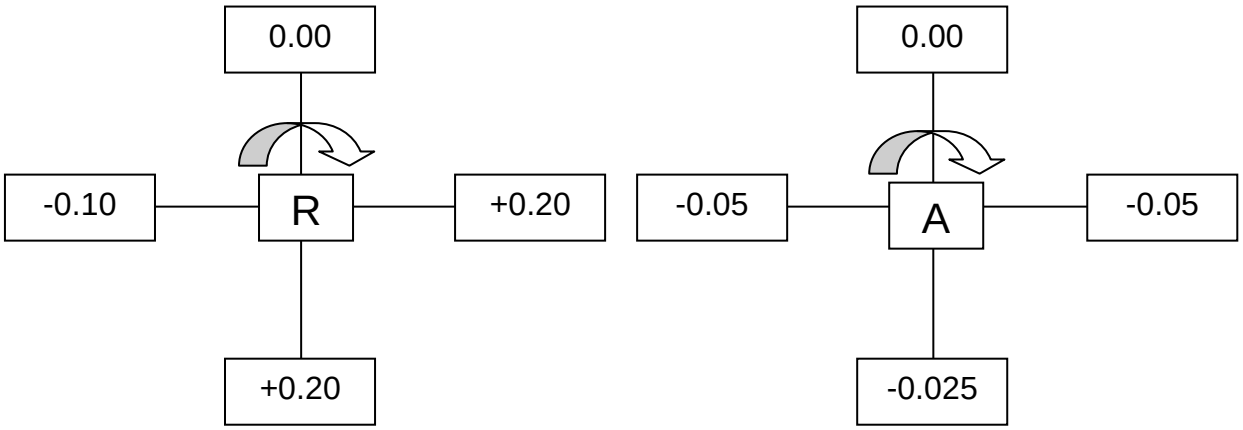
**Final Bearing Clearances**

| Bearing | Clearance by lead wire | Interference |
|---|---|---|
| Pump Front Bearing | 0.25 | 0.05 |
| Pump Rear Bearing | 0.25 | 0.05 |

Thrust float : 0.20

**Note:** All Readings are in mm.

**Final Alignment Reading**




**Note:** 1) Dial on Pump

2) View from Motor Front

3) All Readings are in mm

**P-4401/D CW PUMP PREVENTIVE MAINTENANCE ACTIVITIES:**

**OBSERVATIONS**

- Pump Rear Bearing (Free end side) clearance found on higher side
- Scoring marks observed on pump rear side bearing.

**Preventive Maint Activities:**

- Both the Top covers of the pump are removed
- Bearings are removed on both the sides
- Cleaning of journal on both sides of the pump
- Gland packing removed on both sides of the pump.
- Cleaning of bearings is carried out.
- Adding Shims between bearing top half to bearing top cover (0.30mm) on free end bearing for achieving interference.
- Cleaning of bearings covers is carried out
- Pump Gland packing are replaced with new ones
- Bearing clearances are measured using lead wire
- Bearings are assembled back
- Bearing covers are assembled back

**Final Bearing Clearances**

| Bearing | Clearance by lead wire | Interference |
|---|---|---|
| Pump Front Bearing | 0.21 to 0.24 | 0.04 |
| Pump Rear Bearing | 0.24 to 0.25 | 0.05 |

Note: All Readings are in mm.

## OVERHAULING OF BFW PUMP TURBINE (Q–5111):

### PROBLEMS:

Leakage from Carbon seals

### OBSERVATIONS

Carbon seals clearances were found on higher side

### ACTIONS TAKEN:

- De-coupled the turbine
- Instrumentation probes are removed
- Governor top cover and governor are removed
- Casing parting plane bolts are removed
- Thrust bearing & journal bearings top half's were removed.
- Turbine rotor is lifted
- Cleaning of parting plane is carried out
- Cleaning of rotor shaft is carried out
- Governing components are removed and cleaned
- Rotor sand blasting is carried out
- Checked all the bearing clearances and found to be okay
- Gauss test was conducted on casing & Rotor.
- Rotor is assembled back
- Turbine parting plane blue matching is carried out and found to be ok
- Carbon seals clearances were found on higher side and they are replaced with new ones.
- Over speed test was conducted and turbine tripped at 4670 rpm on 08/04/2013 @23:45 Hrs.

**Turbine Final Clearance Readings**

| * | Clearance | Interference |
|---|---|---|
| Front Bearing | 0.15/0.20 | 0.05 |
| Rear Bearing | 0.15/0.20 | 0.05 |

Trip lever clearance : 2.38mm

Thrust Float : 0.25mm

**Axial clearance**

| | Left | | Right | |
|---|---|---|---|---|
| | +ve | -ve | +ve | -ve |
| 1ST Row | 1.30 | 2.40 | 1.30 | 2.40 |
| 2nd Row | 1.60 | -- | 1.60 | -- |

**Oil Seal Clearance**

| Turbine Front | | Turbine Rear | |
|---|---|---|---|
| Left | Right | Left | Right |
| 0.15 | 0.35 | 0.50 | 0.50 |

**BFW TURBINE**

**BFW PUMP, P-5111**

Preventive maintenance activities

- All the oil pipe lines are disconnected.
- Both the end covers of the pump are removed
- Bearings are removed on both the sides
- Cleaning of journal on both sides of the pump
- Cleaning of bearings and bearing covers is carried out
- DP test was conducted on all the journal bearings & thrust pads and found to be ok.
- Checked the bearing clearance and found ok.
- Rear side thrust bearing is removed
- Thrust pads are found to be ok
- Both the sides bearings and bearing covers are assembled back
- Strainer is removed, cleaned and assembled back.

**Pump Bearing Clearances**

| * | Clearance | Interference |
|---|---|---|
| Front Bearing | 0.14 | 0.04 |
| Rear Bearing | 0.15 | 0.06 |

**Note**: All Readings are in mm.

**Thrust Pads thickness**

| S.No | Active | In Active |
|---|---|---|
| 1 | 22.18 | 22.18 |
| 2 | 22.18 | 22.19 |
| 3 | 22.18 | 22.18 |
| 4 | 22.19 | 22.19 |
| 5 | 22.19 | 22.19 |
| 6 | 22.19 | 22.19 |

Thrust Float : 0.23mm

**Note**: All Readings are in mm.

**BFW PUMP, P-5112**

Preventive Maint. Activities

- All the oil pipe lines are disconnected.
- Both the end covers of the pump are removed
- Bearings are removed on both the sides
- Cleaning of journal on both sides of the pump
- Cleaning of bearings and bearing covers is carried out
- DP test was conducted on all the journal bearings & thrust pads and found to be ok.
- Checked the bearing clearance and found ok.

- Rear side thrust bearing is removed
- Thrust pads are found to be ok
- Both the sides bearings and bearing covers are assembled back
- Strainer is removed, cleaned and assembled back

**Bearing Clearances**

| * | Clearance | Interference |
|---|---|---|
| Front Bearing | 0.14 | 0.05 |
| Rear Bearing | 0.14 | 0.06 |

**Thrust Pads thickness**

| S.No | Active | In Active |
|---|---|---|
| 1 | 22.19 | 22.19 |
| 2 | 22.18 | 22.19 |
| 3 | 22.18 | 22.18 |
| 4 | 22.19 | 22.19 |
| 5 | 22.19 | 22.19 |
| 6 | 22.19 | 22.19 |

Thrust Float : 0.30mm

**Gear Box readings**

| | | Clearance | Interference |
|---|---|---|---|
| Pinion | Front Bearing | 0.17 | 0.05 |
| | Rear Bearing | 0.16 | 0.05 |
| Gear Wheel | Front Bearing | 0.17 | 0.05 |
| | Rear Bearing | 0.17 | 0.05 |

Back lash : 0.20mm

**Note**: All Readings are in mm.

Final Alignment Readings are taken by Laser Alignment Tool

**F.D FAN TRAIN (K-5113):**

Preventive Maint activities

- De coupled the train
- Removal of gear box top cover
- Removal of gear wheel top bearings
- Removal of gear wheel
- Motor side clutch removed
- All the interference fits are removed by heating on both the sides
- Fan radial roller bearings was removed on both sides.(SKF 22230 CC/C3 W33)

- Turbine side clutch bearings were found in damaged condition (SKF 16021) hence bearings are removed by using hydraulic jack.
- Motor side fan radial bearing was removed with gouging.
- Clutch bearing was removed by gouging.
- Clutch rollers removed and thoroughly cleaned and overhauled.
- Turbine side clutch oil seal replaced with new ones.(105*130*12)
- Clutch bearings were Replaced with new ones (2 Nos). (SKF 16021)
- Radial roller bearings replaced with new ones on both the sides .(SKF 22230 CC/C3 W33)

Turbine Gear Box readings

| | | Clearances |
|---|---|---|
| Pinion | Front Bearing | 0.17 |
| | Rear Bearing | 0.16 |
| Gear Wheel | Front Bearing | 0.11/0.12 |
| | Rear Bearing | 0.16/0.20 |

Back lash : 0.20mm

Thrust Float : 0.30mm

**BHEL BOILER JOBS (F-5111):**

**BHEL BOILER INSPECTION/HYDROTEST**:

- Boiler was inspected by Boiler Inspector in open condition on 03/04/2013 & Hydro test was carried out at 90.0 kg/cm2 pressure on 06.04.2013 and witnessed by Boiler Inspector.

**Removal of Boiler Steam Drum Rear Side Eye-hye Level Gauge**

- Boiler Steam Drum Rear Side Eye-Hye level gauge, which was not in use after the implementation of DCS system was removed by taking IBR permission from IBR office.
- Eye-Hye level gauge was cut from its tapping which is of ½" sch.160 from upper and lower location and Butt welded caps of ASTM A234 ½" NB sch.160 was welded and then joints were cleared in radiography test also.

**Replacement of ATA header RV Nozzle.**

The 40 ata RV Nozzle which was in bend condition was replaced with new Nozzle.

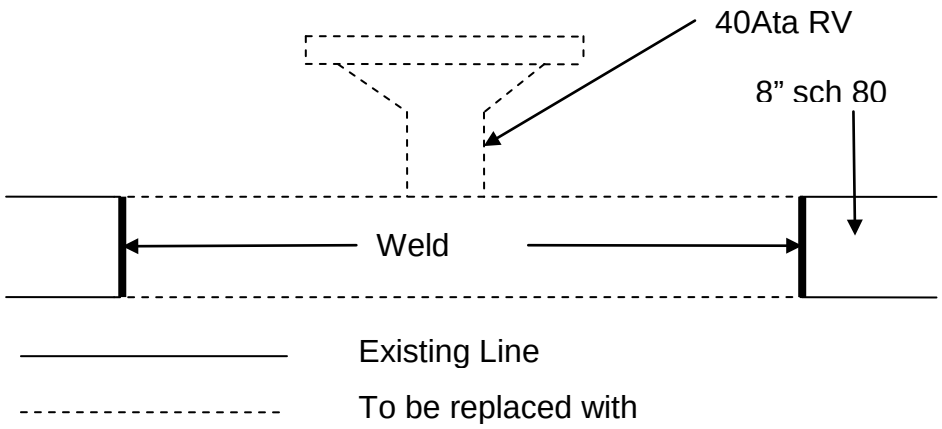
Main Header Pipe Size: 08" x Sch. 80, ASTM A 106 Gr.B

Nozzle Flange Size: Weldneck RTJ 4" X 600#, ASTM A 105

Total No. Joints Involved: 02 No ( 08" x Sch.80)

**The job involves**

- Removal of RV by opening it from its Nozzle flange.
- Cutting of Main RV header of Approx 1500 mm length along with the RV Nozzle by grinder machine.
- Necessary surface preparation including edge preparation for welding of Main Header joints
- Fit-up of Prefabricated Header spool piece with RV Nozzle.
- Welding of Prefabricated Header spool piece as per WPS.
- **Fixing of RV on New Nozzle.**
- **Welding of Supports for strengthening and tying of RV in position.**
- **Inspection** including Weld edge DP, Root weld & final weld DP and final Radiography.




**Removal of Unused 60 Ata Header.**

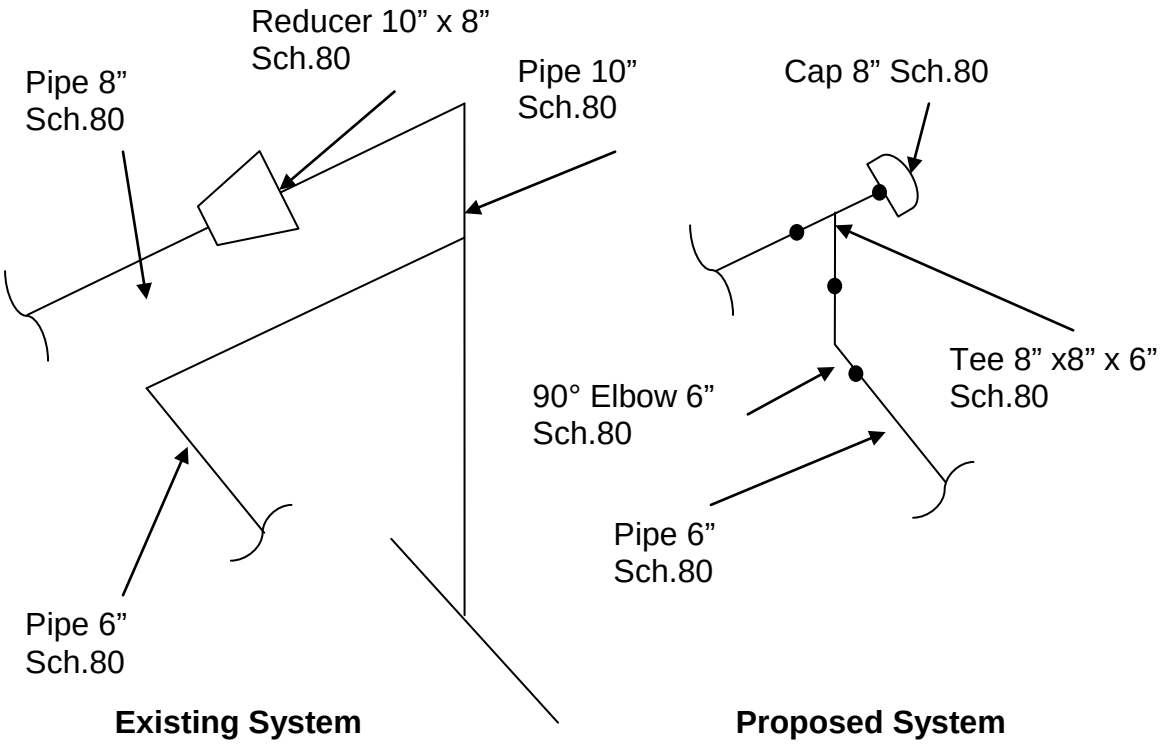
Pipe Size: 8" & 6" Sch. 80, ASTM A 106 Gr.B

No. of Joints Involved: 02 ( 8" NB X Sch.80)

02 ( 6" NB X Sch.80)

**The job involves**

- Cutting and Removal of Unused 60Ata Header by grinding.
- Cutting of 40 Ata Header pipe and its elbow with grinding.
- Necessary surface preparation including edge preparation for welding of joints
- Fit-up & Welding of 8"X8"X6" Sch. 80 Tee as per WPS.
- Fit-up & Welding of 8" sch 80 cap on Tee as per WPS
- **Fit up and welding of 6"NB x Sch.80 elbow in Tee for joining 40 Ata Header with 60 Ata Header.**
- **Inspection** including Weld edge DP, Root weld & final weld DP and final Radiography.




**Testing of Boiler RV’s**

Critical boiler RV’s were removed, overhauled and then tested on test bench.

Superheater Safety valve was also online floated and RV testing readings are as under:

| Description | Popping Pressure Kg/cm2g | Reset Pressure Kg/cm2g |
|---|---|---|
| Drum Rear R.V. ( On Valve testing Machine) | 72.00 | 70.00 |
| Drum Front R.V.( On Valve testing Machine) | 69.50 | 67.00 |
| Super Heater R.V. (Online Floating) | 64.37 | 62.50 |

**Other Boiler Jobs:**

- All inspection window glasses were checked & cleaned. Broken window glasses were replaced. Gaskets of all window glasses were also replaced.
- All dampers of air duct (FD Fan Inlet & Outlet damper, RAH Inlet, Outlet & Bypass damper) were checked and made free by greasing for smooth operation.
- All steam drum connected first and second isolation valves were gland repacked.

**Preventive Maint. Of Re-Generative Air Heater (RAH) H-5111:**

- General condition of Cold End & Hot End baskets was found OK.
- All circumferential and radial seals of hot end and cold end were checked and some broken radial seals were replaced.
- Clearance of radial seals were adjusted as

  Hot End: 1-3 mm, Cold end: 1-4 mm
- Both End Rotor Bearings (Self-aligning Spherical Roller Bearing 22330 CCK/C3 W 33 with Adapter sleeve H 2330 T) housing were opened for inspection, condition of both end bearings were found OK. So it was boxed-up after replacement of Hot End

side Oil seal (125 X 95 X 12mm) and 95 mm dia speedy sleeve and fresh oil (Servo Prime C 100, 8 liters approx.) charged.

- RAH Drive unit (Electric motor with Gear Box & sprocket) was replaced by Re conditioned gearbox. (Code : 141110925101)
- Bearings Clearances were checked by feeler gauge and their readings were as follows:

| Sr. No. | Description | Actual Value (mm) |
|---|---|---|
| 1 | Hot end bearing | 0.24 |
| 2 | Cold end bearing | 0.22 |

- RAH Air Motor Clutch oil flushed.

**Deaerator Inspection:**

- Internal inspection of Deaerator was carried out and all trays were found ok.

**COOLING TOWER AREA JOBS:**

**Replacement of Cooling Water pump rubber Expansion bellow**

- Old deteriorated rubber expansion bellows installed in suction 24''NB & Discharge 30'' NB of Cooling water pump P-4404 were replaced.
- Job carried out through M/s General Engg vide W.O No 201004131369, Dt 28/02/2013 for the replacement of these bellows**.**

**Replacement of 42" NB Corroded CW Header Pipe piece near Mech.shift Office**

CW Header Size: 42" NB Sch. STD (Thickness- 9.5 mm)

Approx. length of the pipe to be replaced- 7 Mtrs

No. of Joints involved: 03 Joints (42" NB Sch. Std)

The job involves

- Removal of corroded CW Header piece by gas cutting or grinder cutting.
- Necessary surface preparation including edge preparation for welding of joints
- Fit up of New Header Piece.
- Welding of New Header Piece as per WPS
- **Inspection** including Weld edge DP, Root weld & final weld DP.

***Welding of SS 304 Patch plate on Hitachi CW Header pipes near ACF***

CW Header Size: 36" NB Sch. STD, MOC: CS

Patch Plate: SS 304, 3 mm Thick.

The job involves

- Removing the wrapping coating with gas burning up to approx 1 mtr depth.
- Cutting of SS-304 patch plate in required quantity and sizes to suit the profile of the pipe.
- Welding of patch plates up to 1 mtr depth on CW headers.
- Wrapping coating of exposed CS pipe surface of CW header.
- **Inspection** including final weld DP.

**Repairing of Cooling Towers, H-4401/1 to 6 and 7 & 8,H-4402/1 to 3, H-4404/1to3,**

- Railing of all towers was also repaired.
- Damaged Colum, spice joint, long diagonal were replaced with new.
- Three base casting grouted of H-4404/1TO3 with the help of civil department.
- Structural members of the cooling towers were also checked and replaced the defective members.
- Corroded fasteners were replaced with new SS304 bolts with SS 304 Square washers.
- Leakages attending of both end wall & louvers.
- Repaired of stair case
- Job carried out through M/s Paharpur cooling tower vide No 201004131237, Dt 08/02/2013 for the repairing of cooling towers**.**

All cooling tower distribution valves were attended for smooth operation.
Internal inspection of 52" CW interconnection line was carried out and M-seal was applied at the cavities of the welding joint.

Bell mouths of the cooling water pump suction lines were also inspected and painting carried out.

**DM PLANT JOB:**

- The Man hole of Degasser tower sump was opened for cleaning & inspection. Degasser sump was found OK and then boxed up with new gasket.

**STEAM LEAK & FABRICATION JOBS:**

- Replaced/repaired all steam traps which were not working as per the list given by Prod. Deptt.
- Carried out various fabrication jobs as per request from the prod. Deptt.
- Replaced various inoperative valves.

# B & MH PLANT
(MECHANICAL)

## PLANT TRANSFER CONVEYOR-M-2110:

Following jobs were carried out.

- Replaced the Complete length of conveyor belt with new oil & heat resistance Conveyor belt(141 meter length & 800 mm width) NN 630 / 4 (Make : MRF,OHR grade)
- Head pulley bearings were replaced with SKF makes sleeve type Spherical roller bearings (No.22217EK) & new rubber lagging done.
- Tail pulley bearings were replaced with SKF make sleeve type Spherical roller bearings (No.22217EK) & new rubber lagging done
- SKF make sleeve type Spherical roller bearings (No.22213EK) of Both Bend pulley were adjusted & new rubber lagging done
- SKF make sleeve type Spherical roller bearings (No.22213EK) of Snub pulley were adjusted & new rubber lagging done
- Gravity pulley was replaced with new NTN bearings (UCPX12).
- Preventive maintenance of Gear Box carried out & coupling done after proper alignment with new rubber bushes.
- Gear box oil was replaced.(Servo system-460)
- Brush pulley was serviced.
- All damaged and noisy carrying rollers, Return rollers, Self alignment carrying roller frames, Self alignment return roller frames and Tracking rollers were replaced.
- New Kaveri make skirt rubber were provided.

## FRESH UREA SHUTTLE CONVEYOR-M-2112:

Following jobs were carried out:

- Replaced the Complete length(450 M) of conveyor belt with new oil & heat resistance Conveyor belt NN 630/3 600 mm width ( M/s Dynamics rubbers)
- Rubber lagging done in Tail end pulley, both bend pulleys, snub pulley and tripper lower pulley.
- Rectification of conveyor belt was done. Proper alignment of Head pulley, tail end pulley, bend pulley, Snub pulley & tripper, rollers frames were done.
- Preventive maintenance of Gear Box carried out & Coupling done after proper alignment with new rubber bushes.
- Gear box oil was replaced.(Servo system-460)
- All noisy and damaged carrier, guide and return rollers replaced with new rollers.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.
- Tripper Gear box over hauled and realigned with motor.
- New Kaveri make skirt rubber were provided.

**RECLAIM CONVEYOR-M-2117:**

Following jobs were carried out

- Preventive maintenance Gear Box and Coupling done after proper alignment with new rubber bushes.
- Gear box oil was replaced.(Servo system-460)
- All noisy and damaged carrying, guide and return rollers were replaced with new rollers.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.

**BAGGING BUILDING FEED CONVEYOR-M-2121:**

Following jobs were carried out

- Preventive maintenance of Gear Box carried out and Coupling done after proper alignment with new rubber bushes.
- Conveyor belt was repaired by belt vulcanizing.
- Complete skirt board sealing system skirt blocks were replaced with new one.
- Replaced all damaged and noisy Carrying, Return, Impact and guide rollers with new rollers.
- Complete greasing of all pedestal bearings done.

**BAGGING BUILDING HOPPER CONVEYOR-M-2122:**

Following jobs were carried out

- Damaged conveyor belt (6 M) was replaced.
- Preventive maintenance of Gear Box and Coupling done after proper alignment with new rubber bushes.
- Replaced all damaged and noisy Carrying, return and guide rollers with new rollers.
- New Kaveri make skirt rubber were provided.
- Complete greasing in all pedestal bearings done.
- Take up studs were replaced.

**BAGGING BUILDING HOPPER CONVEYOR-M-2122A1:**

Following jobs were carried out

- Preventive maintenance of Gear Box carried out and Coupling done after proper alignment with new rubber bushes.
- Replaced all damaged and noisy Carrying, return and guide rollers with new rollers
- Rubber lagging done in tail end pulley.
- Take up studs were replaced.

**BAGGING BUILDING HOPPER CONVEYOR-M-2122 A2:**

Following jobs were carried out

- Preventive maintenance of Gear Box carried out and Coupling done after proper alignment with new rubber bushes.
- Replaced all damaged and noisy Carrying, return and guide rollers with new rollers
- Rubber lagging done in tail end pulley.
- Take up studs were replaced.

**FLAT CONVEYOR BELT-M-2142:**

Following jobs were carried out

- Preventive maintenance of Gear Box carried out and Coupling done after proper alignment with new rubber bushes.
- Replaced all damaged and noisy Carrying and return rollers with reconditioned rollers.

**DUST & UREA LUMPS BELT CONVEYOR-M-2137:**

Following jobs were carried out

- Replaced all damaged and noisy Carrying and return rollers with reconditioned rollers.
- Complete greasing of all bearings done.
- Coupling done after proper alignment with new rubber bushes.

**BAGGING MACHINE - M-2101 / 9A**

- Weighing machine was replaced with complete SS structures.

**BAGGING MACHINE - M-2101 / 1, 2, 3, 4, 7, 8, 10A, 10B**

Following preventive maintenance jobs were carried out

- Overhauling of gate assembly.
- Overhauling of bucket assembly.
- Overhauling of sack grip assembly.
- Servicing of all cylinders.
- Alignment of stabilizer plate.
- Calibration of packer scales.

**SLAT CONVEYOR - M-2124 / 1, 2, 3, 4, 7, 8, 9, 10A, 10B**

- All gearboxes were overhauled.
- Aligned, coupled & oil was replaced.

**STITCHING MACHINE - M-2102 / 1, 2, 3, 4, 7, 8, 9, 10A, 10B**

- All stitching machines and spare machines were overhauled with M/s gabber engg.

**AIR BLOWER-K-2161**

- All lines were removed, cleaned and boxed up.
- Coupling done after proper alignment.

**AIR BLOWER-K-2704**

- All lines were removed, cleaned and boxed up.

**Cyclone separator-V-2704**

- Separator was opened, cleaned and boxed up.

**UREA SOLUTION TANK-T-2704**

- Tank was opened, cleaned and boxed up.

**VIBRATING SCREEN-M-2136/A,B,C,D**

- All screens were removed, cleaned and boxed up.

**RECLAIM MACHINE-M-2116**

- Preventive maintenance of all the gear boxes.
- Replaced all coupling bushes.
- Complete greasing of Reclaim machine.

**RECLAIM MACHINE-M-2116 A**

Following jobs were done with M/s Elecon engg.

- Tie rod bracket was relocated and welding was done.
- Scrapper drive sprockets were replaced.
- Scrapper take up bearings with housing were replaced.
- Sims was provided in travel bogie foundation for scrapper boom leveling.
- Strengthening was done in kingpost bottom.
- Modification done in scrapper and bucket couplings.
- Greasing done in all points.

**AMMONIA CONDENSOR-H-3101**

- Opened & boxed up the channel covers after hydro jetting.

**AMMONIA CONDENSOR-H-3001-A/B**

- Opened & boxed up the channel covers after hydro jetting.

# INSPECTION

# AMMONIA PLANT
(INSPECTION)

The following major Inspection activities were performed in Ammonia Plant.

- Inspection of Primary Reformer catalyst tubes and risers by various NDT Techniques including Automatic Ultrasonic Scanning (AUS) by M/s PDIL. Details are given at **Annexure-1 to 5.**
- Visual inspection of Equipments.
- Ultrasonic flaw detection was carried out on selected critical pipeline weld joints including parent metal of elbows of 108-D (S-50 Converter) loop. Details are given at **Annexure- 6.**
- Thickness measurement of various equipment and HT Convection coils of Primary Reformer was carried out .Details are given at **Annexure-7.**
- Thickness measurement of various pipelines including Bi-phase flow lines was carried out. Details are given at **Annexure-8.**
- Measurement of residual magnetism at various parts of rotating equipments and de - magnetization of the same wherever required. Details are given at **Annexure-9.**
- In-situ Metallography of selected equipment and pipelines was carried out. Detailed summary of observations and microstructure analysis is given at **Annexure-10.**
- Inspection of newly fabricated pipelines and fabrication jobs carried out departmentally by Maintenance and Technical department.
- NDT's viz. UFD & RT was carried out in the Converter loop to assess the condition of weld joints & Elbow parent metal for any deterioration. The details are attached at **Annexure-11.**
- Qualification test of welders employed by contractors.

The detailed observations and recommendations for corrective actions required on individual equipment are given below. All the observations were recorded during inspection and were handed over to concerned Maintenance and Operation group for necessary corrective action.

## PRIMARY REFORMER 101-B

## RADIANT ZONE

## VISUAL INSPECTION

Visual inspection of the entire furnace radiant zone, including harp assemblies, refractory and insulation, burner-blocks, etc. was carried out. The detailed report on observations made is enclosed herewith at **Annexure-1.**

## OTHER NDT ACTIVITIES

- Automatic Ultrasonic Scanning of all the 336 Catalyst tubes and 8 Riser tubes was carried out during Shutdown by PDIL. Amongst all 336 tubes, 142 tubes are placed in B grade and 194 tubes are placed in C grade. Amongst 8 risers, 5 risers are placed in B grade & 3 risers are placed in C grade. Details are attached at **Annexure-2.**

- DP test of 16 nos. of outlet manifold field weld joints & all riser tube to weldolet butt weld-joints was carried out. No service defects were revealed.
- Creep measurement of all the catalyst tubes was carried out using GO-NOGO Gauge at tunnel slab level. In 335 nos. of tubes Creep was found in the range of 0 - 0.17 % and in 01 nos. of tube between 0.17 to 0.70 %. Creep measurement of the riser tubes at tunnel slab level was also carried out using digital micrometer. Creep was found in the range 0.33 – 1.17 % in all 08 nos. of Riser tube. The report is attached at **Annexure-3.**
- Spring Hanger Readings, Transfer line spring support readings and bottom drain readings were taken in 'Cold condition'. The report is attached at **Annexure-4.**
- Bottom Outlet header clearance readings were taken. The report is attached at **Annexure-5.**
- UFD of 05 nos. dissimilar weld joints of P-11 to SS 304-H of Inlet Header was carried out in random.
- Random In-situ Metallography carried out on Catalyst tube parent metal, Riser tube parent metal, Catalyst tube to weldolet weld & Riser tube to weldolet butt weld joint. The detailed report is attached at **Annexure-10.**
- Radiography of all 08 nos. weldolet to riser butt weld joints was carried out. No significant defect was observed.

**CONVECTION ZONE**

Visual inspection of HT convection zone from top and bottom manhole and Auxiliary boiler furnace was carried out. The observations made are as under:

**H.T. CONVECTION SECTION**

**From Top Manhole:**

- HT and LT super heater coils were found in satisfactory condition.
- Supports of LT / HT steam super heater coils were found in satisfactory Condition.
- Extreme East side duct distribution plate was found in hanging condition and few fasteners were found loose and missing.
- Extreme east side insulation protection liner sheet was found burnt out & opened.
- Insulation covering liner sheet found burnt out at few locations and dislocated at two locations.
- HT steam super heater top coil tube fins found damaged in approx. 100 mm length for 02 nos. of tube at East end.
- 02 nos. of thermo well near damper of PRC-23 found bent downward.

**From Bottom Manhole**

- Hard scaling was observed on all the tubes of Mixed Feed Coil.
- Bottom most part of Insulation covering plate was found burnt off at most of the locations. This was observed in previous inspection also.
- Thermo-wells were found slightly bent, scaled & eroded. Thermo-well no. 4 counting from East side found to have concave tip.
- Repairing work of refractory was going on.
- Insulation of East, South & West wall is being replaced during this shutdown.

**AUXILIARY BOILER FURNACE**

- Burner block refractory repair work has been carried out.
- Condition of the tubes was found satisfactory.
- Wall refractory in the N-W corner was found fallen behind the tubes.
- Bottom header refractory was found having cracks at N-W corner.

**VESSELS & OTHER EQUIPMENTS**

**103-D, SECONDARY REFORMER**

**Top Air & Gas Entry:**

- Zig-Zag scattered cracks were observed on the refractory lining all over the cone region and shell.
- At few scattered locations cracks having width approx 3mm or more was observed on refractory.
- C-seam of Top shell liner was found cracked in complete circumference except 12" in length. Need to be rectified.
- One segment of shoulder refractory on top of the cone to top-shell junction was found missing.
- Thermowell was found intact.
- Gap was observed between shift liners of top shell to transfer line.

**Bottom Dome:**

- The refractory around the 101-CA/CB gas inlet nozzles (approx half of the circumference) was found eroded and fallen on the floor. Gap was observed between the 101-CA/CB gas inlet nozzle liner and the shell refractory joint, more prominent towards the 101-CB nozzle. The Gap of approx. 20mm was observed. Needs to be fixed.
- Top Dome refractory was found intact except some of the refractory brick slots were found with alumina balls.
- The liner inside the 101-CA/CB gas inlet nozzle was slightly buckled /distorted. Conditions of the thermowells were satisfactory.
- Loose refractory was found lying in the nozzle of 101-CA.

**107 - D, TRANSFER LINE**

**From Outside**

- Minor buckling/distortion of the liner was observed throughout the length of the Transfer line.
- Minor damage of the refractory was observed at flange (end plug side) of the Transfer line.
- Thermowell was found intact in position.

**102-EB**

**$CO_2$ STRIPPER**

**From Top Manhole**

- Demister pads were found slightly shifted in middle portion.
- Demister pad supporting strips and rods were found distorted in middle portion.
- All the bolts of liquid inlet nozzle flange were found in position & intact.
- West side distributor header was found rubbing with the shell plate in S-W direction causing dent in the shell plate. Same was also observed in previous inspections.
- North side U-Clamp of East side distribution header was found loose as the clamp holes got enlarged. South side distributor header U-clamps were also found loose. Need to be rectified.
- Few fasteners of top tray were found missing.
- Foreign material were found lying on the trays, need to be removed

**From Bottom Manhole**

- Blackish coloration was observed from inside.
- Nozzle condition was found satisfactory.
- Thermowell was found intact in its position.
- Thick scaling was observed on shell from inside.
- 02 nos. clit & bolt missing of bottom most sieve tray segment from West towards South side.

**103-E2 LP (LP FLASH VESSEL)**

**From Top Manhole Compartment (From Outside)**

- Demister pad was found intact in its position in satisfactory condition.
- Condition of bubble caps found satisfactory.
- Out of two Collectors distributor / drain pipes in West direction one was found detached from its weld joint and found lying on the bubble caps. The weld joint of other one also seems to be getting detached. Needs to be rectified.

**101-F, STEAM DRUM**

- Grayish black coloration was observed inside the drum.
- All Cyclone Separators were found intact in position.
- Demister pads were found intact in position.
- Minor pitting of approx. 0.5 to 0.75mm depth was observed at scattered locations.
- One of the hole at South end of phosphate dozing line (1" NB) was found enlarged.
- Few bolts of Demister Pad holding cover plate were found sheared.
- Grill covering the Down Comers were found bent at few locations.

## 102-F , RAW GAS SEPARATOR

- Epoxy paint condition was found satisfactory.
- Demister pads were found intact in position.
- Putty applied on the circumferential weld joint of manhole nozzle with shell from inside was found intact.
- Condition of Gas inlet nozzle located at East side was found satisfactory.

## 103-F, REFLUX DRUM

- Demister pads were found intact in its position.
- Epoxy paint was found peeled off from the few small scattered locations at the bottom half of the vessel. However epoxy primer was found intact at such location.
- Dust & epoxy scales with oil were found lying at the dish end of the vessel need to be cleaned.
- Scales of epoxy paint were found sticking with Mesh of Demister pads.

## MISCELLANEOUS JOBS

## WELDER QUALIFICATION TESTS

- Performance qualification test of 28 Nos. welders offered by M/s General Engineering was carried out. 07 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical departmental welding jobs in the plant.
- Performance qualification test of 10 Nos. welders offered by M/s A. M. Erectors was carried out. 02 nos. of welders were qualified during the test. These welders were allowed to perform welding in replacement of Line no. PR-1208-4”-X1 & PR-1206-6”-X1 in Urea Plant.
- Performance qualification test of 13 Nos. welders offered by Ram Bahadur was carried out. 04 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical & Technical Departments’ welding jobs.

## D.P. TEST

Dye Penetrant examination of weld joints of all the pipelines fabricated by contractors/departmentally, new pipeline fabrication / repairing / modifications job done by technical and maintenance groups etc. was carried out after root run welding and after final welding, as per requirement. Any defects observed during the tests were rectified in the presence of inspector followed by DP test for acceptance.

## RADIOGRAPHY

In order to ensure immediate radiography work and urgent processing of films, teams were hired on round the clock basis during entire shutdown period. Radiography was performed on the weld joints of the pipe lines fabricated / repaired by all contractors as well as departmentally as per the requirement. This includes Super heater Outlet Vent line V-20-4”.

## ULTRASONIC FLAW DETECTION OF WELDS

Weld joints (selected only) of the critical pipe lines and equipment were ultrasonically examined for assessing any development of service defects/growth of the acceptable defects. No abnormalities were observed in any of the weld joints inspected. No discontinuity was required to be repaired.

The detailed list of pipeline inspected is mentioned at **Annexure-6.**

## ULTRASONIC THICKNESS MEASUREMENT

During the shutdown, ultrasonic thickness measurement was carried out on various pipelines and equipment in the plant. The detailed results of inspection are attached herewith at **Annexure-7** (for equipment) and **Annexure- 8** (for pipelines).

## GAUSS MEASUREMENT

During this shutdown measurement of residual magnetism (Gauss) on rotary and stationary parts of various rotary equipment was carried out. Wherever residual magnetism was higher than acceptable limits, same was demagnetized and brought down within acceptable limits. The detailed results of inspection are attached herewith at **Annexure-9.**

## INSITU METALLOGRAPHY EXAMINATION

In order to evaluate the condition of certain critical plant equipment and pipelines operating at more than 300 deg. C temperatures & dissimilar welds, In situ metallographic examination was carried out. List of the lines/equipment checked along with observations and remarks are mentioned at **Annexure-10.**

## INSTALLATION OF NEW PIPELINES

During this shutdown, various pipelines in Ammonia Plant were installed for different schemes and various tapping were taken by Technical Group. Inspection activities viz. DP Test, Radiography review and repairs etc. were carried out on the weld joints to ensure the quality of the job.

## OVER SPEED TRIP TEST

- OST of following Machines was carried out / witnessed:

  101-JT : 7460 RPM

  104-JAT : 4120 RPM

  115-JAT : 5881 RPM

## ANNEXURE-1

**VISUAL INSPECTION REPORT :**

**PRIMARY REFORMER RADIANT ZONE:**

Visual inspection of the entire furnace radiant zone, including refractory, insulation, burner-blocks, etc. was carried out. The detailed report on observations made is as under:

**Burner Blocks:** Following burner blocks were found damaged:

| Burner Row No. | Burner Block No. |
|---|---|
| 1 | 2,5,8,9,12,13 |
| 2 | 2,4,7,8,9 |
| 3 | 5,6,13 |
| 4 | 4,12,13 |
| 5 | 1,3,5,6,7,11,12,14 |
| 6 | 2,3,5,6,7,11,12 |
| 7 | 2,5,8,9,11,13,14 |
| 8 | 1,2,4,6,7,10,13,14 |
| 9 | 1,3,8,10,12,13 |

**Bottom Header Insulation:**

Header insulation was found damaged near following tube nos.:

| Header No. | Tube no(s) where insulation found damaged |
|---|---|
| 1 | Near tube no. 15, 16, 35 |
| 2 | Satisfactory |
| 3 | Near tube no. 21, 27-28 |
| 4 | Near tube no. 16, 27-28 |
| 5 | Near tube no. 15-16, 20-21, 27 |
| 6 | Near tube no. 11,17,23,24 |
| 7 | Near tube no. 8, 9, 11, 15, 26-27, 32 |
| 8 | Near tube no.15, 29 |

**Roof Insulation:**

Roof insulation was found damaged/ dropped/gap has been observed at following locations:

| Row No. | Location |
|---|---|
| Burner Row 1st | Burner no. 1, 13 |
| Tube Row 1st | Near tube no. 34 |
| Burner Row 2nd | Between burner no.2-3, Burner No. 13-14 |
| Burner Row 3rd | Around burner block no. 4 |
| Tube Row 3rd | Near tube no. 29-31 |
| Burner Row 4th | Between burner no.8-9, Around burner block no.14 |
| Burner Row 5th | Around burner no. 1, 3, 4, 13, 14 |
| Burner Row 6th | Around burner no. 3 |
| Burner Row 7th | Around Burner no.2 |
| Tube Row 7th | Near tube no. 31-32 |
| Burner Row 8th | Between burner no. 12-13 |
| Burner Row 9th | Between burner no. 10-11 |

**Refractory / Insulation of Walls:**

- **East wall** **:** Found Satisfactory.
- **West wall** **:** Found satisfactory.
- **North wall**:

  **Z-Modules**
  (a) **Between West wall and Tube Row No.1:** Gap Below Peep Hole
  (b) **Between Tube Row 2-3 :** Gap Below Peep Hole
  (c) **Between Tube Row 4-5 :** Gap Above Peep Hole
  (d) **Between Tube Row 5-6 :** Gap Above Peep Hole
  (e) **In-front of Row No. 7 :** Gap approx 4 ft. above Tunnel Slab Level & above Peep Hole Level.

  **Refractory Walls Upto Tunnel Slab Level**
  **Junction of wall with Tunnel No. 3 &7 to be rectified**

- **South Wall**:

  **Z-Modules**
  **(a) Between Tube Row 2-3:** Gap on walls at scattered locations
  **(b) Between Tube Row 3-4 :** Gap Adjacent to Peep Hole
  **(c) Between Tube Row 4-5 :** Modules found shifted Inwards at Peep hole Level
  **(d) Between Tube Row 8 & East Wall :** Gap Adjacent to Peep Hole

  **Refractory Walls Upto Tunnel Slab Level**
  **Cracks on refractory wall in front of Tube Row No.1**

- **Tunnel Slabs**: Satisfactory

## Annexure - 2 (1/3)

## GRADATION OF TUBES BY AUS CARRIED OUT BY M/s PDIL

| ROW NO.1 | | | | ROW NO.2 | | | |
|---|---|---|---|---|---|---|---|
| Tube No. | Aus Grade | Tube No. | Aus Grade | Tube No. | Aus Grade | Tube No. | Aus Grade |
| 1 | B | 22 | B | 1 | C | 22 | B |
| 2 | B | 23 | B | 2 | B | 23 | C |
| 3 | C | 24 | B | 3 | B | 24 | B |
| 4 | B | 25 | B | 4 | B | 25 | C |
| 5 | C | 26 | B | 5 | B | 26 | C |
| 6 | C | 27 | C | 6 | C | 27 | B |
| 7 | B | 28 | C | 7 | B | 28 | C |
| 8 | B | 29 | B | 8 | B | 29 | C |
| 9 | C | 30 | C | 9 | C | 30 | B |
| 10 | C | 31 | C | 10 | B | 31 | B |
| 11 | B | 32 | C | 11 | B | 32 | C |
| 12 | B | 33 | B | 12 | B | 33 | C |
| 13 | B | 34 | C | 13 | B | 34 | B |
| 14 | B | 35 | C | 14 | B | 35 | C |
| 15 | C | 36 | B | 15 | B | 36 | B |
| 16 | B | 37 | B | 16 | C | 37 | C |
| 17 | B | 38 | C | 17 | B | 38 | C |
| 18 | B | 39 | B | 18 | C | 39 | C |
| 19 | B | 40 | C | 19 | C | 40 | B |
| 20 | B | 41 | B | 20 | B | 41 | B |
| 21 | B | 42 | C | 21 | C | 42 | C |

| ROW NO. 3 | | | | ROW NO. 4 | | | |
|---|---|---|---|---|---|---|---|
| **Tube No.** | **Aus Grade** | **Tube No.** | **Aus Grade** | **Tube No.** | **Aus Grade** | **Tube No.** | **Aus Grade** |
| 1 | C | 22 | C | 1 | C | 22 | B |
| 2 | C | 23 | B | 2 | B | 23 | B |
| 3 | C | 24 | C | 3 | C | 24 | B |
| 4 | C | 25 | C | 4 | C | 25 | B |
| 5 | C | 26 | B | 5 | C | 26 | C |
| 6 | C | 27 | C | 6 | C | 27 | B |
| 7 | B | 28 | C | 7 | B | 28 | C |
| 8 | B | 29 | C | 8 | C | 29 | B |
| 9 | B | 30 | C | 9 | C | 30 | C |
| 10 | C | 31 | C | 10 | C | 31 | C |
| 11 | B | 32 | C | 11 | B | 32 | C |
| 12 | B | 33 | C | 12 | C | 33 | C |
| 13 | B | 34 | B | 13 | B | 34 | C |
| 14 | C | 35 | B | 14 | C | 35 | C |
| 15 | C | 36 | B | 15 | C | 36 | B |
| 16 | C | 37 | B | 16 | B | 37 | B |
| 17 | C | 38 | B | 17 | C | 38 | C |
| 18 | C | 39 | B | 18 | C | 39 | B |
| 19 | B | 40 | C | 19 | B | 40 | C |
| 20 | C | 41 | C | 20 | C | 41 | C |
| 21 | C | 42 | C | 21 | B | 42 | C |

## Annexure - 2 (2/3)

## GRADATION OF TUBES BY AUS CARRIED OUT BY M/s PDIL

| ROW NO. 5 | | | | ROW NO. 6 | | | |
|---|---|---|---|---|---|---|---|
| **Tube No.** | **Aus Grade** | **Tube No.** | **Aus Grade** | **Tube No.** | **Aus Grade** | **Tube No.** | **Aus Grade** |
| 1 | B | 22 | B | 1 | C | 22 | C |
| 2 | B | 23 | B | 2 | B | 23 | B |
| 3 | C | 24 | C | 3 | B | 24 | C |
| 4 | C | 25 | B | 4 | B | 25 | B |
| 5 | B | 26 | B | 5 | C | 26 | B |
| 6 | C | 27 | C | 6 | C | 27 | C |
| 7 | B | 28 | C | 7 | C | 28 | C |
| 8 | C | 29 | C | 8 | C | 29 | B |
| 9 | C | 30 | B | 9 | C | 30 | C |
| 10 | B | 31 | C | 10 | C | 31 | C |
| 11 | C | 32 | B | 11 | B | 32 | C |
| 12 | C | 33 | C | 12 | B | 33 | B |
| 13 | C | 34 | C | 13 | B | 34 | C |
| 14 | C | 35 | B | 14 | C | 35 | C |
| 15 | C | 36 | C | 15 | C | 36 | C |
| 16 | B | 37 | C | 16 | B | 37 | B |
| 17 | C | 38 | C | 17 | C | 38 | C |
| 18 | B | 39 | C | 18 | C | 39 | B |
| 19 | B | 40 | C | 19 | B | 40 | B |
| 20 | C | 41 | B | 20 | C | 41 | C |
| 21 | C | 42 | C | 21 | C | 42 | B |

| ROW NO. 7 | | | | ROW NO. 8 | | | |
|---|---|---|---|---|---|---|---|
| Tube No. | Aus Grade | Tube No. | Aus Grade | Tube No. | Aus Grade | Tube No. | Aus Grade |
| 1 | C | 22 | C | 1 | B | 22 | B |
| 2 | C | 23 | C | 2 | C | 23 | C |
| 3 | B | 24 | C | 3 | C | 24 | C |
| 4 | C | 25 | B | 4 | C | 25 | C |
| 5 | C | 26 | B | 5 | B | 26 | C |
| 6 | B | 27 | B | 6 | B | 27 | C |
| 7 | B | 28 | C | 7 | C | 28 | B |
| 8 | C | 29 | B | 8 | C | 29 | C |
| 9 | B | 30 | C | 9 | C | 30 | B |
| 10 | B | 31 | C | 10 | B | 31 | C |
| 11 | C | 32 | B | 11 | C | 32 | C |
| 12 | C | 33 | C | 12 | C | 33 | B |
| 13 | C | 34 | C | 13 | C | 34 | C |
| 14 | C | 35 | B | 14 | B | 35 | B |
| 15 | C | 36 | C | 15 | C | 36 | C |
| 16 | C | 37 | C | 16 | C | 37 | B |
| 17 | C | 38 | C | 17 | B | 38 | C |
| 18 | C | 39 | C | 18 | C | 39 | B |
| 19 | B | 40 | C | 19 | C | 40 | C |
| 20 | C | 41 | B | 20 | B | 41 | B |
| 21 | C | 42 | C | 21 | C | 42 | B |

## Annexure – 2 (3/3)

## GRADATION OF RISER TUBES BY AUS CARRIED OUT BY PDIL

| ROW NO. | RISER NO. | AUS GRADE |
|---|---|---|
| 1 | 1 | B |
| 2 | 2 | B |
| 3 | 3 | C |
| 4 | 4 | B |
| 5 | 5 | C |
| 6 | 6 | B |
| 7 | 7 | B |
| 8 | 8 | C |

## Annexure – 3 (1/5)

## TUBE NOS 101 TO 242

## CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL

| Tube No. | Creep in Percentage | | | Tube No. | Creep in Percentage | | |
|---|---|---|---|---|---|---|---|
| | 0 – 0.17 | 0.17 – 0.7 | 0.7 – 1.55 | | 0 – 0.17 | 0.17 – 0.7 | 0.7 – 1.55 |
| 101 | X | | | 201 | X | | |
| 102 | X | | | 202 | X | | |
| 103 | X | | | 203 | X | | |
| 104 | X | | | 204 | X | | |
| 105 | X | | | 205 | X | | |
| 106 | X | | | 206 | X | | |
| 107 | X | | | 207 | X | | |
| 108 | X | | | 208 | X | | |
| 109 | X | | | 209 | X | | |
| 110 | X | | | 210 | X | | |
| 111 | X | | | 211 | X | | |
| 112 | X | | | 212 | X | | |
| 113 | X | | | 213 | X | | |
| 114 | X | | | 214 | X | | |
| 115 | X | | | 215 | X | | |
| 116 | X | | | 216 | X | | |
| 117 | X | | | 217 | X | | |
| 118 | X | | | 218 | X | | |
| 119 | X | | | 219 | X | | |
| 120 | X | | | 220 | X | | |
| 121 | X | | | 221 | X | | |
| 122 | X | | | 222 | X | | |
| 123 | X | | | 223 | X | | |
| 124 | X | | | 224 | X | | |
| 125 | X | | | 225 | X | | |
| 126 | X | | | 226 | X | | |
| 127 | X | | | 227 | X | | |
| 128 | X | | | 228 | X | | |
| 129 | X | | | 229 | X | | |
| 130 | X | | | 230 | X | | |
| 131 | X | | | 231 | X | | |
| 132 | X | | | 232 | X | | |
| 133 | X | | | 233 | X | | |
| 134 | X | | | 234 | X | | |
| 135 | X | | | 235 | X | | |
| 136 | X | | | 236 | X | | |
| 137 | X | | | 237 | X | | |
| 138 | X | | | 238 | X | | |
| 139 | X | | | 239 | X | | |
| 140 | X | | | 240 | X | | |
| 141 | X | | | 241 | X | | |
| 142 | X | | | 242 | X | | |
| Total | 42 | 0 | 0 | Total | 42 | 0 | 0 |

## Annexure – 3 (2/5)

## TUBE NOS 301 TO 442

## CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL

| Tube No. | Creep in Percentage | | | Tube No. | Creep in Percentage | | |
|---|---|---|---|---|---|---|---|
| | 0 – 0.17 | 0.17 – 0.7 | 0.7 – 1.55 | | 0 – 0.17 | 0.17 – 0.7 | 0.7 – 1.55 |
| 301 | X | | | 401 | X | | |
| 302 | X | | | 402 | X | | |
| 303 | X | | | 403 | X | | |
| 304 | X | | | 404 | X | | |
| 305 | X | | | 405 | X | | |
| 306 | X | | | 406 | X | | |
| 307 | X | | | 407 | X | | |
| 308 | X | | | 408 | X | | |
| 309 | X | | | 409 | X | | |
| 310 | X | | | 410 | X | | |
| 311 | X | | | 411 | X | | |
| 312 | X | | | 412 | X | | |
| 313 | X | | | 413 | X | | |
| 314 | X | | | 414 | X | | |
| 315 | X | | | 415 | X | | |
| 316 | X | | | 416 | X | | |
| 317 | X | | | 417 | X | | |
| 318 | X | | | 418 | X | | |
| 319 | X | | | 419 | X | | |
| 320 | X | | | 420 | X | | |
| 321 | X | | | 421 | X | | |
| 322 | X | | | 422 | X | | |
| 323 | X | | | 423 | X | | |
| 324 | X | | | 424 | X | | |
| 325 | X | | | 425 | X | | |
| 326 | X | | | 426 | X | | |
| 327 | X | | | 427 | X | | |
| 328 | X | | | 428 | X | | |
| 329 | X | | | 429 | X | | |
| 330 | X | | | 430 | X | | |
| 331 | X | | | 431 | X | | |
| 332 | X | | | 432 | X | | |
| 333 | X | | | 433 | X | | |
| 334 | X | | | 434 | X | | |
| 335 | X | | | 435 | X | | |
| 336 | X | | | 436 | X | | |
| 337 | X | | | 437 | X | | |
| 338 | X | | | 438 | X | | |
| 339 | X | | | 439 | X | | |
| 340 | X | | | 440 | X | | |
| 341 | X | | | 441 | X | | |
| 342 | X | | | 442 | X | | |
| Total | 42 | 0 | 0 | Total | 42 | 0 | 0 |

## Annexure – 3(3/5)

## TUBE NOS 501 TO 642

## CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL

| Tube No. | Creep in Percentage | | | Tube No. | Creep in Percentage | | |
|---|---|---|---|---|---|---|---|
| | 0 – 0.17 | 0.17 – 0.7 | 0.7 – 1.55 | | 0 – 0.17 | 0.17 – 0.7 | 0.7 – 1.55 |
| 501 | X | | | 601 | X | | |
| 502 | X | | | 602 | X | | |
| 503 | X | | | 603 | X | | |
| 504 | X | | | 604 | X | | |
| 505 | X | | | 605 | X | | |
| 506 | X | | | 606 | X | | |
| 507 | X | | | 607 | X | | |
| 508 | X | | | 608 | X | | |
| 509 | X | | | 609 | X | | |
| 510 | X | | | 610 | X | | |
| 511 | X | | | 611 | X | | |
| 512 | X | | | 612 | X | | |
| 513 | X | | | 613 | X | | |
| 514 | X | | | 614 | X | | |
| 515 | X | | | 615 | X | | |
| 516 | X | | | 616 | X | | |
| 517 | X | | | 617 | X | | |
| 518 | X | | | 618 | X | | |
| 519 | X | | | 619 | X | | |
| 520 | X | | | 620 | X | | |
| 521 | X | | | 621 | X | | |
| 522 | X | | | 622 | X | | |
| 523 | X | | | 623 | X | | |
| 524 | X | | | 624 | X | | |
| 525 | X | | | 625 | X | | |
| 526 | X | | | 626 | X | | |
| 527 | X | | | 627 | X | | |
| 528 | X | | | 628 | X | | |
| 529 | X | | | 629 | X | | |
| 530 | X | | | 630 | X | | |
| 531 | X | | | 631 | X | | |
| 532 | X | | | 632 | X | | |
| 533 | X | | | 633 | X | | |
| 534 | X | | | 634 | X | | |
| 535 | X | | | 635 | X | | |
| 536 | X | | | 636 | X | | |
| 537 | X | | | 637 | X | | |
| 538 | X | | | 638 | X | | |
| 539 | | X | | 639 | X | | |
| 540 | X | | | 640 | X | | |
| 541 | X | | | 641 | X | | |
| 542 | X | | | 642 | X | | |
| Total | 41 | 01 | 0 | Total | 42 | 0 | 0 |

## Annexure – 3(4/5)

## TUBE NOS 701 TO 842

## CREEP MEASUREMENT OF PRIMARY REFORMER CATALYST TUBES AT SLAB LEVEL

| Tube No. | Creep in Percentage | | | Tube No. | Creep in Percentage | | |
|---|---|---|---|---|---|---|---|
| | 0 – 0.17 | 0.17 – 0.7 | 0.7 – 1.55 | | 0 – 0.17 | 0.17 – 0.7 | 0.7 – 1.55 |
| 701 | X | | | 801 | X | | |
| 702 | X | | | 802 | X | | |
| 703 | X | | | 803 | X | | |
| 704 | X | | | 804 | X | | |
| 705 | X | | | 805 | X | | |
| 706 | X | | | 806 | X | | |
| 707 | X | | | 807 | X | | |
| 708 | X | | | 808 | X | | |
| 709 | X | | | 809 | X | | |
| 710 | X | | | 810 | X | | |
| 711 | X | | | 811 | X | | |
| 712 | X | | | 812 | X | | |
| 713 | X | | | 813 | X | | |
| 714 | X | | | 814 | X | | |
| 715 | X | | | 815 | X | | |
| 716 | X | | | 816 | X | | |
| 717 | X | | | 817 | X | | |
| 718 | X | | | 818 | X | | |
| 719 | X | | | 819 | X | | |
| 720 | X | | | 820 | X | | |
| 721 | X | | | 821 | X | | |
| 722 | X | | | 822 | X | | |
| 723 | X | | | 823 | X | | |
| 724 | X | | | 824 | X | | |
| 725 | X | | | 825 | X | | |
| 726 | X | | | 826 | X | | |
| 727 | X | | | 827 | X | | |
| 728 | X | | | 828 | X | | |
| 729 | X | | | 829 | X | | |
| 730 | X | | | 830 | X | | |
| 731 | X | | | 831 | X | | |
| 732 | X | | | 832 | X | | |
| 733 | X | | | 833 | X | | |
| 734 | X | | | 834 | X | | |
| 735 | X | | | 835 | X | | |
| 736 | X | | | 836 | X | | |
| 737 | X | | | 837 | X | | |
| 738 | X | | | 838 | X | | |
| 739 | X | | | 839 | X | | |
| 740 | X | | | 840 | X | | |
| 741 | X | | | 841 | X | | |
| 742 | X | | | 842 | X | | |
| Total | 42 | 0 | 0 | Total | 42 | 0 | 0 |

**Annexure – 3(5/5)**

## CREEP MEASUREMENT OF PRIMARY REFORMER RISER TUBES AT SLAB LEVEL

| Riser No. | N- S | E- W | Creep in Percentage | | |
|---|---|---|---|---|---|
| | | | 0 – 0.33 | 0.33 – 1.10 | 1.10 – 1.44 |
| 1 | 125.57 | 125.82 | | X | |
| 2 | 125.05 | 125.19 | | X | |
| 3 | 125.42 | 125.51 | | X | |
| 4 | 125.24 | 125.22 | | X | |
| 5 | 125.78 | 125.74 | | X | |
| 6 | 125.48 | 125.41 | | X | |
| 7 | 125.15 | 125.07 | | X | |
| 8 | 125.05 | 125.11 | | X | |

* Design O.D. of Riser = $124.44^{+1}_{-0}$

## Annexure – 4

## TUBE SPRING HANGER LOAD READINGS OF PRIMARY REFORMER HARP ASSEMBLY (101-B)

### COLD LOAD READINGS IN MM

| ROW | TUBE NOS. (SOUTH TO NORTH) | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 3 | 4 5 | 6 7 | 8 9 | 10 11 | 12 13 | 14 15 | 16 17 | 18 19 | 20 21 | 22 23 | 24 25 | 26 27 | 28 29 | 30 31 | 32 33 | 34 35 | 36 37 | 38 39 | 40 41 | 42 |
| 1 | -6 | -7 | -12 | -12 | -17 | -16 | -20 | -12 | -6 | -5 | -2 | -3 | -7 | -8 | -16 | -15 | -15 | -10 | -13 | -2 | 0 | 17 |
| 2 | -8 | -5 | -6 | -8 | -6 | -6 | -16 | -14 | -4 | -4 | -1 | -3 | 0 | 0 | -6 | -8 | -16 | 3 | -6 | -3 | 0 | -2 |
| 3 | -2 | 2 | -4 | -9 | -7 | -7 | -12 | -8 | -3 | 0 | 4 | 3 | 3 | 0 | -8 | -11 | -8 | -5 | -3 | -2 | 2 | 3 |
| 4 | 0 | 3 | 0 | -4 | -4 | -6 | -3 | -2 | 2 | 0 | 8 | 0 | 0 | 0 | -2 | -2 | 0 | 0 | 0 | 0 | 4 | 7 |
| 5 | 5 | 2 | -1 | -2 | -3 | -3 | -4 | 0 | -2 | 3 | 0 | 0 | 0 | 0 | -4 | 0 | 0 | 2 | 2 | 3 | 7 | 6 |
| 6 | 3 | 2 | 0 | 0 | -4 | -6 | -3 | -2 | -3 | -11 | -2 | -17 | 2 | 4 | -5 | -5 | -8 | -6 | -3 | 2 | 0 | 6 |
| 7 | 4 | 4 | 0 | -3 | -4 | -2 | -5 | -3 | -2 | -2 | 0 | -3 | -4 | -11 | -8 | -9 | -6 | -5 | -3 | 0 | 2 | 9 |
| 8 | 11 | 4 | 2 | 0 | -3 | 0 | -6 | -4 | -2 | -3 | -2 | -3 | -3 | 0 | -12 | -5 | -5 | -2 | 0 | -12 | 11 | 11 |

### TRANSFER LINE SPRING SUPPORT READINGS IN MM

| ROW | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| READINGS | **-32** | **-27** | **-26** | **-33** | **-38** | **-18** | **-16** |

### BOTTOM DRAIN READINGS IN MM

| ROW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| READINGS | **95** | **97** | **100** | **90** | **100** | **98** | **96** | **95** |

### AUXILIARY BOILER SPRING SUPPORT READINGS IN MM

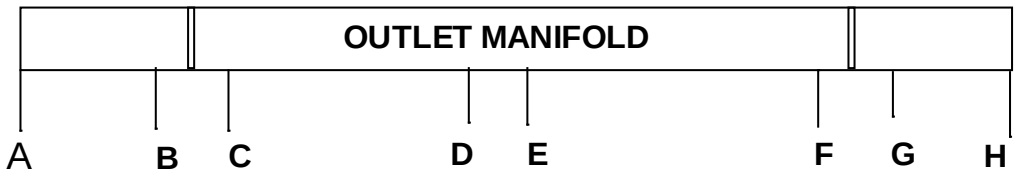
| SPRING | S-E | N-E | S-W | N-W |
|---|---|---|---|---|
| READINGS | **63** | **64** | **60** | **60** |

## Annexure – 5

## CLEARANCE OF OUTLET MANIFOLD FROM GROUND FLOOR IN COLD CONDITION

| Header No. | Location of Meausrement | | | | | |
|---|---|---|---|---|---|---|
| | B | C | D | E | F | G |
| 1 | *180 | *160 | *200 | *130 | *200 | *210 |
| 2 | *180 | 290 | *150 | *200 | *190 | *185 |
| 3 | *170 | *170 | *155 | 280 | *170 | 290 |
| 4 | *140 | 280 | *160 | 290 | 280 | 300 |
| 5 | 280 | 300 | 300 | 300 | 300 | 290 |
| 6 | *200 | *175 | *150 | *190 | *160 | *140 |
| 7 | 290 | 290 | *195 | *200 | 290 | 280 |
| 8 | *200 | *140 | *170 | 300 | *200 | 290 |

**NOTE:** (1) All readings are in mm.
(2) Readings are taken without insulation.
(3) * Readings are taken with insulation




**SOUTH** **NORTH**

## Annexure – 6

## LIST OF PIPELINES FOR ULTRASONIC FLAW DETECTION

| Sr No | Line No | Size (NB) | Sch | From | To | No. of Weld Joints Tested | No. of Elbows Tested | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | SG-1303-08-14” | 14” | 120 | 105-D, SG-33-14 | 108-D Inlet (Bottom) | 12 | 03 | No significant defect was observed. |
| 2 | SG-1303-09-10” | 10” | 120 | 105-D, SG-1303.08-14 | 108-D Inlet (Bottom) | 08 | 04 | |
| 3 | SG-1303-08-10” | 10” | 120 | SG-1303.08-14” (105-D) | 108-D Inlet (Top North) | 06 | 03 | |
| 4 | SG-1303-12-10” | 10” | 120 | SG-1303.08-14” (105-D) | 108-D Inlet (Top South) | 06 | 03 | |
| 5 | SG-1303-10-14” | 14” | 120 | 108-D | 107-C | 12 | 05 | |
| 6 | SG-1303-11-14” | 14” | 140 | 107-C | 123-C | 08 | 04 | |
| 7 | PG-12A | 14” | 30 | 105-CA | PG-26 | 01 | - | |
| 8 | PG-12B | 14” | 30 | 105-CB | PG-26 | 01 | - | |
| 9 | NG-11-A TO H | 6” | 120 | NG-9 | 101-B | 05 | - | |
| 10 | NG-09-12” | 12” | 100 | 101-B | 103-D | 03 | 01 | |
| 11 | SG-1303-02-14” | 14” | 100 | 121-C | SG-12-14” | 15 | 06 | |
| 12 | SG-1303-03-08” | 8” | 100 | SG-12-14” | 137-C | 02 | - | |
| 13 | SG-1303-04-8” | 8” | 100 | 137-C | SG-51-8” | 11 | 04 | |

## Annexure – 7

## THICKNESS MEASUREMENT SUMMARY OF EQUIPMENT

| Sr. No. | Equipt . No. | Equipment Description | Shell | | | Dish End | | | Channel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nom./ Design | Min. Measured | % Red. | Nom./ Design | Min. Measured | % Red | Nom./ Design | Min. Measured | % Red. |
| 1 | 103 - C | Primary Shift Effluent Waste Heat Boiler | 55.56 | 56.04 | | 20.63 | 27.19 | | | | |
| 2 | 109CB1 | aMDEA Solution Exchanger | 12.70 | 12.87 | - | 12.70 | 15.75 | - | | 24.58 | - |
| 3 | 109CB2 | aMDEA Solution Exchanger | 12.70 | 12.66 | 0.31 | 12.70 | 15.12 | - | | 24.33 | - |
| 4 | 112-C | LTS Converter Inlet Boiler | 12.70 | 13.26 | - | 26.99 | 28.81 | - | | | |
| 5 | 150-C | Fuel Preheat Exchanger | 8.38 | 9.97 | - | 12.70 | 12.77 | | | | |
| 6 | 151-C | Fuel Preheat Exchanger | 8.38 | 8.11 | 3.22 | 9.52 | 8.08 | 15.12 | | | |
| 7 | 171-C | Condensate Stripper Exchanger | 9.52 | 2.42** | 74.57 | 9.52 | 7.43 | 21.95 | **Remark: Patch Plates Provided at 04 locations | | |
| 8 | 173 - C | Stripped Condensate Cooler | 9.50 | 9.11 | | | | | | | |
| 9 | 101-F | Steam Drum | 106.4 | 111.49 | - | 106.4 | 107.96 | - | | | |
| 10 | 103 - F | CO2 Stripper Reflux Drum | 11.11 | 11.48 | | 11.11 | 13.98 | | | | |
| 11 | 102 - EB | CO2 Stripper | 15.9 | 15.86 | 0.25 | 15.9 | 19.58 | - | | | |
| 12 | 109 - F | Refrigerant Receiver | 21.40 | 21.18 | | 18.20 | 18.98 | | | | |
| 13 | 114 - F | aMDEA Storage Tank | 4.76 | 4.51 | | 4.76 | - | | | | |
| 14 | 117-F | aMDEA Carbon Filter | 10.0 | 9.58 | | 10.0 | 9.07 | | | | |
| 15 | 141-F | New Instrument Air Receiver | NA | 13.67 | | NA | 11.66 | | | | |
| 16 | 156-F | Blow Down Drum | 11.11 | 10.83 | 2.52 | NA | 11.46 | - | | | |
| 17 | 2001-LF | Hydrazine Mix Tank | NA | 3.06 | | NA | 2.77 | | | | |
| 18 | 2002-LF | Phosphate Mix Tank | NA | 3.08 | | NA | 4.01 | | | | |
| 19 | 2004-LF | Mix Tank | NA | 2.99 | | NA | 2.64 | | | | |
| 20 | 2006-UF-1 | Salt Storage Tank | NA | 5.03 | | NA | 8.17 | | | | |
| 21 | 2006-UF-2 | Salt aMDEAsuring Tank | NA | 9.26 | | NA | 8.31 | | | | |
| 22 | AD-A | Instrument Air Drier | | 6.56 | | | 7.42 | | | | |
| 23 | AD-B | Instrument Air Drier | | 6.17 | | | 6.46 | | | | |
| 24 | ADU-04 | New Instrument Air Drier - A | | 7.95 | | | 7.97 | | | | |
| 25 | ADU-05 | New Instrument Air Drier-B | | 8.05 | | | 7.91 | | | | |

**NOTE:** (1) All readings are in MM

## THICKNESS MEASUREMENT SUMMARY OF HT COILS.

| SR NO | DESCRIPTION | DESIGN THICKNESS | MEASURED THICKNESS | % REDUCTION |
|---|---|---|---|---|
| 1 | HT STEAM SUPER HEATER COIL (HT Convection, 3rd from bottom) | 8.0 | 8.01 | 0 |
| 2 | AIR-PREHEATER COIL (HT Convection, 2nd from bottom) | 6.55 | 6.58 | - |
| 3 | MIXED FEED COIL (HT Convection, bottom most) | 8.0 | 11.70 | - |

**NOTE:** All readings are in MM

## ANNEXURE- 8 (1/2)

## THICKNESS MEASUREMENT OF TWO PHASE FLOW PIPELINES

| SR. NO. | LINE NO. | N.B. (in.) | SCH. | NOM. THK. (mm) | MAT. | LINE DESCRIPTION | | Min. Thickness Observed (mm) | % RED. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FROM | TO | | |
| 1 | BF-1304-01 | 3 | 160 | 11.13 | CS | 142-CA/CB | 107-C | 10.8 | 2.96 |
| 2 | BO-01 | 1.5 | 80 | 5.1 | CS | BO-01-1.5" | BO-17-1.5" | 5.1 | 0 |
| 3 | BO-01H | 1.5 | 80 | 5.1 | CS | 101-F | BO-01-1.5" | 9.36 | - |
| 4 | BO-2H | 1.5 | XXS | 10.2 | CS | 101-F | BO-21-1.5" | 8.12 | 20.39 |
| 5 | BO-3H | 1 | 160 | 6.35 | CS | 102-C | BO-13-1" (SP-7) | 5.88 | 7.40 |
| 6 | BO-4 | 1/1.5 | 80 | 4.5/5.1 | CS | BO-6H-1" (SP-7) | BO-14-3" | 4.25 | 5.55 |
| 7 | BO-06 | 1 | 80 | 4.5 | CS | BO-12H | BO-11-1.5" | 4.4 | 2.22 |
| 8 | BO-6H | 1 | 160 | 6.35 | CS | 103-C | BO-4-1" (SP-7) | 5.81 | 8.50 |
| 9 | BO-07 | 1 | 80 | 4.5 | CS | BO-11-1.5" | BO-14-2" | 4.4 | 2.22 |
| 10 | BO-13 | 1/1.5 | 80 | 4.5/5.1 | CS | BO-21-1.5" | BO-3H-1" | 4.40/4.43 | 13.13 |
| 11 | BO-1304.04 | 2 | 40 | 3.91 | CS | 107- C | 156- F | 3.06 | 21.73 |
| 12 | BO-14BH | 2 | 160 | 8.71 | CS | AUX.BOILER COIL-A | BLOW DOWN BO-7 | 10.2 | - |
| 13 | BO-17 | 1 | 160 | 6.35 | CS | BO-14-3" | 101-CA Header | 4.4 | 30.70 |
| 14 | BO-20 | 1 | 160 | 6.35 | CS | BO-17-1" | BW-21H (101-CB Header) | 5.9 | 7.08 |
| 15 | BO-20H | 1 | 160 | 6.35 | CS | BO-20-1" | 101-CB Header | 5.9 | 7.08 |
| 16 | BO-21 | 1.5 | 80 | 5.1 | CS | BO-2H-1.5" | BO-14-3" | 4.68 | 8.23 |
| 17 | aMDEA-06A | 10 | 40S | 9.27 | SS | 109-C1A | aMDEA-61-12" | 9.83 | - |
| 18 | aMDEA-06A | 8 | 40S | 8.18 | SS | 109-C1A | aMDEA-61-12" | 7.96 | 2.68 |
| 19 | aMDEA-06B | 10 | 40S | 9.27 | SS | 109-C1B | aMDEA-61-12" | 9.65 | - |
| 20 | aMDEA-06B | 8 | 40S | 8.18 | SS | 109C1B/ C2B | MDEA- 7-12" | 8.12 | 0.73 |
| 21 | aMDEA-07 | 10 | 40S | 9.27 | SS | aMDEA-61-12" | 102-EB (aMDEA-9B-10") | 9.2 | 0.75 |
| 22 | aMDEA-17 | 16 | 20 | 7.92 | CS | aMDEA-62-16" | aMDEA-41-16" | 7.02 | 11.36 |
| 23 | aMDEA-24A | 3 | 40 | 5.5 | CS | 108-J | aMDEA-25-3" | 5.01 | 8.90 |
| 24 | aMDEA-24B | 3 | 40 | 5.5 | CS | 108-JA | aMDEA-25-3" | 5.02 | 8.72 |
| 25 | aMDEA-25 | 3 | 40 | 5.5 | CS | aMDEA-24A,B-3" | aMDEA-26B-2.5" | 2.46 | 55.27* |
| 26 | aMDEA-62 | 16 | 20 | 7.92 | CS | HEADER | aMDEA-17-16" | 7.2 | 9.09 |
| 27 | MDEA-1202.01 | 18 | XS | 12.7 | CS | 101- EA | MDEA -1202.02-18" (USV-470) | 11.38 | 10.39 |
| 28 | MDEA-1202.02 | 18 | XS | 12.7 | CS | MDEA-1202.01-18" | 115- HT | 11.43 | 10.0 |
| 29 | MDEA-1202.02 | 18 | XS | 12.7 | SS | 115- HT | 103-E1 | 11.43 | 10.0 |
| 30 | MDEA-1202.02 | 18 | 40S | 12.7 | SS | 115- HT | 103-E1 | 11.43 | 10.0 |
| 31 | MDEA-1203.02 | 18 | 10S | 4.78 | SS | HV-435 (MDEA-1202.03-14") | 103-E1/ E2 | 4.96 | - |
| 32 | MDEA-1204.01 | 24 | 10S | 6.35 | SS | 103- E2 HP | LV-416 | 5.4 | 14.96 |
| 33 | MDEA-1209.02 | 24 | 40 | 17.48 | CS | 103-E2LP (MDEA-1209-01-24" ) | 115- JA | 17.6 | - |
| 34 | MDEA-1209.02 | 24 | STD | 9.53 | CS | 103-E2LP (MDEA-1209-01-24" ) | 115- JA | 9.3 | 2.41 |
| 35 | MDEA-1209.03 | 24 | 40 | 17.48 | CS | 103-E2LP (MDEA-1209-01-24" ) | 115- JB | 16.5 | 5.60 |

| SR. NO. | LINE NO. | N.B. (in.) | SCH. | NOM. THK. (mm) | MAT. | LINE DESCRIPTION | | Min. Thickness Observed (mm) | % RED. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FROM | TO | | |
| 36 | MDEA-1209.03 | 24 | STD | 9.53 | CS | 103-E2LP (MDEA-1209-01-24" ) | 115- JB | 9.4 | 1.36 |
| 37 | MDEA-1209.06 | 12 | 20 | 6.35 | CS | 103-E2LP (MDEA-1209-01-24" ) | MDEA-1209.07/08 (116 JA/ JB) | 6.25 | 1.57 |
| 38 | MDEA-1209.07 | 12 | 10 S | 4.57 | SS | 103-E2LP (MDEA-1209-01-24" ) | 116- JA | 5 | - |
| 39 | MDEA-1209.08 | 12 | 10 S | 4.57 | SS | 103-E2LP (MDEA-1209-01-24" ) | 116- JB | 5.08 | - |
| 40 | MDEA-1212. 01 | 16 | XS | 12.7 | CS | 115- JA | 101-EA (MDEA-1212-03) USV-933 | 9.67 | 23.85 |
| 41 | MDEA-1212. 02 | 16 | XS | 12.7 | CS | 115- JB | 101-EA (MDEA-1212-03) USV-935 | 9.77 | 23.07 |
| 42 | MDEA-1212. 03 | 16 | XS | 12.7 | CS | 115JA / 115-JB(MDEA-1212-01/02) | 101-EA | 12.19 | 4.01 |
| 43 | PG-10 | 18 | 40/STD | 12.7 / 9.53 | CS | 104-D | PG-11-20" | 16.5/ 9.0 | - / 5.56 |
| 44 | PG-11A | 16 | 40 | 12.7 | CS | PG-11-20" | 105-CA | 11.6 | 8.66 |
| 45 | PG-11B | 16 | 40 | 12.7 | CS | PG-11-20" | 105-CB | 12.5 | 1.57 |
| 46 | PG-12A | 14 | 30 | 9.525 | SS-304 | 105-CA | PG-26 18" | 8.52 | 10.55 |
| 47 | PG-12B | 14 | 30 | 9.525 | SS-304 | 105-CB | PG-26 18" | 9.3 | 2.36 |
| 48 | PG-13 | 16 | 30 | 9.525 | SS-304 | 106-C | PG-26 (Header) | 9.45 | 0.78 |
| 49 | PG-26 | 18 | 30 | 11.13 | SS-304 | HEADER | | 10.93 | 1.79 |
| 50 | PG-1212. 01 | 14 | 10 | 6.35 | CS | 101- EA | 136- C | 6.07 | 4.40 |
| 51 | PW-17 | 4 | 120 | 11.13 | CS | PW-1-6" | 170-C | 11.0 | 1.16 |
| 52 | PW-17 | 4 | 40 | 6.02 | SS304 | PW-1-6" | 170-C | 4.27 | 29.06 |
| 53 | PW-19 | 4 | 120 | 11.13 | CS | LC-3A | 104-E | 8.73 | 21.56 |
| 54 | PW-19 | 2 | 10S | 2.77 | SS | LC-3A | 104-E | 2.5 | 9.74 |
| 55 | PW-20 | 6 | 80 | 10.97 | CS | 104-E | 170-J | 9.64 | 12.12 |
| 56 | PW-20A | 6 | 80 | 10.97 | CS | PW-20-6" | 170 JA | 7.84 | 28.53 |
| 57 | PW-24 | 4 | 120 | 11.13 | CS | 173-C | CONTROL VALVE | 10.5 | 5.66 |
| 58 | PW-27 | 6 | 80 | 10.97 | CS | PW-20-6" | PW-28-4" | 10.09 | 8.02188 |
| 59 | PW-29 | 10 | 60 | 12.7 | CS | 171-C | PW-30-14" | 12.0 | 5.51 |
| 60 | PW-30 | 10 | 60 | 12.7 | CS | 171-C (PW-29-10") | PW-31-12" (HEADER) | 10.9 | 14.17 |
| 61 | PW-31 | 12 | 40 | 10.31 | CS | PW-30-14" | 104-E | 9.0 | 12.70 |
| 62 | SC-17 | 3 | 80 | 7.62 | CS | 156-F | SEWER | 6.2 | 18.63 |
| 63 | SC-44 | 2 | 80 | 5.5 | CS | 171-C | STS/45 | 4.87 | 11.45 |
| 64 | SG-13 | 12 | 100 | 21.41 | CS | 120-C | LETDOWN VALVE ( Yellow line ) | 16.7 | 21.99 |

*Segment replaced

## ANNEXURE- 8 (2/2)

## THICKNESS MEASUREMENT OF OTHER PIPELINES

| SR. NO. | LINE NO. | N.B. (in.) | SCH. | NOM. THK. (mm) | MAT. | LINE DESCRIPTION | | Minimum Thickness Observed (mm) | % RED. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FROM | TO | | |
| 1 | A-20 | 10 | 20 | 6.35 | C.S. | 101 J | 101 B | 5.1 | 19.68 |
| 2 | BF-18 | 3 | 80 | 7.62 | CS | BF-22 | 114-C | 6.06 | 20.47 |
| 3 | CO-07 | 24 | XS | 6.35 | SS304 | HEADER | 103-F | 5.88 | 7.40 |
| 4 | aMDEA-10B | 12 | 20 | 6.35 | CS | 102-EB | aMDEA-11 | 4.2 | 33.85 |
| 5 | aMDEA-12A | 12 | 20 | 6.35 | CS | aMDEA-11 | 109C1A | 5.62 | 11.49 |
| 6 | aMDEA-12B | 12 | 20 | 6.35 | CS | aMDEA-11 | 109C1B | 5.78 | 8.97 |
| 7 | aMDEA-13A | 12 | 20 | 6.35 | CS | 109C2A | aMDEA-60 | 6.3 | 0.78 |
| 8 | aMDEA-13B | 12 | 20 | 6.35 | CS | 109C2B | aMDEA-60 | 5.55 | 12.59* |
| 9 | aMDEA-15A | 12 | 20 | 6.35 | CS | aMDEA-14 | 108C1A | 8.48 | - |
| 10 | aMDEA-16A | 12 | 20 | 6.35 | CS | 108C2A | aMDEA-62 | 6.35 | - |
| 11 | aMDEA-19C | 8 | 30 | 8.38 | CS | 107-JB | aMDEA-21 | 7.2 | 14.08 |
| 12 | aMDEA-19D | 8 | 30 | 8.38 | CS | 107-JA | aMDEA-21 | 7.1 | 15.27 |
| 13 | aMDEA-20 | 12 | 30 | 8.38 | CS | aMDEA-21 | 101-E | 8.08 | 3.57 |
| 14 | aMDEA-21 | 12 | 30 | 8.38 | CS | aMDEA-19C+D | aMDEA-20 | 8.12 | 3.10 |
| 15 | aMDEA-22 | 4 | 40 | 6.02 | CS | 103-F | MEA-23A,B | 5.52 | 8.30 |
| 16 | aMDEA-23A | 4 | 40 | 6.02 | CS | aMDEA-22 | 108-J | 5.42 | 9.96 |
| 17 | aMDEA-23B | 4 | 40 | 6.02 | CS | aMDEA-22 | 108-JA | 5.35 | 11.12 |
| 18 | aMDEA-27B | 18 | 20 | 7.92 | CS | 102-EB | aMDEA-33B | 8 | - |
| 19 | aMDEA-41 | 16 | 20 | 7.92 | CS | aMDEA-17 | MEA-18A + B | 6.7 | 15.40 |
| 20 | aMDEA-42 | 16 | 20 | 7.92 | CS | aMDEA-17 | MEA-18C+D | 7.4 | 6.56 |
| 21 | aMDEA-60 | 14 | 20 | 7.92 | CS | HEADER | aMDEA-14 | 7.39 | 6.69 |
| 22 | aMDEA-100 | 3 | 40 | 5.5 | CS | HEADER | 115-F SUMP | 3.4 | 13.04 |
| 23 | HS-10 | 6 | 100 | 13 | P-11 | HS-5 | PIC-13 A | 12.8 | 1.53 |
| 24 | HS-11 | 6 | 120 | 14.27 | P-11 | HS-9 | PIC-13 B | 13.1 | 8.19 |
| 25 | HS-12 | 6 | 100 | 13 | P-11 | HS-9 | MICA-22 | 13.2 | - |
| 26 | HS-20-50 | 2 | | 8.71 | | TRCV-142 STEAM D/S LINE | | 7.94 | 8.84 |
| 27 | MS-12 | 8 | 100 | 15.06 | CS | MICA-22 | MS-9 | 13.5 | 10.35 |
| 28 | MS-13 | 8 | 100 | 15.06 | CS | PIC-13B | MS-9 | 18.2 | - |
| 29 | MS-14 | 8 | 100 | 15.06 | CS | PIC-13A | MS-9 | 13.5 | 10.35 |
| 30 | MS-16 | 2 | 80 | 5.54 | CS | MS-40 | 112-JAT | 4.7 | 15.16 |
| 31 | NG-04 | 6 | 40 | 7.11 | CS | 101-D | NG-6A-8" | 6.46 | 9.14 |
| 32 | NG-06 | 8 | 20 | 6.4 | CS | 150-C | 101-D | 7.06 | - |
| 33 | NG-06A | 8 | 20 | 8.18 | CS | NG-4 | 150-C | 6.22 | 23.96 |
| 34 | NG-11A | 6 | 120 | 14.3 | P-11 | NG-9 | 101-B | 14.37 | - |
| 35 | NG-11B | 6 | 120 | 14.3 | P-11 | NG-9 | 101-B | 13.59 | 4.96 |

| SR. NO. | LINE NO. | N.B. (in.) | SCH. | NOM. THK. (mm) | MAT. | LINE DESCRIPTION | | Minimum Thickness Observed (mm) | % RED. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FROM | TO | | |
| 36 | NG-11D | 6 | 120 | 14.3 | P-11 | NG-9 | 101-B | 14.09 | 1.46 |
| 37 | NG-11F | 6 | 120 | 14.3 | P-11 | NG-9 | 101-B | 13.66 | 4.47 |
| 38 | NG-11H | 6 | 120 | 14.3 | P-11 | NG-9 | 101-B | 13.52 | 5.45 |
| 39 | NG-16 | 8 | 40 | 8.18 | CS | BATT. LIMIT | 151-C | 7.11 | 13.08 |
| | | 6 | 40 | 7.11 | | | | 6.63 | 6.75 |
| 40 | NG-22 | 8 | 40 | 8.18 | CS | 176- F | NG- 30- 24" | 7.8 | 4.64 |
| 41 | NG-50 | 3 | 40 | 5.5 | CS | NG-6 | NG-7 | 4.7 | 14.54 |
| 42 | PW-02 | 2 | 40/S | 3.91 | SS | SPEC.BRK. | PW-12 | 3.2 | 18.15 |
| | | | | 3.05 | SS | | | 2.74 | 10.16 |
| 43 | PW-13 | 6 | 80 | 10.97 | CS | PW-12 | SEWER | 6.46 | 41.11* |
| 44 | SC- 07 | 2.5 | 80 | 7.01 | CS | SC-42 | 101-JC | 4.3 | 38.65 |
| 45 | SC - 20 | 2 | 80 | 5.5 | CS | SC-42 | SC-71 | 4.6 | 16.36 |
| 46 | SC-41A | 4 | 40 | 6.02 | CS | 112-JA | SC-42 | 6.7 | - |
| 47 | SC-41B | 4 | 40 | 6.02 | CS | 112-J | SC-42 | 6.7 | - |
| 48 | SC-42 | 4 | 40 | 6.02 | CS | SC-41A | CV | 6.3 | - |
| 49 | SC-42 | 6 | 40 | 7.11 | CS | CV | 2005-V | 6.3 | 11.39 |
| 50 | SC-42 | 4 | 40 | 6.02 | CS | CV-A | LC-2 | 6.3 | - |
| 51 | SC-45 | 2 | 80 | 5.5 | CS | STS-45 | SC-72 | 4 | 27.27 |
| 52 | SC-51 | 2 | 80 | 5.5 | CS | 150-C | STS-51 | 4.66 | 15.27 |
| 53 | SC-52 | 2 | 80 | 5.5 | CS | STS-51 | SC-72 | 4.99 | 9.27 |
| 54 | SC-53 | 2 | 80 | 5.5 | CS | 151-C | STS-53 | 4.92 | 10.54 |
| 55 | SC-54 | 2 | 80 | 5.5 | CS | STS-53 | SC-72 | 4.89 | 11.09 |
| 56 | SC-71 | 4 | 80 | 6.02 | CS | SC-20 | 101-CA&CB | 7.84 | - |
| 57 | SG-53 | 3 | 160 | 11.13 | CS | SG-22 | EVPT. DISC | 9.7 | 12.84 |
| 58 | SG-62-A | 4 | xx | 17.11 | P5 | 102-B | SG-32 | 16.47 | 3.74 |
| 59 | SG-62-B | 4 | xx | 17.11 | P5 | 103-B | SG-32 | 17.29 | - |
| 60 | SG-32 | 6 | 7/8" | 22.22 | P-5 | SG-62 A & B | SG-25 | 21.74 | 2.16 |

*Segment replaced/Patch provided

## Annexure-9

## GAUSS MEASUREMENT & DE-MAGNETIZATION REPORT

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| **101-BJT (Turbine)** | | | |
| Front side Journal Bearing (Governor side) | Top | 1.2 | |
| | Bottom | 2.2 | |
| Shaft Journal (Governor side) | | 2.4 | |
| Rear side Journal Bearing (Coupling side) | Top | 0.8 | |
| | Bottom | 2.2 | |
| Shaft Journal (Coupling side) | | 2.4 | |
| **101-BJR (High Speed Drive Pinion)** | | | |
| Journal Bearing | East Side(CT side) | T-0.4 B-0.8 | |
| | West Side(Silo side) | T-0.5 B-0.7 | |
| Shaft Journal | CT side/Silo side | 1.5/2.2 | |
| **101-BJR (Low Speed Driven Gear)** | | | |
| Journal Bearing Liner | East Side(CT side) | T-1.5 B-0.5 | |
| | West Side(Silo side) | T-0.5 B-1.5 | |
| Shaft Journal | CT side/Silo side | 2.9/2.6 | |
| **101-BJ (ID FAN)** | | | |
| Front side Journal Bearing (GB side) | Top | 1.9 | |
| | Bottom | 0.6 | |
| Front side Thrust Collar (GB side) | Active | 0.3 | |
| | In Active | 0.6 | |
| Front Journal Shaft (GB side) | | 0.9 | |
| Rear side Journal Bearing (End side) | Top | 2.2 | |
| | Bottom | 1.5 | |
| Rear Journal Shaft (End side) | | 2.2 | |
| **101-JT** | | | |
| Journal Bearing Pad | Thrust End | T-1.7 B-1.3 | |
| | Non Thrust End | T-0.6 B-1.3 | |
| Journal Bearing Base ring | Thrust End | 1.5 | |
| | Non Thrust End | 1.8 | |
| Thrust Bearing Pads | Active | 2.2 | |
| | Inactive | 0.9 | |
| Thrust Bearing Base ring | Active | 1.7 | |
| | Inactive | 1.6 | |

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| Shaft Journal | Thrust End | 2.8 | |
| | Non Thrust End | 2.7 | |
| **101-JLP** | | | |
| Journal Bearing Pads | Thrust End | T-0.8 B-1.9 | |
| | Non Thrust End | T-1.5 B-3.2 | |
| Journal Bearing Base ring | Thrust End | 2.0 | |
| | Non Thrust End | 1.9 | |
| Thrust Bearing Pads | Active | 1.7 | |
| | Inactive | 1.5 | |
| Thrust Bearing Base ring | Active | 1.5 | |
| | Inactive | 1.4 | |
| Shaft Journal | Thrust End | 2.9 | |
| | Non Thrust End | 3.1 | |
| **101-JR** | | | |
| Gear Journal Bearing | North | 1.7 | |
| | South | 1.4 | |
| Pinion Journal Bearing | North | 1.3 | |
| | South | 1.3 | |
| Thrust Bearing | Active | 1.4 | |
| | Inactive | 1.3 | |
| Shaft Journal | Thrust End | 2.1 | |
| | Non Thrust End | 2.3 | |
| **101-JHP** | | | |
| Journal Bearing Pads | Thrust End | 1.4 | |
| | Non Thrust End | 1.2 | |
| Journal Bearing Base ring | Thrust End | 1.6 | |
| | Non Thrust End | 1.4 | |
| Thrust Bearing Pads | Active | 1.5 | |
| | Inactive | 1.3 | |
| Thrust Bearing Base ring | Active | 1.6 | |
| | Inactive | 1.4 | |
| Shaft Journal | Thrust End | 2.7 | |
| | Non Thrust End | 2.3 | |
| **104-JT** | | | |
| Journal Bearing Sleeve | Thrust End | T-0.9 B-1.4 | |
| | Non Thrust End | T-0.6 B-1.2 | |
| Shaft Journal | Thrust End | 1.1 | |
| | Non Thrust End | 1.2 | |

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| **104-J** | | | |
| Journal Bearing Sleeve | Thrust End | T-0.8 B-1.6 | |
| | Non Thrust End | T-0.5 B-0.6 | |
| Thrust Bearing Pads | Active | 1.8 | |
| | Inactive | 1.9 | |
| Thrust Bearing Base ring | Active | 1.2 | |
| | Inactive | 2.2 | |
| Thrust Collar | | 2.2 | |
| Shaft Journal | Thrust End | 1.5 | |
| | Non Thrust End | 1.2 | |
| **104-JA** | | | |
| Journal Bearing Pad | North side | T-0.3 B-0.3 | |
| | South Side | T-0.5 B-0.6 | |
| Thrust Bearing Pads | Active | 0.6 | |
| | Inactive | 0.8 | |
| Pump Thrust Collar | Active | 1.0 | |
| | Inactive | 0.8 | |
| Shaft Journal | NDE | 1.1 | |
| | Coupling End | 0.9 | |
| **104-JAT** | | | |
| Journal Bearing Pad | North side | T-0.5 B-0.3 | |
| | South Side | T-0.2 B-0.5 | |
| Thrust Bearing Pads | Active | 1.2 | |
| | Inactive | 1.3 | |
| Turbine Thrust Collar (North Side) | Active | 1.8 | |
| | In Active | 1.2 | |
| Shaft Journal (New) | NDE | 1.1 | |
| | Coupling End | 1.3 | |
| **107-JT (MURRY TURBINE)** | | | |
| Journal Bearing Governor End | Top Half | 1.5 | |
| | Bottom Half | 1.5 | |
| | Shaft | 2.2 | |
| Journal Bearing Coupling End | Top Half | 1.3 | |
| | Bottom Half | 0.9 | |
| | Shaft | 2.3 | |
| Thrust Bearing Pads | Active | 0.1 | |
| | Inactive | 1.5 | |
| Thrust Bearing Collar | Active | 2.3 | |
| | In Active | 2.5 | |

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| **115-HT (Hydraulic Turbine)** | | | |
| Front side Journal Bearing (Clutch side) | Top | 1.1 | |
| | Bottom | 1.2 | |
| Front Journal Shaft (Clutch side) | | 1.3 | |
| Rear side Journal Bearing (End side) | Top | 0.6 | |
| | Bottom | 1.1 | |
| Rear side Thrust Bearing Pad (End side) | Active | 0.7 | |
| | In Active | 0.8 | |
| Rear side Thrust Collar (End side) | Active | 0.8 | |
| | In Active | 1.2 | |
| Rear Journal Shaft | | 1.0 | |
| **115-JAR (Gear Box)** | | | |
| HS Pinion Gear Journal Bearing (Turbine side) | Top | 2.3 | |
| | Bottom | 1.6 | |
| HS Pinion Gear Journal Bearing (Pump side) | Top | 1.7 | |
| | Bottom | 1.0 | |
| HS Shaft Journal | | 2.2 | |
| LS Turbine side Journal Bearing | Top | 2.6 | |
| | Bottom | 0.9 | |
| LS Pump side Journal Bearing | Top | 2.0 | |
| | Bottom | 1.5 | |
| LS Shaft Journal | | 2.3 | |
| **115-JA (Pump)** | | | |
| Pump DE Journal Bearing (GB side) | Top | 2.2 | |
| | Bottom | 2.6 | |
| Shaft Journal (GB side) | | 1.6 | |
| Pump NDE Journal Bearing (Clutch side) | Top | 2.3 | |
| | Bottom | 1.9 | |
| Pump NDE Thrust Pads (Clutch side) | Active | 2.5 | |
| | In Active | 1.3 | |
| Pump NDE Thrust Collar (Clutch side) | Active | 1.2 | |
| | In Active | 1.1 | |
| Shaft Journal (Clutch side) | | 1.5 | |
| **115-JAT (Turbine)** | | | |
| Journal Bearing (Thrust End) | Top | 0.8 | |
| | Bottom | 1.5 | |
| Thrust Bearing Pads | Active | 0.8 | |
| | In Active | 1.3 | |
| Thrust Collar | Active | 1.8 | |
| | In Active | 3.2 | |
| Shaft Journal (Gov. side) | | 3.7 | |
| Journal Bearing (GB side) | Top | 0.3 | |
| | Bottom | 0.5 | |
| Shaft Journal (GBside) | | 2.6 | |

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| **115-JB (Pump)** | | | |
| Journal Bearing, Thrust End | Top | 1.2 | |
| | Bottom | 0.6 | |
| Journal Bearing, Non Thrust End | Top | 1.1 | |
| | Bottom | 1.3 | |
| Thrust Bearing Pads | Active | 0.8 | |
| | Non Active | 0.7 | |
| Thrust Bearing Base Rings | Active | 1.2 | |
| | Non Active | 1.4 | |
| Shaft Journal | Thrust End | 1.3 | |
| | Non Thrust End | 1.1 | |
| **115-JBR (Gear Box)** | | | |
| Gear Journal Bearing | DE | 3 | |
| | NDE | 3.6 | |
| Pinion Journal Bearing | DE | 2.6 | |
| | NDE | 1.5 | |
| Shaft Journal (Gear) | DE | 2.3 | |
| | NDE | 2.5 | |
| Shaft Journal (Pinion) | DE | 1.7 | |
| | NDE | 2.1 | |
| **115-JBT (Turbine)** | | | |
| Journal Bearing, Thrust End | Top | 0.9 | |
| | Bottom | 1.3 | |
| Journal Bearing, Non Thrust End | Top | 1.8 | |
| | Bottom | 1.2 | |
| Thrust Bearing Pads | Active | 0.7 | |
| | Non Active | 1.1 | |
| Thrust Bearing Base Rings | Active | 3.4 | |
| | Non Active | 2.0 | |
| Shaft Journal | Thrust End | 3.5 | |
| | Non Thrust End | 2.6 | |
| **116-JT** | | | |
| Turbine Front Journal Bearing (Governor side) | Top | Journal Bearing replaced during S/D 2013. | |
| | Bottom | | |
| Fr. Shaft Journal (Governor side) | | 1.1 | |
| Turbine Rear Journal Bearing (Coupling side) | Top | 1.8 | |
| | Bottom | 4.5 | 0.5 |
| Rear Shaft Journal (Coupling side) | | 1.2 | |

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| **103-JAT** | | | |
| Journal Bearing Sleeve | Thrust End | 1.4 | |
| | Non Thrust End | 0.9 | |
| Thrust Bearing Pads | Active | 2.4 | |
| | Inactive | 2.4 | |
| Thrust Bearing Base ring | Active | 2.2 | |
| | Inactive | 2.3 | |
| Shaft Journal | Thrust End | 2.3 | |
| | Non Thrust End | 1.6 | |
| **103-JBT** | | | |
| Journal Bearing Sleeve | Thrust End | T-2.2 B-2.3 | |
| | Non Thrust End | T-2.2 B-1.6 | |
| Thrust Bearing Pads | Active | T-2.2 B-1.5 | |
| | Inactive | T-1.5 B-1.2 | |
| Thrust Bearing Base ring | Active | T-1.9 B-2.5 | |
| | Inactive | T-1.2 B-1.4 | |
| Shaft Journal | Thrust End | 1.5 | |
| | Non Thrust End | 2.5 | |
| **105-JT** | | | |
| Journal Bearing Pad | Thrust End | 1.5 | |
| | Non Thrust End | 0.7 | |
| Journal Bearing Base ring | Thrust End | 1.3 | |
| | Non Thrust End | 1.9 | |
| Thrust Bearing Pads | Active | 1.9 | |
| | Inactive | 1.2 | |
| Thrust Bearing Base ring | Active | 1.7 | |
| | Inactive | 1.7 | |
| Shaft Journal | Thrust End | 1.3 | |
| | Non Thrust End | 0.8 | |
| Thrust Collar | Active | 0.8 | |
| | Inactive | 1.3 | |

## ANNEXURE- 10

## DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 1. | Location: 1<br>(Weld/HAZ/PM)<br>SG-1303 11-14 (H-34) On 107C Gas outlet nozzle & HAZ of nozzle | P-11 | Weld microstructure shows ferrite and carbides in dendrite form.<br>Microstructure at HAZ shows fine-grained bainite and ferrite structure.<br>Parent metal microstructure shows fine-grained ferrite and pearlite structure. In-situ spherodization of pearlite is observed.<br>Indications of isolated creep cavities are observed. | IInd stage of creep degradations.<br>Monitor after 1 year of service. |
| 2. | Location: 2<br>(Weld/HAZ/PM)<br>SG-1303 11-14 (H-34) On 107C Gas outlet nozzle & HAZ of bend | P-11 | Microstructure at weld shows dendritic structure ferrite and carbides and bainite structure.<br>Microstructure at HAZ shows fine & coarse-grained pearlite/bainite and ferrite structure.<br>Parent metal microstructure shows fine-grained ferrite and pearlite structure. | No significant degradation observed.<br>Monitor after 2 years of service. |
| 3 | Location: 3<br>(Weld/HAZ/PM)<br>SG-1303, 09-10 (H-36) On 108D converter outlet nozzle, HAZ of nozzle. | P-22 | Weld microstructure shows ferrite and carbides in dendrite form, Whereas at HAZ microstructure shows fine-grained ferrite & bainite structure.<br>Parent metal microstructure shows fine-grained ferrite and bainite structure. In-situ spheroidization of bainite is observed. | IInd stage of creep degradations.<br>Monitor after 1 year of service. |
| 4. | Location: 4<br>(Weld/HAZ/PM)<br>SG-1303, 09-10 (H-36) On 108D converter Inlet nozzle of bend at bottom | P-22 | Weld microstructure shows ferrite and carbides in dendrite form, Whereas at HAZ microstructure shows fine-grained ferrite & bainite structure.<br>Parent metal microstructure shows fine-grained ferrite and bainite structure. In-situ spheroidization of bainite is observed. | IInd stage of creep degradations.<br>Monitor after 1 year of service. |
| 5 | Location: 5<br>(Weld/HAZ/PM)<br>SG-1303, 10-14 (H-36) On 108D converter Outlet nozzle, HAZ of nozzle | P-22 | Weld microstructure shows ferrite and carbides in dendrite form, Whereas at HAZ microstructure shows fine-grained ferrite & bainite structure.<br>Parent metal microstructure shows fine-grained ferrite and bainite structure. In-situ spheroidization of bainite is observed. | IInd stage of creep degradations.<br>Monitor after 1 year of service. |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 6. | Location: 6<br>(Weld/HAZ/PM)<br>SG-1303, 10-14 (H-36) On 108D converter Outlet nozzle of bend at top | P-22 | Weld microstructure shows ferrite and carbides in dendrite form, Whereas at HAZ microstructure shows fine tempered bainite structure.<br>Parent metal microstructure shows fine tempered bainite structure. In-situ spheroidization of bainite is observed. | . IInd stage of creep degradations.<br>Monitor after 1 year of service. |
| 7. | Location: 7<br>(Weld/HAZ/PM)<br>SG-26-6”<br>MICA-16 Upstream Flange weld | Carbon steel | Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure.<br>Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure. Presences of widmanstatten ferrite are observed. | IInd stage of creep degradations.<br>Monitor after 1 year of service. |
| 8. | Location: 8<br>(Weld/HAZ/PM)<br>SG-27-6”<br>MICA-14 Upstream Flange weld | Carbon steel | Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure.<br>Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure. Presences of widmanstatten ferrite are observed. | IInd stage of creep degradations.<br>Monitor after 1 year of service. |
| 9. | Location: 9<br>(Weld/HAZ/PM)<br>SG-28-6”<br>MICA 13 Upstream Flange weld | Carbon steel | Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure.<br>Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure. Presences of widmanstatten ferrite are observed. | IInd stage of creep degradations.<br>Monitor after 1 year of service. |
| 10. | Location: 10<br>(Weld/HAZ/PM)<br>SG-32-6”<br>MICA-15<br>Upstream weld | Carbon steel | Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure.<br>Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure. Presences of widmanstatten ferrite are observed. | IInd stage of creep degradations.<br>Monitor after 1 year of service. |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 11. | Location: 11<br>(Weld/HAZ/PM)<br>On dissimilar weld between pipe & flange of PG-12B-14", 105 CB to PG-26-18 (106-C) | SS 304 to CS | Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix. Whereas at HAZ microstructure shows fine-ferrite & pearlite structure.<br>Microstructure shows fine-grained ferrite and pearlite structure. | Microstructure is free from any micro cracks.<br>Monitor after 1 year of service. |
| 12. | Location: 12<br>(Weld/HAZ/PM)<br>On dissimilar weld between pipe & flange of PG-12A-14", 105 CA to PG-26-18 (106-C) | SS 304 to CS | Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix. Whereas at HAZ microstructure shows fine-ferrite & pearlite structure.<br>Microstructure shows fine-grained ferrite and pearlite structure | Microstructure is free from any micro cracks.<br>Monitor after 1 year of service. |
| 13. | Location: 13<br>(Weld/HAZ)<br>On weld bet$^{n}$. flange & Bend of gas inlet nozzle.<br>PG-6 –18 towards east side of 103-C | P 11 | Microstructure at weld metal shows ferrite and carbides in dendritic form. Coarsening of ferrite is observed in the weld region, Whereas at HAZ microstructure shows essentially fine-grained ferrite with few pearlite structure.<br>Parent metal shows essentially fine-grained ferrite with few pearlite structure. Pearlite is observed at the grain boundaries. Possibilities of isolated creep cavities are observed. | SEM interpretation shows Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries Creep cavities are present. IInd stage of creep. Monitor after 2 year of service.. |
| 14. | Location: 14<br>(Weld/HAZ)<br>On Weld Between BFW outlet Nozzle (East) of 103C to elbow weld+HAZ towards elbow (BW-11H-8) | CS | Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure.<br>Parent metal shows fine-grained ferrite and pearlite structure. Initial stage of in-situ spheroidization of pearlite is observed at grain boundaries. | IInd stage of creep degradations.<br>Monitor after 1 year of service. |
| 15. | Location: 15<br>(Weld/HAZ)<br>112-C,LT Shift Converter Boiler South dished side HAZ | CS | Microstructure at weld metal shows ferrite and carbides in dendritic form, Whereas at HAZ microstructure shows fine-grained ferrite & pearlite structure.<br>Parent metal shows coarse-grained widmanstatten ferrite and pearlite structure. | No significant degradations.<br>Monitor after 2 year of service. |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 16. | Location: 16<br>(Weld/HAZ)<br>112-C,LT Shift Converter Boiler South shell side HAZ | CS | Microstructure at weld metal shows ferrite and carbides in dendritic form, Whereas at HAZ microstructure shows fine-grained ferrite & pearlite structure.<br>Parent metal shows fine-grained ferrite and pearlite structure. Presence of widmanstatten ferrite is observed. | No significant degradation observed.<br>Monitor after 2 years of service. |
| 17. | Location: 17<br>(Parent Metal)<br>101-F, Steam Drum South dished side PM | SA 515 Gr.70 | Microstructure shows fine-grained ferrite and pearlite structure. In-situ spherodization of pearlite is observed at the grain boundaries.<br>Possibilities of isolated creep cavities are observed. | SEM interpretation shows alloy carbides with isolated creep cavities at the grain boundaries. Creep cavities are present. IInd stage of creep. Monitor after 2 year of service. |
| 18 | Location: 18<br>(Parent Metal)<br>On face of 1st Bend of NG-9-12" (101B-mixed feed coil outlet to NG-11) | P 11 | Microstructure shows fine-grained ferrite and pearlite structure.<br>Degradation of pearlite observed in terms of spherodization.<br>Possibilities of isolated creep cavities are observed. | SEM interpretation Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries. Creep cavities are present. IInd stage of creep. Monitor after 2 year of service. |
| 19. | Location: 19<br>(Weld/HAZ)<br>On weld betn. Pipe & Elbow<br>(elbow side) of NG-9-12" (101B-mixed feed coil outlet to NG-11) | P 11 | Microstructure at weld shows ferrite and bainite in dendritic form Whereas at HAZ shows fine-grained bainite and ferrite structure.<br>Microstructure at parent metal shows fine-grained ferrite and pearlite structure.<br>Degradation of pearlite observed in terms of spherodization.<br>Possibilities of isolated creep cavities are observed. | SEM interpretation shows alloy carbides with isolated creep cavities at the grain boundaries. Creep cavities are present. IInd stage of creep. Monitor after 2 year of service. |
| 20 | Location: 20<br>**(Weld / HAZ )**<br>On dissimilar weld betn. pipe piece & nozzle<br>of header towards HAZ of P-11, NG-9-12" (101B-mixed feed coil outlet to NG-11) | P 11 to SS304H | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix, Whereas at HAZ shows fusion is normal. No significant defect is observed at the HAZ region.<br>Microstructure at parent metal shows fine-grained ferrite and pearlite/bainite structure. | No significant degradation observed.<br>Monitor after 2 years of service. |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 21 | Location: 21<br>(Weld/HAZ)<br>On dissimilar Weld Between pipe & Nozzle of Header<br>NG-9-12" (101B-mixed feed coil outlet to NG-11) | 304H to 304H | Parent metal & HAZ microstructure (SS 304H) shows fine-grained worked austenitic grain with twins. Second phase carbide precipitations observed at grain boundaries.<br>Weld metal shows dendritic structure of ferrite pools in austenite matrix. | Monitor after 2 years of service. |
| 22. | Location: 24<br>(Weld/HAZ)<br>103-D, Secondary Reformer LS Weld & PM, HAZ in north side bottom to cone shell in jacket | CS | Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite & pearlite structure.<br>Parent metal shows fine-grained ferrite and pearlite structure. Few widmanstatten ferrite is observed. | No significant degradation observed.<br>Monitor after 2 years of service. |
| 23 | Location: 25<br>(Weld/HAZ)<br>Riser No.-8, Riser to Weldolet Weld Joint | Tube-G-4852M<br>Weldolet<br>800HT | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains.<br>Microstructure at parent metal shows coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. | Microstructure is free from any micro cracks.<br>Monitor after 2 years of service. |
| 24 | Location: 26<br>(Parent Metal)<br>Riser Tube<br>No.-7 | Tube-G-4852M | Microstructure shows dendrite structure of primary carbides along with secondary precipitation including carbides in the austenite matrix. The primary and secondary fine precipitate seems to have coarsened within the matrix. | Microstructure is free from any micro cracks.<br>Monitor after 2 years of service. |
| 25 | Location: 27<br>(Weld/HAZ)<br>Riser No.-7, Riser to Weldolet Weld Joint | Tube-G-4852M<br>Weldolet<br>800HT | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains.<br>Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. | Microstructure is free from any micro cracks.<br>Monitor after 2 years of service. |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 26 | Location: 28<br>(Weld/HAZ)<br>Riser No.-6, Riser to Weldolet Weld Joint | Tube-G-4852M<br>Weldolet<br>800HT | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains.<br>Microstructure at parent metal shows coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries.<br>Presence of inter-granular cracks observed at HAZ region. | Inter-granular cracks are observed at HAZ region.<br>**Needs attention.** |
| 27 | Location: 29<br>(Weld/HAZ)<br>Row No.-6,<br>Tube No.18<br>Tube to Weldolet Weld Joint | Tube-G-4852M<br>Weldolet<br>800HT | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains.<br>Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries.<br>Presence of inter-granular cracks observed at HAZ region. | Inter-granular cracks are observed at HAZ region.<br>**Needs attention.** |
| 28 | Location: 30<br>(Weld/HAZ)<br>Riser No.-5, Riser to Weldolet Weld Joint | Tube-G-4852M<br>Weldolet<br>800HT | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains.<br>Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries.<br>Presence of inter-granular cracks observed at HAZ region. | Inter-granular cracks are observed at HAZ region.<br>**Needs attention.** |
| 29 | Location: 31<br>(Weld/HAZ)<br>Riser No.-4, Riser to Weldolet Weld Joint | Tube-G-4852M<br>Weldolet<br>800HT | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains.<br>Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries.<br>Presence of inter-granular cracks observed at HAZ region. | Inter-granular cracks are observed at HAZ region.<br>**Needs attention.** |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 30 | Location: 32<br>(Weld/HAZ)<br>Riser No.-3, Riser to Weldolet Weld Joint | Tube-G-4852M<br>Weldolet<br>800HT | Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains.<br>Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins.<br>Presence of inter-granular cracks observed at HAZ region. | Inter-granular cracks are observed at HAZ region.<br>**Needs attention.** |
| 31 | Location: 33<br>(Weld/HAZ)<br>Row No.-3, Tube NO.40, Tube to Weldolet Weld Joint | Tube-G-4852M<br>Weldolet<br>800HT | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains.<br>Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries.<br>Presence of inter-granular cracks observed at HAZ region. | Inter-granular cracks are observed at HAZ region.<br>**Needs attention.** |
| 32 | Location: 34<br>(Weld/HAZ)<br>Riser No.-2, Riser to Weldolet Weld Joint | Tube-G-4852M<br>Weldolet<br>800HT | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains.<br>Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries.<br>Presence of inter-granular cracks observed at HAZ region. | Inter-granular cracks are observed at HAZ region.<br>**Needs attention.** |
| 33 | Location: 35<br>(Weld/HAZ)<br>Riser No.-1, Riser to Weldolet Weld Joint | Tube-G-4852M<br>Weldolet<br>800HT | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows fine & coarse-grained austenitic grains.<br>Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. | Microstructure is free from any micro cracks.<br>Monitor after 2 years of service. |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 34 | Location: 36 (Weld/HAZ) Row No.-1, Tube NO.35, Tube to Weldolet Weld Joint | Tube-G-4852M Weldolet 800HT | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. Presence of inter-granular cracks observed at HAZ region. | Inter-granular cracks are observed at HAZ region. **Needs attention.** |
| 35 | Location: 37 (Weld/HAZ) Row No.-7, Tube NO.37, Tube to Weldolet Weld Joint | Tube-G-4852M Weldolet 800HT | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. | Microstructure is free from any micro cracks. Monitor after 2 years of service. |
| 36 | Location: 38 (Weld/HAZ) 102B SG-62A-4" line | P5 | Weld microstructure shows dendritic structure of tempered bainite/martensite structure, Whereas at HAZ shows fine tempered bainite structure. Parent metal microstructure shows fine tempered bainite structure. In-situ spherodization of bainite is observed. | IInd stage of creep degradations. Monitor after 1 year of service. |
| 37 | Location: 39 (Weld/HAZ) 102B SG-62B-4" line | P5 | Weld microstructure shows dendritic structure of tempered bainite/martensite structure, Whereas at HAZ shows fine tempered bainite structure. Parent metal microstructure shows fine tempered bainite structure. In-situ spherodization of bainite is observed. | IInd stage of creep degradations. Monitor after 1 year of service. |
| 38 | Location: 42 (Parent Metal) 116 Inlet line, 103-E2 LP Flash (MDEA 1209.07-12") | CS | Microstructure shows fine-grained ferrite & pearlite structure. | No significant degradation observed. Monitor after 2 years of service. |
| 39 | Location: 43 (Parent Metal) 116 Inlet line, 103-E2 LP Flash (MDEA 1209.07-12") | CS | Microstructure shows fine-grained ferrite & pearlite structure. | No significant degradation observed. Monitor after 2 years of service. |

**Note:** Location no. 28,29,30,31,32,33,34 and 36 shall be monitored during next turnaround in detail as recommended by M/S TCR

## Annexure - 11

## UFD & RT STATUS OF CONVERTER LOOPPIPELINES

| JOINT NO. | 2010 | | 2011 | | 2012 | | 2013 | |
|---|---|---|---|---|---|---|---|---|
| | UFD | RT | UFD | RT | UFD | RT | UFD | RT |
| **FROM 108D TO 107C,** **LINE NO: SG-1303-10-14**", SCH-120 (27.79MM NOM THICK.) | | | | | | | | |
| Elbows 1 to 5 | NSD | Elbow No 5, NSD | NSD | -- | NSD | -- | NSD | -- |
| J-1 | NSD | -- | NSD | NSD | NSD | -- | NSD | -- |
| J-2 | NSD | -- | NSD | NSD | NSD | -- | NSD | -- |
| J-3 | NSD | -- | NSD | NSD | NSD | -- | NSD | -- |
| J-4 | NSD | -- | NSD | NSD | NSD | -- | NSD | -- |
| J-5 | NSD | -- | NSD | NSD | NSD | -- | NSD | -- |
| J-6 | Indication Observed | NSD | NSD | -- | NSD | -- | NSD | NSD |
| J-7 | Indication Observed | NSD | NSD | -- | NSD | -- | NSD | NSD |
| J-8 | NSD | -- | NSD | NSD | NSD | -- | NSD | -- |
| J-9 | NSD | -- | NSD | NSD | NSD | -- | NSD | -- |
| J-10 | NSD | -- | NSD | NSD | NSD | | NSD | -- |
| J-11 | Indication Observed | NSD | NSD | NSD | NSD | New Joint NSD, After SR | NSD | -- |
| J-12 | NSD | -- | NSD | -- | NSD | New Joint NSD, After SR | NSD | -- |
| **FROM 105D TO 108D,** **LINE NO: SG-1303-8-10"** SCH-120 (21.44MM NOM THICK.), **SG-1303-8-14"** SCH 120 (27.79MM NOM THICK.), **SG-1303-9-10"** SCH-120 (21.44MM NOM THICK.) & **SG-1303-12-10**" SCH-120 (21.44 MM NOM THICK.) | | | | | | | | |
| Elbows 1 to 15 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-1 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-2 | -- | -- | NSD | -- | NSD | -- | NSD | -- |
| J-3 | **--** | NSD | NSD | -- | NSD | -- | -- | -- |
| J-4 | NSD | NSD | NSD | -- | NSD | -- | -- | -- |
| J-5 | NSD | NSD | NSD | -- | NSD | -- | NSD | -- |
| J-6 | NSD | NSD | NSD | -- | NSD | -- | NSD | -- |
| J-7 | -- | -- | NSD | -- | NSD | -- | NSD | -- |
| J-8 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-9 | NSD | NSD | NSD | -- | NSD | NSD | -- | NSD |
| J-9A | Crack hence Repair | Repair, NSD | NSD | NSD | NSD | NSD | -- | NSD |
| J-9B | NSD | NSD | NSD | -- | NSD | -- | -- | NSD |
| J-10 | NSD | -- | NSD | -- | NSD | NSD | -- | -- |

| JOINT NO. | 2010 | | 2011 | | 2012 | | 2013 | |
|---|---|---|---|---|---|---|---|---|
| | UFD | RT | UFD | RT | UFD | RT | UFD | RT |
| J-11 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-12 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-13 | Indication Observed | NSD | NSD | -- | NSD | NSD | NSD | -- |
| J-14 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-15 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-16 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-17 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-18 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-19 | NSD | -- | NSD | NSD | NSD | NSD | NSD | -- |
| J-20 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-21 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-22 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-23 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-24 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-25 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-26 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-27 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-28 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-29 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-30 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-T1 | Indication Observed | NSD | NSD | -- | NSD | -- | NSD | NSD |
| J-T2 | Indication Observed | NSD | NSD | -- | NSD | -- | NSD | NSD |
| J-T3 | NSD | -- | NSD | -- | NSD | -- | NSD | NSD |
| J-T4 | NSD | -- | NSD | -- | NSD | -- | NSD | NSD |
| J-T5 | NSD | -- | NSD | -- | NSD | -- | NSD | NSD |
| J-T6 | NSD | -- | NSD | -- | NSD | -- | NSD | NSD |
| **FROM 107C TO 123C,**<br>**LINE NO: SG-1303-11-14**", SCH-140 (31.75MM NOM THICK.) | | | | | | | | |
| Elbows 1 to 6 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-1 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-2 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-3 | NSD | -- | NSD | -- | NSD | -- | -- | -- |
| J-4 | NSD | -- | NSD | -- | NSD | -- | -- | -- |
| J-5 | NSD | -- | NSD | -- | NSD | -- | -- | -- |
| J-6 | NSD | -- | NSD | -- | NSD | -- | -- | -- |
| J-7 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-8 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-9 | NSD | -- | NSD | -- | NSD | -- | NSD | NSD |
| J-10 | NSD | -- | NSD | -- | NSD | -- | NSD | NSD |
| J-11 | NSD | -- | NSD | -- | NSD | -- | NSD | NSD |
| J-12 | NSD | -- | NSD | -- | NSD | -- | NSD | NSD |

**NSD: No Significant Defect**

# UREA PLANT
(INSPECTION)

During Shutdown 2013, the following major inspection activities were performed in the Urea plant.

- Internal inspection of High-pressure vessels viz. Autoclave (V-1201), H.P Stripper (H-1201), H.P Condenser (H-1202).
- Eddy Current Testing of H.P. Stripper (H-1201) tubes by M/s TesTex NDT India Pvt. Limited.
- Eddy Current Testing of H.P. Carbamate Condenser (H-1202) tubes by M/s TesTex NDT India Pvt. Limited.
- Inspection of L.P. Carbamate Condenser (H-1205) tubes by M/s TesTex NDT India Pvt. Limited by Internal Rotating Inspection System (IRIS).
- Internal inspection of other vessels.
- Ultrasonic thickness measurement of **HP Lines.** Detailed report is attached at **Annexure-1.**
- Ultrasonic thickness measurement of **Steam Condensate Lines.** Detailed report is attached at **Annexure-2.**
- Ultrasonic thickness measurement of various **Equipment**. Detailed report is attached at **Annexure-3.**
- Dye Penetrant examination and radiography of weld joints of lines fabricated, erected and offered by Mech. Maint./Technical Department as per the requirement including HP lines PR-1205-6"-X1, PR-1206-4"-X1 & PR-1208-4"-X1.
- Qualification tests of welders employed by contractors.
- Residual magnetism measurement and demagnetization, wherever required of Hitachi Compressor (K-1801) Train. Detail report is attached at **Annexure-4**.
- Insitu-Metallography was carried out at selected locations on equipment. Summary of observations and microstructure analysis is given at **Annexure-5**.
- The detailed observations and recommendations for corrective actions required on individual equipment are given below. All the observations were recorded during inspection and were handed over to concerned maintenance and operation group for necessary corrective action.

## HIGH PRESSURE VESSELS

Following High-pressure equipments were inspected. Main observations are listed below:

## AUTOCLAVE (V-1201)

## VISUAL INSPECTION

Thorough visual inspection of the liner, its welds, trays and internals was carried out. Observations made in each compartment are mentioned below.

**Compartment No.1 (Top Compartment)**

- Roughening /corrosion of dome liner was observed and grayish oxide layer was observed on dome and man way surface.
- Dark brown –grayish patches observed on East side of shell liner.
- Liner segment just below dome liner was found silver bright in colour through out in circumference.
- Overall Tray corrosion is high and it is dominant in West side tray segment.
- Few fasteners of tray segments were found loose and 2 no's of tray segment bolts and 1nos of "J" bolt found missing just below down comer funnel at north side.
- Manway liner having Pits/Localized erosion of 2mm depth,10-12 mm long,3-4 mm wide marked as 1A.

**Compartment No.2**

- Roughening of tray holding clits and grayish brown oxide layer was observed on bottom side of trays, same was observed during previous inspection.
- Few nos. of tray holding 'J' bolts, tray segment fasteners were found loose.
- Weld joints condition was found satisfactory.
- 01 no. of tray holding clit was found to be blackish in coloration and having severe corrosion attack including its welds, same observed in last inspection.
- Due to corrosion / erosion of trays, cavities/gaps were observed between tray and it's welding with annular plate.
- Overall Tray corrosion is high.
- Down comer found dark brown in colour and rough in surface.
- Manway liner having Pits/Localized erosion of 2mm depth,10-12 mm long,4mm width marked as 2A.
- In Shell liner South West corner, 2'' above C-seam near tray clit Pits/Localized erosion of 2mm depth, 10-12 mm long marked as 2B.

**Compartment No.3**

- Bulging of approx. 8mm depth and 2.5" width was observed behind tray skirt in SW to South direction, same was observed during previous inspection.
- 04 nos. of tray holding clits were found to be blackish in coloration and having severe corrosion attack including its welding, same observed in last inspection
- Few nos. fasteners of tray segments and tray holding 'J' bolts were found loose.
- Due to corrosion / erosion of trays, cavities/gaps were observed between tray and it's welding with annular plate.

**Compartment No.4**

- Approx. 30 mm below circumferential weld a depression of approx. 100 mm dia. and 3 mm depth was observed at west side liner. Same was observed during last inspection also.
- Convex bulging of liner plate observed just above circumferential weld approx. 4 mm height in complete circumference. Same was observed during last inspection also.

- Concave depression of approx 2-5 mm depth observed at approx. 200mm below the C-weld seam in approx. 80% of the periphery. Same was observed during last inspection also.
- Grayish and brownish oxide layer was observed on the bottom side of trays.
- 03 nos. of tray holding clits were found black and found to have severed corrosion attack including its welding, same observed in last inspection.
- Due to corrosion / erosion of trays, cavities/gaps were observed between tray and it's welding with annular plate.
- Few nos. fasteners of tray segments and tray holding 'J' bolts were found loose.
- North side in shell liner Corrosion/Erosion Pits of 1.5 mm depth,4-5mm dia observed and marked as 4A.
- Manway liner having Pits/Localized erosion of 1.5mm depth,4-5 mm dia marked as 4B.

**Compartment No.5**

- Convex bulging of liner plate was observed just above the circumferential weld joint by approx. 3 to 9 mm height in almost all the periphery. The same was observed during last inspection also.
- Concave depression of approx 2-6 mm was observed at approx. 500 mm below the C-weld seam in full periphery. The same was observed during last inspection also.
- Grayish and brownish oxide layer was observed on the bottom side of trays.
- Approx. 750mm. of NW long seam was found to have corrosion leading to weld reinforcement reduction. Same was observed during last inspection also.
- Few nos. fasteners of tray segments and tray holding 'J' bolts were found loose.
- East side long seam near top "Tee" joint C-Seam welding minor corroded marked as 5A,Near that shell liner Corrosion/Erosion Pits of 1.5 mm depth,4-5mm dia observed and marked as 5B.

**Compartment No.6**

- Convex bulging of liner plate was observed above the circumferential weld joint by approx. 3 to 10 mm height, which starts from North-West to South-East direction in approx. Length of 4500 mm. The same was observed during last inspection also.
- Concave depression of approx. 5 mm depth was observed at approx. One meter below C-weld seam from East to West side L-seam through North side of the shell. The same was observed during last inspection also.
- Few nos. fasteners of tray segments and tray holding 'J' bolts were found loose.
- New welding was done on circumferential weld seam and long seam by M/s. Dowel Erectors in 2012.
- Manway liner having Pits/Localized erosion of 2mm depth,3''long,6-7 mm wide marked as 6A.
- South side liner just below C-Seam two minor pits 1.5-2 mm deep,4-5mm dia observed marked as 6B.

**Compartment No.7**

- Convex bulging of liner plate was observed above the circumferential weld joint by approx. 2-6 mm height at few locations. The same was observed during last inspection also.
- Concave bulging 1200mm below C seam and max. 5 mm. depth in approx. 60% periphery.
- 04 nos. of tray holding clits were found to be blackish in coloration and having severe corrosion attack including it's welding, same observed in last inspection.
- Erosion of the tray was observed.
- Few nos. fasteners of tray segments and tray holding 'J' bolts were found loose.
- Roughening in both Long seams welding observed.

**Compartment No.8**

- Concave bulging at the elevation of approx. 300 mm above tray and 3 to 6mm. deep was observed in complete circumference. The same was observed during last inspection also.
- Few nos. fasteners of tray segments and tray holding 'J' bolts were found loose.
- 05 nos. of tray holding clits were found to be blackish in coloration and having corrosion attack including its welding, same observed in last inspection.

**Compartment No.9**

- 02 no. of tray holding clit was found to be blackish in coloration and having severe corrosion attack including its welding, same observed in last inspection.
- No noticeable bulging observed in liners.
- Few fasteners of tray segments were found loose.
- All tray holding 'J' bolts were found satisfactory.
- East and West side both Long seam welding roughening found.

**Compartment No.10**

- Concave depression of approx 7mm depth at approx 70mm below the C-weld seam in south side of shell in approx. 100 mm dia was observed. Same was observed during last Inspection.
- Concave depression of approx. 9 mm depth just above the C-weld seam towards the south side of man way and adjacent to L-seam in approx. 100 mm dia. was observed. Same was observed during last Inspection.
- Vertical bulging of approx. 2-3 mm height 25mm wide was observed from the C seam to the bottom of the compartment in north side of the shell. The same was observed during last inspection also.
- Concave depression of about 5mm depth at approx 70mm below C seam in west side just adjacent to L seam was observed in 100 mm area. The same was observed during last inspection also.
- 100mm. dia. with annular plate. & 4 mm. concave bulging was observed in NE direction approx. 25mm. above tray. The same was observed during last inspection also.
- Few fasteners of tray segments and tray holding 'J' bolts were found loose.

- 02 nos. of tray holding clits were found to be blackish in coloration and having severe corrosion attack including its welding, same observed in last inspection
- East and West side both Long seam welding roughening found.

**Compartment No.11**

- Just below circumferential weld concave depression of approx. 4 to 6 mm depth in approx. 80mm dia. in North-West direction was observed. The same was observed during last inspection also.
- Concave depression of approx. 5mm and 9mm deep in approx. 100mm dia. was observed just below the C-weld seam in North and West side of the shell respectively. The same was observed during last inspection also.
- On new liner segment convex bulging up to max. 3 mm height having width approx. 10 mm observed just above circumferential stitch welds (approx. 125 mm long). Same was observed during last Inspection also.
- Concave depression of about 5-6 mm was observed just above and below of C-weld seam in old and new liner. The same was observed during last inspection also.
- Few tray holding 'J' bolts were found loose.
- Few fasteners of tray segments were found loose.
- East and West side both Long seam welding roughening found.

**Compartment No.12 (Bottom Compartment)**

- South side tray skirt is touching the shell liner may cause rubbing with liners. Same was observed during last inspection also.
- Down comer nozzle with dish end liner weld joint edges were observed exposed. The same was observed during last inspection also.
- Dark brown coloration on dish end. The same was observed during last inspection also.
- Concave depression of approx. 2-3 mm depth and approx. 5mm depth were observed at approx. 200mm above the C-weld seam in 4"dia in east and west direction of the shell respectively. The same was observed during last inspection also.
- Roughening / corrosion/erosion was observed at bottom of the tray.
- All tray holding clits were found blackish in colour and having corrosion attack including its welding.

**NOTE:**

- Total 09 No's defects marked with yellow chowlk Compartment wise e.g. 1A-1st Compartment first defect, 2A-2nd Compartment first defect,2B -2nd Compartment second defect etc. counting from top to bottom.
- Severe etching observed on down-comer in almost all the compartment.
- Ferrite was also measured on liner & welds, found Nil.
- NE-North East, SW-South West, NW-North West, SE- South East
- L-Long seam, C-Circumferential seam.
- In general, few tray holding bolts and tray segment fasteners were found loose in all the compartments hence it may be checked.

- Welding by using 25-22-2 LMn filler wire dia. 2.4mm
- Clean and passivate the weld by washing with 10% HNO3 and rinse with plenty of DM water.

| DETAILED THICKNESS REPORT OF AUTOCLAVE (V-1201) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **COMPARTMENT NO.** | **LOCATION OF MEASURMENT** | **NOM. THK. (mm.)** | **OBSERVED THICKNESS (in mm.)** | | | | **REMARK** |
| | | | **EAST (1)** | **WEST (2)** | **NORTH (3)** | **SOUTH (4)** | |
| 01<br><br>TOP<br><br>COMPARTMENT | Shell Liner (New) | 6.50 | 6.67 | 6.78 | 6.95 | 6.70 | 750mmSection Replaced in Yr. 2002 by BC-05. |
| | Shell Liner Old (Top) | 5.00 | 3.70 | 3.99 | 4.06 | 3.85 | |
| | Shell Liner (Middle) | 5.00 | 4.45 | 4.68 | 4.58 | 4.92 | |
| | Shell Liner (Bottom) | 5.00 | 4.09 | 4.62 | 4.52 | 3.98 | |
| | Top-Dome | 6.50 | 6.62 | 6.23 | 6.54 | 6.78 | Replaced in Yr. 2002 by BC-05. |
| | Tray Segment -1 | 8.00 | 3.99 | **3.61** | 3.68 | 3.71 | Overall Min. tray thickness |
| | Tray Segment -2 | 8.00 | 3.95 | 3.90 | 4.02 | 4.08 | |
| | Tray Segment -3 | 8.00 | 3.88 | 3.69 | 3.75 | 3.62 | |
| | Tray Segment -4 | 4.42 | 3.88 | 5.61 | 6.37 | 4.42 | |
| | Manway Liner | 6.88 | 6.93 | 6.90 | 6.86 | 6.88 | Replaced in Yr. 2002 by BC-05. |
| 02 | Shell Liner (Top) | 5.00 | 3.68 | 4.29 | **3.53** | 3.82 | Overall Min. liner thick. |
| | Shell Liner (Middle) | 5.00 | 3.92 | 4.23 | 4.27 | 4.21 | |
| | Shell Liner (Bottom) | 5.00 | 3.98 | 4.58 | 4.23 | 4.17 | |
| | Tray Segment-1 | 8.00 | 4.28 | 5.12 | 3.80 | 5.76 | |
| | Tray Segment-2 | 8.00 | 3.97 | 4.28 | 4.16 | 4.11 | |
| | Tray Segment-3 | 8.00 | 3.95 | 3.96 | 3.98 | 4.10 | |
| | Tray Segment-4 | 8.00 | 3.92 | 3.89 | 4.04 | 3.98 | |
| | Down-Comer | 10.00 | 6.12 | 6.14 | 6.29 | **6.12** | Overall Minimum Down-Comer thickness |
| 03 | Shell Liner (Top) | 5.00 | 3.84 | 4.37 | 4.23 | 3.80 | |
| | Shell Liner (Middle) | 5.00 | 4.32 | 4.29 | 4.24 | 3.97 | |
| | Shell Liner (Bottom) | 5.00 | 4.35 | 4.22 | 4.17 | 3.92 | |
| | Tray Segment-1 | 8.00 | 4.18 | 4.14 | 4.64 | 4.40 | |
| | Tray Segment-2 | 8.00 | 4.42 | 4.37 | 4.41 | 4.39 | |
| | Tray Segment-3 | 8.00 | 3.86 | 3.92 | 3.98 | 3.90 | |
| | Tray Segment-4 | 8.00 | 4.25 | 4.25 | 4.36 | 4.45 | |
| | Insert Liner | 6.50 | 6.92 | 6.88 | 6.85 | 6.84 | Replaced in Yr. 1997 |
| | Down-Comer (Shiny) | 10.00 | 9.08 | 9.08 | 8.98 | 9.21 | |
| | Down-Comer | 10.00 | 6.82 | 6.32 | 6.47 | 6.15 | |
| 04 | Shell Liner (Top) | 5.00 | 4.13 | 4.04 | 3.63 | 4.36 | |
| | Shell Liner (Middle) | 5.00 | 4.38 | 4.23 | 4.24 | 4.20 | |
| | Shell Liner (Bottom) | 5.00 | 4.24 | 4.32 | 4.25 | 4.24 | |

| DETAILED THICKNESS REPORT OF AUTOCLAVE (V-1201) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **COMPARTMENT NO.** | **LOCATION OF MEASURMENT** | **NOM. THK. (mm.)** | **OBSERVED THICKNESS (in mm.)** | | | | **REMARK** |
| | | | **EAST (1)** | **WEST (2)** | **NORTH (3)** | **SOUTH (4)** | |
| | Tray Segment-1 | 8.00 | 4.41 | 4.34 | 4.54 | 4.39 | |
| | Tray Segment-2 | 8.00 | 4.44 | 4.48 | 4.84 | 4.46 | |
| | Tray Segment-3 | 8.00 | 4.59 | 4.44 | 4.43 | 3.92 | |
| | Tray Segment-4 | 8.00 | 3.83 | 4.52 | 4.28 | 3.86 | |
| | Insert Liner | 6.50 | 6.31 | 6.36 | 6.26 | 6.32 | Replaced in Yr.1999 |
| | Down-Comer | 10.00 | 6.24 | 6.79 | 6.31 | 6.36 | |
| 05 | Shell Liner (Top) | 5.00 | 4.48 | 4.72 | 4.31 | 4.72 | |
| | Shell Liner (Middle) | 5.00 | 4.57 | 4.87 | 4.68 | 4.77 | |
| | Shell Liner (Bottom) | 5.00 | 4.83 | 4.90 | 4.48 | 4.72 | |
| | Tray Segment-1 | 8.00 | 4.82 | 4.76 | 4.72 | 4.66 | |
| | Tray Segment-2 | 8.00 | 4.70 | 4.82 | 4.73 | 4.69 | |
| | Tray Segment-3 | 8.00 | 4.61 | 4.55 | 4.62 | 4.85 | |
| | Tray Segment-4 | 8.00 | 4.54 | 4.45 | 4.73 | 4.38 | |
| | Down-Comer | 10.00 | 6.56 | 6.85 | 6.31 | 6.47 | |
| | Down-Comer (Shiny) | 10.00 | 8.94 | 9.65 | 9.24 | 9.22 | |
| 06 | Shell Liner (Top) | 5.00 | 4.39 | 4.58 | 4.33 | 4.38 | |
| | Shell Liner (Middle) | 5.00 | 4.40 | 4.63 | 4.51 | 4.36 | |
| | Shell Liner (Bottom) | 5.00 | 4.44 | 4.82 | 4.43 | 4.75 | |
| | Tray Segment-1 | 8.00 | 4.86 | 3.81 | 5.26 | 4.82 | |
| | Tray Segment-2 | 8.00 | 5.12 | 5.14 | 4.97 | 5.17 | |
| | Tray Segment-3 | 8.00 | 5.06 | 4.93 | 5.07 | 5.69 | |
| | Tray Segment-4 | 8.00 | 5.42 | 4.99 | 5.34 | 5.56 | |
| | Down-Comer | 10.00 | 6.48 | 6.61 | 6.44 | 6.88 | |
| 07 | Shell Liner (Top) | 5.00 | 4.36 | 4.26 | 4.45 | 4.52 | |
| | Shell Liner (Middle) | 5.00 | 4.43 | 4.70 | 4.54 | 4.67 | |
| | Shell Liner (Bottom) | 5.00 | 4.35 | 4.82 | 4.58 | 4.81 | |
| | Tray Segment-1 | 8.00 | 5.10 | 5.66 | 5.31 | 5.20 | |
| | Tray Segment-2 | 8.00 | 5.20 | 5.12 | 5.48 | 5.55 | |
| | Tray Segment-3 | 8.00 | 4.97 | 5.11 | 5.03 | 4.93 | |
| | Tray Segment-4 | 8.00 | 5.39 | 5.34 | 5.24 | 5.64 | |
| | Down-Comer | 10.00 | 6.71 | 6.72 | 6.62 | 6.67 | |
| 08 | Shell Liner (Top) | 5.00 | 4.54 | 4.49 | 4.53 | 4.62 | |
| | Shell Liner (Middle) | 5.00 | 4.81 | 4.70 | 4.79 | 4.76 | |
| | Shell Liner (Bottom) | 5.00 | 4.74 | 4.64 | 4.72 | 4.68 | |
| | Tray Segment-1 | 8.00 | 5.66 | 6.12 | 5.70 | 5.39 | |
| | Tray Segment-2 | 8.00 | 6.12 | 6.27 | 6.10 | 6.29 | |
| | Tray Segment-3 | 8.00 | 6.25 | 6.51 | 6.37 | 6.24 | |
| | Tray Segment-4 | 8.00 | 6.25 | 6.35 | 6.38 | 6.40 | |
| | Insert Liner | 6.50 | 6.52 | 6.77 | 6.72 | 6.67 | Replaced in |

| DETAILED THICKNESS REPORT OF AUTOCLAVE (V-1201) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **COMPARTMENT NO.** | **LOCATION OF MEASURMENT** | **NOM. THK. (mm.)** | **OBSERVED THICKNESS (in mm.)** | | | | **REMARK** |
| | | | **EAST (1)** | **WEST (2)** | **NORTH (3)** | **SOUTH (4)** | |
| | | | | | | | Yr. 2000 |
| | Down-Comer | 10.00 | 7.09 | 7.12 | 7.06 | 7.24 | |
| 09 | Shell Liner (Top) | 5.00 | 4.45 | 4.60 | 4.79 | 4.43 | |
| | Shell Liner (Middle) | 5.00 | 4.82 | 4.79 | 4.81 | 4.35 | |
| | Shell Liner (Bottom) | 5.00 | 4.84 | 4.56 | 4.73 | 4.72 | |
| | Tray Segment-1 | 8.00 | 6.79 | 6.74 | 6.68 | 6.78 | |
| | Tray Segment-2 | 8.00 | 6.88 | 6.98 | 6.94 | 6.88 | |
| | Tray Segment-3 | 8.00 | 6.27 | 6.44 | 6.37 | 6.64 | |
| | Tray Segment-4 | 8.00 | 6.51 | 6.90 | 6.68 | 6.50 | |
| | Insert Liner | 6.50 | 6.47 | 6.69 | 6.75 | 6.37 | Replaced in Yr. 2001 |
| | Down-Comer | 10.00 | 7.39 | 7.64 | 7.44 | 7.36 | |
| 10 | Shell Liner (Top) | 5.00 | 4.82 | 5.16 | 5.24 | 4.72 | |
| | Shell Liner (Middle) | 5.00 | 5.05 | 5.24 | 5.28 | 5.64 | |
| | Shell Liner (Bottom) | 5.00 | 4.92 | 5.52 | 5.25 | 5.18 | |
| | Tray Segment-1 | 8.00 | 6.52 | 6.89 | 6.74 | 6.73 | |
| | Tray Segment-2 | 8.00 | 7.12 | 7.39 | 7.35 | 7.12 | |
| | Tray Segment-3 | 8.00 | 7.13 | 7.25 | 7.22 | 7.07 | |
| | Tray Segment-4 | 8.00 | 6.97 | 7.21 | 7.23 | 7.17 | |
| | Insert Liner | 6.50 | 6.64 | 6.63 | 6.54 | 6.63 | Replaced in Yr. 2002 |
| | Down-Comer | 10.00 | 7.94 | 7.29 | 7.71 | 8.14 | |
| 11 | Shell Liner (Top) | 5.00 | 4.59 | 4.70 | 4.57 | 4.62 | |
| | Shell Liner (Middle) | 5.00 | 4.73 | 4.77 | 4.73 | 4.77 | |
| | Shell Liner (Bottom) | 5.00 | 4.74 | 4.74 | 4.26 | 4.78 | |
| | Tray Segment-1 | 8.00 | 7.14 | 7.20 | 7.21 | 7.05 | |
| | Tray Segment-2 | 8.00 | 7.32 | 7.75 | 7.51 | 7.11 | |
| | Tray Segment-3 | 8.00 | 7.77 | 7.68 | 7.64 | 7.70 | |
| | Tray Segment-4 | 8.00 | 7.51 | 7.65 | 7.62 | 7.66 | |
| | INSERT LINER | 6.50 | 6.68 | 6.75 | 6.57 | 6.76 | Replaced in Yr. 2002 |
| | DOWN-COMER | 10.00 | 8.18 | 7.88 | 7.98 | 8.27 | |
| 12- (BOTTOM COMPARTMENT) | SHELL LINER | 5.00 | 4.64 | 4.79 | 4.72 | 4.72 | |
| | PETAL PLATE | 7.00 | 5.14 | 6.16 | 6.39 | 6.20 | |
| | BOTTOM DOME | 7.00 | 6.54 | 6.25 | 6.58 | 6.18 | Replaced in Yr. 1993 |
| | REDUCER- 10" X 8" | 10.00 | 9.82 | 9.78 | 9.80 | 9.81 | Replaced in Yr. 1997 |
| | 10" - PIPE | 10.00 | 8.35 | 8.24 | 8.18 | 8.39 | |
| | 8" - PIPE (DISTANCE PIECE) | 6.00 | 5.03 | 5.98 | 4.88 | 4.95 | Replaced in Yr. 2000 |
| | NOZZLE-8" | 6.00 | 4.31 | 4.51 | 4.42 | 4.93 | |

Note :

1. Tray segment No. 01 from East side and Meas. point no. 1 from North side.
2. The Complete down-comer was replaced in 1997.
3. All the Trays were replaced in 1997 by H.E. trays supplied by Scholler & Blackmenn, Austria.

## HP STRIPPER (H-1201)

## VISUAL INSPECTION

### Top Channel

- The condition of sealing face was satisfactory.
- A thin blue grey oxide layer covered the overlay welding and liner in the gas phase (man way, dome and part of cylinder), except for the areas between the strip beads. The liner and liquid inlet box in the liquid phase were grey and slightly etched. No corrosion has been observed.
- The overlay welding on the tube sheet was grey and slightly etched.
- The tube welds were bright and smooth. Thick & hard oxide deposition was observed, more prominent in East - West direction between the tubes on tube sheet area.
- The tubes were found smooth from inside.
- At the central tube sheet area some of the tube ends were found having minor damage. This was observed in previous inspection also.

### Bottom Channel

- The condition of sealing face was found satisfactory.
- The overlay welds in the man way were grey and slightly etched.
- The overlay welds in the hemi-head were grey and etched. Many patches of approx. 2”x2” size on the hemi-head overlay welds were found more etched than the surrounding areas.
- 01 no. of cavity was observed on longitudinal weld seam of cylindrical liner just above $CO_2$ inlet line (this was observed in previous inspection also) & 01 more crevice cavity was observed adjacent to it on liner. Marked with Yellow chalk.
- The tube sheet was covered with a thin bluish grey oxide layer. This layer seams to be more hard & intact on tube-sheet to shell weld joint.
- The tubes from inside were smooth.
- The liquid outlet pipe and the gas inlet pipe were bright, shiny and showed no defects. Their nozzles and welds were in satisfactory condition.
- 04 nos. fasteners for Urea Solution outlet line flanges were found loose, turned black & corroded.
- 02 no. fasteners for $CO_2$ inlet line flange turned black & corroded.

**Bottom Cover**

- The overlay welding was very smooth and shows no defects.
- The vortex strips were in good condition.

**THICKNESS MEASUREMENT**

The weld overlay thickness is measured with a Fischer Dual Scope MP40 & liner thickness was measured using DMS-2 Ultrasonic thickness meter.

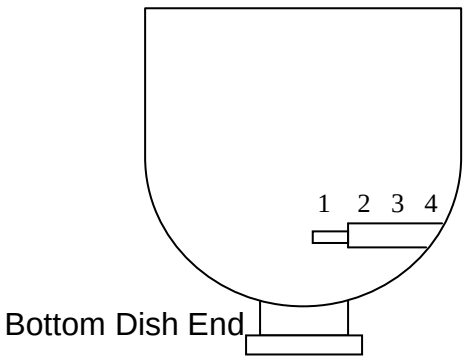
**Bottom Dome**

| | Minimum Thickness (mm) | Maximum Thickness (mm) | Design Thickness, mm (Minimum) |
|---|---|---|---|
| **Man way (Overlay)** | 18.97 | 23.57 | 8.0 |
| **Dome area (Overlay)** | 12.72 | 14.90 | 8.0 |
| **Cylindrical area (Liner)** | 8.02 | 10.55 | 8.0 |
| **Tube sheet-Overlay weld** | 13.0 (Machined) | 15.65 (Machined) | 8.0 |
| **Bottom Cover (Overlay)** | 16.16 | 19.30 | 8.0 |

**Top Dome**

| | Minimum Thickness (mm) | Maximum Thickness (mm) | Design Thickness, mm (Minimum) |
|---|---|---|---|
| **Man way (Overlay)** | 20.55 | 23.20 | 8.00 |
| **Dome area (Overlay)** | 12.11 | 14.16 | 8.00 |
| **Cylindrical area (Liner)-Gas phase** | 7.98 | 8.48 | 8.00 |
| **Cylindrical area (Liner)-Liquid phase** | 7.92 | 8.26 | 8.00 |
| **Tube sheet-Overlay weld** | 12.45 (Machined) | 14.20 (Machined) | 8.00 |

**RADIOACTIVE SOURCE WELL**



| POINT NO. | DESIGN THK. | MEASURED THICKNESS (Minimum in mm) |
|---|---|---|
| 1 | 7.5 | 8.37 |
| 2 | 19.0 | 18.70 |
| 3 | 19.0 | 18.81 |
| 4 | 19.0 | 18.93 |

## FERRITE MEASUREMENT

Ferrite measurement was carried out at random locations on welds and parent metal. No ferrite was found.

## EDDY CURRENT TESTING OF TUBES

Eddy current inspection of tubes was carried out by M/s TesTex NDT India Pvt. Ltd. for 2599 tubes from top tube sheet end up to a length of 4.5 meters. 01 tube was plugged before inspection. (Total no of tubes 2600).The Results are as under:

- Wall loss : 0.510 to 0.600 mm observed in 228 tubes
- Wall loss : 0.610 to 0.640 mm observed in 263 tubes
- Wall loss : 0.641 to 0.689 mm observed in 327 tubes
- Wall loss : 0.690 to 0.750 mm observed in 948 tubes
- Wall loss : 0.760 to 0.800 mm observed in 784 tubes
- Wall loss : 0.810 to 0.850 mm observed in 18 tubes
- Wall loss : 0.860 to 0.900 mm observed in 27 tubes
- Wall loss : 0.910 to 0.950 mm observed in 4 tubes

Result and Conclusion: Majority of the wall thinning was observed between $2^{nd}$ to $5^{th}$ baffle from top tube-sheet. (Tube sheet layout attached at **Annexure-6**)

## H.P. CONDENSER (H-1202)

### Top Channel Head

- The gasket sealing face was found satisfactory.
- The liner and welds in the man way were shiny and smooth.
- The liner and welds in the channel were shiny and slightly rough.
- 01 no. crevice cavity was observed on the Circumferential Weld seam patch plate in South direction & 01 no. cavity on C-Seam HAZ area in West direction. Need to fused / weld deposited. (Marked with Yellow chalk)
- The liners adjacent to the gas inlet were partly covered with a bluish grey oxide scale.
- Minor roughening was observed on the tube sheet overlay near tube sheet to channel circumferential weld joint in complete periphery. It was observed more predominant in West & South direction.
- Gas inlet line elbow was found having thick grayish passivation layer.
- The tray support clips were shiny and slightly etched.

- The tube-to-tube sheet welds were found satisfactory.
- The few tube ends were found slightly damaged.
- Condition of the patch plates were found satisfactory.
- Many tube showed burn-through at ID of tube, these were also observed in earlier inspections.

**Bottom Channel Head**

- The sealing face was found satisfactory.
- The man way liner was dark brownish in colouration and smooth.
- In the hemi-head and cylindrical area the liner was silvery, shiny and etched.
- All liner welds and repairs were bright and smooth.
- The tube to tube sheet welds were bright shiny and smooth.
- Many tubes showed burn-through defects, these were also observed in earlier inspections.

**Bottom Cover**

- The sealing face was found satisfactory.
- The liner was shiny and slightly etched.
- The vortex breaker and welds were smooth and intact.

**THICKNESS MEASUREMENT**

**Weld Overlay and Liner thickness measurement:**

The wall thickness of the liner was measured using a Krautkramer DMS-2 thickness meter (accuracy 0.01 mm).The weld overlay thickness has been measured using a Dual Scope MP40.

**Bottom Dome**

| Location of Measurement | Minimum Thickness (mm) | Maximum Thickness (mm) | Design Thickness (mm) |
|---|---|---|---|
| **Man way (Liner)** | **4.28*** | 7.52 | 6.0 |
| **Dome area (Liner)** | 6.59 | 6.97 | 6.0 |
| **Cylindrical area (Liner)** | 6.38 | 6.81 | 6.0 |
| **Tube sheet-Overlay weld** | 8.50 | 11.60 | 8.0 (Min) |
| **Bottom Cover (Liner)** | 19.08 | 19.42 | 18.0 |

*****Near vertical seam (Thickness was observed in the same range during previous inspection also)

**Top Dome**

| Location of Measurement | Minimum Thickness mm | Maximum Thickness mm | Design Thickness mm (Minimum) |
|---|---|---|---|
| **Man way (Liner)** | 6.21 | 7.01 | 6.0 |
| **Dome area (Liner)** | 6.59 | 6.75 | 6.0 |
| **Cylindrical area (Liner)** | 6.45 | 6.73 | 6.0 |
| **Tube sheet-Overlay weld** | 7.5 | 11.5 | 8.0 (min) |

## EDDY CURRENT TESTING OF TUBES

Eddy current inspection was carried out by M/s TesTex NDT India Pvt. Ltd. Total tubes in H.P. condenser are 1970 out of which 220 tubes were tested for 12000mm tube length and 1728 tubes tested for 3000mm length. 10 tubes could not be tested due to tray support pads obstructing the probe. 12 tubes were plugged before inspection. The observations are as under:

- No reduction in wall thickness or any abnormality was detected in other inspected tubes as compared to Calibration tube.

(Tube sheet layout attached at **Annexure-7**)

## AIR-BUBBLE TEST FOR LEAK DETECTION

The Condenser was running with higher shell side conductivity than its normal level & tube leak was suspected. For detection of tube leakage it was planned to do Air-bubble test. The shell side was pressurized at 4.2 Kg/cm2 and thorough soap-bubble test was carried out from both top & bottom tube sheets. Finally leak was observed from one no. tube (Row no. 29 & tube no. 27, as shown in Annexure-7) approx. 15mm. below top of the tube end. The tube was plugged. The Condenser was hydro-tested and found satisfactory.

## FERRITE MEASUREMENT

- Random Ferrite measurement was carried out on welds and parent metal.
- No Ferrite was found.

## INSPECTION OF OTHER VESSELS

### H-1131-A (LO COOLER OF P-1102-A)

- Condition of tube to tube sheet weld was found satisfactory.
- Thick brownish scales were observed on the channel area & baffle plate.

### H-1131-B (LO COOLER OF P-1102-B)

- Thin creamy scales were observed inside the tubes.
- Thick brownish scales were observed on the tube sheet, channel area & baffle plate.
- Deep cavities were observed on the tube-sheet area.

### H-1131-C (LO COOLER OF P-1102-C)

- Thin creamy scales were observed inside the tubes.
- Overall condition of the cooler was found satisfactory.

**H-1104 ($C0_2$ SPRAY COOLER)**

- Demister pad condition was found satisfactory.
- Risers holding clamps with Liquid distributor tray were found satisfactory.
- Weld joint condition was found satisfactory.

**H-1205 (L.P. CARBAMATE CONDENSER)**

- In Annual turnaround the tubes were inspected by M/s TesTex NDT India Pvt. Ltd, Mumbai by Internal Rotating Ultrasonic Inspection System (IRIS). 05 nos. tubes were plugged on basis of IRIS inspection. 88 Nos. of tubes were plugged earlier due to leakage in past.

  Result and Conclusion:

  It was observed that majority of the wall thinning was due to tube fretting under baffles. Hence total 05 nos. of tubes which had recorded thinning in the range of 55-67 % were plugged. (Tube sheet layout is attached at Annexure**-8**)**. Total 93 nos. of tubes are plugged till date.**

**H-1207 (CIRCULATION SYSTEM -II COOLER)**

- Pitting and scaling was observed on the tube sheet area.
- Channel cover was found pitted / corroded from inside.
- Scaling was observed on the inside surface of all tubes.

**H-1231-A (LO COOLER OF P-1201- A)**

- Condition of tube to tube sheet weld was found satisfactory.
- Thin creamy scales were observed inside the tubes.
- Overall condition of the coolers was found satisfactory.

**H-1231-B (LO COOLER OF P-1201- B)**

- West side end flange sealing face ID was found corroded.
- Thin creamy scales were observed inside the tubes.
- Overall condition of the coolers was found satisfactory

**H-1352 (REFLUX CONDENSER)**

**TOP TUBE SHEET**

- Tube to tube sheet welding was found satisfactory.
- Hard scaling was observed on the inside surface of all the tubes.

**BOTTOM TUBE SHEET**

- Tube to tube sheet welding was found satisfactory on CW inlet side.
- Thick scaling was found on the CW outlet side tube sheet.
- On cooling water outlet side, hard creamy scaling was observed inside all the tubes and on the tube projections, including inside of outlet pipeline elbow. The same was observed during last inspection also.
- Paint inside the channel area was observed peeled off & thick scales were found Sticking on channel and baffle plate.
- Thermowells found intact in position, however CW outlet side thermo well found covered with paint/scaling. The same was observed during last inspection also.

**H-1419 (PRE-EVAPORATOR CONDENSER)**

**TOP TUBESHEET:**

- Tube to tube sheet weld found satisfactory.
- Minor whitish scaling was observed inside the tubes.
- Brownish coloration was observed on the tube sheet at few location.
- Overall condition of heat exchanger found satisfactory.

**H-1420 - TOP ( FINAL CONDENSER )**

- Tube to tube sheet welding was found satisfactory.
- Inside surface of the tubes was having minor scaling.

**H-1421, FLASH TANK CONDENSER**

- Tube to tube sheet welding was found satisfactory.
- Minor scales observed inside most of the tubes, more prominent in East side half.
- Most of the tubes were found filled with water.

**H-1422 ( 1ST STAGE EVAPORATOR )**

- The shell and Dish ends have grayish black in coloration with scattered brownish and whitish patches.
- Coloration of tube sheet was brownish.
- Tubes to tube sheet weld joints were found satisfactory.
- Condition of impingement cone was found satisfactory.
- Impingement cone to support welding was found satisfactory.
- Top distributor outlet vanes found intact.
- Condensate flushing spargers (08 nos.) were found in satisfactory condition.
- Inspection was carried out from manhole.

**H-1423 (FIRST STAGE EVAPORATOR CONDENSER)**

- Tube to tube sheet welding was found satisfactory.
- Brownish scaling was observed in the 1.0 and on tube sheet.
- Scales were observed inside few tubes more in north half.
- Tube sheet was found brownish in coloration.
- All the tubes were found filled with water.

**H-1424 ( 2ND STAGE EVAPORATOR )**

- Shiny surface was observed inside the vessel.
- Impingement cone was found bent in downward direction at two locations, one is in North-west direction and the other is in south-west direction. This was also observed in earlier inspection.
- Few sparger supports near by manhole found bend and its “U” clamps found sheared suitable corrective action may be taken.

**H-1425 (SECOND EVAPORATOR FIRST CONDENSER)**

- Tube to tube sheet welding was found satisfactory.
- Whitish scale was observed inside the tubes.
- Overall condition of heat exchanger was found satisfactory.

**H-1426 (SECOND EVAPORATOR SECOND CONDENSER)**

- Tube to tube sheet welding was found satisfactory.
- Minor brownish/Whitish scales were observed inside of tubes.
- Minor scales were observed inside few tubes.
- Tubes were found filled with water.
- Epoxy coating was found peeled off at several locations in the dome covers, Channel & baffle plates

**H-1815 (SURFACE CONDENSER)**

**SOUTH SIDE HALF (EAST SIDE CHANNEL)**

**Top Half**

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found peeled off at few locations.
- Thermowell was found intact.
- Minor scaling was observed at ID of few tubes.

**Bottom Half**

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found peeled off from the channel cover.
- Minor scaling was observed at ID of few tubes.

**SOUTH SIDE HALF (WEST SIDE CHANNEL)**

**Top Half**

- Tube sheet was found in satisfactory condition.
- Minor scaling was observed inside the tubes.
- Epoxy coating was found peeled off on baffle plate, channel & cover.
- Debris was found collected above portion plate.

**Bottom Half**

- Tube sheet was found in satisfactory condition.
- Thermo well was found intact.

**NORTH SIDE HALF (West Side Channel)**

- Tube sheet was found in satisfactory condition.
- Epoxy Primer coating was found peeled off at few locations.
- Thermowell was found intact.
- Debris was found collected above partition plate.
- Scaling was observed at 10 of few tubes so re-hydrojeting is recommended.

**V-1101 ($CO_2$ KNOCK OUT DRUM ):**

- Epoxy paint was found peeled off from several locations and primer is exposed in 25-30%area in shell.
- Demister pads found proper in its position.
- The top dish end coloration was brownish

**V-1102 (NH3 SUCTION FILTER)**

- Colouration of vessel was found brownish from inside.
- Filter support ring and strips were found intact.
- Condition of the weld joint was found satisfactory.
- Condition of SS filter was found satisfactory.

**V-1202 (RECTIFYING COLUMN)**

**From Top Manhole**

- Colouration of vessel was grayish at manhole, dome and shell portion.
- Grey hard scales were observed on the top dish end and on the shell portion.
- Insulation sheet and glasswool wastage found in the tray.
- Trays were covered with grayish hard scales.
- Clits for holding the trays have fastener holes, these holes were observed elongated downwards. This was also observed in earlier inspection.

**From Bottom Manhole**

- Colouration of vessel was grayish at manhole, dome and shell portion
- Overall welding and nozzles found satisfactory.

**V-1206 (ATMOSPHERIC VENT SCRUBBER):**

- Demister pads were found intact in position and condition of the same was found satisfactory.
- Reddish brown coloration was observed inside the vessel.
- Overall condition found satisfactory.

**V-1301 (SECOND DESORBER)**

**Top Compartment**

- Brownish coloration was observed inside the vessel.
- All fasteners and clamps of the perforated tray were found in good condition.
- Top nozzle was found satisfactory.

**V-1351 (HYDROLYSER)**

**Top Compartment**

- Top dish end and shell has brownish black coloration.
- Brownish coloration was observed on the trays.
- Fasteners of top sieve tray were found intact in position.
- Condition of top sieve tray was found satisfactory.

**Bottom Compartment**

- Grayish black coloration was observed from inside.
- Condition of the perforated trays found satisfactory.
- Tray clamps & steam inlet pipe found satisfactory.

**V-1352 ( FIRST DESORBER )**

**From Bottom Manhole**

- Brownish coloration was observed inside the vessel.
- Weld joint condition was found satisfactory.

**From Top Manhole**

- Brownish coloration was observed inside the vessel.
- All fasteners were found intact
- Weld joint condition was found satisfactory.
- All internals were found intact in position.
- Leakage marks and observed from one of the inlet flange bolts of 11/2" reflux line towards south.
- From outside, Top dish end insulation petal sheet found missing caused insulation deterioration.

**V-1423 (1ST STAGE EVAPORATOR SCRUBBER)**

- Reddish Brown coloration was observed inside the vessel.
- Demister pads were found slightly damaged, loosened & lifted at several locations.
- Support channels and outer ring of demister pads were found lifted in East direction, tied by metallic wires which are broken.
- Few numbers J- bolt was found loose.

**V-1501 (4 ATA STEAM DRUM)**

- Shell and Dish ends were found Grayish with Reddish brown coloration at scattered locations.
- Distribution sparger was found intact in position.

- Demister pads were found intact in position and condition of the same was found satisfactory.
- Condition of weld joints was found satisfactory.
- Minor pitting was observed on bottom of the shell.
- Hard scaling was observed on both the dished ends.

**V-1502 (23 ATA STEAM DRUM)**

- Brownish black coloration was observed inside the vessel.
- Scaling was observed at both dished ends.
- Condition of distributor pipe, all welds, all nozzles and thermo-well found satisfactory.
- Accumulated water found at bottom of the vessels, proper cleaning, draining is required.

**V-1503 (9 ATA STEAM DRUM)**

- Grayish black coloration was observed inside the vessel.
- Nut of South side U-clamp of inlet steam header was found missing. Need to be provided
- I.D. of 1" bottom nozzle for Level controller in East direction at center portion of the shell was found having pitting/cavities up to 1.5mm depth. This was observed in previous inspections also.
- Overall condition of the vessel was found satisfactory.

**T-1301 (AMMONIA WATER TANK)**

- Brownish coloration was observed on bottom plate and bottom half of shell and Silver bright coloration was observed on top half of shell.
- Bottom plate was found bulged upwards at various locations, same was observed in past inspection also.
- Weld joints and nozzle condition was found satisfactory.
- Thermowell condition was found satisfactory.
- Internal surface of the shell was found oily.
- Condition of the Roof was found satisfactory.

**T-1301-A , NEW AMMONIA WATER TANK**

- Brownish coloration was observed on bottom plate & bottom half of shell
- All the weld joints and nozzle condition was found satisfactory.
- Thermo-well was found intact.
- Overall condition was satisfactory.

## T-1401, UREA SOLUTION TANK

- Brownish coloration observed inside of the shell.
- Thermo-well condition found satisfactory.
- Nozzles and weld joints condition found satisfactory.
- Bottom plate having bulging upwards and downward as observed in the past also.
- Stiffener provided on top roof plate was found intact in position.

## T-1401-A , NEW UREA SOLUTION TANK

- Brownish gray coloration observed inside of the shell.
- Thermo-well condition found satisfactory.
- Nozzles and weld joint condition satisfactory.
- Thermo-well condition found satisfactory.
- Overall condition found satisfactory

## T-1501 (CONDENSATE TANK)

- Condition of weld joints was found satisfactory.
- Reddish brown coloration was observed inside the tank.
- Supports of 6" condensate inlet were found intact.
- Overall condition of the tank was found satisfactory.

## MISCELLANEOUS JOBS

### D.P. TEST

Dye Penetrant examination of weld joints of all the pipelines fabricated by contractors/departmentally, new pipeline fabrication / repairing / modifications job done by technical and maintenance groups etc. was carried out after root run welding and after final welding, as per requirement. Any defects observed during the tests were rectified in the presence of inspector followed by DP test for acceptance.

### RADIOGRAPHY

In order to ensure immediate radiography work and urgent processing of films, teams were hired on round the clock basis during entire shutdown period. Radiography was performed on the weld joints of the pipe lines fabricated / repaired by all contractors as well as departmentally as per the requirement.

### INSTALLATION OF NEW PIPELINES

During this shutdown, various pipelines in Urea Plant were installed for different schemes and various tapping were taken by Technical Group. Inspection activities viz. DP Test, Radiography review and repairs etc. were carried out on the weld joints as per fabrication procedures.

## ANNEXURE-1 (1/3)

## PIPELINE THICKNESS MEASUREMENT SUMMARY OF HP LINES

| Sr. No | LINE NO. | NB (inch) | SCH. | NOM. THK. (MM) | LINE DESCRIPTION | | MIN. THK. OBSERVED | %AGE RED. |
|---|---|---|---|---|---|---|---|---|
| | | | | | FROM | TO | | |
| 1 | CO-F10-2119-PP25 | 8 | 160 | 23.01 | K-1801,III | H-1813 | 22.15 | 3.73 |
| 1A | CO-F10-2119-PP25 | 1.5 | 160 | 7.14 | K-1801,III | H-1813 | 7.06 | 1.12 |
| 1B | CO-F10-2119-PP25 | 0.75 | 160 | 5.54 | K-1801,III | H-1813 | 5.23 | 5.59 |
| 2 | CO-F10-2124 | 8 | 160 | 23.01 | K-1801,DIS. | GA-1112 | 22.48 | 2.23 |
| 2A | CO-F10-2124 | 0.75 | 160 | 5.54 | K-1801,DIS. | GA-1112 | 5.25 | 5.23 |
| 3 | CO-E10-2139-PP25 | 4 | 80 | 8.56 | CO-F10-2140-4” (TV-1808) | CO-E10-2122-6” | 6.92 | 19.15 |
| 4 | CO-F10-2140 | 4 | 160 | 13.49 | K-1801,III | V-1813 | 12.32 | 8.67 |
| 4A | CO-F10-2140 | 0.75 | 160 | 5.56 | CO-F10-2140-PP25 | DRAIN | 5.30 | 4.67 |
| 5 | CO-E10-2122 | 6 | 80 | 10.97 | H-1813 | V-1813 | 9.87 | 10.02 |
| 6 | GA-1112 | 6 | F2 | 14.27 | K-1101-2 | GA-1201 | 11.35 | 20.46 |
| 6A | GA-1112 | 1.5 | X1 | 5.08 | FROM GA-1112 | TO BYPASS | 3.83 | 24.60 |
| 7 | GA-1201 | 6 | X4 | 13.33 | GA-1112 | H-1201 | 13.82 | 1.2 |
| 7A | GA-1201 TI-1207 | 1.5 | X4 | 5.08 | GA-1112 | H-1201 | 4.98 | 10 |
| 8 | GA-1202 | 1 | F2 | 6.35 | GA-1112-6" | C-VALVE (GA-1203) | 4.15 | 34.64 |
| 9 | GA-1203 | 1 | X1 | 4.51 | GA-1202 | H-1203 | 3.59 | 20.39 |
| 9A | GA-1203 DRAIN | 0.5 | X1 | 3.73 | GA-1202 | H-1203 | 3.60 | 3.48 |
| 10 | GA-1204 | 1 | X1 | 4.51 | H-1203 | PR-1231 | 3.98 | 11.75 |
| 10A | GA-1204 DRAIN | 0.5 | X1 | 3.73 | H-1203 | PR-1231 | 2.99 | 19.83 |
| 11 | GA-1602 | 8 | F2 | 22.83 | K-1801 | GA-1112 | 21.68 | 5.03 |
| 11A | GA-1602 | 0.5 | 3.73 | 3.73 | K-1801 | GA-1112 | 3.71 | 13.8 |
| 12 | GA-1603 | 4 | F2 | 11.13 | GA-1602 | GA-1604 | 10.53 | 5.39 |
| 13 | GA-1606 | 1 | B3 | 3.38 | GA-1607-0.75’’ | GA-1350-1” | 3.07 | 9.17 |
| 14 | GA-1607 | 0.75 | B3 | 2.87 | K-1801 | GA-1606-1” | 2.20 | 23.34 |
| 15 | MA-1106-B | 4 | E2 | 8.56 | MA-1605-6" | MA-1203-4" | 6.91 | 19.27 |
| 15A | MA-1106-B | 1 | E2 | 4.55 | MA-1605-6" | MA-1203-4" | 4.72 | --- |
| 15B | MA-1106-B | 0.75 | E2 | 3.91 | MA-1605-6" | MA-1203-4" | 3.98 | --- |

## ANNEXURE-1 (2/3)

| Sr. No | LINE NO. | NB (inch) | SCH. | NOM. THK. (MM) | LINE DESCRIPTION | | MIN. THK. OBSERVED | %AGE RED. |
|---|---|---|---|---|---|---|---|---|
| | | | | | FROM | TO | | |
| 15C | MA-1106-B | 1.5 | E2 | 3.68 | MA-1605-6" | MA-1203-4" | 3.98 | --- |
| 16 | MA-1106-A | 4 | E2 | 8.56 | P-1102-A | MA-1605-6” | 7.48 | 12.5 |
| 16A | MA-1106-A | 1 | E2 | 4.55 | P-1102-A | MA-1605-6” | 4.02 | 18.20 |
| 16B | MA-1106-A | 0.5 | E2 | 3.73 | P-1102-A | MA-1605-6” | 4.02 | --- |
| 17 | MA-1123 | 4 | E2 | 8.56 | P-1102/B | MA-1605 | 7.43 | 13.20 |
| 17A | MA-1123 | 0.75 | E2 | 3.91 | P-1102/B | MA-1605 | 3.89 | 0.51 |
| 18 | MA-1201 | 3 | E2 | 7.62 | MA-1605-6" | MA-1202-3" | 5.84 | 23.35 |
| 18A | MA-1201 | 1.5 | E2 | 5.08 | MA-1605-6" | MA-1202-3" | 3.66 | 27.95 |
| 19 | MA-1202 | 3 | X4 | 7.62 | MA-1201 | V-1201 | 6.43 | 15.61 |
| 19A | MA-1202 | 2 | X4 | 5.54 | MA-1201 | V-1201 | 5.69 | --- |
| 20 | MA-1203 | 4 | X4 | 9.14 | MA-1106-6" | PR-1230 | 9.22 | --- |
| 21 | MA-1603 | 6 | C2 | 7.11 | MA-1122-6" | P-1102 /C | 6.24 | 12.23 |
| 21A | MA-1603 | 1 | C2 | 4.55 | MA-1122-6" | P-1102 /C | 4.49 | 1.31 |
| 21B | MA-1603 | 0.75 | C2 | 3.91 | MA-1122-6" | P-1102 /C | 2.95 | 24.55 |
| 22 | MA-1603 | 4 | C2 | 6.02 | MA-1122-6" | P-1102 /C | 5.47 | 9.13 |
| 23 | MA-1604 | 3 | E2 | 7.62 | P-1102 /C Dis | MA-1604-4" | 5.96 | 21.78 |
| 23A | MA-1604 | 1 | E2 | 4.55 | P-1102 /C Dis | RV | 4.56 | --- |
| 24 | MA-1604 | 4 | E2 | 8.56 | MA-1604-3" | MA-1605-6" | 7.32 | 14.48 |
| 24A | MA-1604 | 1.5 | E2 | 5.08 | MA-1604-3" | MA-1605-6" | 4.56 | 10.23 |
| 24B | MA-1604 | 0.75 | E2 | 3.91 | MA-1604-3" | MA-1605-6" | 3.14 | 19.69 |
| 25 | MA-1605 | 6 | E2 | 14.27 | MA-1106 | MA-1203 | 12.84 | 10.02 |
| 25A | MA-1605 | 0.75 | E2 | 3.91 | MA-1106 | MA-1203 | 4.18 | --- |
| 26 | MA-1605 | 4 | E2 | 8.56 | MA-1106 | MA-1203 | 8.11 | 5.25 |
| 27 | MA-1607 | 4 | C2 | 6.02 | MA-1605 | MA-1116 | 5.42 | 9.96 |
| 27A | MA-1607 DRAIN | 0.75 | C2 | 3.91 | MA-1605 | MA-1116 | 3.21 | 17.90 |
| 28 | MA-1609 | 4 | C2 | 6.02 | MA-1603-6” | MA-1604-3” | 4.98 | 17.27 |
| 29 | PR-1201 | 8 | X1 | 19.58 | V-1201 | H-1201 | 17.40 | 11.13 |

## ANNEXURE-1 (3/3)

| Sr. No | LINE NO. | NB (inch) | SCH. | NOM. THK. (MM) | LINE DESCRIPTION | | MIN. THK. OBSERVED | %AGE RED. |
|---|---|---|---|---|---|---|---|---|
| 30 | PR-1202 | 10 | X1 | 24.33 | H-1201 | H-1202 | 20.10 | 17.38 |
| 31 | PR-1203 | 8 | X1 | 19.58 | HP-Cond. H-1202 | V-1201 (Vapor Line) | 17.84 | 8.88 |
| 32 | PR-1204 | 8 | X1 | 19.58 | HP-Condenser | V-1201 (Liquid Line) | 18.06 | 5.20 |
| 32A | PR-1204 TR-1202 | 1.5 | X1 | 5.08 | HP-Condenser | V-1201 (Liquid line) | 4.11 | 19.09 |
| 33 | PR-1205 | 6 | X1 | 15.24 | PR-1205-8" | V-1202 | 10.74 | 29.52 |
| 33A | PR-1205 | 1.5 | X1 | 5.08 | PR-1205-8" | V-1202 | 4.39 | 13.58 |
| 33B | PR-1205 | 0.75 | X1 | 3.91 | PR-1205-8" | Rectifying Column | 3.51 | 10.23 |
| 34 | PR-1205 | 8 | X1 | 19.58 | Stripper Bottom | V-1202 | 16.87 | 13.84 |
| 34A | PR-1205 | 6 | X1 | 15.24 | Stripper Bottom | V-1202 | 11.94 | 21.65 |
| 34B | PR-1205 TR-1210 | 1.5 | X1 | 5.08 | Stripper Bottom | V-1202 | 4.77 | 6.15 |
| **35** | PR-1206 | 4 | X1 | 10.40 | PR-1210-10” | H-1203 | 12.60 | --- |
| **36** | PR-1208 | 4 | X1 | 10.40 | Autoclave Top | PR-1206-4" | 10.30 | 0.96 |
| 36A | PR-1208 TR-1206 | 1.5 | X1 | 5.08 | Autoclave Top | PR-1206-4" | 6.62 | --- |
| 37 | PR-1211 | 1.5 | X1 | 5.08 | PR-1208-4” | PR-1212-4" | 4.22 | 16.92 |
| 38 | PR-1212 | 4 | X1 | 10.40 | Scrubber | V-1201 | 9.16 | 11.92 |
| 38A | PR-1212 | 2 | X1 | 5.54 | Scrubber | V-1201 | 4.83 | 12.81 |
| 39 | PR-1213 | 2 | X4 | 5.54 | PR-1201 | PR-1205-6" | 4.11 | 25.81 |
| 40 | PR-1224 | 3 | X4 | 7.62 | P-1201B | PR-1638-4" | 7.30 | 4.19 |
| 41 | PR-1225 | 3 | X4 | 7.62 | P-1201A/B, PR1638-4" | H-1203 | 6.80 | 10.76 |
| 42 | PR-1226 | 2 | X4 | 5.54 | PR-1224 | H-1205 | 4.36 | 21.29 |
| 43 | PR-1230 | 6 | X1 | 15.24 | MA-1203-4" | H-1202 | 14.28 | 6.29 |
| 43A | PR-1230 TR-1205 | 1.5 | X1 | 5.08 | MA-1203-4" | H-1203 | 3.92 | 22.84 |
| 44 | PR-1231 | 3 | X1 | 8.12 | H-1203 | PRCV-1201 | 7.27 | 10.46 |
| 45 | PR-1232 (JAKET) | 6 | - | - | PRCV-1201 (RV-1209) | ATMOS | 3.17 | --- |
| 46 | PR-1234 | 4 | X4 | 10.41 | PRC-1201 | V-1203 | 10.42 | - |
| 47 | PR-1234 | 3 | X4 | 7.62 | P-1201A | PR-1638-4" | 6.27 | 17.71 |
| 48 | PR-1637 | 3 | X4 | 7.62 | P-1201C | PR-1638-4" | 6.80 | 10.76 |
| 49 | PR-1638 | 4 | X4A | 9.14 | P-1201A/B/C | PR-1230-6" | 12.14 | --- |
| 49A | PR-1638 | 1.5 | X4A | 5.08 | P-1201A/B/C | PR-1230-6" | 5.79 | --- |
| 50 | PR-1666 | 2 | X4A | 5.54 | PR-1637 | PR-1226 | 4.32 | 22.02 |

**Note**: **Pipeline Replacement in this Turn-Around**

- PR-1205-6”-X1

  LRCV-1201 replaced along with pipe segment & 02 nos. elbows.

- PR-1206-4”-X1

  Pipe segment along with HICV-1202 replaced.

- PR-1208-4”-X1 (Autoclave Off-gas line)

  Straight Pipe segment along with 01 no. elbow upstream of RV’s replaced.

## ANNEXURE-2

## PIPELINE THICKNESS MEASUREMENT SUMMARY (STEAM CONDENSATE LINE)

| Sr. No | LINE NO. | NB (inch) | SCH. | NOM. THK. (MM) | LINE DESCRIPTION | | MIN. THK. OBSERVED | %AGE RED. |
|---|---|---|---|---|---|---|---|---|
| | | | | | FROM | TO | | |
| 1 | SC-1209 | 10 | C2 | 9.27 | H-1207 | H-1203 | 7.7 | 16.9 |
| 2 | SC-1211 | 8 | C2 | 8.18 | H-1203 | P-1204 | 7.4 | 20 |
| 3 | SC-1211 | 10 | C2 | 9.27 | H-1203 | P-1204 | 7.4 | 20.17 |
| 4 | SC-1212 | 10 | C2 | 9.27 | SC-1210 | SC-1209 | 8.2 | 11.54 |
| 5 | SC-1212 | 8 | C2 | 8.18 | SC-1210 | SC-1209 | 8.3 | - |
| 6 | SC-1212** | 4 | C2 | 6.02 | SC-1210 | SC-1209 | - | High External corrosion/ Pitting on Reducer & Tee may be replaced in next S/D |
| 7 | SC-1220 | 14 | 20 | 11.13 | H-1206 | H-1205 | 10.05 | 9.5 |
| 8 | SC-1222 | 12'' | B4 | 9.52 | H-1205 | P-1202A/B | 8.70 | 8.4 |
| 9 | SC-1502 | 3 | B4 | 5.48 | P-1501/6 | V-1501 | 3.9 | 28 |
| 10 | SC-1509 | 3 | B4 | 5.48 | SC-1507 | B/L | 4.5 | 18 |
| 11 | SC-1512 | 4 | C1 | 6.02 | SC-1213 | LCV-1501 | 3.76 | 3.8 |
| 12 | SC-1513 | 4 | B4 | 6.02 | LCV-1501 | V-1503 | 10.60 | --- |
| 13 | SC-1521 | 3 | B4 | 5.49 | SC-1507 | HS No.1,3,5,7 | 4.76 | 13.2 |
| 14 | SC-1521 | 1 | B4 | 4.55 | SC-1507 | HS No.1,3,5,7 | 4.20 | 7.6 |
| 15 | SC-1521 | 2 | B4 | 3.91 | SC-1507 | HS No.1,3,5,7 | 3.75 | 4.0 |
| 16 | SC-1522 | 2 | B4 | 3.91 | SC-1529 | SC-1409 | 4.4 | --- |
| 17 | SC-1522 | 3 | B4 | 5.49 | SC-1529 | SC-1409 | 5.6 | --- |
| 18 | SC-1601 | 10 | C2 | 9.27 | SC-1211 | H-1418 | 7.8 | 15.8 |
| 19 | SC-1606 | 10 | C2 | 9.27 | H-1418 | SC-1211 | 8.8 | 5 |
| 20 | SC-1507 | 3 | B4 | 5.49 | P-1505 A/B | T-1501/DEARATOR | 4.9 | 10.00 |
| 21 | SC-1237 I FROM NE | 16 | B4 | 9.53 | H-1202 | V-1501 | 8.7 | 8.70 |
| 22 | SC-1238 II FROM NE | 16 | B4 | 9.53 | H-1202 | V-1501 | 12.7 | --- |
| 23 | SC-1239 III FROM NE** | 16 | B4 | 9.53 | H-1202 | V-1501 | 6.92* | 27.38 Patch Provided In 4''x4'' area |
| 24 | SC-1240 IV FROM NE | 16 | B4 | 9.53 | H-1202 | V-1501 | 9.8 | --- |
| 25 | SC-1241 I FROM NW | 16 | B4 | 9.53 | H-1202 | V-1501 | 9.5 | 0.31 |
| 26 | SC-1242 II FROM NW | 16 | B4 | 9.53 | H-1202 | V-1501 | 9.0 | 5.56 |

| Sr. No | LINE NO. | NB (inch) | SCH. | NOM. THK. (MM) | LINE DESCRIPTION | | MIN. THK. OBSERVED | %AGE RED. |
|---|---|---|---|---|---|---|---|---|
| | | | | | FROM | TO | | |
| 27 | SC-1243 III FROM NW | 16 | B4 | 9.53 | H-1202 | V-1501 | N.A | --- |
| 28 | SC-1244 IV FROM NW | 16 | B4 | 9.53 | H-1202 | V-1501 | 10.3 | --- |
| 29 | ST-1123 | 20 | B4 | 9.53 | PICV-1129 | ST-1106 | 8.77 | 7.9 |
| 30 | ST-1123 | 14 | B4 | 9.53 | PICV-1129 | ST-1106 | 9.86 | --- |
| 31 | ST-1124 | 6 | E3 | 10.97 | ST-1104 | PICV-1128 | 9.60 | 12.4 |
| 32 | ST-1125 | 10 | C1 | 9.27 | ST-1116 | PICV-1129 | 7.95 | 14.2 |
| 33 | ST-1128 | 12 | B4 | 9.53 | ST-1608 | HITACHI B/L | 8.00 | 16.0 |
| 34 | ST-1206 | 8 | B4 | 8.18 | ST-1506 | H-1204 | 7.57 | 7.4 |
| 35 | ST-1206 | 10 | B4 | 9.27 | ST-1506 | H-1204 | 7.58 | 18 |
| 36 | ST-1211 | 2 | B4 | 3.91 | ST-1206 | H-1202 | 4.3 | --- |
| 37 | ST-1212 | 6 | C1 | 7.11 | H-1201 | BD-1202 | 6.41 | 9.8 |
| 38 | ST-1221 | 2 | B4 | 3.91 | ST-1225 | PRILL TOWER | 4.10 | --- |
| 39 | ST-1224 | 6 | B4 | 7.11 | ST-1206 | H-1202 | 6.14 | 13 |
| 40 | ST-1225 | 3 | B4 | 5.49 | ST-1224 | HEADER | 3.92 | 28 |
| 41 | ST-1226 | 6 | B4 | 7.11 | ST-1224 | ST-1225-3" | 5.89 | 17 |
| 42 | ST-1352 | 4 | 10S | 3.05 | 23 ATA HEADER | HYDROLYSER | 3.02 | 0.5 |
| 43 | ST-1352 | 3 | | 5.5 | 23 ATA HEADER | HYDROLYSER | 4.80 | 12 |
| 44 | ST-1409 | 4 | | 6.02 | ST-1504 | H-1424 | 5.0 | 16.5 |
| 45 | ST-1503 | 3 | B4 | 5.49 | PICV-1502A | V-1503 | 5.3 | 1.8 |
| 46 | ST-1503 | 12 | B4 | 9.52 | PICV-1502A | V-1503 | 8.2 | 13.9 |
| 47 | ST-1504 | 6 | B4 | 7.11 | V-1503 | ST-1302 | 6.25 | 12 |
| 48 | ST-1504 | 10 | B4 | 9.27 | V-1503 | ST-1302 | 8.43 | 9.3 |
| 49 | ST-1505 | 14 | B4 | 9.53 | PICV-1502B | ST-1506 | 8.78 | 7.8 |
| 50 | ST-1506 | 14 | B4 | 9.53 | V-1501 | ST-1106 | 8.60 | 9.7 |
| 51 | ST-1507 | 6 | B4 | 7.11 | ST-1506 | ST-1302 | 5.66 | 20 |
| 52 | ST-1509 | 10 | B4 | 9.27 | T-1501 | H-1502 | 8.46 | 9.7 |
| 53 | ST-1510 | 10 | B4 | 9.27 | T-1501 | H-1502 | 8.2 | 11.2 |
| 54 | ST-1607 | 12 | C1 | 9.52 | HITACHI BL | 23 ATA HEADER | 9.4 | 1.3 |
| 55 | ST-1608 | 16 | B4 | 9.53 | ST-1128(EXISTING) | HITACHI BL | | |

**Note(**)**:

1. SC-1239 III-16'' FROM NE, On Elbow patch provided In 4''x4'' area.

2. SC-1212**-4'' High External corrosion/Pitting on Reducer & Tee observed may be replaced in next S/D

## ANNEXURE-3

## UREA PLANT VESSEL THICKNESS MEASUREMENT SUMMARY

| Sl. No | Equip. No. | Equip. Description | Shell | | | Dish End | | | Channel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nom./ Design | Min./ Meas. | % Red. | Nom./ Design | Min./ Meas. | % Red | Nom./ Design | Min./ Meas. | % Red. |
| 1 | H-1104 | $CO_2$ SPRAY COOLER | 10.00 | 8.1 | 19 | 9.0 / 13.0 | 11.8 | 9.2 | - | - | - |
| 2 | H-1205 | LP CARBAMATE CONDENSER | 7.00 | 7.3 | -- | 11.00 | 10.8 | 1.8 | - | - | - |
| 3 | H-1301-A | ADDITIONAL DESORBER HEAT EXCHANGER | 9.5 | 7.8 | 17 | -- | -- | -- | -- | -- | -- |
| 4 | H-1301-B | ADDITIONAL DESORBER HEAT EXCHANGER | 9.5 | 12.5 | --- | -- | -- | -- | -- | -- | - |
| 5 | H-1351-A | HYDROLYSER FEED PRE HEATER | 12.00 | 12.7 | -- | 12.0 | 12.2 | --- | -- | -- | -- |
| 6 | H-1351-B | HYDROLYSER FEED PRE HEATER | 12.00 | 12.1 | - | 12.00 | 12.2 | -- | -- | -- | -- |
| 7 | H-1351-C | HYDROLYSER FEED PRE HEATER | 12.00 | 12.1 | -- | 12.00 | 11.2 | 6.3 | -- | -- | -- |
| 8 | H-1352 | REFLUX CONDENSER | 8.0 | 7.8 | 2.8 | -- | -- | -- | -- | -- | -- |
| 9 | V-1422 | $1^{ST}$ STAGE EVOPRATOR SEPERATOR | 12.00 | 12.6 | -- | -- | -- | -- | -- | -- | -- |
| 10 | H-1427 | CIRCULATION COOLER FOR V-1423 | 8.00 | 8.6 | -- | -- | -- | -- | -- | -- | -- |
| 11 | T-1301 | LEAN AMMONICAL WATER TANK | 6.0 | 6.0 | -- | 5.0 (Roof) 7.0 (Bot) | 4.7 (Roof) 7.3 (Bot) | 6.0 | -- | -- | -- |
| 12 | T-1701-B | UREA DUST DESOLVING TANK | 5.00 | 6.00 | -- | -- | -- | -- | -- | -- | -- |

| Sl. No | Equip. No. | Equip. Description | Shell | | | Dish End | | | Channel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nom./ Design | Min./ Meas. | % Red. | Nom./ Design | Min./ Meas. | % Red | Nom./ Design | Min./ Meas. | % Red. |
| 13 | V-1102 | AMMONIA FILTER | 11 | 10.9 | 0.9 | -- | -- | -- | -- | -- | -- |
| 14 | V-1103 | AMMONIA SUC.VESSEL | 21.00 | 21.00 | 21.0 / 23.0 | 22.2 | -- | -- | -- | -- | -- |
| 15 | V-1200 | LEAN CARBAMATE SEPERATOR | 5.0 | 4.9 | 0.9 | 6.0 | 6.3 | -- | -- | -- | -- |
| 16 | V-1203 | LOW PRESSURE ABSORBER | 6.00 | 5.8 | 2 | 12.0 | 13.0 | -- | -- | -- | -- |
| 17 | T-1301-A | STRONG AMMONICAL WATER TANK | 6.0 | 5.3 | 11 | -- | -- | -- | -- | -- | -- |
| 18 | T-1401-A | UREA SOLUTION TANK | 6.0 | 5.4 | 12 | 6.0 (Bot) | 6.0 | -- | -- | -- | -- |
| 19 | T-1701-A | UREA DUST DESOLVING TANK | 6.0 | 5.9 | 1.0 | -- | -- | -- | -- | -- | -- |
| 20 | V-1206 | ATM.VENT SCRUBBER | 5.0 | 5.1 | -- | -- | -- | -- | -- | -- | -- |
| 21 | V-1207 | AMMONIA SCRUBBER | 6.0 | 5.5 | 8 | -- | -- | -- | -- | -- | -- |
| 22 | V-1351 | HYDROLYSER | 28.0 | 30.1 | -- | -- | -- | -- | -- | -- | -- |
| 23 | V-1423 | $1^{ST}$ EVAPORATOR SCRUBBER | 8.0 | 8.1 | - | 10.0 | 10.7 | -- | -- | -- | -- |
| 24 | V-1503 | 9 ATA STEAM DRUM | 13.0 | 12.8 | 1.5 | -- | -- | -- | -- | -- | -- |
| 25 | H-1205-A | ADDI.CARBA. CONDENSER | 12.0 | 11.3 | 5.8 | 10.0 | 9.6 | 4.0 | -- | -- | -- |
| 26 | T-1401 | UREA SOLUTION TANK | 6.0 | 5.8 | 3.33 | 6.0 (ROOF) / BOT | 5.9 | 9.7/ 5.9 | 3.33 | -- | -- |
| 27 | V-1501 | 4 ATA STEAM DRUM | 15 | 14.4 | 4.0 | 15.0 / 18.0 | 16.1 | -- | -- | -- | - |

## ANNEXURE-4

## GAUSS MEASUREMENT & DEMAGNETIZATION REPORT OF K-1801 (HITACHI COMPRESSOR)

| DESCRIPTION | POSITION | BEFORE (Gauss-max.) | AFTER (Gauss max.) |
|---|---|---|---|
| **TURBINE (FREE ENDSIDE)** | | | |
| Journal Bearing Pads | Governor side | 0.3 | Within limits |
| Journal Bearing Base Ring | Governor side | Top–1.2<br>Bottom–1.4 | " |
| Shaft Journal | Governor side | 1.2 | " |
| Thrust Collar | Governor side | 0.8 | " |
| Thrust Bearing | Governor side | 0.6 | " |
| Thrust Base Ring | Governor side | 1.2 | " |
| Thrust Bearing Pads | Governor side | 0.6 | " |
| **TURBINE (NORTH END)** | | | |
| Journal Bearing Pads | Top Half | 0.6 | " |
| | Bottom half | 0.8 | " |
| Shaft Journal | | 0.8 | " |
| Journal Bearing Base Ring | Top Half | 0.8 | " |
| | Bottom half | 0.8 | " |
| Collar | Active | 1.2 | " |
| | Inactive | 0.9 | " |
| **L.P. CASE (TURBINE END)** | | | |
| Shaft Journal | | 0.5 | " |
| Journal Bearing Pads | | Top– 0.4<br>Bottom–1.2 | " |
| Journal Bearing Base Ring | Top | 1.5 | " |
| | Bottom | 1.8 | |
| **L.P. CASE (G.B. END)** | | | |
| Shaft Journal | | 0.5 | " |
| Journal Bearing Pads | | 0.5 Max | " |
| Journal Bearing Base Ring | Top | 1.4 | " |
| | Bottom | 2.4 | |
| Thrust Base Ring | Active | 0.6 | " |
| | Non active | 0.8 | " |
| Thrust Bearing Pads | Active | 0.3 | " |
| | Non active | 0.4 | |
| Thrust Collar | | 1.2 | " |

| DESCRIPTION | POSITION | BEFORE (Gauss-max.) | AFTER (Gauss max.) |
|---|---|---|---|
| **GEAR BOX** | | | |
| L.S. Shaft Journal Bearing L.P. Side | Top half | 0.4 | " |
| | Bottom half | 1.8 | |
| L.S. Shaft Journal Bearing H.P. Side | Top half | 0.5 | " |
| | Bottom half | 0.6 | |
| H.S. Shaft Journal Bearing L.P. Side | Top half | 0.8 | " |
| | Bottom half | 0.9 | |
| H.S. Shaft Journal Bearing H.P. Side | Top half | 1.1 | " |
| | Bottom half | 0.6 | |
| | | | |
| Journal Bearing Pads | | Top–0.5 Bottom–1.2 | " |
| Journal Bearing Base Ring | Top | 0.2 | " |
| | Bottom | 0.5 | " |
| Thrust Base Ring | Inboard side | Top–0.5 Bottom–1.5 | " |
| | Outboard side | Top– 1.4 Bottom–1.6 | |
| Thrust Pads | Inboard side | 0.4 | " |
| | Outboard side | 0.3 | |
| Thrust Collar | | 0.3 | " |
| Thrust Collar Journal | | 1.2 | " |
| **H.P. CASE (G.B. SIDE)** | | | |
| Shaft Journal | | 0.4 | " |
| Journal Bearing Pads | | Top– 0.4 Bottom–0.6 | " |
| Journal Bearing Base Ring | Top | 1.0 | " |
| | Bottom | 1.2 | " |
| Oil Rings (2 Nos.) | Top | 0.8 | " |
| | Bottom | 0.6 | |
| **H.P. CASE (FREE END SIDE)** | | | |
| Shaft Journal | | 0.3 | " |
| Journal Bearing Pads | | Top– 0.5 Bottom–1.2 | " |
| Journal Bearing Base Ring | Top | 0.2 | " |
| | Bottom | 0.5 | " |
| Thrust pads | Top/Bottom | 0.5/0.9 | " |
| Thrust Collar | | 0.3 | " |
| Thrust collar journal | | 0.9 | " |

## ANNEXURE-5

## DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 1 | Location: 22<br>(Weld/HAZ)<br>V-1501, 4 Ata Steam Drum weld + shell pm, HAZ from north side | CS | Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine and coarse grained ferrite/pearlite structure.<br>Parent metal shows fine-grained ferrite and pearlite structure.<br>Initial stage of in-situ spheroidization of pearlite is observed at the grain boundaries. | IInd stage of creep degradations.<br>Monitor after 1 year of service. |
| 2 | Location: 23<br>(Weld/HAZ)<br>V-1501, 4Ata Steam Drum<br>weld +dish end pm, HAZ from north side | CS | Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite & pearlite structure.<br>Parent metal shows fine-grained widmanstatten ferrite and pearlite structure. | No significant degradation observed.<br>Monitor after 2 years of service. |
| 3 | Location: 40<br>(Parent Metal)<br>HP Condenser<br>H-1202<br>Stub end Gas outlet bottom side | SS | Presence of weld spot is observed at PM region.<br>Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix.<br>Microstructure at parent metal shows fine & coarse-grained worked austenitic structure with twins. | Presence of weld spot is observed at PM region.<br>No significant degradation observed.<br>Monitor after 1 year of service. |
| 4 | Location: 41<br>(Parent Metal)<br>LP Carbamate Separator<br>V-1205 – From outside | SS 304L | Microstructure shows fine-grained worked austenitic structure with twins.<br>Presences of ferrite stringers are observed. | Microstructure is free from any micro cracks.<br>Monitor after 1 year of service. |

## ANNEXURE- 6

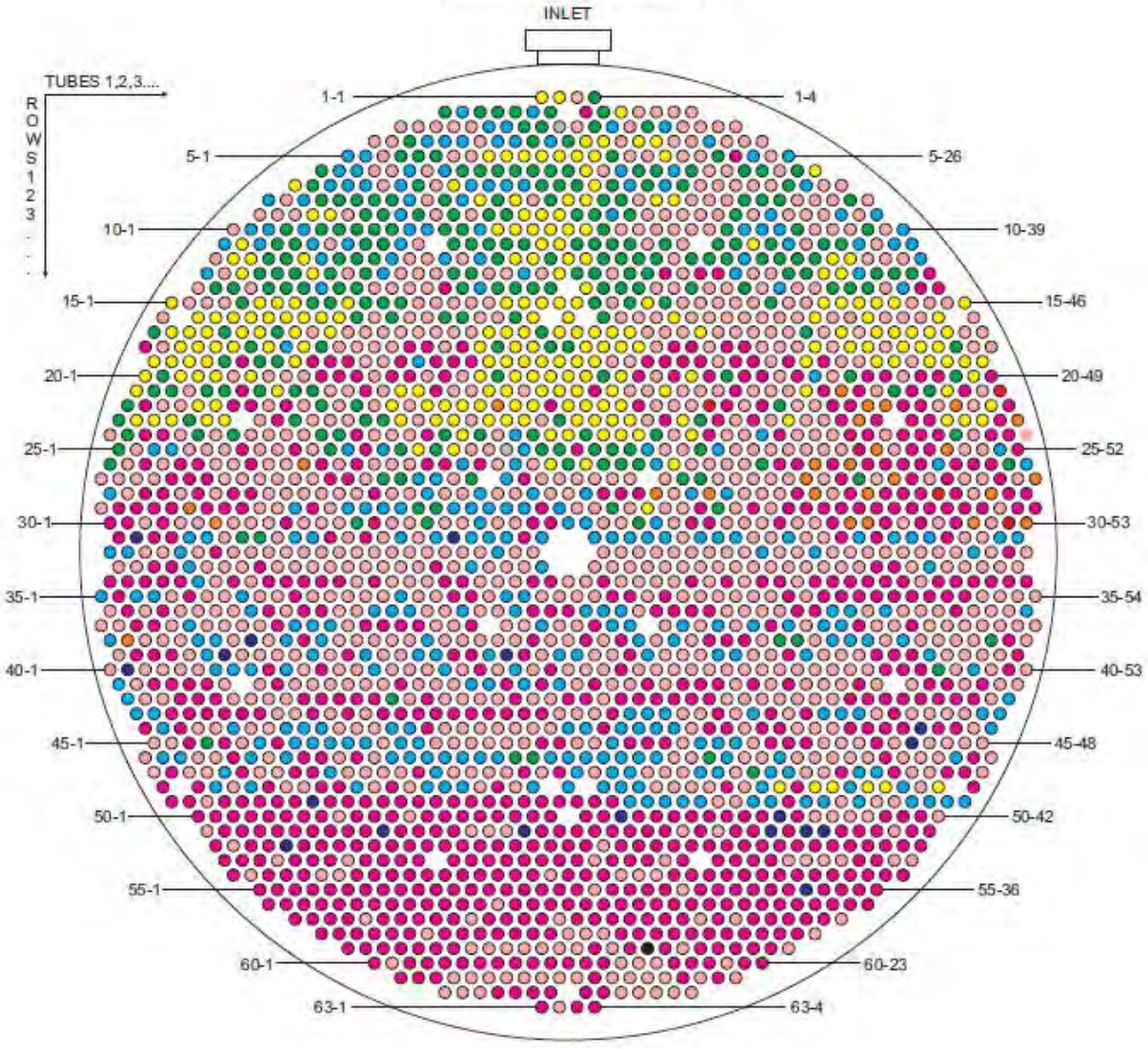
## TUBE SHEET LAY OUT OF H-1201

## (VIEWED FROM TOP)

IFFCO
Kalol,Gujarat

**UREA STRIPPER**
**H-1201/A**

**Viewed from Top Side**




**INSPECTION SUMMARY**

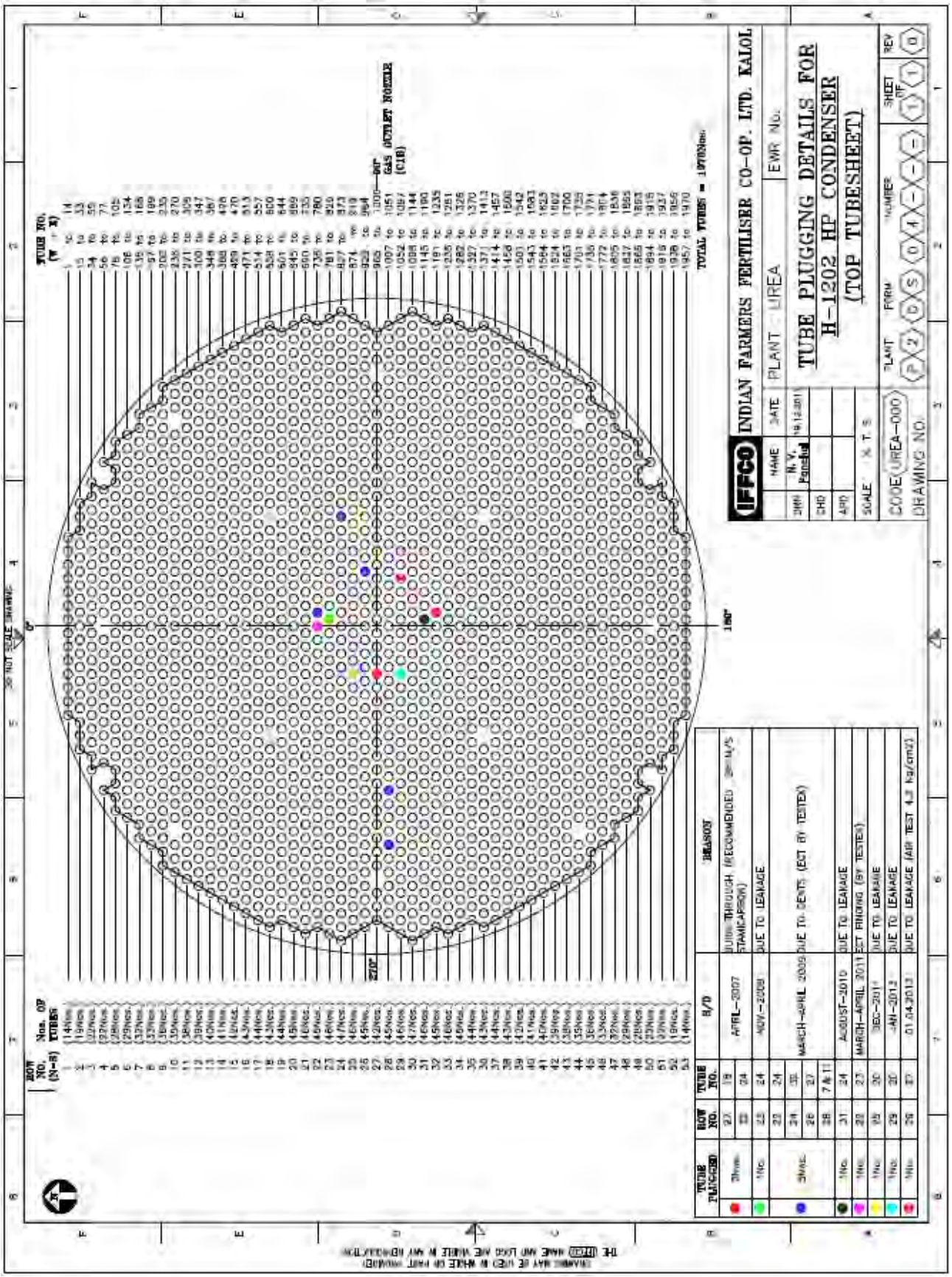
*Denotes: Wall Loss*

| | | | |
|---|---|---|---|
| ○ 0.3mm to 0.50mm | ● 0.51mm to 0.60mm | ● 0.61mm to 0.64mm | ● 0.641mm to 0.689mm |
| ● 0.69mm to 0.75mm | ● 0.76mm to 0.80mm | ● 0.81mm to 0.85mm | ● 0.86 mm to 0.90mm |
| ● 0.91mm to 0.95mm | ● Plugged | ● Blocked | |

TesTex

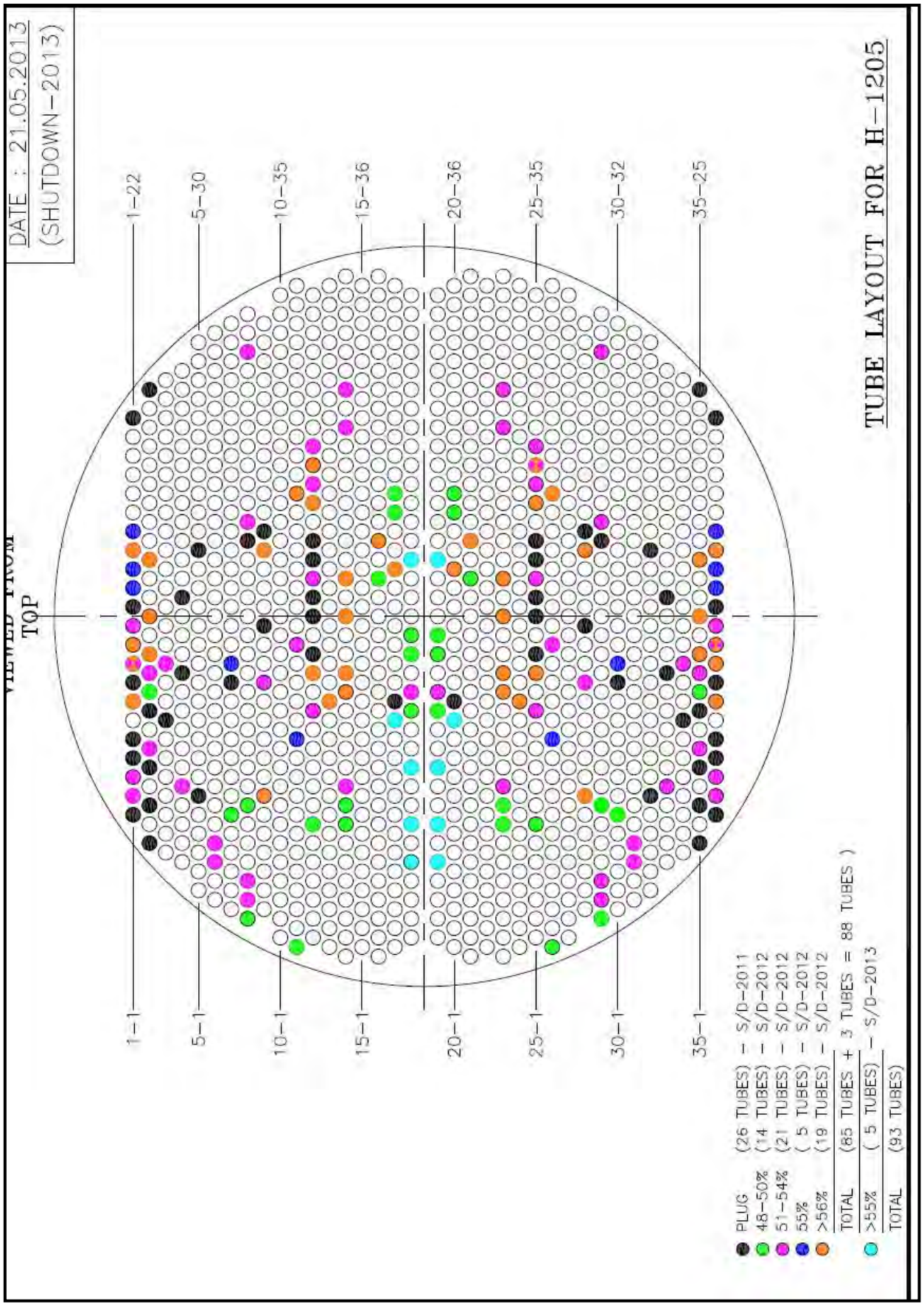
## ANNEXURE- 7

## TUBE SHEET LAY OUT OF H-1202 (VIEWED FROM TOP)



## ANNEXURE- 8

## TUBE SHEET LAY OUT OF H-1205 (VIEWED FROM TOP)



# UTILITY PLANT
(INSPECTION)

The following major inspection activities were performed in Utility Plant.

- Inspection of Deaerator.
- Inspection of 52" NB CW Inter connection line of P-4405 and P-4401 C/D sump.
- Thickness measurement of BFW line from boiler to ammonia and back to boiler.

The detailed observations on individual equipment are given below. All the observations were recorded during inspection and were handed over to concerned Maintenance and Operation group for necessary corrective action.

**DEAERATOR:**

**Deaerator Head:**

- All tray segments and its supports were found intact in its position. However, some of its holding bolts were found loose.
- Brownish coloration was observed inside the shell and dish end.

**Deaerator Storage Shell:**

- Brownish coloration was observed inside the shell and dish end.
- Condition of the weld joint was found satisfactory.
- Scaling was observed at both dished end.

**52"NB CW INTER CONNECTION LINE OF P-4405 TO P4401-C/D**:

- Out of 33 Circumferential weld joints (Including Bend's), Initial and last three joints were found more corroded from welding with compare to others from inside and previously applied putty found peeled off at several locations.
- Epoxy paint was found peeled off at many locations resulting in oxide layer formation.
- Blisters of Epoxy paint also observed at many locations.
- Removal of oxide layers, blisters and application of epoxy paint at such locations is recommended to prevent corrosion.
- P-4405 and P-4401/D suction line portion inside the sump severely corroded. Necessary action recommended.

## BFW Line from P-5111/P-5112 to BFW preheater coil(Ammonia Plant LT Convection) and back to BHEL Boiler:

Ultrasonic thickness measurement was carried out and found satisfactory. Minimum thickness of 8.07mm was observed against nominal thickness of 10.97mm ( 6" NB x Sch 80 ) MRT as per design calculation is 5.5 mm.

## MISCELLANEOUS JOBS:

### D.P. TEST:

Dye penetrant examination of weld joints of all the pipelines fabricated by contractors/departmentally, new pipeline fabrication / modifications job done by technical and maintenance groups etc. was carried out after root run welding and after final welding, as per requirement. Any defects observed during the tests were rectified in the presence of inspector followed by DP test for acceptance.

### RADIOGRAPHIC EXAMINATION:

Radiographic examination of butt weld joints of 40 Ata steam line of RV-5151 header, 60 to 40 Ata letdown station and steam drum level gauge cap weld etc. was carried out and found satisfactory.

### GAUSS MEASUREMENT:

Measurement of residual magnetism (gauss) on rotary and stationary parts of BFW pump (P-5111) and its drive turbine bearings was carried out. Wherever residual magnetism was higher than acceptable limits, same was demagnetized and brought down within acceptable limits.

### WELDER QUALIFICATION TESTS:

- Performance qualification test of 28 Nos. welders offered by M/s General Engineering was carried out. 07 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical departmental welding jobs in the plant.
- Performance qualification test of 13 Nos. welders offered by Ram Bahadur was carried out. 04 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical departmental welding jobs in the plant.

# INSTRUMENTATION

## CONTROL VALVE MAINTENANCE JOBS

**FRCV- 1:** Actuator diaphragm was checked, found ok. General cleaning of air filter regulator was carried out. Gland packings were replaced. Finally control valve stroke was checked.

**FRCV-2:** Removed from bonnet & found that plug was damaged, so it was replaced with repaired one. Actuator diaphragm was checked, found ok. Air regulator was replaced with new one. General cleaning of positioner, air filter regulator was carried out. Gland packings were replaced. The control valve was assembled, reinstalled and stroke was checked.

**FRCV-3:** The Control valve was removed from bonnet and trim parts were checked. All parts were cleaned and overhauled. Actuator diaphragm was opened and checked & found damaged, so replaced with new one. General cleaning of valve positioner was carried out. Gland packings were replaced. Finally the stroke was checked.

**FICV-485 & LCV-490:** Replaced old kentintrol ltd. make control valve with new kentintrol make control valve with a body material ASTM 217 WC6 and modified Trim material SS 420 to protect against high temp & high DP BFW service. Related signal & air supply tubing work were carried out. C/V stroke was checked and found ok.

**FICV-485 & LCV-490**

**PICV-11A:** The Control Valve was removed from Bonnet. Actuator diaphragm was checked and found ok. All parts were cleaned & overhauled. New air regulator was provided. The stroke of C/V was checked.

**FRCV- 5:** The control valve was opened from bonnet for inspection of trim parts. Found plug seating part was damaged so it was repaired in central workshop. Actuator diaphragm was opened, inspected & found ok. New gland packings had been provided. Finally Stroke was checked.


**Damaged seating part of FRCV- 5**

**V-5:** Complete Overhauling of the valve was carried out. The Control valve was removed from bonnet, machining was carried out in plug for tight shutoff. Actuator diaphragm was opened and checked, found damage so replaced with new one. New gland packings were provided. Finally its stroke was checked.

**FICV-14:** C/V was opened from bonnet. Plug & seat were taken out for inspection. All parts were cleaned, overhauled, gland packing was replaced & old tubing replaced with new one, finally assembled & taken in line and stroke was checked.

**TRCV- 10:** Actuator diaphragm was opened and checked, found ok. New gland packings were provided. Stroke was checked.

**LC-41 & LC-42:** Control valves were removed from line, Machining was carried out in plug for tight shutoff. Actuator diaphragm was opened and checked, found ok. Complete Overhauling was carried out & also provided new gland packings. Hydro-testing was carried out at 75.00 kg/cm2 & found ok. Finally stroke was checked.

**PCV (103-J L.O Console):** Control valve was removed from line for complete overhauling. Actuator diaphragm was opened and checked, found ok. Complete Overhauling was carried out including hydro-test at 3.00 kg/cm2, found ok. New gland packings had been provided. Finally Stroke was checked.

**PICV- 3:** Control valve removed from bonnet, cleaning of trim parts was carried out. The control valve was checked for tight shutoff. Fine cut was provided on Plug seat. Actuator diaphragm was inspected & found ok. Complete Overhauling was carried out & also provided new gland packings & bottom gasket. Finally Stroke was checked.

**PRCV-4:** Control Valve diaphragm was checked and found ok. Hand jack assemblyfound jam so, it was overhauled & found free. New gland packings were provided. Finally Stroke was checked.

**PICV-006A/B & PICV-002:** C/V diaphragm was checked and found ok. New gland packings were provided. Stroke was checked.

**PICV-27:** Control Valve Stroke was adjusted & Gland packings were replaced. General cleaning & greasing was carried out. Finally C/V stroke was checked.

**PICV-44:** I/P Convertor & Gland packings were replaced. General cleaning & greasing was carried out. Finally C/V stroke was checked & found ok.

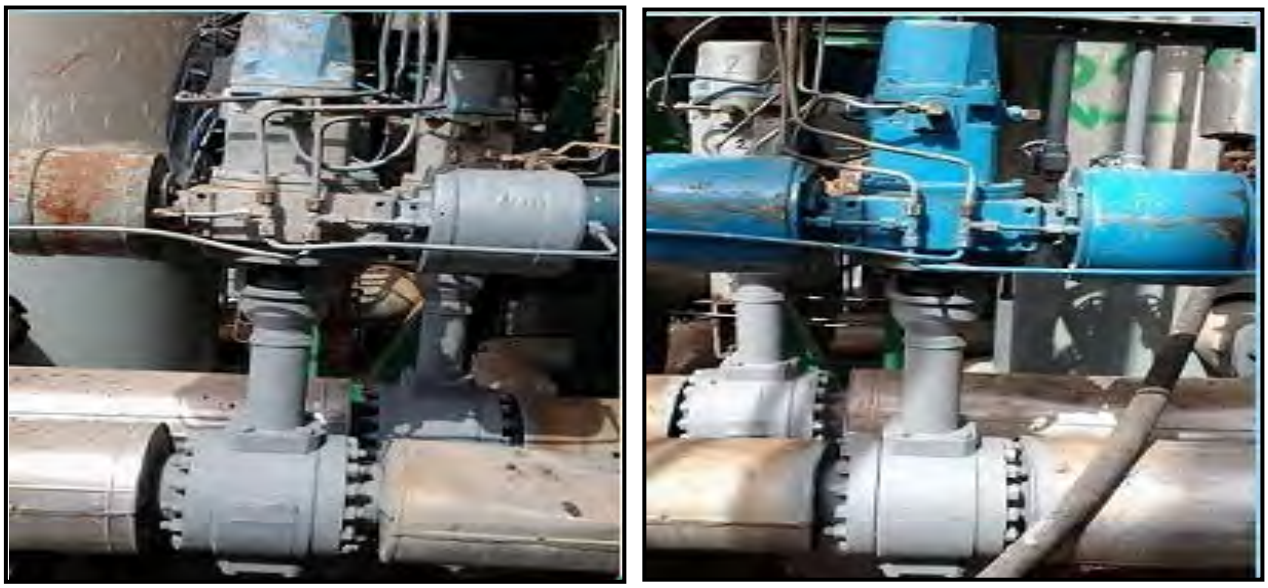
**LIC-12:** Control valve removed from bonnet for complete overhauling. Actuator diaphragm was opened and checked, found ok. Complete Overhauling was carried out & also provided new gland packings. Finally Stroke was checked.

**LICV-20:** I/P Convertor & Gland packing were replaced. General cleaning & greasing was carried out. Finally C/V stroke was checked & found ok.

**LIC-8 & FICV-11:** Gland packing were replaced & also provided new diaphragm and air filter regulator. The valve stroke was checked and found ok.

**PRCV-1 & PICV-1A:** General cleaning/greasing, replacement of gland packing, overhauling job of hand-jack assembly were carried out. C/V stroke was checked.

**KV 120-8:** Actuator Assembly was replaced with new One. Checked operation of on/off ball valve and found ok.



**Old Actuator** **New Actuator**

**Old and New Actuators for KV- 120 – 8 Change over valve in PGR Plant**

### General Maintenance & Stroke checking of Control Valves :

Following important control valves general /cleaning/ greasing were carried out. Provided new gland packing wherever required. Also valve positioner was cleaned and air header & regulators also flushed & stroke checking were carried out

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | V-4 | 5. | LICV-27 | 9. | MICV-16 | 13. | LCV-16 |
| 2. | PRCV-1 | 6. | FICV-100B | 10. | PICV-002 | 14. | LCV-18 |
| 3. | PICV-1A | 7. | MICV-17 | 11. | MICV 1A to 9A | 15 | VS-18 |
| 4. | PIC-44 | 8. | FICV-11 | 12. | LCV-15,16, 18 | | |

## COMPRESSOR HOUSE JOBS:

### Air Compressor (101-J)

Removed all Radial, Axial and key-phasor probes along with relevant junction Boxes, speed pick-ups, bearing pad temp T/C & RTD, pressure gauges and local THI to facilitate M/M jobs. All proximitor JBs were cleaned. After completion of M/M jobs the instruments and probes/pick-ups were fixed back after cleaning/functional checking. Gap voltage adjustments for radial and axial probes were carried out.

**HIC-101-J:** General cleaning and overhauling of governor positioner was carried out. Positioner was replaced with new one. New lip seal of piston/Cylinder was provided. Air lock out relay was checked. Calibration of I/P Converter was carried out. New pressure gauge was provided for I/P converter, air supply Regulator. Finally governor actuator was fixed and stroke checking was performed.

**TRIP-101-J:** Mechanical trip feedback Limit switch was overhauled and checked its operation operation.

**VS-101-J:** The Trip Solenoid valve was overhauled. Trip solenoid valve operation was checked.

**101-J / 105-J MOP:** Electronic governor actuator output signal cable & two nos. of MPUs were removed to facilitate mech. maintenance Jobs and also speed probe location modified as per M/M. After completion of jobs the same were fixed back.

**101-J (Trip logic):** Checked the setting for alarm and trip logic.

**ZSH-18:** Control valve OPEN/CLOSE Feedback Limit switch was overhauled and checked its operation.

**1H** probe was replaced with new one. Removed all Radial, Axial and key phasor probes along with relevant junction boxes, speed pick-ups, T/C, pressure gauges and THIs to facilitate mechanical jobs. All Proximitor JBs were cleaned. After completion of Mech. jobs the instruments and probes/pick-ups were fixed back after cleaning/functional checking. Gap voltage adjustments for radial and axial probes were carried out.

**PRC-9** : General cleaning and overhauling of governor positioner carried out. Air lock out relay was checked. New lip seal of Piston/Cylinder was provided. New pressure gauges were provided for I/P Converter, air supply Regulator & Positioner. Calibration of I/P converter was carried out. Finally governor actuator was fixed and stroke checking was performed.

**TRIP-105-J:** Mechanical trip feedback Limit switch was overhauled and its operation was checked.

**VS-105-J:** The Trip Solenoid valve was overhauled. Finally Trip solenoid valve operation was checked.

**105-J (Trip logic):** Checked the setting for alarm and trip logic.

### Synthesis Gas Compressor 103-J

- Removed all Radial, Axial and key-phasor probes along with relevant junction boxes, speed pick-ups, T/C, pressure gauges and THIs to facilitate mechanical jobs. All Proximitor JBs were cleaned. After completion of Mech. jobs the instruments and probes/pick-ups were fixed back after cleaning/functional checking. All the Temp points were sealed. Gap voltage adjustments for radial and axial probes were carried out. Replaced probe of point BA & BB.

- **PRCV-12 (103-JAT):** Replaced the lip-seal of Piston/Cylinder & positioner assembly with spare ones. Air lock out relay was replaced with new one. Calibration of I/P converter was carried out. New pressure gauges were provided for I/P converter, air supply Regulator & Positioner. Finally re-fixed and stroke checking was performed.
- **MIC-23 (103-JBT)**: General cleaning and overhauling of governor positioner carried out. New lip seal of Piston/Cylinder was provided. Checked lock out relay & found ok. New pressure gauges were provided for I/P converter, air supply Regulator & Positioner. Calibration of I/P converter was carried out. Governor actuator was re-fixed and stroke checking was performed.
- **VS-103J & VS-103:** Trip solenoid valves VS-103J & VS-103 were overhauled. Finally Trip solenoid valve operation was checked & found ok.
- **103-J (Trip logic):** Checked the setting for alarm and trip logic.
- Following K Type Thermocouple were replaced with new one for 103-J:

  **1.** TI-103-8 **2.** TI-103-10 **3.** TI-103-10B **4.** TI-103-11 **5.** TI-103-11B
  **6.** TI-103-12 **7.** TI-103-12B

**Field Instrument jobs:**

- **115-JAT:** Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 115-JAT to facilitate Mech. Maintenance jobs. Checked both MPUs of Electronic Governor for 115-JAT.
- **TI-0043:** Thermowell with leakage problem at the old spare tapping was replaced with new one.
- **101-BJT:** Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 101-BJT to facilitate Mech. Maint. Jobs. Checked both MPUs of Electronic Governor for 101-BJT.
- **107-JAT:** Various instruments (PI, TI, SV, etc.) were removed at 107-JAT to facilitate Mech. Maintenance jobs. After completion of Mech. jobs the instruments were reinstalled.
- Provided low range Pressure Gauges at different locations in plant as per requirement of production dept. for purging & maintenance purpose.
- **FIC-11:** I/P Convertor had been shifted to new location & related tubing work was done.
- **Level-State (101-F):** All Electrodes were cleaned by flushing the chamber & connections had been tighten.
- **FR-95:** Pitot tube was removed from line for cleaning & then re-fixed.
- **Boiler Inspection** (101F, 112C & 107C): Provided standard 10" dial size Pressure gauges on steam drum, 112C and 107C. Pressure transmitter flushing and zero checking and other jobs related with Boiler inspection were carried out. After completion of inspection Pressure gauges were reverted to original.
- **FIC-14:** Transmitter tapping leakage problem had been attended.
- **FT-53A and PT-11:** New Transmitters were taken in line for new loop. Related tubing, cable lying, ferrule work had been done. Finally defined in IOM & taken in Line.

- **FIC-7 & FIC-8:** Pitot-venturi tubes were removed for inspection & after general cleaning & dimensional checking same were re-fixed.
- **104-JA:** Relocated local Pressure gauge panel of 104-JA and related impulse tubing work carried out. Air tubing for new TTV & power cable for trip solenoid valve had been provided.
- **116-JB:** Flow Switch was replaced with a new one.
- **PRC-23:** Piston cylinder was checked for leakage & operation checked, found ok.
- **LC-26:** Old Air Filter Regulator was replaced with new one.
- **LC-25:** Local controller was replaced with a new one.
- Old Pneumatic Junction Box outside ammonia control room was removed.
- **PSL-104J & PSLL-104-J:** Switch setting for Pressure switches were checked & then calibrated. Finally taken in line.
- **TTV-107-JA:** New output was defined in logic page I-304 for 107-JAT TTV Trip. Related termination in ESD Cabinet as well as JB was carried out.
- Copper tubing were replaced with SS tubing for the following control valves:

  **a) PICV-5 b) C-3 c) LC-12**
- **Steam Drum (101F):** Following instruments of steam drum were checked.
  1. Level monitoring system- Level State.
  2. Level transmitters.
  3. Pressure Transmitters.
  4. Level switches.
- General cleaning & Calibration were carried out of ISO & CDM related instruments.
- **FQI-181:** CDM related Transmitter replaced with new one to increase the reliability of Plant.
- **LICV-20 & PICV-44:** I/P Convertor were replaced with new one.
- Following Transmitters Zero checking had been done:-

  **PT-100, LI-1, PT-82,** and **PRC-18**
- Following ISO related Quality/Safety affecting instruments were calibrated:-

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | PT-7 | **7.** | TRC-12 | **13.** | PT-1027 | **19.** | PT-36 | **25.** | PT-80 |
| **2.** | PT-150 | **8.** | PT-501 | **14.** | TI -0117 | **20.** | FT-100 | **26.** | FT-1 |
| **3.** | PT-62 | **9.** | PT-8 | **15.** | TI-0039 | **21.** | FT-1006 | **27.** | TI-104E |
| **4.** | FT-2 | **10.** | PT-5 | **16.** | PT-503 | **22.** | TRC-10 | **28.** | FT-1005 |
| **5.** | AR-1 | **11.** | PT-9 | **17.** | PT-10 | **23.** | TI-0036 | **29.** | TI-0011 |
| **6.** | PIC-1A | **12.** | FT-3 | **18.** | PT-4 | **24.** | PT-28 | **30.** | TIC-1025 |

- Following CDM related Quality/Safety affecting instruments were calibrated:-

| | | | | | |
|---|---|---|---|---|---|
| **1.** | PI-82 | **4.** | FQI-181 | **7.** | TI-0043 |
| **2.** | FR-6 | **5.** | PI-676 | **8.** | TI-0023 |
| **3** | FI-65 | **6** | AR-5 | **9.** | TI-0065 |

## Annual Maintenance Jobs for DCS/ESD, UPSS & Gas Analyzers

### YIL DCS

DCS shutdown maintenance activities were carried out as per the AMC procedure.

The following activities were carried out in Ammonia plant.

- Before starting preventive maintenance activities / AMC jobs, tuning parameters of all
- Control stations were saved on Engineering station. Project back up was taken.
- Checking of System healthiness was carried out from System details display and found normal.
- AC and DC voltages and Battery voltages were measured wherever applicable for all
- stations and were found within limit.
- The system was dismantled as per plant clearance and operating conditions like dust, moisture and temperature were checked. All parameters were checked and found within limit. Interior of system cabinets, ENGS and HIS consoles were cleaned thoroughly. PCBs were inspected and inspection of data bus and connectors were done. No abnormality was observed.
- Printers were cleaned/overhauled, wherever applicable. CPU back-up battery voltage and grounding were checked and the same were found within specified limit in all stations.
- Function of each component of the DCS was checked. YOKOGAWA diagnostic software was run on FCS, the results of the test Program indicated the healthiness of the system.
- Redundancy checks were performed on V net / IP Bus, CPU, PS and AAB841 cards wherever applicable. As per redundancy feature, control transfer took place to the stand by one properly.
- HIS to HIS communication was checked by pinging and found normal. After cleaning functionality of all HIS were checked and found working ok.
- Latest project backup was taken on DVD media.
- Operating System of all HIS was upgraded from Windows Vista to Windows 7 Professional.
- RAM of all HIS were upgraded to 6 GB.
- McAfee Antivirus was updated in all HIS & ENGS Station PCs.

### Prosafe - RS ESDS

Prosafe-RS ESD shutdown/ preventive maintenance activities were carried out as per the AMC procedure.

- Cleaning of filters, fans, cabinets etc. was carried out for all the three SCS.
- Redundancy of all the CPU, PS, V net / IP Bus and IO cards was checked and found ok.
- Latest Back up was taken on DVD media.
- Logic Modification job was done for ESD Graphic pages. List of Interlock are as follow:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | IS-4 | **5.** | I-3B | **9.** | I-17 | **13.** | IS-87 | **17.** | IS-5 |
| **2.** | IS-8 | **6.** | IS-7 | **10.** | I-101B | **14.** | IS-105 | **18.** | I-308 |
| **3.** | I-16 | **7.** | I-20 | **11.** | I-105B | **15.** | IS-103H | **19.** | IS-14 |
| **4.** | I-33 | **8.** | I-35 | **12.** | IS-101 | **16.** | IS-303 | **20.** | IS-304 |

**Fuji UPSS**

- Servicing of UPSS was carried out by IL service engineers. Air filters of all the cabinets were cleaned and the exhaust/cooling fans were checked. Voltage on all the test points was measured.
- Load testing for the battery bank was carried out. Duration for that was 50 minutes, with plant load 54 amp, 110 VAC.
- Electrolyte was poured into the cells wherever required. Finally voltage readings of battery bank as well as each battery had been taken. (Total no of cells: 175).
- Alarm & trip setting for UPSS were checked & found ok.
- Software data were checked by UPS Loader & the same was found ok.
- Tightening of all control cables & sockets were done.

**On line Gas Analyzer: ABB make $CH_4$ and $CO_2$ (AR-1 & AR-2):**

- Preventive maintenance of ABB make $CO_2$ and $CH_4$ analyzers were carried out. $CO_2$ and $CH_4$ analyzers were checked. Conditions of sample cells were good. Sensor CPU board, detector and cells were checked. Paper filters in sample system were replaced with spare ones. Sensors were cleaned.
- Analyzer was unable to get power supply, so, power supply was replaced with spare one.
- Manual Calibration of $CO_2$ and $CH_4$ analyzers were performed & found ok.

**On line Gas Analyzer: $O_2$ and $H_2$ (AR-4 & ARC-3)**

- Preventive maintenance of Oxygen analyzer AR-4 and Hydrogen analyzer ARC-3 was carried out. Cleaned sample path of AR-4 by flushing it with air jet. Cleaned sample conditioning system of ARC-3.
- Manual Calibration of $O_2$ and $H_2$ analyzers were performed & found ok.

**CONTROL ROOM JOBS**

- 24V DC Power cables from C-250 & C-251 to ESD Marshalling cabinets C-272,273,274 & 275 were replaced with new cable.
- TBs inside System Cabinet, Marshalling Cabinets & Auxiliary Console were tightened.
- 24VDC Power supply to DCS/ESD Marshalling cabinet & Aux. Console were measured & found ok.
- 07 nos. of old 12-pair signal cables from Junction Box to Analog Marshalling cabinets, 02 nos. of old 12 Pair signal cable from Junction Box to Digital Marshalling Cabinet & 03 nos. of old 12-pair signal cables from Junction Box to PLC cabinets were replaced with new 12-pair signal cables. The cables from JBC-8, 9, 21, 25,

25A, 34, 35, JBS-22, 22A & 23, JBA-2, 22 were replaced. Cable Laying, dressing, Cable glanding, related ferruling and termination jobs were carried out at both ends.

- Old disconnected and presently un-used cables were removed from marshalling room.
- Power cable was laid from PDB C-121 to Digital Marshalling Cabinet C-111for DCS Digital Output.

- **Contactor Box Replacement Job:**
  - All Cables related to contactor box were disconnected one by one from MCC side JB & then from Contactor end.
  - All cables were removed from gland. Finally old contactor box was removed.
  - New Contactor Box installed on wall & re-glanding work of cables had been done.
  - Relevant connection to the contactor with proper ferrule was carried out & also cables were Re-connected in MCC end.
  - Old JB for MOV indication was removed & all connection was taken inside contactor box.
  - Finally Power had been provided to contactor box & all connection were checked & found ok.

**CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND**

**CONTROL VALVES**

- **FICV-485 & LCV-490 :** Replaced old kentintrol ltd. make control valve with new kentintrol ltd. make control valve have a body material ASTM 217 WC6 and modified Trim material SS 420 to protect against high temp. and high DP BFW service. Related signal & air supply tubing work were carried out. C/V stroke was checked and found ok.

- **Current to Pneumatic Converter:**

  **LC-20 & PCV-44:** I/P Converter were replaced with new one.

- **Guided Wave Radar (GWR) Level Transmitters:**

  **LI-101A:** New GWR (Model: FMP51-146V3/0) of M/s E&H was installed for $CO_2$ Stripper level measurement. Related cable laying, glanding, termination work was carried out. Tag definition & related engineering job was carried out in Engg. Station. Finally taken in line & found ok.

**EWR / SUGGESTION SCHEME / RECOMMENDATION COMMITTEE AND TECHNICAL DEPT. RELATED JOBS**

**104-JA Modification Job:**

- A new Junction box JBS-26 was installed near 104-J BFW Pump.
- Three numbers of speed proximity probes were fixed & local push button for 104- JA Manual Trip was installed & cable laying , dressing & termination was carried out.
- Three nos. of F/I Convertors were installed in ESD Cabinet C-273 & related wirings inside cabinet had been done.
- Programming for F/I Convertor was carried out with trip setting.
- Logic for 104-JAT Trip, I-39 block was modified to incorporate the 2 out of 3 high speed & manual trip. Logic was checked & found ok. Finally OST had been performed & found ok.

**CONTINUAL IMPROVEMENT:**

**LI-101A:** New GWR (Model: FMP51-146V3/0) of M/s E&H was installed for $CO_2$ Stripper level measurement. As mentioned in Para 6.3 above.

# UREA PLANT
(INSTRUMENTATION)

## CONTROL VALVES MAINTENANCE JOBS

- **HICV-1421**: Valve was opened from line. It was overhauled and provided new actuator 'O' Ring & then fixed back. Replaced its SOV with a new one. Its operation and stroke checking was carried out.
- **PICV-1481**: The control valve was opened from bonnet. Overhauling and cleaning was carried out. Plug and seat were replaced by new ones. New gland packings were provided. The valve was assembled and its operation and stroke checking was carried out.
- **HICV-1201:** Valve was opened from bonnet. Replaced the actuator with a new one. Provided new gland packing and seal rings. Also provided new I/P converter and air pressure regulator. All parts were cleaned & overhauled. Valve was assembled and its stroke was checked.
- **LICV-1201:** Valve was opened from bonnet. Overhauling and cleaning was carried out. The actuator diaphragm, actuator 'O' ring, gland packings were replaced by new ones. The valves were assembled and its operation and stroke were checked.
- **LICV-1352:** Valve was opened from bonnet. Its guide bush was repaired by machining for its damaged area. Overhauling and cleaning was carried out. New gland packings were provided. The valves was assembled and its operation and stroke checking was carried out.
- **HICV-1208:** Valve was opened from bonnet. Provided new seat & bonnet gaskets and gland packing. Overhauling and cleaning was carried out. New gland packings were provided. The valves were assembled and its operation and stroke were checked.
- The following control valves were removed from line. Lapping of plug and seat, overhauling and cleaning was carried out. New gland packings were provided The valve were assembled and refixed in line. Their operation and stroke checking were carried out.

  **PICV-1202, HICV-1206, HICV-1207.**
- The following control valves were opened from bonnet. Overhauling and cleaning was carried out. New gland packings were provided. The valves were assembled and their operation and stroke checking was carried out.

  **PICV-1481, LICV-1502A, LICV-1235, FICV-1281, TICV-1226, FICV-1351.**
- The following control valves were provided with new booster relay and air pressure regulator in place of the old ones and required modification in their tubing was carried out and their operation and stroke were checked.

  **PICV-1130 & LRCV-1421**
- The following control valves' valve positioner were overhauled and their operation and stroke were checked.

  **PRCV-1201, FICV-1204, FICV-1202 & HICV-1202.**

- The following control valves' current to pneumatic converters were provided with new ones in place of old ones and their operation and stroke were checked.

  **MICV-1101 , FICV-1204, LRCV-1501, LICV-1281, HICV-1385, PICV-1502A/B, HICV-1581 & PICV-1131.**

- General cleaning & stroke checking of following control valves were carried out:

  **PICV-1128, PICV-1129, PICV- 1130, PICV-1131, FICV-1102, PICV-1181, HICV-1581, PRCV-1202, PICV-1502 A/B, LICV-1502 A/B, FICV-1204.**

## COMPRESSOR HOUSE JOBS

- All bearing RTDs fixed in turbine's HP case, LP case & Gear Box were removed to facilitate mechanical jobs. Provided new RTD for TI-1821/22.They were checked and re-fixed after the completion of the jobs.
- Removed all Radial, Axial and key-phasor probes in turbine's HP case, LP case and Gear Box to facilitate mechanical jobs. After completion of the jobs, the same were re-fixed. Gap voltage adjustments for radial and axial and key-phasor probes were carried out.
- Following Trip and Alarm Switches were cleaned, checked and calibrated:

  **PSLL-1801A, PSLL-1801B, PSLL-1801C,**
  **PSLL-1818A, PSLL-1818B, PSLL-1818C,**
  **PSLL-1838A, PSLL-1838B, PSLL-1838C,**
  **PSHH-1839A, PSHH-1839B, PSHH-1839C,**
  **PSHH-1843A, PSHH-1843B, PSHH-1843C,**
  **PSL-1816, PSL-1812, PSL-1813, and PSLL-1844.**

- Following low level and high level switches of separators & surface condenser were calibrated:

  **LSHH-1804, LSHH-1806, LSHH-1808, LSL-1824, LSHH-1822 & LSL- 1823.**

- Following leveltrols were calibrated:

  **LICT-1805, LICT-1807 & LICT-1821.**

- Woodward governor's MPUs for turbine speed measurement were removed and Checked.
- Local Control Panel and turbine local control box were cleaned, all wiring connections were tightened.
- New separate air header was provided for control valve PICV-1810 and required modification in the instrument tubings was carried out.
- Hitachi Compressor's Anti surge flow indicating transmitters FR-1801 (for Anti surge controller CCC & DCS) were replaced by new ones.

**Anti surge flow indicating transmitters FR-1801**

- General cleaning & stroke checking of following control valves in the compressor area was carried out:

  **HICV-1801, HICV-1802, HICV-1803, PICV-1810, LICV-1803, LICV-1805, LICV-1807, LICV-1821A/B.**

**FIELD JOBS**

- HP Stripper's and Autoclave's Pressurized as well as empty count readings for LRC-1201 & LR-1201 detectors were taken and recorded.
- Autoclave & Stripper radio active level measurement instruments' source was removed and installed back to facilitate mechanical maintenance jobs.
- Scintillation Counter (HP Stripper) was removed & installed back to facilitate mech. maintenance jobs.
- Calibration of "Radiac Relay" unit and its spare unit for LR-1201 (Autoclave level) was carried out.
- A ll HP Thermowells were removed, hydro tested & checked by inspection department. Two new Thermowells and their ring joint gasket for TR-1207 and TR-1210 were replaced with new ones (of 2RE69 MOC).
- Calibration of Ammonia Mass flow meter (FS-1101) was done at EQDC.
- Inspection of following magnetic flow meters was done:

  **FRCT-1435, FICT-1203, FICT-1352, FICT-1353 & FT-1204.**

- Following extended pad type transmitters were calibrated:

  **LICT-1421, LRCT-1421, LICT-1201, LICT-1202, LICT-1282, LICT-1353 and LT-1481.**

- Following Quality affecting instruments declared in ISO were calibrated:

  **PT-1121, PT-1145, PRCT-1201, PT-1802, SI-1401A, SI- 1401B, FT-1201, PICT-1202, PT-1421, PT-1422, PRC-1202, PT-5503, PT-4405 & PT-1105.**

- Following leveltrols were calibrated:

  **LICT-1235, LICT-1501 & LICT-1203**

- Maintenance of N/C Ratio Meter was carried out as detailed below:
  - N/C Ratio Meter monoblock valve was replaced by a new one of MOC 2RE69 after hydro testing & inspection of the same.
  - Actuator overhauled for the same.
  - Checked & cleaned the RTD TI-241.
- **FICT-1303:** The flow transmitter was replaced by a new one.
- A pinhole leakage in Instrument air line at PT Top was rectified by welding.
- Weep holes were checked for HP Vessels (Autoclave Source side & Scrubber Top side) and required tubing was modified for the same.
- Instrument air header needle valves were replaced for PIC-1502, HICV-1102. Two spare needle valves near PICV-4801air header were also replaced.
- Provided new impulse tubing for transmitter PRC-1504 and FR-1502.
- Painting and earthing on all Prill Tower top control valves was done.

**DCS related Control /Marshalling room jobs:**

- New Earth plates for System and Panel Earth were fabricated and fixed in the DCS Marshalling Room. Earth cables from New Earth pit to Marshalling Room earth plates were laid down. Individual old earthing cables from main earthing plates to panels and system were replaced by new cables.
- DCS System & Panel earth resistance was measured.
- The measured resistance values were:
- Ohms for system and 5.1 Ohms for Panel.
- Following jobs were carried out in vibration monitoring system:
  - TDXNET Modules were installed in Vibration monitoring cabinet and established all the necessary connections for transferring CO2 Compressor's vibration data to Inspection Department.
  - Performance of the Vibration Monitoring System in case of power failure was checked successfully to avoid false tripping of the machine under monitoring.
  - Old and aged 16A MCB (for Vibration monitoring) was replaced in ACDB with new one.
  - Cleaning of Vibration display modules and the Vibration Monitoring Cabinet was carried out.

**TDXNET Modules**

- In the DCS System, complete system was "powered down" and dismantled. All the hardware of FCS0201, FCS0501 and HIS0260 to HIS0263 and Engineering station were cleaned and installed back. All the System, marshalling and vibration cabinets were cleaned. The system was "powered on" and taken online. After power ON, system functioning was found ok.
- Measured control room temperature and dust level, both were found within limits.
- AC/ DC and battery voltages were measured, wherever applicable, for all the stations and found within limit.
- Checked System healthiness. Checked CPU, PSU and communication cards redundancy and found working fine. Checked overall system functionality and found working normal.

- Replaced the Unit (AMN-11) for the faulty channel Z012105 for FIC-1303 and checked all the channels of the Unit for the faulty channel Z071103 for FI-1501. All the necessary wirings and connections were checked for both the units.
- DCS Operating System up graded to Windows7 in all the operator stations. All operator stations and Engg. Stations were up graded with anti-virus McAfee AV updates.
- Application Project backup was taken for DCS in DVDs (two set). One Set of the backup retained with us and one set of the backup is kept by M/S YIL for their future reference.

## CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND

- Following existing control valves were replaced with the new valves.
  - **LICV-1502B**
  - **LICV-1501**
  - **LRCV-1201 –** With line modification to facilitate future maintenance of valve.


**Newly installed LRCV-1201 Control Valve**

- Following existing Junction Boxes were replaced with Stainless steel JBs.

  **PJB-01, AJB-05, JBT-03, JBT-02 and JBT-16**.

## CONTINUAL IMPROVEMENT

- Old and obsolete control valve LRCV-1201 was replaced with new control valve manufactured and supplied by M/s BHDT, Austria. The new valve is with improved design and high corrosion resistant trim material. Also, the line was modified to have better access for maintenance.

# OFFSITE & UTILITY PLANT
(INSTRUMENTATION)

## BOILER PLANT

## CONTROL VALVES

- Following control valves were removed from line for complete overhauling:
  **LCV-5111, HICV-5151, TCV-4, MICV-4401-B, and LCV-4.**
- The control valves were opened from Bonnet for partial maintenance. Inspection of Seat/Plug, valve positioner, Actuator diaphragm, Gland packing, control valve stroke checking etc.:

  **LCV- 01** and **LCV- 02.**
- Following control valve's preventive maintenance was carried out. General cleaning and control valve stroke checking:

  **FCV-42, PCV-42, PCV-3, LCV-3, PICV-25, FRCV-22, LRCV-4, TCV- 25, and FCV-1 (100% BFW), FCV-2 (30%). LCV-3058 B, LCV-3051B, LCV- 3055 B, PCV-3065 B, PCV- 3064 B, PCV-3009, HICV-5153.**
- **ESDV–3001:** This new Ammonia Storage Tank control valve was overhauled. Replaced its air diaphragm with new one, general cleaning, and stroke checking was carried out.
- **MICV-4401:** The valve was opened from bonnet and its plug and seat were inspected. Gland packings were replaced. General cleaning and stroke checking was carried out.

## FIELD JOBS BOILER

- F.D. Fan & BFW pump turbine related field inst. were removed for mech. maintenance job and installed back.
- FD fan suction damper I/P was replaced with new one. Also overhauled positioner.
- Cleaning of 8 nos. of Furnace draft points, PSH-11and PSH-12.
- Pressure Gauges PI-2, PI-3, PI-4 and PI-5 were calibrated w.r.t. Boiler inspection.
- RAH pneumatic motor air supply line filter lubricator was cleaned and refilled lubricator with oil.
- Flushed air header of Boiler and DM Plant area and also checked joints for leakages. Mech. Isolation valve on outlet air line from Boiler Air receiver was replaced with new one by Mech. Maint.
- TR-13 Furnace Temp. T/C was replaced with a new 'S' type and TR-13-A was replaced with 'K' type T/C. Connected air purging at TI-13-A
- Following Damper's limit switches, solenoid valves, air regulators etc. were overhauled and checked their operation. F D. fan inlet and outlet damper. Air heater inlet and outlet damper.
- Checked and calibrated ISO instruments as per schedule.

- Following field switch set value were checked: Furnace pressure high alarm switch PSH-11 setting was checked (set at 300mmwc) and Furnace pressure high trip switch PSH-12 (set at 350mmwc) LSLL-1 of steam drum level. Provided new lugs on wire terminals.
- Following Pressure switches set value were checked:
- P-5112 (BFW pump - motor driven): PAL-5115, PLCI-5114, PLCO- 5113,PLCI-5115 and PAL-5113,P-5111 (BFW - turbine driven) : PAL-5114, PLCI-5113, PLCO-5112,PLCOI-5111, PLCI-5112 and PAL 511.
- High tech" make steam drum level indicator electrodes were checked and tighten all terminals.
- Field junction boxes (BM-13, BM-15.BM-10-1,BM-12,BM-11,BM-5,JBC-9A,JBC-9, TJB-1, JB, BM16-2 and BM-14) were cleaned and tighten terminals.
- Deaerator high level switch LAHH-5111 was replaced with new one. It was taken in service.
- Igniters**:** Cleaning & checking of both the burner's igniter and scanner was carried out.
- FT-11- The original M/s "Emerson" make transmitter was replaced with a new M/s "Yokogawa" make transmitter.

**FIELD JOBS NH3 STORAGE**

- Following V-Automat make level transmitters were checked for calibration.
- LIC-3058A, LIC-3053A, LIC-3055A, LIC-3051A.
- Following press. Switches were cleaned and checked for their set value.
- PSH-3063A, PSH-3057A, PSH-3060A, PSL-3071A & PSLL-3072A.
- LI-3001 Enraf servo level gauge was programmed for zero level by Service Engineer from M/s Honeywell as the tank was under maintenance and empty.
- Q- 4401 (Elliott Turbine.) All radial vibration probes, speed pick-up probe, local ThI and local THI and PI were removed & reinstalled to facilitate mechanical maintenance.
- All the three level switches (LSAL-01, LSAH-01 & LSHH-01) of H-4411 (Surface Condenser) were cleaned & checked.
- Tachometer of Q-4402 & Q-4403 were cleaned, checked and fixed back.
- Disconnected tachometer, PI/TI from P-4402 for mech. maintenance. jobs and reinstalled after mechanical Maintenance.
- Cleaning of control panel & tightening of all terminals inside panel was carried out.
- Cleaned and Checked calibration of Surface condenser level transmitter LT-01.

**FIELD JOBS I. G. PLANT**

- Servicing and calibration of ABB make H2 analyzer of new I. G. Plant was
- carried out by Service engineer from M/s ABB in our presence.
- Attended all running jobs.

## FIELD JOBS E.T. PLANT

- Cleaning of sampling system and calibration of Ammonia analyzer were carried out
- Attended routine running jobs.

## DCS RELATED JOBS BOILER

- AMC jobs for DCS / Stardom PLC. Upgraded Operating System of DCS HIS from Windows vista to Windows 7. LinX Application modified to work on Windows7.Antivirus patch updated in HIS PC. Checked the DCS redundancy. Found OK. Taken up the application project back up in DVD.

## DCS RELATED JOBS D.M.W.T. PLANT

- Carried out AMC jobs for DCS
- Filter cleaning of all the DCS cabinets were carried out.
- Upgraded Operating System of DCS HIS fro Windows Vista to Windows 7.
- Antivirus patch updated in HIS PC
- Checked the DCS redundancy. Found OK
- Taken up the application project back up in DVD.

## DCS / PLC RELATED JOBS NARMADA W.T.P.

- Filter cleaning of all the DCS cabinets were carried out. Carried out AMC
- jobs for DCS.
- Upgraded Operating System of DCS HIS fro Windows Vista to Windows 7.
- LinX Application modified to work on Windows 7 OS.
- Antivirus software patch updated in DCS HIS PC.
- Checked the DCS redundancy. Found OK.
- Taken up the application project back up in DVD.

## UPSS SYSTEM

### EMERSON make 2 X 60 KVA

- Connected power cable for IG and Cooling Tower DCS Panel in ACDB panel at DM Pplant.
- AMC jobs for 'EMERSON' make 2 x 60 KVA UPSS and AMCO battery bank was carried out by Service Engineer from EMERSON Network Power System Ltd. and M/s Syntech Power System (AMCO). Performance of UPSS was checked successfully with draining of battery for about One Hrs. Redundancy Functionality of UPS checked.
- Replaced UPS logic board (PCB) in UPS -2 (2 X 60 KVA) for CANBUS Failure Alarms occurring often.

**DB MAKE 2 X 5 KVA UPS (JASPUR)**

- AMC Jobs for 2 X 5 KVA DB Make UPS carried out .Rectifier board of UPS-1 replaced with New One . Battery Bank of UPS replaced with New Battery Bank. Redundancy/functionality test carried out . Found O.K.

**DB MAKE 2 X 10 KVA UPS (NARMADA WTP)**

- AMC Jobs for 2 X 10 KVA DB Make UPS carried out .Redundancy/functionality test carried out. Found O.K.

**CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND**

- **PICV-3102** and **PICV-5154** control valve were replaced with new dresser make control valve.

**FIELD JOBS: BAGGING & MH PLANT**

**"ASHBEE" MAKE WEIGH BRIDGE**

- Ashbee make Weigh bridge maintenance was carried out by service engineer from M/S Ashbee Systems. Calibration of Weigh Bridge was carried out with standard weights. Stamping of the weigh bridge got done. Painting of platform was also carried out.

**"POWER BUILD" MAKE AUTOMATIC BAGGING M/C**

- Following activities were carried out for the below mentioned Power Build" make automatic bagging m/c:

**P/S No. : 1, 2, 3, 4, 7, 8, 9A, 9B, 10 A and 10B**

- Cleaning and tightening of terminals in local, load cell junction box and proximity Switch junction box of all the p/s was carried out. Provided lugs in solenoid box where required.
- P/S No. 9 & 10: Hopper level s/w was cleaned and checked it's operation.
- Diverter 1 & 2: Cleaned solenoids, relay, limit switch etc. and checked it's function.
- Checked wiring terminals in the main panel, local panel, Solenoid boxes, and Load cell boxes.
- Cleaned and checked CSC-25, relay board, fuses, and all sensors.
- Checked functioning and calibration of all Packer Scales.
- All the solenoid valves were overhauled.
- Fabrication for door locks in all the solenoid box was carried out.
- Calibration and maintenance of both Belt weighers and packer scales were carried out by EMTICI's service engineer under AMC.

**"METLLER - TOLLEDO" MAKE WEIGHING SCALES**

- Carried out cleaning & calibration of Mettler weigh scales located at railway platform and empty bag storage area. Cleaning & painting of all Mettler weighing scale's platform was done. FIELD JOBS: DUST EXTRACTION SYSTEM.
- Cleaned the Dust Extraction plant panel.
- Cleaned all field instruments (C/V, Flow Tx ,Level Tx etc.) related to DES.

# ELECTRICAL

# AMMONIA PLANT
(ELECTRICAL)

## Modification and New Installations

- Replacement of old heating elements of PGR Heater with SS321 tube material.
- Installation of Flameproof telephone instruments at PGR area, Primary reformer, Post B area, Steam drum area, Ammonia loading Gantry.

## Scheduled Preventive Maintenance

- Preventive maintenance of transformers TR-21, TR-6, TR-22 and TR-Start-up heater was carried out and the job details are as under:
  - Measurement of Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked.
  - Condition of silica gel was checked. Accordingly discharged silica gel was replaced.
  - Leakage of oil from HV & LV bushing observed in TR-6, gasket & oil seal of both bushings changed.
  - Moisture contents observed in LV bus bar chamber of TR-6, Gasket changed.
  - Low IR value found at HV side between HV-E, HV Bus bar chamber Oil changed in TR-6.
  - Low IR value found at LV side between LV-E, LV Bus bar chamber Oil changed in TR-6.

- Preventive maintenance carried out on all the feeder compartments in MCC-5, MCC-5A, MCC-5 B & MCC-16 and the job details are as under:
  - Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders.
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts etc.
  - Checking of operation of breakers with all interlocks.
  - 10 Nos.of Defective door knobs were replaced in MCC 16.

- Overhauling of following motors was carried out:
  - 15JB, 2004LJ, 2004J, 104JAT, 104-JT, 101-BJ, PC-2B, PC-2A, 170-JA, 170-J, P 117 J A.O.P, 112 J, P 201-A, P 201-B, 112 JB, PHOSPHAT DISING PUMP MOTOR, 108 J, 108 JA, P117 J

- Preventive maintenance of actuators carried out for the following MOVs and tested with their interlocks (If any):
  - SP1, SP3, SP4, SP5, SP70, SP151, SP152, SP 154, SP 156 and SP 158 & SP 159.

- Testing and calibration of power analyzer installed in MCC-16 for 117J compressor have been carried out.
- Testing and Preventive maintenance of LT TMG make Air circuit Breakers installed in MCC 5 was carried out.

# UREA PLANT
(ELECTRICAL)

## New Installations

- Installation of weatherproof telephone instruments at Urea Hitachi comp. F.F., Urea Hitachi comp. G.F., Urea PCS F. F., Urea PCS top, Urea Prilling room Areas.

## Scheduled Preventive Maintenance

- Preventive maintenance of transformers TR-17, TR-18, TR-20, and TR-7B & TR-7A.was carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connections.
  - Testing & Measurement of parameters like Earthing resistance, Insulation resistance of HV, LV & HV-LV ,BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked.
  - Condition of silica gel was checked. Discharged silica gel was replaced.
  - Oil leakages from the transformers were attended. In TR-17, Oil leakage observed from breather's oil cup, breather was replaced.

- Preventive maintenance of the all feeder compartment in MCC 6, MCC 14, and MCC 15 were carried out and the job details are as under:
  - Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders.
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts, etc.
  - Alignment of isolators was done in two feeders for perfect operation in MCC 14.
  - Change over from incomer to emergency & vice versa was checked by giving 415 V temporary power at incoming of DG. incomer was checked & found OK in MCC 15 sec-C,N/E Sec.
  - Checked & found DC contactor, K-81 faulty in MCC 15 sec A, Replaced the coil of the contactor and tested.

- Complete overhauling of following LT motors—
  - K-1401/1, K-1401/3, M1403/1, M1403/3, M1421, P-1408, K-1401/2, K-1401/4, M 1402-1, M 1402-2, M 1403-2, M 1419, M 1401-A, M 1401-B, M-1402 spare motor, K-1701
- Preventive maintenance of actuators of following MOVs was carried out:
  - MOV 1101, 1102, 1201, 1202, 1203, 1501 & 1801, 1501

- Preventive maintenance of LT Air circuit Breakers of TMG make, installed in MCC 6 was carried out
- Maintenance of following pull cord switch performed.
  - M-1403/1, M-1403/2, M1403/3, M1419, M-1421, M-1702

# OFFSITE & UTILITY PLANT
(ELECTRICAL)

## OFFSITE PLANT

### Modification and New Installations

- Erection, testing and commissioning of flooded lead acid tubular batteries (OPzS 200P) in place of Ni-Cd batteries:
  - Shifting of old Ni-Cd battery bank with stand to one side of room without affecting the plant.
  - Erection of new batteries along with stands in battery room
  - 220V,50 A boost charger was separated from main Chhabi make charger
  - Testing of separated boost charger done
  - Connection of all cells with interlinks cable and interconnectors was completed.
  - 110 cells were filled with acid and 72 hours initial charging was performed to ensure that every cell take1000 Ah.
  - Discharging & charging cycle of batteries completed.
  - Setting of Main, stand by float charger was carried out as according to lead acid batteries after taking boost charger in line.
  - Paralleling of two DC source to take the new battery bank in line.
  - Old battery bank was removed.

- Installation of weatherproof telephone instruments at 66 KV Switchyard TPC pole OHE line.

### Scheduled Preventive Maintenance

- Preventive maintenance of transformers TR-1A, TR-1B, TR-15 and TR-4A, TR-4B, TR-DG set was carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
  - Recommended Testing & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked.
  - Condition of silica gel was checked. Discharged silica gel was replaced.
  - Oil leakages from on the transformers were attended and damaged gaskets was replaced.
  - Trip signal from Buchholz was not coming in appropriate way. Trip assembly interchanged with alarm in TR-4B & TR-4A.
  - BDV value of oil in HV bus bar chamber found low, Oil changed in TR-4A.

- Spindle of valve between conservator tank and Buchholz relay movement found free in open position, Valve changed in TR-4A.
- Breather thread was found damaged in TR-4A, Breather replaced.
- In TR-1B,Low BDV value found of OLTC oil and Low IR value at HV side between HV-E found, Oil of OLTC changed. Filtration of main tank oil performed.
- Oil leakage observed from flange of valve located at top cover of main tank and from Buchholz relay, Gasket changed in TR-15.
- Oil leakage observed from flange of valve between conservator and Buchholz relay, flange of top valve, LV bushing and OLTC inspection window of TR 1A, Tightened the bolts & bushings.

➢ Preventive Maintenance/Servicing of 66 KV BHEL make Minimum oil circuit breakers installed at switchyard was carried out.

- Cleaning of Structure was performed.
- Tightness of hardware on support/insulators, terminal connections, was checked.
- Oil level in interrupters was checked.
- All poles were washed by oil and Oil was replaced with fresh oil after confirming BDV value of Oil.
- Control panels of all breakers were cleaned and outgoing cable terminals were checked for its tightness or hot spot.
- Silica Gel replaced in breathers of all breakers.
- All the moving parts were cleaned and lubricated.
- Closing & Tripping time was measured of all the Breakers.
- Contact Length was measured in all Breakers.

➢ Preventive maintenance jobs were carried out in 66 KV Switchyard:

- Cleaning of insulators of all the CT & PT units, bus bar support, lightning arrester, breakers, etc.
- Insulation Resistance was measured of all the CTs & PTs.
- All the moving parts of isolators were cleaned and lubricated.
- 11 KV VCB panels were cleaned and outgoing cable terminals were checked for its tightness or hot spot.
- Press Type Palm connectors installed at LA side, at CT connector, at isolator side were replaced for ACSR Dog conductors in Sabarmati line.

➢ Preventive maintenance/Servicing of 11 KV Jyoti Breakers was carried out at 11KV MPSS.

- Visual inspection of breakers for any abnormality.
- Thorough cleaning of breakers was carried out
- Checked power & control circuit connections in the breaker for tightness.
- Vacuum of vacuum interrupters was checked

- Gear box operation, tripping mechanism, spring charging limit switch Operation , Circlips ,Mechanical interlocks were checked
- Mechanism was tested and lubricated.
- Insulation resistance of each breaker was measured
- Closing & Tripping time of all the Breakers was measured.
- Closing coil & Tripping coil resistance was measured.
- Contact resistance of each breaker was measured

➢ Preventive maintenance of the all feeder compartment in DG MCC, MCC-3, MCC-10, MCC-10 A and Jaspur MCC was carried out and the job details are as under:

- Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders.
- Thoroughly cleaned the feeder compartments.
- Replaced damaged/ worn out contacts, fuse bases, defective indicating lamps etc.
- In MCC 3 Sec B,P-3103/A & B were in same section , hence the change over done in change over box to run P-3103/A.
- Adjustment of door & mechanical switch was done in Jaspur MCC
- Checked & found limit switch contact of isolator faulty at DG MCC, Bypassed the same contacts of limit switch at isolator.

➢ Servicing of Chabhi make Battery charger in 11 KV MPSS was carried out.

➢ Servicing of following Rotork make MOV installed at Offsite plant was Carried out.

6001,6002,6003,6004,6201,6202,6203,6204,6205,6206,6207,6208, 6209, 6101 6102, 6103

➢ Preventive maintenance and servicing of 11KV MPSS, DCDB, and Capacitor bank in installed at 11 KV MPSS were carried out.

- Cleaning of all incoming & bus coupler feeder of Siemens & Jyoti panels.
- Checking & cleaning of bus bars & HT cables was carried out.
- Cleaning of Siemens breaker contacts
- Checking of operation of breakers with all interlocks
- On checking it was found the contactor K-5 in panel 1 FB, normal incomer to emergency section was faulty. Also contactor, K-42 in 2F, emergency from DG MCC was also found faulty. Coils of both contactor (K5 & K42) were replaced.
- Visually Inspected checked & cleaned DCDB feeders.
- Checking & cleaning of all the 4 capacitor banks done.
- Checked oil level of all capacitor banks & top-up done.
- Checked BDV value of oil in Capacitor bank No-3 & 4.

➢ Overhauling of following LT motors was carried out MP-6113, MP-6114, MP6115-A, MP-6115-B

## Utility Plant

### Modification and New Installations

- Revamping of MCC-2F sec A, with new Siemens panel
  - Removed and shifted old panel from existing location and all power and control cables disconnected from old MCC panel.
  - Testing, installation and commissioning of new panel Section A was done. Re-termination of all power and control cables was carried out in new panel.
  - Old MCC 2F sec A was removed.
  - Connection on new MCC 2F Section A with existing section B was carried out by doing bus bar modification.

- Modification of LV terminal Box of TR-3B
  - New Panel of MCC-2F had provision for termination of only 10 cables in LT breaker in normal way but our requirement was for 17 Cables that include 10 for MCC-2F and 7 for MCC-2
  - Instead of adding one additional adopter panel to accommodate 7 cables, LV cable box of TR-3B was modified to make system more reliable.
  - Now in new scheme, 17 cables originate from LV terminal box of TR-3B .Out of these 17 cables, 10 cables terminate to MCC-2F and 7 cables to MCC-2.

### Scheduled Preventive Maintenance

- Preventive maintenance of transformers TR-2A, TR-2B, TR-3A, TR-3B, TR-8, TR-11, TR-12, TR-13 TR-14, TR-16 and TR-23 were carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
  - Measurement of Earthing resistance, Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked. Trip signal from Buchholz was not coming in appropriate way in TR-2A, Trip assembly interchanged with alarm.
  - Condition of silica gel was checked in each transformer. Discharged silica gel was accordingly replaced.
  - Oil leakages from the transformers were attended.
  - Oil top up was done in each transformer to maintain the level of transformer oil.
  - Moisture contents found in TR-12 in main tank oil.Filteration of oil was done to achieve target BDV value.
  - Low IR value observed at LV side between LV-E in TR-12, oil of LV bus bar chamber changed.

- Crack observed in support insulator of bus bar. All three support insulator changed in TR-13.
- Corrosion found in HV terminal box, Red varnish coating performed in terminal box of TR-13.
- Moisture contents found in HV terminal box of TR-13.HV side Gasket changed.
- Low IR value at HV side between HV-E, HV Bus bar chamber oil changed and filtration of main tank oil in TR-2A.
- Low IR value observed at LV side between LV-E in TR-2A, LV Bus bar chamber Oil, bushing gasket and oil seal of bushing changed and filtration of main tank oil performed.
- Oil Leakage found from inspection window located at top cover of main tank in TR-16, Top cover inspection window gasket changed.

➢ Preventive maintenance of the all feeder compartment in MCC-1, MCC-2B/2E, MCC-11 and MCC-13 was carried out and the job details are as under:

- Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders.
- Thoroughly cleaned the feeder compartments.
- Replaced damaged/ worn out contacts, etc.
- R-phase lead was burnt in incoming cable from MCC-1 in change over Box of MLDB in MCC-1. The lead was repaired & re-lugged and tested.
- Change over from incomer to emergency & vice versa was checked by giving 415V temporary power at incoming of DG incomer & found OK in MCC 1.

➢ Overhauling of the following LT motors was carried out:

H4402/2 (C.T.Fan),P 5112- B ,P 5111- A, P 5111-B, P 5113 A.O.P, P 4206- B, P 5118 – A, P 5118 – B, P 5117 P 5119, P 5112- A ,Q-4401-A ,Q-4401-B, Q-4403, P-4411-A, H-4402/3 (C.T.Fan)

➢ Servicing of following Rotork make actuators installed in utility plant were carried out.

FL2 (MAIN), FL2 (BYPASS), S2 (MAIN), S2 (BYPASS), S5, S6, P-4403(700), P-4403(900), P-4401/A, P-4401/B, P-4401/C, P-4401/D, P-4402

➢ Preventive maintenance of LT Air circuit Breakers of TMG make installed at MCC -3 was carried out.

➢ Preventive Maintenance of HT motor terminal Boxes was carried out.

# B & MH PLANT
(ELECTRICAL)

**New Installations**

Installation of weatherproof telephone instruments at bagging platform, Dust Collection system Area, Bagging Hopper floor, new cooling tower area

**Scheduled Preventive Maintenance**

- Preventive maintenance of transformers TR-5A, TR-5B was carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
  - Recommended Testing & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked. Servicing of Buchholz Relay of transformers was carried out.
  - Condition of silica gel was checked. Discharged silica gel was recharged.
  - Oil leakages from on the transformers were attended and damaged gaskets was replaced.
  - R and Y phase Leads found overheated. Recrimping of Lug of all leads, R and Y phase Leads repaired and placed bi-metallic washer between lug and bus bar.

- Preventive maintenance of the all feeder compartment in MCC-4 and MCC 4A (New & Old) was carried out and the job details are as under:
  - Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders.
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts, 9 nos of defective door knob in MCC 4 Sec B.
  - Connection of two tube light of Bagging MCC 4A (New) was shifted to MCC-4A old in the circuit of MCC 4 power.

- Overhauling of following LT motors was carried out

  M 2110 ,M 2112,M 2116/1 ,M 2116/2, M 2116/3, M 2116/4, M 2116/5, M 2117, M 2121-OLD, M 2121- NEW, M 2122, M 2122- A1, M 2122 –A2, M 2704/3, K 2161, M-2137, M2110 Spare motor, M2112 Spare motor

- Maintenance of all pull cord switches performed.

**Non plant**

**Scheduled Preventive Maintenance**

- Preventive maintenance of transformers TR-10A and TR-10B, TR-T/S1, TR-T/S2 was carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
  - Recommended Testing & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked. Servicing of Buchholz Relay of transformers was carried out.
  - Condition of silica gel was checked. Discharged silica gel was recharged.
  - Oil Leakage observed from HV, LV bushing of TR T/S 1 & TR T/S2, Tightened the bushing & oil seal in all three bushing changed, Tightened the bushing.
  - Oil Leakage observed from Buchholz relay, Gasket of Buchholz relay changed.

- Preventive maintenance of the all feeder compartment in Fire MCC was carried out and the job details are as under:
  - Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders.
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts, fuse bases, defective indicating lamps etc.
  - Control wiring connector was found burnt due to loose connection in M-3701 feeder (3R). The connectors were replaced.
  - Incoming breaker from MCC-15 was not getting closed .Now the link is provided in Connector No- 7 & 9 in Fire MCC incoming feeder from MCC-15

# CIVIL

# AMMONIA PLANT

(CIVIL)

- Refractory jobs carried out in primary reformer (HT & LT Zone), Secondary reformer, and in Auxiliary Boiler.
- Total 90 Damaged AC sheets over the roof of Primary Reformer were replaced.

# UREA PLANT

(CIVIL)

- Chemical Pressure Grouting was done on Scrapper floor to arrest seepage problem. IP Net protective coating was provided on Prill tower top (ID Fan, Beams, bucket room, etc.). IP net coating is provided in Transformer 7A & 7B in urea plant area

- The bitumastic work was carried out on the steps of Prill Cooling System (PCS) in Urea plant & top of the prill tower (Around ID fan).

- Providing and applying Epoxy monolithic plaster at various locations on structure of PCS. Epoxy is provided on walls and foundation structure of CO2 spray cooler sump.

# UTILITY PLANT

(CIVIL)

- The plywood sheets were replaced at the deck of Ammonia, Urea & New cooling tower.

- Old bitumastic removed from flooring of Water Treatment plant.IPS is to be carried out and layer of bitumastic is to be provided.

# B & MH PLANT

(CIVIL)

- Epoxy painting was provided on Columns, Walls & Ceilings of bagging plant at Packing floor & loading floor & also on the stairs of PCS in Urea plant. White wash was applied on the walls of hopper floors.

- Providing and applying epoxy monolithic plaster at B & MH building and Conveyor gallery at silo.

- Repair of Floor at B & MH plant by providing Kota stone

- Providing and applying IP net protective coating on RCC structures of Silo, B & MH plant area, Conveyor Gallery

# TECHNICAL

**Modification in Jacket water system of Secondary Reformer (103-D) and Waste Heat Boiler (101-CA/CB)**

Secondary Reformer (103-D) and Waste Heat Boilers (101-CA /CB) are enveloped in water jacket. This is very much essential to keep pressure shells within the designed temperatures. The source of jacket water are stripped process condensate, DM water, turbine condensate and cooling water.

Presently, stripped process condensate is used as jacket water. The common flow of Jacket water is indicated by FI-53 and low flow alarm is also provided. Level of jacket for waste heat boilers (101-CA and 101-CB) is controlled by LC-26 and there are low level alarms LAL-106 and LAL-121 for jackets of 101-CA and 101-CB respectively. There is an over flow line for each jacket. Level of Jacket water in transfer line and 103-D jacket is controlled by LC-25. LAL-103 gives low level alarm in Secondary Reformer jacket.

In the EWR No. A-276 it was asked to check line size of jacket water flow and to provide flow measuring element in 103-D jacket water flow line and 101-CA/CB jacket water flow line and make arrangement to measure overflow quantity.

Accordingly, following jobs have been carried out :

(A) Separate flow indication for 103-D and 101CA/CB, flow orifice provided at **two location**

1. Jacket water flow line(1.5”) to 103-D at upstream of LCV-25

Detail of above orifice are as under :-

| | | |
|---|---|---|
| Flow Rate | : | 5.00 Cubic Meters /Hour |
| Differential Pressure | : | 0.20 bar |
| Flowing Specific Gravity | : | 1.00 |
| Pipe Diameter | : | 1.610 Inches |
| Bore Diameter (approximate) | : | 21.188 Millimeters |
| Beta (approximate) | : | 0.51812 |

2. Jacket water flow line (2.0”) to 101CA/CB at upstream of LCV-26

Detail of above orifice are as under :-

| | | |
|---|---|---|
| Flow Rate | : | 5.00 Cubic Meters /Hour |
| Differential Pressure | : | 0.20 bar |
| Flowing Specific Gravity | : | 1.00 |
| Pipe Diameter | : | 2.067 Inches |
| Bore Diameter (approximate) | : | 21.436 Millimeters |
| Beta (approximate) | : | 0.40830 |

Separate jacket water flow indication for 103-D and 101CA/CB will increase plant reliability, safety of equipment and proper control of jacket water flow.

B) Jacket water system for Secondary Reformer and Waste Heat Boilers modified to maintain inlet/ outlet flow of water for improving safety of the equipment.

For implementation of above job, collection pots of material of construction as SS were fabricated in work shop and all the piping material were used from the existing stock from store.

The approximate cost of the modification was around Rs.80,000/- excluding the cost of replacement of level control valves (LC-25 & LV-26) which has already been procured for replacement due to non availability of spares.

**PERFORMANCE IMPROVEMENT OF TURBINE (101-JT) GLAND CONDENSERS**

During existing conditions , a raw water sparger is provided on gland condenser shell of air compressor turbine (101-JT) to meet the condensing heat duty. Spray water flows into open drain. Existing gland condenser is designed to condense about 81 kg/hr of steam at inlet temperature of about 172 degC from both ends glands and is having the surface area of about 2.5 m2.

As a modification, bigger size gland condenser (7.3 m2) in place of existing one has been provided. Design of new gland condenser is carried out in-house and fabricated at

our workshop with detail drawings provided by General Engg. This also required modification in Piping connected with existing Gland condenser.

With above modification, operational reliability of 101-JT will be improved and marginal water (0.3 -0.4 m3/hr) saving will be achieved.

- Replacement of Gland condenser for 101 JT and its Cooling Water Piping
- Modification in Cooling Water lines to to 103 JBT Gland Condenser.

**VACUUM IMPROVEMENT OF SURFACE CONDENSER (101-JCA)**

In existing conditions , existing Inter Condenser (IC) and After Condenser (AC) of Surface Condenser (101-JCA) have two pass on CW side. Presently, 4" tapping supply the CW for both IC and AC and have common CW retune line.

IC/AC found heavily choked due phosphate deposits in cooling water(CW) side. Phosphate deposit may be due to lower CW velocity, higher localized temperature or ineffective biocides/dispersion of CW treatment. Also, similar choking was found on 103JBT gland condenser on CW side.

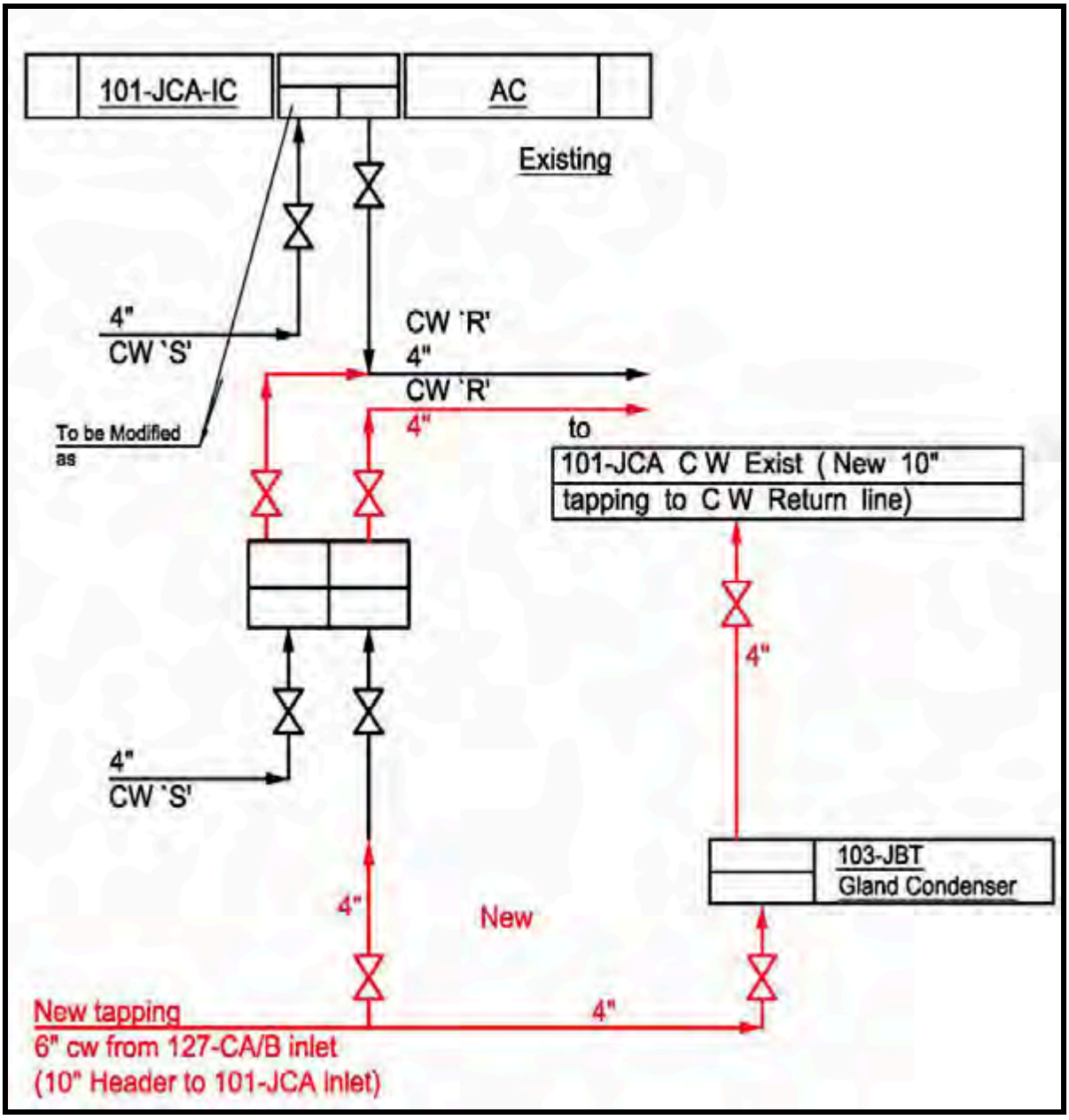
As a modification, separate CW supply and return lines for IC/ AC of 101-JCA and 103-JBT gland condenser have provided. This provision will resulted into higher CW velocity through the condensers and will also have lower CW exit temperature from condensers.

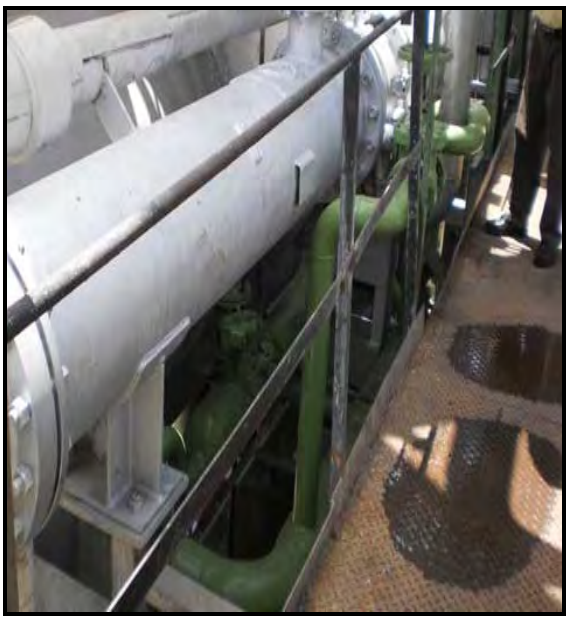
Also, modification in Cooling Water lines to 103 JBT Gland Condenser have been carried out.New 4" CW supply and return lines for 103-JBT gland condenser provided.

This will improve the performance of IC/AC of 101-JCA & 103-JBT gland condenser, and also minimize the chances of phosphate deposits on CW side.

Following jobs have been done to implement the job :

- One 6" CW tapping from upstream of existing isolation valve on 10" CW supply to 101-JCA (from 127-CA/B inlet). New 6" CW header upto IC/AC and then 4" CW header upto 103-JBT gland condenser.
- Two 4" new tapping on existing common channel cover of condensers.
- Partition plate existing common channel cover of condensers will be modified for separate the CW flow to each condenser.
- Two 4" CW headers with isolation valves for IC and AF -CW return lines .
- One 4" CW tapping, on 10" CW return line to cooling tower, was available on 101-JCA CW exit line to connect 4" CW exit line of IC .
- Existing 103-JBT gland condenser have 4" CW inlet and exit nozzles, however, CW supply and return lines are 2½ inch, it is proposed to have separate 4" CW supply line from new CW header.
- New 4" CW return tapping provided for 103-JBT CW return on 10" CW return line to cooling tower on 101-JCA exit CW line.





**Reformer ID Fan Stack 4" Size Tappings ( 04 Nos ) at 29.5 mtr Height**

GPCB has asked to provide online ammonia analyzer for condensate stripper off gases.

Utilizing provision of diverting 104-E off gases to primary reformer stack, it was possible to install on line analyzer on primary reformer stack as per Pollution control board guide line.

Accordingly, 4 inch tappings have provided for sampling port.

**RELAIBLITY IMPROVEMENT OF LO & SO PUMPS' OPERATION FOR 103 J / JT**

Syn Gas Compressor (103-J) has common oil console for lube oil(LO) and Seal oil (SO). LO and SO have common turbine drive for normal operation and common motor drive for emergency operation. Due to common drive, various operational limitations have been faced in LO/SO system and few 103-J trip have been occurred due to LO/SO system limitation.

Following remedial actions were implemented to improve the reliability of Syn gas compressor and its auxiliaries :

- **<u>Separate suction line LO pumps:</u>**

  Separate suction line (4") for turbine driven LO pump with isolation valve have provided. One redundant blind flange was available on oil console at same elevation & of same size of existing suction flange used for new suction line for LO pumps.

- **Separate PSV for Motor Driven LO Pump**

  It is proposed to have a separate suction line (4") for turbine driven LO pump with isolation valve. One redundant blind flange is available on oil console at same elevation & of same size of existing

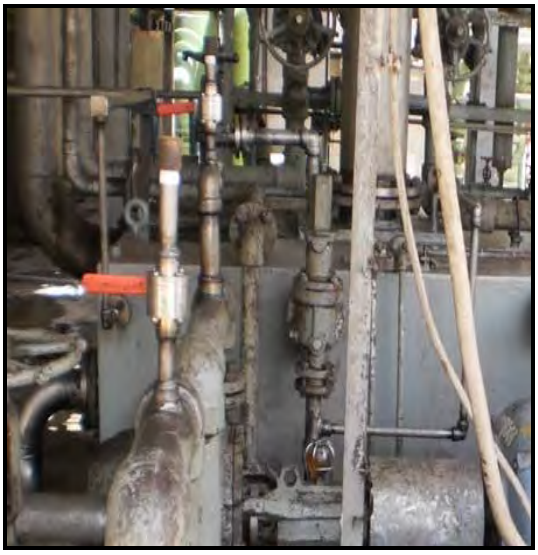
  In existing conditions, PSV was installed on main LO pump and PSV downstream flange is connected to oil console. As a modification, new PSV on stand by motor driven LO pump of same capacity of existing one has provided. The existing flange of oil console used to installed both the PSV of LO pumps.

  One bypass line of 1½ " with isolation valve installed on both PSV for start up activities.

  Presently, PSV is installed on main LO pump and PSV downstream flange is connected to oil console. It is proposed to installed new PSV on stand by motor driven LO pump also [of same capacity of existing one]. The existing flange of oil console will be used to installed both the PSV of LO pumps. One bypass line of 1½ " with isolation valve will be installed on both PSV for start up activities.

- **By pass line for Motor Driven SO Pump :**

  One bypass line of 15 mm with isolation valve installed on PSV on motor driven SO Pump for start up activities same as installed on turbine driven SO pump.



- **Low Low LO Header Pressure**

  One bypass line of 15 mm with isolation valve will be installed on PSV on motor driven SO Pump for start up activities [ same as installed on turbine driven SO pump).

  Three new tapping for pressure switch on LO header pressure will be required for new pressure switch for 2 out of 3 logic for IS103A.

- **LO and SO pressure in DCS**

  Four new tapping from existing field PI indicators of each LO/SO pumps have taken for pressure switch for DCS indication. Necessary cable and transmitter have provided by ammonia instrumentation.

  The cost of above modifications was around Rs. 5.0 Lakhs and the job have been executed by M/s J&J through SOR contract.

**Corrosion coupons in CO2 Removal Section of Ammonia Plant :**

In existing conditions, corrosion coupons were installed in Cooling water side on CW return lines to measures the corrosion rate and corrosion coupons are not available in CO2 removal system.

One corrosion rake on Semi-lean solution pump (116-J A/B) discharge line [in parallel to aMDEA filter (101-L)] installed and commissioned. For this purpose, two tapping of 1" (SS304) with isolation valves have provided.
The job was carried out by M/s Smitha Engineers through shutdown fabrication contract.

**DM water supply line for cooling of Start up heater panel ( S 50):**

Water (3.6 m3/hr) at pressure of about 3.6 to 5.0 bar is required for panel cooling of Start-up heater of S-50 Ammonia converter. At present, cooling water is available at less than 2 bar pressure for panel cooling which frequently generates low water pressure alarm and sometimes trips the panel. Also, present cooling water line needs frequent flushing.

To overcome above limitation, a new 1½ inch SS tapping from DM water inlet line of phosphate dosing tank of 107-C and laid the new line through culvert [cables of electric heater] to transformer room of Electric start-up heater of S-50 converter.

New 2 inch CS return line laid upto secondary reformer water jacket over flow funnel through the same culvert.

Above modification provide required DM flow and pressure at Startup heater transformer room and the cost of above modification was about Rs. 1.9 Lakhs.

**Operational safety Improvement of Deaerator(101-U) and CO2 Stripper (102-E)**

Presently, two HP boiler feed water pumps (104-JA/J) are provided to feed water from de-aerator to steam drum through various exchangers for waste heat boilers and auxiliary boiler. No trip block is provided to stop the pump, if low level appears in de-aerator.

Also there was no provision of a trip block for tripping of a-MDEA Circulation Pump (107 J/JA) and CO2 Removal System which will be actuated by low level in CO2 Stripper.

As a measure to improve operational safety of Deaerator (101-U) and CO2 Stripper (102-E), one tapping of 2.5" with isolation valves at Deaerator bottom and 3.0" with isolation valves at CO2 Stripper taken to provide three low level switch (LSLL) in each which will actuate the trip based on 2 out of 3 signals.

The approximate cost for taking tapping was around Rs.50,000/- (Rupees fifty thousand only). The approximate cost of the instrumentation is about 10,00,000/- (Rupees Ten Lakh only).

**To provide separate line for sending process condensate to cooling tower or to provide NRV to condensate outlet line to cooling tower. (EWR: A-267 Dated 25-Jul-2012)**

At present, condensate coming out from process condensate stripper (104-E) after cooling in 173-C is sent to SPC unit in Utility (part of same is also used for Jacket cooling of transfer line, Secondary reformer etc). During upset condition in 104-E (when the conductivity of condensate is high), condensate is diverted to Cooling tower as make -up. This line PW-25-4” is connected with C-2 exit line 3"-EF-160-01-B24 of Ammonia Recovery Unit (ARU).

Due to leakage of HE-4 & HE-2 of ARU, process condensate was contaminated with cooling water and was diverted to cooling tower in place of SPC Unit.

To overcome the problem NRV has been installed in the line no. PW-25-4” downstream of isolation valve.

The benefit of modification of above EWR is that each hour of safe operation will save about 45 m3 of DM water.

**Provision of condensate flushing point at outlet of Lean Carbamate Pump Vessel (V-1200). Ref : EWR No. U-247 dated 27/11/2012.**

In existing conditions, Lean carbamate pump vessel (V-1200) is provided at the downstream of flash tank condenser (H-1421). Lean carbamate formed from flash tank condenser (H-1421) is pumped via Lean carbamate pump vessel (V-1200) by process water pump (P-1305 A/B) to reflux condenser (H-1352) and LP carbamate condenser (H-1205 A).

There was no provision of condensate flushing at outlet of V-1200 and needs to be heated externally to clear if it is choked.

Following condensate flushing connections from steam condensate pump (P-1505 A/B) discharge to lean carbamate pump vessel (V-1200) were provided to improve the flexibility in operation.

- 1" process condensate flushing connection at upstream of Isolation valve
- 1" process condensate flushing connection at down stream of Isolation valve

**Laying of 1-1/2 inch cooling water supply and return headers and to reduce the bends in CW supply line for CCS-II pump bearing/ seal.**

In existing conditions, ¾'' supply and return lines of ¾'' were provided. Cooling was not proper due to line size and more number of bends in existing lines.

To remove the limitation supply line have been converted into 1-1/2'' and return line in 2'' size.

The job was carried out by M/s Smitha Engineers and the cost of modification was approximate Rs. 50,000/-

# UTILITY PLANT
(TECHNICAL)

**Installation of Chlorine Leak Handling System in New CT area. (EWR-CW-100)**

Presently Chlorination is being done for circulating CW and Narmada water at three different locations. Chlorine leak detection and handling system (leak detector, hood for tonner, suction blower, alkali scrubber etc.) have been provided in ammonia & urea CT and Narmada water Pre-treatment plant as per statutory requirement. There is no Chlorine leak detection and neutralization system for chlorination system of new cooling tower.

As per the rules, there shall be chlorine leak detection and neutralization in New CT area also.

To comply with the statutory requirements, installation of chlorine leak detection and handling system of new CT/Supply chlorinated water to new CT from old CT area have completed .

Following jobs have carried out to complete the job :

- New CPVC line of 3 inch size have installed upto new CT.
- Existing ejector have shifted to new location with piping modification.
- Strainer has also provided upstream of ejector.
- New chlorination hose has provided by laying under road
- Associated FRP piping work of 6 inch size for providing tapping to chlorine tonner have carried out by M/s Gandhi & Associates.
- New FRP HOOD installed which was manufactured by M/s Gandhi & associates.

# B&MH PLANT

(TECHNICAL)

**RE-ROUTING OF LINES PASSING UNDER CONVEYOR M-2110 FOR EASE OF MAINT (EWR NO. B-89 Dated 22/10/2012).**

Plant transfer conveyor (M-2110) is transferring the product urea prills from Urea plant to Silo/ B&MH plant. Following pipelines were passing under the plant transfer conveyor

- Plant air line-2"NB
- DM Water line- 2"NB
- 4 ATASteam line-2"NB
- Instrument air line-1-1/2"NB
- Urea solution line with tracing-2"NB from B&MH plant to prill cooling system.

To avoid unsafe condition and to have good housekeeping, above lines were re-routed. This has improved the safety of operating staff. Working environment and operation flexibility of plant and also helped in ensuring good housekeeping.

**The approx. Cost of modification of above job was 6.0Lakhs.**