MTC / REPORT / 01

REPORT NO. 37 / 2017

KALOL UNIT


# PLANT TURNAROUND REPORT

# (MARCH – APRIL – 2017)

# INDEX

# PREFACE

The Annual Plant Turnaround for the year 2017 was taken from 12th March, 2017 to 24th of April, 2017 for carrying out ESP Phase III (Energy Saving Project), Preventive maintenance jobs of Static & Rotary equipments and various jobs pending for plant shut down. Under ESP Phase-III, installation and commissioning of various equipments, vessels and piping was carried out.

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 12th March, 2017. This shutdown report contains details of the jobs carried out plant wise and section wise. Ammonia plant was put back in to operation on 23$^{rd}$ April, 2017 after a shutdown period of 43 days from production to production.

The turnaround was carried out smoothly due to meticulous planning of all activities like planning of manpower, material and other are resources. Due to exemplary efforts put in by all Personnel at all levels, turnaround jobs could be completed satisfactorily.

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.

A brief details of Major jobs carried out by all sections during shutdown are as under.

## MECHANICAL

### ❖ AMMONIA PLANT

- Replaced existing Synthesis Gas Drive Turbine, 103-JAT & 103-JBT by new Single Extraction cum Condensing Turbine, 103-JT along with HP Control Oil System & accessories. Complete system was supplied by M/s. Siemens India.
- Replaced Steam-Air Preheat Coil with SS304H material and new HDS-II (Hot De-Sulphuriser) coil added in HT Convection zone of Primary Reformer.
- The Air line from Steam Air coil up to secondary reformer,103-D was replaced with SS 321H material & provision of insulation sleeve made on flanged connection at the entry of 103-D.
- Replacement of complete Shell Liner, Refractory & Tube Bundle of waste heat boilers, 101-CA & 101-CB carried out.
- Following New Equipments were installed:
  - ➢ Process Condensate MP Stripper, 1104-E
  - ➢ Flash Gas Washing Column, 106-E
  - ➢ Hot Desulphuriser, 114-D
  - ➢ HTS BFW Preheaters, 1104-C1/C2/C3
  - ➢ Methanator Feed/Effluent Heat Exchangers, 1114-CA/CB

- Methanator Trim Heater, 1115-C
- Waste Heat Boiler, 1123-C
- Stripper Feed/Effluent Heat Exchangers,1170-CA/CB
- Methanator Effluent Cooler, 115-C
- Condensate Pumps, 1170-J/JA
- Top Washing Pumps, 106-EJ1A/EJ1B
- Ammonical Water Pumps, 106-EJ2A/EJ2B
- Phosphate Dozing Pumps, P-202-A/B
- Desuperheater, TRC 142

- Following Old Equipments were removed:
  - Desulphurisers, 101-D & 102-D
  - Methanator feed heater, 104-C
  - LP Stripper, 104-E
  - LTS inlet Boiler, 112-C
  - Methanator Effluent feed water heater, 114-C
  - Methanator Effluent Cooler, 115-C
  - Condensate Stripper feed bottom Exchanger, 170-C
  - Condensate Stripper Exchanger, 171-C
  - 103-JBT Gland Condenser
  - Stripped condensate pumps, 170-J & JA
- Additional jobs carried out during shutdown were:
  - Replaced Existing Lube Oil System of 101-J/105-J by new Lube Oil System supplied by M/s. Enpro Industries Pvt. Ltd., Pune. Separate Rundown Tanks provided for 101-J Train & 105-J Train.
  - Provision of separate Rundown Tanks for 103-JT & 103-JLP/103-JHP made in 103-J Lube Oil System. Rundown Tanks supplied by M/s. Enpro Industries Pvt Ltd., Pune.
  - Major Overhauling of 101-JLP, 103-JLP & 103-JHP Compressor, 104-JT & 117-J carried out.
  - Replaced Tube Bundle of Air Compressor Interstage cooler, 130-JC.

## ❖ UREA PLANT

- Major overhauling of $CO_2$ compressor drive turbine (Q-1801)
- Minor overhauling of $CO_2$ compressor LP case (K-1801-1)
- Minor overhauling of $CO_2$ compressor HP case (K-1801-2)
- Autoclave V-1201, Modification of $CO_2$ inlet Nozzle to Goose Neck(Casale)
- Replacement of HP Condenser (H-1202) under ESP-III by Full Flow Condenser.

- Modification of HP Piping for Split Flow Casale Technology
- HP Scrubber H-1203, lowering of tube bundle for its inspection along with shell.
- Installation of 400 Tr VAM (Vapour Absorption Machine), SJ50B Series under ESP-III
- P-1102/C ammonia pump shifting to new location under ESP-III
- Overhauling of Prill Tower scraper (M-1402)
- Replacement of off Gas line RV-1201 A/B/C
- Addition of H-1250, Ammonia Preheater and P-1250 , Ejector under ESP-III
- Installation of new H-1424, $2^{nd}$ Stage Evaporator under ESP-III
- Removal of $CO_2$ washing system and installation of H-1150, $CO_2$ Cooler under ESP-III
- Increase of height of PT Fan Stack and change of Fan Blades angle of prill tower ID fans K-1401 1/2/3/4

❖ **<u>OFFSITE & UTILITY PLANT</u>**

- Complete revamping of ammonia cooling tower cells (H-4401-7 & 8) with pultruded FRP components.
- Overhauling of cooling water pump drive Elliot make steam turbine (Q-4411).
- Replacement of existing hollow FRP fan blades of CT fan (K-4401-7& 8) with new efficient aerofoil designed hollow FRP fan blades along with new seal disk.
- Replacement of existing CS impeller with new Indigenous SS impeller in CW pump, P-4401C
- IBR inspection / Hydrotest of BHEL Boiler (GT-2068).
- Replacement of Sintex make partition wall in Urea cooling tower cells (H-4402-1/2/3).
- Refurbishing of Jash make sluice gate of cooling water pump sump.
- Overhauling of all cooling tower distribution valves.
- Insitu refurbishment of discharge gate valve, 1100mm NB x 150# and check valve 1050mm NB x 150# of cooling water pump P-4401A.
- Re-rubber lining of SPC unit vessel & HCL unloading tank.

❖ **<u>B&MH PLANT</u>**

- Overhauling of New and Old reclaim machine, M 2116-A (HM 470) and M 2116 (HM 122)
- Preventive maintenance of all conveyor gear boxes, weighing machines, packer scales and stitching machines.

# INSTRUMENTATION

## ❖ AMMONIA PLANT

- Major focus area of Instrumentation jobs was ESP-III execution. New Turbine Control Cabinet (TCC) for 103-JT was installed in new DCS marshalling room adjacent to CCR. 01 no. Analog Marshalling Cabinet and 01 no. Digital Marshalling Cabinet were also installed in the same area as a part of DCS I/O enhancement.

- On-line Mass Spectrometer was installed and commissioned for monitoring of critical LNG and process gas parameters for the first time in any of the IFFCO units.

- 04 nos. PGR Ball Valves were replaced by new contemporary design valves as a part of phased replacement of PGR Ball Valves.

- 01 no. new HIS was installed and commissioned in Shift Engineer office and new 64-Keys type keyboards were provided in 02 nos. HIS of control room.

## ❖ UREA PLANT

- Centum-CS part of Urea DCS was upgraded to latest Centum-VP DCS by replacing 02 nos. control stations, all marshalling cabinets and power distribution cabinet. 01 no. new HIS in Shift Engineer Office and 01 no. SOE (Sequence of Events) stations in CCR were installed and commissioned.

- Control Valves HICV-1222A, HICV-1222B & TRCV-1202 of CCS-I and level control valves LICV-1504B and LICV-1204 were replaced by new Control Valves as a part of phased replacement of old and obsolete design Control Valves.

- Low accuracy rotameter was replaced by highly accurate Micro motion Mass Flow meter for measurement of neem oil flow.

- 04 nos. Ultrasonic Level Transmitters were installed for measurement of level in 04 nos. Neem Oil Tanks and 01 no. Ultrasonic Level Transmitter was installed for measurement of level in Ammonical Water Tank by replacing existing dp transmitters.

## ❖ UTILITY AND OFFSITE

- Conventional Leveltrol for level measurement of surface condenser of cooling water turbine was replaced by latest Guided Wave RADAR type level transmitter.

- 02 nos. Guided Wave RADAR type level transmitters were installed and commissioned for level measurement of HCL storage tanks in DM Plant area.

- Modification in Load Control Scheme of BHEL Utility Boiler was carried out and implemented to improve the Boiler load ramp up in case of Urea Plant tripping.

## ELECTRICAL

- **Critical job / new installation**
  - Replacement of old aging conventional protection relay for motor and transformer with new microprocessor based relay in MCC-16 & 15
  - Erection & line up of overhead cable rack from 11KV MPSS to MCC-13
  - Replacement of power transformer for MCC-5 to enhance the MCC capacity
  - Replacement of Rotork make actuators and installation of new actuators
  - Extension of MCC-15 to meet the additional load requirement of ESP
  - Installation, testing & commissioning of load management system
  - Replacement of old battery charger at 11KV MPSS
  - Replacement of conventional isolators with motorized isolators in 66KV yard
  - Installation of Nitrogen injection fire protection & extinguishing system for main
  - Transformers Tr-1A & TR-1B at switch yard
  - Installation of critical motors under ESP project
  - Replacement of motor control Centre-11.

- **Scheduled preventive maintenance and modification work**
  - Servicing of Jyoti make 11 KV HT Vacuum circuit breaker (VCB)
  - Servicing of Rotork make valve actuators
  - Maintenance of transformers
  - Overhauling of critical motors
  - Maintenance of Motor control center MCCs
  - Maintenance of 66 KV switch yard
  - Checking of Rope switches in conveyors

## CIVIL

### AMMONIA PLANT

- Construction of foundations for ESP III
- Refractory repairing jobs in primary reformer (HT & LT zone), Auxiliary boiler and secondary reformer
- Construction of pipe supports and grouting of base plate

### UREA PLANT

- Anti corrosive treatment of Prill tower inside.
- Construction of foundations for ESP III
- Low viscosity chemical injection grouting of bucket room at prill tower top.

### ❖ OFFSITES & UTILITY PLANT

- Construction of new cable trench & concrete flooring in MCC-11
- Provision of cut out and construction of wall in cooling tower channel.
- Construction of foundation for P-4401 C & P-4402 in cooling tower basin
- Replacement of damaged plywood at cooling tower deck
- Construction of foundation for nitrogen injection fire extinguishing system

### ❖ B & MH PLANT

- Epoxy painting of conveyor gallery (beams, columns & soffit), transfer tower, silo and other areas of B & MH plant
- Epoxy screeding on the floor of urea silo.

## TECHNICAL

- Execution of jobs related to Energy Saving Project, various EWRs and modification schemes in Ammonia and Urea plant.
- Piping Job of ESP-III was carried out mainly in Ammonia and Urea Plant.

JGM (Maintenance)
IFFCO-Kalol

**PLANT TURNAROUND APRIL - 2017**

**GENERAL - DETAILS**

| SR. NO. | CATEGORY QUANTITY | |
|---|---|---|
| **(A)** | **EQUIPMENT UTILIZED :** | |
| | **IFFCO :** | |
| | 135 T Kobelco Crane | 01 No |
| | 100 T Kobelco Crane | 01 No |
| | 55 T TIL RT-760 Tyre mounted mobile 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 No. |
| | 909 Tata (Mini Truck) | 01 No |
| | 400 T Liebherr Crane | 01 No |

**(B) MANPOWER UTILIZED:**

**(I) IFFCO MANPOWER:**

| | | |
|---|---|---|
| 1 | Mechanical | } |
| 2 | Mechanical Services | } Existing |
| 3 | Electrical | } strength |
| 4 | Instrument | } & IFFCO other unit |
| 5 | Inspection | } |
| 6 | Civil | } |

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

| Sr. No. | Category | Man days |
|---|---|---|
| 1 | General Fitter | 770 |
| 2 | Rigger | 1235 |
| 3 | S.S. Rigger | 2587 |
| 4 | Fabricator | 171 |
| 5 | Grinder | 208 |
| 6 | Gas Cutter | 155 |
| 7 | IBR Welder | 62 |
| 8 | Non-IBR Welder | 124 |

## 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 |
| 34 | 2014 | 26-03-14 | 28-04-14 | 33.34 | 800.25 | 26-03-14 | 24-04-14 | 28.75 | 689.92 | Planned |
| 35 | 2015 | 01-04-15 | 13-04-15 | 11.95 | 286.83 | 01-04-15 | 12-04-15 | 11.69 | 280.50 | Planned |
| 36 | 2016 | 19-03-16 | 05-04-16 | 17.36 | 416.75 | 19-03-16 | 05-04-16 | 16.97 | 407.25 | Planned |
| 37 | 2017 | 11-03-17 | 23-04-17 | 42.10 | 1010.33 | 11-03-17 | 24-04-17 | 43.42 | 1042.16 | Planned-ESP III |

## COMPLETION STATUS OF MAJOR JOBS SHUTDOWN - 2017

| Sr. No. | Description | Start Date | Duration In days | Completion Date | Remarks |
|---|---|---|---|---|---|
| 1 | Overall shutdown period. (Production to Production) | 12.03.2017 | 41 | 22.04.2017 | |
| 2 | Replacement of Liner and Refractory of 101-CA & CB | 13.03.2017 | 22 | 04.04.2017 | |
| 3 | Replacement of Air Preheat and New HDS coil | 13.03.2017 | 18 | 31.03.2017 | |
| 4 | Replacement of 101-J / 105-J LO system | 13.03.2017 | 31 | 13.04.2017 | Flushing of Lube oil extended. Governor configuration problem in Turbine |
| 5 | Replacement of 103-JAT & 103-JBT Syn. Gas Compressor Drive Turbine | 13.03.2017 | 39 | 21.04.2017 | HP Oil Console piping job was extended, Inlet & Extraction piping alignment with turbine nozzle delayed |
| 6 | Overhauling of Syn. Gas compressors | 13.03.2017 | 15 | 28.03.2017 | |
| 7 | Overhauling of Air compressor 101-JLP | 13.03.2017 | 13 | 26.03.2017 | |
| 8 | Replacement of HPCC H-1202 | 13.03.2017 | 5 | 18.03.2017 | |
| 9 | High Pressure Urea Grade piping for Split Loop as per Casale Modifications | | 42 | 24.04.2017 | Modifications and Additional piping took more time. |
| 10 | Installation of H-1424 | 16.03.2017 | 12 | 28.03.2017 | Clubbed with Urea Grade piping Job |
| 11 | Installation of VAM Machine | 12.03.2017 | 9 | 21.03.2017 | |
| 12 | Shifting of Peroni make Ammonia Pump P-1102/C | 06.03.2017 | 14 | 20.03.2017 | Huge amount of concrete was embedded in The Base frame, which took time for removal. |
| 13 | Overhauling of CO2 Compressor Drive Turbine Q-1801 | 13.03.2017 | 15 | 28.03.2017 | |
| 14 | Erection of Recycle Carbamate Ejector P-1250 | 27.03.2017 | 3 | 30.03.2017 | |
| 15 | Overhauling of Scrapper Arm drive System | 13.03.2017 | 12 | 25.03.2017 | Internal Painting of tower has been taken up simultaneously |

| Sr. No. | Description | Start Date | Duration In days | Completion Date | Remarks |
|---|---|---|---|---|---|
| 16 | Opening, Hydro Jetting and Box-up of heat Exchangers | 13.03.2017 | 17 | 30.03.2017 | |
| 17 | Overhauling of PT Top Fans and Change in Blade Angle | 14.03.2017 | 6 | 20.03.2017 | |
| 18 | Lowering of tube Bundle of Scrubber H-1203 , Inspection, and Box-up | 18.03.2017 | 3 | 21.03.2017 | |
| 19 | Complete Revamping of Ammonia Wooden Cooling Tower cell H-4401/7 & H-4401/8 ( Model No. 664-3-02 ) with Pultruded FRP structural member. | 11.03.2017 | 30 | 10.04.2017 | Delay due to manpower shortage by party at initial stage of job. |

## SHUT DOWN RELATED CONTRACTS

| SR. NO | PLANT | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME |
|---|---|---|---|---|
| 1 | Mechanical Ammonia | 201004171302 13/12/2016 | Erection of equipments & piping works for ESP-Kalol | Onshore construction Co. Pvt ltd, Mumbai |
| 2 | Mechanical Ammonia | 201004171570 16/02/2017 | Supply cum application of insulation works at IFFCO Kalol unit as per details of loi nr em-144/e/602/k | ASSOCIATED INSULATION CO, VADODARA |
| 3 | Mechanical Ammonia | 201004161387 21/01/2016 | Dismantling, erection, commissioning of convection coil of Ammonia plant | Heurtey petrochem india private ltd, Mumbai |
| 4 | Mechanical Ammonia | 201004160271 22/05/2015 | Supervisory services for erection, installation & commissioning of turbine and governing system | Siemens ltd |
| 5 | Mechanical Ammonia | 201004161504 17/02/2016 | Supervisory services for replacement of lube oil & seal oil system of 101-J / 105-J TRAIN. | Enpro industries private ltd, Pune |
| 6 | Mechanical Ammonia | 201004171637 08/02/2017 | Contract for supply and application of castable insulation for 101-CA & CB | Calderys india refractories ltd., Ahmedabad |
| 7 | Mechanical Ammonia | 201004171723 21/02/2017 | Supply and application of ceramic fibre insulation in convection zone of primary reformer | Unifrax India Pvt. Ltd, Mumbai |
| 8 | Mechanical Ammonia | 201004171641 08/02/2017 | Replacement of liners of 101-CA & 101 CB waste heat boilers | Skywin Erectors, Ahmedabad |
| 9 | Mechanical Ammonia | 201004171642 08/02/2017 | | Shree Ganesh Engg Co., Ahmedabad |
| 10 | Mechanical Ammonia | 201004170003 04/04/2016 | Erection and commissioning of MP boiler | L & T, Mumbai |
| 11 | Mechanical Ammonia | 201004170023 08/04/2016 | Commissioning of 106 E J 1 & EJ2 | KEPL, Pune |
| 12 | Mechanical Ammonia | 201004170010 18/04/2016 | Commissioning of 1170 J /JA | KSB, Pune |
| 13 | Mechanical Ammonia | 201004180241 08/06/2017 | Regulatory order bolt tightening services for 1123-c syn. Gas mp boiler | Power Master Engineers Pvt. Ltd., Navi Mumbai |
| 14 | Mechanical Ammonia | 201004171580 09/02/2017 | Overhauling & preventive maint. Of rotating equipments in Urea and Utility plants | Turbo Engg. Services, AP |

| SR. NO | PLANT | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME |
|---|---|---|---|---|
| 15 | Mechanical Ammonia | 201004171581 09/02/2017 | Overhauling and preventive maint. Of rotating equipments in Ammonia plant | Bvl Power Systems Pvt. Ltd, Hyderabad |
| 16 | Mechanical Ammonia | 201004171481 16/01/2017 | Overhauling of re-cycle gas compressor, 117-j | Malhan Enterprises Pvt. Ltd., Ahmedabad |
| 17 | Mechanical Ammonia | 201004171687 08/02/2017 | Critical fabrication jobs during shutdown 2017 in ammonia plant | J&J Engineers, Shertha |
| 18 | Mechanical Ammonia | 201004171568 09/02/2017 | Scaffolding & blinding/de-blinding jobs | Mahavir Engg. Works, Vadodara |
| 19 | Mechanical Urea | 201004171897 , 16-MAR-17 | Lowering & Box-up Activities for Tube Bundle of H-1203( HP Scrubber) | M/s Skywin Erectors |
| 20 | Mechanical Urea | 201004180163 , 28-JUN-17 | Anti -Adhesive Ceramic coating and Anti -Corrosive paints for Prill Tower Srapper arm and PCS Blowers | M/s Armate Corporation |
| 21 | Mechanical Urea | 201004171580 , 09/02/2017 | Overhauling and Preventive maintenance of Rotating equipments | M/s BVL Hyderabad |
| 22 | Mechanical Urea | 201004171568 , 09/02/2017 | Scaffolding & Blinding jobs during Shutdown | M/s Mahavir Engg. Works. |
| 23 | Mechanical Urea | 201004161158 | Overhauling / reconditioning of valves | M/s Flotec |
| 24 | Mechanical Offsite | 201004170654 & 16/08/2016 | Complete Revamping of Ammonia Cooling Tower cell H- 4401/7 & H-4401/8 ( Model No. 664-3-02 ) | M/s Souhtern Cooling Tower Pvt. Ltd. Kolkata |
| 25 | Mechanical Offsite | 201004171812 & 22/02/2017 | Services For In-Situ Gland Re Packing Of Valves | M/s Flotec Industries, Ahmedabad |
| 26 | Mechanical Offsite | 201004171640 & 21/02/2017 | Supply and installation of Sintex Make PVC Panel in Partition wall of Urea Cooling Tower (H-4402-1/2/3) | M/s Jainam Enterprises, Mehsana |
| 27 | Mechanical Offsite | 201004161302 & 18/01/2016 | Servicing/Repairing of Jash make Sluice Gates. | M/s Jash Engg Ltd, Indore |
| 28 | Mechanical Offsite | 201004171816 & 22/02/2017 | Situ Overhauling / repairing of gate valve / check valve | M/s FlotecTechnosmart (India) Private Limited, Surat |

| SR. NO | PLANT | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME |
|---|---|---|---|---|
| 29 | Mechanical B&MH | 201004150817 14.12.2014 | ARC for providing rubber linings on belt conveyor pulleys | M/s J. K. Rubber Works, Ahmedabad |
| 30 | Mechanical B&MH | 201004151289 01.04.2015 | Splicing and Vulcanizing of conveyor belts | M/s J. K. Rubber Works, Ahmedabad |
| 31 | Mechanical B&MH | 201004171412 , 05.01.2017 Amendment-1 | Requirement of skilled Engineer & Technician for Reclaim machine | M/s Elecon Epc Projects Ltd, VV Nagar |
| 32 | Inspection | 201004160637 Dt 12-09-2015 | Radiography work | NDT Services, Ahmedabad |
| 33 | Inspection | 201004170537 Dt 29-07-2016 | ECT of HP stripper tubes | TESTEX, MUMBAI |
| 34 | Inspection | 201004170499 Dt 22-07-2016 | IRIS of LPCC tubes | TESTEX, MUMBAI |
| 35 | Inspection | 201004150874 Dt 18-11-2014 | Metallography work | TCR Advanced Engg., Vadodara |
| 36 | Inspection | 201004160956 Dt 03-12-2015 | NDT Teams for DP, UFD and Thickness | SR Technical services, Mumbai |
| 37 | Inspection | 201004160957 Dt 04-12-2015 | NDT Team for MPI work | NDT Services, Ahmedabad |
| 38 | Inspection | 201004170592 Dt 09-08-2016 | AUS of Reformer Tubes | PDIL, Noida |
| 39 | Inspection | 201004171751 Dt 14-02-2017 | RFET of 102-C | TESTEX, MUMBAI |
| 40 | Instrument (Ammonia) | 201004151491 Dt: 17-03-2015 | AMC for Yokogawa make DCS/ESD Systems | M/S Yokogawa India Limited, Baroda |
| 41 | Instrument (Ammonia) | 201004161286 Dt: 12-01-2016 | Maintenance of control valves | M/S FlotecTechnosmart (india) private limited, Surat |
| 42 | Instrument (Urea) | 201004161319 Dt: 27-01-2016 | Hiring of skilled Instrument Manpower for shutdown | M/s A-Z Instrument Services, Vadodara |
| 43 | Instrument (Urea) | 201004150975 Dt: 12-12-2014 | Autoclave and Stripper level Measurement System | M/s Berthold Technologies (India) Pvt. Ltd., Chennai |
| 44 | Instrument (Urea) | 201004161301 Dt: 19-01-2016 | Checking and calibration of Ammonia Mass flowmeter. | M/s Electronic & Quality Development Center, Gandhinagar |
| 45 | Instrument (Offsite) | 201004161500 dt: 24/02/2016 | Annual Maintenance Contract for UPS System(60KVA & 2X10KVA ) | Emerson Network Power (INDIA) PVT. LTD., Ahmedabad |

| SR. NO | PLANT | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME |
|---|---|---|---|---|
| 46 | Instrument (Offsite) | 201004151195 Dated 12.01.2015 | Annual Maintenance Contract for UPS System-10 KVA AMM STG UPS | Emerson Network Power (INDIA) PVT. LTD., Ahmedabad |
| 47 | Instrument (Offsite) | 201004171971 dt:27/03/2017 | AMC for M/S PBL Make Belt weigher System & Bag Filling M/C for Bagging Plant. | ELECON ENGINEERING CO. LIMITED |
| 48 | Instrument (Offsite) | 201004171734 Dated 08.02.2017 | AMC for AMCO Batteries for UPSS | Syntech Power Systems, Vadodara |
| 49 | Electrical | 201001170617 | Replacement of old aging conventional protection relay for motor and transformer with new microprocessor based relay in MCC-16. | M/S Elcon |
| 50 | Electrical | 201004161633 | Installation, commissioning & testing of LMS | M/S SOFTCON SYSTEMS |
| 51 | Electrical | 201004171199 | Replacement of power transformer for MCC-5 to enhance the MCC capacity | M/S Voltamp |
| 52 | Electrical | 201004170674, 201004170383 | Replacement of manual operated isolators with motorized isolators at 66 KV switch yard | M/S ABB |
| 53 | Electrical | 201004170784 | Installation of Nitrogen injection fire protection & extinguishing system for main transformers Tr-1A & TR-1B at switch yard | M/S CTR |
| 54 | Electrical | 201004171439 | Shifting of urea plant motor feeders from MCC-6 to MCC-15 and removal of MCC-6 | M/S EDAC |
| 55 | Electrical | 201004170843 | Supply of MCC-11 | M/S L & T |
| 56 | Electrical | 201004170574 | Replacement of old battery charger at MPSS | M/s Universal |
| 57 | Electrical | 201004171403 | Replacement & modification in MCC panels to upgrade changeover scheme and feeder modules | M/S L & T |

| SR. NO | PLANT | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME |
|---|---|---|---|---|
| 58 | Electrical | 201004171551 | Extension of MCC-5 to meet the additional load requirement of ESP | M/S L & T |
| 59 | Electrical | 201004171649 | Modification in Phase Sequence Bus bar arrangement in MCC-14 | M/S. INTERLEC |
| 60 | Electrical | 201004171781 | Replacement of Motor control centre-11 | M/s.Parikh electrical |
| 61 | Electrical | 201004171775 | Preventive maintenance & testing of transformers | M/s. Voltamp |
| 62 | Electrical | 201004171836 | Servicing of Rotork make valve actuators | M/s. Rotork |
| 63 | Electrical | 201004171878 | Servicing of Jyoti make 11 KV HT Vacuum circuit breakers | M/s. Jyoti |
| 64 | Electrical | 201004171758 | Services of Electricians required for Shut-Down Jobs | M/s. D A mewada |
| 65 | Electrical | 201004171413 | Motor Overhauling | M/s. New National Electric |
| 66 | Electrical | 201001170617 | Replacement of old aging conventional protection relay for motor and transformer with new microprocessor based relay in MCC-16. | M/S Elcon |
| 67 | Planning | 201004170755 14/09/2016 | Overhauling & testing of HP / LP Relief valves | M/s Flotec Technosmart (India) Pvt. Ltd, Surat |
| 68 | Planning | 201004170773 26/10/2016 | Overhauling & testing of various Relief valves | M/s Flotec Technosmart (India) Pvt. Ltd, Surat |
| 69 | Planning | 201004161448 | Opening & Boxed up of Heat Exchangers | M/s General Engg Works, Bharuch |
| 70 | Planning | 201004171161 08/12/2016 | Assisting IFFCO during Plant turnaround 2017 | M/s General Engg Works, Bharuch |
| 71 | Planning | 201004171160 08/12/2016 | Assisting IFFCO during Plant turnaround 2017 | M/s J & J Engineering, Shertha |
| 72 | Planning | 201004171080 26/10/2016 | Hydro jetting cleaning of Heat exchangers tubes | M/s Deluxe Hydro Blasting Services, Mumbai |
| 73 | Planning | 201004171928 17/03/2017 | Hydro jetting cleaning of Heat exchangers tubes | M/s Hydro Jetting Services, Ahmedabad |
| 74 | Planning | 201004171471 16/01/2017 | Fabrication jobs in Plant | M/s J & J Engineering, Shertha |

| SR. NO | PLANT | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME |
|---|---|---|---|---|
| 75 | Planning | 201004171470 16/01/2017 | Fabrication jobs in Plant | M/s General Engg Works, Bharuch |
| 76 | Planning | 201004161418 24/02/2016 | Insulation jobs in Plants | M/s Balaji Insulation, Mumbai |
| 77 | Planning | 201004161417 24/02/2016 | Insulation jobs in Plants | M/s Khandelwal Insulation, Mumbai |
| 78 | Planning | 201004160985 01/12/2015 | Petty maintenance jobs in Plants | M/s J & J Engineering, Shertha |
| 79 | Planning | 201004171627 02/02/2017 | On line sealing jobs in plant | M/s Dynamic Meta Sealing Engineers, Bharuch |
| 80 | Planning | 201004160239 02/06/2015 | EOT overhauling jobs in Plant | M/s Hi-Tech Industries , Ahmedabad |
| 81 | Planning | 201004150549 08/09/2014 | Painting jobs in Plants | M/s B Chauhan & Co, Kalol |
| 82 | Civil (Ammonia, Urea &Offsites Plant) | 201004171659 dt. 04/02/2017 | Pre, during & post annual turnaround civil jobs in IFFCO Kalol Plant | M/S VidyaShanker Upadhyay |
| 83 | Civil (Urea &B&Mh Plant) | 201004171615 dt. 30/01/2017 | Epoxy paint Transfer tower & Conveyors gallery at B & MH plant in IFFCO kalol fertilizer complex during annual shutdown. | M/S VidyaShanker Upadhyay |
| 84 | Civil -- (B&Mh plant) | 201004171992 dt. 30/03/2017 | Epoxy screeding at floor of urea silo in Kalolunit . | M/s Maruti Refractories |
| 85 | Civil (Urea plant) | 201004180031 dt. 17.04.2017 | Providing and applying painting of prilling tower inside at Kalol unit during shutdown. | M/s Dewan Enterprises. |
| 86 | Technical | 201004171302 13/12/2016 | For ESP Jobs | M/s Onshore Construction |
| 87 | Technical | 201004171900 11/03/2017 | For EWRs Jobs | M/s J&J Engg. |

# MECHANICAL

# AMMONIA PLANT
(MECHANICAL)

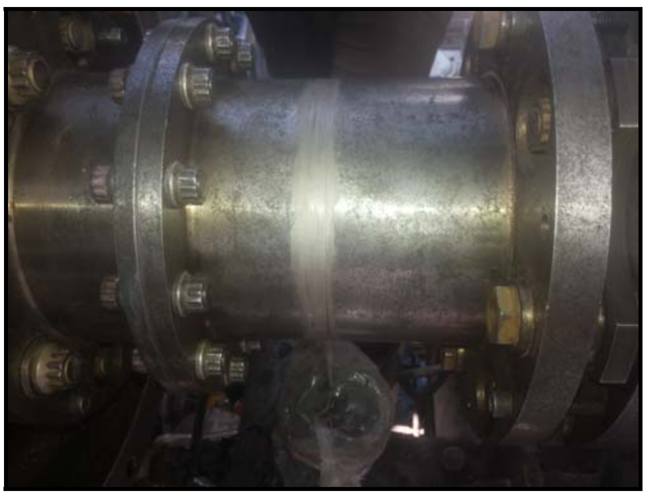
## AIR COMPRESSOR TRAIN (101-J)

Overhauling and PM of Rotary equipment's was carried out by M/s. BVL Power Systems Pvt. Ltd., Hyderabad against WO No. 201004171581.
Major overhauling of LP Compressor (101-JLP) and Preventive Maintenance of 101-JT, 101-JR & 101-JHP was carried out.

### 101-JT, Air Compressor Drive Turbine

Turbine was decoupled and both end Journal bearings and Thrust bearing were removed for inspection. The bearings were visually inspected & DP test of pads carried out. Bearings found in good condition. Gauss readings of the bearing pads & shaft journal were measured and found within limits. Journal Bearing clearances were taken and found within the design range.

Replaced the Oil Guard (Governor end) as edges found damaged and worn out. Earthing brush was damaged and the holder of brush was touching the spacer, due to which marks were found on spacer.



**Marks on 101-JT to JLP spacer**

**Earthing brush found completely worn out**

### 101-JLP, Air Compressor

Major overhauling of 101-JLP was done during SD-2013. It was taken for major overhauling after 4 years to check the condition of internals.

101-JLP was decoupled from both ends. Casing bolts were opened & compressor casing top half lifted by using crane. After opening, it was observed that the condition of rotor, diaphragm and flow path is good and there was no major dust/corrosion in these areas.

Clearances of all internals with rotor were measured & recorded. Rotor was lifted out of the casing by crane. Rotor was cleaned properly and run out was checked, found 0.02 mm max. Manual cleaning of bottom casing half & hydrojet cleaning of top casing half and rotor was carried out. Replaced the Oil Guard of both ends as edges found damaged. Placed the rotor on the bottom half of casing & again clearances of all internals with rotor checked & recorded. Placed the top casing half after applying Birkosit compound over the parting plane & box-up the two halves by tightening the casing bolts. Journal bearings and Thrust bearings were visually inspected and Dye penetration test also carried out. 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.

**Rotor after removal of top casing**

**View of internals after removal of top 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 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 test was also carried out. 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. Replaced the Oil Guard of Thrust end as edges found damaged.

**PREVENTIVE MAINTENANCE RECORDS: 101-J TRAIN**

**COUPLINGS**

| Description | Position | Design (Inch) | Before (Inch) | After (Inch) |
|---|---|---|---|---|
| **DBSE (With Rotor at extreme ends)** | | | | |
| 101 JT-JLP | --- | 10.500 | 10. 51 | 10.513 |
| 101 JLP-JR | --- | 8.250 | 8.300 | 8.294 |
| 101 JR-JHP | --- | 8.250 | 8.290 | 8.280 |
| **Distance between Hub Face (With Rotor at extreme ends)** | | | | |
| 101 JT-JLP | --- | 10.557 | 10.553 | 10.56 |
| 101 JLP-JR | --- | 8.250 | 8.349 | 8.340 |
| 101 JR-JHP | --- | 8.250 | 8.272 | 8.270 |

**PREVENTIVE MAINTENANCE RECORDS: 101 - JT**

| Description | Position | Dwg. Ref | Design Clearances (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|---|
| **JLP End** | | | | | |
| Journal Bearing | Mandrel | B | 0.007-0.009 | 0.00944(0.24) | 0.00944(0.24) |
| | Filler / lead wire | | | - | - |
| Oil Guard (For Jr. Brg Housing) | L / R | C | 0.015-0.021 | 0.006(0.15) | 0.006(0.15) |
| | | G | 0.058-0.097 | 0.005(0.127) | 0.006(0.15) |
| Oil Guard (For Seal Housing ) | - | D | 0.077-0.109 | 0.0098(0.249) | 0.010(0.254) |
| **Governor End** | | | | | |
| Journal Bearing | Mandrel | B | 0.007-0.009 | 0.0094(0.239) | 0.0094(0.239) |
| | Filler / lead wire | | | - | - |
| Oil Guard (For Brg. Housing) | South | - | - | 0.007(0.18) | 0.007(0.18) |
| | North | C | 0.015-0.021 | 0.007(0.18) | 0.007(0.18) |
| Oil Guard (For Thrust Brg.) | South | A | 0.002-0.04 | 0.003(0.076) | 0.003(0.076) |
| | North | A | 0.002-0.004 | 0.004(0.10) | 0.004(0.10) |
| Oil Guard (For Seal Housing) | - | D | 0.077-0.109 | 0.0098(0.249) | 0.0027(0.069) |
| Axial Thrust. | With Top Housing | - | 0.008-0.012 | 0.0157 (0.399) | 0.0098(0.249) |
| | Without Top Housing | - | | - | - |

| Journal Bearing Pads Thickness | | | | |
|---|---|---|---|---|
| PAD | NORTH SIDE BEARING | | SOUTH SIDE BEARING | |
| | Before | After | Before | After |
| No 1 | 20.63 | 20.63 | 20.63 | 20.63 |
| No 2 | 20.62 | 20.62 | 20.63 | 20.63 |
| No 3 | 20.63 | 20.63 | 20.62 | 20.62 |
| No 4 | 20.63 | 20.63 | 20.62 | 20.62 |
| No 5 | 20.63 | 20.63 | 20.63 | 20.63 |
| **Thrust Bearing Pads Thickness** | | | | |
| **Pad** | **ACTIVE** | | **INACTIVE** | |
| | **Before** | **After New Pads** | **Before** | **After** |
| No 1 | 23.07 | 23.07 | 12.67 | 12.67 |
| No 2 | 23.05 | 23.05 | 12.68 | 12.68 |
| No 3 | 22.06 | 23.06 | 12.67 | 12.67 |
| No 4 | 23.07 | 23.07 | 12.68 | 12.68 |
| No 5 | 23.05 | 23.05 | 12.67 | 12.67 |
| No 6 | 23.06 | 23.06 | 12.68 | 12.68 |

**MAJOR OVERHAULING RECORDS : 101 – JLP**

| Description | Position | Dwg. Ref. | Design Clearances (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|---|
| **TURBINE END** | | | | | |
| Journal Bearing Clearance | Mandrel | D-1 | 0.005-0.008 | 0.0074(0.188) | 0.0074(0.188) |
| | Filler / lead wire | | | - | - |
| Oil Guard (For Journal Bearing) | L / R | C-1 | 0.013-0.015 | 0.0039(0.10) | 0.0039(0.10) |
| | South | C-1 | 0.013-0.015 | 0.0039(0.10) | 0.0039(0.10) |
| Oil Guard (For Outer Housing) | North | A-1 | 0.021-0.027 | 0.0078(0.20) | 0.0066(0.17) |
| | South | A-1 | 0.021-0.027 | - | - |
| **GEAR BOX END** | | | | | |
| Journal Bearing Clearance | Mandrel | D-1 | 0.005-0.008 | 0.0098(0.25) | 0.0098(0.25) |
| | Filler / lead wire | | | - | - |
| Oil Guard (For Journal Bearing) | North | C-1 | 0.013-0.015 | 0.0031(0.08) | 0.0031(0.08) |
| | South | C-1 | 0.013-0.015 | 0.0031(0.08) | 0.0031(0.08) |
| Oil Guard (For Thrust bearing) | North | M-1 | 0.002-0.004 | 0.004(0.10) | 0.004(0.10) |
| | South | S-1 | 0.002-0.04 | 0.003(0.08) | 0.003(0.08) |
| Oil Guard (For Outer Housing) | CT side | A1 | 0.021-0.027 | 0.0059(0.15) | 0.007(0.18) |
| | Silo side | A1 | 0.021-0.027 | 0.0078(0.20) | 0.0059(0.15) |
| Axial Thrust | With Top Housing | - | 0.010-0.015 | 0.0135(0.34) | 0.0122(0.31) |
| | Without Top Housing | - | | - | - |
| Total Float | - | - | 7.144-8.730 | - | - |

# IFFCO - KALOL

## DIAMETRICAL CLEARANCES - 101 JLP

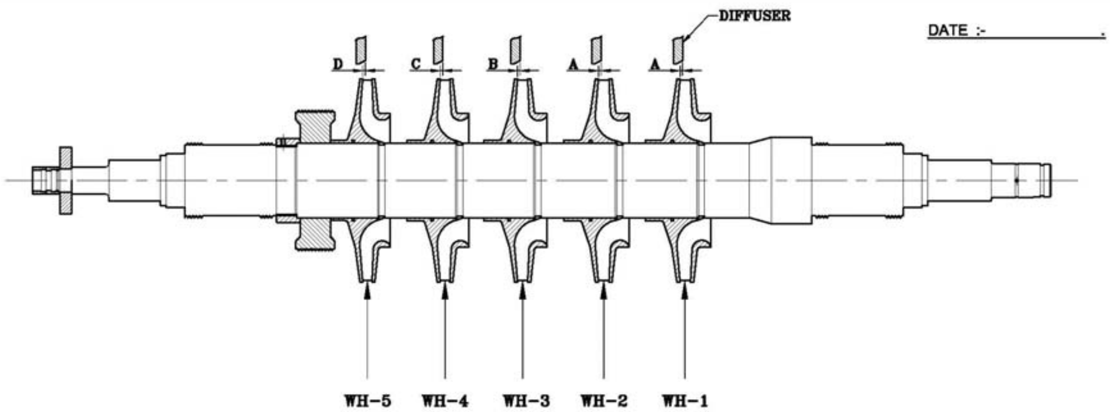
| REF. | CLEARANCE - INCHES | BETWEEN | REF. | CLEARANCE - INCHES | BETWEEN |
|---|---|---|---|---|---|
| A | 0.010 TO 0.014 | BALANCING RING TO BALANCING DRUM | A1 | 0.021 TO 0.027 | OIL GUARD TO SHAFT |
| B | 0.026 TO 0.030 | IMPELLER TO LABYRINTH | C1 | 0.013 TO 0.015 | BEARING HOUSING TO SHAFT |
| 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 |
|---|---|---|---|---|
| | | OIL GUARD - A1 | 0.007 | 0.007 |
| | | OIL GUARD - M1 | 0.0059 | 0.0059 |
| | | THRUST BRG. OIL GUARD - S1 (NORTH) | 0.003 | 0.003 |
| | | JR. BRG. C1 | 0.0031 | 0.0031 |
| | | D1 | — | — |
| | | C1 | 0.0031 | 0.0031 |
| | | OIL GUARD - A1 | | |
| 0.05 | 0.02 | RING - E | 0.03 | 0.05 |
| 0.30 | 0.20 | WHEEL - 1 B | 0.20 | 0.25 |
| 0.35 | 0.30 | D | 0.40 | 0.20 |
| 0.25 | 0.30 | WHEEL - 2 B | 0.15 | 0.25 |
| 0.20 | 0.20 | F | 0.10 | 0.20 |
| 0.10 | 0.05 | WHEEL - 3 C | 0.20 | 0.30 |
| 0.10 | 0.05 | D | 0.30 | 0.30 |
| 0.10 | 0.05 | WHEEL - 4 C | 0.30 | 0.30 |
| 0.20 | 0.15 | D | 0.30 | 0.30 |
| 0.15 | 0.15 | WHEEL - 5 C | 0.20 | 0.20 |
| 0.05 | 0.05 | BALANCING DRUM A | 0.25 | 0.20 |
| 0.05 | 0.05 | RING - E | 0.05 | 0.05 |
| | | OIL GUARD - A1 | 0.0078 | 0.0066 |
| | | JR. BRG. C1 | 0.0039 | 0.0039 |
| | | D1 | — | — |
| | | C1 (SOUTH) | 0.0039 | 0.0039 |
| | | OIL GUARD - A1 | | |

COUPLING

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

**IFFCO :-**
**PARTY :-**
**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 BEFORE | SILO SIDE [WEST] | 0.200" | 0.220" | 0.157" | 0.094" | 0.065" |
| | COOLING TOWER SIDE [EAST] | 0.208" | 0.230" | 0.161" | 0.098" | 0.065" |
| AFTER | SILO SIDE [WEST] | 0.208" | 0.228" | 1.61" | 0.100" | 0.065" |
| | COOLING TOWER SIDE [EAST] | 0.208" | 0.230" | 1.61" | 0.100" | 0.065" |

**IFFCO - KALOL**

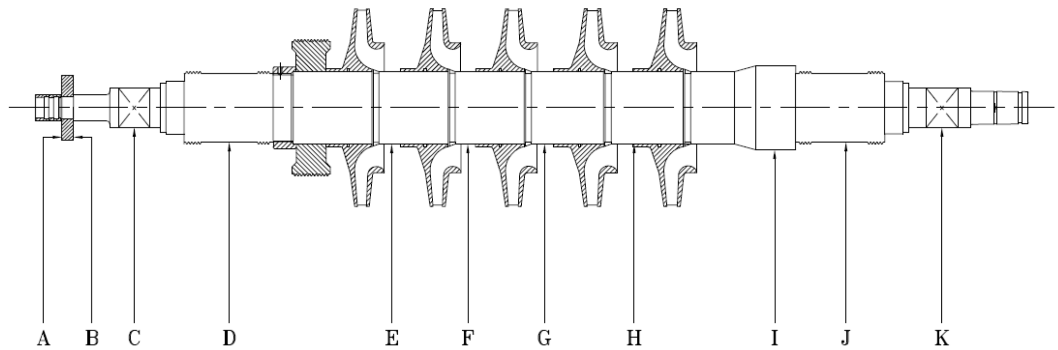
WHEEL POSITION W.R.T. DIFFUSER FOR 101-JLP

PLANT : AMMONIA

| Journal Bearing Pads Thickness | | | | |
|---|---|---|---|---|
| PAD | NORTH SIDE BEARING | | SOUTH SIDE BEARING | |
| | Before | After | Before | After |
| No 1 | 19.07 | 19.07 | 19.08 | 19.08 |
| No 2 | 19.07 | 19.08 | 19.08 | 19.08 |
| No 3 | 19.08 | 19.07 | 19.08 | 19.08 |
| No 4 | 19.08 | 19.08 | 19.07 | 19.07 |
| No 5 | 19.07 | 19.08 | 19.07 | 19.07 |

| Thrust Bearing Pads Thickness | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pad | ACTIVE | | INACTIVE | | PAD | ACTIVE | | INACTIVE | |
| | Before | After | Before | After | | Before | After | Before | After |
| No 1 | 20.82 | 20.82 | 20.82 | 20.82 | No 5 | 20.81 | 20.81 | 20.81 | 20.81 |
| No 2 | 20.83 | 20.83 | 20.80 | 20.80 | No 6 | 20.82 | 20.82 | 20.80 | 20.80 |
| No 3 | 20.81 | 20.81 | 20.80 | 20.80 | No 7 | 20.84 | 20.84 | 20.81 | 20.81 |
| No 4 | 20.82 | 20.82 | 20.82 | 20.82 | No 8 | 20.85 | 20.85 | 20.78 | 20.78 |

DATE :-




| DESCRIPTION | ROTOR NO. | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EXISTING ROTOR | | 0.015 | 0.015 | 0.01 | 0.01 | 0.02 | 0.02 | 0.005 | 0.01 | 0.01 | 0.01 | 0.01 |
| IF NEW ROTOR IS INSTALLED | — | — | — | — | — | — | — | — | — | — | — | — |

**IFFCO - KALOL**

RUNOUT RECORD FOR 101-JLP

PLANT : AMMONIA

**PREVENTIVE MAINTENANCE RECORDS: 101-JR**

| Description | Position | Design Clearances (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|
| Journal Bearing (Low Speed drive gear) | North | 0.008-0.010 | 0.0102 (0.26) | 0.0102 (0.26) |
| | South | 0.008-0.010 | 0.0102 (0.26) | 0.0102 (0.26) |
| Axial Thrust | - | 0.014-0.024 | 0.0125 (0.318) | 0.0125 (0.318) |
| Journal Bearing (High Speed driven Pinion) | North | 0.009-0.011 | 0.0098 (0.25) | 0.0098 (0.25) |
| | South | 0.009-0.011 | 0.0102 (0.26) | 0.0102 (0.26) |
| Free float –PINION | - | - | - | 0.039 (0.99) |
| Backlash | - | - | 0.0157 (0.40) | 0.0157 (0.40) |
| Shaft Diameter (Low Speed drive Gear) | North Side Bearing. | - | 4.492” | 4.492” |
| | South Side Bearing. | - | 4.492” | 4.492” |
| Shaft Diameter. (High Speed driven Pinion) | North Side Bearing. | - | 3.494” | 3.494” |
| | South Side Bearing. | - | 3.494” | 3.494” |

## **PREVENTIVE MAINTENANCE RECORDS : 101- JHP**

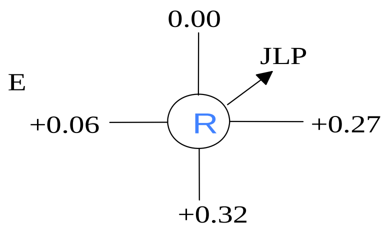
| Description | Position | Dwg. Ref. | Design Clearances (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|---|
| **GEAR BOX END** | | | | | |
| Journal Bearing Clearance | Mandrel | C-1 | 0.004-0.007 | 0.007 (0.18) | 0.007 (0.18) |
| | Filler / lead wire | | | - | - |
| Shaft Dia. | Journal Bearing | ------ | 2.996 | - | - |
| Oil Guard (For Journal Bearing) | CT side | B-1 | 0.013-0.016 | 0.0039 (0.10) | 0.0039 (0.10) |
| | SILO side | B-1 | 0.013-0.016 | 0.0059 (0.15) | 0.0059 (0.15) |
| Oil Guard (For Top Housing) | North | D-1 | 0.015-0.022 | 0.0039 (0.10) | 0.004 (0.10) |
| | South | D-1 | 0.015-0.022 | - | - |
| **NON DRIVE END** | | | | | |
| Journal Bearing Clearance | Mandrel | D-1 | 0.015-0.022 | 0.00669 (0.17) | 0.00669 (0.17) |
| | Filler / lead wire | | | - | - |
| Shaft Dia. | Journal bearing | ------ | 2.996 | - | - |
| Oil Guard (For Journal Bearing) | North | B-1 | 0.013-0.016 | 0.005 (0.127) | - |
| | South | B-1 | 0.013-0.016 | 0.006 (0.152) | - |
| Oil Guard (For Thrust bearing) | North | A-1 | 0.002-0.004 | 0.003 (0.076) | - |
| | South | A-1 | 0.002-0.04 | 0.0078 (0.20) | 0.0035 (0.089) |
| Oil Guard (For Top Housing) | North | ------ | ------ | ------ | ------ |
| | South | D-1 | 0.015-0.022 | - | - |
| Axial Thrust | With Top Housing | ------ | 0.008 - 0.012 | 0.0078 (0.20) | 0.0118 (0.30) |
| | Without Top Housing | ------ | | - | - |

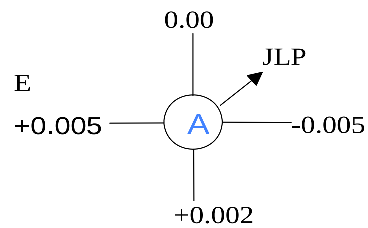
| **Journal Bearing Pads Thickness** | | | | |
|---|---|---|---|---|
| **PAD** | **NORTH SIDE BEARING** | | **SOUTH SIDE BEARING** | |
| | **Before** | **After** | **Before** | **After** |
| No 1 | 14.27 | 14.27 | 14.26 | 14.26 |
| No 2 | 14.27 | 14.27 | 14.26 | 14.26 |
| No 3 | 14.27 | 14.27 | 14.26 | 14.26 |
| No 4 | 14.27 | 14.27 | 14.26 | 14.26 |
| No 5 | 14.27 | 14.27 | 14.26 | 14.26 |
| **Thrust Bearing Pads Thickness** | | | | |
| **Pad** | **ACTIVE (Inner)** | | **INACTIVE (Outer)** | |
| | **Before** | **After** | **Before** | **After** |
| No 1 | 12.67 | 12.67 | 12.67 | 12.67 |
| No 2 | 12.67 | 12.67 | 12.67 | 12.67 |
| No 3 | 12.67 | 12.67 | 12.66 | 12.66 |
| No 4 | 12.65 | 12.65 | 12.66 | 12.66 |
| No 5 | 12.68 | 12.68 | 12.67 | 12.67 |
| No 6 | 12.66 | 12.66 | 12.66 | 12.66 |

## ALIGNMENT READING RECORDS: 101-J TRAIN

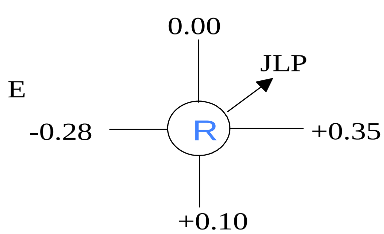
### 101-JT to 101-JLP

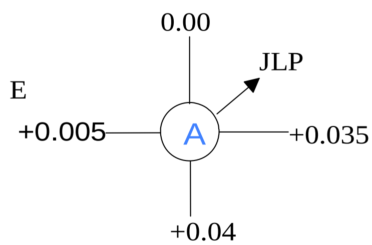
**Before Preventive Maintenance**



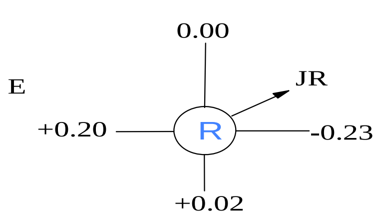

**After Preventive Maintenance**

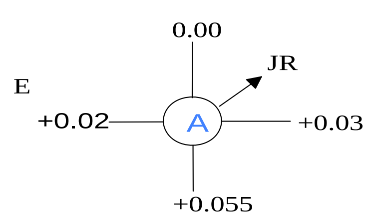


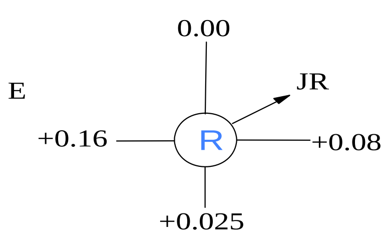

### 101-JLP to 101-JR

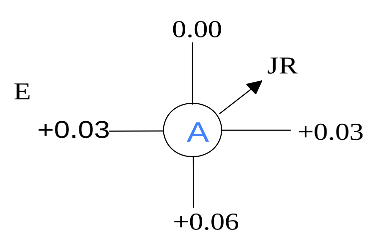
**Before Preventive Maintenance**



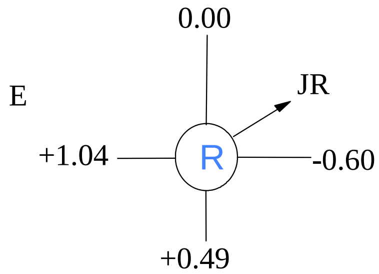

**After Preventive Maintenance**

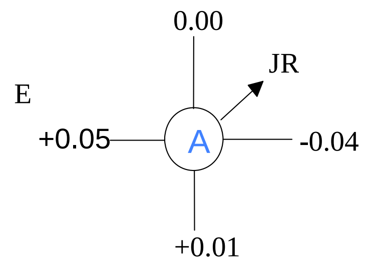


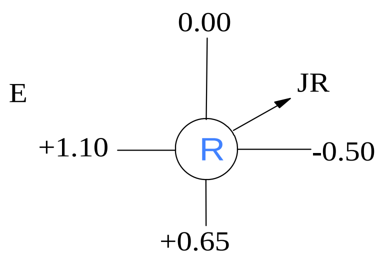
## 101-JR to 101-JHP

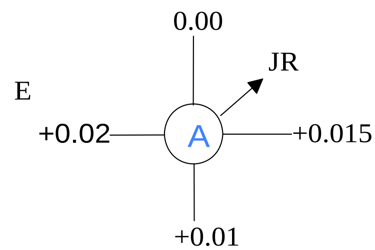
**Before Preventive Maintenance**




**After Preventive Maintenance**




## REPLACEMENT OF LO CONSOLE OF 101-J/105-J

The existing LO Console of 101 J and 105 J Train was supplied and installed by M/s De-Laval along with the compressor train. The main Lube oil and Auxiliary oil pumps are vertically mounted and have Carbon Steel Oil Console. Due to ageing, instrumentation is of old design and the switch over time is not sufficient, making the system unreliable. In view of this, replacement of the existing Lube oil & Seal oil with complete new System having horizontal pumps, Turbine and Lube Oil Console as per API 614 with increased capacity and Stainless Steel construction was planned to increase the reliability of 101-J and 105-J trains. Also by making pumps and drive turbines horizontal, the maintenance will be easy and can be carried out fast.

Order for supply of the console was placed on M/s. Enpro Industries Pvt Ltd., Pune against PO No. – 201004161503 dtd 01-MAR-16.

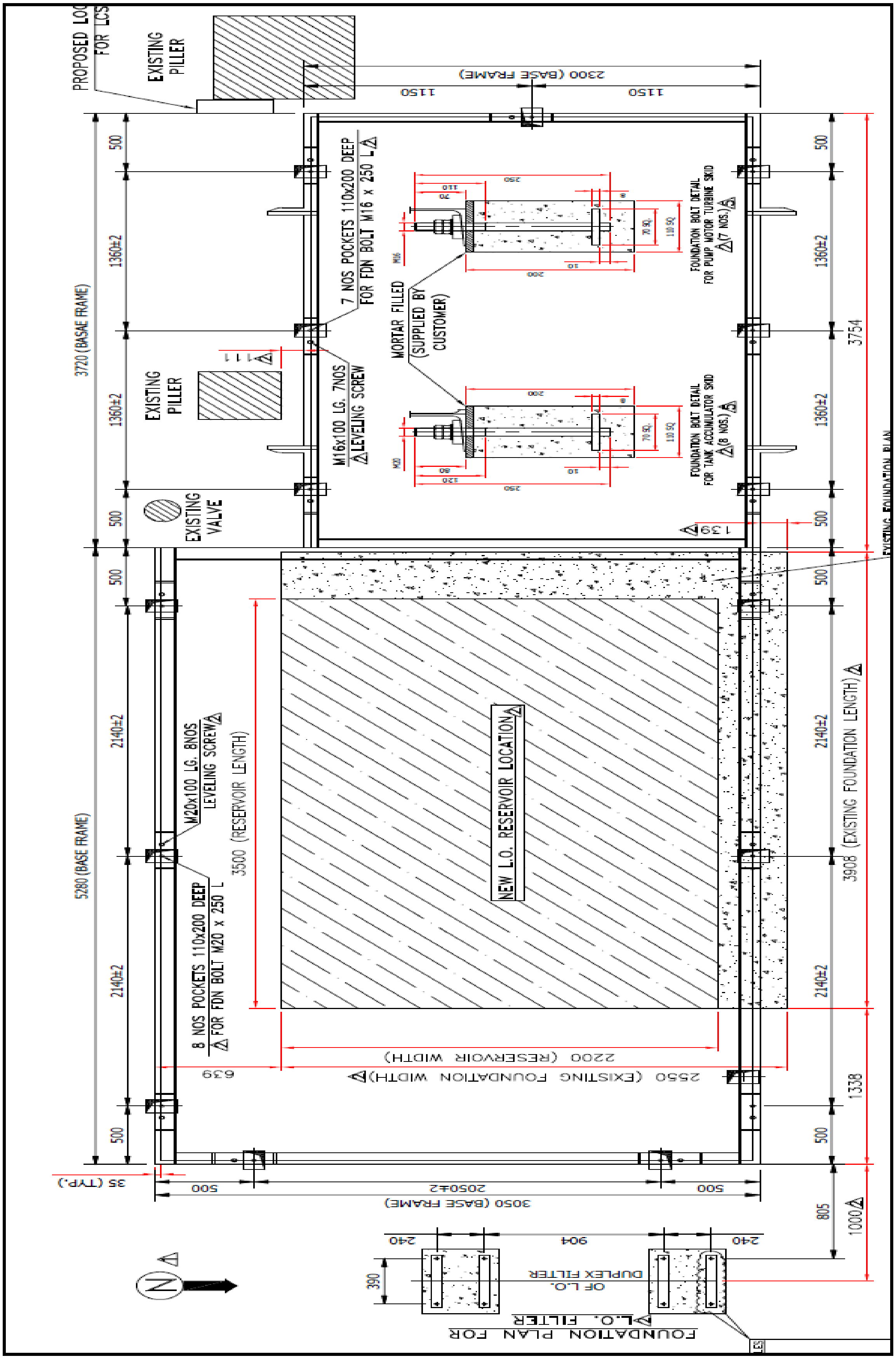
New Rundown tank for 101-J and 105-J was also installed. Both RD tank was supplied by M/s. Enpro against the above PO.

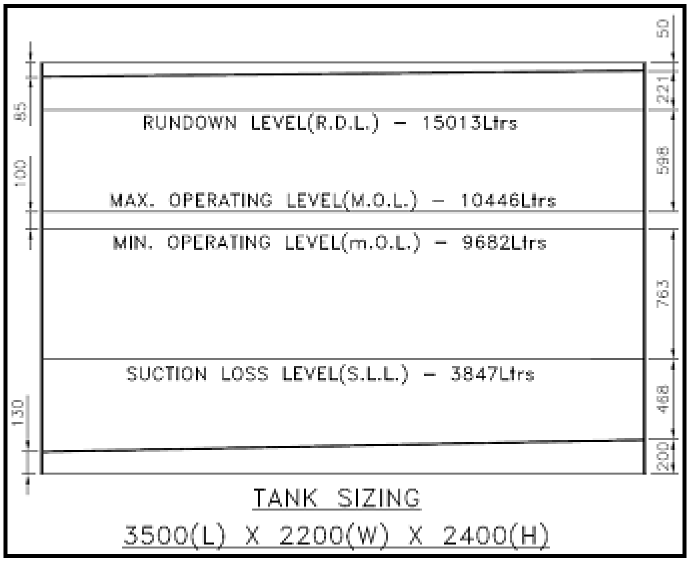
Complete replacement of LO Console, RD tanks and all steam piping were included in the scope of M/s. Onshore Construction Pvt., Ltd., Mumbai against Erection Contract of ESP. Work order No 201004171302 dtd. 13/12/2016.

The fabrication jobs for rerouting the LO lines of 101-J /105-J Console and fabrication of LO lines of RD tank and installation of these lines was carried out by M/s J&J, Shertha against WO no. 201004171687 dtd. 08/02/2017.

**Capacity of New L.O. Console is given below :**

The approx. Rundown capacity of old console is 10860 Ltrs & Operating Capacity is 9250 ltrs.


FOUNDATION PLAN FOR L.O. FILTER
DUPLEX FILTER OF L.O.
PROPOSED LOC FOR LCS
EXISTING PILLER
EXISTING VALVE
2300 (BASE FRAME)
3720 (BASE FRAME)
5280 (BASE FRAME)
3050 (BASE FRAME)
7 NOS POCKETS 110x200 DEEP FOR FDN BOLT M16 x 250 L
M16x100 LG. 7NOS LEVELING SCREW
MORTAR FILLED (SUPPLIED BY CUSTOMER)
FOUNDATION BOLT DETAIL FOR PUMP MOTOR TURBINE SKID (7 NOS.)
FOUNDATION BOLT DETAIL FOR TANK ACCUMULATOR SKID (8 NOS.)
M20x100 LG. 8NOS LEVELING SCREW
8 NOS POCKETS 110x200 DEEP FOR FDN BOLT M20 x 250 L
3500 (RESERVOIR LENGTH)
NEW L.O. RESERVOIR LOCATION
2200 (RESERVOIR WIDTH)
2550 (EXISTING FOUNDATION WIDTH)
3908 (EXISTING FOUNDATION LENGTH)
EXISTING FOUNDATION PLAN
35 (TYP.)




**New 101-J/105-J LO Console Sizing**

**The following activities were carried out for replacement of Console:**

<u>Pre Shutdown Activities</u>

- Ladder near LO Console was removed
- Pre fabrication of LO lines of 101-J and 105-J to RD tank wherever possible was started
- Base plate of new console was in two parts- One for LO console and other for pump and drives. The excavation job for foundation of base plate of Pump was started and foundation was laid before Shutdown.
- Underground cooling water lines which were required to be rerouted where pre fabricated and kept ready. Excavation job was also started.
- Inlet line and Outlet line of 130-JC was to be modified from 6” to 8”. Pre fabrication of this line wherever possible was kept ready
- Fabrication of all temporary piping and spool pieces for flushing of LO piping were made ready.

**Excavation job for foundation and CW lines modification**

**Foundation job of pump and drives under progress**

Shutdown Jobs

- Existing instruments, instrument cables, tubing etc were removed
- Electrical cables and JB's were removed
- Existing LO filters 6 way valves and cooler lines were removed
- LO was drained to old LO drums using centrifuge and pump
- The structure above the console were cut and removed for removal of console.
- The foundation bolts were loosened
- The LO Console was lifted by 250 MT Crane of M/s Onshore along with existing pump and drives were removed from LO console.(Appx Weight – 7 MT)


**Dismantling & Removal of existing 101-J / 105-J LO console**

- The crane was placed at 127-CA/CB side during removal.
- Bottom level of new LO Console was to be kept at a lower level than the old one. Hence Top of old foundation was broken and removed by Civil. Top of LO Console foundation was made parallel to the top of the foundation for pump and drive.

**Foundation after removal of LO console**

**Foundation of LO console after breaking of top portion**

- The dimension of LO console was checked with the available space and it was observed that the Instrument Panel mounted on the new Console will foul with the steam inlet line of 101-JT. Hence the top portion of panel was cut and removed and instrument position was changed before erection.

- The LO console base plate was also shifted slightly towards Silo side for accommodating the length of the console.

**Lifting of new 101-J/105-J LO Console for Erection**

**Erection of LO Console**

- The weights are given below:

| Description | Approx. Weight | Remarks |
|---|---|---|
| LO Console skid | 14.5 MT | Accumulators were not installed in the skid during erection. |
| Pump and drive skid | 6.4 MT | |

- Base plate with LO Pump and drives were lifted and inserted.
- However it was not kept in position to provide space for erection of LO console skid.
- Then LO console skid was lifted. Accumulator's and LO piping were not installed in the skid during erection. The structures which were fouling were cut and removed during erection.
- Erection was done using 450 MT Liebherr crane of M/s Onshore
- After positioning LO console base plate, pump base plate was also positioned.
- Then the bolting between the two skid was provided
- LO pump suction and discharge lines were provided. Before final tightening, it was ensured that pump to drive alignment was not disturbed.
- Then Levelling of base plate was done by water level
- Master level of AOP and MOP was checked.
- Released for pocket grouting.
- After curing (24 hrs) Alignment of MOP and AOP checked.
- Alignment of Pump to turbine was adjusted. Suction line of MOP was cut and re-weld for correcting the alignment
- Released for base plate grouting
- Accumulators and LO piping were installed. GO accumulator filling pressure- 8.5 Kg/cm2g & LO accumulator filling pressure – 5.5 Kg/cm2g.
- All LO piping in skid was provided. Minor modification was required in the LO piping to cooler as the Console base plate was shifted from its original position.

- LO Filters were installed near console skid as per the layout and routing was done.

**<u>Fabrication of LO Piping</u>** (Ref Drg Nos. P1-DS-13078 to 82)

- Lube Oil & Governor Oil inlet and return headers of 101-J was modified.
- Lube Oil & Seal / Governor Oil inlet and return headers of 105-J was modified as per requirement
- RD tank inlet and overflow lines of 101-J and 105-J tanks were fabricated
- Lube oil lines of Centrifuge and make up oil pumps were rerouted
- Pickling & passivation of all SS pipes carried out.
- These lines are cleaned by hydojetting and then by air blowing

**<u>LO Flushing</u>**

- Manhole of new LO Console was opened and internal inspection was done.
- LO which was removed from the Console was filled upto minimum level
- 101-J AOP was used for flushing.
- Flushing was started on 25/03/2017, 22.00 Hrs. LO was circulated through the inlet header and then to RD tank overflow line and through RD tank overflow line it was connected to return header. Compressor headers on platform were not taken in circulation.

**105-J GO and LO lines bypassed**

**For flushing LO inlet header 101-J GO and LO lines bypassed**

- RD tank was also not kept in circulation loop.
- Spool piece made for installation of 2oo3 of both 101-J and 105-J was also flushed by providing in the loop.
- Conical strainer with 100 mesh screens was installed at the return line flange connection to console.
- MOP was started at 02:00 Hrs on 29.03.17

- Degasser was also taken in line. But it was observed that black deposits in degasser were getting circulated in the loop. Hence degasser was removed from loop. Then it was cleaned. Later it was taken in line.
- After clean mesh was obtained, LO filter was also taken in line.
- AOP was started for flushing and after few hours of running, when filter was opened, it was found that the filter was torn and badly damaged.
- Replaced the filter and pump was started. Again it was observed that the filter was torn and badly damaged.
- Again AOP started after replacement of filter and dP was observed. The dP increased upto 1.3 Kg/cm2 and then reduced to 0.11 Kg/cm2g.

**Damaged Filter cartridge of 101-J LO Console**

- M/s. Enpro was contacted and they informed that the filter and filter elements are designed for outward to inward flow. But the piping connection attached to the filter nozzles are such that the oil flow is from inward to outward. This was a major error made by M/s. Enpro during fabrication.
- Piping was modified such that oil inlet to filter was connected to top nozzle and outlet connection was connected to the bottom nozzle of filter.
- Spool piece was separately flushed from outside and then it was installed and flushing was started again.
- After 100 mesh was found Ok, then 200 mesh filter was taken in line of flushing loop.
- During flushing, RD tank was bypassed by interconnecting inlet and overflow line. Later blind was provided at inlet line of RD tank as the time taken for draining the LO in RD tank piping was more and isolation time for checking and cleaning of mesh was increased.

- On 05.04.17 after mesh was found OK, oil console was drained and cleaned. Both RD Tank was also cleaned

- New oil was filled

- LO Circulation was started on 07.04.17, 11.00 PM with 200 mesh without filter
  - Mesh was provided at bearing header inlet and return header outlet
  - Blind was provided at all bearing inlet of turbine and compressor
  - Blind at Governor oil inlet
  - Blind at RD tank inlet line
  - End of the inlet header was connected to return header.
- Then filter was taken in line.
- On 10.04.17, 11.00 hr. 200 mesh screen was provided at GO inlet and all bearing inlet to turbine and compressor and flushing started through bearings.
- Seal oil lines were not in line during flushing to avoid the entry of oil in compressor casing due to insufficient pressure of IG.
- Removed all mesh screens & boxed up the lines finally after clean mesh was observed.
- On 10.04.17, 23.00 hrs, LO system was taken in line.

**Other Jobs**

- Existing gland condenser of 101-JT was shifted as it was fouling the location of filter. CW line, steam line and condensate line of GSC were rerouted as per site requirement.

- Underground Cooling water lines were re routed as per requirement.

- LO cooler inlet and outlet line were required to be modified as the LO Console was shifted slightly towards Silo side.

- Cooling water lines to turbine bearing were fabricated.

- Drain lines of turbines were fabricated.

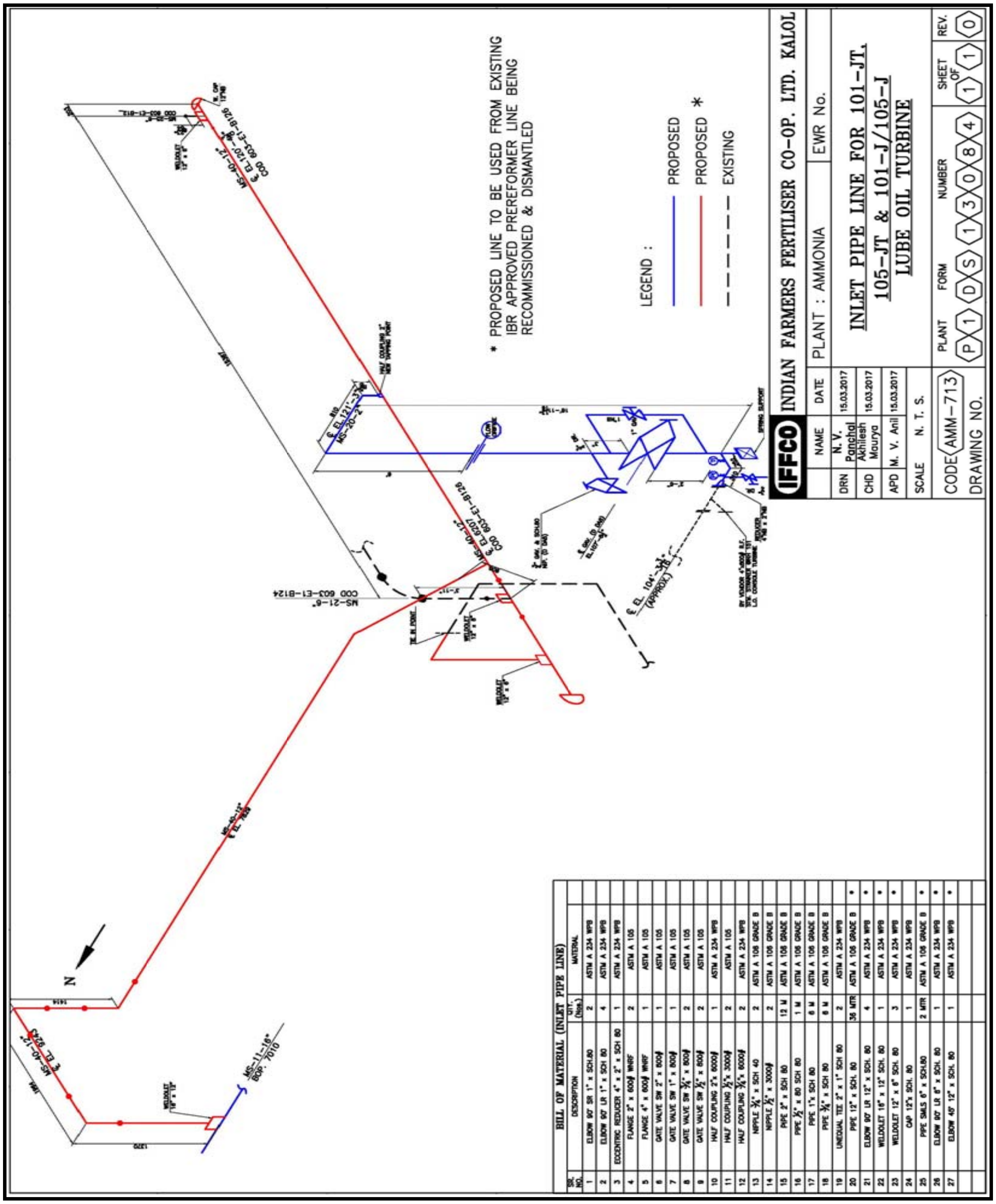
**Steam inlet and Exhaust Fabrication**

- Fabrication of steam inlet line of new LO turbine was made. Refer isometric drg No.: P1-DS-13084.

- Fabrication of arrangement for target blowing was also made and steam blowing was done.

- Steam blowing of inlet line was done and after target was found OK, line was connected with turbine.

- Fabrication of steam exhaust line of new LO turbine was made as per Isometric Drg No: P1-DS-13087




**NOTE**:

- Inlet line of 112 JAT was also modified which is not shown in the above Iso
- Please Refer As built drg for the above and other minor changes made as per site requirement.

**LO Pump Drive Turbine (101-JLJT) Commissioning**

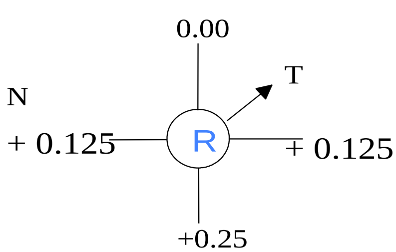
| | |
|---|---|
| Tag No. | TDD – 100140723 – 0020 |
| Model | KTB-18-EG III |
| So. No. | 50200011 |
| Sr.No. | KTBE16D010 |

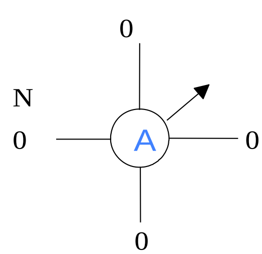

**Turbine Name Plate Detail**

- Turbine was started with new actuator (Sr. No. 20604615, Part No. 8516-050) supplied along with turbine. The existing Woodword governor PEAK 150 was used.
- Solo run of turbine carried out. OST was done on 12.04.2017
  - Mech trip was done thrice: OST- 1680 /1712/1690 RPM
  - Electronic Trip from governor set at - 1660 RPM
- Coupling with pump was done after final alignment.
- The following problems were encountered during commissioning of turbine:
  - During load it was observed that the governor valve get stuck up.
  - After opening, it was observed that governor valve stem was 0.3 mm bend at follower area. Light cut taken at gland portion and end seat area by 0.2 mm. Then assembled and found ok.
  - It was observed that the TTV was passing. Hence lapping between valve and valve seat done. After checking found ok.
  - Earlier the existing PEAK 150 was used. This was replaced with new PEAK 150 supplied along with the turbine.
  - During solo and load run, governor tuning was done. However the turbine was tripping while running. To resolve this issue, KEPL called Woodword Engineer. It was resolved after configuring the Woodword governor.
  - During load run, it was observed that the governor was hunting. Again governor tuning was done and found Ok.
  - During alignment of Turbine to pump it was observed that the coupling hub of turbine is loose with shaft. It was tightened with grub screw.

**<u>Alignment of Turbine with Pump</u>**

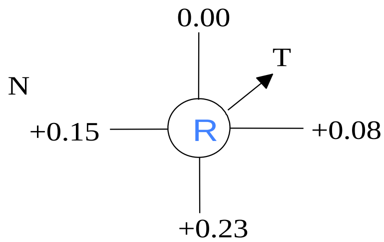
**<u>101-JLJT Protocol Reading</u>**

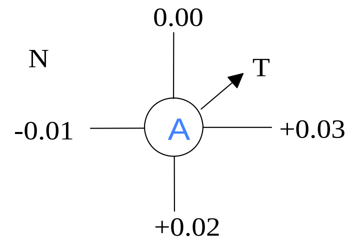



Allowable – 0.25 +/- 0.05 mm
DBSE= 140.0mm +/- 0.50

**Final Alignment Reading**




DBSE= 140.40 mm

**<u>Guarantee Test Run of 101-JLJT</u>**

GTR of turbine was done on Dt.: 24 May, 2017. MOM is attached below.

**Records of Minutes of Meeting held between M/s Siemens Limited, M/s IFFCO at IFFCO Plant, Kalol, Gujarat**

**Sub. : Performance evaluation of new steam turbine [12.5 MW] drive of Synthesis Gas Compressor (103-J) supplied by M/s Siemens, Vadodara**

**Dated : 19th June 2017**

**Members Present:**

| Siemens Limited | IFFCO |
|---|---|
| Mr. Laxmaiah Rakam | Mr. BPS Mehta |
| Mr. Raju Kadian | Mr. Sandeep Ghosh |
| Mr. Avnishdutt Pandya | Mr M M Patel |
| Mr. Niraj Patel | Mr.O.P.Yadav |
| | Mr. Santosh Kataria |
| | Mr. Upendra Chaudhary |
| | Mr A K Gupta |
| | Mr Amarkant |
| | Mr. MV Anil |
| | Mr Akhilesh Maurya |

Following points were discussed and agreed during the visit at IFFCO, Kalol site on 24th May-17 for performance evaluation of new steam turbine [12.5 MW] drive of Synthesis Gas Compressor (103-J), supplied by M/s Siemens, Vadodara .

1. As requested by M/s IFFCO, M/s Siemens had submitted comparison of original HMBD and new HMBD of 11.7 MW with detailed break-up vide mail 25th May 2017 and the same being attached herewith as Annexure-1 *for reference*.
2. Based on the plant actual operating readings, following points are discussed and agreed for performance evaluation of new steam turbine drive of Synthesis Gas Compressor (103-J) at Ammonia Plant:

Page **1** of **3**

a) Since the readings of turbine Inlet steam flow (FR8101) does not match with the Turbine HP Wheel chamber pressure, Steam drum (101-F) out steam flow (FR-33) will be considered for calculation of Turbine power.

b) The extraction steam flow requirement of Ammonia Plant fairly matches with the measured flow at Turbine extraction steam flow nozzle (FR8104), compensated steam flow of FR8104 will be considered for extraction steam from turbine.

c) Exhaust steam flow will be calculated based on the difference of steam drum outlet steam flow (FR 33) less measured extraction steam flow (FR 8104). That the calculated exhaust flow matches fairly with the measured LP Chamber pressure.

3. Due to lower HP steam superheat temperature at turbine inlet, it was not possible for M/s. IFFCO to achieve turbine Inlet temperature of 441 degC as per original HMBD for 12.5 MW power. Hence, it was mutually agreed to conduct a PG test at about 12.5 MW on 24th May-17 at present operating conditions.

4. Turbine & Compressor data collected during the PG Test and parameters are attached as Annexure-II for reference. Turbine Performance Guarantee Test results (PG) has been given at Annexure-1 (Column –D).

5. THE PG test results shows that new steam turbine(103-JT) is delivering the guaranteed power of 12.5 MW at prevailing steam conditions for 1140 MTPD ammonia plant load.

6. M/s Siemens agrees to jointly re-evaluate the performance of turbine alongwith M/s. IFFCO when HP steam superheat temperature of 441 degC at turbine inlet will be achieved after about one year . This evaluation at a future date shall be carried out by M/s. Siemens without any financial and contractual liability to each other.

7. Turbine performance test was conducted on 24th May-17 with following activities :

a. All flow measurements have been checked for correctness of ranges and design data input for compensation.

b. Before data collection, below drains were *closed* for cycle isolation

- Drains in main steam line from Boiler flow orifice (FR33) to TG Inlet
- Turbine control valve drains
- Turbine casing drain [High Pressure], [Low pressure drains were kept Open].
- Turbine Balance Piston (AK-1) line drain

c. The test was conducted on 24th May-17 from 16:15 to 17:15. The data were collected at an interval of 3 mins for both compressor & Turbine simultaneously in the form of screenshots. All data have been tabulated & attached herewith (Refer annexure-2).

8. M/s Siemens and M/s IFFCO evaluated jointly the test data and results are indicated in column D of Annexure-I for reference. Based on results it has been concluded that the PG test of turbine is completed and accepted by M/s. IFFCO corresponding to load point -7 ( 12.5 MW – normal power with minimum inlet steam parameters) of original contractual HMBD.

9. PG test report has been submitted along with this MOM as annexure – 3. Based on the test data and evaluation , corrected specific steam consumption is 14.86 kg/kwhr against 15.17 Kg/kwhr.

**SIEMENS LIMITED (SL)**

19.6.17

N.D. Patel

**M/s IFFCO**

19.6.17

Sandeep Ghosh 19.6.17

19.6.17.

19.6.17

19.06.17

19.6.17

## Commissioning of new LO Console

- LO circulation was started with AOP.
- Lube oil pressure was set at 2.1 kg/cm2 and governor oil pressure set at 10.00 kg/cm2 at 48 deg C temperature.
- AOP start command during pump change over changed from transmitter (PT 407) to (PT 403).Ref PID of LO Console of M/s. Enpro, Drg. No- 15247, Rev 03.
- When both pumps were tripped,
  - Accumulator lube oil header pressure hold up to 24 sec (Designed for 16 sec)
  - Governor oil header pressure sustained 9.5 kg/cm2 for more than 2 minutes (Designed for 32 sec)
  - Seal oil inlet valve was fully closed during both pumps tripping condition.
- Lube / Gov oil dump valve (PCV-401) sensing point was changed
  - from accumulator d/s to filter outlet PI
  - Then it was shifted to upstream of PCV

- Started AOP while MOP is running during which PRV was not lifted and there was no hunting of PCV. Maximum lube oil header 2.5 kg/cm2 and Discharge pressure 12.7 Kg/cm2.
- MOP to AOP change over checked and was within 3 second without pressure drop.
- AOP to MOP changeover was checked and was within 3 second without any pressure drop.

**NEW RUNDOWN TANK FOR 101-J TRAIN, 103-J TRAIN & 105-J TRAIN**

The Air compressors & drive turbine, Refrigeration compressors & drive turbine and Synthesis gas compressor & drive turbine were not having any special provisions to ensure adequate supply of backup lube oil in the event of complete failure of their primary lube oil supply system.

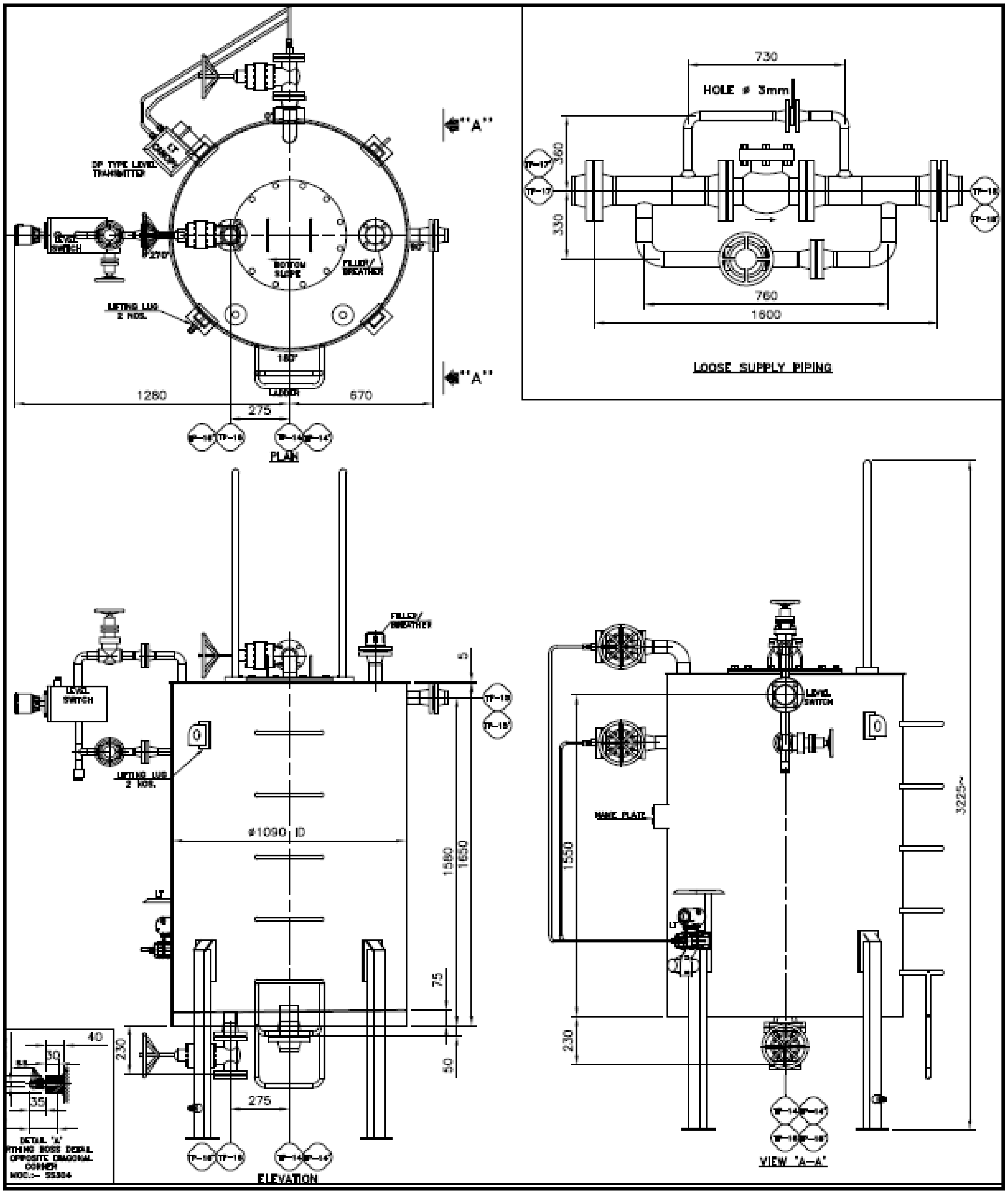
In line with API-614, it was decided to provide provision of rundown tanks to supply the backup lube oil. Atmospheric rundown tanks were designed, manufactured & supplied by M/s Enpro Industries. These tanks were designed for minimum 3 minutes of coast-down time.

| EQUIPMENT | LUBE OIL FLOW (LITERS/MIN) | VOL / 3 MIN (LITERS) | RUNDOWN TANK VOLUME (LITERS) |
|---|---|---|---|
| 101-J | 422 | 1266 | 1350 |
| 105-J | 414.5 | 1243.5 | 1350 |
| 103-JAT | 186.6 | 559.8 | 1000 |
| 103-JLP/JHP | 125 | 475 | 1000 |

For installation of the tanks, the elevation of the overflow nozzle was calculated so as to maintain a maximum static head less than the low Lube oil trip pressure at the beginning of the coast-down.

| Sr No | Description | 101-J | 105-J | 103-JLP / JHP | 103-JT |
|---|---|---|---|---|---|
| 1 | Height of CL of Overflow Nozzle from CL of turbine (mm) | 5780.35 | 5780.35 | 5834.31 | 12835.47 |
| 2 | Centre line of Turbine from Ground level (mm) | 4791.4 | 4502.4 | 4026 | 4064 |
| 3 | Approx. Elevation of Overflow Nozzle from Ground Level (mm) | 10571.75 | 10282.75 | 9860.31 | 16899.47 |
| 4 | Pressure at Overflow Nozzle (Kg/cm2g) | 0.5 | 0.5 | 0.5 | 1.1 |
| 5 | Trip Pressure (Kg/cm2g) | 0.56 | 0.56 | 0.55 | 1.5 |
| 6 | Sp. Gravity | 0.865 | 0.865 | 0.857 | 0.857 |

**Erection of 101-J RD Tank**



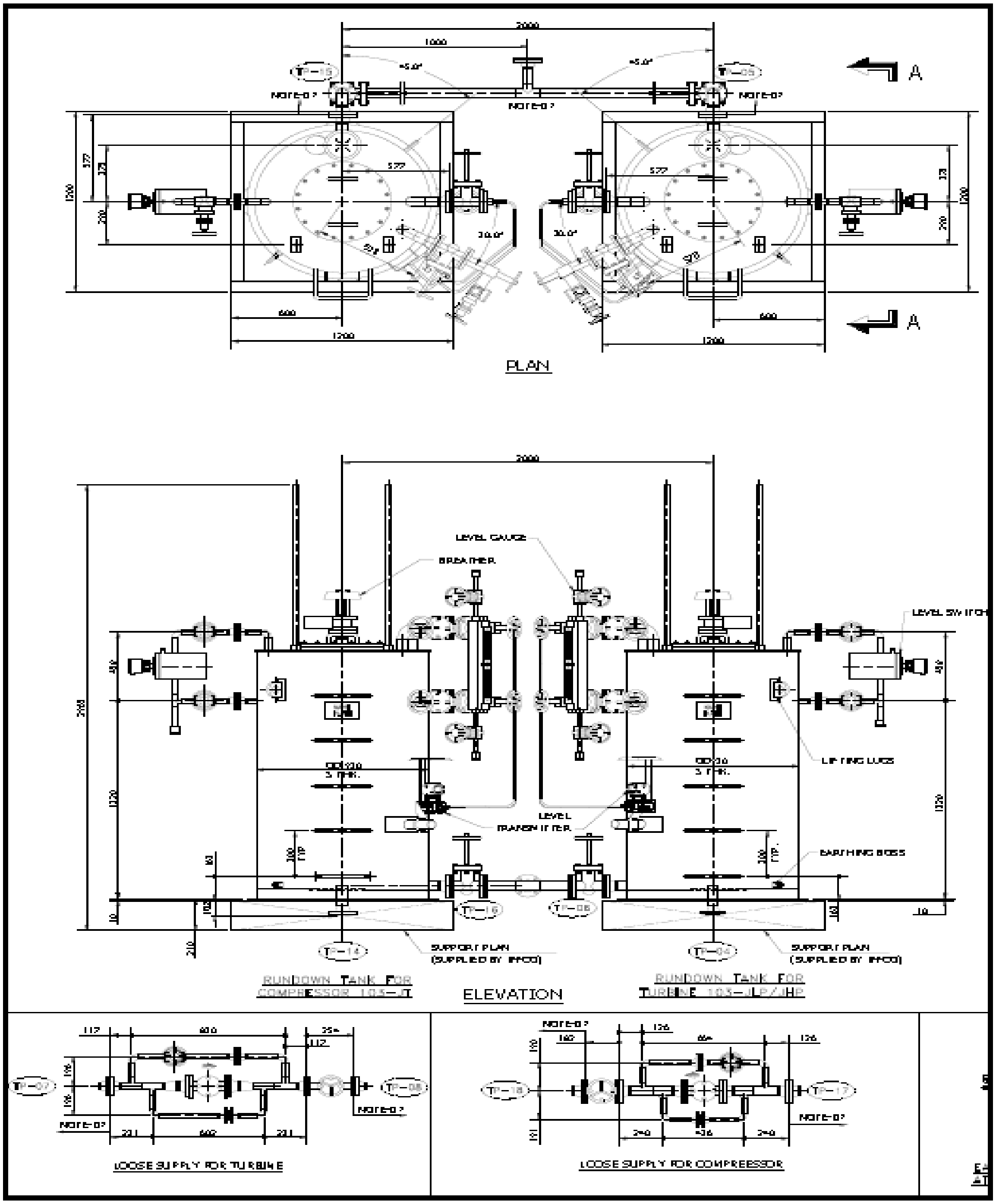

**101-J & 105-J RUNDOWN TANK**

**101-J**

Type : Atmospheric
Tank Capacity : 1350 litres
Material of construction : SS 304
Lube oil supply line : 3” NB
Overflow line : 2” NB
Oil : ISO VG 68
Supply period : Approx. 3.19 minutes
Max static head : 0.5 kg/cm2

**105-J**

Type : Atmospheric
Tank Capacity : 1350 Litres
Material of construction : SS 304
Lube oil supply line : 3” NB
Overflow line : 2” NB
Oil : ISO VG 68
Supply period : Approx. 3.25 minutes
Max static head : 0.5 kg/cm2




**103-JT & 103-J RUNDOWN TANK**

**103-JT**

Tank Capacity : 1000 litres
Type : Atmospheric
Material of construction : SS 304
Lube oil supply line : 2” NB
Overflow line : 2” NB
Oil :  ISO VG 32
Supply period : Approx. 5.35 minutes
Max static head : 1.1 kg/cm2

**103-JLP / JHP**

Tank Capacity : 1000 litres
Type : Atmospheric
Material of construction : SS 304
Lube oil supply line : 1 ½” NB
Overflow line : 2” NB
Oil :  ISO VG 32
Supply period : Approx. 8.0 minutes
Max static head : 0.5 kg/cm2

**INSTALLATION OF RD TANKS**

New platforms were fabricated and erected for the above tanks. To maintain the desired elevation, stools were fabricated for rundown tank of 105-J, 103-JT and 103-JLP/JHP. The rundown tanks were erected and levelled. The fabrication of piping were carried out as per the isometric and site conditions.(Refer 101-J /105-J, 103-JT and 103-JLP/HP LO line fabrication) The fabricated lines were removed and cleaned by hydro jetting. Wire brush cleaning followed by pickling of the weld joints were carried out with a solution of 20% $HNO_3$, 4% HF & DM water. All these lines were reinstalled and arrangement for flushing was done. The rundown tank was completely bypassed by connecting the overflow line & inlet/outlet line using a flexible hose jump-over. Flushing was carried out with 100 and 200 size mesh in line. This mesh was cleaned from time to time & flushing was continued till no particle was found on the mesh.

Post flushing, the rundown tanks were connected with their respective piping. The tanks level switch & PD type level transmitter which were hooked up with DCS for low-level alarm and high-level permissive start functions.

**SYNTHESIS GAS COMPRESSOR TRAIN, 103-J**

Synthesis gas compressor 103-JLP & 103-JHP is driven by back pressure turbine (103-JAT) and condensing turbine (103-JBT) in tandem. The replacement of both turbines with single extraction cum condensing turbine (103-JT) was planned under Energy Saving Project – III. The replacement was carried out during Annual turnaround, 2017.

The Purchase order No. 201004160192 dtd 09/07/2015 for Supply of Steam Turbine along with New Governing system was placed on M/s Siemens, Vadodara. The turbine was manufactured indigenously by Siemens at their Vadodara works. Supervisory Services for Erection, Installation & Commissioning of Turbine and Governing System was also carried out by Siemens against WO No. 201004160271 dtd 09/07/2015.

Complete replacement of Turbine and accessories and Piping jobs of Steam Inlet, Extraction and Exhaust, HP Control oil piping, GSC Piping were included in the scope of M/s Onshore Construction Pvt., Ltd., Mumbai against Erection Contract of ESP. Work order No. 201004171302 dtd 13/12/2016. Sub contract was given by M/s Onshore Construction to M/s BVL, Hyderabad for turbine removal and installation jobs.

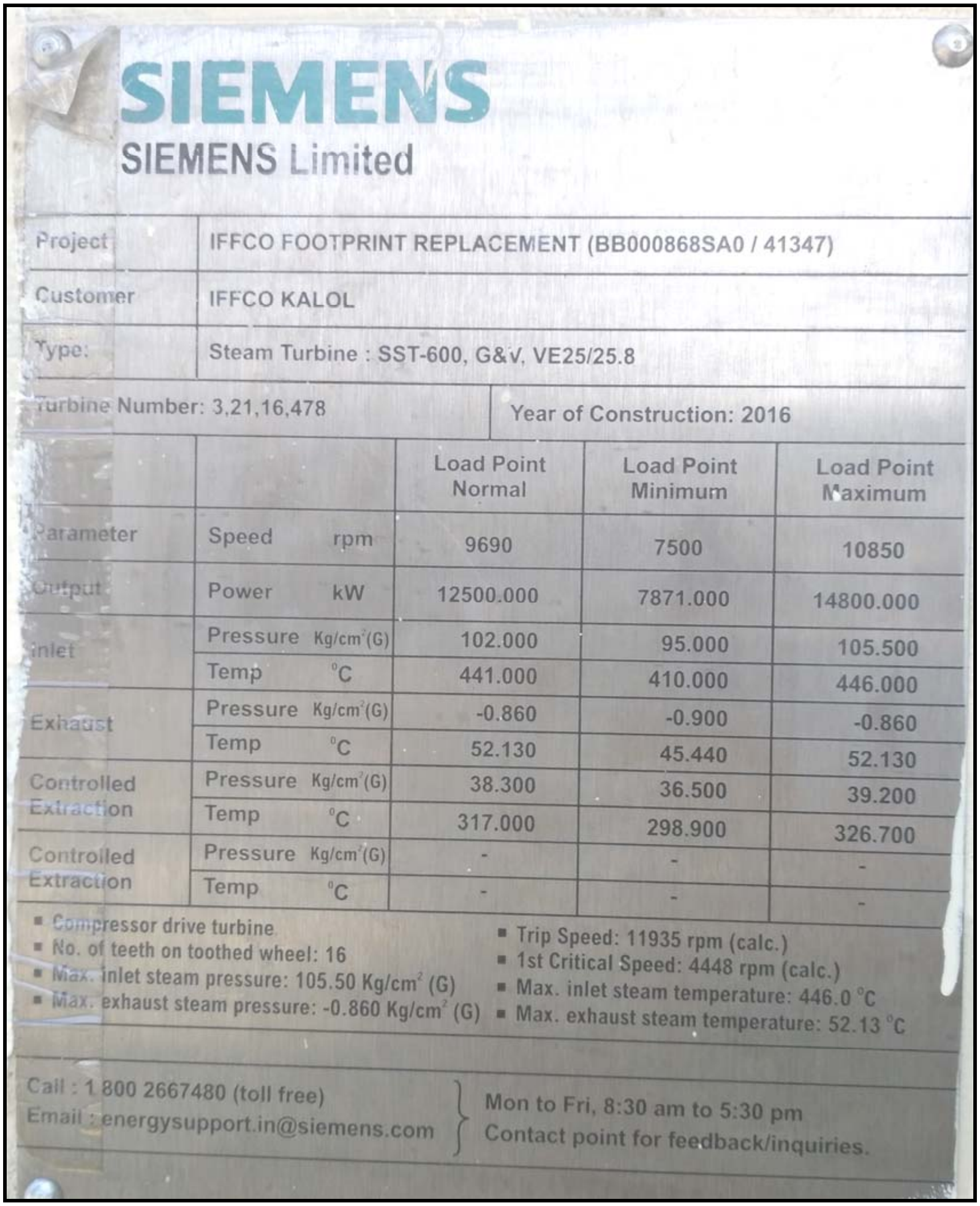
New separate Rundown tanks were also installed for 103-JT turbine and 103-JLP & 103-JHP compressors due to different LO header pressure for turbine & compressors in the modified LO system. RD tank was supplied by M/s Enpro Industries Pvt. Ltd, Pune against PO No. 201004171097 dtd 11/09/2016.

The fabrication and installation of new LO lines of 103-JT, 103-JLP and 103-JHP RD tanks were carried out by M/s J&J, Shertha against WO no 201004171687 dtd 08/02/2017.

The Hose & Hose fittings required for HP oil flushing were procured from M/s. Hydroflex Pipe Pvt. Ltd., Ahmedabad against PO No. 201004180219 dtd 27/05/2017

Rear view of New Turbine

Front view of New Turbine



SIEMENS

SIEMENS Limited

| | |
|---|---|
| Project | IFFCO FOOTPRINT REPLACEMENT (BB000868SA0 / 41347) |
| Customer | IFFCO KALOL |
| Type: | Steam Turbine : SST-600, G&V, VE25/25.8 |
| Turbine Number: 3,21,16,478 | Year of Construction: 2016 |

| | | | Load Point Normal | Load Point Minimum | Load Point Maximum |
|---|---|---|---|---|---|
| Parameter | Speed | rpm | 9690 | 7500 | 10850 |
| Output | Power | kW | 12500.000 | 7871.000 | 14800.000 |
| Inlet | Pressure | Kg/cm²(G) | 102.000 | 95.000 | 105.500 |
| | Temp | °C | 441.000 | 410.000 | 446.000 |
| Exhaust | Pressure | Kg/cm²(G) | -0.860 | -0.900 | -0.860 |
| | Temp | °C | 52.130 | 45.440 | 52.130 |
| Controlled Extraction | Pressure | Kg/cm²(G) | 38.300 | 36.500 | 39.200 |
| | Temp | °C | 317.000 | 298.900 | 326.700 |
| Controlled Extraction | Pressure | Kg/cm²(G) | - | - | - |
| | Temp | °C | - | - | - |

- Compressor drive turbine
- No. of teeth on toothed wheel: 16
- Max. inlet steam pressure: 105.50 Kg/cm² (G)
- Max. exhaust steam pressure: -0.860 Kg/cm² (G)
- Trip Speed: 11935 rpm (calc.)
- 1st Critical Speed: 4448 rpm (calc.)
- Max. inlet steam temperature: 446.0 °C
- Max. exhaust steam temperature: 52.13 °C

Call : 1 800 2667480 (toll free)
Email : energysupport.in@siemens.com
Mon to Fri, 8:30 am to 5:30 pm
Contact point for feedback/inquiries.

**Name Plate Detail of New Syn. Gas Comp. Drive Turbine, 103-JT**

**Supply of turbine includes the following:**

- Extraction cum Condensing turbine
- Turloop Speed Governing System
- High Pressure Control oil system which includes HP oil console, HP Oil pumps, Oil circulation pumps, HP Oil Coolers, Accumulator station and Electrostatic Oil Purifier.
- Gland Steam Condenser with Flash Box
- Barring Gear

**Sequence of Activities:**

Pre-shutdown Activities

- Foundation Layout of components i.e. HP Control Oil System, HP Oil Cooler, Accumulator station, Flash Box was marked at site as per the Layout drg.

**Marking of Foundation Layout of HP Oil system and Accumulator**

**View after digging & debris removal**

- Foundation for these components was made and erection of these components except Accumulator station (due to restricted space) was carried out. Accumulator was installed during Shutdown after removal of 103-JAT exhaust piping.

**Pedestals of HPCOS & HP Oil Cooler**

**Pedestals of Accumulator**

Erection of HP Control Oil Console

Erection of HP Oil Cooler

- Gland Steam Condenser & Barring Gear skid was erected during shutdown on 26/03/2017. Position of Gland Steam Condenser was changed from the Layout drg. as per the site requirement. Support structure for Gland Steam Condenser was made to maintain the centerline of GSC 1225 mm from Turbine base frame bottom.
- Support base frame for Barring Gear skid was made & erection carried out on 05/04/2017.

**Gland Steam Condenser erected on 26/03/2017**

**Barring Gear skid Erection on 05/04/2017**

- Pre-fabrication of the following Piping's started as per Siemens isometric-drawings:

  62OC4007680_U1_623240005 – 01 to 14 Rev. A for IBR Piping
  62OC4007680_U1_623240008– 15 to 35 Rev. A for NIBR Piping
  62OC4007680_U1_623240008 – 36 to 43 Rev. A for Control Oil Piping

<u>Shutdown Activities</u>

- Plant shutdown was taken on 12/03/2017.
- Equipment was isolated and handed over to Maintenance on 13/03/2017.
- Lube Oil Circulation was stopped.

- All the instrument probes were disconnected and removed.
- Coupling Guards was opened.
- Couplings between 103-JAT & 103-JLP, 103-JLP & 103-JHP were disconnected.
- Turbine, LP & HP rotor moved towards HP compressor end. Measured DBSE between Turbine & LP = 445.11mm, DBSE between LP & HP = 487.04mm.
- Measured Thrust Float of LP Rotor = 0.38 mm, HP Rotor = 0.48mm
- Rotor centre was marked on base frame & elevation of rotor centerline was transferred to the nearby vertical column & measured with respect to base frame bottom of turbine.
- Removed insulation of piping.
- Disconnected the flanges & removed the piping of 103-JAT & 103-JBT Steam Inlet, extraction & Exhaust lines, LO Inlet & Outlet lines, drain lines etc.
- Loosened the nuts of foundation bolts of turbine base frame. Removed the nuts.
- After disconnecting all interconnected piping, electrical & Instrument connections & clearing area around the turbine, the complete turbine assembly alongwith base frame (weighing 30 ton) was lifted & removed from site at 16.30 hrs on 14.03.2017 by using 135 MT Kobelco Crane.

**Removal of Steam Inlet & Extraction Piping**

**Removal of Exhaust Piping**

**Removal of Extraction I/V**

**Removal of 103-JAT & 103-JBT alongwith baseframe**

**103-JAT and 103-JBT removed and kept on Ground floor**

**Foundation of 103-JAT and JBT after removal**

- Steam line connected with extraction line i.e. 101-JT & 105-JT steam inlet (8”), 103-JLOT, 103-JSOT steam inlet line (6”), 112-JAT steam inlet line (2-1/2”) were cut & removed the complete 8” steam header.

- Old epoxy layer and grouting material was broken using concrete breaker and cleaning of complete Turbine foundation area carried out. Manual cleaning after applying Tri Sodium Phosphate and then Hydrojetting was carried out to make the floor surface free from Oil which was necessary for bonding between old surface & new grouting.

**Turbine Floor Before cleaning** **Turbine Floor Cleaning**

- Centerline of turbine, position of foundation bolts and turbine base frame layout marked on the floor. Elevation was also checked.

**Marking of New Turbine Base frame layout on floor**

- Front 2 nos foundation bolts (M25 bolts) towards Control room side which were above the beam were to be reused. Hence these bolts were not removed.
- 6 Nos Foundation bolts (M25 bolts) were removed from the sleeve by hammering. The epoxy inside the sleeve was also removed.
- 2 nos foundation bolts towards Maintenance side was cut and removed as these foundation bolts were not required.

- 2 nos. new hole of 50mm dia was cut at the front end of foundation for additional HILTI foundation bolts of M36 as per the layout drg. using core cutter machine. The core cutting was done by outside agency by Civil.

**Core cutting for M 36 bolts**

- Position of 24 nos. packer plates (supplied by siemens) marked on the floor as per the layout drawing.

**Packer Plate positions marked on floor**

**Breaking & removal of Old grouting matl.**

- Micro chipping carried out on concrete solid foundation below packing plate area.
- Prussian blue applied on plate to check contact between packing plate and foundation and achieved more than 75% contact.
- Level of packer plate was checked with Master level (Max 0.02mm )
- After completion of Micro-chipping work, surface was cleaned by air & water.
- Packer plates (12mm thick) were fixed in their position using Shrinkkomp.(Min 6 hrs curing)

**Micro chipping**

**Blue check of Packer Plates**

**Packer Plate Level checking by Master Level**

**Fixing of Packer Plates using Shrinkomp**

**Surface Cleaned after Micro chipping & Blue checking**

**Packer plates fixed in their position using Shrinkomp**

- Elevation level of each packer plate measured. The turbine baseplate bottom was kept at **978mm** below the turbine centerline.
- Accordingly Shim plates of approx. 45mm (25+20mm) kept above packer plates
- Fixator supplied by Siemens (Fixator height was set at 37.50 mm) was kept on shim plates. Fixator is to be used for minor level adjustments during levelling of turbine.
- Water level of fixator top was checked

**Foundation after positioning of shim plates and fixator**

**Shim plates and fixator**

**Level checking**

- New HILTI foundation bolts of M32 were installed.
- Turbine assembly alongwith base frame (weighing 21 ton) was lifted using spreader beam by 250 MT Crane of M/s Onshore and placed on the foundation deck on 19/03/2017 at 18:30 Hrs.

**Turbine being lifted**

**Turbine being positioned on foundation**

- Center of the turbine base plate was matched with the existing shaft center.
- Water level of base plate checked and leveling of turbine was carried out by inserting shim as & where required.
- Polythene piece placed between rotor and bearing at both sides to prevent any damage during transportation was removed.
- Turbine centering and leveling by master level was carried out.

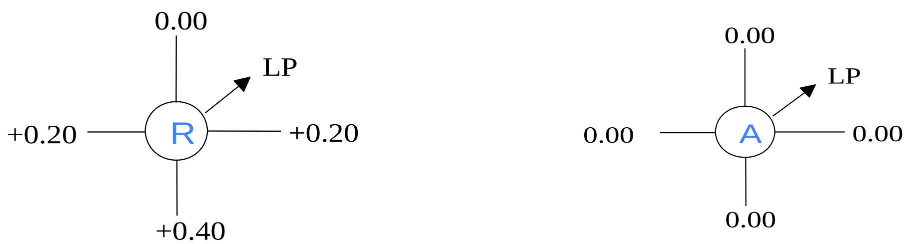
- To carry out leveling, turbine front & rear bearing top cover was opened and master level placed at machined surface of front bearing housing parting plane.
- The levelling was done using shims and adjustment of fixator

**Pre Alignment**

- LP compressor was placed on its foundation on 21/03/2017 after overhauling.
- Alignment fixture was made at workshop for carrying out alignment between turbine & LP compressor.
- Alignment of Turbine with LP compressor carried out on 22/03/2017.

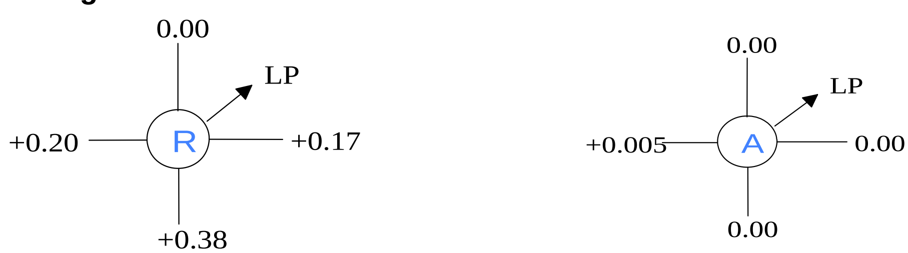
  Initial DBSE = 748.50 mm
- 2.5 mm shims were provided at compressor bottom

**Protocol Reading**




Note – Turbine to be kept 0.2 mm above compressor

**Actual Reading obtained**




- Front 2 nos. M32 foundation bolt pocket was grouted by Hilti make epoxy based chemical (HIT-RE 500).Nuts were hand tightened.

**Grouting of front 2 bolts using Hilti Chemical**

**Alignment Fixture fixed**

- The other foundation bolts pockets were grouted using epoxy.
- Nuts of M32 Foundation bolts (6 nos.) at the middle was hand tightened after fixing washer from top & Lock plate from bottom (Surface was leveled at the bottom and blue matching was done with the lock plate).

**Foundation bolt exposed from bottom**

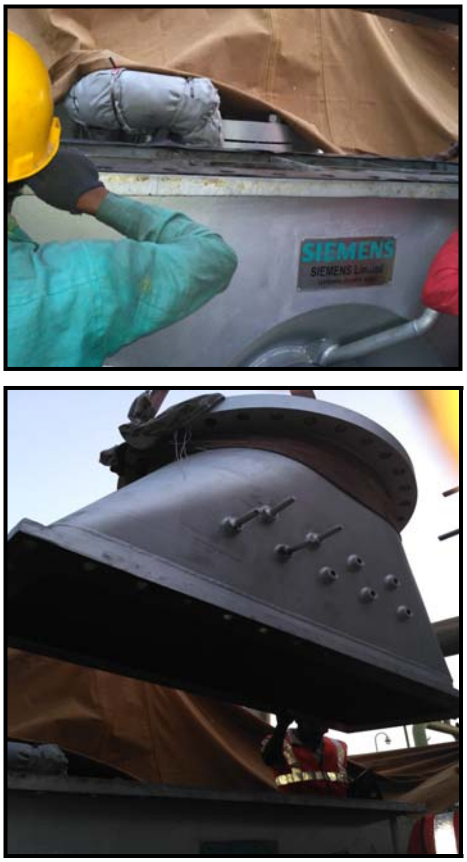
**Lock Plate fixed from bottom**

- Also the nuts of 2 nos. M 25 foundation bolts tightened by hand.
- After 12 hrs, Foundation bolts at the middle were tightened at torque value of 1300 Nm.
- Shrinkkomp was filled at the bottom of pockets of 6 nos. bolt to make a thin layer and after that sand was filled in the pockets.

**Shrinkkomp filling in the pockets of foundation holes**

**Sand filling in the pockets of foundation holes**

- Hilti bolts was tightened as per the required torque value
- 2 nos M 25 bolts were tightened by hammering.
- Shuttering was done covering surface 2” extended outside surface of base frame as per drg. and then shrinkkomp filled and allowed it to set properly.
- Transition piece was placed on turbine after putting rubber gasket at parting plane. All 38 nos. bolts with nuts & washers fixed and tightened uniformly. Washer OD was reduced to 62mm to properly seat the washer in the groove.




**Installation of Transition Piece**

**Installation of Expansion Bellow**

- Expansion bellow of 36” installed above transition piece after putting 36”X 150# SW gasket. All 32 nos. bolts with nuts & washers fixed & tightened uniformly.
- Two rundown tanks, one for turbine header & one for compressor header was installed
- Erection of Accumulator station, Gland condenser, Barring Gear skid was carried out.

**<u>FABRICATION OF PIPING</u>**

**<u>HP Oil Piping Fabrication</u>**

- The following HP Control oil tubing / Piping were done as per Siemens PID & Isometry Drgs No. 62OC4007680_U1_623240008 – 36 to 43 Rev. A:
  - Control oil supply and return lines from HP console to 3 HP Control valves, Extraction Control Valves & ESV.

    - Piping of Accumulator station to and from HP Console
    - Piping of HP control oil circulation through Cooler
- Fit-up and fabrication of HP control oil system tubing was carried out.
- RT of all butt weld joints of HP lines & DP of all socket weld joints done.
- Pickling & passivation of all SS pipes & tubing carried out.
- These lines were cleaned by hydojetting and then by air blowing
- Fixed all the tubing/piping in position and checked fit up.

**HP Oil Flushing**

- Spool Pieces were made for the CO flushing circuit as per Siemens Flushing Arrangement Doc. No. 1CYJ470054.
- Flushing was carried out as per Siemens Scheme for Flushing HP Control Oil System.
- HP control Oil console cover was opened, cleaned properly & then boxed up.
- Fresh oil 2 barrels (approx. 460 Ltr.) was charged in the console.
- Oil was heated using inbuilt heater of console to raise the temperature upto 70 degree C.
- Flushing was carried out by using Circulation pump with 10 micron mesh in line.
- In HP oil circuit, all NRV's were removed.
- Recirculation pump started at 05.00 PM on 08.04.17
- NAS value of new oil was 10. NAS value improved upto 4
- New HP oil filled after removal of old one and console cleaning.
- Again Oil circulation was done.
- Final NAS value achieved – 6

**Installation of Electrostatic Oil Purifier**

- Oil purifier (ESOP) was connected to HP Oil Console and Oil was circulated for improving NAS value
- Oil purifier started at 10.00 Hrs on 11.04.17

**Details of HP Oil**

It is fire resistant phosphate ester based hydraulic fluid.

HYDRANSAFE FR-NSG 38,

Make - Total, Viscosity - 150 VG 46

**HP Oil Circulation**

- After flushing was done and required NAS value was obtained, circuit for flushing was dismantled and HP oil line was connected to Control Valves and ESP. All NRV's fixed back at their respective positions.
- HP oil pump started at 01.00 hrs on 14.04.17.
- Both HP oil pumps (COP-8503 & COP-8504) checked by ON/OFF one by one

- Then Circulation taken thru PCV and checked for any leakage
- Then circulation made through safety block with valve open and safety block de-energised. Then safety block was energised.
- Then HP oil was circulated with isolation valves of all ESV and CV's closed.
- Then isolation valves of ESV and CV's were opened and oil was circulated.
- Each time, the system was checked for any leakage during circulation.
- Shock test of HP oil Control system was done. The discharge pressure increased upto 175 Kg/cm2 g. Pump was started intermittently. The test was done 5 times.

**<u>Fabrication of LO Piping</u>**

Ref. Drg. Nos. P1-DS- 13074, 75 & 76 & Siemens P&ID Lube Oil 62OC_4007680_U1_623010310 Rev G

- The LO header pressure of 103-JAT/JBT/JLP and JHP was 1.5Kg/cm2 g. The LO header pressure of new turbine is 2.5 Kg/cm2g. Hence separate LO header was fabricated for 103-JT.
- Also the LO supply header of 103-JLP & HP Compressors was replaced & size was reduced from 3" to 1-1/2".
- Fabrication was carried out as per Drg. Nos. P1-DS-13074, 75 & 76. Modifications as per requirement were carried out.
- The following LO piping were fabricated:
  - ➢ LO supply and return header of turbine
  - ➢ LO inlet an return lines of bearings at both ends
  - ➢ LO supply and return header of compressor
  - ➢ LO inlet and return lines Compressor bearings
  - ➢ RD tank inlet and overflow lines of both compressor and turbine
- After fabrication of LO lines pickling & passivation carried out.
- These lines were cleaned by hydojetting and then by air blowing

**<u>LO Flushing</u>**

- 103-J Lube Oil console was emptied out on 07.04.17
- Old oil of 103-J LO console was removed using centrifuge and stored in the empty drums. LO console was cleaned & refilled with the same oil for flushing.

**Inside view of LO Console**

- 103-J AOP i.e. 103-JLJB pump was used for flushing.

- Flushing was started on 30/03/2017, 05.00 Hrs. after making a loop of pipes. Conical strainer with 100 mesh screen was installed at the return line flange connection to console.
- After 100 mesh was found Ok, then 200 mesh 103-J LO filter was taken in line of flushing loop on 02/04/2017.
- Flushing was stopped on 03/04/2017 to connect the pipes at their position but LO supply & return pipes of 103-JT couldn't be connected due to mismatch. Hence, these lines were cut, modified, cleaned properly & installed back.
- Flushing of LO lines through bearings of 103-JT carried out with 200 mesh screen at front & rear bearing inlet and return line to console.
- After sometime filter cartridge replaced with other having 10 micron mesh wrapped over it and LO circulation started.
- Removed all mesh screens & boxed up the lines finally after cleaned mesh was observed.
- Started normal LO circulation at 18.30 hrs on 12.04.17. Stopped again to attend RD tank line leakages
- Finally LO circulation was started on 13.04.17 15.00 hrs.

**Note**

103-J LO filter 3-way inlet valve (Amm. Maint. side) was passing. Teflon packings from M/s Flowchem was procured and it was replaced

**Fabrication of Steam Piping**

- Steam Inlet (10"), Steam extraction line (16") & Exhaust line (36") fabrication carried out.

**Extraction line fabrication u/p**

**Inlet Line Fabrication u/p**

**Exhaust line fabrication u/p**

**Flow nozzle in Steam inlet Line** **Flow nozzle of Extraction Line lifted**

- New Startup Vent Valve of 2” was also provided at steam inlet line as per recommendation of Siemens.
- In Exhaust line ring was welded at top to align the line with turbine Nozzle.
- The flow nozzle of inlet line FN-8101 was having a upstream length of 1094 (Recommended- 984 mm with addl. 0.5% uncertainty) and d/s length of 6720 (Recommended- 3935 mm with addl. 0.5% uncertainty)
- The flow nozzle of extraction line FN-8102 was having an upstream length of 4370 mm (Recommended- 5453 mm with addl. 0.5% uncertainty) and d/s length of 1650 mm (Recommended- 1309 mm with addl. 0.5% uncertainty). The required length for upstream side was unable to achieve due to restriction of position of steam lines.
- To reduce the pressure drop, the existing MS header of 8” line was replaced to 12”. The 12” line to Pre-reformer was dismantled and used for fabrication of new MS header.
- Tapping for Steam header of 12” taken from extraction line & header laid for steam supply to 101-JT, 105-JT, 103-JLOT, 103-JSOT, 101-JLT and 112-JAT.
- The supports of steam inlet and extraction line were done as per PDIL drg. All Spring Hangers were replaced by new one procured from M/s. PROCYON TECHNO INDUSTRY, Kadi, Mehsana.
- Piping Offset & Parallelity was checked to ensure stress free joint between Steam Inlet, Extraction and Exhaust pipe & turbine nozzles.
- Steam blowing of steam piping was carried out initially without target plate & then with target plate.

**Blowing arrangement of Steam inlet line**

- After clearing target, Steam inlet, extraction & exhaust pipes connected with the turbine nozzles.
- Exhaust line bellow Lock support was cut. After cutting the length was measured in cold condition = Silo side – 884 mm & CT side – 888 mm

| Drg No | Description | Remarks |
|---|---|---|
| P1-DS-07085 Dtd 30.03.2017 | Inlet line for 103-JT | Please Refer As built drg for changes made as per site requirement |
| EM-144-11Rev 1 of PDIL | For Inlet line for 103-JT | For supports |
| P1-DS-13083 Dtd 14.03.2017 | Extraction line of 103-JT | Please Refer As built drg for changes made as per site requirement |
| EM-144-11Rev 1 of PDIL | For Extraction line of 103-JT | For supports |
| P1-CL-13086 | Exhaust line of 103-JT | Please Refer As built drg for changes made as per site requirement |
| P1-DS-13084 | 12" MS header | Please Refer As built drg for changes made as per site requirement<br>Inlet line of 112 JAT was also modified which is not shown in the above Isometry |

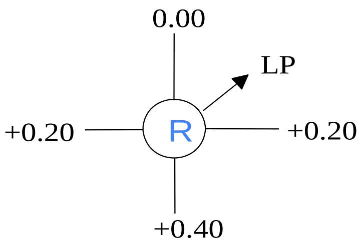
**<u>Gland Steam Condenser Piping</u>**

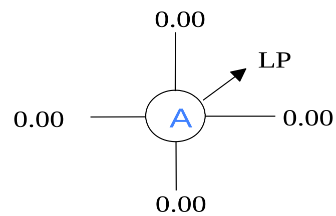
- Existing 4" CW supply & return line of old Gland Condenser was utilized for providing Cooling Water supply to & Return from new Gland condenser (2") & HP Oil Cooler (2").
- Steam for ejector of GSC was taken from the existing LP steam (3.5 kg/cm2g) line.

## Other Miscellaneous Piping

- Tapping from Condensate Extraction Pump discharge line was utilized for Condensate supply to Flash Box, Desuperheater & Exhaust hood.
- Steam condensate drain piping fabrication carried out.

## Protocol Reading

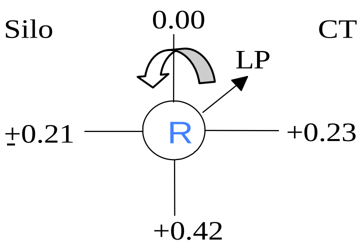


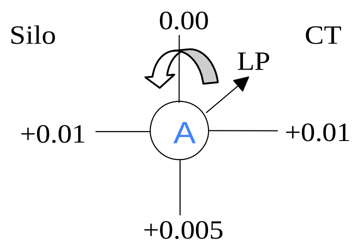




Note – Turbine to be kept 0.2 mm above compressor

## Final Alignment

- Cold Alignment reading taken & correction done after connecting pipes with the turbine nozzles.




DBSE – 749.30 mm

Axial Thrust of turbine – 0.30 mm

- Instrument probes fixed at both the front & rear bearing housing.

**Front end bearing housing view**

**Rear end bearing housing view**

- Boxed up front & rear bearing assy. after cleaning the bearing housing.
- Coupling installed between turbine & LP Comp.

**View of Turbine after completion of work**

**QCNRV & Barring Gear Piping**

Ref Siemens P&ID Lube Oil 62OC_4007680_U1_623010310 Rev G

- Line size of QCNRV tubing was increased from ¼" to ½" upto QCNRV as sufficient flow was not available for its proper action.

**Commissioning of Turbine**

- Control Valve stroke testing from TCC panel done. Stroke length measured. CV1 – 38 mm, CV2- 40 mm, CV3- 40 mm.
- ESV was coupled and stroke test done. Note – The thickness of distance provided between Piston rod of servomotor = Gap + 3 mm
- Extraction Control Valve was coupled. The thickness of distance piece was provided between Piston rod and valve spindle of servomotor = Gap + 1.5 mm, so that the Extraction valve will be open min of 1.5 mm. This is given for the protection of exhaust side. Lift – 45 mm.
- Purifier was not functioning. Pump shaft was replaced with new one.
- Barring gear was not functioning as pump was not developing the required pressure. Pump was opened and removed dirt. Then it was found OK.
- Logics of HP pumps were checked
- Locking provided on turbine Front end Casing holding down bolts – 2 Nos. and Bearing housing pedestal bolts - 4 nos. were removed. Spacer were machined and provided below bolts to maintain a Clearance of 0.08-0.12 mm.

**Slow Roll of turbine**

- Slow roll of 103-JT done at 08.45 hrs on 19.04.17. Steam inlet temp. : 300 deg C at 38 Kg/cm2 g, Vacuum - 600 mm Hg
- Started as per Cold Startup Procedure in Manual. Run at 1000 RPM for 5 min, then 3000 RPM for 30 min and then taken to min gov speed – 7350 RPM. Housing vibration was taken during each speed and found normal

- Then speed was raised and turbine continued upto OST - 11935 RPM.
- Dial gauge was kept for measuring expansion

**Coupled Run with IG**

- The turbine was kept in Barring gear
- On 19.04.17 night shift, after the casing temperature was reduced upto 140 deg C, Bearing circulation was stopped.
- Coupling between turbine and compressor was done. For coupling, bearing housing top half of 103-JT is to be removed for proper access. Alignment not checked.
- On 20.04.17 coupled run was done with IG. This was done to check for any leakages in compressor
- At 08.17 Hrs- 103-J started on 1000 RPM.vib measured, reported normal.
- At 08.35 Hrs- speed increased up to 3000 RPM. Vibration measured, found normal.
- At 09.00 Hrs, turbine was stopped.
- Expansion readings : L – 1.69, R – 1.83

**Final Coupled run with Compressor**

- Turbine was started with Synthesis gas on 21.04.17 at 17.54 Hrs
- Taken to 1000 RPM and kept for 5 min (Exhaust end Vibration found high - 56 microns)
- Then taken to 3000 RPM and kept for 35 min
- Condition for Extraction CV opening
  - LP wheel chamber pr greater than 22 kg/cm2g
  - DP between header pressure and extraction pressure – 0.1 Kg/cm2

If these conditions meet, then give command to QCNRV to open

- Speed was increased upto 8779 RPM. HP Wheel chamber pr- 38.9, LP wheel chamber Pr – 22 Kg/cm2, flow 36 T/hr
- Suddenly turbine was tripped on high exhaust press PI-8107 A/B/C at -0.81 Kg/cm2g
- Then started again. Tripped due to high vibration of 86 microns at Exhaust end
- Extraction enable changed to 17 Kg/cm2 g
- But unable to start due to problem in programming of Turloop
- The problem resolved after continuous efforts of Siemens
- Started turbine again and extraction was started. Extraction pressure increased slowly, when extraction pressure was above header pr by 0.5 kg/cm2g, flow to be started
- But when extraction was started, CV1 opened due to high steam demand and tripped at low steam temperature (386 Deg C)
- Then started again. Tripped due to high vibration

- Extraction enable changed to 10 Kg/cm2 g
- Then started again**.** When extraction pr above header by 0.2, LPCV closed suddenly
- Then extraction started and steam flow increased, header temp increased and run upto 8650 RPM
- On 22.04.2017, Due to leakage of HP Comp discharge flange, 103-JT was stopped.
- On 22.04.2017, 18.00 Hrs, turbine started again
- Turbine kept at low RPM of about 150 RPM till vibration is less than 12 microns.
- 103-J started and speed increased up to 7300 RPM.
- QCNRV was not getting opened even though command from DCS. Attended by Siemens /Instrument. It was observed that the Air line to QCNRV was choked.
- Then again started the turbine and taken in Auto upto Min Gov speed
- Started QCNRV enable at 7336 RPM and LP chamber pressure 10 Kg/cm2g.
- Increased the speed of turbine
- Expansion readings Final : L – 4.17 mm R – 4.27 mm
- It was observed that the Condensing steam flow was more even after closing the Extraction Control Valve completely. Hence as per Siemens recommendation, it was decided to remove the Pre-opening kept in Extraction valve by changing the thk. of distance piece so that the Extraction Valve can be completely closed.
- This job was taken up during Forced Shutdown of Plant on 23.04.2017 due to 1123-C Channel flange leakage.
- The following activities were done:

  For removing the Pre-opening of Extraction Control Valve

  - Steam inlet I/V and Extraction line MOV was closed
  - Decoupled Extraction CV and Servomotor
  - Gap between valve spindle and servomotor stem was measured=27.5 mm
  - Servomotor kept in closed condition
  - HP Oil system stopped
  - Servomotor was supported by Chain blocks and bolt were loosened and pulled back
  - The existing distance piece and sleeve were removed
  - New distance piece length was machined and made to 27.5 mm.
  - New distance piece and sleeve were provided
  - Servomotor kept in position and coupled with valve spindle.
  - Control valve stroke was checked

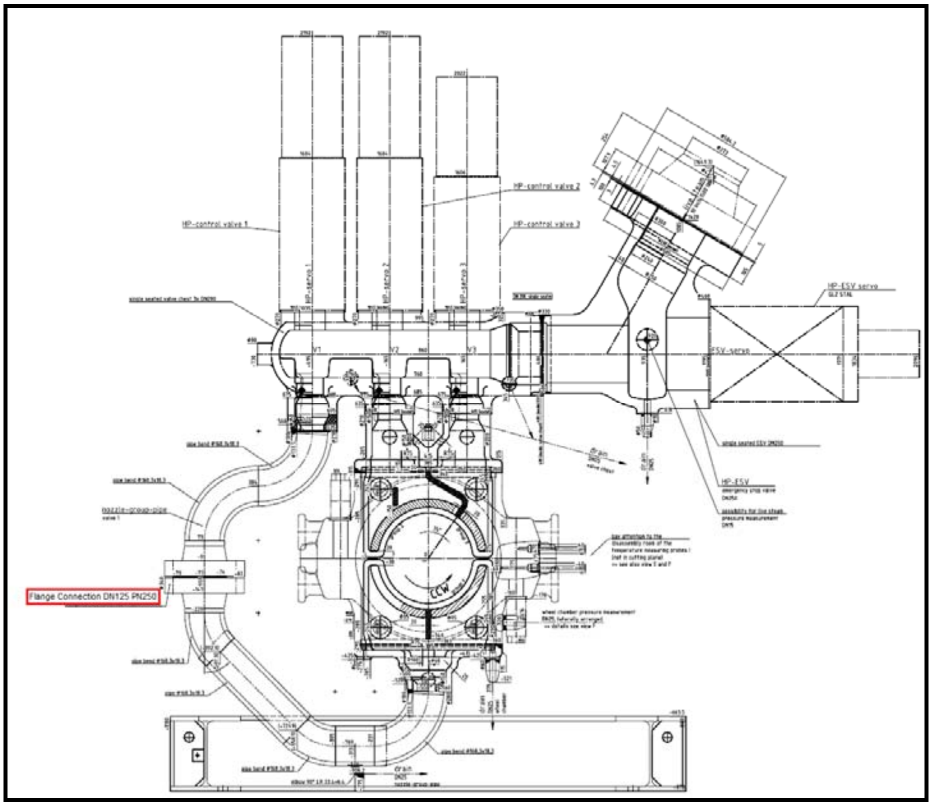
  **<u>Other jobs</u>**

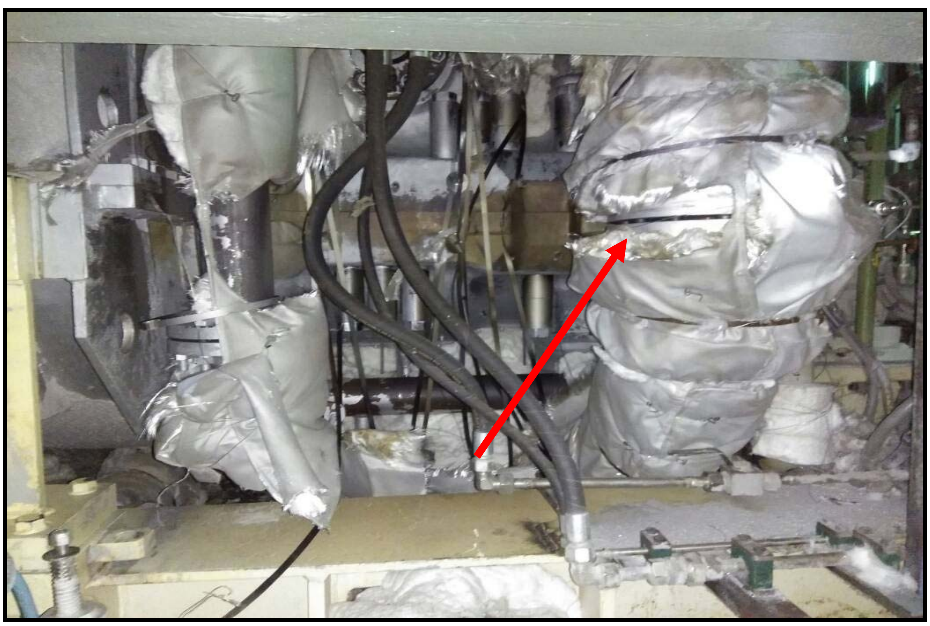
  - An additional Pressure Transmitter was installed in last stage GBC drain line (PT-8106)
  - Front housing holding down bolt spacer machining done to maintain clearance
  - Drain lines were installed in front leak off line and leak off header

- Turbine was started on 25.04.2017 after attending 1123-C. It was observed that After starting turbine, it was observed that condensing flow was reduced.

**Flange leak of 103-JT**

- On 11/05/2017 when turbine was started after attending cooling water leakage problem, the gasket of pipe joint from steam chest to turbine (CV1 valve downstream) got burst. Damaged gasket (Serrated Gasket, Size: DN125 PN250, MOC: SS316) was replaced.



**Flange marked in red color leaked during startup**

## Guarantee Test Run of 103-JT

- GTR of 103-JT was carried out on 24.05.2017 and performance was found satisfactory

**Records of Minutes of Meeting held between M/s Siemens Limited, M/s IFFCO at IFFCO Plant, Kalol, Gujarat**

**Sub. : Performance evaluation of new steam turbine [12.5 MW] drive of Synthesis Gas Compressor (103-J) supplied by M/s Siemens, Vadodara**

**Dated : 19th June 2017**

**Members Present:**

| Siemens Limited | IFFCO |
|---|---|
| Mr. Laxmaiah Rakam | Mr. BPS Mehta |
| Mr. Raju Kadian | Mr. Sandeep Ghosh |
| Mr. Avnishdutt Pandya | Mr M M Patel |
| Mr. Niraj Patel | Mr.O.P.Yadav |
| | Mr. Santosh Kataria |
| | Mr. Upendra Chaudhary |
| | Mr A K Gupta |
| | Mr Amarkant |
| | Mr. MV Anil |
| | Mr Akhilesh Maurya |

Following points were discussed and agreed during the visit at IFFCO, Kalol site on 24th May-17 for performance evaluation of new steam turbine [12.5 MW] drive of Synthesis Gas Compressor (103-J), supplied by M/s Siemens, Vadodara .

1. As requested by M/s IFFCO, M/s Siemens had submitted comparison of original HMBD and new HMBD of 11.7 MW with detailed break-up vide mail 25th May 2017 and the same being attached herewith as Annexure-1 *for reference*.
2. Based on the plant actual operating readings, following points are discussed and agreed for performance evaluation of new steam turbine drive of Synthesis Gas Compressor (103-J) at Ammonia Plant:

a) Since the readings of turbine Inlet steam flow (FR8101) does not match with the Turbine HP Wheel chamber pressure, Steam drum (101-F) out steam flow (FR-33) will be considered for calculation of Turbine power.

b) The extraction steam flow requirement of Ammonia Plant fairly matches with the measured flow at Turbine extraction steam flow nozzle (FR8104), compensated steam flow of FR8104 will be considered for extraction steam from turbine.

c) Exhaust steam flow will be calculated based on the difference of steam drum outlet steam flow (FR 33) less measured extraction steam flow (FR 8104). That the calculated exhaust flow matches fairly with the measured LP Chamber pressure.

3. Due to lower HP steam superheat temperature at turbine inlet, it was not possible for M/s. IFFCO to achieve turbine Inlet temperature of 441 degC as per original HMBD for 12.5 MW power. Hence, it was mutually agreed to conduct a PG test at about 12.5 MW on 24th May-17 at present operating conditions.

4. Turbine & Compressor data collected during the PG Test and parameters are attached as Annexure-II for reference. Turbine Performance Guarantee Test results (PG) has been given at Annexure-1 (Column –D).

5. THE PG test results shows that new steam turbine(103-JT) is delivering the guaranteed power of 12.5 MW at prevailing steam conditions for 1140 MTPD ammonia plant load.

6. M/s Siemens agrees to jointly re-evaluate the performance of turbine alongwith M/s. IFFCO when HP steam superheat temperature of 441 degC at turbine inlet will be achieved after about one year . This evaluation at a future date shall be carried out by M/s. Siemens without any financial and contractual liability to each other.

7. Turbine performance test was conducted on 24th May-17 with following activities :

a. All flow measurements have been checked for correctness of ranges and design data input for compensation.

b. Before data collection, below drains were *closed* for cycle isolation

- Drains in main steam line from Boiler flow orifice (FR33) to TG Inlet
- Turbine control valve drains
- Turbine casing drain [High Pressure], [Low pressure drains were kept Open].
- Turbine Balance Piston (AK-1) line drain

c. The test was conducted on 24th May-17 from 16:15 to 17:15. The data were collected at an interval of 3 mins for both compressor & Turbine simultaneously in the form of screenshots. All data have been tabulated & attached herewith (Refer annexure-2).

8. M/s Siemens and M/s IFFCO evaluated jointly the test data and results are indicated in column D of Annexure-I for reference. Based on results it has been concluded that the PG test of turbine is completed and accepted by M/s. IFFCO corresponding to load point -7 ( 12.5 MW – normal power with minimum inlet steam parameters) of original contractual HMBD.

9. PG test report has been submitted along with this MOM as annexure – 3. Based on the test data and evaluation , corrected specific steam consumption is 14.86 kg/kwhr against 15.17 Kg/kwhr.

**SIEMENS LIMITED (SL)**

19.6.17

N.D. Patel

**M/s IFFCO**

19.6.17

19.6.17

19.6.17.

19.6.17

19.06.17

19.6.17

Page 3 of 3

## SYNTHESIS COMPRESSER OVERHAULING - 103 J LP / JHP (2BC9 / 2BF9-8)

### Introduction

Revamp of LP and HP Synthesis Compressor was carried out in SD-2006. It was taken for overhauling for the first time after 11 years.

### DISMANTLING OF LP CASE (2BC9): 7 ton

- Decoupled the LP case at both ends.
- DBSE of LP to HP and LP to turbine was measured and recorded

- Alignment of LP compressor with HP compressor and turbine was measured and recorded.
- Thrust and Journal bearing clearances were taken
- Rotor Shaft end position was measured from Barrel end and noted.
- All vibration probes and TIDs were disconnected from the casing to facilitate the removal of the barrels.
- All other process lines and lube oil lines were dismantled. Suction & discharge piping to the compressor were then disconnected.
- Pedestal bolts of the casings were opened. The barrel assembly were hoisted with help of 250 MT Crane of M/s Onshore (Approximate weight of LP case barrel was 7 Ton).
- The barrel assembly was then kept on its stand. Then it was loaded in the IFFCO truck, tied with nylon rope and shifted to main workshop.


**LP Compressor base after removal of compressor**

- The Barrel was unloaded in main workshop from the truck with the help of hydra.
- Coupling hubs were removed
- Reference of rotor position measured from shaft end to thrust disk outer face.
- The thrust collar was pulled out with the help of Hydraulic tool as per disassembly procedure given in the DR manual page No.M.18 (1) Rev. 01. Maximum 25000 Psig hydraulic pressure was applied in the expander to remove the thrust collar, keeping the pusher pressure just positive. (SPECIAL TOOL 1)
- The intake & discharge end seal assemblies were taken out with the help of tool supplied by DR applying the procedure given in the manual, page no. M.3 (1). Rev.01 (SPECIAL TOOL 2). After the removal of seal from one end, shaft was locked for arresting the axial movement, to facilitate the removal of second seal on other shaft end. Greyish deposits were observed in the oil seal. The O-rings were also damaged. After cleaning, the clearances of oil seal were measured.

**Oil Seal discharge end**

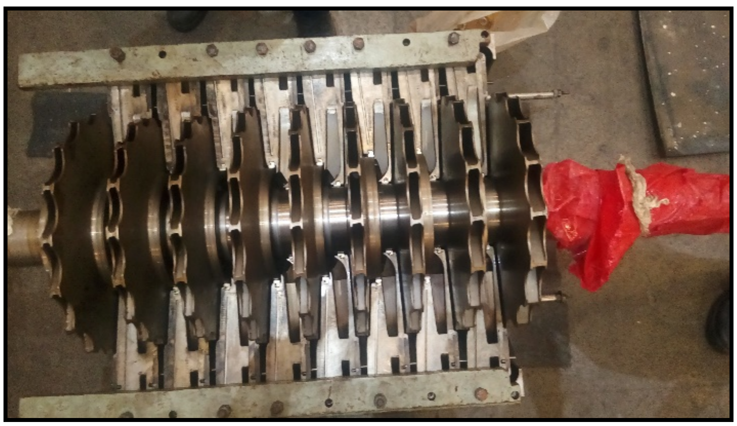
- Finally bearing housings from both ends were removed
- LP Case intake end was removed with the help of jacking bolts and EOT crane.
- References recorded after removal of the LP Case discharge head
  - Distance from LP Bundle face to barrel face (intake end): 128.40 mm
- After removing 4 pipe plugs in face of intake ring, tie rods (SPECIAL TOOL 3) were inserted through the bundle to lock it before taking out the bundle assembly.
- Locking pin was taken out after removing the screw to slide out the bundle assembly.
- LP Case inner bundle assembly was pulled out using bundle puller (SPECIAL TOOL 4) and EOT crane. During withdrawal, suitable cradle (SPECIAL TOOL5) was provided for supporting the bundle.


**Bundle being pulled out from barrel**

- Bundle length was measured and noted down
- Provide lifting tool (SPECIAL TOOL 6) on top half of the bundle and remove top half.

**Top half with lifting tool**

- Provide clamps (SPECIAL TOOL 7) on parting planes of both halves of bundle



**Clamps provided on parting plane**

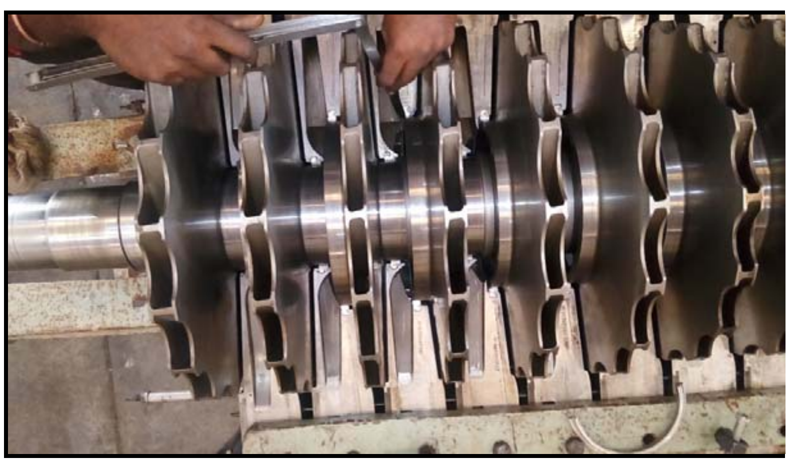
- Provide dummy labyrinths and Measure all clearances
- Lifted  rotor and kept on stand

**LP Rotor**

- Removed bundle key after removing the locking screw.
- Then bundle was dismantled
- After cleaning the barrel, head covers and studs, DPT was carried out and found no defects.
- Rotor was cleaned and DPT was done
- Gauss was checked on all parts and found OK.
- Major items replaced:
  - Impeller labyrinths (Stage 6) was found damaged and hence replaced
  - Both ends complete oil seal assembly

**ASSEMBLY OF NEW INNER BUNDLE ASSEMBLY OF LP CASE**

- Run out of the rotor was checked and found Ok
- Last stage Diaphragm bottom half was kept on floor with inlet side up
- Other diaphragms kept above as per the sequence
- Continue same procedure and place all diaphragm halves
- Provide clamp (SPECIAL TOOL 7) and bolt up so that all the faces are matching
- Keep bundle in horizontal position and provide tie rods (SPECIAL TOOL 3) and bolt up
- Lift the bundle and provide key and lock by lock screw
- Assemble top half as per the above procedure
- Keep rotor on both halve on dummy labyrinths and note down clearances.



**Measuring Clearance of bottom half**

- Free float was recorded.
- Upper half of inner bundle was placed on the bottom half with rotor resting on the bottom half.
- Tightened the upper half and bottom half of inner bundle assembly together with fasteners.

- Intake ring was assembled
- Overall length & OD of the assembled bundle was measured
- Provide new Bundle O-ring and back up ring
- Insert bundle in casing in reverse of removal procedure


**Insertion of bundle in casing**

- Install bundle pin, retainer and screw.
- Remove tie rods (SPECIAL TOOL 3) and reinstall 4 pipe plugs
- Provide inlet head with new gasket-part 15, drg-424-363-001
- Placing dummy bearing halves in the bottom half of the bearing housing to support the rotor shaft on normal center. The rotor was checked for its free rotation.
- Clearances of new oil seal were measured and noted down
- Intake and discharge end wind back seal assemblies as per drg-597-032-201, 596-357-201 & 596-357-202 were installed.
- Seal assemblies were installed with the help of tool (SPECIAL TOOL 2)
- After installation at seal on one side shaft was locked to facilitate installation of other side seal.


**Intake side seal**

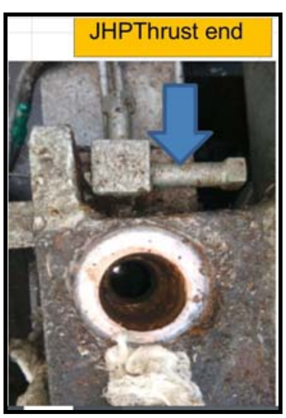

**Discharge side seal**

- Journal Bearings were boxed up.

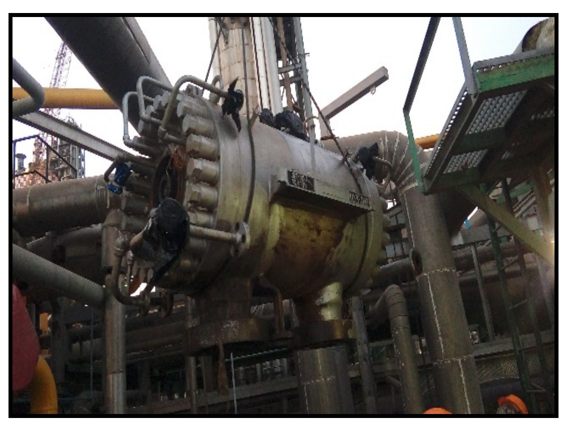
- Thrust Disc was installed Hydraulic pressure of 22000 Psig was applied in the expander keeping pusher pressure up to 6000 psig.
- Axial Float was measured. Checked rotor assembly for its free rotation and found the rotor moving freely.
- Verified run out of the thrust disk before & after the coupling installation.
- New coupling hub of 103-JT turbine to LP compressor was installed. Verified the blue matching of Coupling Hubs on Rotor without O-ring and found more than 95% blue impression
- The Barrel was placed on stand and shifted to Plant using Hydra and Truck
- LP compressor was installed in position.
- LP compressor (and HP compressor) was shifted towards North side to properly center the bolts of HP Compressor.
- Due to difference in DBSE of 103-JLP to JHP (Before -487.04, After – 486.55 i.e. 0.49 less), 2 nos shims of 0.22 mm thk were removed

**<u>DISMANTLING OF HP CASE (2BF9-8)</u>**

- Thrust and Journal bearing clearances of HP compressor were taken
- Rotor Shaft end position was measured from Barrel end and noted.
- All vibration probes and TIDs were disconnected from the casing to facilitate the removal of the barrels.
- All other process lines and lube oil lines were dismantled. Suction, recycle & discharge piping to the compressor were then disconnected.
- Pedestal bolts of the casings were opened.
- The barrel assembly was hoisted with help of Kobelco 135 MT Crane. (Approximate weight of HP 10.8 Tons).
- The barrel assembly was then kept on its stand.
- HP case was shifted to main workshop by 23 MT Hydra of M/s Onshore. The Barrel was unloaded in main workshop.
- It was observed that the all 6 nos pedestal bolts of HP was not properly centered. All the bolts were machined at the non threaded portion. The compressor is required to be moved towards North for proper centering. Decided to correct it during installation




**HP Base bolt hole were offcentre with foundation bolt holes**



**HP Case removed from foundation**

- Coupling hub was removed
- Reference of rotor position measured from shaft end to thrust disk outer face was measured.
- Removed HP Thrust collar with the help of Hydraulic tool as per disassembly procedure given in the DR manual, page no.M.18 (7) for HP Rev.01. Hydraulic Pressure of 20000 psig in the expander for the removal of thrust collar keeping the pusher pressure just positive.(SPECIAL TOOL 1)
- Removed intake and discharge end seal assemblies with the help of tool applying the procedure given in the manual, page no. M.3 (1), Rev.01. .(SPECIAL TOOL 2) After removal of one seal, shaft was locked for arresting the movement of the shaft to facilitate the removal of second seal on other shaft end.

  Sludge deposit was observed in both intake and discharge end seals. Discharge end seal (at compressor end) was having deep scoring marks. The O-rings were also damaged.

  After cleaning, the clearances of oil seal were measured. The oil seal inlet and outlet lines connected to the compressor were removed and cleaned.

**Oil Seal Intake end**

**Oil seal Discharge end**

- Finally bearing housings from both ends were removed
- HP Case Intake head was removed with the help of jacking bolts and holding by EOT crane.

**Discharge head cover removed from barrel**

- References recorded after removal of the HP Case heads
  - Distance from HP Bundle face to barrel face (intake end): 141.0 mm
- After removing 4 pipe plugs in face of intake ring, tie rods (SPECIAL TOOL 3) were inserted through the bundle to lock it before taking out the bundle assembly.
- Locking pin was taken out after removing the screw to slide out the bundle assembly.
- HP Case inner bundle assembly was pulled out using bundle puller (SPECIAL TOOL 4) and EOT crane. During withdrawal, suitable cradle (SPECIAL TOOL5) was provided for supporting the bundle.
- Bundle length was measured and noted down
- Provide lifting tool (SPECIAL TOOL 6) on top half of the bundle and remove top half.
- Provide clamps (SPECIAL TOOL 7) on parting planes of both halves of bundle

**Bottom half of inner bundle**

- Provide dummy labyrinths and Measure all clearances
- Lifted  rotor and kept on stand

**JHP rotor**

- Removed bundle key after removing the locking screw.
- Then bundle was dismantled
- After cleaning the barrel, head covers and studs, DPT was carried out and found no defects.
- Rotor was cleaned and DPT was done
- Gauss was checked on all parts and found OK.
- Major items replaced:
  - Both ends complete oil seal assembly
  - All Impeller and shaft labyrinths were replaced

**ASSEMBLY OF BUNDLE ASSEMBLY OF HP CASE**

- Run out of the rotor was checked and found Ok
- Last stage Diaphragm bottom half was kept on floor with inlet side up
- Keep the other diaphragms above as per the sequnce
- Continue same procedure and place all diaphragm halve
- Provide clamp (SPECIAL TOOL 7) and bolt up so that all the faces are matching
- Keep bundle in horizontal position and provide tie rods (SPECIAL TOOL 3) and bolt up
- Lift vertically and provide key and lock by lock screw
- Similarly assemble top half
- Keep rotor on both halve on dummy labyrinths and note down clearances.
- Free float was recorded.
- Upper half of inner bundle was placed on the bottom half with rotor resting on the bottom half.
- Tightened the upper half and bottom half of inner bundle assembly together with fasteners.
- Intake ring was assembled
- Overall length & OD of the assembled bundle was measured
- Provide new Bundle O-ring and back up ring O-ring (part - 31, drg 002-271-806) & back up ring (part-32, drg-002-310-015).
- Insert bundle in casing in reverse of removal procedure
- Install bundle pin, retainer and screw.
- Remove tie rods (SPECIAL TOOL 3) and reinstall 4 pipe plugs
- Outlet head drg was assembled with new gasket-part 19, drg-424-467-001 was installed.
- Placing dummy bearing halves in the bottom half of the bearing housing to support the rotor shaft on normal center. The rotor was checked for its free rotation.
- Clearances of new oil seal were measured and noted down
- Intake and discharge end wind back seal assemblies as per drg-596-139-201, 596-144-201 & 596-144-202 were installed. Installed seal assemblies with the help of tool as per assembly procedure given in the manual, page no. M.3 (1), Rev.01.
- After installation at one side seal, shaft was locked this side to facilitate installation of other side of seal.
- Journal Bearings were boxed up.
- Thrust Disc was installed Hydraulic pressure of 22000 Psig was applied in the expander keeping pusher pressure up to 4500 psig.
- Axial Float was measured. Checked rotor assembly for its free rotation and found the rotor moving freely.
- Verified run out of the thrust disk before & after the coupling installation.
- New coupling hub of 103-JT turbine to LP compressor was installed

- The Barrel was placed on stand and shifted to Plant using Hydra.


**JHP Barrel being taken outside from Workshop**

- HP compressor was installed in position.
- To properly centre the foundation bolts in bolt holes, the HP casing and accordingly LP casing were shifted towards North. Then LP to turbine and LP to HP alignment was done

**SPECIAL TOOL LIST FOR LP COMPRESSOR**

| | | |
|---|---|---|
| SPECIAL TOOL 1 | Coupling hub, Thrust Disc Removal Tool | Pump common for LP & HP |
| SPECIAL TOOL 2 | Oil seal removal tool | |
| SPECIAL TOOL 3 | Tie rod for pulling out Inner tube bundle | |
| SPECIAL TOOL 4 | Puller for Pulling put inner tube bundle | |
| SPECIAL TOOL 5 | Cradle for supporting inner tube bundle during pull out | |
| SPECIAL TOOL 6 | Lifting tool for lifting of bundle halves | |
| SPECIAL TOOL 7 | Clamps on parting planes for holding on top/bottom halves | |
| | Dummy Labyrinths - 4 Nos. | |
| | Barrel Stand | |
| | Rotor stand | |

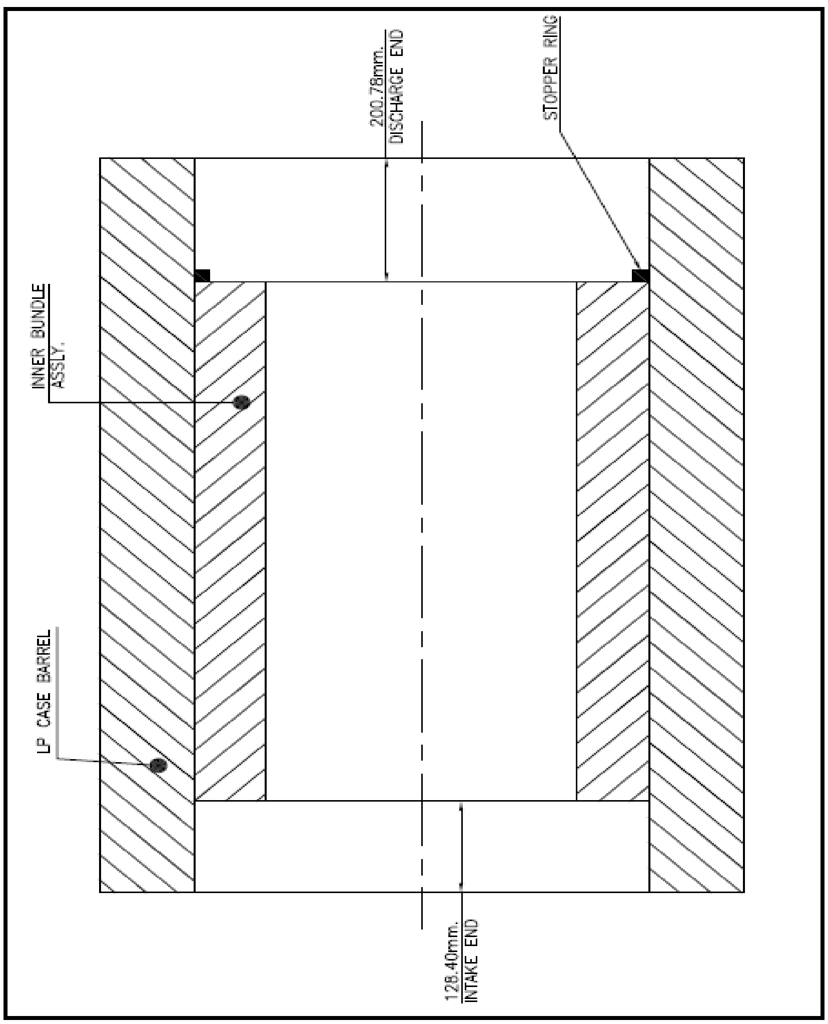
**SPECIAL TOOL LIST FOR HP COMPRESSOR**

| | | |
|---|---|---|
| SPECIAL TOOL 1 | Coupling hub, Thrust Disc Removal Tool | Pump common for LP & HP |
| SPECIAL TOOL 2 | Oil seal removal tool | |
| SPECIAL TOOL 3 | Tie rod for pulling out Inner tube bundle | |
| SPECIAL TOOL 4 | Puller for Pulling put inner tube bundle | |
| SPECIAL TOOL 5 | Cradle for supporting inner tube bundle during pull out | |
| SPECIAL TOOL 6 | Lifting tool for lifting of bundle halves | |
| SPECIAL TOOL 7 | Clamps on parting planes for holding on top/bottom halves | |
| | Dummy Labyrinths - 4 Nos. | |
| | Barrel Stand | |
| | Rotor stand | |

The various clearances recorded are as follows :

## CLEARANCE CHART LIST- 103-JLP

| SR NO | DESCRIPTION | DESCRIPTION | |
|---|---|---|---|
| 1 | SHAFT END TO CASING COVER WHEN SHAFT AT BOTH EXTREME END IN POSITION | BEFORE | AFTER |
| | | | |
| 2 | REFERENCE OF ROTOR POSITION MEASURED FROM SHAFT END TO THRUST DISK OUTER FACE | BEFORE | AFTER |
| | | | |
| 3 | BARREL END TO BUNDLE (INTAKE END) | REF BELOW | |
| 4 | BARREL END TO BUNDLE (STOPPER RING END) | COVER NOT REMOVED | |
| 5 | CLEARANCE CHART OF LP CASE | REF BELOW | |
| 6 | DIMENSIONS OF SEAL ASSEMBLY INTAKE AND DISCHARGE END | REF BELOW | |
| 7 | PARTING PLANE LEVEL | REF BELOW | |
| 8 | BUNDLE LENGTH TOTAL AND INDIVIDUAL | REF BELOW | |
| 9 | THRUST COLLAR INSTALLATION / REMOVAL DETAILS | REF BELOW | |
| 10 | RUN OUT OF ROTOR | WITHIN +/- 0.02 | |
| 11 | PAD THICKNESS, GAUSS MEASUREMENT | REF BELOW | |
| 12 | COUPLING INSTALLATION / REMOVAL DETAILS | REF BELOW | |




**Bundle Removal Detail of 103-JLP in SD 2006 given above**

Bundle Removal Detail of 103-JLP in SD 2017

- Distance from LP Bundle face to barrel face (intake end): 128.40 mm

**BARREL END TO BUNDLE**

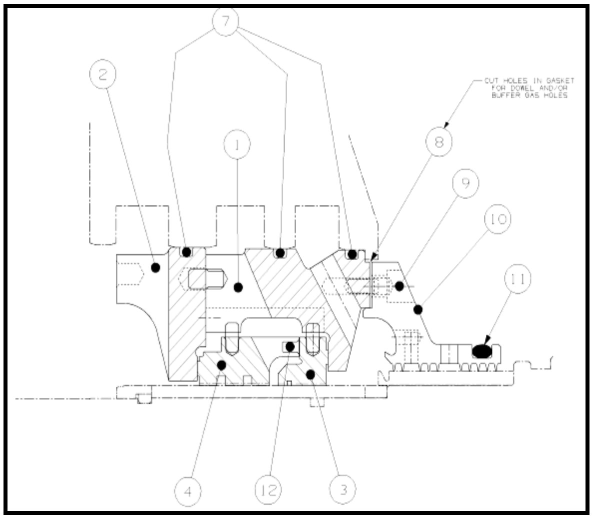
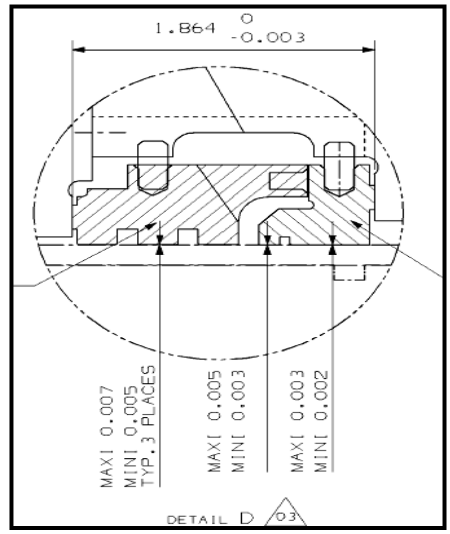
**CLEARANCE CHART OF LP CASE -2 BC 9**

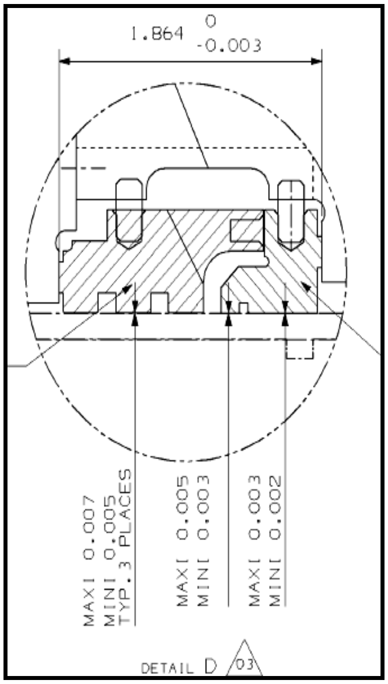
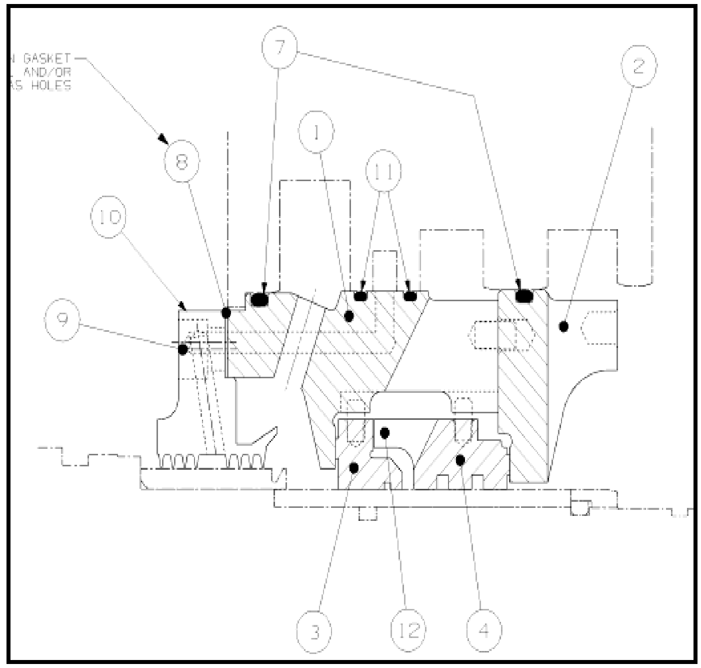
**REF DRG . NO. 597-032 Sh. 1 of 2 & 3 of 3, Rev. 3**

**NOTE- All clearances except * are radials running clearances, Unless otherwise specified**

| Sr. No. | Component | Detail on Drg. | Design Clearances Inch & mm | Actual Clearances Before mm | | | | Actual Clearances After mm | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Bearings- Intake End** | | | | | | | | | | |
| 1 | Shaft Journal dia | | | 104.78 | | | | | | | |
| 2 | Journal Bearing, Part No. 6, Intake end | **C** | 0.002" to 0.004" 0.05 to 0.10 | 0.11 mm | | | | 0.11 mm | | | |
| 3 | Seal Ring Journal Bearing,(Intake End)- North | **C** | 0.008" to 0.013" 0.20 to 0.33 | 00.22/0.235 | | | | 0.26 | | | |
| 4 | Seal Ring Journal Bearing,(Intake End)- South | **C** | 0.008" to 0.013" 0.20 to 0.33 | | | | | | | | |
| 5 | ***** Thrust Bearing, Part No. 6 | **B** | 0.015" to 0.022" 0.381 to 0.56 | 0.38mm | | | | 0.42mm | | | |
| 6 | Seal Ring Thrust Bearing | **A** | 0.003" to 0.004" | | | | | | | | |
| | **Bearings- Discharge End** | | | | | | | | | | |
| 7 | Shaft Journal dia | | | 104.78 | | | | | | | |
| 8 | Journal Bearing, Part No. 7, Dis. End | **C** | 0.002" to 0.004" 0.05 to 0.10 | 0.10 | | | | 0.10 | | | |
| 9 | Seal Ring Journal Bearing, Dis. End - North | **C** | 0.008" to 0.013" 0.20 to 0.33 | 0.13 | | | | 0.13 | | | |
| 10 | Seal Ring Journal Bearing, Dis. End - South | **C** | 0.008" to 0.013" 0.20 to 0.33 | | | | | | | | |
| 11 | Free float | | | | | | | 5.85 mm | | | |
| | **<u>Inlet Guide Labyrinth</u>** | | | **Top** | | **Bottom** | | **Top** | | **Bottom** | |
| | | | | **L** | **R** | **L** | **R** | **L** | **R** | **L** | **R** |
| | **Small, Part No. 21-1st** | **F** (All Stages ) | 0.008" to 0.012" 0.20 to 0.30 | | | | | 0.20 | 0.15 | | |
| 12 | Stage - 2nd from Intake End | **F** | 0.008" to 0.012" | | | 0.20 | 0.15 | 0.20 | 0.15 | 0.20 | 0.15 |

| Sr. No. | Component | Detail on Drg. | Design Clearances Inch & mm | Actual Clearances Before mm | | | | Actual Clearances After mm | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | Stage - 3rd from Intake End | **F** | 0.008" to 0.012" | | | 0.20 | 0.15 | 0.20 | 0.15 | 0.20 | 0.15 |
| 14 | Stage - 4th from Intake End | **F** | 0.008" to 0.012" | | | 0.20 | 0.15 | 0.20 | 0.15 | 0.20 | 0.15 |
| 15 | Stage - 5th from Intake End | **F** | 0.008" to 0.012" | | | 0.20 | 0.15 | 0.20 | 0.15 | 0.20 | 0.15 |
| 16 | Stage - 6th from Intake End | **F** | 0.008" to 0.012" | | | 0.20 | 0.15 | 0.20 | 0.15 | 0.20 | 0.15 |
| 17 | Stage - 7th from Intake End | **F** | 0.008" to 0.012" | | | 0.20 | 0.15 | 0.20 | 0.15 | 0.20 | 0.15 |
| 18 | Stage - 8th from Intake End | **F** | 0.008" to 0.012" | | | 0.20 | 0.15 | 0.20 | 0.15 | 0.20 | 0.15 |
| 19 | Stage - 9th from Intake End | **F** | 0.008" to 0.012" | | | 0.20 | 0.15 | 0.20 | 0.15 | 0.20 | 0.15 |
| | **Impeller Laby** | | | **Top** | | **Bottom** | | **Top** | | **Bottom** | |
| | | | | L | R | L | R | L | R | L | R |
| | **Large, Part No. 18- 1st** | **G**-1-2-3-4 | 0.0130" to 0.0195"<br>0.33 to 0.495 | | | | | - | - | - | - |
| 20 | Stage - 2nd from Intake End | **G** | 0.0130" to 0.0195" | | | 0.25 | 0.25 | 0.3 | 0.3 | 0.35 | 0.35 |
| 21 | Stage - 3rd from Intake End | **G** | 0.0130" to 0.0195" | | | 0.25 | 0.25 | 0.35 | 0.25 | 0.30 | 0.25 |
| 22 | Stage - 4th from Intake End | **G** | 0.0130" to 0.0195" | | | 0.25 | 0.25 | 0.35 | 0.25 | 0.35 | 0.25 |
| | **Large, Part No. 19- 5th** | **G**-5-6-7-8-9 | 0.0110" to 0.0165"<br>0.279 to 0.419 | | | 0.25 | 0.25 | 0.35 | 0.25 | 0.35 | 0.30 |
| 22 | Stage - 6th from Intake End | G | 0.0110" to 0.0165" | | | 0.25 | 0.20 | 0.35 | 0.25 | 0.3 | 0.25 |
| 23 | Stage - 7th from Intake End | **G** | 0.0110" to 0.0165" | | | 0.25 | 0.20 | 0.25 | 0.20 | 0.25 | 0.20 |
| 24 | Stage - 8th from Intake End | **G** | 0.0110" to 0.0165" | | | 0.25 | 0.20 | 0.25 | 0.25 | 0.25 | 0.20 |
| 25 | Stage - 9th from Intake End | **G** | 0.0110" to 0.0165" | | | 0.25 | 0.20 | 0.30 | 0.25 | 0.35 | 0.30 |
| 26 | **Balance Piston Labyrinth, Part No. 20** | **H** | 0.0070" to 0.0105"<br>0.178 to 0.267 | 0.255 | | | | 0.255 | | | |
| 27 | Impeller shaft dia (Stage 1 to 5) at spacer | | | 231.78 | | | | | | | |

| Sr. No. | Component | Detail on Drg. | Design Clearances Inch & mm | Actual Clearances Before mm | Actual Clearances After mm |
|---|---|---|---|---|---|
| 28 | Impeller shaft dia (Stage 6 to 9) at spacer | | | 255.600 | |
| 29 | Balance Piston shaft dia | | | 234.93 | |
|  | | | |  | |
| **<u>Wind back Seal Assembly Intake End /Thrust end (Drg. No. 596-357-201, Sh. 1 of 1, Rev.0, Main Part No.-4)</u>** | | | | **Before** | **After** |
| 30 | Seal Labyrinth, Part No. 10 | **E** | 0.004" to 0.006" 0.10 to 0.15 | 0.20/0.225 | 0.16 |
| 31 | Inner Seal Ring, Part No. 3 (Inner Side), | **D** | 0.002" to 0.003" 0.05 to 0.075 | 0.10 | 0.04 |
| 32 | Inner Seal Ring, Part No. 3 (Outer Side) | **D** | 0.003" to 0.005" 0.075 to 0.125 | 0.13 | 0.065 |
| 33 | Middle Floating Ring, Part No-4 1st | **D** | 0.005" to 0.007" 0.125 to 0.175 (Typ. 3 places) | 0.09 | 0.09 |
| 34 | " 2nd | **D** | " | 0.09 | 0.09 |
| 35 | " 3rd | **D** | " | 0.09 | 0.09 |
| 36 | Shaft dia at seal area | | | 114.30 | |
| 37 | Shaft dia at laby area | | | 123.80 | |

| Sr. No. | Component | Detail on Drg. | Design Clearances Inch & mm | Actual Clearances Before mm | Actual Clearances After mm |
|---|---|---|---|---|---|
|  | | |  | | |
| | **<u>Wind back Seal Assly Discharge End /Non thrust end (Drg. No. 596-357-202, Sh. 1 of 1, Rev.0, Main Part No.-5)</u>** | | | **Before** | **After** |
| 38 | Seal Labyrinth, Part No. 10 | **I** | 0.004" to 0.006" 0.10 to 0.15 | 0.275 | 0.16 |
| 39 | Inner Seal Ring, Part No. 3 (Inner Side), | **D** | 0.002" to 0.003" 0.05 to 0.075 | 0.075 | 0.04 |
| 40 | Inner Seal Ring, Part No. 3 (Outer Side) | **D** | 0.003" to 0.005" 0.075 to 0.125 | 0.09 | 0.09 |
| 41 | Middle Floating Ring, Part No4– 1st | **D** | 0.005" to 0.007" 0.125 to 0.175 (Typ. 3 places) | 0.09 | 0.09 |
| 42 | “2nd | **D** | “ | 0.09 | 0.09 |
| 43 | “3rd | **D** | “ | 0.09 | 0.09 |
| 44 | Shaft dia at seal area | | | 114.30 | |
| 45 | Shaft dia at laby area | | | 123.80 | |

| Dimensions of Seal Assembly Intake End /Thrust end | | | | | |
|---|---|---|---|---|---|
| Sr No | Location | Before | | After | |
| | | Seal OD | Seal cavity ID | Seal OD | Seal cavity ID |
| 1 | At O-ring # 7 | | | | |
| 2 | At O-ring # 7 | | | | |
| 3 | At O-ring # 7 | | | | |
| 4 | Axial Length of seal / Compressor head seal cavity | | | | |

| Dimensions of Seal Assly Discharge End /Non thrust end | | | | | |
|---|---|---|---|---|---|
| Sr No | Location | Before | | After | |
| | | Seal OD | Seal cavity ID | Seal OD | Seal cavity ID |
| 1 | At Laby # 10 | | | | |
| 2 | At O-ring # 7 | | | 203.14 | |
| 3 | At O-ring # 11 | | | | |
| 4 | At O-ring # 11 | | | 203.90 | |
| 5 | At O-ring # 7 | | | 204.72 | |
| 6 | Axial Length of seal / Compressor head seal cavity | | | | |

**BUNDLE LENGTH TOTAL AND INDIVIDUAL (TOP)**

**Ref – Page M 8(4)**

| | |
|---|---|
| 1 | Intake ring = 185.50 |
| 2 | 51.00 |
| 3 | 166.50 |
| 4 | 101.80 |
| 5 | 101.60 |
| 6 | 100.60 |
| 7 | 100.50 |
| 8 | 103.00 |
| 9 | 100.50 |

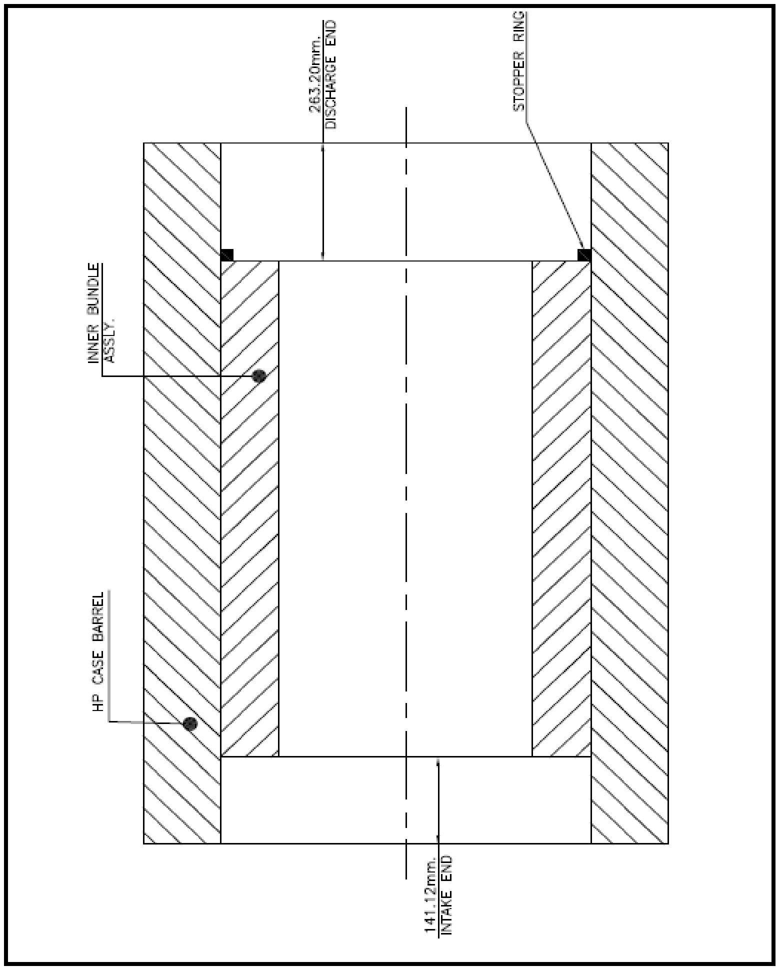
| Parting Plane Level | | | | |
|---|---|---|---|---|
| Stage | Top Half | | Bottom Half | |
| 1 | +0.20 | +0.18 | 0.0 | -0.21 |
| 2 | -0.27 | +0.06 | -0.62 | +0.01 |
| 3 | -0.56 | +0.04 | -0.40 | 0.00 |
| 4 | -0.46 | -0.10 | -0.32 | -0.21 |
| 5 | -0.55 | -0.02 | -0.50 | -0.04 |
| 6 | -0.15 | -0.03 | -0.07 | -0.06 |
| 7 | -0.29 | +0.05 | -0.41 | +0.04 |
| 8 | -0.31 | -0.07 | -0.32 | +0.04 |
| 9 | -0.22 | -0.32 | -0.22 | +0.08 |

| | | |
|---|---|---|
| | **Removal of Thrust collar-JLP** | |
| 1 | JLP Thrust collar Expander Pressure - PSIG | 19000 |
| | **Installation of Thrust collar - JLP** | |
| 2 | JLP Thrust collar Expander pressure - PSIG | 22000 |
| 3 | JLP Thrust collar Pusher pressure - PSIG | 6000 |
| | | |

| **Thrust Bearing Pads Thickness** | | | | |
|---|---|---|---|---|
| **Pad** | **ACTIVE** | | **INACTIVE** | |
| | **Before** | **After** | **Before** | **After** |
| **No 1** | | 141.26 | | 141.25 |
| **No 2** | | 141.26 | | 141.26 |
| **No 3** | | 141.25 | | 141.26 |
| **No 4** | | 141.25 | | 141.25 |
| **No 5** | | 141.26 | | 141.25 |
| **No 6** | | 141.25 | | 141.25 |
| **No 7** | | 141.26 | | 141.26 |
| **No 8** | | 141.26 | | 141.25 |

**CLEARANCE CHART LIST- 103-JHP**

| **SR NO** | **DESCRIPTION** | **DESCRIPTION** | |
|---|---|---|---|
| 1 | SHAFT END TO CASING COVER WHEN SHAFT AT BOTH EXTREME END IN POSITION | BEFORE | AFTER |
| | | | |
| 2 | REFERENCE OF ROTOR POSITION MEASURED FROM SHAFT END TO THRUST DISK OUTER FACE | BEFORE | AFTER |
| | | | |
| 3 | BARREL END TO BUNDLE (INTAKE END) | REF PAGE BELOW | |
| 4 | BARREL END TO BUNDLE (STOPPER RING END) | COVER NOT REMOVED | |
| 5 | CLEARANCE CHART OF HP CASE | REF BELOW | |
| 6 | DIMENSIONS OF SEAL ASSEMBLY INTAKE AND DISCHARGE END | REF BELOW | |
| 7 | PARTING PLANE LEVEL | REF BELOW | |
| 8 | BUNDLE LENGTH TOTAL AND INDIVIDUAL | REF BELOW | |
| 9 | THRUST COLLAR INSTALLATION / REMOVAL DETAILS | REF BELOW | |
| 10 | RUN OUT OF ROTOR | WITHIN +/- 0.02 | |
| 11 | PAD THICKNESS, GAUSS MEASUREMENT | REF BELOW | |
| 12 | COUPLING INSTALLATION / REMOVAL DETAILS | REF BELOW | |




Bundle Removal Detail of 103-JHP in SD 2006 given above

- Distance from HP Bundle face to barrel face (intake end): 141.0 mm

**BARREL END TO BUNDLE**

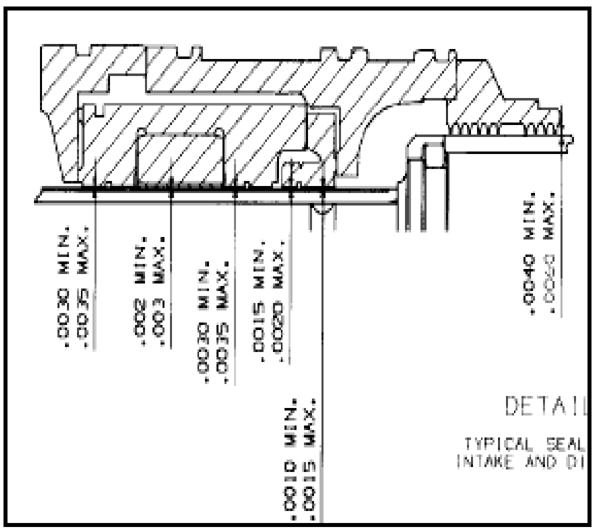
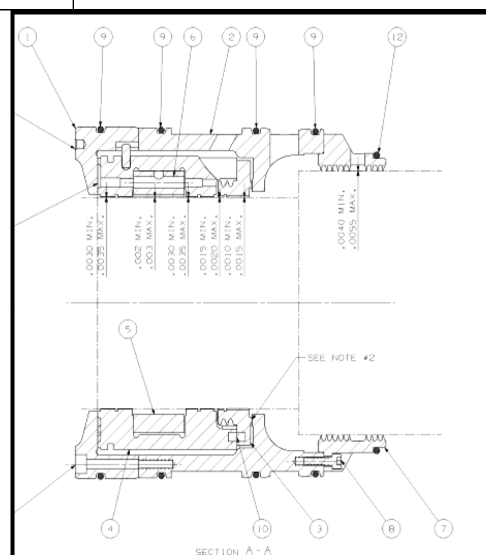
**CLEARANCE CHART OF HP CASE -2 BF9-8**

**REF DRG . NO. 596-139-201 Sh. 1, 2 & 3 of 3, Rev. 2**

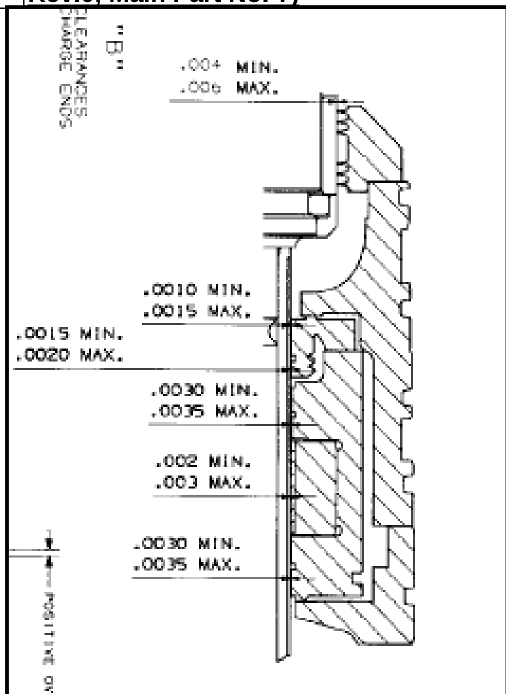
**All clearances except * are radials running clearances, Unless otherwise specified**

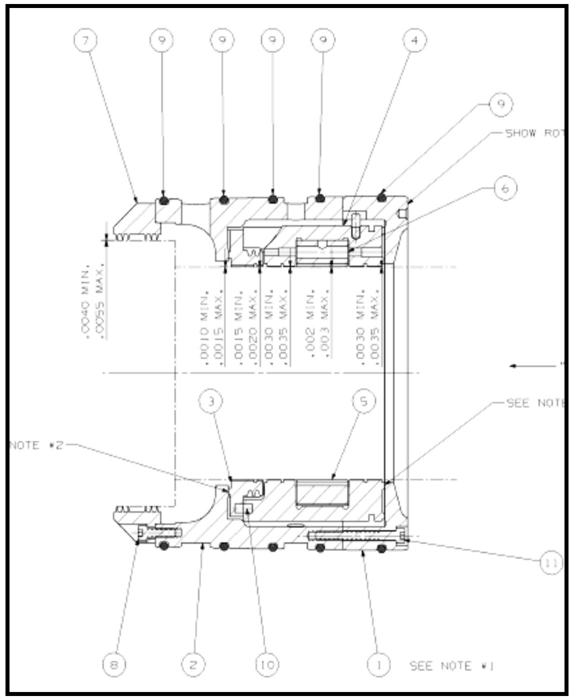
| Sr. No. | Component | Detail on Drg. | Design Clearances | Actual Clearances Before | Actual Clearances After |
|---|---|---|---|---|---|
| | **Bearings- Intake ends** | | | | |
| 1 | Shaft Journal dia (mm) | | | 104.78 | |
| 2 | Journal Bearing, Part No. 4, (Intake end) | **A** | 0.0023" to 0.0033"<br>0.058 to 0.084 | 0.11 | 0.11 |
| 3 | Seal Ring Journal Bearing, (Intake End)-North | **A** | 0.0085" to 0.0115"<br>0.22 – 0.29 | 0.19 | 0.19 |
| 4 | Seal Ring Journal Bearing, (Intake End) -South | **A** | 0.0085" to 0.0115"<br>0.22 – 0.29 | | |
| 5 | ***** Thrust Bearing, Part No. 4 (Axial) | **F** | 0.015" to 0.022"<br>0.38 to 0.56 | 0.48 | 0.36 |
| 6 | Seal Ring Thrust Bearing | **F** | 0.00250" to 0.00375"<br>0.06 to 0.095 | | |

| Sr. No. | Component | Detail on Drg. | Design Clearances | Actual Clearances Before | | | | Actual Clearances After | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Bearings – Discharge End** | | | | | | | | | | |
| 7 | Shaft Journal dia | | | 104.78 | | | | | | | |
| 8 | Journal Bearing, Part No. 5, (Discharge End) | **A** | 0.0023" to 0.0033" 0.058 to 0.084 | 0.11 | | | | 0.11 | | | |
| 9 | Seal Ring Journal Bearing, Discharge End- North | **A** | 0.0085" to 0.0115" 0.22 – 0.29 | 0.19 | | | | 0.19 | | | |
| 10 | Seal Ring Journal Bearing, Discharge End - South | **A** | 0.0085" to 0.0115" 0.22 – 0.29 | | | | | | | | |
| 11 | Free Float | | | | | | | 5.97 | | | |
| | **Inlet Guide Labyrinth** | | | **Top** | | **Bottom** | | **Top** | | **Bottom** | |
| | | | | **L** | **R** | **L** | **R** | **L** | **R** | **L** | **R** |
| 12 | **Small, Part No. 16- 1st** | **D** (All Stages) | 0.0100" to 0.0150" 0.25 to 0.38 | | | | | | | 0.25 | 0.20 |
| 13 | Stage - 2nd from Intake End | **D** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.30 | 0.25 | 0.30 | 0.25 | 0.20 | 0.15 |
| 14 | Stage - 3rd from Intake End | **D** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.30 | 0.30 | 0.30 | 0.25 | 0.20 | 0.15 |
| 15 | Stage - 4th from Intake End | **D** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.30 | 0.30 | 0.30 | 0.30 | 0.25 | 0.15 |
| 16 | Stage - 5th from Intake End | **D** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.25 | 0.30 | 0.30 | 0.30 | 0.25 | 0.15 |
| 17 | Stage - 6th from Intake End | **D** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.25 | 0.30 | 0.25 | 0.30 | 0.25 | 0.15 |
| 18 | Stage - 7th from Intake End | **D** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.25 | 0.30 | 0.25 | 0.30 | 0.25 | 0.15 |
| 19 | Stage - 8th from Intake End | **D** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.20 | 0.20 | 0.25 | 0.30 | 0.20 | 0.15 |
| | | | | **Top** | | **Bottom** | | **Top** | | **Bottom** | |
| | **Impeller Laby** | | | **L** | **R** | **L** | **R** | **L** | **R** | | **R** |
| | **Large, Part No. 18- 1st** | **E** (All Stages) | 0.0100" to 0.0150" 0.25 to 0.38 | | | - | - | 0.25 | 0.20 | - | - |
| 20 | Stage - 2nd from Intake End | **E** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.35 | 0.35 | 0.20 | 0.20 | 0.30 | 0.30 |
| 21 | Stage - 3rd from Intake End | **E** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.35 | 0.35 | 0.15 | 0.20 | 0.30 | 0.25 |
| 22 | Stage - 4th from Intake End | **E** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.40 | 0.35 | 0.15 | 0.25 | 0.30 | 0.25 |
| 23 | Stage - 5th from Intake End | **E** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.40 | 0.35 | 0.15 | 0.25 | 0.30 | 0.25 |
| 24 | Stage - 6th from Intake End | **E** | 0.0100" to 0.0150" 0.25 to 0.38 | | | 0.40 | 0.30 | 0.15 | 0.25 | 0.25 | 0.20 |

| Sr. No. | Component | Detail on Drg. | Design Clearances | Actual Clearances Before | Actual Clearances After |
|---|---|---|---|---|---|
| 25 | Stage - 7th from Intake End | **E** | 0.0100" to 0.0150"<br>0.25 to 0.38 | 0.40 0.35 | 0.15 0.25 0.30 0.25 |
| 26 | Stage - 8th from Intake End | **E** | 0.0100" to 0.0150"<br>0.25 to 0.38 | 0.40 0.35 | 0.15 0.20 0.25 0.30 |
| 20 | **Balance Piston Labyrinth,** | **C** | 0.115" to 0.172"<br>2.92 to 4.37 | - | - |
| 21 | Balance Piston Labyrinth | **C** | 0.0075" to 0.0112"<br>0.19 to 0.28 | 0.20 | 0.20 |
| 27 | Impeller shaft dia | | | | |
| 28 | Balance Piston shaft dia | 215.87 | | | |
|  | | | |  | |
| | **Wind back Seal Assembly Intake End /Thrust end (Drg. No. 596-357-201, Sh. 1 of 1, Rev.0, Main Part No.-6)** | | | **Before** | **After** |
| | | | | | |
| 29 | Inner Labyrinth, Part No. 7 | **B** | 0.004" to 0.006"<br>0.10 to 0.15 | 0.19/0.22 | 0.15 |
| 30 | Inner Seal Ring, Part No. 3 (Inner Side) | **B** | 0.0010" to 0.0015"<br>.025 to 0.038 | 0.075 | 0.045 |
| 31 | Inner Seal Ring, Part No. 3 (Outer Side) | **B** | 0.0015" to 0.0020"<br>0.038 to 0.051 | 0.075 | 0.045 |
| 32 | Tilt Pad Seal Ring, Part No. 4 (Inner Side) | **B** | 0.0030" to 0.0035"<br>0.076 to 0.089 | 0.095 | 0.085 |
| 33 | Tilt Pad , Part No. 5 | **B** | 0.0020" to 0.0030"<br>0.051 to .076 | 0.095 | 0.085 |
| 34 | Tilt Pad Seal Ring, Part No. 4 (Outer Side) | **B** | 0.0030" to 0.0035"<br>0.076 to 0.089 | 0.095 | 0.085 |
| 35 | Shaft dia at seal area | 114.30 | | | |
| 36 | Shaft dia at laby area | 143.00 | | | |

| Sr. No. | Component | Detail on Drg. | Design Clearances | Actual Clearances Before | Actual Clearances After |
|---|---|---|---|---|---|
| | **Wind back Seal Assly Discharge End /Non Thrust end (Drg. No. 596-357-202, Sh. 1 of 1, Rev.0, Main Part No.-7)** | | | | |




| Sr. No. | Component | Detail on Drg. | Design Clearances | Actual Clearances Before | Actual Clearances After |
|---|---|---|---|---|---|
| 37 | Inner Labyrinth, Part No. 7 | **B** | 0.004" to 0.006"<br>0.10 to 0.15 | 0.205 | 0.07 |
| 38 | Inner Seal Ring, Part No. 3 (Inner Side) | **B** | 0.0010" to 0.0015"<br>.025 to 0.038 | 0.09 | 0.045 |
| 39 | Inner Seal Ring, Part No. 3 (Outer Side) | **B** | 0.0015" to 0.0020"<br>0.038 to 0.051 | 0.09 | 0.045 |
| 40 | Tilt Pad Seal Ring, Part No. 4 (Inner Side) | **B** | 0.0030" to 0.0035"<br>0.076 to 0.089 | 0.095 | 0.085 |
| 41 | Tilt Pad , Part No. 5 | **B** | 0.0020" to 0.0030"<br>0.051 to .076 | 0.095 | 0.085 |
| 42 | Tilt Pad Seal Ring, Part No. 4 (Outer Side) | **B** | 0.0030" to 0.0035"<br>0.076 to 0.089 | 0.095 | 0.085 |
| 43 | Shaft dia at seal area | 114.30 | | | |
| 44 | Shaft dia at laby area | 143.50 | | | |

| | | |
|---|---|---|
| | **Removal of Thrust collar-JHP** | |
| 1 | JHP Thrust collar Expander Pressure - PSIG | 20000 |
| | **Installation of Thrust collar- JHP** | |
| 2 | JHP Thrust collar Expander pressure - PSIG | 22000 |
| 3 | JHP Thrust collar pusher pressure - PSIG | 4500 |

**<u>Diaphragm Thk (TOP)</u>**

**Ref – Page M 8(4)**

| | |
|---|---|
| 1 | Intake ring -95 |
| 2 | 155.5 |
| 3 | 701.50 |
| 4 | 102 |
| 5 | 02 |
| 6 | 100 |
| 7 | 75.5 |
| 8 | 170.50 |

| **103-JHP<br>Journal Bearing Pads thickness** | | | | |
|---|---|---|---|---|
| **Sr No** | **NORTH SIDE BEARING** | | **SOUTH SIDE BEARING** | |
| | **Before** | **After** | **Before** | **After** |
| **1** | | 18.92 | | 18.93 |
| **2** | | 18.93 | | 18.93 |
| **3** | | 18.92 | | 18.90 |
| **4** | | 18.91 | | 18.90 |
| **5** | | 18.93 | | 18.92 |
| **Thrust Bearing Pad Thickness** | | | | |
| **Pad** | **ACTIVE** | | **INACTIVE** | |
| | **Before** | **After** | **Before** | **After** |
| **No 1** | | 14.26 | | 14.25 |
| **No 2** | | 14.26 | | 14.25 |
| **No 3** | | 14.25 | | 14.26 |
| **No 4** | | 14.25 | | 14.26 |
| **No 5** | | 14.25 | | 14.26 |
| **No 6** | | 14.26 | | 14.25 |
| **No 7** | | 14.25 | | 14.26 |
| **No 8** | | 14.25 | | 14.25 |

**<u>COUPLING RECORDS</u>**

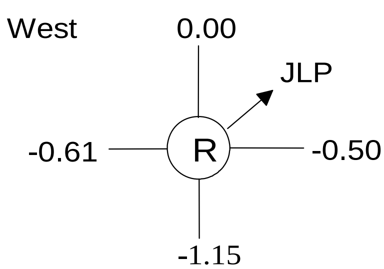
| **Description** | **Position** | | **Design (Inch)** | **Before (Inch)** | **After (Inch)** |
|---|---|---|---|---|---|
| **DBSE** (With Rotor towards HP Side) | | | | | |
| 103 JAT - JLP | --- | | | 445.11 | Removed |
| 103 JT - JLP | --- | | | - | 749.30 |
| 103 JLP- JHP | --- | | | 487.04 | 486.55 |
| **Coupling Hub / Shaft Overhang** | | | | | |
| 103 JLP | JT End | Hub | | 3.72 | 3.70 |
| | | Shaft | | | |
| | JHP End | Hub | | 2.95 | 2.80 |
| | | Shaft | | | |
| 103 JHP | JLP End | Hub | | 3.00 | 3.00 |
| | | Shaft | | | |

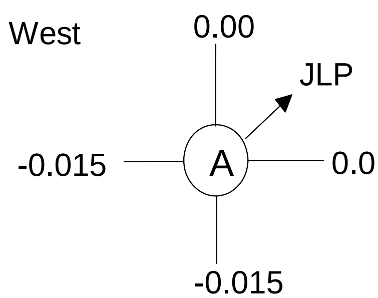
| Coupling Installation Data sheet - 103-JLP to 103-JHP | | | | |
|---|---|---|---|---|
| **Sr. No.** | **Steps / Activity** | **Design (mm)** | **(JLP) NDE** | **Remarks** |
| | **Coupling installation on 103 - JLP shaft** | | | |
| 1 | Dry fit stand off (without O-Ring) : 'A' | | 7.70 | |
| 2 | Pull up Required : 'B' (As per OEM Drg.) | 4.57 +0.25/- 0.00 | | Calculated Value= 4.90 |
| 3 | Overhang stand off Target : 'C=A-B' | | 2.80 | Actual Measured |
| 4 | Wet fit stand off (with O-Ring) : D" | | 8.40 | |
| 5 | Travel of Hub Required (on 20mm Dial Gauge Measured) : 'E=D-C' | | 5.60 | |
| 6 | Expander Pressure | 1600 Bar / 23000 PSIG | 20000 PSIG | |
| 7 | Pusher Pressure | | 1500 PSIG | |
| 8 | Blue match after Inserting Hub on Shaft without "O" Ring & Back - up Rings | 85% | | |
| | **Coupling installation on 103 - JHP shaft** | | | |
| 1 | Dry fit stand off (without O-Ring) : 'A' | 8 | 8.50 | |
| 2 | Pull up Reqried : 'B' | 4.57 +0.25/- 0.00 | | Calculated Value= 5.50 |
| 3 | Overhang stand off Target : 'C=A-B' | 3.43 | 3.00 | Actual Measured |
| 4 | Wet fit stand off (with O-Ring) : D" | | 9.40 | |
| 5 | Travel of Hub Required (on 20mm Dial Gouge Measured) : 'E=D-C' | | 6.40 | |
| 6 | Expander Pressure | 1600Bar / 23000 PSIG | 22000 PSIG | |
| 7 | Pusher Pressure | | 1800 PSIG | |
| 8 | Blue match after Inserting Hub on Shoft without "O" Ring & Back - up Rings | 85% | 85% | |
| | **Removal of Coupling Hub** | | | |
| 1 | JLP Coupling hub Expander Pressure PSIG | | 25000 | |
| 2 | JHP Coupling hub Expander Pressure -PSIG | | 27000 | |

| Coupling Installation Data sheet – 103-JT to 103-JLP | | | |
|---|---|---|---|
| **Sr. No.** | **Steps / Activity** | **Design (mm)** | **JLP** |
| | **Coupling installation on 103 - JLP shaft** | | |
| | | | |
| 1 | Dry fit stand off (without O-Ring) : 'A' | | 10.00 |
| 2 | Pull up Reqried : 'B' (As per OEM Drg.) | 6.10 to 6.35 | 06.30 |
| 3 | Overhang stand off Target : 'C=A-B' | | 03.70 |
| 4 | Wet fit stand off (with O-Ring) : D" | | 10.80 |
| 5 | Travel of Hub Required (on 20mm Dial Gouge Measured) : 'E=D-C' | | 7.10 |
| 6 | Expander Pressure | 1600 Bar / 23000 PSIG | 35000 PSIG |
| 7 | Pusher Pressure | | 4000 PSIG |
| 8 | Blue match after Inserting Hub on Shaft without "O" Ring & Back - up Rings | 85% | |
| | **Removal of Coupling Hub** | | |
| | JLP DE side Coupling hub Removal Pressure PSIG | | 32000 |
| | | | |

**ALIGNMENT READING - 103 JLP to JHP**

**After**




**REFRIGERATION COMPRESSOR TRAIN, 105-J**

**Refrigeration Compressor Drive Turbine, 105-JT**

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.

**Refrigeration Compressor, 105-JLP**

105-JLP, gear box end was decoupled. Axial thrust was measured (0.29 mm) and found within limit. Journal Bearings clearances checked by rotor lifting.

**Gear Box, 105-JR**

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 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.

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

105-JHP, gear box end was decoupled. Axial thrust was measured (0.40 mm). All couplings were visually inspected. Journal Bearing Clearances checked by Rotor lifting. No damage in flexible elements was observed, all the hubs were found to be in their position intact.

**PREVENTIVE MAINTENANCE RECORDS: 105 - JT**

| Description | Position | Dwg. Ref | Design Clear. (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|---|
| **JLP End** | | | | | |
| Journal Bearing | Mandrel | | 0.007-0.009 | 0.18 | 0.18 |
| | Filler / lead wire | | | - | - |
| Oil Guard (For Jr. Brg Housing) | South | | 0.015-0.021 | - | - |
| | North | | 0.058-0.097 | 0.15 | 0.15 |
| Oil Guard (For Seal Housing) | - | | 0.077-0.109 | - | - |
| **Governor End** | | | | | |
| Journal Bearing | Mandrel | | 0.007-0.009 | 0.21 | 0.21 |
| | Filler / lead wire | | | - | - |
| Oil Guard (For Brg. Housing) | South | | - | - | - |
| | North | | 0.015-0.021 | 0.15/0.20 | 0.15/0.20 |
| Oil Guard (For Thrust Brg.) | South | | 0.002-0.04 | - | - |
| | North | | 0.002-0.004 | - | - |
| Oil Guard (For Seal Housing) | - | | 0.077-0.109 | - | - |
| Axial Thrust. | With Top Housing | | 0.008-0.012 | 0.30 | 0.31 |
| | Without top Housing | | | 0.42 | 0.42 |

| **Journal Bearing Pads Thickness** | | | | |
|---|---|---|---|---|
| PAD | NORTH SIDE BEARING | | SOUTH SIDE BEARING | |
| | Before | After | Before | After |
| No 1 | 20.65 | 20.65 | 20.62 | 20.62 |
| No 2 | 20.61 | 20.61 | 20.63 | 20.63 |
| No 3 | 20.63 | 20.63 | 20.63 | 20.63 |
| No 4 | 20.64 | 20.64 | 20.63 | 20.63 |
| No 5 | 20.65 | 20.65 | 20.63 | 20.63 |
| **Thrust Bearing Pads Thickness** | | | | |
| Pad | ACTIVE | | INACTIVE | |
| | Before | After | Before | After |
| No 1 | 19.07 | 19.07 | Thrust ring Top – 15.91 to 15.92 Bottom – 15.91 to 15.92 | Thrust ring Top – 15.91 to 15.92 Bottom – 15.91 to 15.92 |
| No 2 | 19.07 | 19.07 | | |
| No 3 | 18.96 | 18.96 | | |
| No 4 | 19.07 | 19.07 | | |
| No 5 | 19.08 | 19.08 | | |
| No 6 | 19.05 | 19.05 | | |

**PREVENTIVE MAINTENANCE RECORDS: 105 – JLP**

| Description | Position | Dwg. Ref. | Design Clearances (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|---|
| **TURBINE END** | | | | | |
| Oil Guard ( For Outer Housing ) | - | T | 0.020-0.026 | 0.20 | 0.20 |
| **GEAR BOX END** | | | | | |
| Axial Thrust | With Top Housing | - | 0.011-0.015 | 0.29 | 0.28 |
| | Without Top Housing | - | | 0.36 | 0.36 |

| Thrust Bearing Pads Thickness | | | | |
|---|---|---|---|---|
| PAD | ACTIVE Outer | | INACTIVE Inner | |
| | Before | After | Before | After |
| No 1 & 2 | 19.78 & 19.78 | 19.78 & 19.78 | 19.78 & 19.77 | 19.78 & 19.77 |
| No 3 & 4 | 19.77 & 19.75 | 19.77 & 19.75 | 19.76 & 19.77 | 19.76 & 19.77 |
| No 5 & 6 | 19.76 & 19.75 | 19.76 & 19.75 | 19.75 & 19.76 | 19.75 & 19.76 |
| No 7 & 8 | 19.76 & 19.75 | 19.76 & 19.75 | 19.76 & 19.77 | 19.76 & 19.77 |

**PREVENTIVE MAINTENANCE RECORDS: 105-JR**

| Description | Position | Design Clear. (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|
| Journal Bearing (Low Speed drive gear) With lead wire | North | 0.014 – 0.016 | 0.34 | 0.34 |
| | South | -- do -- | 0.35 | 0.35 |
| Axial Thrust | --- | 0.014-0.024 | 0.39 | 0.39 |
| Journal Bearing (High Speed driven Pinion) | North | 0.013 - | 0.44 | 0.44 |
| | South | -- do -- | 0.42 | 0.42 |
| Free float – pinion | --- | --- | - | - |
| Backlash | --- | --- | 0.25 | 0.25 |

**PREVENTIVE MAINTENANCE RECORDS : 105 – JHP**

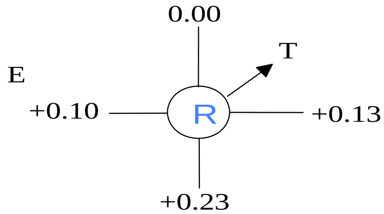
| Description | Position | Dwg. Ref. | Design Clear. (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|---|
| Axial Thrust | With Top Housing | --- | 0.009 – 0.013 | 0.42 | 0.42 |
| | Without Top Housing | --- | | 0.42 | 0.41 |

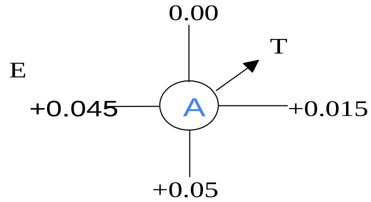
| Thrust Bearing Pads Thickness | | | | |
|---|---|---|---|---|
| PAD | ACTIVE | | INACTIVE | |
| | Before | After | Before | After |
| No 1 & 2 | 14.23 & 14.24 | 14.23 & 14.24 | 14.27 & 14.30 | 14.27 & 14.30 |
| No 3 & 4 | 14.24 & 14.24 | 14.24 & 14.24 | 14.27 & 14.30 | 14.27 & 14.30 |
| No 5 & 6 | 14.23 & 14.23 | 14.23 & 14.23 | 14.28 & 14.29 | 14.28 & 14.29 |
| No 7 & 8 | 14.24 & 14.24 | 14.24 & 14.24 | 14.29 & 14.30 | 14.29 & 14.30 |

## ALIGNMENT READING RECORDS : 105-J TRAIN

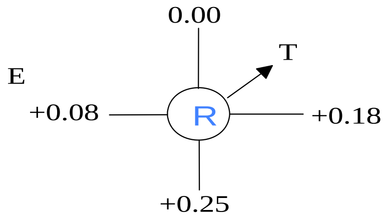
### 105-JT to 105-JLP

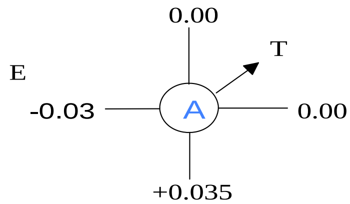
**Before Preventive Maintenance**



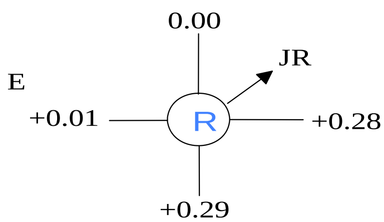

**After Preventive Maintenance**

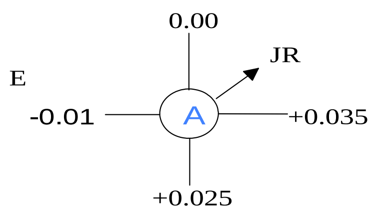


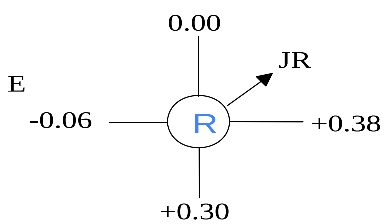

### 105-JLP to 105-JR

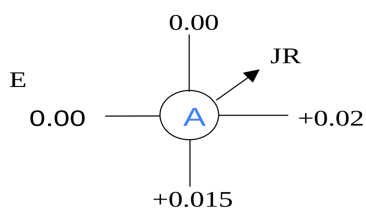
**Before Preventive Maintenance**



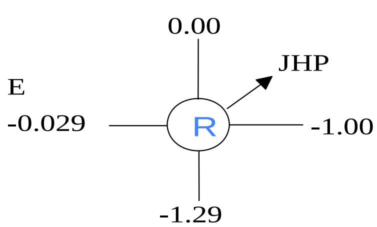

**After Preventive Maintenance**

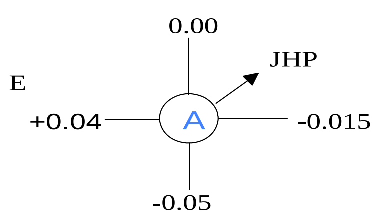


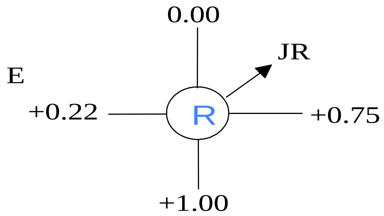

### 105-JR to 105-JHP

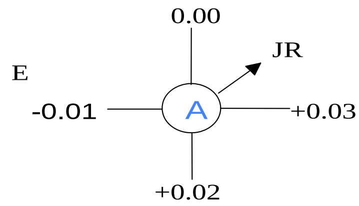
**Before Preventive Maintenance**



**After Preventive Maintenance**




## INDUCED DRAFT FAN 101-BJ TRAIN

### 101- BJ Fan

Journal bearings and thrust bearings were inspected and found OK. 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. Water was circulated in lines and no leaks were observed. The final bearing clearance was measured and found within design range.

### 101- BJT

101-BJT and Gear box were taken for Preventive Maintenance. 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, DP checked and found OK. The gauss measurement was taken and found within acceptable limit. The PGPL actuator drive gear was checked and oil was flushed. Actuator was tested at test bench & found ok.

### 101-BJR Gear box

The top cover of GB was removed. The bearings were dye penetration 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 and found OK.

### PREVENTIVE MAINTENANCE RECORDS: 101-BJ TRAIN

### COUPLINGS

| Description | Position | Design (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|
| Coupling Float (For Gear Coupling Only) | | | | |
| 101 GB- BJ | --- | --- | 5.62 | 5.62 |
| DBSE (With Rotor at extreme ends) | | | | |
| 101 BJT-GB | --- | --- | 151.90 | 151.90 |
| 101 GB- BJ | --- | --- | 13.05 | 13.05 |
| Distance between Hub Face (With Rotor at extreme ends) | | | | |
| 101 BJT-GB | --- | --- | 150.64 | 150.64 |
| DBSE of GB - MOP coupling | | 5 to 6 mm | - | 5.5 |

**PREVENTIVE MAINTENANCE RECORDS: 101-BJT**

| Description | Position | Dwg. Ref | Design Clear. (mm) | Before ( mm) | After (mm) |
|---|---|---|---|---|---|
| **Gear Box End** | | | | | |
| Journal Bearing | Mandrel | --- | | - | - |
| | Filler / lead wire | | | 0.29 | 0.29 |
| Oil Guard (For Jr. Brg Housing) | CT Side | --- | | 0.30 (Urea)<br>0.25 (Amm) | 0.30 (Urea)<br>0.25 (Amm) |
| | SILO Side | --- | | 0.20 (Urea)<br>0.20 (Amm) | 0.20 (Urea)<br>0.20 (Amm) |
| **Governor End** | | | | | |
| Journal Bearing | Mandrel | --- | | - | - |
| | Filler / lead wire | | | 0.25 | 0.25 |
| Oil Guard (For Brg. Housing | UREA | --- | | 0.30 | 0.30 |
| | AMM | ---- | | 0.25 | 0.25 |
| Axial Thrust. | With Top Housing | --- | | - | - |
| | Without top Housing | --- | | 0.45 | 0.45 |

**PREVENTIVE MAINTENANCE RECORDS: 101-BJR**

| Description | Position | Design Clear. (mm) | Before (mm) | After (mm) |
|---|---|---|---|---|
| Journal Bearing (High Speed drive Pinion ) | CT Side | | 0.13 | 0.13 |
| | SILO Side | | 0.12/0.13 | 0.12/0.13 |
| Axial Thrust | Low speed<br>High Speed | | 0.30<br>0.25 | 0.25<br>0.90 |
| Journal Bearing (Low Speed driven Gear ) | CT Side | | 0.16/0.17 | 0.16/0.17 |
| | SILO Side | | 0.18 | 0.18 |
| Backlash | --- | | 0.43 | 0.43 |
| Gear Wheel Oil Guard Labyrinth clearance | | | 0.10 mm / 0.06 mm | |
| Pinion Oil Guard Labyrinth clearance | | | 0.06 mm / 0.08 mm | |

**PREVENTIVE MAINTENANCE RECORDS: 101 - BJ**

| Description | Position | Dwg. Ref | Design Clearances (Inch) | Before (Inch) | After (Inch) |
|---|---|---|---|---|---|
| **Gear Box End** | | | | | |
| Journal Bearing | Mandrel | --- | 0.008” - 0.012” | - | - |
| | Filler / lead wire | | | 0.30 | 0.30 |
| **Free End** | | | | | |
| Journal Bearing | Mandrel | --- | 0.008” - 0.012” | - | - |
| | Filler / lead wire | | | 0.39 | 0.39 |
| Axial Thrust. | With Top Housing | --- | --- | - | - |

**ALIGNMENT READING RECORDS: 101-BJ TRAIN**

**101-BJT to 101-BJR**

**Before Preventive Maintenance**

**Alignment Reading:**

Vertical:
Offset Value = -0.24mm; Angular Value = +0.04/100mm
Horizontal:
Offset Value = +0.06mm; Angular Value = +0.03/100mm

**S - Turbine, M - Gear Box**

**After Preventive Maintenance**

**Alignment Reading:**

Vertical:
Offset Value = -0.12 mm; Angular Value = +0.02/100mm
Horizontal:
Offset Value = +0.08 mm; Angular Value = +0.01/100mm

**101-BJR to 101-BJ**

**Before Preventive Maintenance**

**Alignment Reading:**

Vertical:

Offset Value = +0.69mm; Angular Value = +0.19/100mm

Horizontal:

Offset Value = +0.45mm; Angular Value = +0.16/100mm

**S - Gear Box, M - Fan**

**After Preventive Maintenance**

**Alignment Reading:**

Vertical:
Offset Value = -0.04mm; Angular Value = +0.04/100mm
Horizontal:
Offset Value = -0.01mm; Angular Value = +0.0/100mm

**SEMILEAN SOLUTION PUMP, 115-JA TRAIN**

Preventive Maintenance of complete train was carried out.

**Pump, 115-JA**

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.

Oil of LO console was removed, console was cleaned and filled with new oil.

**Drive Turbine, 115- JAT**

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.

Actuator filter was cleaned and the actuator was flushed with oil SERVO ULTRA 40.

The condition of TB woods coupling sleeve was not good and hence replaced with new one.

Governing valve spindle was found bent. Hence it was straightened & provided, gland packing was also replaced.

**Gear Box, 115-JAR**

Gear Box was opened and all the bearings were inspected and found O.K. Both the gear as well as Pinion were inspected and found 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. The oil piping's were cleaned with air.

**Hydraulic Turbine, 115-HT**

The hydraulic turbine was decoupled. 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.

**Clutch**

Top cover of clutch was opened and cleaned. Sight glass was also cleaned. The hydraulic turbine to clutch alignment readings were measured and recorded. Turbine to clutch coupling was done.

**PREVENTIVE MAINTENANCE RECORDS 115-JA TRAIN**

| **Coupling Records** | | | | |
|---|---|---|---|---|
| **Description** | | **Design Clearances ( Inch )** | **Before (mm)** | **After (mm)** |
| **115-JAT to 115-JAR** | | | | |
| DBSE | | - | 404.94 | 404.70 |
| **115-JA to 115-JAR** | | | | |
| DBSE | | - | 298.06 | 299.00 |
| **115-JA to Clutch** | | | | |
| DBSE | | - | 311.45 | 311.45 |
| 115-JA | Hub Override | - | 0.2 | 0.2 |
| 115-Clutch | Hub Override | - | 0.06 | 0.06 |

**CLEARANCE RECORDS : SEMILEAN SOLUTION PUMP, 115-JA**

| Description | Design Clearances | Before (mm) | After (mm) |
|---|---|---|---|
| Thrust end bearing | 0.005”-0.0098” (0.217-0.249mm) | 0.21 | 0.21 |
| Opp Thrust end bearing | --- do--- | 0.21 | 0.21 |
| Axial Thrust | 0.013” – 0.015” (0.35 - 0.40 mm) | 0.24 | 0.24 |

| Journal Bearing Pads Thickness (Sleeve Bearing) | | | | |
|---|---|---|---|---|
| SLEEVE | THRUST END BEARING | | NON THRUST END BEARING | |
| | Before (mm) | After (mm) | Before (mm) | After (mm) |
| TOP | 34.85 | 34.85 | 34.84 | 34.84 |
| BOTTOM | 34.85 | 34.85 | 34.85 | 34.85 |

| Thrust Bearing Pads Thickness | | | | |
|---|---|---|---|---|
| Pad | ACTIVE | | INACTIVE | |
| | Before (mm) | After (mm) | Before (mm) | After (mm) |
| No 1 | | 31.77 | | 31.76 |
| No 2 | | 31.77 | | 31.76 |
| No 3 | | 31.77 | | 31.77 |
| No 4 | | 31.77 | | 31.75 |
| No 5 | | 31.77 | | 31.77 |
| No 6 | | 31.77 | | 31.76 |
| No 7 | | 31.77 | | 31.76 |
| No 8 | | 31.77 | | 31.75 |

**CLEARANCE RECORDS : GEAR BOX, 115- JR**

| Description | Position | Before (mm) | After (mm) |
|---|---|---|---|
| Axial Thrust | HIGH SPEED SHAFT<br>LOW SPEED SHAFT | 1.12 mm<br>2.00 mm | 1.12 mm<br>2.00 mm |
| High Speed Shaft bearing | Silo Side<br>CT Side | 0.23 mm<br>0.23 mm | 0.23 mm<br>0.23 mm |
| Low Speed Shaft Bearing | Silo Side<br>CT Side | 0.24 mm<br>0.25 mm | 0.24 mm<br>0.25 mm |

| Thin Shell Bearing - Thickness | | | | |
|---|---|---|---|---|
| | Low speed Shaft BEARING | | High Speed Shaft BEARING | |
| | CT Side | Turbine Side | CT side | Turbine Side |
| TOP | 4.05 mm | 4.07 mm | 3.95 mm | 3.93 mm |
| BOTTOM | 4.08 mm | 4.05 mm | 3.96 mm | 3.94 mm |

**CLEARANCE RECORDS : DRIVE TURBINE, 115- JAT**

| Description | | Design Clearances | Before (mm) | After (mm) |
|---|---|---|---|---|
| Axial Thrust | | 0.010 – 0.012 | 0.24 | 0.24 |
| Coupling side bearing | | 0.0055-0.008 | 0.34 / 0.35 | 0.34 / 0.35 |
| Governor side bearing | | Inboard<br>Outboard | 0.19<br>0.20 | 0.19<br>0.20 |
| **Oil Gland** Coupling side (IB) | Radial | 0.0100-0.0125 | 0.10 | 0.15 |
| | Axial | 0.040-0.050 | | |
| **Oil Gland** Coupling side (OB) | Radial | 0.0100-0.0125 | 0.15 | 0.15 |
| | Axial | 0.080-0.090 | | |
| **Oil Gland** Governor side | Radial | 0.0100-0.0125 | 0.15 | 0.15 |
| | Axial | 0.030-0.040 | | |

**Journal Bearing Pads Thickness (Thin Shell Bearing Thickness in mm)**

| LINER | THRUST END BEARING | | NON THRUST END BEARING | |
|---|---|---|---|---|
| | Before | After | Before | After |
| TOP | 2.91 | 2.91 | 2.92 | 2.92 |
| BOTTOM | 2.91 | 2.91 | 2.92 | 2.92 |

**Thrust Bearing Pads Thickness**

| PAD | ACTIVE | | INACTIVE | |
|---|---|---|---|---|
| | Before | After | Before | After |
| No 1 | 17.45 mm | 17.45 mm | 17.47 mm | 17.47 mm |
| No 2 | 17.45 mm | 17.45 mm | 17.47 mm | 17.47 mm |
| No 3 | 17.45 mm | 17.45 mm | 17.47 mm | 17.47 mm |
| No 4 | 17.47 mm | 17.47 mm | 17.46 mm | 17.46 mm |
| No 5 | 17.47 mm | 17.47 mm | 17.47 mm | 17.47 mm |
| No 6 | 17.45 mm | 17.45 mm | 17.47 mm | 17.47 mm |

**CLEARANCE RECORDS : SEMILEAN SOLUTION PUMP 115-HT**

| Description | Design Clear. (mm) | Before (mm) | After (mm) |
|---|---|---|---|
| Thrust end bearing | 0.124 – 0.148 | 0.16 | 0.15/0.16 |
| Opp Thrust end bearing | 0.124 – 0.148 | 0.19 | 0.17 |
| Axial Thrust | 0.25 – 0.30 | 0.40 | 0.35 |

**Journal Bearing Pads Thickness**

| SLEEVE | THRUST END BEARING | | NON THRUST END BEARING | |
|---|---|---|---|---|
| | Before (mm) | After (mm) | Before (mm) | After (mm) |
| TOP | 22.16 mm | 22.16 mm | 22.16 mm | 22.16 mm |
| BOTTOM | 22.16 mm | 22.16 mm | 22.16 mm | 22.16 mm |

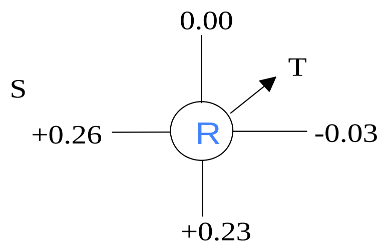
**Thrust Bearing Pad Thickness**

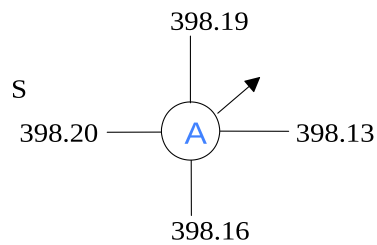
| PAD | ACTIVE | | INACTIVE | |
|---|---|---|---|---|
| | Before (mm) | After (mm) | Before (mm) | After (mm) |
| No 1 | 18.85 mm | 18.85 mm | 18.89 mm | 18.89 mm |
| No 2 | 18.85 mm | 18.85 mm | 18.88 mm | 18.88 mm |
| No 3 | 18.88 mm | 18.88 mm | 18.89 mm | 18.89 mm |
| No 4 | 18.85 mm | 18.85 mm | 18.89 mm | 18.89 mm |
| No 5 | 18.85 mm | 18.85 mm | 18.89 mm | 18.89 mm |
| No 6 | 18.85 mm | 18.85 mm | 18.89 mm | 18.89 mm |

# ALIGNMENT READING RECORDS : 115-JA TRAIN

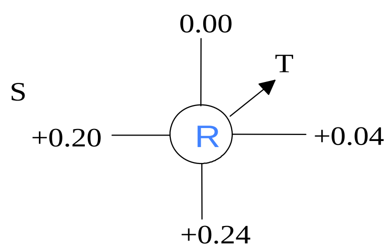
## 115-JAT to 115-JR

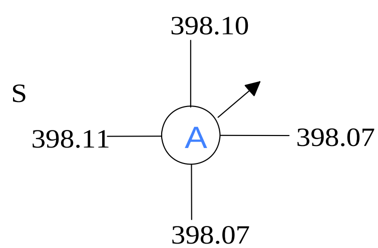
### Before Preventive Maintenance



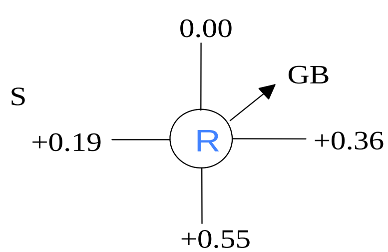

### After Preventive Maintenance

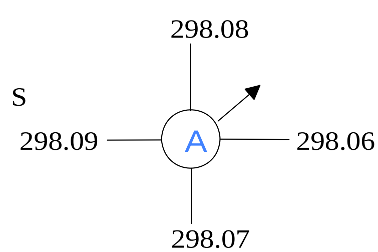


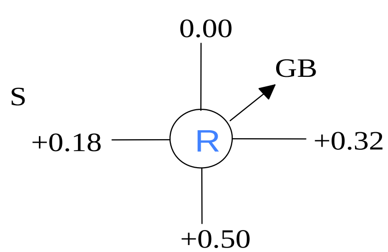

## 115-JAR to 115-JA

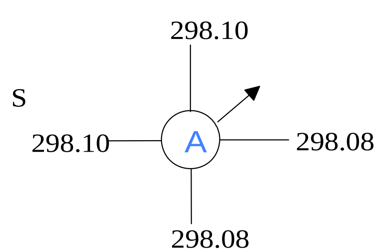
### Before Preventive Maintenance



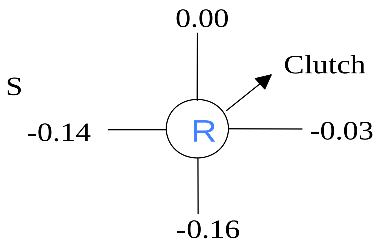

### After Preventive Maintenance

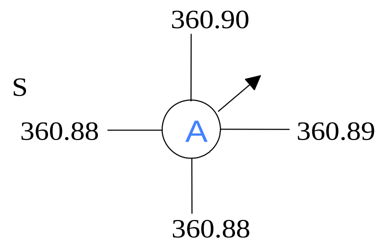


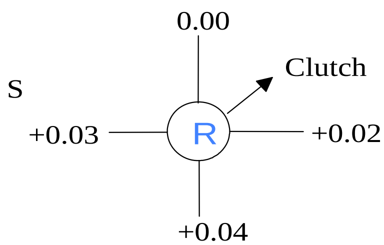
## 115-JA to Clutch

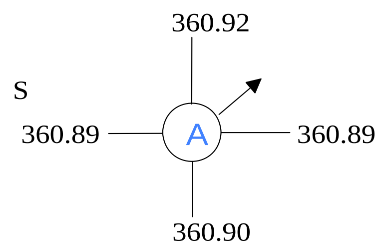
**Before Preventive Maintenance**



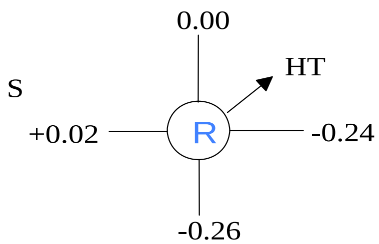

**After Preventive Maintenance**

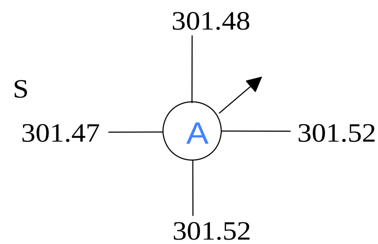


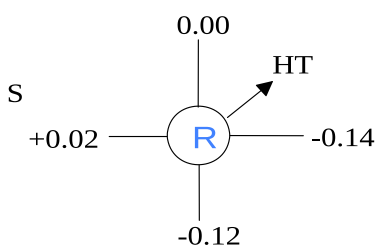

## 115-HT to Clutch

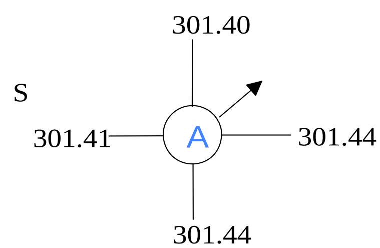
**Before Preventive Maintenance**




**After Preventive Maintenance**




## SEMILEAN SOLUTION PUMP, 115-JB TRAIN

Preventive Maintenance of complete train was carried out.

## 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 was checked and found within acceptable limit. The suction strainer was cleaned.

Oil of LO console was removed; console was cleaned and filled with new oil.

**Drive Turbine, 115- JBT**

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 was checked and found within acceptable limit.

Actuator filter was cleaned and the actuator was flushed with oil SERVO ULTRA 40.

The condition of TB woods coupling sleeve was not good and hence replaced with new one.

Governing valve spindle was found bent. Hence it was straightened & provided, gland packing was also replaced. Actuator drive shaft was having play. Hence this was replaced.

**Gear Box, 115-JBR**

Gear Box was opened and all the bearings were inspected and found O.K. Both the gear as well as Pinion were inspected and found 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. The oil piping's were cleaned with air.

**PREVENTIVE MAINTENANCE RECORDS 115-JB TRAIN**

| Coupling Records | | |
|---|---|---|
| **Description** | **Before (mm)** | **After (mm)** |
| DBSE of 115-JBT to 115-JBR | 406.83 | 406.61 |
| DBSE of 115-JB to 115-JBR | 300.08 | 299.95 |

**CLEARANCE RECORDS : SEMILEAN SOLUTION PUMP, 115-JB**

<table>
<tr><th colspan="2">Description</th><th colspan="2">Design Clearances</th><th>Before (mm)</th><th>After (mm)</th></tr>
<tr><td colspan="2">Thrust end bearing</td><td colspan="2">0.005”-0.0098”<br>(0.217-0.249mm)</td><td>0.21</td><td>0.21</td></tr>
<tr><td colspan="2">Opp. Thrust end bearing</td><td colspan="2">--- do---</td><td>0.21</td><td>0.21</td></tr>
<tr><td colspan="2">Axial Thrust</td><td colspan="2">0.013” – 0.015”<br>(0.35 - 0.40 mm)</td><td>0.48</td><td>0.45</td></tr>
<tr><td colspan="6">Journal Bearing Pads Thickness (Sleeve Bearing)</td></tr>
<tr><th rowspan="2">SLEEVE</th><th colspan="2">THRUST END BEARING</th><th colspan="2">NON THRUST END BEARING</th><th></th></tr>
<tr><th>Before (mm)</th><th>After (mm)</th><th>Before (mm)</th><th>After (mm)</th><th></th></tr>
<tr><td>TOP</td><td>34.85</td><td>34.85</td><td>34.86</td><td>34.86</td><td></td></tr>
<tr><td>BOTTOM</td><td>34.85</td><td>34.85</td><td>34.85</td><td>34.85</td><td></td></tr>
<tr><td colspan="6">Thrust Bearing Pads Thickness</td></tr>
<tr><th rowspan="2">Pad</th><th colspan="2">ACTIVE</th><th colspan="2">INACTIVE</th><th></th></tr>
<tr><th>Before (mm)</th><th>After (mm)</th><th>Before (mm)</th><th>After (mm)</th><th></th></tr>
<tr><td>No 1</td><td></td><td>31.68</td><td></td><td>31.68</td><td></td></tr>
<tr><td>No 2</td><td></td><td>31.68</td><td></td><td>31.70</td><td></td></tr>
<tr><td>No 3</td><td></td><td>31.68</td><td></td><td>31.69</td><td></td></tr>
<tr><td>No 4</td><td></td><td>31.67</td><td></td><td>31.69</td><td></td></tr>
<tr><td>No 5</td><td></td><td>31.67</td><td></td><td>31.68</td><td></td></tr>
<tr><td>No 6</td><td></td><td>31.67</td><td></td><td>31.69</td><td></td></tr>
<tr><td>No 7</td><td></td><td>31.67</td><td></td><td>31.68</td><td></td></tr>
<tr><td>No 8</td><td></td><td>31.68</td><td></td><td>31.68</td><td></td></tr>
</table>

## CLEARANCE RECORDS : GEAR BOX, 115- JBR

| Description | | Before(mm) | After (mm) |
|---|---|---|---|
| Float | HIGH SPEED SHAFT<br>LOW SPEED SHAFT | 1.17 mm<br>2.90 mm | 1.17 mm<br>2.90 mm |
| High Speed Shaft bearing | Front Side<br>Rear Side | 0.25 mm<br>0.27 mm | 0.25 mm<br>0.27 mm |
| Low Speed Shaft Bearing | Front Side<br>Rear Side | 0.21 mm<br>0.25 mm | 0.21 mm<br>0.25 mm |
| GB Backlash | | 0.48 mm | 0.22 mm |

| **Thin Shell Bearing - Thickness** | | | | |
|---|---|---|---|---|
| | **Low speed Shaft BEARING** | | **High Speed Shaft BEARING** | |
| | **Front Side** | **Rear Side** | **Front Side** | **Rear Side** |
| TOP | 3.97 mm | 3.97 mm | 3.98 mm | 3.97 mm |
| BOTTOM | 3.97 mm | 3.97 mm | 3.98 mm | 3.97 mm |

## CLEARANCE RECORDS : DRIVE TURBINE, 115- JBT

| | | | | |
|---|---|---|---|---|
| Axial Thrust | | 0.010 – 0.012 | 0.19 mm | 0.19 mm |
| Coupling side bearing | | 0.0055-0.008 | 0.30 mm | 0.30 mm |
| Governor side bearing | | Inboard<br>Outboard | 0.20 mm<br>0.21 mm | 0.20 mm<br>0.21 mm |
| **Oil Gland**<br>Coupling side (IB) | Radial | 0.0100-0.0125 | 0.15 mm | 0.15 mm |
| | Axial | 0.040-0.050 | | |
| **Oil Gland**<br>Coupling side (OB) | Radial | 0.0100-0.0125 | 0.15 mm | 0.15 mm |
| | Axial | 0.080-0.090 | | |
| **Oil Gland**<br>Governor side | Radial | 0.0100-0.0125 | 0.15 mm | 0.15 mm |
| | Axial | 0.030-0.040 | | |

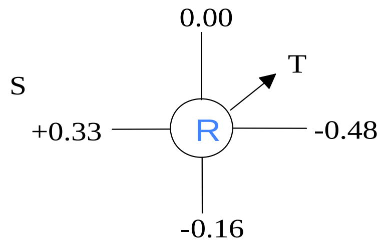
| **Journal Bearing Pads Thickness (Thin Shell Bearing Thickness in mm)** | | | | |
|---|---|---|---|---|
| **LINER** | **THRUST END BEARING** | | **NON THRUST END BEARING** | |
| | **Before** | **After** | **Before** | **After** |
| TOP | 2.91 | 2.91 | 2.91 | 2.91 |
| BOTTOM | 2.90 | 2.90 | 2.91 | 2.91 |

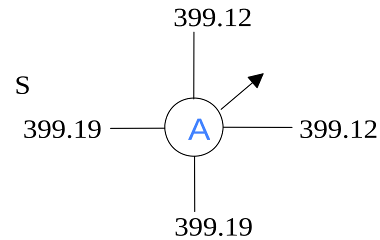
| **Thrust Bearing Pads Thickness** | | | | |
|---|---|---|---|---|
| **PAD** | **ACTIVE** | | **INACTIVE** | |
| | **Before** | **After** | **Before** | **After** |
| No 1 | 17.44 mm | 17.44 mm | 17.44 mm | 17.44 mm |
| No 2 | 17.44 mm | 17.44 mm | 17.43 mm | 17.43 mm |
| No 3 | 17.44 mm | 17.44 mm | 17.43 mm | 17.43 mm |
| No 4 | 17.44 mm | 17.44 mm | 17.44 mm | 17.44 mm |
| No 5 | 17.43 mm | 17.43 mm | 17.44 mm | 17.44 mm |
| No 6 | 17.44 mm | 17.44 mm | 17.44 mm | 17.44 mm |

**<u>ALIGNMENT READING RECORDS</u> : <u>115-JA TRAIN</u>**

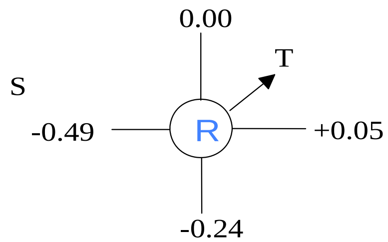
**<u>115-JBT to 115-JBR</u>**

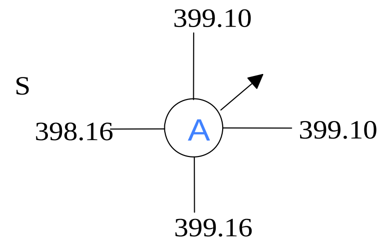
**Before Preventive Maintenance**



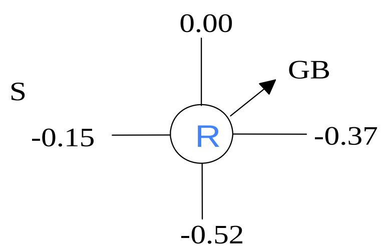

**After Preventive Maintenance**

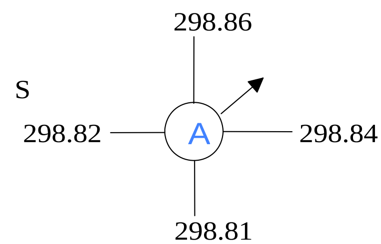


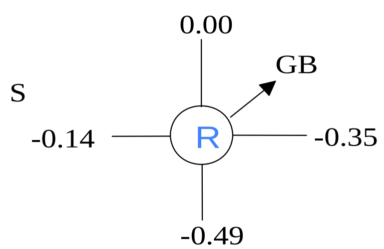

**<u>115-JBR to 115-JB</u>**

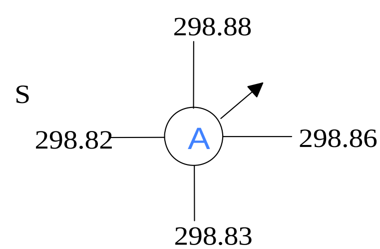
**Before Preventive Maintenance**




**After Preventive Maintenance**




**<u>BOILER FEED WATER PUMP DRIVE TURBINE, 104-JT</u>**

Major overhauling of Boiler Feed Water Pump Drive Turbine, 104-JT was carried out.

- Turbine was decoupled after removing Coupling Guard.
- All instruments & probes mounted over the turbine were disconnected & removed.
- Axial thrust was measured and recorded.
- Both end bearing housing and Casing bolts were opened.
- Bearing housing top halves at both ends & casing top half was removed.
- All clearances were measured and recorded. Refer chart below
- Rotor was lifted out of the casing.
- Casing top & bottom halves were cleaned properly.

- Rotor was also cleaned.
- Carbon rings clearances found increased, hence all the carbon rings (total 8 nos.) were replaced by new ones. Carbon rings clearances were measured & recorded.
- Thrust bearing (Bearing No. 6310 Z – 1 No.) was also replaced by the new one.
- After assembly, Rotor was placed in the bottom half of the casing. Again all the clearances were measured and recorded.
- Casing top half & bearing housing top halves were placed at its position & bolts tightened.
- All the instruments & probes were mounted over the turbine and connected.
- Alignment of turbine with pump was done & coupled with pump.
- Turbine was started & trial taken. Found OK.
- After running sometime hunting was observed and then speed of the pump increased above normal speed and suddenly pump got stopped.
- Pump & turbine was decoupled. Checked both pump & turbine individually by hand rotation. Pump was free but turbine rotor was getting stuck up.
- Turbine casing top half was removed.
- Found "U" lock staple of trip pin assembly broken & trip pin was stucking up with Plunger assembly. "U" lock staple was replaced & Plunger assembly was removed. The open space was filled with putty.

**Trip pin & Plunger of 104-JT**

- Turbine casing was boxed up.
- Turbine OST was checked in decouple condition (Electronic OST through Butterfly Trip Valve )

**Rotor of 104-JT**

**Some blades were found bend slightly**

## COUPLINGS

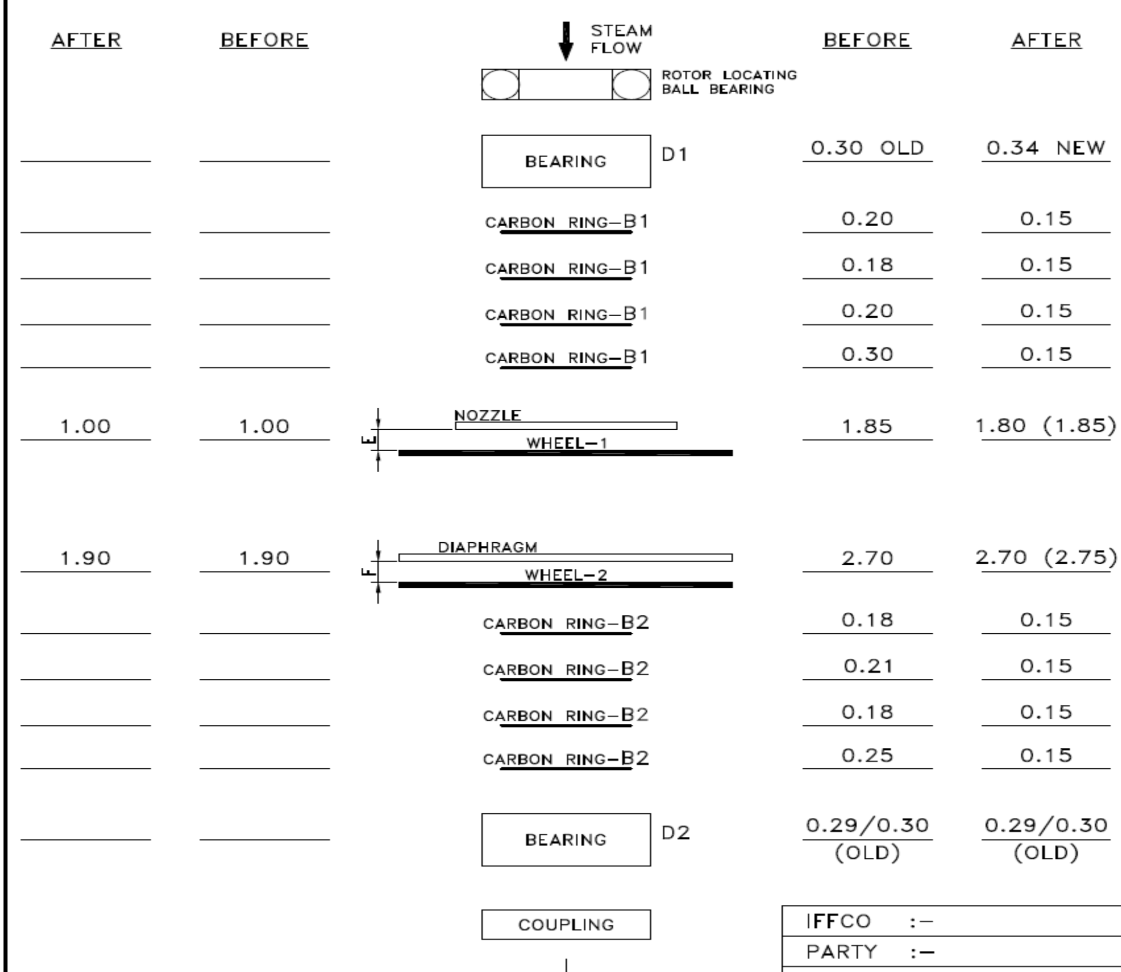
| Description | Position | Before (mm) | After (mm) |
|---|---|---|---|
| DBSE (With Rotor at extreme ends) | --- | 122.33 | 122.34 |
| Distance between Hub Face (With Rotor at extreme ends) | --- | 67.04 | 67.10 |

## OIL GUARD CLEARANCE

| Description | Position | Axial (mm) | Radial (mm) |
|---|---|---|---|
| **Coupling end** | **South** | 1.00 to 1.25 | 0.15 |
| | **North** | 1.10 to 1.90 | 0.15 |
| **Governor end** | | 1.20 to 1.25 | 0.15 |

**IFFCO - KALOL**

| DIAMETRICAL CLEARANCES – ELLIOT TURBINE 104-JT | | | | |
|---|---|---|---|---|
| REF. | CLEARANCE – INCHES | | REF. | CLEARANCE – INCHES |
| D1 | 0.007 TO 0.010 | | D1 | 0.007 TO 0.010 |
| D2 | 0.004 TO 0.007 | | D2 | 0.004 TO 0.007 |
| B1 | 0.020 TO 0.025 | | B1 | 0.020 TO 0.025 |
| B2 | 0.005 TO 0.007 | | B2 | 0.005 TO 0.007 |




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

**<u>ALIGNMENT READING RECORDS</u> : <u>104-JT to 104-J</u>**

**Before Preventive Maintenance**

**Alignment Reading:**

Vertical:

Offset Value = +0.20mm; Angular Value = +0.07/100mm

Horizontal:

Offset Value = +0.42mm; Angular Value = +0.10/100mm

**<u>S- Turbine, M-Pump</u>**

**After Preventive Maintenance**

**Alignment Reading:**

Vertical:

Offset Value = +0.35mm; Angular Value = +0.07/100mm

Horizontal:

Offset Value = +0.48mm; Angular Value = +0.11/100mm

**<u>S- Turbine, M-Pump</u>**

**<u>BOILER FEED WATER PUMP, TRAIN 104-JA</u>**

**<u>104-JA Boiler Feed Water Pump</u>**

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.

**<u>104-JAT Drive Turbine</u>**

The turbine was taken for preventive maintenance. Both ends journal bearing pads were visually inspected and dye penetration tested and found OK. The journal bearing clearance were measured and found within design range. Axial Thrust was measured & found 0.68mm, Hence, Thrust bearing Pads were replaced by new one. Gauss of the bearings was checked and found within desired value.

**<u>PREVENTIVE MAINTENANCE RECORDS: 104-JA TRAIN</u>**

**<u>COUPLINGS</u>**

| Description | Position | Before (mm) | After (mm) |
|---|---|---|---|
| DBSE<br>(With Rotor at extreme ends) | --- | 126.93 | 126.70 |
| Distance between Hub Face (With Rotor at extreme ends) | --- | 128.98 | 128.76 |

**PREVENTIVE MAINTENANCE RECORDS : 104-JAT**

| Description | Position | Dwg. Ref | Design Clearances (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|---|
| **Coupling End** | | | | | |
| Journal Bearing | Mandrel | | 0.005" – 0.007" | - | - |
| | Filler / lead wire | | | 0.19 | 0.19 |
| Oil Guard (For Jr. Brg Housing) | South CT | | | 0.15 | 0.15 |
| | North Silo | | | 0.06 | 0.06 |
| **Governor End** | | | | | |
| Journal Bearing | Mandrel | | 0.005" – 0.007" | - | - |
| | Filler / lead wire | | | 0.19 | 0.19 |
| Oil Guard (For Brg. Housing | South | | | 0.15 | 0.15 |
| Axial Thrust. | With Top Housing | | 0.011" – 0.016" | 0.68 | 0.55 |
| | Without top Housing | | | - | 1.00 |

| Journal Bearing Sleeve Thickness : 104-JAT | | | | |
|---|---|---|---|---|
| PAD | NORTH SIDE BEARING (DE) | | SOUTH SIDE BEARING (NDE) | |
| | Before (mm) | After (mm) | Before | After |
| Upper | 19.70 | 19.70 | - | - |
| Lower | 19.80 | 19.80 | - | - |
| **Thrust Bearing Pads Thickness : 104-JAT** | | | | |
| PAD | ACTIVE | | INACTIVE | |
| | Before | After(New) | Before | After(New) |
| No 1 | 15.86 | 15.89 | 15.92 | 15.91 |
| No 2 | 15.83 | 15.89 | 15.90 | 15.91 |
| No 3 | 15.86 | 15.89 | 15.88 | 15.91 |
| No 4 | 15.93 | 15.90 | 15.90 | 15.92 |
| No 5 | 15.79 | 15.89 | 15.93 | 15.92 |
| No 6 | 15.81 | 15.90 (Old) | 15.90 | 15.91 |

**PREVENTIVE MAINTENANCE RECORDS: 104-JA**

| Description | Design Clearance (Inch) | Before PM (mm) | After PM (mm) |
|---|---|---|---|
| Journal bearing (Thrust end bearing) | 0.006 - 0.008 | 0.18 | 0.18 |
| Journal bearing (Opposite thrust end ) | 0.006 - 0.008 | 0.20 | 0.20 |
| Axial Thrust | 0.014 | 0.02 | 0.30 |

| Journal Bearing Sleeve Thickness : 104-JA | | | | |
|---|---|---|---|---|
| PAD | UREA SIDE BEARING | | AMM SIDE BEARING | |
| | Before | After | Before | After |
| Upper | 11.06 / 17.46 | | 11.09 /17.40 | 11.09 /17.40 |
| Lower | 11.07 / 17.41 | | 11.1/17.38 | 11.1/17.38 |
| **Thrust Bearing Pads Thickness : 104-JA** | | | | |
| PAD | ACTIVE | | INACTIVE | |
| | Before | After | Before | After |
| No 1 | 25.38 | 25.38 | 25.39 | 25.39 |
| No 2 | 25.38 | 25.38 | 25.38 | 25.38 |
| No 3 | 25.39 | 25.39 | 25.36 | 25.36 |
| No 4 | 25.38 | 25.38 | 25.38 | 25.38 |
| No 5 | 25.39 | 25.39 | 25.39 | 25.39 |
| No 6 | 25.38 | 25.38 | 25.39 | 25.39 |

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

**Before Preventive Maintenance**

**Alignment Reading:**

Vertical:

Offset Value = +0.19mm; Angular Value = +0.10/100mm

Horizontal:

Offset Value = +0.04mm; Angular Value = +0.04/100mm

**After Preventive Maintenance**

**Alignment Reading:**

Vertical:

Offset Value = +0.21mm; Angular Value = +0.09/100mm

Horizontal:

Offset Value = +0.14mm; Angular Value = +0.06/100mm

**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 found bonding of white metal with base metal damaged in NDE brg. Hence, NDE journal bearing replaced by spare brg. Magnetism level of all bearings was found to be within limit. Clearances were measured and found to be within limit.

**107-J aMDEA Pump :**

Both ends bearing housing oil flushed. Alignment between Turbine & Pump was done and final coupling of the turbine to pump done.

**COUPLINGS**

| Description | Position | Design (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|
| DBSE (With Rotor at extreme ends) | --- | | 182.62 | 182.62 |
| Distance between Hub Face (With Rotor at extreme ends) | --- | | 178.49 | 178.49 |

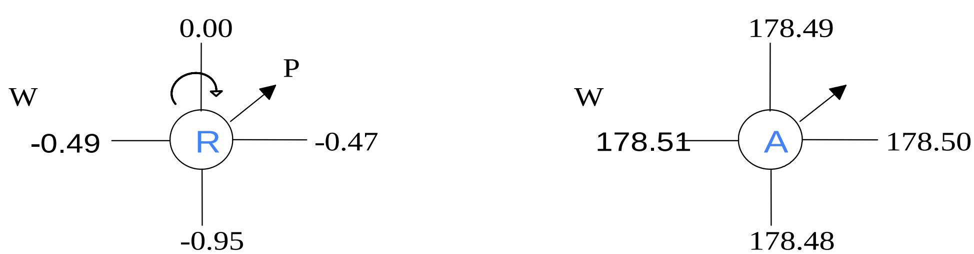
**PREVENTIVE MAINTENANCE RECORDS: 107 - JT**

| Description | Position | Design Clear. (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|
| **Coupling End** | | | | |
| Journal Bearing | Mandrel | 0.005” – 0.007” | - | - |
| | Filler / lead wire | | 0.18/0.19 | 0.18/0.19 |
| Oil Guard (For Jr. Brg Housing) | South (In Board) | AMM<br>Urea | 0.20<br>0.21 | 0.20<br>0.21 |
| | North (Out board) | AMM<br>UREA | 0.15<br>0.15 | 0.15<br>0.15 |
| **Governor End** | | | | |
| Journal Bearing | Mandrel | 0.005” – 0.007” | - | - |
| | Filler / lead wire | | 0.19/0.20 | 0.19/0.20 |

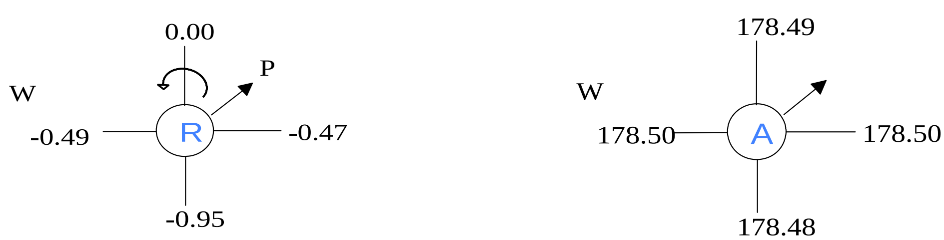
| Description | Position | Design Clear. (Inch) | Before (mm) | After (mm) |
|---|---|---|---|---|
| **Coupling End** | | | | |
| Oil Guard (For Brg. Housing) | South AMM. UREA | | 0.15<br>0.15 | 0.15<br>0.15 |
| Axial Thrust | With Top Housing | 0.011" – 0.016" | 0.45<br>0.40 | 0.45 |
| | Without top Housing | | | 0.40 |

| **Journal Bearing Sleeve Thickness : 107-JT** | | | | |
|---|---|---|---|---|
| **PAD** | **DE BEARING** | | **NDE BEARING** | |
| | **Before (mm)** | **After (mm)** | **Before (mm)** | **After (mm)** |
| Upper | 23.55 | 23.55 | 24.80 | 24.36 |
| Lower | 24.00 | 24.00 | 24.85 | 24.85 |
| **Thrust Bearing Pads Thickness : 107-JT** | | | | |
| **PAD** | **ACTIVE** | | **INACTIVE** | |
| | **Before (mm)** | **After (mm)** | **Before (mm)** | **After (mm)** |
| No 1 | 15.87 | 15.87 | 15.88 | 15.88 |
| No 2 | 15.88 | 15.88 | 15.87 | 15.87 |
| No 3 | 15.87 | 15.87 | 15.88 | 15.88 |

**<u>ALIGNMENT READINGS : 107-JT to 107-J (Before PM)</u>**




**<u>ALIGNMENT READINGS : 107-JT to 107-J (After PM)</u>**




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

Compressor was taken for major Overhauling. For the first time crossheads and tyre coupling was replaced.

### 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 piston assembly of both the cylinders was replaced. Spare refurbished gas packings were reinstalled on both the cylinders. All the suction and discharge valves were replaced by spare refurbished valves.

## 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 piston rod assembly of both cylinders was replaced by new one with new gas packing. All the suction and discharge valves were replaced by spare refurbished valves.

## Crank Case Assembly Overhauling

- The 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. These 5 set bearings were replaced by new ones.
- Big End bearings and Gudgeon Pin of all 4 nos. connecting rods were replaced by new one
- 4 nos. Cross head were replaced for the first time. For removal of cross head distance piece were dismantled.
- All the clearances were measured and recorded.
- 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 (4 nos.) were replaced by new one.
- Tyre coupling was replaced for the first time.

## Miscellaneous jobs

- The tube bundle of the inter stage 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.
- Flanged spool piece was provided at both HP cylinder inlet for easy removal of intercooler.

## CLEARANCE CHART : 117-J TRAIN

<table>
<tr><th>Description</th><th colspan="2">Position</th><th>Design clear. (mm)</th><th>Before (mm)</th><th>After (mm)</th></tr>
<tr><td rowspan="4">Piston end clr.<br>(Front /TDC)</td><td rowspan="2">LP</td><td>Urea side</td><td>2</td><td></td><td>2.60</td></tr>
<tr><td>Ammonia side</td><td>-- do --</td><td></td><td>2.60</td></tr>
<tr><td rowspan="2">HP</td><td>Urea side</td><td>-- do --</td><td></td><td>2.50</td></tr>
<tr><td>Ammonia side</td><td>-- do --</td><td></td><td>2.60</td></tr>
<tr><td rowspan="4">Piston end clr.<br>(Intermediate /BDC)</td><td rowspan="2">LP</td><td>Urea side</td><td>1.5</td><td></td><td>1.60</td></tr>
<tr><td>Ammonia side</td><td>-- do --</td><td></td><td>1.70</td></tr>
<tr><td rowspan="2">HP</td><td>Urea side</td><td>-- do --</td><td></td><td>1.60</td></tr>
<tr><td>Ammonia side</td><td>-- do --</td><td></td><td>1.60</td></tr>
<tr><td rowspan="5">Main bearing</td><td>I</td><td rowspan="5">Urea side<br>to<br>Ammonia side</td><td>0.08-0.15<br>(0.3 MAX)</td><td></td><td>0.20</td></tr>
<tr><td>II</td><td>-- do --</td><td></td><td>0.22</td></tr>
<tr><td>III</td><td>-- do --</td><td></td><td>0.20</td></tr>
<tr><td>IV</td><td>-- do --</td><td></td><td>0.20</td></tr>
<tr><td>V</td><td>-- do --</td><td></td><td>0.20</td></tr>
</table>

| Description | Position | | Design clear. (mm) | Before (mm) | After (mm) |
|---|---|---|---|---|---|
| **Big end bearing** | LP | Urea side | 0.07-0.13 (0.3 MAX) | | 0.20 |
| | | Ammonia side | -- do -- | | 0.20 |
| | HP | Urea side | -- do -- | | 0.20 |
| | | Ammonia side | -- do -- | | 0.21 |
| **Small end bearing** | LP | Urea side | 0.05-0.10 (0.2 MAX) | 0.07 | 0.05 |
| | | Ammonia side | -- do -- | 0.07 | 0.05 |
| | HP | Urea side | -- do -- | 0.07 | 0.05 |
| | | Ammonia side | -- do -- | 0.07 | 0.05 |
| **Cross head guide** | LP | Urea side | 0.18-0.26 (0.6 MAX) | 0.25 | 0.25 |
| | | Ammonia side | -- do -- | 0.25 | 0.20 |
| | HP | Urea side | -- do -- | 0.25 | 0.20 |
| | | Ammonia side | -- do -- | 0.25 | 0.25 |
| **Side clearance** (Crank shaft) | ---- | Crank shaft | 0.45-0.60 (0.9 MAX) | 0.80 | 0.80 |
| **Side clearance** (Connecting rod big end) | LP | Urea side | 0.33-0.42 (0.6 MAX) | 0.20 | 0.15 |
| | | Ammonia side | -- do -- | 0.15 | 0.15 |
| | HP | Urea side | -- do -- | 0.25 | 0.20 |
| | | Ammonia side | -- do -- | 0.25 | 0.20 |

**Alignment Reading between Motor & GB:**

Vertical:

Offset Value = 0.03mm; Angular Value = 0.00/100mm

Horizontal:

Offset Value = 0.03mm; Angular Value = 0.02/100mm

## PRIMARY REFORMER, AUXILIARY BOILER & SECONDARY REFORMER JOBS

### The Primary Reformer Radiant Zone

Burner blocks were inspected and six damaged burner blocks were replaced by Unifrax make, Model: Moldafrax BBM 15 burner blocks.

| Row No. | Burner Nos. |
|---|---|
| 1 | Nil |
| 2 | Nil |
| 3 | 313 |
| 5 | Nil |
| 6 | 609, 613 |
| 7 | 704, 706 |
| 8 | 813 |
| 9 | Nil |

The roof insulations were inspected. Damaged/dropped insulation blocks were replaced by new ones and gap was filled.

Fallen down Z-module of side wall at peep hole elevation was replaced. However, side wall insulation at other locations were intact & in satisfactory condition.

Damaged header insulation were replaced / repaired.

Scaffolding erected & cleaning of all reformer tubes was carried out.

NDT of reformer tubes were carried out by Inspection section.

Damaged / broken tunnel slabs were replaced by new ones & damaged wall refractory were repaired.

All spring hangers locked for inspection & catalyst replacement & unlocked after completion of the job.

All catalyst tubes (336 nos.) plugs were opened for catalyst replacement of top portion. Top 25% catalyst of all tubes except tube nos. 210, 212, 229, 232, 317, 325, 439, 533, 538, 540, 601, 603 (total 12 nos. tubes) in which 100% catalyst & tube nos. 711, 730, 738 & 837 (total 4 nos. tubes) in which 50% catalyst replaced. All tube plugs boxed up with new gasket.

All Inlet Manifold end covers were opened & boxed up after job completion.

All burners air resistor overhauling done.

All Naphtha Gun removed from Arch Burner assembly the roof of the radiant section & cap fixed at the opening now.

**Replacement of Air Preheat Coil and installation of new HDS-II Coil**

Air Preheat coil was replaced and New Hot de-sulphuriser coil was installed as part of Energy saving project under consultation of M/s CASALE. The contract for complete supply, dismantling, installation, erection and commissioning of Coil was awarded to M/s Heurtey Petrochem. Vide PO No 1010/201004161386 and WO 201004161387 dtd. 24-FEB-16. M/s Heurtey had given sub contract to M/S Onshore Pvt. Ltd for complete replacement of coils and to M/s Ciria India Pvt., Ltd., for Insulation and refractory jobs.

**Purpose of Convection Coil Revamp**

- Existing Air preheat coil construction of material is P-11 and design outlet temperature was 462 Deg C. Hence it was limiting the air outlet temperature.
- Casale had modifies desulphurization by replacing activated carbon with hot desulphurization. De-sulphuriser (101-D &102-D) was removed and New Hot De-Sulphuriser Vessel (114-D) was installed. Accordingly to preheat the NG to 380$^{o}$C, New HDS-II coil was installed.
- M/s. Casale have suggested these modifications which will further reduce the existing stack temperature which is nearly 165$^{o}$C Pre Shutdown.

**Pre Shutdown Activities**

- Material checking was done
- Blowing of coils and headers was flushed by DM water and dried by air.
- Welder test was done
- Welding of blinds of inlet and outlet manifold for hydrotest was done and kept ready.
- Scaffolding was made on CT side and Silo side for replacement job.

**Replacement of Air Preheat Coil (A.P.H) E-102**

**Comparison of new and old coils**

| Sr. No. | Description | New coil | Old Coil | |
|---|---|---|---|---|
| 1 | No of tubes | 30 | 24 | |
| | | | 16 | 8 |
| 2 | Material | A312 TP 304-H | P-11 | A 106 Gr. B |
| 3 | OD of the Tubes | 127.3 mm | 127.3 mm | 141.3 |
| 4 | MW of the Tubes | Sch 40 | 10.16 mm | Sch 40 |
| 5 | Length of the tube | 14395 mm | 14200 mm | |
| 6 | Process Design Inlet temp | 200.6ºC | 167ºC | |
| 7 | Process Design Outlet temp | 520ºC | 462ºC | |
| 8 | Actual inlet temp | 190ºC (20.07.17) | | |
| 9 | Actual outlet temp | 524 ºC (20.07.17) | | |
| 10 | Design Inlet Pressure | 35.1 kg/cm$^2$ | 33.4 Kg/Cm$^2$ | |
| 11 | Design Outlet pressure | 34.3 Kg/Cm$^2$ | 32.7 Kg/Cm$^2$ | |
| 12 | Mechanical design Temp | 630ºC | | |
| 13 | Mechanical design pressure | 36.9 kg/cm$^2$ | | |

**Shut Down Activities**

- Ammonia Plant was shut down at 23.00 Hr on 12th march 2017 the following activities carried out during revamp of coil.
- For opening of panel cover from cooling tower and silo side, permission from production at 09.30 Hr of 13th march.

**Removal of Old Coil**

Dismantling started: 13th march 2017 at 17:00 hr

Dismantling completed: 14th march 2017 04:00 hrs

The following activities were carried out

- After removal of the panel cover of both sides, cutting the joints of header with pipe, weldolets, and return bends of coil is carried out.
- Supports of Intermediate tube sheet of Air preheat coil had got damaged and it was dislocated from its original position. In Shutdown 2014, we have provided additional support to this coil from bottom. These supports were cut and removed.
- Removed coils (U-pin) with help of Hydra 14T and kept on Ground floor
- While pulling out the coil in the form of U-pins there was a problem of stuck due to the bend of the coil. So they were removed in the form of single tubes by cutting R-bends.
- Then removal of the End Tube sheet (ETS) from the silo side and 4 no Intermediate Tube sheets (ITS) one by one from the cooling tower side.

- Marking for removal of existing Insulation (4-1/2” thk Ceramic Fibre insulation and incoloy protection sheet) was done on the wall 5 and 7 of the section. Approx. width of insulation removed was 761 mm at both sides.
- Removing of old insulation and installation of New insulation work was carried out by the M/S Ciria India Limited (Sub Contractor of M/s Heurtey Petrochem)
- Then Cutting of the existing ITS guides and supports by gas cutting was done.

**<u>Installation of New Coil</u>**

**Old Steam Air coil**

**Old Steam Air coil removed from position**


**Removal of Coil under progress**

Installation stated on 14th March 2017, 08.00 hrs.

Installation completed: 03rd April 2017, 20.00 hrs.

- Cleaning of the insulation blanket area of the grid wall 5 and 7 with wire brush.
- Marking done by considering the master level from the top of the platform of convection section as per drawing of IFFCO drg no 01CB02232.
  - ➢ EL of top platform: 103’-6”
  - ➢ Elevation of coil area
    - ▪ Top: El + 36.844 m
    - ▪ Bottom: El + 35.908 m

- Marking of the bolts of new ITS support, guide and for the welding of the studs on the wall/ grid 5 & 7 was done as per the drawing (1102-FE-503 of Heurtey petrochem)
- The bolt hole on the wall was made by gas cutting and then grinding was done to the required size.
- Internal width of the panel as per drawing was 2349 mm but the actual measured values at the support and guide location was different. Hence plates of various thickness were provided (16mm, 20mm, 25mm, 25mm etc) on both side walls to maintain the Inside width.

| Sr. No. | Actual value at wall 5 | Actual value at Wall 6 | Difference (Req - Actual) |
|---|---|---|---|
| 1 | 2379 mm | 2379mm | 16mm |
| 2 | 2403 mm | 2404 mm | 25 mm |
| 3 | 2386 mm | 2387 mm | 20 mm |
| 4 | 2402 mm | 2407 mm | 30 mm |

- ITS support was placed on the provided plates at the required location, verified the center as per the support elevation drawing (NI15017: Skt-A1) by transferring the water level and tightening of bolts was carried. Same procedure was carried for ITS Guides also

**Insulation Jobs**

- Studs (Incoloy 800H Long 165 MM) along with the Retainer plate welded on side wall of 5 and 6
- Then shalikote was applied on the walls
- Ceramic Fibre blanket (1425ºC , 128 kg/cm$^2$ density and 150mm thick -6 layers of 25mmthk) was provided
- Incoloy 800 sheet of 0.5 mm thk was provided
- Corbels were provided to reduce the bypass of flue gas.

**Insulation removed on wall #5**

**Corbel provided on wall # 5**

- End Tube sheet Casting
  - ➢ Shalikote was applied on End Tube sheet
  - ➢ Welding of Anchors (22 Nos, Matl- SS310) as per the drawing (1102-FE-503) was done.

➢ After drying of the shalikote castable refractory (Insulcast super 1000 S) was filled after providing Wooden supports at edges of the ETS

➢ Allowed to dry for 48 h.

- After that removed the wooden supports and fine finishing was given.

## Coil Installation

- End Tube Sheet and 4 nos. Intermediate tube sheets were shifted with help of Hydra (of M/s. Onshore) inside the panel by placing the sleeper and dragged to their location one by one by the chain block.

**Erection of End tube sheet**

- ITS were placed on their supports and elevation checked by the water level and then it was locked with the guide.
- For alignment of center of the tube sheets by taking the reference of the End tube sheet as the center tube hole and piano wire was passed through the all intermediate sheet holes.
- Verified the center and taken the clearance of the bearing plate and casing. (Measured value - 39.5mm min 17 mm required for the expansion)

| Location | Wall 5 (toward reformer side) | Wall 6 (towards ID fan) |
|---|---|---|
| ITS 1 | 30 MM | 43 MM |
| ITS 2 | 32 MM | 44 MM |
| ITS 3 | 35 MM | 39 MM |
| ITS 4 | 44 MM | 40 MM |

**ITS placed in position**

**Header end of coil after insertion of coils**

- The coils were supplied as U-Pins. Installation of total 15 nos coil in form of U-pins from top right side of the ITS was started.
- Alignment of the coil done by moving horizontally and maintaining the distance of 405 mm from coil R-bend to the end panel cover with insulation.
- The fit up and welding of the R-bend towards the header box side was difficult. So Coils were pulled towards the silo side and fit up carried out by alternate joints.
- Welding of the SS304H material was done by filler wire of 308L of dia 2.4 mm. Argon gas of 99.99% purity was used. After completion of the welding the joints radiography was done.
- However all the 8 joints failed in radiography and hence these joints were grinded and removed.
- Refitting of the R-bends and welding carried, radiography of the joints is ok.
- After completing all welding of all joints (Total –20 Nos U coil joints, 10 Nos Return bend joints) fitting of the outlet header and welding of the header joints were done (Total 2 joints).
- Repairing of in few segments of header joints was carried out. Final radiography was done and found OK.
- The DM water is filled in coil assembly and Hydrotest carried at 119.3 $kg/cm^2$ witnessed by production , mechanical maintenance and heurtey petrochem
- Welding of SS 304 studs was done on header box side panel cover as per drawing (1102-FE-503) and shalikote paint applied and then ceramic fiber insulation was applied
- Final box up is done by locking with bolts on both of the panel covers.
- Blowing of line was carried out alongwith new piping of 103-D.

**Header end of coil after header welding**

**Header blinded for hydro test**

## Installation of Hot De-Sulphuriser-II Coil (HDS-II) E-106 B

**Details of New HDS-II coils**

| Sr. No. | Description | New coil |
|---|---|---|
| 1 | Tubes | Finned |
| 2 | No of tubes | 24 |
| 3 | Material | A335 TP P22 |
| 4 | OD of the Tubes | 114.3mm (4") |
| 5 | MW of the Tubes | Sch80 (08.56thk) |
| 6 | Length of the tube | 14m |
| 7 | Process Design Inlet temp | 208$^o$C |
| 8 | Process Design Outlet temp | 380$^o$C |
| 9 | Design Inlet Pressure | 36.95 kg/cm$^2$ |
| 10 | Design Outlet pressure | 37 kg/cm$^2$ |
| 11 | Operating temp IN/OUT as on 20.07.17 | 275 / 376 Deg C |
| 12 | Mechanical design Temp | 441$^o$C |
| 13 | Mechanical design pressure | 43.39 kg/cm$^2$ |
| | **Fins details** | |
| 14 | Fins type | Solid fins |
| 15 | Material | 11-13 cr |
| 16 | Thickness | 1.25mm |
| 17 | Spacing (fins/m) | 197 |
| 18 | Maximum (cal)Tip Temp | 445$^o$C |
| 19 | Extension ratio (total / bare area) | 13.34 |

## Shut Down Activities

Following activities carried out during installation of New coil.

### Installation of New Coil :

Installation starting: 13$^{th}$ march 2017 08.00 Hrs.

Installation completed: 03$^{rd}$ April 2017 20.00 Hrs.

The sequence of activities is as follows:

- Marking done by considering the master level from the top of the platform of convection section as per drawing of IFFCO drg no 01CB02232. EL of top platform: 103'-6".
- Marking of the required coil location done according to the drawing (1102-FD-001)
- Cutting of panel cover towards cooling tower and silo side above HT super heater coil in HT convection started at 09.30 Hr on 13$^{th}$ march.
- The height of wall on South side was to be increased to avoid the bypassing of flue gas. Hence existing refractory of HT to LT section of approx. width 250 mm was removed.
- Marking and removing of existing ceramic fiber blanket of approx. 670 mm width on 5$^{th}$ wall and on 6$^{th}$ wall started.
- Existing studs were removed

- Then this area was cleaned by wire brush.
- Marking of the ITS support bolts on the wall 5 & 6 as per the drawing (1102-FE-503) was done.
- Welding of ITS Guides mounting plate with stiffener (SS304 of 10thk X250 X14000 lg) plate on wall 6.
- The holes in ITS Guides mounting plate was 20 mm upwards with compared to the drawing (1102-FE-503) so marking of ITS support bolts of wall 5 was made as per reference of wall 6.
- The bolt hole on the wall was made by gas cutting and then grinding was done to the required size.

**Existing refractory of HT to LT section of approx. width 250 mm was removed**

**ITS Guides mounting plate with stiffener welded on HT to LT section wall**

**Provision for installation of ITS support and guides on wall 6**

- Internal width of the panel as per drawing was 2349 mm and the actual dimension measured was almost matching.

| Sr. No. | Actual value at wall 5 | Actual value at wall 6 | Difference (Req-Actual) |
|---|---|---|---|
| 1 | 2349 mm | 2349 mm | 0 mm |
| 2 | 2343 mm | 2343 mm | 6 mm |
| 3 | 2347 mm | 2347 mm | 2 mm |
| 4 | 2349 mm | 2449 mm | 0 mm |

- The manhole which was on North side above HT coil was shifted above LT coil on South side.
- ITS support placed at location, verified the center as per the support elevation drawing (NI15017: Skt-A1) by transferring the water level and tightening of bolts was done. Same procedure is carried for ITS Guides.
- Welding of the V-Anchors (Dia= 6mm, H=220 mm, SS304) of 85 nos and V-Anchors (Dia.=6mm, H=130mm, SS304) of 150 Nos. on ITS guide SS304 mounting plate for refractory.
- End Tube sheet Casting
  - Shalikote was applied on End Tube sheet
  - Welding of 12Nos of Anchors (6mm Dia, H=95mm,SS304) as per the drawing(1102-FE-503
  - After drying of the shalikote, castable refractory (Insulcast super 1000 S) was filled after providing Wooden supports at edges of the ETS
  - Allowed to dry for 48 h.
  - After that removed the wooden supports and fine finishing was given.

**<u>Insulation Jobs on wall NO 5: (as per drawing 1102-FE-503).</u>**

- Studs (Incoloy 800H Long 165 MM) along with 2 Retainer plate at 193.5mm as per drawing on side wall of 5.
- Then shalikote was applied on the walls
- Ceramic Fibre blanket (1425$^{o}$C , 128 kg/cm$^2$ density and 150mm thick -6 layers of 25mmthk) was provided
- Incoloy 800 sheet of 0.5 mm thk was provided
- Corbels were provided to reduce the bypass of flue gas.
- Inside panel with after the refractory is 2060 mm.

**Retainer plate and studs provided on wall for insulation. Manhole above HT Coil is closed**

**Insulation provided on wall**

**Incoloy sheet provided on wall** **Refractory provided on wall 6**

**<u>Refractory at wall No 6 (as per drawing 1102-FE-503)</u>**

- Wooden shutter was made in the shape of corbel, fixed on ITS guide mounting plate.
- Filling of Castable Refractory (Insulcast super 1000 S) was done and allowed to cure for 24 hrs. Then removed the shutter and finishing was also done.

**<u>Coil Installation</u>**

- End Tube Sheet and 4 nos. Intermediate tube sheets were shifted with help of Hydra (of M/s Onshore) inside the panel by placing the sleeper and dragged to their location one by one by the chain block.

**Coil lifted for installation** **Supports of ITS**

- ITS were placed on their supports and elevation checked by the water level and then it was locked with the guide.
- For alignment of center of the tube sheets by taking the reference of the End tube sheet as the center tube hole and piano wire was passed through the all intermediate sheet holes.
- Verified the center and checked the clearance of the bearing plate and casing = 39.5mm min 17 mm required for the expansion.

| Location | Wall 5 mm | Wall 6 mm |
|---|---|---|
| ITS 1 | 34 | 47 |
| ITS 2 | 47 | 50 |
| ITS 3 | 38 | 47 |
| ITS 4 | 47 | 53 |

**Outlet header end after positioning of coil**

**Outlet header after final welding**

- The coils were supplied as U-Pins. Installation of total 12 nos. coil in form of U-pins from top right side of the ITS was started.
- Alignment of the coil done by moving horizontally and maintaining the distance of 325 mm from coil R-bend to the end panel cover with insulation.
- The distance between the last coil center to wall 6 with refractory was 170 mm (as per drg – 120 mm) and towards wall 5 with insulation is 238 mm (as per drg – 241.2 mm)
- For joints of U-bends due to restriction in location, preheating was done by flame heating (180degC) and after welding post weld heating was done at 300 Deg C for one hour
- Filler wire ER 90S B3 of 2.5 mm dia was used for welding
- For the PWHT (post weld heat treatment).
  - ➢ Temp range : 720ºC ± 10ºC
  - ➢ Holding time : 2 Hrs
  - ➢ Hold temp : 720ºC
  - ➢ Rate of heating : 130ºC/hr From 300ºC
  - ➢ Rate of cooling : 100ºC / hr Upto 300ºC
- The fit up and welding of the R-bend towards the header box side was difficult. So Coils were pulled towards the silo side and fit up carried out by alternate joints.
- Radiography was carried out before and after PWHT. Later radiography done after PWHT only.
- After completing all welding of all joints (Total –16 Nos. U coil joints, 8 Nos Return bend joints) fitting of the outlet header and welding of the header joints were done (Total 2 joints).

- DM water filled in the coil assembly and conducted hydro test at 138 $kg/cm^2$ witnessed by the production, mechanical maintenance and Heurtey Petrochem.
- Welding of SS 304 studs was done on header box side panel cover as per drawing (1102-FE-503) and shalikote paint applied and then ceramic fiber insulation was applied
- Header box panel cover and end cover of cooling tower side are provided with 210mm thick of insulation.
- After Hydro test both panels were boxed up.
- Blowing of line was carried out alongwith new piping of 114-D.

**Other jobs in Primary Reformer Convection Zone**

- The LT and HT end panel walls were opened for external cleaning of the coils.
- Dry ice blasting was carried out to clean external scaling of all HT coils & LT coils including BFW coil in the duct by CMW, Vadodara.
- HT & LT panels were boxed up with new gasket after repairing damaged refractory.
- The transfer line end cover was opened for inspection, repaired the crack at the weld joint of cylindrical portion with flange & other cracks on the liners and then boxed up.

**Replacement of Insulation of Duct between Hotwell to HT convection zone (Near PRC-23)**

- Replacement of ceramic fibre insulation was done as insulation in this area was damaged.
- Earlier it was planned to carry out replacement of insulation above new coil also. However this was not done as the insulation of this area was found Ok.
- The details of insulation are as under: (Ref Drg. No. P1 DS 03468)
    - 4 ½” thick Ceramic Fiber blanket { 1460 Deg Grade, Density – 128 Kg/m3} insulation with 0.5 mm Thk. Incoloy-800 H lining
    - 3/8 “ dia. X 5” long Studs with nuts and washer of Incoloy
    - The approximate area is 40 m2
- The supply and application of insulation was done by M/s Unifrax India Pvt., Ltd, Mumbai against WO No – 201004171723 dtd 21-FEB-17.
- Incoloy sheet and Studs were provided by IFFCO as free supply.

**Replacement of PRC-23 Dampener**

- PRC-23 Damper blades and shafts were pre-fabricated as per M W Kellog drawing NO 214 D 16. The blades were fabricated so that there is an overlap with adjacent blades. The length of shaft was kept more for adjustment of length.
- The damper blade material was Incoloy 800 H and shaft was SS 304
- PRC 23 was dismantled after removing the linkages and measurement was done.
- Shaft length was cut and kept as the required length

- After assembly, setting of opening gap carried out as per the production requirement.
- Overhauling of the remaining mechanism carried out for free movement of dampers.
- The Bearing No 39423 DE, Size : 2- 7/16   Make Timken – of dampener was not replaced

**PRC-23 dampener area after replacement of dampener and CF insulation**

**Replacement of damaged supports of Mixed Feed coil**

- It was observed that all 4 nos ITS supports of MFC at south ends were damaged badly and coil is slightly downward at this side.
- Hence new supports were provided and coil was supported
- Supports were made from the old supports (Inconel 600) of Air preheat coil which was removed

**Damaged 2nd ITS support**

**Damaged 3rd ITS support**

1st ITS support after repair

3rd ITS support after repair

## The Secondary Reformer

Bottom cover was opened for inspection. Minor damage of refractory was observed and the same was repaired.

Top cover with Air Nozzle was opened & removed to inspect the condition of new distributor supplied by M/s. Casale under ESP-III scheme which was installed in Shutdown 2016. The catalyst distribution was found ok.  (The dimension of 103-D liner ID -740/745 mm and Distriutor OD – 725 mm)

The Air line from Steam Air coil upto 103-D was replaced with SS 321 H line by Technical. For replacement job, 103-D top cover was removed. Reddish deposits were observed at the tip of burner and inside. The Burner was inspected- DPT of all weld joints, burner tip and distributor welds at random was done and found OK.

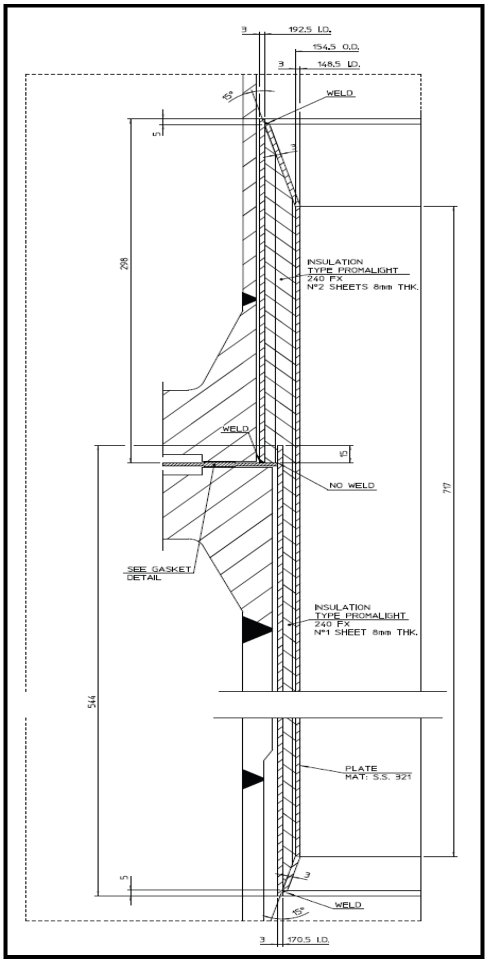
103-D Burner

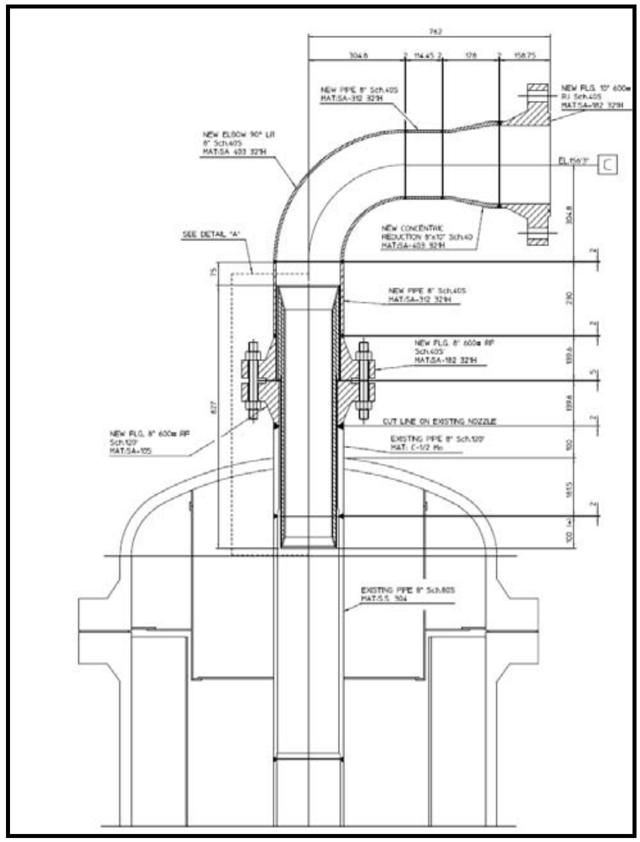
Insulation sleeve

Inlet line was cut leaving 100mm from top cover and A 105 flange of 8”X 600# was provided. Its counter flange of material SS321H was welded with air inlet line.

Insulation sleeve was pre-fabricated at workshop from 3.0 mm thick sheet of SS321 material. (Filler wire – ER 347) It was filled by insulation Microtherm Overstitched 100 R of 10 mm thk (procured from M/s. MG Materials, New Delhi against PO No. 201004171258) as per attached drawing provided by M/s. Casale. Note - The insulation thickness was kept 10mm instead of 8 & 16 mm.

Cam profile Gasket of size 317.5MM OD X 176.5MM ID X 5MM THK., MOC: SS321 CORE with 0.5 mm thk graphite layer as per drg No- P1-ES-03468 was procured from M/s Goodrich Gasket Pvt Ltd., against PO No. 201004171252, dtd 17-DEC-16




**Ref Casale Drg No - A00710A-E-MDL-801-REV00**

## Auxiliary Boiler

- All Manholes were opened.
- Scaffolding was erected for cleaning of tubes & repairing of damaged refractory of walls.
- Repairing of severely damaged wall refractory around burner no-5 (topmost), minor damages around other burners, walls and headers were carried out. Cracked / damaged refractory bricks of Centre partition wall were replaced.
- Cleaning of tubes carried out.
- Scaffolding was removed from both sides.
- Manhole was closed by putting bricks and ceramic blanket.

## HEAT EXCHANGERS AND COOLER JOBS

## REPLACEMENT OF REFRACTORY AND LINER OF 101-CA & 101-CB

Under ESP-III, S/C ratio is to be lowered from 3.3 to 3.0. To prevent Metal Dusting at elevated temperature on shell side, existing 6.0 mm thick liner material need to be upgraded from Incoloy 800H to Inconel Alloy 693. As the metal dusting was observed near the gas outlet nozzle at the top of the shell, it was decided to replace the top three segments of liner with upgraded MOC of Alloy 693 & others with the same material Incoloy 800H.

To prevent from metal dusting, MOC of the baffle plates, guides & ribs, tie rods & nuts, spacers of the tube bundle also upgraded to Alloy 693 (ASTM B 168 UNS N06693).

Two tube bundles (Bundle No.4 & Bundle No.1) were sent to works of M/s. Anup Engineering Pvt. Ltd., Ahmedabad one by one against WO No. 201004161457 dated 12/02/2016 to carry out the above upgradation.

IFFCO engaged two Contractors for liner replacement jobs. Replacement of Liners of 101-CA was carried out by M/s. Skywin Erectors, Ahmedabad and 101-CB by M/s. Shree Ganesh Engineering Company, Ahmedabad against WO Nos. 201004171641 & 201004171642 respectively. Supply & Application of Refractory work was carried out by M/s. Calderys India Refractories Ltd., Ahmedabad against WO No. 201004171637.

### Pre Shutdown Jobs

- Incoloy 800 H / Inconel Alloy 693 plates of 6.0 mm thick & 10.0mm thick was issued to contractor by IFFCO for rolling
- Rolling was done from Ahmedabad by the Contractors.
- Pre-fabrication of liners, cone, support etc was started.
- Rolling of shell was carried out from Ahmedabad by the Vendors. For fabrication, the liner ID was kept at 1046 mm (-0.0 / +2.0)
- The arrangement of stack for dry out was made
- PCV for reducing the NG pressure from 38 Kg/cm2 g to 2 Kg/cm2 g which was used by IFFCO Phulpur was bought.

**PCV arrangement**

- The temporary line for the gas line was also fabricated and kept ready

## Shutdown Jobs

After plant shutdown, blinds fixed at gas side and BFW/Steam side to isolate the 101-CA & 101-CB. Platform cut around 101-CA & CB fouling with the removal of the bundle. Insulation of Downcomer elbow removed.

Both the tube bundle assy. were dismantled by unbolting & detaching downcomer flange joint (18”X 1500#), top cover to channel flange joint, both riser flange joints (14”X 1500#) & outer tube sheet to shell flange joint one by one. Removed the top cover (weight: 7 Tons) & fixed the lifting cover by the help of Kobelco crane.

Removed both the tube bundles from shell by the help of Kobelco crane & shift it to the ground. Both the tube bundles were laid down in the horizontal position by the help of another crane. Later both the bundle shifted to the

Black deposits were observed on shell liners and tubes. The deposit was more at the top portion. Shell inspection of both 101-CA & 101-CB was carried out and it was decided not to replace the inside liners of nozzles S1 & S2.

Measurement of existing liner was taken before cutting as reference for fabrication of new liner.

**Old 101 CB tube bundle**

**Shell liner removed from 101-C**

## Removal of Liner and Refractory

Refer Drg No 302 D 101, 01-BS-04027 Sh 3 of 6 and 01-BS-04028

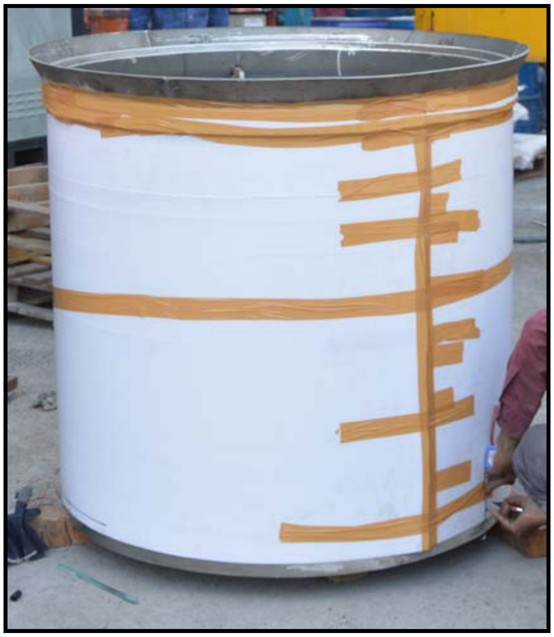
- Inlet gas distributors were cut & removed from the shell.
- Segment wise cutting and removal of liner including cone plate & cone cover was carried out by grinding and plasma cutting.
- The removal was carried out from top to bottom one by one alongwith removal of refractory.
- Removed drain pipe of nozzle S3.
- Cleaning of shell surface was carried out by wire brush/grinding
- After removal of refractory, it was found that strip of width 75 mm is welded on the shell on which cone cover and spokes are welded. This is not shown the original drawing of 101-C. As there was no direct welding with shell, pre heating was not required to be done as planned earlier.

**101-CA after complete removal of liner and refractory**

## Installation of Liner and Refractory

- After cleaning, the bottom pipe Part no 215 (4" Sch10S Incoloy 800H) with 3/8" thk cardboard layer inserted inside the shell and refractory job at the bottom was carried out.
- Bottom shell liner Part no 213 & 214 was inserted, void space of 2" was maintained by putting cardboard & leveling was done.
- Inserted bottom shell liner Part no. 169 with cone and backing plate wrapped with 3/8" thk sunpack sheet (also known as plastic corrugated sheets) inside shell, fit up and then welding of cone plate with strip on shell was carried out as per drg.
- After Welding, the job was covered with Asbestos cloth.
- DP of weld joint was carried out.
- Refractory (Tabcast 97L) was poured through the cone cover opening. Welding of cone cover plate with the strip on shell was carried out.
- Shell liners Part No. 170, 173,171A, 171,172 with backing plate and cone (with a layer of 3/8" thk. card board) were inserted sequentially, refractory jobs carried out and cone cover plates were welded in similar manner.

- Welding of liner Part No. 175 at Nozzle S2 was carried out.
- Final DP of all welding joints & repair works were carried out accordingly.



**Liner wrapped with sunpack sheet**

- The detailed fabrication drawing with Part nos. and welding details are given in the drawings- Drg No 01-BS-04027 Sh 3 of 6 and 01-BS-04028. The following liners along with their guide rings, cone, cone opening cover, padding plate, pipe etc replaced.

| Sr No | Description | Part No. of liners | New Material |
|---|---|---|---|
| 1 | 1st liner shell with flange | 172 | Inconel 693 |
| 2 | Backing plate, Cone & Cone cover (Ref Det A) | 193,191, 178 | Inconel 693 |
| 3 | 2nd liner shell | 171 | Inconel 693 |
| 4 | Cone & Cone cover, Backing plate (Ref Det B) | 196,194, 179 | Inconel 693 |
| 5 | 3rd liner shell | 171 A | Inconel 693 |
| 6 | Backing plate, Cone & Cone cover (Ref Det F) | 197,195, 180 | Inconel 693 |
| 7 | 4th liner shell | 173 | Incoloy 800 H |
| 8 | Backing plate (Ref Det D) | 189 | Incoloy 800 H |
| 10 | 5th liner shell | 170 | Incoloy 800 H |
| 11 | Backing plate, Cone & Cone cover (Ref Det F) | 192,190, 177 | Incoloy 800 H |
| 12 | 6th liner shell | 169 | Incoloy 800 H |
| 13 | Bottom shell liner with 4 “ NB pipe | 213,214,215 | Incoloy 800 H |
| 14 | Inlet distributor (Prefabricated by IFFCO ) and supports | Distributor, 176,SG1 | Incoloy 800 H |
| 15 | Liners of Nozzle S2 | 175, | Incoloy 800 H |

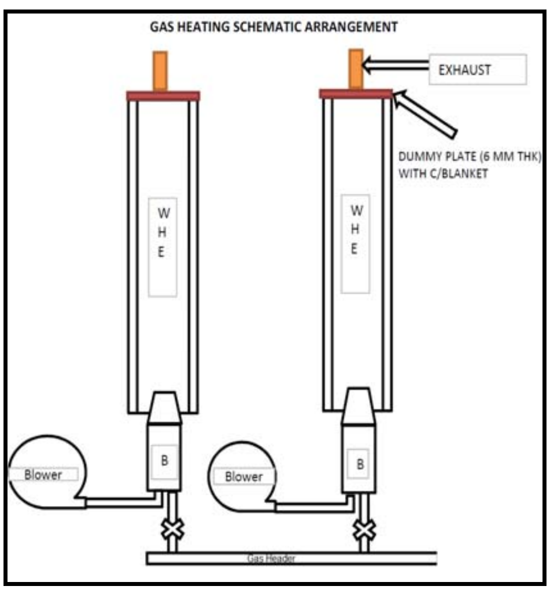
**<u>Welding Filler Wires used for Liner Welding by TIG</u>**

- Welding of 693 joints were carried out by TIG
- Welding of joints of cover and cover plate (of 800 H) which were not exposed was carried out by electrode

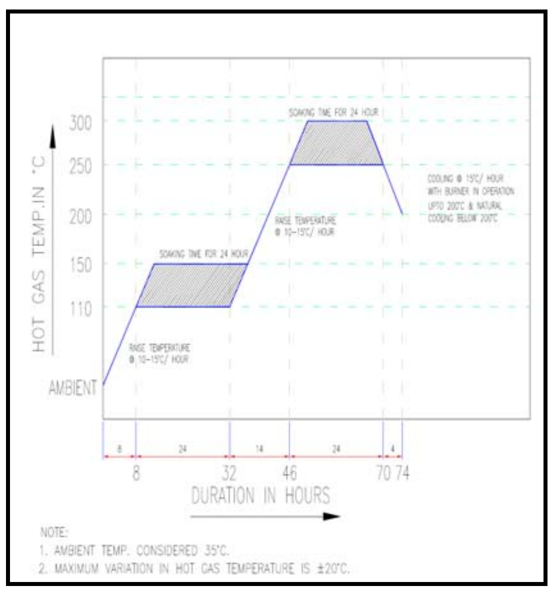
| Sr No | Description | Filler Wire | Electrode |
|---|---|---|---|
| 1 | Inconel Alloy 693 | 53MD 0.093 X 36 UNS #: N06693 (ER NiCrFeAl-1) | - |
| 2 | Incoloy 800H | Incoweld A (ER NiCrFe-2) | Inconel 117 (ENiCrCoMo-1) |
| 3 | Inconel 693 to CS | Inconel 82 (ER Ni Cr3) | Inconel 117 (ENiCrCoMo-1) |
| 4 | Incoloy 800H to CS | Inconel 82 (ER Ni Cr3) | Incoweld A (E NiCrFe-2) / Inconel 117 (ENiCrCoMo-1) |

**<u>Refractory Dry out</u>**

- Refractory dry out was started after 24 hrs of completion of top liner refractory.
- Refractory dry out was carried out by providing Gas burner at bottom of 101-C.
- S 1 nozzle was covered with ceramic fiber insulation.
- Provision of exhaust was made at 101-C shell top.
- Installation of gas burners, Thermocouple (2 nos one at bottom and another at top) and Recorder was done
- Refractory dry out was done with Natural Gas from Gail. The pressure was reduced to 2 kg/cm2 g providing PCV.
- Dry out carried out as per the dry out curve given below.
  - ➢ Increasing temp from 40 to 110 Deg C /150 Deg C @15 Deg C /hr
  - ➢ Holding at 110 Deg C/150 deg C
  - ➢ Increasing temp from 110 to 250/300 Deg C @15 Deg C /hr
  - ➢ Holding at 250 / 300 Deg C
  - ➢ Decreasing temp from 300 to 200 Deg C @15 Deg C /hr
  - ➢ Decreasing temp from 200 Deg C to atm temp




**Schematic Arrangement for heating**




**Dry out chart**

NG line taken from GAIL and connected to 101 CA & B

Burner provided at bottom of 101-CA/B

101-C covered with plate & exhaust provided

- After completion of dry out, Installation of new distributor and support at Nozzle S 1 was carried out.

Tube Bundle insertion

- After completing shell liner repair jobs, tube bundle assy. was inserted into the shell with new joint gasket (Kempchen make) by the help of Kobelco crane.
- Removed the lifting cover & placed the top cover with new gasket (Kempchen make).
- Tightened cover to channel & channel to shell flange joint bolts.
- Inserted new gasket & then tightened downcomer & both riser flange joints bolts as per prescribed torque values.
- De-blinding on Gas side & BFW/steam side was carried out.

| **Description of Activities** | **101-CA/CB** |
|---|---|
| Bundle removed on | 16.03.2017 |
| Removal of Liner / refractory was started on | 16.03.2017 |
| Removal of Liner / refractory was completed on | 20.03.2017 |
| Installation of liner / Refractory started on | 20.03.2017 |
| Installation of liner / Refractory completed on | 27.03.2017 |
| Dry out started on | 28.03.2017 |
| Dry out completed | 31.03.2017 |
| Tube Bundle inserted | 02.04.2017 |
| Hydrotest of BFW loop at 146 Kg/cm2g pressure | 06.04.2017 |

**102-C tube cleaning**

- Mechanical cleaning of 102-C tubes was carried out. Tube size - 25.4 OD X 4.19 mm thk X 4028 lg.
- Cleaning by hydrojetting was done.
- The cleaning was carried out by M/s Powermaster make tube cleaning machine (Portable Electric Tube Cleaning System Model PTC-150) under their supervision.
- The following items were procured for tube cleaning from M/s Powermaster:
  - "PFS" Type Flexible Shaft with High Carbon Spring Steel inner core size: 7.9 mm dia and Nylon outer casing: 12.7 mm dia.
  - Flexible Shaft Length: 11 Mtrs, Model : PFS-500-110
  - Nylon Wire Brush Size : 15.9 mm + Size : 17.5 mm (01 no = 1 piece of each size brush) Model : N-625 + N-687
  - Stainless Steel Wire Brush size : 15.9 mm + 17.5 mm (01 no = 1 piece of each size brush) Model : SS-625 + SS-687
- The appx ID of 102-C tubes – with deposit before cleaning -16.40 mm and after cleaning – 16.55/ 16.70 mm
- 102-C deposit residue Analysis report :
  - Iron as $Fe_2O_3$ = 30.0 % w/w
  - Phosphate as $PO_4$ = 2.5 % w/w
  - T.H. as $CaCO_3$ = 17 % w/w
  - Loss on Ignition = 11.5 % w/w
- RFET of tubes was carried out by Inspection Section. No abnormalities was found.

## Installation of 154-C NG Preheater

- E-110 of Pre Reformer was installed as 154-C NG preheater at GAIL station to increase the temperature of NG. This will remove the problem of moisture condensation of Fuel line.
- Minor modifications were carried out before installation

## MP Boiler 1123-C

- 1123-C chemical cleaning was carried out by Production as per Procedure given by M/s L&T.
- Diaphragm gasket (Inconel 600) of Channel cover of 1123-C was not welded at M/s. L&T workshop as per instruction of IFFCO.
- It was welded at site after internal inspection & piping joints were completed
- The tightening of channel cover was carried out using hydraulic bolt tensioner of M/s Power master, Mumbai against order placed by IFFCO. Regulatory WO No-201004180241, Order Date: 08.06.2017.
- Open inspection of 1123-C was carried out by Boiler Inspector - IBR, Gujarat.
- 1123-C demister pad fixed and boxed up.
- However after plant start up on 23.04.2017, leakage through channel cover was observed and hence Plant was stopped.
- Observation: Leakage of the Diaphragm at South side observed, due to the welding crack.
- Removed the channel cover using hydraulic bolt tensioner of M/s Power master.
- The diaphragm gasket was cut and removed.
- DP was carried out on edges after grinding.
- New diaphragm gasket was provided and welding was done using Filler wire ER NiCr-3 supplied by L&T.
- Channel cover placed and bolts were provided.
- Bolt tightening was carried out at pump oil pressure of 142 Bar, 307 Bar, 471 bar and 471 bar sequentially as per Table T1 of L&T procedure using hydraulic bolt tensioner of M/s Power master.
- The diaphragm gasket assembly was done as per procedure S010081-DIAPH-ASLY and bolt tightening was done as per procedure LTHE-FPSB-15068-BTP of M/s L&T

| Activities | Start | | Completed | |
|---|---|---|---|---|
| Handover | 18.30 hrs | 23.04.2017 | | |
| Removal of Cover | 18.30 hrs | 23.04.2017 | 04.00 hrs | 24.04.2017 |
| Removal of Diaphragm | 14.00 hrs | 24.04.2017 | 15.15 hrs | 24.04.2017 |
| Diaphragm welding | 20.30 hrs | 24.04.2017 | 11.00 hrs | 25.04.2017 |
| Cover fixing and tightening | 15.30 hrs | 25.04.2017 | 22.00 hrs | 25.04.2017 |

**OTHER EXCHANGERS**

| EQP TAG | | HYDROJETTING | | HYDRO TEST PR. | Remarks |
|---|---|---|---|---|---|
| | | TUBE SIDE | SHELL SIDE (Tube bundle pull out) | | |
| 101-JCA | | ✓ | | | |
| 101-JCA | I/A COOLER | ✓ | | | |
| 101-JCB | | ✓ | | | |
| 101-JCB | I/A COOLER | ✓ | | | |
| 101-BJT | LUBE OIL COOLER | ✓ | | | |
| 101-JLC1 | LUBE OIL COOLER | ✓ | | | |
| 101-JLC2 | LUBE OIL COOLER | ✓ | | | |
| 101-JT | GLAND CONDENSER | ✓ | | | |
| 103-JLC1 | LUBE OIL COOLER | ✓ | | | |
| 103-JLC2 | LUBE OIL COOLER | ✓ | | | |
| 103-JBT | GLAND CONDENSER | | | | Removed & replaced by new one |
| 104-J | LUBE OIL COOLER | ✓ | | | Cleaning done before shutdown |
| 104-JT | LUBE OIL COOLER | ✓ | | | |
| 104-JT | GOV OIL COOLER | ✓ | | | |
| 104-JA | LUBE OIL COOLER | ✓ | | | |
| 104-JAT | LUBE OIL COOLER | ✓ | | | |
| 104-JAT | ACTUATOR OIL COOLER | ✓ | | | |
| 105-JT | GLAND CONDENSER | ✓ | | | |
| 105-CA | | ✓ | ✓ | ✓ | Shell Side: 40 Kg/cm2 & Tube Side: Head Pressure |
| 105-CB | | ✓ | ✓ | ✓ | |
| 107-JT | LUBE OIL COOLER | ✓ | | | |
| 107-JAT | LUBE OIL COOLER | ✓ | | | Cleaning done before shutdown |

| EQP TAG | | HYDROJETTING | | HYDRO TEST PR. | Remarks |
|---|---|---|---|---|---|
| | | TUBE SIDE | SHELL SIDE (Tube bundle pull out) | | |
| 108-C1A | | ✓ | | ✓ | Shell side : 8.0 Kg/cm2g. Tube side : 6.0 Kg/cm2g. |
| 108-C2A | | ✓ | | ✓ | |
| 109-C1A | SILO SIDE | ✓ | ✓ | ✓ | Shell side : 8.0 Kg/cm2g. Tube side : 6.0 Kg/cm2g. Shell side : 8.0 Kg/cm2g. |
| 109-C2A | SILO SIDE | ✓ | ✓ | ✓ | |
| 110-CA | | ✓ | | | |
| 110-CB | | ✓ | | | |
| 114-C | | | | | Removed |
| 115-C | | | | | Removed & replaced by new one |
| 115-JALC1 | LUBE OIL COOLER | ✓ | | | |
| 115-JALC2 | LUBE OIL COOLER | ✓ | | | |
| 115-JBLC1 | LUBE OIL COOLER | ✓ | | | |
| 115-JBLC2 | LUBE OIL COOLER | ✓ | | | |
| 116-C | | | ✓ | ✓ | Shell side : 8.0 Kg/cm2g |
| 117-J | INTERCOOLER | ✓ | ✓ | ✓ | |
| 117-J | 1st STAGE COOLER | ✓ | | | |
| 117-J | LO COOLER | ✓ | | | |
| 124-C | | | ✓ | ✓ | Shell side : 8.0 Kg/cm2g |
| 127-CA | | ✓ | | ✓ | Shell side : 27.0 Kg/cm2g Strainers repaired & Lock plates new fabricated in both HE |
| 127-CB | | ✓ | | ✓ | |
| 128-C | | ✓ | | | |

| EQP TAG | | HYDROJETTING | | HYDRO TEST PR. | Remarks |
|---|---|---|---|---|---|
| | | TUBE SIDE | SHELL SIDE (Tube bundle pull out) | | |
| 129-JC | 101-J INTERCOOLER | ✓ | ✓ | ✓ | 6.0 Kg/cm2g In Dummy Shell |
| 130-JC | 101-J INTERCOOLER | | ✓ | | Tube bundle replaced by new one |
| 131-JC | 101-J INTERCOOLER | ✓ | ✓ | | |
| 150-C | | ✓ | | | |
| 173-C | | ✓ | | | |
| HE-2 | PGR | ✓ | | ✓ | Shell side : 25.0 Kg/cm2g |
| HE-4 | PGR | ✓ | | | |

- In 105-CA aMDEA leak in shell side was observed when it was taken in line. Bottom & top cover was opened, test ring fixed & hydrotest carried out. Leakage in 11 nos. tubes was found which was plugged.
- HE-2 was also found having leakage after shutdown. 17 Nos tubes were plugged. Total 30 Nos tube is plugged. Hydrotest done at 35 Kg/cm2g.

**Air Compressor Interstage Cooler,129-JC 130-JC & 131-JC**

**In 130-JC**, additional water was continuously sprayed throughout the year over the shell from outside to improve the heat exchanging performance. 24 nos. tubes were plugged during annual shutdown 2016. Hence, it was planned to replace the tube bundle & increase the size of Cooling water inlet & outlet line from 6” to 8” upto nozzle connection. Nozzles were already of 8” size.

New tube bundle for 130-JC was procured from M/s. Patel Airtemp (India) Ltd. against PO No. 201004170714 dated 29/08/2016.Old tube bundle was pulled out & New Tube Bundle was inserted carefully inside the shell with new gasket & O-ring after shell cleaning.

**In 129-JC,** old tube bundle was pulled out from the shell, cleaned by hydrojetting. Tube Bundles were inserted inside the Dummy shell to carry out Hydrotest. Hydrotest of 129-JC was carried out at 6.0 Kg/cm2g. H-type silicon seal at top & bottom replaced.

Replaced the damaged studs with new ones (made in workshop) & rectangular washers were provided to support the studs in enlarged holes.

Stud: 8mm OD X 425mm long with M8 thread at both ends

Washer : 50mm X 25mm X 4mm Thk., 10mm Dia. Hole at centre.

MOC: SS 304

Boxed-up the 129-JC with new gasket & O-ring.

**In 131-JC**, old tube bundle was pulled out from the shell, cleaned by hydrojetting. Tube Bundles Hydrotest of 131-JC was carried out at 6.0 Kg/cm2g in position after providing blinds. H-type silicon seal at top & bottom replaced.

**<u>VESSEL INSPECTION / REPAIR JOBS</u>:**

- 101-EA, $CO_2$ Absorber: All Manholes were opened for inspection.

  In compartment of Manhole 3, loose 01 no. Rasching ring holding clamp at south side tightened. In compartment of Manhole No. 4, Corrosion cavities and holes were observed on South most liquid distributor collector plate, located just below the liquid distributor.

  In compartment of Manhole No. 5, repaired the detached Sample collector by welding.

- 102-EB, $CO_2$ Stripper: Top Manhole opened & boxed up after inspection, cleaning, tightening loose U-Clamps of North-East and South-West side distribution header, repairing of following by welding:

  - cracked/detached Header support pipe at North-West side,
  - enlarged hole in bottom plate of North-East side U-clamp. Missing U-clamp nut provided.
  - crack in the bottom of North-West side distribution header U-clamp support plate.

- 103-E1, HP Flash Vessel: Top & Bottom manholes were opened for inspection and then boxed up. No repairing points observed.

- 103-E2, LP Flash Vessel: All three manholes were opened for inspection. No repairing points observed in the compartments of top & bottom manhole.

  Following repairing was carried out in the compartment of second manhole:

  - Tightened loose Holding bolts of bottom tray & 3 nos. missing bolts provided.
  - Repaired detached bubble cap tray drain line from top plate & support plate by welding.
  - New 03 nos. holding clamp of top bubble tray provided against the missing one.

  Boxed up all the manholes after repairing.

- 105-E, Dehydrator: Top & Bottom manholes were opened for inspection and then boxed up. No repairing points observed.

- 101-F, Steam Drum: Side Manholes opened, tightened loose bolts and clamps of Demister Pad holding cover plate & provided new against missing one, 02 nos. loose bolts of flange tightened in 6" BFW header. On East side demister pad stiffener plate missing fastener at 04 locations at bottom side of plate was fixed. On East side, detached tack welding of Stiffener plate at few locations of bottom demister pad was repaired.

  101-F open inspection was done on 17.03.2017 and hydrotest was done on 06.04.2017

- 102-F, Raw Gas Separator: Manhole opened for inspection and then boxed up after applying fresh putty against the detached one on the circumferential weld joint of manhole nozzle with shell from inside.

- 103-F, Reflux Drum: Manhole opened for inspection and then boxed up. No repairing points observed.
- 104-F, Synthesis Gas Compressor Suction Drum: Manhole opened & boxed up after inspection & cleaning. No repairing points observed.
- 105-F, Synthesis Gas Compressor 1st Stage Separator: Manhole opened & boxed up after inspection & cleaning. No repairing points observed.
- 106-F, Ammonia Separator: Manhole opened & boxed up after inspection & cleaning. No repairing points observed.
- 107-F, Primary Ammonia Separator: Manhole opened for inspection and then boxed up. No repairing points observed.
- 109-F, Refrigerant Receiver: Manhole opened for inspection, cleaning done and then boxed up. No repairing points observed.
- 110-F (1st Stage), 111-F (2nd stage), 112-F (3rd stage) Refrigerant Flash Drum**:** Manhole opened for inspection, cleaning done and then boxed up. No repairing points observed.

**OPEN INSPECTION & HYDROTEST OF BOILERS :**

Open inspections as well as hydro test of the following boiler was successfully executed in presence of IBR inspector:

| Sr. No. | Tag No. | Identification No. | Hydrotest Pressure ($kg/cm^2$) |
|---|---|---|---|
| 1 | 101-F | Boiler No. GT-1632 | 146.0 |
| 2 | 107-C | Boiler No. GT-5217 | 67.5 |
| 3 | 1123-C | Boiler No. GT-9410 (New) | - |

**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) | 118.80 |
| 2 | RV-101-F 2 | 2.5” X 6” (2.545) | 117.00 |
| 3 | RV-101-F 3 | 2.5” X 6” (2.545) | 115.30 |
| 4 | RV-101-B | 3” X M(3.6) X 6” | 111.10 (Online Floating) |
| 5 | PSV-986 (107-C) | 4 L 6 | 45.00 |
| 6 | PSV-987 (107-C) | 4 L 6 | 46.00 |
| 7 | RV-103-J | 3 K 4 | 159.00 |
| 8 | RV-103-JA | 3 J 4 | 158.90 |
| 9 | RV-105-D | 3 J 4 | 152.80 |
| 10 | RV-106-F | 1.5” X 2” | 157.90 |
| 11 | RV-102-F | 6 R 8 | 30.50 |
| 12 | RV-123-CA | 3 J 6 | 122.00 |
| 13 | RV-123-CB | 3 J 6 | 122.00 |
| 14 | RV-MS-9 | 4 P 6 | 42.20 |
| 15 | RV-BFW-1 | 1-1/2 G 2-1/2 | 92.00 |

| Sr. No. | RV Tag NO | Valve Size | Set Pressure (kg/cm$^2$) g |
|---|---|---|---|
| 16 | RV-112-CA | 1-1/2 H 3 | 10.50 |
| 17 | RV-112-CB | 1-1/2 H 3 | 10.50 |
| 18 | RV-109-F | 6 Q 8 | 19.00 |
| 19 | RV-110-F (N) | 3 L 4 | 7.00 |
| 20 | RV-110-F (S) | 3 L 4 | 7.00 |
| 21 | RV-111-F | 4 P 6 | 6.30 |
| 22 | RV-112-F | 4 M 6 | 6.30 |
| 23 | RV-104-D1 | 6 Q 8 | 35.0 (Reset:31.5) |
| 24 | RV-104-D2 | 1-1/2 F 2 | 34.10 |
| 25 | RV 101-J | 4 M 6 | 36.90 |
| 26 | RV-S-7 | 4 P 6 | 14.80 |
| 27 | RV-LS-1 | 4 N 6 | 12.20 |
| 28 | RV-170-C (Shell side) | 3 K 4 | 5.30 |
| 29 | RV-170-C (Tube side) | ¾" X 1" | 30.50 |
| 30 | RV-129-C | 1 E 2 | 8.40 |
| 31 | RV-PG-39 | 4 M 6 | 5.30 |
| 32 | PSV-977 (Absorber Inlet) | 4 P 6 | 32.20 |
| 33 | PSV-976 (Absorber Inlet) | 4" X 6" | 30.60 |
| 34 | RV-104-F (Syn. Gas Comp. Suction separator) | 1" E 2" | 30.50 |
| 35 | PSV-954 | 8 T 10 | 0.7 |
| 36 | PSV-951 | 8 T 10 | 0.7 |
| 37 | PSV-983 | 6 Q 8 | 7.0 |
| 38 | SV-01 (117-J) | 1-1/2" H 3" | 5.80 |
| 39 | SV-02 (117-J) | 1.5 G 3 | 15.80 |
| 40 | SV-03 (117-J) | 1 E 2 | 30.20 |
| 41 | PSV-111 (Purge E4 HE Tubes) | 15 X 20 | 57.08 |
| 42 | PSV-177 (Purge Gas E1) | 15 X 20 | 57.08 |
| 43 | RV-104-JAT | 8 T 10 | 0.35 |
| 44 | RV - 935<br>(116-JAT Exhaust RV) | 3 J 4 | 6.10 |
| 45 | RV-105-F (103-J 1st stage separator) | 1 E 2 | 73.80 |
| 46 | RV-103-JAT(A) | 3 J 4 | 46.40 |
| 47 | RV-103-JAT(B) | 3 J 4 | 46.40 |

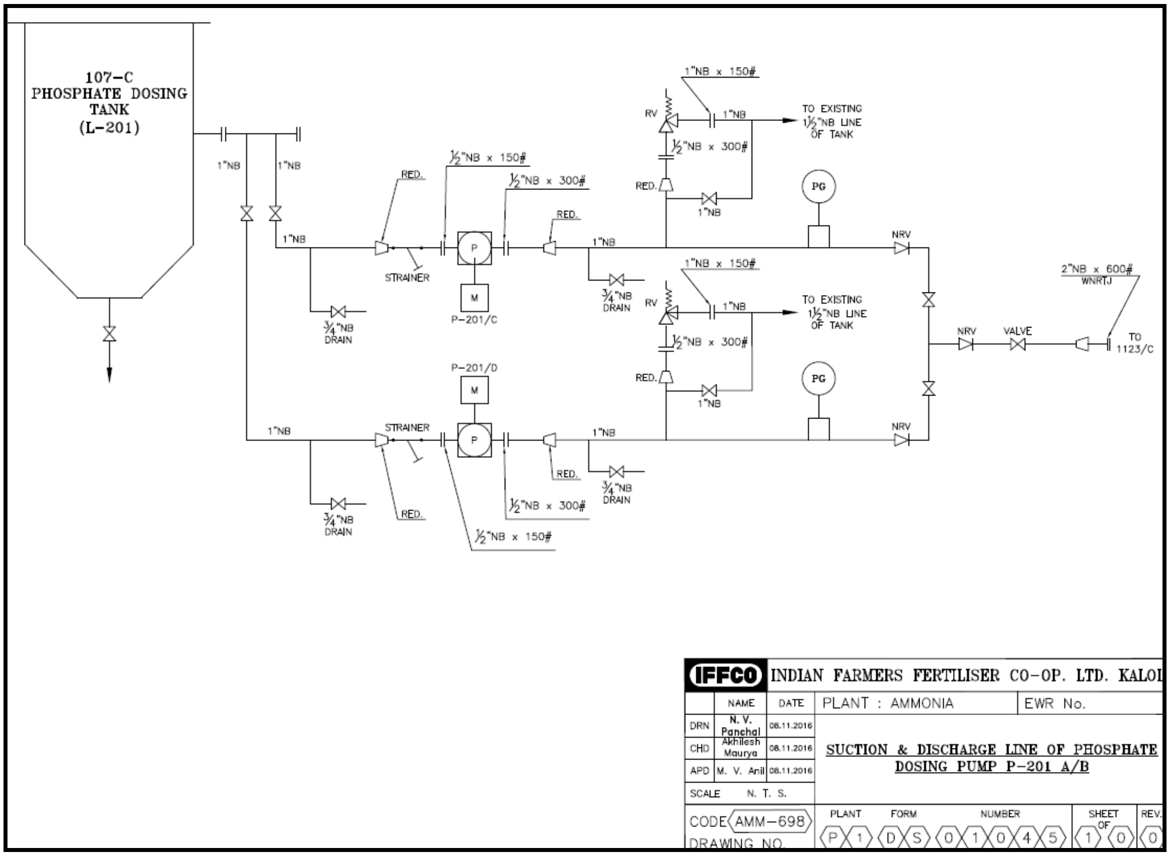
## FABRICATION JOBS

Fabrication contract i.e. WO No. 201004171687 dated 08/02/2017 was placed on M/s. J&J Engineers, Shertha to carry out following jobs:

| SR. NO. | JOBS |
|---|---|
| 1 | Fabrication of Lube Oil piping for 103-J Train |
| 2 | Fabrication of Lube Oil, Seal Oil / Gov. Oil piping for 101-J & 105-J Train |

Following Fabrication jobs were carried out departmentally as well as by ARC Contractor M/s. J&J Engineers:

| SR. NO. | JOBS |
|---|---|
| 1 | New P-202-A & B pump base frame fabricated & installed. Suction & Discharge piping fabricated as per PID P1-DS-01045 |
| 2 | Replaced Bypass line of PIC-13A & B and MIC-22 with P22 material & provision of drain line made with Gate Valve |
| 3 | Flanges – 8nos. replaced by WNRF Flange, 4" X 600#, SS304 for installation of Valves KV-1, 2, 3 & 4 in PGR |
| 4 | Additional flange was provided at R1/R2 regeneration outlet line at PGR (4"X 600#) for provision of blind |
| 5 | 107-JT LO cooler Cooling Water leakage – CW Inlet & Outlet line modified |
| 6 | Leakage started during running from the Flange connecting 107-F vapour nozzle with line having RV which was arrested by furmaniting. Reduced line thickness was also found due to corrosion. – Pipe (3"XSch40) with flange (3"X300#) was replaced |
| 7 | 108-J/JA discharge line to stripper (102-EB) pin hole leak on 102-EB platform attended by welding. |
| 8 | Provision of flanged NRV (3"X 300#) in the discharge line of 108-JA was made. Two SORF flanges of 3"X 300# welded after cutting spool piece of required length. |
| 9 | 110-CA/CB passing vent 1st I/V replaced. |
| 10 | Root I/V (HP Tapping) of FI-935 (115-JAT Inlet Flow) is not operatable – Valve replaced |
| 11 | CO2 Absorber Gas Inlet PI TX Root Isolation valve Pinhole leak. (Peening done & steel putty applied) – Valve replaced |
| 12 | 107-C outlet Trap I/V bonnet leak near 156-F – Valve replaced |
| 13 | Isolation valve provided at FR-6 D/S point from where water is fill up during Hydrotest of 101-F to save water while draining the line – Valve Size: 3"X1500# |
| 14 | Flange modifications of Interstage cooler of 117-J carried out. |
| 15 | MIC-003 C/V d/s drain is choked – Line replaced |
| 16 | PIC-14 u/s trap passing – Trap replaced |
| 17 | Rerouting of instrument air line near 104-JAT centrifuge carried out |
| 18 | Rerouting of Cooling Water inlet line (6"X Sch40) from CW supply header for 101-J/105-J LO coolers & 130-JC carried out. |
| 19 | Modification of CW inlet and outlet line size of 130-JC from 6" to 8" was carried out. |
| 20 | Platform to reach FI-935 Tx (115-JAT INLET FLOW) made. |
| 21 | Platform for 1104-E fabricated (Pre-SD) & erected as per drg. |
| 22 | Temporary Provision of gas supply for refractory curing of 101-CA/CB made(Pre-SD) |
| 23 | Inst. Cable running over ID Fan GB rerouted as it creates hindrance during maintenance activity. |
| 24 | FIC-14 bypass line leak (mseal provided) - Attended |
| 25 | Shift Converter (104-D) Top Platform Steam Line Leak attended |
| 26 | Auxiliary Boiler Platform railing provided. |
| 27 | 103-D top platform & Hand railing replaced |
| 28 | Platform of Absorber, RV-101-EA extended for easy and safe removal of RV to carry out maintenance |




**Replaced Bypass line of PIC-13A & B and MIC-22 with P22 material from HP side upto above indicated I/V including I/V**

## VALVE GLAND REPACKING JOBS:

Gland packing of the following valves was replaced by new ones:

- All adjoining valves of 101-F & 107-C
- Blowdown valves near Aux boiler (Valves - 5 nos.)
- 101-CA/CB riser & downcomer root I/V
- 101-JCB Inter/After Condenser CW inlet valve
- All valves in ARU
- 103-J Discharge Line pilot operated RV U/S I/V
- FRC-505 root I/V

## MISCELLENEOUS JOBS

| SR. NO. | JOB |
|---|---|
| 1 | LRC-1 (radar) bottom I/V bonnet leak (furmanited) – Bonnet Gasket of 2”X1500# valve replaced. |
| 2 | HCV-11 flange leak – Gasket 10”X1500# RTJ Octagonal replaced R-54 Soft iron |
| 3 | 104-D Manhole No.2 flange leak – Gasket replaced. |
| 4 | HCV-10 flange leak - Gasket replaced. |
| 5 | PIC-502 u/s i/v flange leak – Gasket replaced (4” X 600#) |
| 6 | PR-62 root i/v passing – Threaded valve replaced |
| 7 | 103-J LO/SO Turbine steam Inlet end flange leak (furmanited) – Flange machined & Gasket (6”X 600#) replaced |
| 8 | 156-F drain valve hard to operate – Valve roused. |
| 9 | 101-J Roll-o-matic filter mechanism overhauling done |
| 10 | Bag filters of 101-J replaced. |
| 11 | 104-J ARV/NRV replaced by spare one. |
| 12 | Ameral charging dosing Pot power fluid second I/V Bonnet leak - Attended |
| 13 | 115-JA discharge line drain I/V union leak – Attended thread leak |
| 14 | 103-J Lube oil filter Change over valve top overhauled to attend valve passing problem. Valve Seat & other soft seals & packings replaced. |
| 15 | 115-JA/JB, 115-HT, 116-JA strainer cleaned |
| 16 | Valve was hard to operate. Hence overhauling of Gear box of Actuator of 141-C gas side I/V carried out. |

## INSPECTION OF FOLLOWING NRVs

Inspection of following critical check valves were carried out during Annual Turnaround:

- 105-F outlet to 103-J (short loop) HP Case suction
- 103-J final discharge u/s of SP-1
- 103-D Air inlet NRV replaced

## ENERGY SAVING PROJECT-III

Based on Consultation of M/s Casale, following Schemes were implementation under Energy Saving Project (ESP):

- Hot Desulphurisation of Feed gas –
  - ➢ Existing Sulphur Absorber R-111 was modified and used as 114-D
  - ➢ Existing Desuphuriser’s (101-D & 102-D ) were removed
- Coils replacement in Convection section of Primary Reformer.
  - ➢ Replacement of existing Air-Steam coil (E102)
  - ➢ New Feed Pre-heat coil-II (E106B) at HT section of primary reformer furnace
- Reduction in steam to carbon ratio to 3.0 from 3.3.

  Liners and internals of Primary WHB (101-CA/CB) replaced with improved MOC (alloy 693)
- New Secondary Reformer burner assembly-

  Casale proprietary design new burner assembly. (Already implemented in SD 2016). Also, existing process line from new air-steam coil exit to 103-D inlet was replaced-304H

- Optimization of heat recovery in BFW circuit-
  - Three new heat exchanger HTS exit-BFW pre-heater (1104-C),
  - Methanator Feed/ Effluent Exchanger (1114-C),
  - Methanator Trim Exchanger (1115-C).
  - Existing 104-C and 112-C removed from site.
- Replacement of Synthesis Gas Compressor Turbines with new single Steam turbine-

  New single steam turbine (103-JT) drive in place of existing two steam turbines (103-JAT/103-JBT) for syn gas compressor drive turbine in the existing civil foundation.
- New additional MP Boiler in between Ammonia Converters

  New MP Boiler (1123-C) in between ammonia converters (105-D & 108-D).
- Ammonia Recovery from Synthesis Loop
  - LP Purge Gases New Flash Gas Column (106-E), two motor drive pumps (106-E J1/J1A), 106-E J2/J2A).
- Installation of MP Stripper for Process Condensate Stripping
  - New MP Process Condensate Stripper (1104-E), process condensate feed pumps with motor drive (1170-J/JA), Feed/ Effluent Exchanger (1170-C).
  - Existing 104-E, 170-C, 171-C will be removed from site.
- Export of saturated MP Steam from Ammonia to Urea Plant MP (Saturated) Steam header and control valves.
- Desuperheater

**ENERGY SAVING PROJECT-III JOBS**

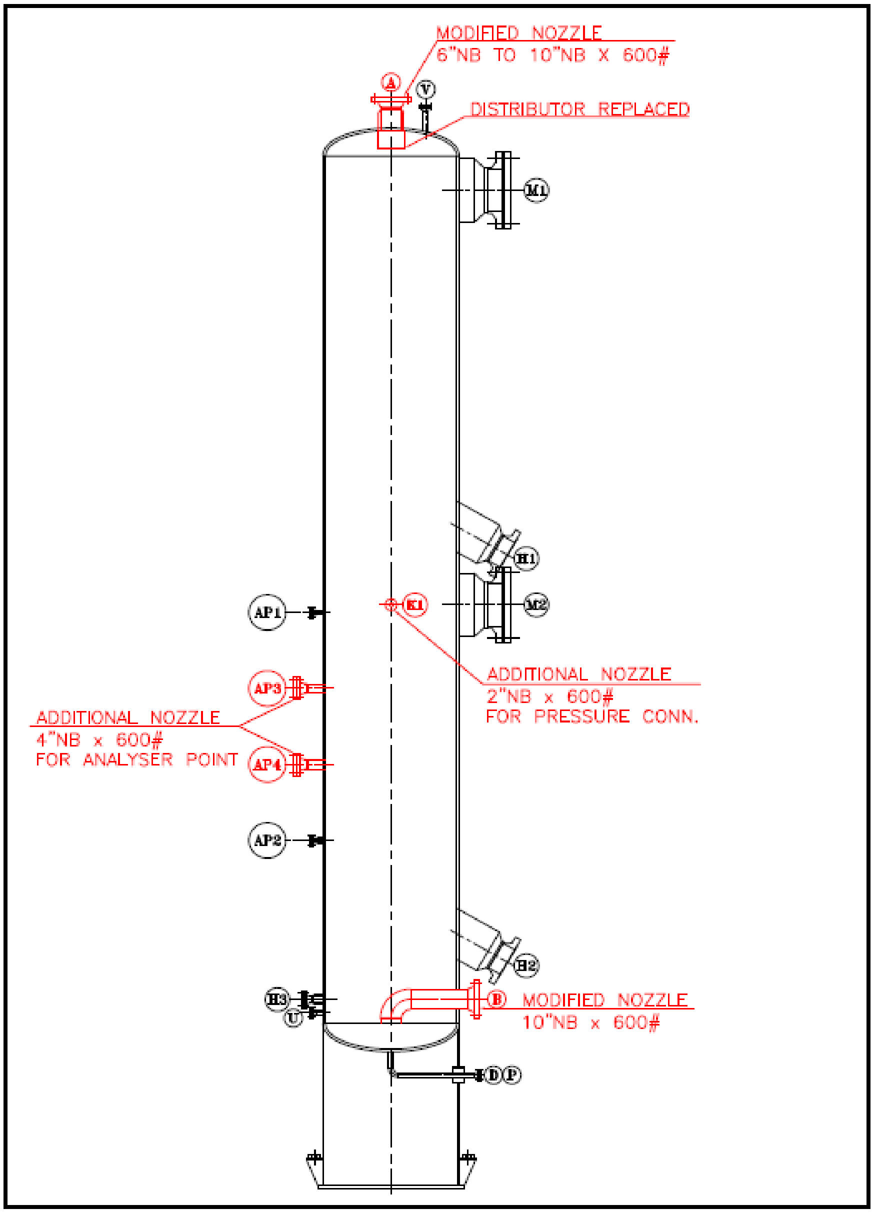
Removal of old equipment's, Erection of new equipment's and Piping jobs were carried out by Onshore Construction Pvt., Ltd., Mumbai against Erection Contract of ESP. Work order No 201004171302 dtd. 13/12/2016.

**Pre Shutdown Activities**

**In-house Modification of Old R-111 to use as 114-D**

- M/s Casale has proposed three reactors i.e. one Hydrogenator Reactor (111-D) and two Desulphurisers (112-D1/112-D2) for hot desulphurisation of feed gas
- It was decided to use Suphur Absorber, R-111 of old Pre Reformer section for hot desulphurisation of feed gas in place of three new reactors.
- Top bed will be used for hydrogenator catalyst and bottom bed will be used for desulphuriser catalyst.
- Following modifications were required to use old R-111 as 114-D:
  - Replacement of both inlet and outlet process gas nozzles from 6" #600 to 10" # 600.
  - Fabrication of two additional Nozzles (4" #600) for analyser point at the bottom desulpuriser catalyst bed
  - Additional Nozzle (2" #600) for Pressure connection.
  - Replacement of gas distributor at inlet

- Hydro test of Vessel done successfully at 60 Kg/cm2 pressure.
- The Equipment was erected on Foundation on 25.01.2017
- Platform and ladder was fabricated by M/s J&J Engg. Shertha.

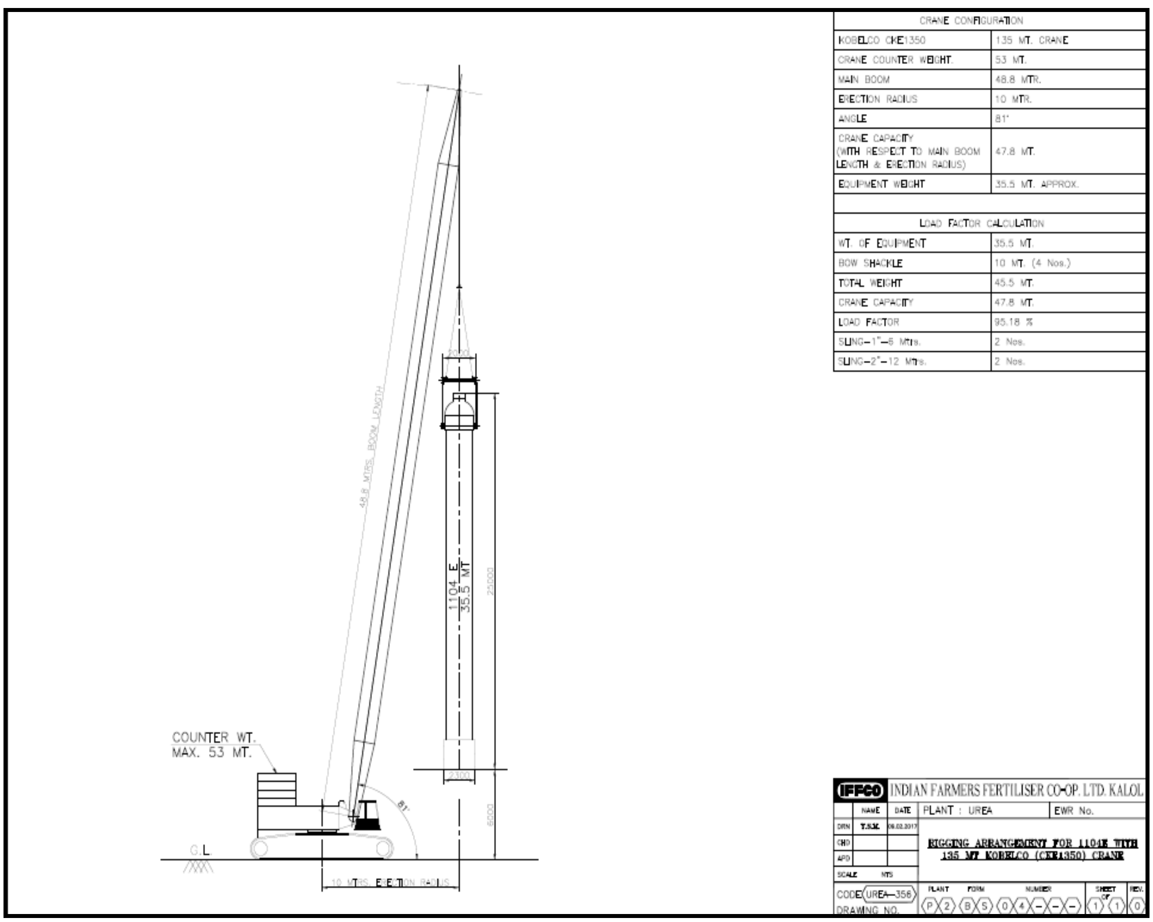



**Sketch of modifications done in 114-D**

**Template of 114-D in position**

## Installation of 1104-E

- Erection of 1104 E was done on 09.02.2017
- After erection, Internals were provided under supervision of M/s Kevin Enterprises Private Limited and M/s M/s Patel Air temp, Ahmedabad.
- Platform and ladder was fabricated by M/s J&J Engg. Shertha.



Foundation of 1104-E

Erection of 1104-E

**<u>Installation of 106-E</u>**

- 106-E was installed during mid February
- After erection, Internals were inspected after opening the top flange in presence of M/s Kevin Enterprises Private Limited and M/s M/s Patel Air temp, Ahmedabad.
- Installation of packings, Model PAK #25 was carried out in their presence.
- Structures were fabricated by M/s Onshore

**Template of 106-E provided in foundation**

**Installation of 1114-CA/B**

- The location of 1114-CA/B was shifted appx 500mm towards Silo side due to fouling with 104-D
- 1114-C A was installed on 16.02.2017
- 1114-CB was installed 17.02.2017.
- Both exchangers were installed using 450 MT Liebherr crane of M/s Onshore.

**Foundation of 1114-CA/B ready and 1104-CA/B/C u/p**

**Erection of 1114-CA/B**

**Removal of 101-D**

- 101-D was removed on 23.02.2017 Pre-Shut down to complete the foundation jobs of 1104-C A/B/C
- Removal was done using 450 MT Liebherr crane of M/s Onshore

**101-D Removal**

## Installation of 106-EJ1 A/B and 106-EJ2 A/B

- 106-EJ1 A/B and 106-EJ2 A/B were installed on 18.02.2017 and 11.02.2017
- Trial of both pump were taken in DM water in presence of KEPL Engineer in April first week.

## Installation of 1170-J/JA

- Erection of 1170-J & JA was done by December end.
- Trial of both pump were taken on 08.04.2017 in DM water in ARC mode for 15 minutes in presence of KSB Engineer.
- Pump Model No – RPH A8 (MOD) 50-450 SO No – 1170-J :973119553-100, 1170-JA : 9973119553-200
- 1170-J- DBSE- 142.40 mm, Hub to hub distance – 140.05 mm
- 1170-JA - Hub to hub distance – 140.75 mm

## Installation of 1123-C

- Erection of MP Boiler 1123-C was done on 04.03.2017

**Template made for 1123-C**

**Foundation of 1123-C**

**Erection of MP Boiler**

## SHUTDOWN JOBS

The following Equipment erection / Removal jobs were carried out by Technical Department during Shutdown:

- **Removal of 102-D**

  Removal was done using 450 MT Liebherr crane of M/s Onshore
- **Erection of 1104-C A/B/C**

  Erection of 1104-C A/B/C was done using 450 MT Liebherr crane of M/s Onshore
- **Erection of 1115-C**

  Erection of 1115-C was using 450 MT Liebherr crane of M/s Onshore
- **Removal of 104-C**

  Removal of 104-C was done by Hydra and then manually shifted towards 1104 E side and lifted by Crane
- **Removal of 112-C**
- **Removal of 114-C**

- **Removal of 115-C and installation of new 115-C**
  - Existing U-tube Exchanger was replaced with straight tube Exchanger
  - Crane used -250 MT Crane of M/s Onshore
- **Removal of 170-J & JA**
- **Removal of 170-C, 171-C and installation of 1170-C**
- **Removal of 104-E**

  104-E removed on 12.03.2017 (@ 15 m Radius, Wt – 22.5 MT using 250 MT Crane of M/s Onshore**)**

**Removal of 104-E**

**List of Equipments Installed / Replaced in ESP-III**

| Sr. No. | Equipment No. | Description | Approx. Wt (MT) | Remarks |
|---|---|---|---|---|
| 1 | E 106B | HDS Coil | - | New |
| 2 | E-102 | Steam-Air Preheat Coil | - | Replacement |
| 3 | 1104-C1,2&3 | HTS Exit BFW Heater | 121 | New |
| 4 | 1114-CA&B | Methanator Effluent / Feed Heat Exchanger | 100 | New |
| 5 | 1115-C | Methanator Trim Heater | 8.2 | New |
| 6 | 1123-C | MP Boiler | 58 | New |
| 7 | 114-D | Hot Desulphuriser (Old R-111) | 35 | New |
| 8 | 115-C | Methanator Effluent Cooler | 15 | Replacement |
| 9 | 101-J/105-J LO System | 101-J/105-J LO System | 23 (Old-7) | Replacement |
| 10 | 103-JT | Syngas Compressor drive Turbine | 18 | New |
| 11 | 103-JT Accessories | HP Oil Control oil system, Barring gear system, Flash box, Gland Condenser | 8 | New |
| 12 | 106-EJ1A&B | Top Washing Pumps | 7 | New |
| 13 | 106-EJ2A&B | Ammonical Water Pumps | 6 | New |
| 14 | 1170-J&JA | Condensate Pump | 5 | New |
| 15 | P-202-A&B | Phosphate Dozing Pump | | New |
| 16 | 1170-CA&B | MP Process Feed / Effluent Heat Exchanger | 42 | New |
| 17 | 106-E | Flash Gas Column | 2 | New |
| 18 | 1104-E | MP Stripper | 35.5 | New |
| 19 | TRC 142 | Desuperheater | - | Replacement |

**List of Equipments Removed in ESP-III**

| Sr. No. | Equipment No. | Description | Approx. Wt (MT) | Remarks |
|---|---|---|---|---|
| 1 | 170-J&JA | Stripped condensate pump | 1.0 | |
| 2 | 101-D | Desulphuriser | 38 | Pre S/d |
| 3 | 102-D | Desulphuriser | 38 | |
| 4 | 104-C | Methanator feed heater | 19 | |
| 5 | 104-E | LP Stripper | 13.5 | |
| 6 | 112-C | LTS inlet Boiler | 18.1 | |
| 7 | 114-C | Methanator Effluent feed water heater | 21.2 | |
| 8 | 170-C | Condensate Stripper feed bottom Exchanger | 1.8 | |
| 9 | 171-C | Condensate Stripper Exchanger | 2.2 | |
| 10 | 103-JAT & JBT | Syngas Compressor drive Turbine | 21 | Replacement |
| 11 | 103-JBT GC | Gland Condenser of 103-JBT | - | |

**Details of Major Purchase Orders of ESP-III / Shutdown 2017**

| Sr No | Equipment No. | Procured From Vendor | Purchase Order No. & Date | Cost of the Equipment | Remarks |
|---|---|---|---|---|---|
| 1 | 101-J/105-J LO System | M/s. Enpro Industries Pvt. Ltd., Pune | 201004161503 01/03/2016 | 41586300.00 | Replaced |
| 2 | Rundown Tank for 101-J Train | | | | |
| 3 | Rundown Tank for 105-J Train | | | | |
| 4 | 103-JT, Drive Turbine with accessories including GSC, Flash box HP Control oil system, barring gear etc | M/s. Siemens Ltd. Vadodara | 201004160192 09/07/2015 | 184342346.00 | Replaced |
| 6 | Separate Rundown Tank for 103-JLP/JHP & 103-JT | M/s. Enpro Industries Pvt. Ltd., Pune | 201004171097 11/11/2016 | 3890250.00 | |
| 7 | METALLIC EXPANSION BELLOW for 103-JT | M/s. MB Metallic Bellows Pvt. Ltd., Chennai | PNMM/EM-144/P/ 6802/ICB, 22/07/2016 201004171089 27/10/2016 | 367090.00 | |
| 8 | 1104-C1/2/3, HTS Exit BFW Heater (3nos.) | M/s Godrej & Boyce Mfg. Co. Ltd., Mumbai | PNMM/EM-140-144/E/373/NCB 22/12/2015 | 89923500.00 | Replaced |
| 9 | 1114-CA/B (2nos.) Methanator Effluent / Feed Heat Exchanger | | | | 1114-C – Pre S/d |
| 10 | 1115-C, | | | | |

| Sr. No | Equipment No. | Procured From Vendor | Purchase Order No. & Date | Cost of the Equipment | Remarks |
|---|---|---|---|---|---|
| | Methanator Trim Heater | | | | |
| 11 | 1123-C, MP Boiler | M/s. Larsen & Toubro Ltd., Mumbai | PNMM/EM-144/P/ 370A/ICB, 17/12/2015 | | Pre-SD |
| 12 | 1170-CA/B, MP Process Feed / Effluent Heat Exchanger (2 nos.) | M/s. The Anup Engg. Ltd., Ahmedabad | PNMM/EM-144/P/ 354 A /NCB, 24/08/2015 201004161060 29/12/2015 | 14919316.00 | |
| 13 | 114-D, Hot Desulphuriser (Old R-111) | M/s. Teekay Tubes Pvt. Ltd., Mumbai | 201004170455 20/07/2016 — Elbow | 39000.00 | |
| 14 | | M/s. Tube Products Incorporate, Vadodara | 201004170454 20/07/2016 — Nozzles & Flanges | 308700.00 | Pre-SD |
| 15 | | M/s. Tightwell Fasteners | 201004171374 28/12/2016 — Foundation Bolt | 78000.00 | |
| 16 | 106-E, Flash Gas Column | M/s. Patels Airtemp (India) Ltd., Ahmedabad | PNMM/EM-144/P/304A/ NCB, 27/06/2016 | 9735000.00 | Pre-SD |
| 17 | 1104-E, MP Stripper | | | | Pre-SD |
| 18 | 115-C, Methanator Effluent Cooler | M/s. The Anup Engg. Ltd., Ahmedabad | PNMM/EM-143/P/376A/ NCB, 16/05/2016 | 8660380.00 | Replaced |
| 19 | 106-EJ1A/B, Top Washing Pumps | M/s. Kirloskar Ebara Pumps Ltd., Maharashtra | PNMM/EM-144/P/505 A/NCB, 12/01/2016 201004161653 06/04/2016 | 13572058.10 | Pre-SD |
| 20 | 106-EJ2A/B, Ammonical Water Pumps | | | | Pre-SD |
| 21 | 1170-J/JA, Condensate Pump | M/s. KSB Pumps Ltd., Noida | PNMM/EM-144/E/505/N CB, 08/10/2015 | 4264530.00 | Pre-SD |
| 22 | P-202-A/B, Phosphate Dozing Pump | M/s. JEE Pumps (Guj.) Pvt. Ltd., Ahmedabad | 201004171249 08/12/2016 | 190400.00 | |
| 23 | Convection Coils i.e. HDS Coil & Steam-Air Preheat Coil | M/s. Heurtey Petrochem ndia Pvt. Ltd., Mumbai | PNMM/EM-144/E/941A/ ICB, 17/09/2015 201004161386, 24/02/2016 | 30456531.00 | |
| 24 | Retubing of 101-CA & 101-CB Tube Bundle with upgraded MOC | M/s. The Anup Engg. Ltd., Ahmedabad | 201004161457 12/02/2016 | 16960000.00 | |
| 25 | Replacement of Shell Liners of 101-CA &101-CB | M/s. Huntington Alloys Corporation, A Special Metals Company, USA | 201004161453 01/03/2016 | 11955545.28 | Alloy-693 Plates |
| 26 | | M/s.Blue Star Metals, Bharuch | 201004170643 26/08/2016 | 4050521.86 | Incoloy 800H Plates |

| Sr. No | Equipment No. | Procured From Vendor | Purchase Order No. & Date | Cost of the Equipment | Remarks |
|---|---|---|---|---|---|
| 27 | | M/s. Metal Tube Industries, Mumbai | 201004171482 10/01/2017 | 59400.00 | Incoloy 800H Pipes |
| 28 | | M/s. Calderys India Refractories Ltd., Ahmedabad | 201004171629 08/02/2017 | 1254000.00 | Castable Refractory, Tabcast 97L |
| 29 | Tube Bundle of 101-J, Air Compressor 2nd interstage cooler,130-JC | M/s. Patels Airtemp (India) Ltd., Ahmedabad | 201004170714 29/08/2016 | 1416000.00 | |
| 30 | Modification of Air inlet line of Secondary Reformer (103-D). | M/s. MG Materials, New Delhi | 201004171258 08/12/2016 | 20700.00 | Insulation |
| 31 | Desuperheater Assembly (2”) | M/s. Chemtrols Industries Pvt. Ltd., Mumbai | PNMM/EM-144/P/6805/ICB, 02/09/2016 201004171073 11/11/2016 | 85000.00 | |

**Details of Major Work Orders of ESP-III / Shutdown 2017**

| SR. NO. | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR’S NAME | WO Value |
|---|---|---|---|---|
| 1 | 201004171302 13/12/2016 | ERECTION OF EQUIPMENTS & PIPING WORKS FOR ESP KALOL | ONSHORE CONSTRUCTION CO. PVT LTD, MUMBAI | 76816249.00 |
| 2 | 201004171570 16/02/2017 | SUPPLY CUM APPLICATION OF INSULATION WORKS AT IFFCO KALOL UNIT AS PER DETAILS OF LOI NR EM-144/E/602/K | ASSOCIATED INSULATION CO, VADODARA | 8641715.00 |
| 3 | 201004161387 21/01/2016 | DISMANTLING, ERECTION, COMMISSIONING OF CONVECTION COIL OF AMMONIA PLANT | HEURTEY PETROCHEM INDIA PRIVATE LTD, MUMBAI | 19870824.00 |
| 4 | 201004160271 22/05/2015 | SUPERVISORY SERVICES FOR ERECTION, INSTALLATION & COMMISSIONING OF TURBINE AND GOVERNING SYSTEM | SIEMENS LTD | 3732500.00 |
| 5 | 201004161504 17/02/2016 | SUPERVISORY SERVICES FOR REPLACEMENT OF LUBE OIL & SEAL OIL SYSTEM OF 101-J/105-J TRAIN. | ENPRO INDUSTRIES PRIVATE LTD, PUNE | 675000.00 |

| SR. NO. | WO NO. & DATE | DESCRIPTION OF JOB | VENDOR'S NAME | WO Value |
|---|---|---|---|---|
| 6 | 201004171637 08/02/2017 | CONTRACT FOR SUPPLY AND APPLICATION OF CASTABLE INSULATION FOR 101-CA & CB | CALDERYS INDIA REFRACTORIES LTD., AHMEDABAD | 977500.00 |
| 7 | 201004171723 21/02/2017 | SUPPLY AND APPLICATION OF CERAMIC FIBRE INSULATION IN CONVECTION ZONE OF PRIMARY REFORMER | UNIFRAX INDIA PVT LTD, MUMBAI | 360000.00 |
| 8 | 201004171641 08/02/2017 | REPLACEMENT OF LINERS OF 101-CA & 101 CB WASTE HEAT BOILERS | SKYWIN ERECTORS, AHMEDABAD | 2070000.00 |
| 9 | 201004171642 08/02/2017 | | SHREE GANESH ENGG CO, AHMEDABAD | 2070000.00 |
| 10 | 201004170003 04/04/2016 | ERECTION AND COMMISSIONING OF MP BOILER | L & T, MUMBAI | 375000.00 |
| 11 | 201004170023 08/04/2016 | COMMISSIONING OF 106 E J 1 & EJ2 | KEPL, PUNE | 120000.00 |
| 12 | 201004170010 18/04/2016 | COMMISSIONING OF 1170 J /JA | KSB, PUNE | 189000.00 |
| 13 | 201004180241 08/06/2017 | REGULATORY ORDER BOLT TIGHTENING SERVICES FOR 1123-C SYN. GAS MP BOILER | POWER MASTER ENGINEERS PVT. LTD., NAVI MUMBAI | 184000.00 |
| 14 | 201004171580 09/02/2017 | OVERHAULING & PREVENTIVE MAINT. OF ROTATING EQUIPMENTS IN UREA AND UTILITY PLANTS | TURBO ENGG. SERVICES, AP | 1458000.00 |
| 15 | 201004171581 09/02/2017 | OVERHAULING AND PREVENTIVE MAINT. OF ROTATING EQUIPMENTS IN AMMONIA PLANT | BVL POWER SYSTEMS PVT LTD, HYDERABAD | 1900000.00 |
| 16 | 201004171481 16/01/2017 | OVERHAULING OF RE-CYCLE GAS COMPRESSOR, 117-J | MALHAN ENTERPRISES PVT. LTD., AHMEDABAD | 130000.00 |
| 17 | 201004171687 08/02/2017 | CRITICAL FABRICATION JOBS DURING SHUTDOWN 2017 IN AMMONIA PLANT | J&J ENGINEERS, SHERTHA | 1117800.00 |
| 18 | 201004171568 09/02/2017 | SCAFFOLDING & BLINDING/DE-BLINDING JOBS | MAHAVIR ENGG WORKS, BARODA | 1282865.00 |

**LIST OF CRANES OF M/S ONSHORE**

| Sr No | Mobile Eqt Details | Qty |
|---|---|---|
| 1 | Crane – 500 MT Liebherr (telescopic, Tyre Mounted) | 1 |
| 2 | Crane – 250 MT Liebherr (telescopic, Tyre Mounted) | 1 |
| 3 | Crane – 60 MT Kobelco (Crawler ) | 1 |
| 4 | Hydra – F23 | 2 |
| 5 | Hydra – F15 | 3 |
| 6 | Hydra – 14 MT | 2 |
| 7 | Trailer – 40FT | 2 |

**LIST OF CRANES OF IFFCO**

| Sr No | Mobile Eqt Details |
|---|---|
| 1 | Crane – 135 MT Kobelco (Crawler ) |
| 2 | Crane – 100 MT Kobelco (Crawler ) |
| 3 | RT Crane 55 (telescopic, Tyre Mounted) |
| 4 | Hydra – 14 T |
| 5 | Hydra – 10 T |
| 6 | Crane – 400 MT Liebherr (Crawler) of IFFCO Phulpur – Used in Urea Plant only |

# UREA PLANT

(MECHANICAL)

## ROTATING EQUIPMENT:

## MAJOR OVERHAULING OF $CO_2$ COMPRESSOR DRIVE TURBINE (Q-1801)

### TECHNICAL DATA:

| | | |
|---|---|---|
| MAKE | : | M/S .SIEMENS GERMNY |
| TYPE | : | ENK 32/45/8/20-7 |
| M/C NO | : | Q-1801 |
| MAXIMUM OUT PUT | : | 7679 KW |
| DESIGN RATING | : | 9690 KW |
| SPEED | : | 7875 RPM |
| INLET STEAM PRESSURE | : | 60 ATA |
| INLET STEAM TEMPERATURE | : | 395 DEGREE CEN |
| EXHAUST STEAM PRESSURE | : | 0.12 ATA |
| EXTRACTION STEAM PRESSURE | : | 23 ATA |
| INDUCTION STEAM | : | 4.91 ATA |

Last major overhauling of Siemens Turbine (Q-1801) was carried out during Shutdown - 2011. It was decided to execute overhauling of turbine. Activities performed are as under. Following readings were recorded on 11-03-2017 (before shutdown) and 29-05-2017 (after shutdown) for reference.

**Table 1: Reference Data Sheet for Q-1801**

| Description | Unit | Before overhauling | After overhauling |
|---|---|---|---|
| Date & Time | | 11-03-2017 & 10:50 AM | 29-05-2017 & 9.00 AM |
| Plant Load | % | 110 | 108 |
| Prilling Load | % | 110 | 111.9 |
| **Turbine (Q-1801)** | | | |
| Speed | rpm | 6852 | 6880 |
| Casing Expansion | mm | 5 | 5 |
| Main steam pressure **PI-1941** | kg/cm2 g | 63.8 | 62 |
| Extraction steam pressure **PI-1944** | kg/cm2 g | 21.2 | 23.8 |
| Trip Oil pressure **PI-1971** | kg/cm2 g | 11.2 | 9.5 |
| Lube Oil Pressure **PI-1967** | kg/cm2 g | 2.1 | 2.12 |
| Secondary Oil Pressure ( HP ) **PI-1974** | kg/cm2 g | 3.6 | 3.75 |
| Secondary Oil Pressure (LP ) **PI-1975** | kg/cm2 g | 3.1 | 3.2 |
| Control Oil Pressure **PI-1977** | kg/cm2 g | 11.2 | 11.3 |
| Before Stage group I **PI-1942** | kg/cm2 g | 45 | 37 |

| Description | Unit | Before overhauling | After overhauling |
|---|---|---|---|
| Exhaust Steam **PI-1946** | kg/cm2 g | 0.875 | 0.86 |
| HP Control valve opening | div | 31 | 28.5 |
| MP Control valve opening | div | 8.5 | 10 |
| LP Control valve opening | div | 37 | 34 |
| Air pressure for seal – Rear side | kg/cm2 g | 1.3 | 0.55 |
| Air pressure for seal – Front side | kg/cm2 | 1.6 | 1.3 |
| 60 ata steam temperature | °C | 410 | 410.3 |
| | | | |
| Bearing oil pressure – Turbine Side | kg/cm2 g | 1.9 | 1.9 |
| Bearing oil pressure – Free end side | kg/cm2 g | 2.0 | 2.05 |
| Thrust bearing oil pressure – HP side | kg/cm2 g | 0.75 | 0.8 |
| | | | |
| Bearing oil pressure – LP Side | kg/cm2 g | 2.0 | 2.0 |
| Bearing oil pressure – Free end side | kg/cm2 g | 1.9 | 2.1 |
| Thrust bearing oil pressure – Free end side | kg/cm2 g | 0.35 | 0.43 |
| Air pressure for seal – free end side | Kg/cm2g | 0.50 | 0.58 |
| 1$^{st}$ Suction pressure **PI-1901** | kg/cm2 g | 0.15 | 0.13 |
| 1$^{st}$ Discharge pressure **PI-1902** | kg/cm2 g | 4.7 | 4.5 |
| 2$^{nd}$ Suction pressure **PI-1903** | kg/cm2 g | 4.4 | 4.5 |
| 2$^{nd}$ Discharge pressure **PI-1904** | kg/cm2 g | 20.4 | 22.5 |
| 3$^{rd}$ suction pressure **PI-1905** | kg/cm2 g | 20.9 | 19.6 |
| 3$^{rd}$ discharge pressure **PI-1906** | kg/cm2 g | 91 | 93 |
| 4$^{th}$ suction pressure **PI-1907** | kg/cm2 g | 90 | 91 |
| 4$^{th}$ discharge pressure **PI-1908** | kg/cm2 g | 155 | 152 |

Turbine was stopped at 01.30 AM on 11-03-2017 and barring gear was started. Barring gear and lube oil circulation was stopped at 10.30 AM. At the same time Insulation removal started from top of the casing. Temperature was 250 °C at 60 ata main steam inlet pressure gauge and casing expansion reduced to 4.0 mm.

**Disassembly of Turbine:**

Disassembly started when turbine cooled down to normal condition and casing expansion was reduced to 1.0mm. Following activities were carried out for disassembly of Turbine.

- For decoupling the turbine with LP compressor, coupling guard with bellow was removed, and then coupling spacer was removed with the help of jack bolts.
- After removing the barring gear pipe line and instrument probe, top cover of rear bearing was lifted.
- Emergency trip gear gap measured after keeping OST pin perpendicular to the face of lever. It was 0.92 mm.
- Earthing brush was removed by electrical department. Then top cover of front bearing pedestal was removed.

- Rotor axial thrust was measured and it was 0.32 mm.
- 60 ata steam servo cylinder with pilot valve removed.
- Alignment fixture was fixed with turbine coupling half and dial indicator was kept at LP case coupling half. Alignment reading between Turbine and LP Compressor was measured and recorded.
- Steam pipe lines (23ata steam inlet and outlet at the top of casing & 4ata induction steam line) connected to casing were removed.
- Both 60ata Emergency stop valves were removed
- 23ata servo cylinder and pilot valve were removed.
- 4ata emergency stop valve & servo cylinder and pilot valve were removed.
- Turbine front end journal bearing clearance was measured and found to be 0.26 mm
- Turbine rear end journal bearing clearance was measured and found to be 0.35 mm
- At front bearing pedestal, oil guard clearance was measured. ( Ref 12+ )

| | | |
|---|---|---|
| Front oil guard | Left – 0.50mm, | Right – 0.50mm |
| Rear oil guard | Left – 0.50mm, | Right – 0.50 mm |
| Aluminum oil guard | Left – 0.45mm, | Right – 0.45mm |

**OIL GLAND CLEARANCES**

**FRONT OIL GLAND:**

| | Left | Right | Bottom |
|---|---|---|---|
| Radial clearance C | 0.10 | 0.05 | 0.05 |
| Axial Clearance | 2.40 | 2.45 | - |

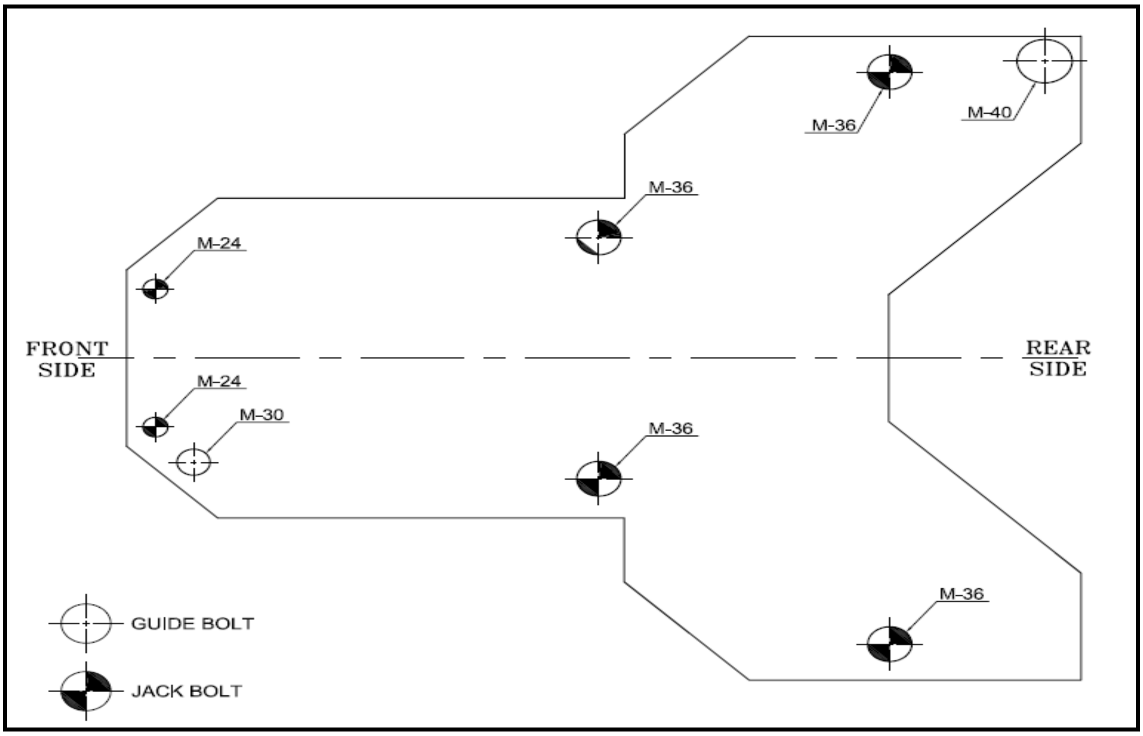
**REAR OIL GLAND:**

| | Left | Right | Bottom |
|---|---|---|---|
| Radial clearance C | 0.10 | 0.05 | 0.05 |
| Axial Clearance | 2.40 | 2.45 | - |

- Oil Seal clearances at rear side were measured. ( Ref 12+ )

| | | |
|---|---|---|
| Rear (radial) | Left – 0.10mm, | Right – 0.25mm as |
| Rear (axial) | Left - 4.50mm, | Right – 4.46mm |
| Aluminum oil guard | Left - 0.50mm, | Right – 0.45mm |

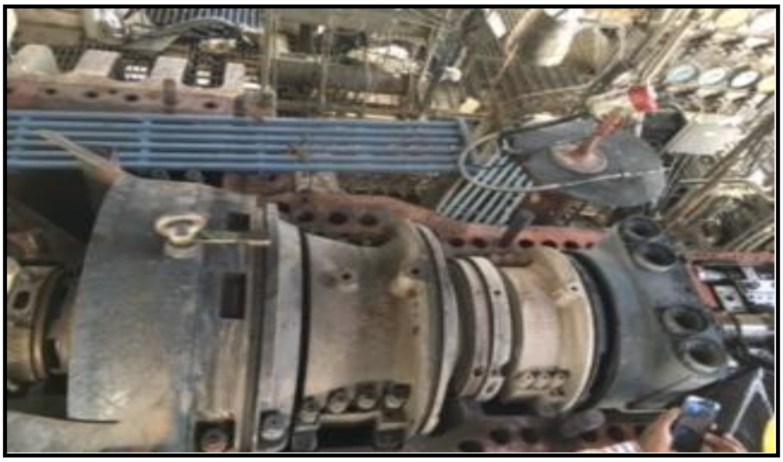
- Total float of rotor was measured after removal of active and non active side thrust pads. It was 3.95 mm.
- All casing bolts were removed. (Spanner Size - 50mm / 55mm / 60mm / 65mm / 75mm).
- For lifting the top casing, 2 nos. of guide bolts and 6 nos. of jack bolts were provided at front and rear side as shown in figure below :



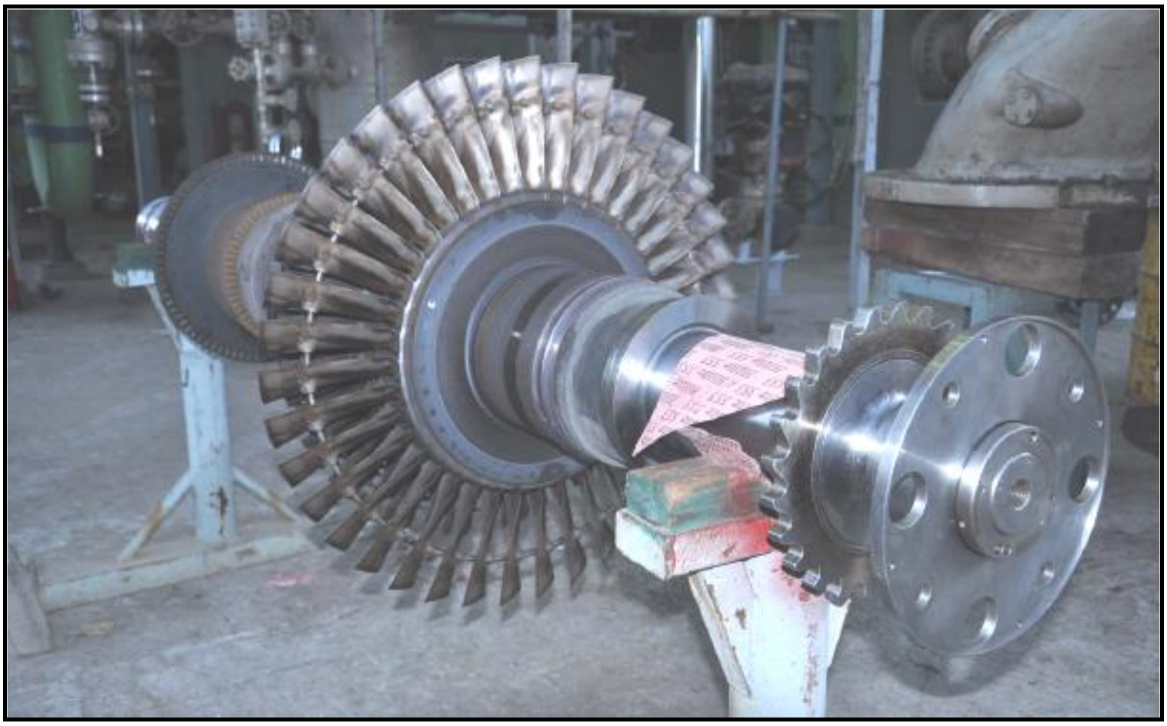

- 2 nos. of 5 ton chain block at front side of casing and 2 nos. of 3 ton slings at rear side were provided.
- Top casing was lifted by 100mm by jack bolt, and then lifted by Overhead crane (as shown in picture. Top casing was shifted to ground and placed at Wooden Planks.



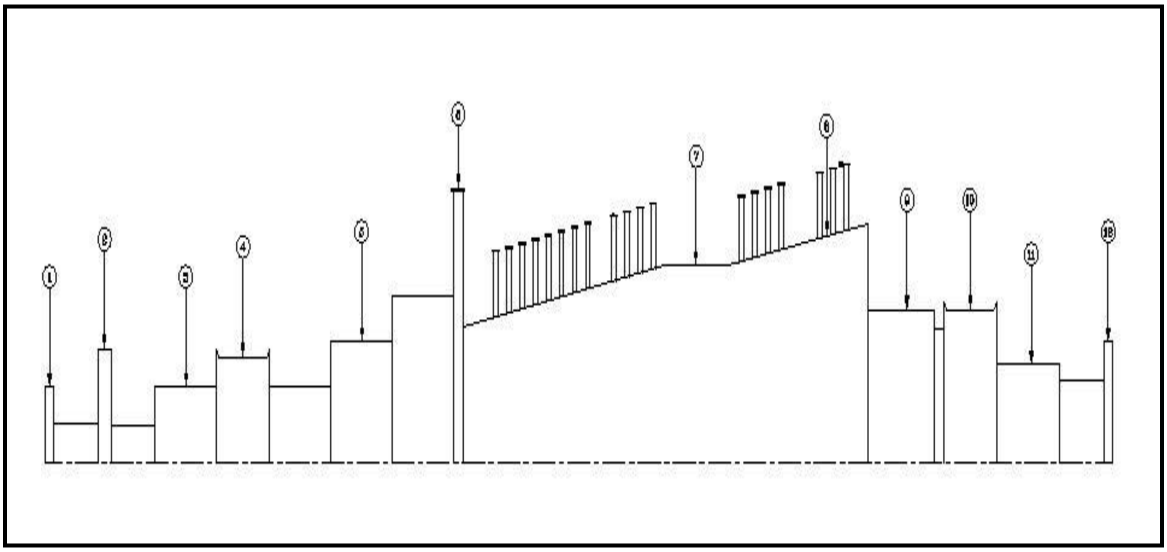

- After removal of top casing, bottom casing was kept on jack bolts provided at bottom.
- Tack welding on bolts between top and bottom halves of guide blade carriers (3nos), steam chamber and inner gland were grind and removed by barring cutter.
- Top half of all guide blade carriers lifted one by one from HP to LP side then top half of inner gland and steam chambers were lifted.



- Axial labyrinth clearances were measured and recorded.
- Front and rear steam gland removed.
- For lifting the rotor, level of same was maintained by 2 nos. of bolt provided in special rigging arrangement. Rotor was lifted using 2 nos. of 3 ton web sling and shifted to ground and placed on stand as shown in Figure.



- Run out of rotor was checked at eight point which are as :



| Sr. No. | Location | Run-Out Value |
|---|---|---|
| 1 | Thrust Collar | 0.01 |
| 2 | Front Journal | 0.00 |
| 3 | Front oil gland | 0.02 |
| 4 | Front steam gland | 0.03 |
| 5 | IP gland | 0.05 |
| 6 | Rear steam gland | 0.03 |
| 7 | Rear oil gland | 0.02 |
| 8 | Rear journal bearing | 0.00 |

- Gap between casing and guide blade carriers are measured with help of filler gauge as shown in figure below and recorded in table given below.

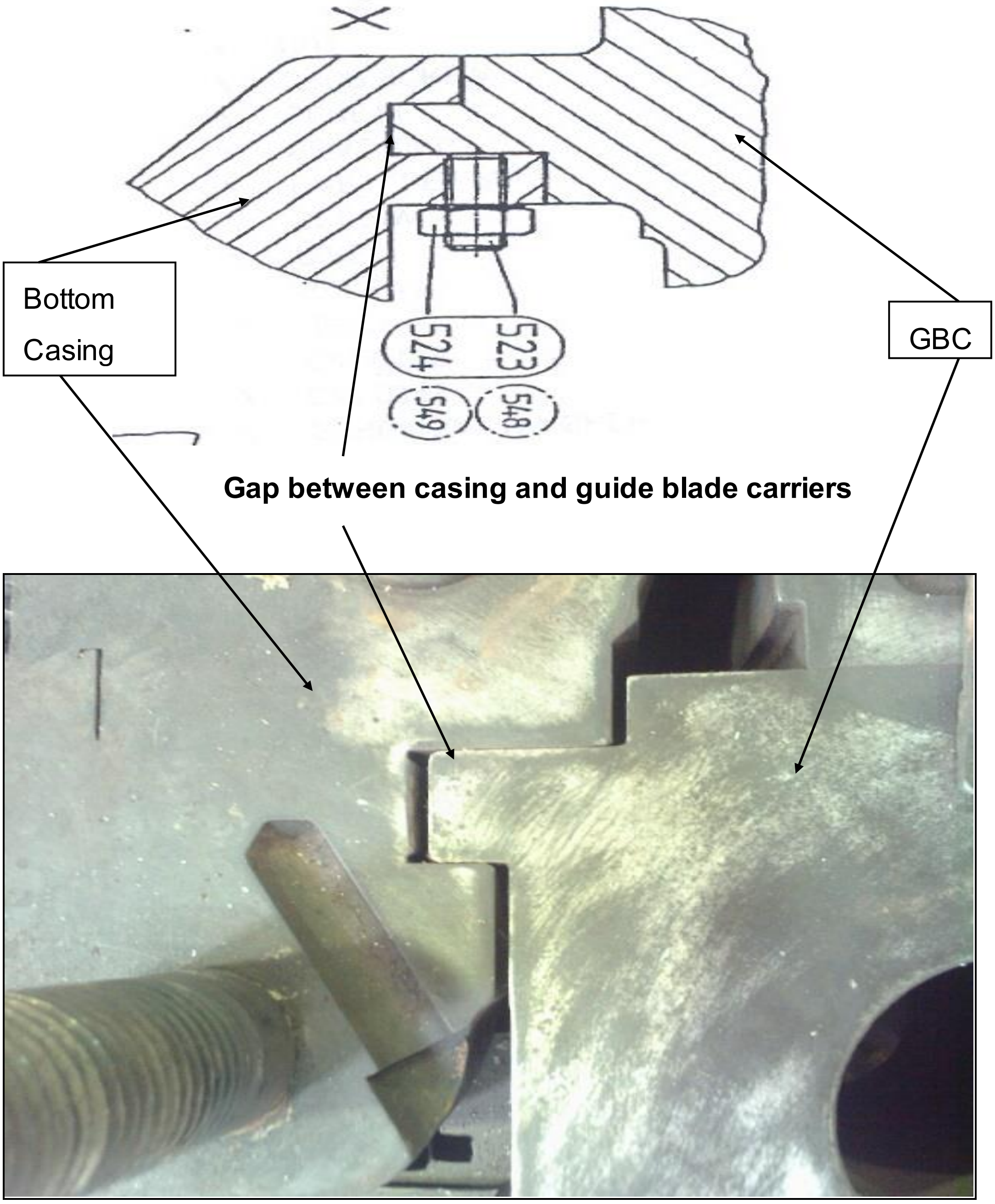
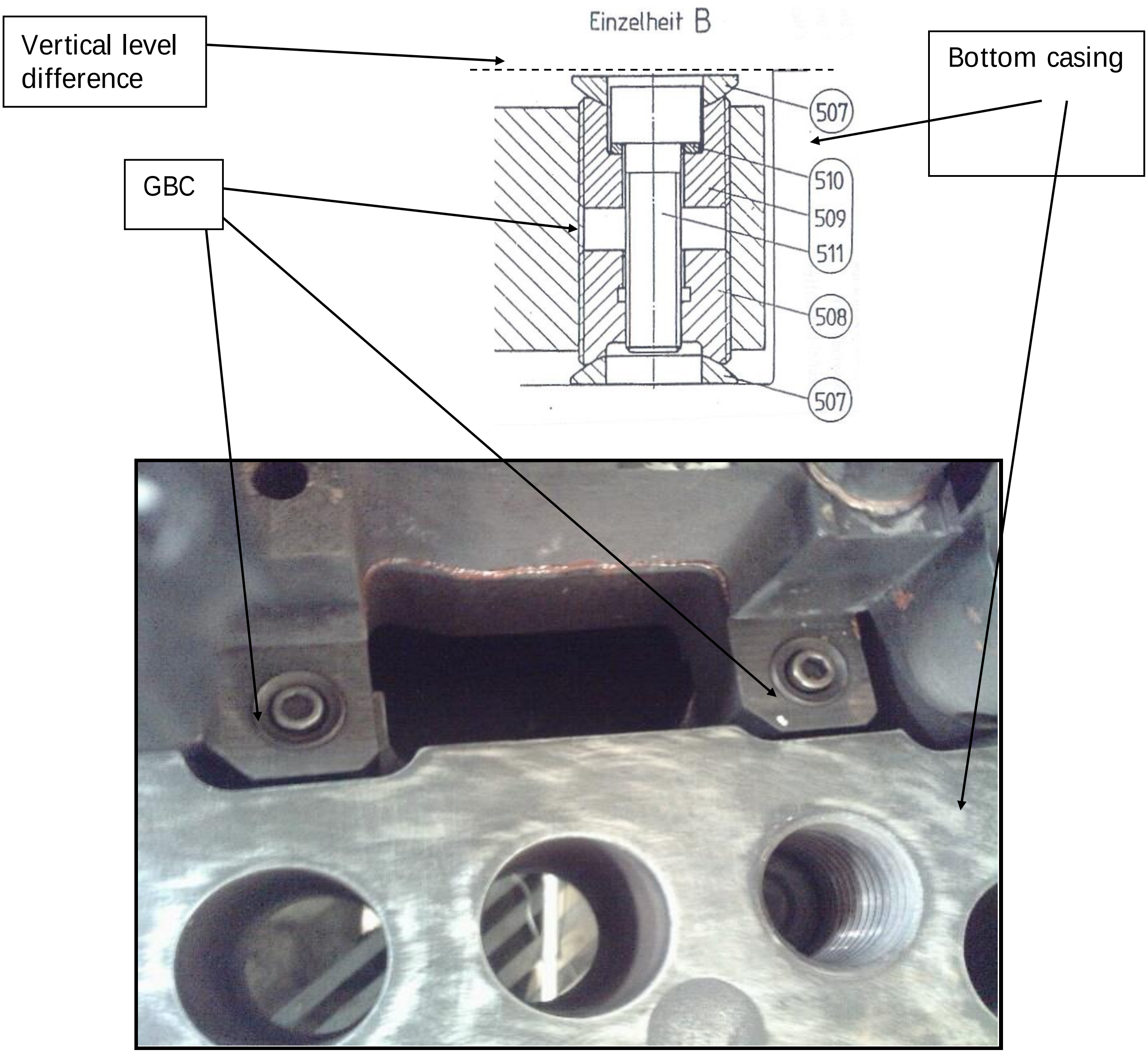



**Table : Gap between casing and guide blade cariiers**

| Sr. No. | Description | Left side | Right side |
|---|---|---|---|
| 1 | Nozzle | 2.05 mm | 2.00 mm |
| 2 | 1st guide blade carrier | 1.50 mm | 1.55 mm |
| 3 | 2nd guide blade carrier | 1.25 mm | 1.85 mm |
| 4 | 3rd guide blade carrier | 2.20 mm | 1.85 mm |

- Vertical level difference between casing and guide blade carrier (gap between spherical washer level and casing facing level as shown in figure was measured and recorded.




- Removed bottom halves of all three Guide blade carrier, steam chamber and inner gland one by one front side to rear side.
- Scaling was observed on fin area of rotor specially at area of 23 ata extraction steam.

**<u>Scaling observed in above picture</u>**

- Rotor, guide blade carriers, steam chamber (Nozzle block) and inner gland were cleaned by grit blasting at yard near Onshore Yard.

- DP test of rotor, all guide blade carriers, steam chamber and inner gland were done which were found ok.

**Assembly of Turbine**

Following activities were carried out for assembly of Turbine.

- Bottom half of both side journal bearing were assembled. Bottom half of thrust bearing was placed.
- Kept the bottom spherical washer at both sides of the bottom casing. Placed the bottom half of GBC on bottom casing ensuring that washer is not displaced from position
- Assembly of bottom halves of GBC was done from LP to HP section.
- Then bottom half of nozzle block and inner gland was placed.
- Rotor was lifted from the stand after checking level with help of spirit level using leveling bolts in rigging arrangement. Placed the rotor on bottom casing.
- For centering the rotor following activities were carried out.
  - All 6 nos. of locking bolts were loosened
  - Bottom half of thrust bearing assembly was done.
  - Dial was kept at bearing pedestal shims (POS 38), as shown in figure-8 and bottom casing was kept at 0.10 mm below from bearing pedestal with shims using jack bolt.
  - One dial gauge was placed at rotor free end with dial on front bearing pedestal bottom, second dial gauge at bearing oil seal area, of front pedestal and third dial gauge was kept on rear bearing pedestal.

**FINAL CENTERING READINGS**

Thrust bearing

0.00 +0.05

-0.04

FOS

0.00 +0.04

-0.04

FSG

| | | |
|---|---|---|
| 0.00 | | +0.02 |
| | +0.04 | |

RSG

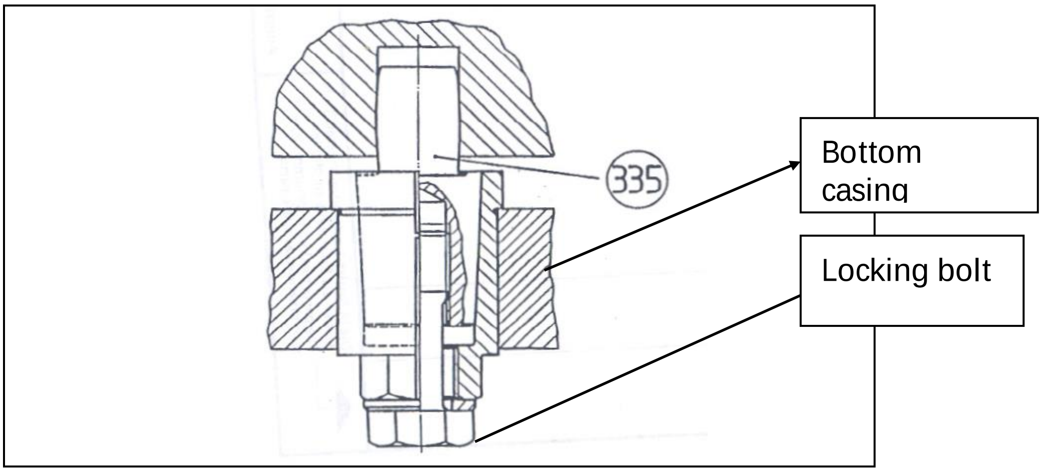
| | | |
|---|---|---|
| 0.00 | | -0.05 |
| | +0.01 | |

ROS

| | | |
|---|---|---|
| 0.00 | | -0.05 |
| | **+0.02** | |

- Following activities were carried out for centering of bottom of GBC-1 (Guide Blade Carrier-1) w.r.to rotor in a horizontal plane:
  - Labyrinth clearances were 0.30 mm at left side and 0.70 mm at right side.
  - Lifted the Guide Blade carrier and removed the guide pin**.** The guide pin are positioned in slots as shown in figure below

  - For shifting the bottom of GBC towards left, tack welding was done at right side of guide pin. On the slot at left side, metal was removed by grinding by same amount.
  - Pin was placed at slot and guide blade carrier no.1was placed at position and clearance was found ok.
- Similar procedure adopted for shifting GBC-2.
  - After placing rotor, clearance was checked and found ok. ()



- Now vertical alignment of all Guide blade carriers was required to be corrected. Following activities were carried out for GBC-III.
  - Dial gauge base was placed on top face of bottom casing and dial point was placed on top of bottom half of GBC-III bottom on both sides.
  - Lifting and lowering of GBC-III was done by bottom calotte.
  - By loosening the bottom calotte (POS 508), GBC-III was lowered
  - When we loose the calotte, GBC-III was lowering, at the time of contacting with casing, sound came, so, we stopped and checked the reading.
  - Accordingly, GBC was set to optimum reading.

0.50

0.50

Total float is 1 mm

  - Then top calotte was placed and tightened.
  - Then socket head screw and ring was tightened and spherical washer was placed on it.
  - The position of spherical washer w.r.to bottom case plane was checked. By adjusting top calotte level of spherical washer was made 0.15mm below bottom casing.
  - Then locked the both calotte by socket head screw with ring.
- The same procedure was adopted for GBC-II & I.

| GBC-II | GBC-I |
|---|---|
| 0.55 | 0.75 |
| 0.50 | 0.65 |
| GBC-II | GBC-I |
| Total float is 1.05 mm | Total float is 1.4 mm |

- Top half of all guide blade carrier, steam chamber and inner gland were placed. All bolts were tightened. Tack welding of bolt done with guide blade carrier body by TIG welding using 2.5 mm dia filler wire - ER 70 S2.
- Top casing was lifted after checking the level with the help of measuring scale. Birkosit was applied on both face of casing. Top casing was placed on bottom casing using 6 nos. of guide bolts.
- Tightening of bolt was done sequentially as per shown in figure.

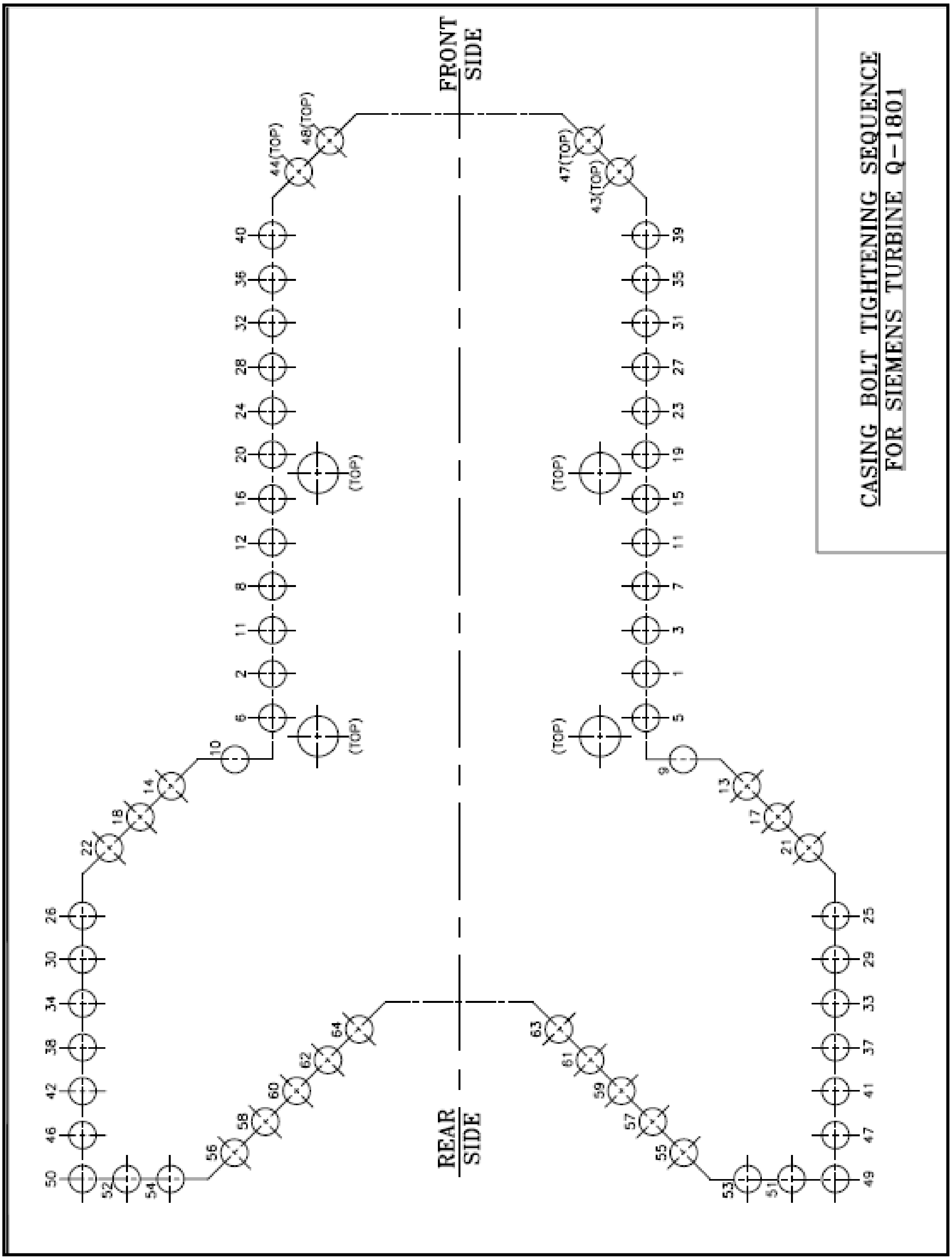



**Figure -15: Tightening sequence**

- Both 60 ata inlet flange was tightened using new gasket.
- Placed the lift bar. 60 ata emergency stop valve (ESV) were assembled.
- 23 ata servo cylinders with pilot valve was assembled on the position.

- All steam piping flange (4 ata induction line, 23 ata extraction line top and bottom) to casing were tightened
- 4 ata servo cylinder with pilot valve was assembled
- All locking washer of top casing were loosened.
- Alignment between turbine and LP was checked and corrected.
- Instrument probe was provided in front and rear bearing assembly.
- Axial thrust of rotor was checked and calibrated it with instrument's reading. Placed the rotor in center position.
- Box-up the front and rear vent line of turbine.
- Front end pedestal top cover of turbine was placed and boxed up.
- Earthing brush was provided.
- Top cover of rear end pedestal bearing was placed.
- AOP started, no leakage observed.
- Motor drive Lube oil pump was started.
- 60 ata, 23 ata and 4 ata governing valve lift was checked w.r.t secondary oil pressure, found as per protocol value shown in Table.

NOTE :

| Sr. No | Observation | Action taken |
|---|---|---|
| 1. | Guide blade carrier threaded bush damaged condition | It was replaced with new one |
| 2. | HP 60 ata servo motor seal kit damaged condition. | Replaced with new seal kit and aluminum bush |
| 3. | LP 23 ata servo motor seal kit damaged condition | Replaced with new seal kit and aluminum bush |
| 4. | LP 4 ata servo motor seal kit damaged condition and oil leakage is also there. | Replaced with new seal kit and aluminum bush |
| 5. | Turbine steam gland and BP gland and IP gland bolts damaged condition | Replaced with new bolts |

Governing valve lift w.r.t secondary oil pressure – Protocol value

| Sr. No. | WW-505 DCS out-put in % | 60 ata | | 23 ata | | 4 ata | | |
|---|---|---|---|---|---|---|---|---|
| | | Secondary oil pressure | Valve Lift (Div) | Secondary oil pressure | Valve Lift (Div) | Current in mA | Secondary oil Pressure | Valve Lift (Div) |
| 1 | 0 | 1.5 | 0 | 1.5 | 0 | 4 | 1.5 | 0 |
| 2 | 10 | 1.75 | 3.5 | 1.7 | 2.5 | 8 | 2.15 | 7 |
| 3 | 20 | 2 | 9.5 | 1.95 | 2.5 | 12 | 2.88 | 28 |
| 4 | 30 | 2.2 | 13 | 2.2 | 3.5 | 16 | 3.7 | 41 |
| 5 | 40 | 2.65 | 17 | 2.5 | 5.5 | 20 | 4.6 | 55 |
| 6 | 50 | 2.9 | 20.5 | 2.8 | 7 | | | |
| 7 | 60 | 3.3 | 24.5 | 3.05 | 9 | | | |
| 8 | 70 | 3.6 | 29 | 3.4 | 11.5 | | | |
| 9 | 80 | 4.0 | 34 | 3.75 | 13.5 | | | |
| 10 | 90 | 4.3 | 38 | 4.1 | 16 | | | |
| 11 | 95 | 4.5 | 40 | 4.2 | 18.5 | | | |
| 12 | 100 | 4.7 | 42 | 4.45 | 32 | | | |

- Placed the dial indicator on the top casing – front side.

- Before the start up of turbine, turbine was run by barring gear for heating the turbine.
- Barring was started by production and it was observed that barring was stopped after some time. This problem was observed again and again and it was discussed by production, instrument and mechanical.
- Barring was checked by mechanical and it was found ok.
- Instrument had checked the proxy and it was reset and all wiring were replaced.
- Heating of turbine started by the 60 ata main bypass valve, valve regulated slowly. Barring started and Heating was done for 2 hrs.
- Instrument speed indictor shown 2000 rpm during barring. Same was recalibrated by instrument department.
- After 4 hrs. Turbine was kept at slow roll at 2000 rpm. Casing expansion was 0.60 mm when 60 ata main steam temperature was 280 C.
- At the time of start up of turbine, it was observed that start up oil was not generated in the system.
- There were some problem in getting signal from DCS, control room. After hours of discussion and testing between mechanical, production and instruments deptt., It worked and startup oil was generated.
- Turbine speed increased up to 4600 rpm for by passing the critical speed range. Hold it at 4600 rpm for 5 minute.
- Increased speed up to minimum governor speed 6375 rpm and hold for 30 minute. 60 ata main steam temperature was 280 C,
- Turbine speed increased to max. Governor speed 7875 rpm and over speed lock was bypassed by control room.
- Speed increased and OST done at 8620 rpm. ( design valve : 8663 rpm +/- 1% )
- Oil line leakage from the 60 ata was attended.
- Removed the rear bearing pedestal top cover.
- Coupled the turbine with LP case and placed the top cover of rear end pedestal cover.
- Turbine handed over to production department.
- Bearing temperature and vibration were within acceptable limit.
- Consumed spares are shown in table below.

**<u>Overhauling of Accessories</u>**

**<u>60 ata Control valve :</u>**

- Dismantled the 60 ata stem chest valve and taken to ground with the help of EOT Crane.
- Both side Emergency stop valve were dismantled.
- It was observed that silica was deposited on both side strainers.
- Both side strainers were cleaned.

- Both stem runout were checked and runout of right side was 0.1 mm and runout of left side was 0.7 mm.
- Both Stem's (Store code - 122023851900) were replaced with new one
- Both ESV sealing set were replaced.
- In 60 ata and 23 ata control valve, stem gland packing were replaced with new one. measured the packing length for both control valve, it was 42.00 mm.
- Consumed spares are shown in table- 6

**<u>60 ata servo cylinder and Pilot valve</u>**

- 60 ata servo cylinder and Pilot valve were opened.
- Both were cleaned properly.
- Complete sealing set of servo cylinder were replaced by newone.

**<u>23 ata servo cylinder and Pilot valve</u>**

- 23 ata servo cylinder and Pilot valve were opened and cleaned.
- Complete sealing set of servo cylinder were replaced by new one.
- Consumed spares are shown in table -7

**<u>4 ata servo cylinder and Pilot valve</u>**

- 4 ata servo cylinder and Pilot valve were opened and cleaned.
- Complete sealing set of servo cylinder were replaced by new one.
- Consumed spares are shown in table given below.

**<u>Barring Gear Tripping</u>**

- It was reported that barring gear was getting tripped frequently.
- The normal operation time for barring gear is observed as 15 seconds and trip is set for 130 seconds.
- No mechanical nature problem could be identified.
- Complete re-cabling work was performed by instrument team and then barring gear was operating continuously.

**<u>Re-Nitrogen Filling in Oil Accumlator.</u>**


- The Balloon was checked and found approx 3.0 Kg pressure in Balloon.
- Gas filling Kit is available for filling of Nitrogen to oil accumulator.
- As per name plate details available on the body of Accumulator, nitrogen pressure may be kept between 6.0 kg to 9.0 kg. It was kept as 7.0 kg.

## Insulation of Turbine

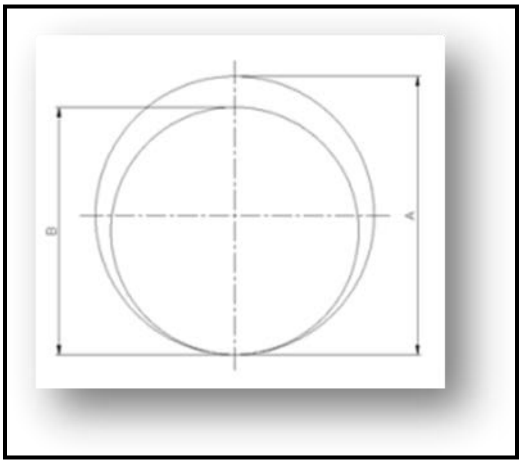
The some of the existing insulation blankets of turbine was observed damaged. Hence it was decided to replace the damaged blankets. New blankets were made from glass cloth of 10 mil thk (temperature tolerance – 400 C) and filling it with 2 layers of Ceramic fiber blanket rolls and Pyroblock Insulation.

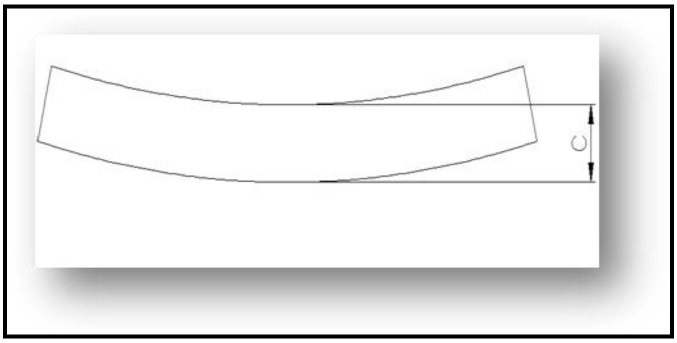
## Consumed Spares:

| Sr. No. | ITEM CODE | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | 2010122023851900 | VALVE SPINDLE, SACH-NO:2-1616-1603-07, POS-21, OF 60 ATA CONTROL VALVE (POS-0038), DRG. NO.: 0-0006-0802-04 FOR Q-1801, SIEMENS TURBINE | 2 |
| 2 | 2010122023326420 | GLAND PACKING, FLOJET MAKE, (POS-503/504), SIZE : 19.95MM ID X 32MM OD X 6MM THICK ,OF 60 ATA CONTROL VALVE (POS-0038), DRG. NO.: 0-0006-0802-04 FOR Q-1801, SIEMENS TURBINE | 10 |
| 3 | 2010122023326410 | GLAND PACKING, FLOJET MAKE, (POS-503/504), SIZE : 19.95MM ID X 32MM OD X 4MM THICK ,OF 60 ATA CONTROL VALVE (POS-0038), DRG. NO.: 0-0006-0802-04 FOR Q-1801, SIEMENS TURBINE | 15 |
| 4 | 2010122029424770 | GASKET DN 150 PN 160 POS-28,OF GASKETS FOR STEAM PIPING (POS-0601) FOR Q-1801, SIEMENS TURBINE | 02 |
| 5 | 2010122029424740 | GASKET DN 80 PN 40 POS-25,OF GASKETS FOR STEAM PIPING(POS-0601) FOR Q-1801, SIEMENS TURBINE | 02 |
| 6 | 0000993790600000 | MAINT. CHEMICALS / SEALANT / ADHESIVE COMPOUND BIRKOSITE COMPOUND STAG "B" 1 KG PACK | 2 |
| 7 | 2010122024647800 | SEALING BUSHING,POS-100 OF 60 ATA SERVO CYLINDER (POS-0046), DRG. NO.: 0-0006-1900-07 FOR Q-1801, SIEMENS TURBINE | 1 |
| 8 | 2010122023539510 | O-RING, SACH-NR. : 5-6748-3210- 25, POS 37, SIZE-210X4, OF INDUCTION STEAM STOP VALVE (POS-0035), DRG NO : 0-0006-2302- 05, FOR Q-1801, SIEMENS TURBINE | 1 |
| 9 | 2010122023564600 | WIPER, SACH-NR.: 5-6569-9102-00, POS-33, OF INDUCTION STEAM STOP VALVE (POS-0035), DRG NO : 0-0006-2302-05, FOR Q-1801, SIEMENS TURBINE | 1 |
| 10 | 2010122024645000 | RETAINING RING,POS-13,OF 60 ATA SERVO CYLINDER (POS-0046), DRG. NO.: 0-0006-1900-07 FOR Q-1801, SIEMENS TURBINE | 1 |
| 11 | 2010122025947800 | SEALING SET, SACH-NR : 5-6568-2055-02,POS-101,OF EXTRACTION (23 ATA) & INDUCTION (4 ATA) SERVO CYLINDER (POS-0050 & 0059), DRG. NO.: 0-0006-1900-08 FOR Q-1801, SIEMENS TURBINE (Turbo make) | 2 |
| 12 | 2010122024647810 | SEALING SET,POS-101,OF 60 ATA SERVO CYLINDER (POS-0046), DRG. NO.: 0-0006-1900-07 FOR Q-1801, SIEMENS TURBINE (Turbo make) | 1 |
| 13 | | GBC threaded Cup M33 | 2 |
| 14 | | Clamping sleeve | 2 |
| 15 | | Protection roller bearing | 1 |
| 16 | | ESV seal Kit | 2 |

**DATA SHEET OF TURBINE, Q-1801 :**

**TURBINE BEARING CLEARANCES**




**Front journal bearing:**

| Sr. No. | pad thickness | Description | Design Value | Actual Value |
|---|---|---|---|---|
| 1 | 17.46 | Bearing shell bore | | 159.98/99 |
| 2 | 17.46 | Journal Bearing Bore (A) | | 125.06 |
| 3 | 17.45 | Journal Dia. (B) | | 124.80 |
| 4 | 17.46 | Clearance (A-B) | 0.18 TO 0.31 | 0.26 |
| 5 | 17.48 | Interference | | 0.03 |

**Rear journal bearing** :

| Sr. No. | Pad Thickness | Description | Design value | Actual Value |
|---|---|---|---|---|
| 1 | 22.46 | Bearing shell bore | | 204.98 |
| 2 | 22.47 | Journal Bearing Bore (A) | | 160.05/06 |
| 3 | 22.47 | Journal Dia. (B) | | 159.70/71 |
| 4 | 22.46 | Clearance (A-B) | 0.24 TO 0.35 | 0.35/36 |
| 5 | 22.42 | Interference | | 0.04 |

**THRUST PADS THICKNESS:**

| SR. NO. | THICKNESS (mm) | |
|---|---|---|
| | ACTIVE (t) | NON – ACTIVE (t) |
| 1 | 20.14 | 19.96 |
| 2 | 20.13 | 19.96 |
| 3 | 20.13 | 19.97 |
| 4 | 20.14 | 19.98 |
| 5 | 20.15 | 19.97 |
| 6 | 20.14 | 19.96 |
| 7 | 20.14 | 19.98 |
| 8 | 20.14 | 19.98 |

**THRUST FLOATS :**

**ACTUAL VALUES**

- Rotor free float +ve : 2.10
- Rotor free float -ve : 1.85
- Total free float : 3.95
- Thrust float with all internals : 0.32/33
- housing movement : 0.12/13

**(Design value : 0.25 to 0.35)**

**FINAL OIL GLAND CLEARANCES:**

**FRONT OIL GLAND:**

| DESCRIPTION | Left | Right | Bottom |
|---|---|---|---|
| Radial clearance C | 0.10 | 0.05 | 0.05 |
| Axial Clearance | 2.40 | 2.45 | - |

**REAR OIL GLAND:**

| DESCRIPTION | Left | Right | Bottom |
|---|---|---|---|
| Radial clearance C | 0.10 | 0.10 | 0.05 |

**FINAL STEAM GLAND CLEARANCES BETWEEN ROTOR FINS AND GLAND FINS**

**FRONT**

| Between gland fins to rotor body | | Between rotor fins to gland body | |
|---|---|---|---|
| **B** | | **A** | |
| Left | Right | Left | Right |
| 0.40 | 0.35 | 0.35 | 0.35 |

**REAR**

| Between gland fins to rotor body | | Between rotor fins to gland body | |
|---|---|---|---|
| **B** | | **A** | |
| Left | Right | Left | Right |
| 0.45 | 0.45 | 0.45 | 0.45 |

**NOTE:**

**PP : Parting Plate**

**BP : Balancing Piston**

**GBC: Guide blade carrier**

**B P GLAND**

| Between gland fins to rotor body | | Between rotor fins to gland body | |
|---|---|---|---|
| **B** | | **A** | |
| **Left** | Right | Left | Right |
| 0.55 | 0.60 | 0.35 | 0.40 |

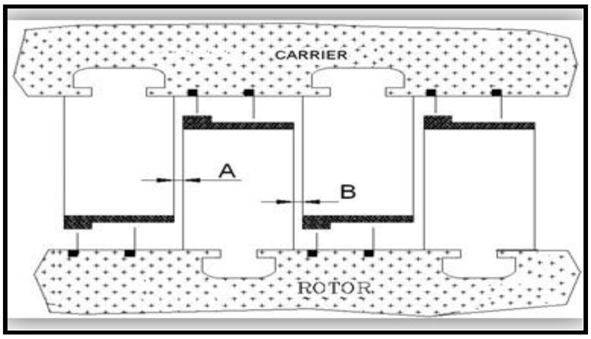
**Bottom half carriers P.P. Levels & Thermal Gaps with respect to bottom casing before Overhauling**

| Sr. no. | Description | PP levels | | Thermal gaps | |
|---|---|---|---|---|---|
| | | Left | right | left | right |
| 1 | Balance piston gland | -0.08 | -0.08 | 1.60 | 2.40 |
| 2 | GCB – I | +0.50 | +0.95 | 1.00 | 1.95 |
| 3 | GCB – II | +0.45 | +0.65 | 2.15 | 1.70 |
| 4 | GCB – III | +0.45 | | 1.95 | 2.65 |

**Bottom half carriers P.P. Levels & Thermal Gaps with respect to bottom casing after Overhauling**

| Sr. no. | Description | PP levels | | Thermal gaps | |
|---|---|---|---|---|---|
| | | Left | right | left | right |
| 1 | Balance piston gland | -0.08 | -0.08 | 2.05 | 2.00 |
| 2 | GBC – I | +0.23 | +0.14 | 1.50 | 1.55 |
| 3 | GBC – II | +0.20 | +0.18 | 1.25 | 1.85 |
| 4 | GBC – III | +0.55 | +0.38 | 2.40 | 2.50 |

**AXIAL CLEARANCES**



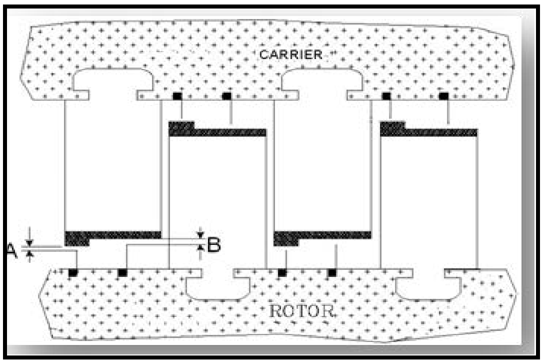

| Sr. No. | DESCRIPTION | Active side (B) | | Non active side (A) | |
|---|---|---|---|---|---|
| | | Left | right | left | right |
| 1 | A-Wheel | -- | -- | 5.30 | 5.40 |
| 2 | Row no.01 | 4.20 | 4.20 | 1.90 | 2.30 |
| 3 | Row no.02 | 4.10 | 4.00 | 2.30 | 2.40 |
| 4 | Row no.03 | 4.50 | 4.40 | 2.20 | 2.60 |
| 5 | Row no.04 | 4.20 | 4.20 | 3.00 | 2.90 |
| 6 | Row no.05 | 4.60 | 4.60 | 3.20 | 3.20 |
| 7 | Row no.06 | -- | -- | 3.40 | 3.30 |
| 8 | GBC -2 Row no.07 | 5.70 | 5.80 | 3.50 | 3.10 |
| 9 | Row no.08 | 5.70 | 5.80 | 3.60 | 3.40 |
| 10 | Row no.09 | 5.80 | 6.10 | 3.80 | 3.50 |
| 11 | Row no.10 | 6.00 | 5.90 | 4.00 | 3.50 |
| 12 | Row no.11 | 5.90 | 6.10 | 3.80 | 3.80 |
| 13 | Row no.12 | 6.20 | 6.50 | 3.80 | 3.80 |
| 14 | Row no.13 | 6.30 | 6.60 | 4.10 | 3.92 |
| 15 | Row no.14 | 6.70 | 7.00 | 3.90 | 3.90 |
| 16 | Row no.15 | 6.80 | 7.20 | 3.80 | 4.00 |
| 17 | Row no.16 | 7.20 | 7.10 | 3.80 | 4.00 |
| 18 | Row no.17 | 7.40 | 7.40 | 3.80 | 3.90 |
| 19 | Row no.18 | -- | -- | 4.40 | 4.30 |
| 20 | GBC – 3 Row no.19 | 7.40 | 7.60 | 4.90 | 4.70 |

| Sr. No. | DESCRIPTION | Active side (B) | | Non active side (A) | |
|---|---|---|---|---|---|
| 21 | Row no.20 | 8.20 | 8.20 | 4.80 | 4.70 |
| 22 | Row no.21 | -- | -- | 5.30 | 5.20 |
| 23 | Row no.22 | -- | -- | -- | -- |
| 24 | Row no.23 | -- | -- | -- | -- |
| 30 | Row no.29 | | | | |

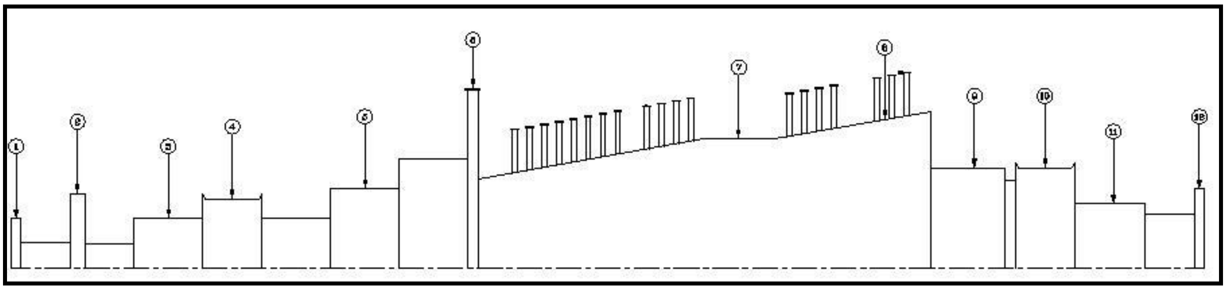
Remarks: Where clearance values were not mentioned in the table, the Clearances at these locations are wide open

**RADIAL CLEARANCE**

**(Rotor Fins to Carrier Blade and carrier fins to rotor body)**




| Sr. No. | Description | GBC Fins | | ROTOR Fins | |
|---|---|---|---|---|---|
| | | Left | Right | Left | Right |
| 1 | A-Wheel | -- | --- | 1.90 | 1.95 |
| 2 | Row no.1 | 0.50 | 0.45 | 0.50 | 0.50 |
| 3 | Row no.2 | 0.45 | 0.45 | 0.55 | 0.50 |
| 4 | Row no.3 | 0.45 | 0.45 | 0.50 | 0.50 |
| 5 | Row no.4 | 0.50 | 0.45 | 0.50 | 0.55 |
| 6 | Row no.5 | 0.50 | 0.45 | 0.50 | 0.50 |
| 7 | Row no.6 | 0.45 | 0.45 | 0.50 | 0.50 |
| 8 | GBC -2 Row no.7 | 0.45 | 0.50 | 0.50 | 0.55 |
| 9 | Row no.8 | 0.40 | 0.50 | 0.50 | 0.55 |
| 10 | Row no.9 | 0.40 | 0.55 | 0.55 | 0.55 |
| 11 | Row no.10 | 0.45 | 0.50 | 0.55 | 0.55 |
| 12 | Row no.11 | 0.45 | 0.50 | 0.50 | 0.55 |
| 13 | Row no.12 | 0.40 | 0.55 | 0.50 | 0.55 |
| 14 | Row no.13 | 0.40 | 0.55 | 0.50 | 0.55 |
| 15 | Row no.14 | 0.40 | 0.50 | 0.50 | 0.55 |
| 16 | Row no.15 | 0.40 | 0.50 | 0.50 | 0.55 |
| 17 | Row no.16 | 0.40 | 0.50 | 0.50 | 0.55 |
| 18 | Row no.17 | 0.40 | 0.50 | 0.55 | 0.40 |
| 19 | Row no.18 | 0.50 | 0.50 | 0.55 | 0.40 |
| 20 | Row no.19 | 0.40 | 0.50 | 0.50 | 0.55 |
| 21 | GBC -3 Row no.20 | 0.60 | 0.60 | 0.60 | 0.60 |
| 22 | Row no.21 | 0.65 | 0.60 | 0.85 | 0.65 |
| 23 | Row no.22 | 0.65 | 0.60 | 0.85 | 0.70 |
| 24 | Row no.23 | 3.15 | 3.20 | 0.85 | 0.70 |
| 25 | Row no.24 | 4.45 | 4.20 | 0.85 | 0.70 |
| 30 | Row no.29 | | | | |

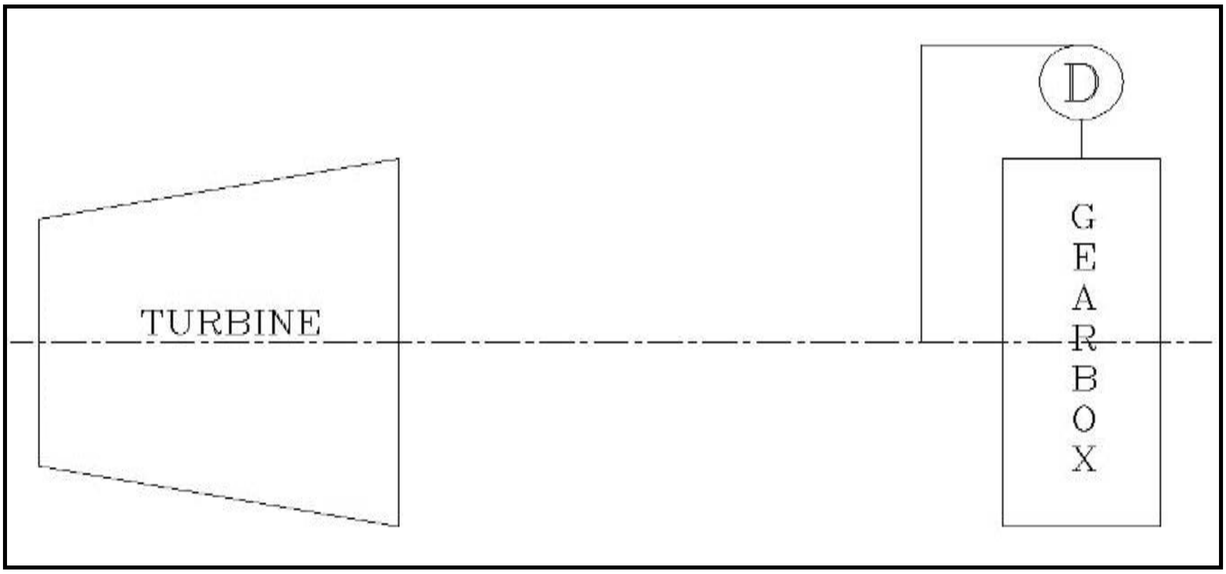


**ROTOR RUN OUTS**

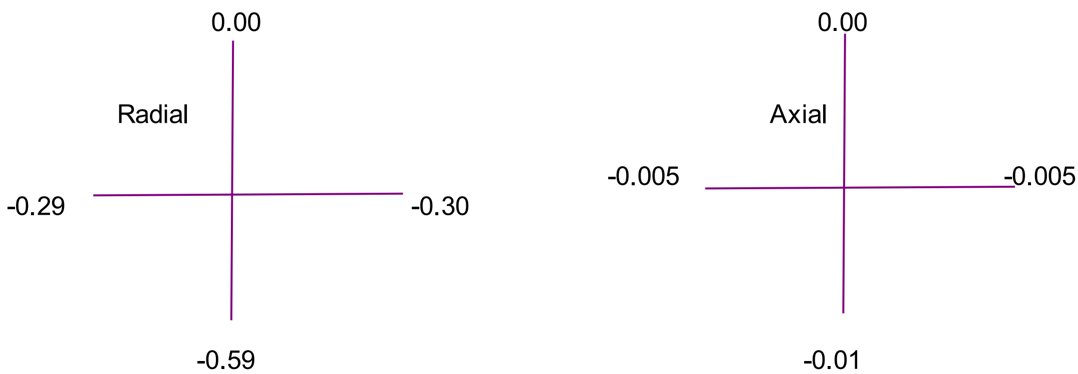
| Sr. No. | Location | Run-Out Value |
|---|---|---|
| 1 | THRUST COLLAR | 0.01 |
| 2 | FRONT Journal | 0.00 |
| 3 | Front oil gland | 0.02 |
| 4 | Front steam gland | 0.03 |
| 5 | IP gland | 0.05 |
| 6 | Rear steam gland | 0.03 |
| 7 | Rear oil gland | 0.02 |
| 8 | Rear journal bearing | 0.00 |

**FINAL ALIGNMENT READINGS**

**TURBINE TO LP:**




**Fixture on Turbine , Dial Reading on LP**



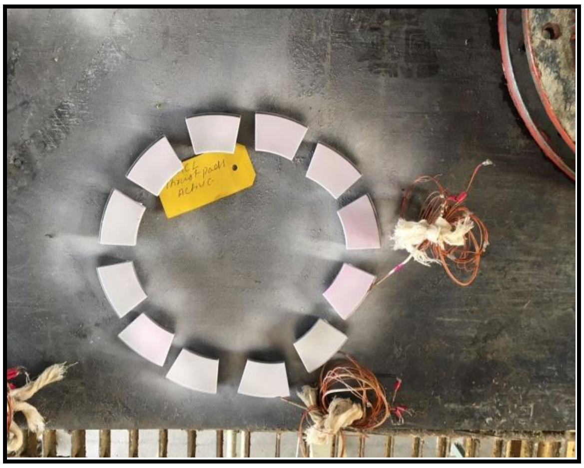
## MINOR OVERHAULING OF $CO_2$ COMPRESSOR LP CASE (K-1801-1):

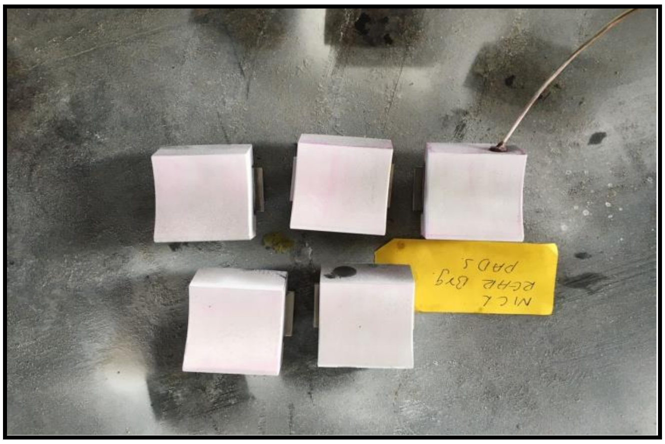
**TECHNICAL DATA**

| | | |
|---|---|---|
| MAKE | : | M/S HITACHI LTD .TOKYO ,JAPAN |
| SERIAL NO | : | K-1801-1 /K-1801-2 |
| TYPE | : | 2MCH607+2BC306A |
| MANUFACTURING YEAR | : | 1997 |
| NORMAL CAPACITY | : | 64680 KG/HR WET |
| SUCTION PRESSURE | : | 0.99 G/CM2 |
| DELIVERY PRESSURE | : | 165.25 KG/CM2 A |
| POWER | : | 41039 |
| NORMAL SPEED | : | 7500/14826 RPM |
| MAX CONTINOUS SPEED | : | 7875/15567 RPM |
| FIRST CRITICAL SPEED | : | 3200/8200 |
| CASING DESIGN PRESSURE | : | 31/191 KG/CM2 A |
| CASING DESIGN TEMPERATURE | : | 250 DEG CEN |

LP compressor was taken up for minor overhauling. Following activities were carried out:

- Decoupled the LP case from Gear box.
- Alignment of LP case and gear box was checked and noted.
- Journal bearing pads on GB side were opened for inspection.
- Journal bearing pads on Turbine side were opened for inspection.
- Thrust bearing was opened for inspection. Clearances value found within acceptable limits.
- Gauss measurement of pads, Thrust collar, journal shaft & bearing housing were carried out by Inspection section and found within acceptable limit.
- DP testing of thrust pads, thrust collar and shaft journal was done and the same found acceptable.





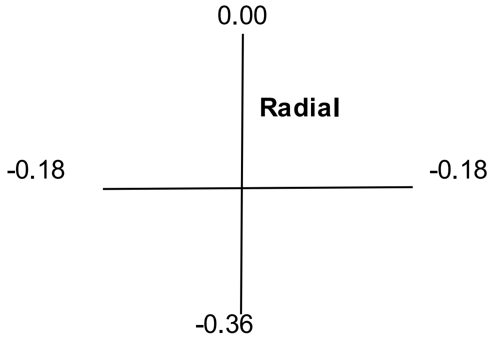
- Alignment between LP Case & Gear box was corrected as per OEM reference values.
- LP case and Gear box was coupled at required tightening torque 20 kgf.m (196 Nm). Finally spacers between LP case & gearbox were assembled after alignment correction.

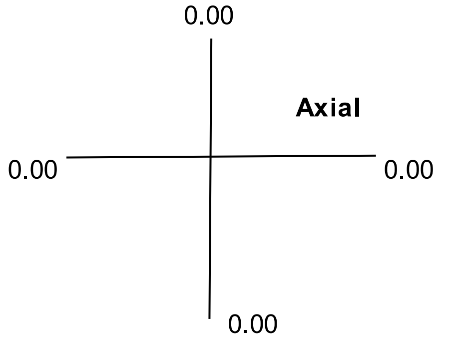
**Table 2- Bearing Clearances Data Sheet of K-1801-1**

| Bearing Description | Design value (mm) | After PM (mm) |
|---|---|---|
| Journal bearing clearance on Turbine side | 0.11 ~ 0.15 | 0.14 |
| Journal bearing clearance on Gear Box side | 0.11 ~ 0.15 | 0.14 |
| Axial Thrust | 0.28 ~ 0.38 | 0.32 |

## ALIGNMENT BETWEEN LP TO GEARBOX

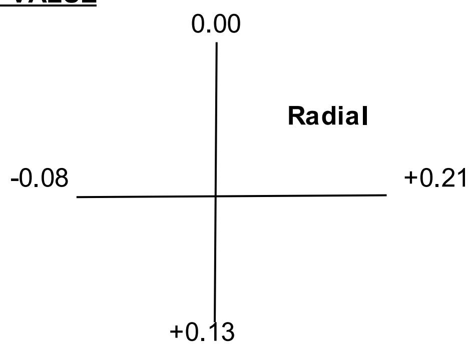
**DESIGN VALUE**

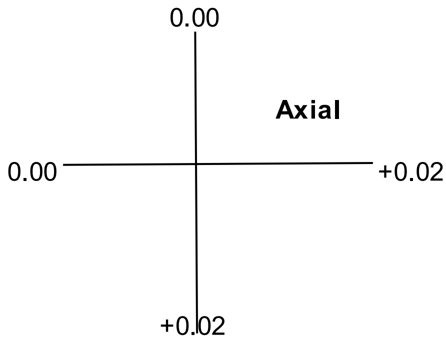



- Fixture mounted on gearbox.
- Dial reading taken on LP

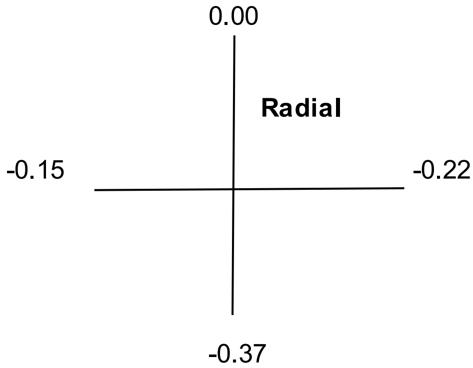
**BEFORE VALUE**

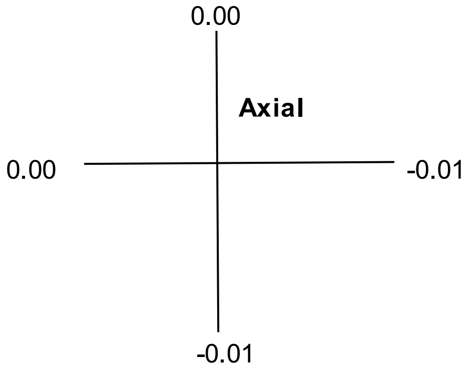



- Fixture mounted on LP.
- Dial reading taken on GB.

**ACTUAL VALUE**




- Fixture mounted on GEARBOX.
- Dial reading taken on LP.

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

### TECHNICAL DATA

| | | |
|---|---|---|
| MAKE | : | M/S HITACHI LTD .TOKYO ,JAPAN |
| SERIAL NO | : | K-1801-1 /K-1801-2 |
| TYPE | : | 2MCH607+2BC306A |
| MANUFACTURING YEAR | : | 1997 |
| NORMAL CAPACITY | : | 64680 KG/HR WET |
| SUCTION PRESSURE | : | 0.99 G/CM2 |
| DELIVERY PRESSURE | : | 165.25 KG/CM2 A |
| POWER | : | 41039 |
| NORMAL SPEED | : | 7500/14826 RPM |
| MAX CONTINOUS SPEED | : | 7875/15567 RPM |
| FIRST CRITICAL SPEED | : | 3200/8200 |
| CASING DESIGN PRESSURE | : | 31/191 KG/CM2 A |
| CASING DESIGN TEMPERATURE | : | 250 DEG CEN |

HP compressor was taken up for minor overhauling. Following activities were carried out:

- Decoupled the HP case from Gear box
- Alignment readings were checked and found disturbed.
- Journal bearing pads on Gear box side were opened for inspection.
- Journal bearing pads on free end side were opened for inspection.
- Thrust bearing was opened for inspection. Thickness of the thrust pads was checked and clearances values found within acceptable limits.
- Gauss measurement of pads, Thrust collar, journal shaft & bearing housing were carried out by Inspection section and found within acceptable limit.
- DP testing of thrust pads, thrust collar and shaft journal was done and the same found acceptable.
- Alignment between HP-Gearbox was corrected as per OEM reference values. Details are given in this report.

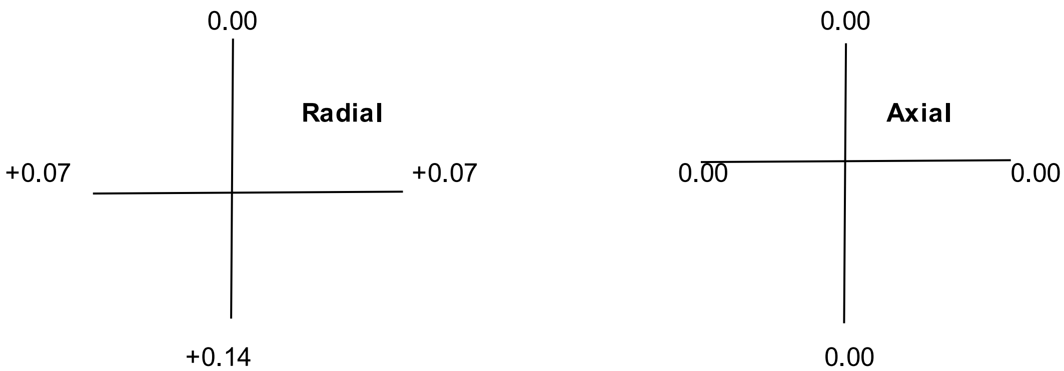
- HP case and Gear Box was coupled at the required tightening torque 9.7 kgf.m (95.06 Nm).

**Table 3- Bearing Clearance Details for HP case**

| Description | Design Value (mm) | After PM (mm) |
|---|---|---|
| Journal bearing clearance on Free end | 0.11 to 0.14 | 0.15 |
| Journal bearing clearance on Gear Box side | 0.11 to 0.14 | 0.15 |
| Thrust bearing clearance | 0.25 to 0.35 | 0.30 |

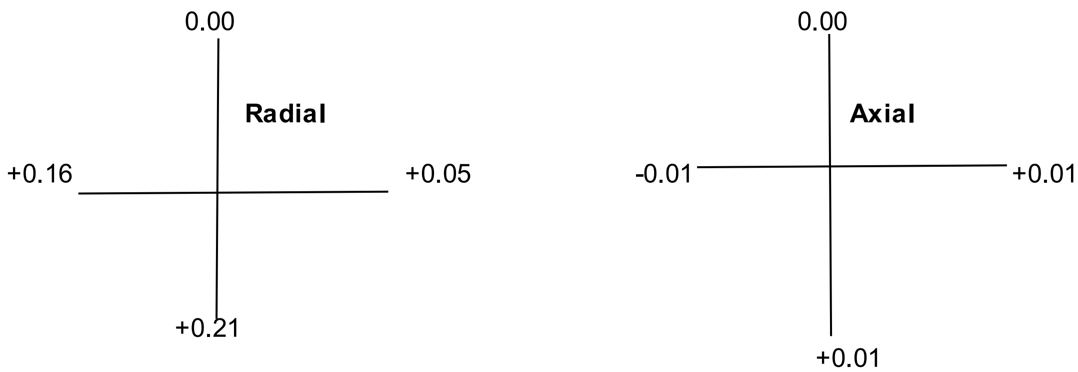
**ALIGNMENT BETWEEN GEAR BOX TO HP**

**DESIGN VALUE**



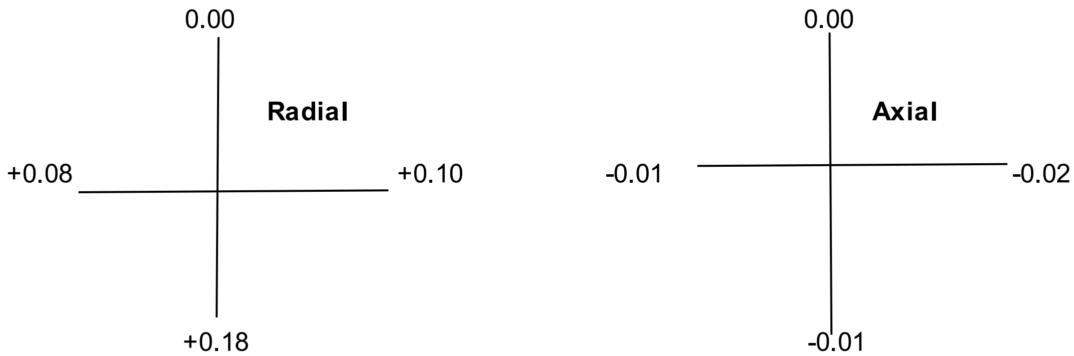

- Fixture mounted on Gear box.
- Dial reading taken on HP

**BEFORE VALUE**




- Fixture mounted on gearbox.
- Dial reading taken on HP.

**ACTUAL VALUE**




- Fixture mounted on.
- Dial reading taken on.

**Note :**

- It was observed that after stopping of lube oil pump, oil was leaked from $CO_2$ drain line.
- It was decided to open the free end bearing cover.
- It was found that after opening of cover that instrument probe wire was not fixed at position as adhesive compound was not filled in gap by instrument deptt.
- It was fixed by rubber compound by instrument and cover boxed up.
- After that, no leakage was observed.

**Overhauling of Gear Box :**

| | | TECHNICAL DATA: |
|---|---|---|
| MANUFACTURER | : | M/S HITACHI TOKYA JAPAN |
| TYPE | : | HCD025 |
| RATED POWER | : | 3900 KW |
| INPUT | : | 7500 RPM |
| RATIO | : | 1.9768 |
| OUTPUT | : | 14826 RPM |
| LUBRICATION oil | : | VG46 |
| INLET OIL TEMPERATURE | : | 45˚C+ |
| INLET PRESSURE | : | 2.0 kg/cm G |
| OIL QTY | : | 220 LTR/MIN |

**ACTIVITIES CARRIED OUT ON GEAR BOX**

- Removal of Lube Oil line around the gear box.
- Dismantling of gear box parting plane bolts.
- Removal of top cover of gearbox.
- Checking the backlash between pinion and gearwheel.
- Dismantling of front & rear bearings of pinion and gearwheel.
- Removal of pinion & gear wheel from position.
- Thorough cleaning of gearbox top and bottom casings.
- Thorough cleaning of pinion and gear wheel.
- Inspection of the teeth & journals of pinion & gear wheels ( visual, DP check and measurement of journals )
- Inspection of all bearings by visual and DP check. All are found to be in good condition.
- Taking the bearing clearances and interference
- Blue matching of the bearings, placement of bottom half bearings of pinion shaft and gear wheel.
- Boxing up of all bearings and checking the backlash between pinion and gearwheel.
- Box up the gearbox.
- Connecting high speed and low speed couplings

**BEARING CLEARANCES (PINION WHEEL)**

**FRONT JOURNAL BEARING:**

| | | |
|---|---|---|
| Bearing Bore (A) | : | **85.05** |
| Journal diameter (B) | : | 84.89 |
| Clearance (A-B) | : | 0.16 |
| Interference | : | 0.14 |
| Design Value | : | 0.14 to 0.21 |

**REAR JOURNAL BEARING:**

| | | |
|---|---|---|
| Bearing Bore (A) | : | 85.06 |
| Journal diameter (B) | : | 84.84 |
| Clearance (A-B) | : | 0.22 |
| Interference | : | 0.08 |
| Design Value | : | 0.14 to 0.21 |

**BEARING CLEARANCES (GEARWHEEL)**

**FRONT JOURNAL BEARING:**

| | | |
|---|---|---|
| Bearing Bore (A) | : | 100.04 |
| Journal diameter (B) | : | 99.87 |
| Clearance (A-B) | : | 0.17 |
| Interference | : | 0.13 |
| Design Value | : | 0.125 to 0.185 |

**REAR JOURNAL BEARING:**

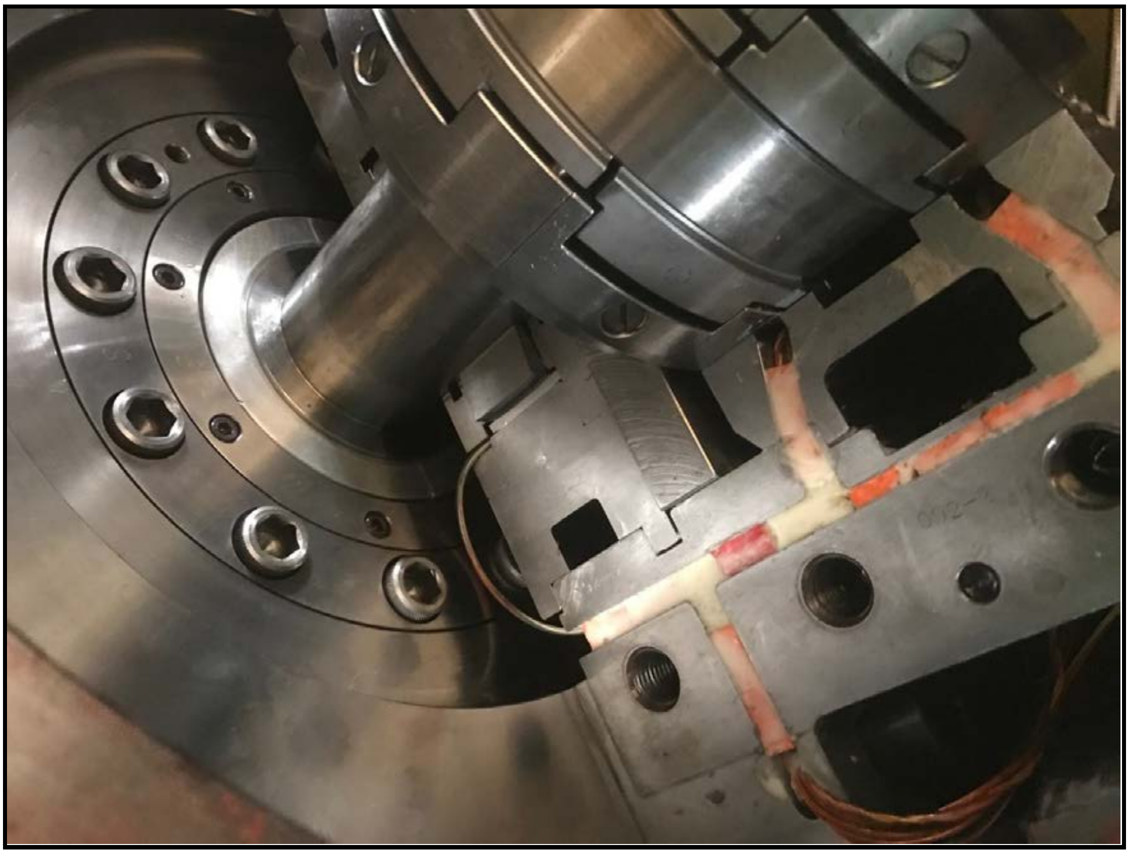
| | | |
|---|---|---|
| Bearing Bore (A) | : | 100.04 |
| Journal diameter (B) | : | 99.87 |
| Clearance (A-B) | : | 0.17 |
| Interference | : | 0.14 |
| Design Value | : | 0.125 to 0.185 |
| Gearwheel Thrust Float | : | 0.43 (Design Value : 0.38 to 0.61) |
| Backlash between pinion & gearwheel | : | 0.44 (Design Value: 0.383 to 0.608) |

**NOTE: -** All Dimensions are in “mm”

**Problem Observed.**

After taking Turbine compressor train in to Lub oil Circulation, it was observed that there is oil leak from HP Compressor Body drain flange and also huge oil was found in Instrument Air Line.

All the Oil supply system was checked. There is Gravity Drop type NRV in Lub Oil system and it was found OK. Then Bearing Housing covers were opened and found that Leak was coming from cable path of RTD, wherein, Sealant needs to be applied.



**H.P. Vessel**:

**Autoclave V-1201**

All the 11 Trays of Autoclave were opened for inspection and it was observed that some bolts were missing from plates, so we provided the same.

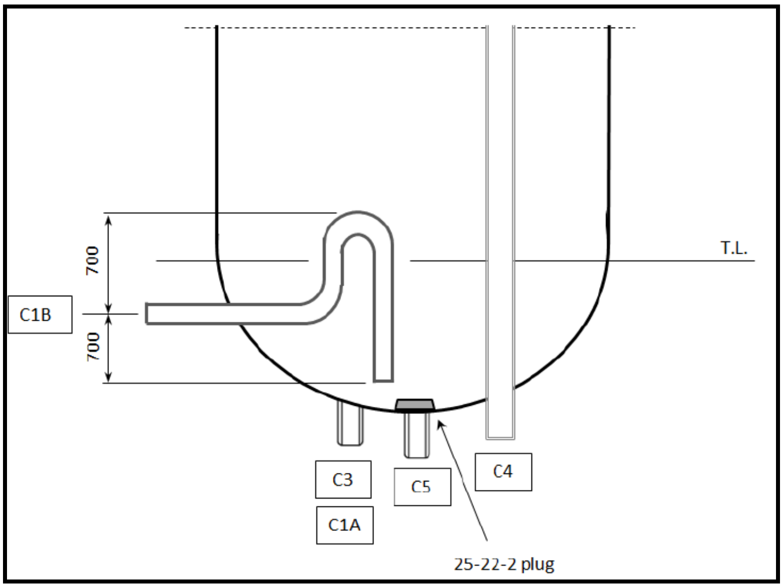
**Modification of nozzle of reactor**

Casale has asked to execute modification of nozzle of reactor to meet the requirement of process design, i.e. split flow.

Casale has asked to modify the nozzle of reactor by 8” goose neck pipe system.

Nozzle C5 was plugged from inside with a 25-22-2 plug welded over the internal lining.

Nozzle C1B distributor pipe was replaced as per drawing given below.




Job was done by Shri Ganesh Engineering Co. against Order No. **201004180018.**

**Work completion** :

- Final inspection and cleaning by industrial vacuum cleaner starting from the top to the bottom.
- Remove all protections including the temporary plug.
- Install and bolt the final sectors of each tray starting from the bottom up to the top. Required torque is 16 Nm.

During removal of ladder and lightening arrangement from the V-1201, all tray segment bolts were tightened. Joint Inspection (Maintenance + production) was carried out and Trays were boxed up.Then after water washing by production from the Top, The 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.

| | |
|---|---|
| 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 |

**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.
- No repairs /rectifications were required to be carried out.

**Top Dome**

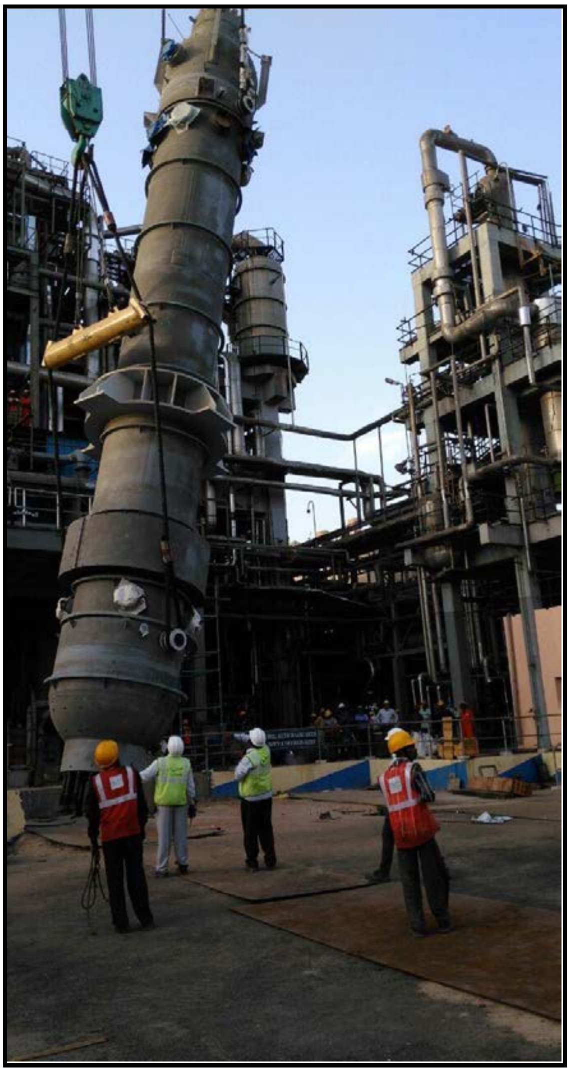
- Top cover was removed using bolt tensioner at 900 kg/cm2.
- The top cover was shifted below the platform using monorail hoist and chain blocks.

- Ferrules were removed from position. Ferrules were thoroughly cleaned by Production department.
- Eddy current testing was carried out by Inspection Department. Cleaning work was carried out as per inspection report.
- 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 new "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.

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

**<u>HP Condenser (H-1202)</u>**

New HPCC was erected and commissioned as per ESP -17 project by M/s Onshore Contractors and Casale.



**New HPCC was based on split flow system.**

**Equipment data sheet given below**

| | | | | | | |
|---|---|---|---|---|---|---|
| | **HEAT EXCHANGER DATA SHEET** | | | | | Rev |
| 1 | Service of Unit | HP Carbamate Condenser | | Item No 1 | H-1202 | |
| 2 | Size (1) 1810 x 16500 mm | Type N E N | Vertical | Connected In Series | Parallel | |
| 3 | Surf/Unit(Eff) (2) 1748.0 m2 | Shell/Unit 1 | | Surf/Shell(Eff) (2) 1748.0 m2 | | |
| 4 | **PERFORMANCE OF ONE UNIT - OPERATING CASE EOR** | | | | | |
| 5 | Fluid Allocation | Shell Side | | Tube Side | | |
| 6 | Fluid Name | Steam and Steam Condensate | | Carbamate Solution and Process Vapors | | |
| 7 | Fluid Quantity, Total kg/h | 61310.0 | | 172998.7 | | 01 |
| 8 | Total Vapor (In/Out) kg/h | | 61310.0 | 96409.1 | 3594.5 | 01 |
| 9 | Total Liquid kg/h | 61310.0 | | 76589.6 | 169404.2 | 01 |
| 10 | Steam kg/h | | | | | |
| 11 | Water kg/h | | | | | |
| 12 | Noncondensable kg/h | | | | | |
| 13 | Temperature (In/Out) °C | 147.7 | 147.7 | 176.3 | 170.0 | |
| 14 | Density Vapor kg/m3 | | 2.40 | 130.8 | 118.4 | 01 |
| 15 | Liquid kg/m3 | 919.2 | | 1091.0 | 1097.5 | 01 |
| 16 | Molecular Weight Vapor g/mol | | 18.0 | 23.9 | 23.6 | 01 |
| 17 | Nonconden. g/mol | | | | | |
| 18 | Specific Heat Vapor kcal/kg K | | | | | |
| 19 | Liquid kcal/kg K | | | | | |
| 20 | Thermal Conductivity Vapor W/m K | | | | | |
| 21 | Liquid W/m K | | | | | |
| 22 | Viscosity Vapor mPa s | | 0.014 | 0.021 | 0.021 | 01 |
| 23 | Liquid mPa s | 0.185 | | 0.247 | 0.274 | 01 |
| 24 | Latent Heat kcal/Kg | | | | | |
| 25 | Inlet Pressure kg/cm2g | 4.72 | | 148.5 | | |
| 26 | Velocity m/s | | | | | |
| 27 | Pressure Drop, Allow/Calc kg/cm2 | | 1.2 | | 1.4 | |
| 28 | Fouling Resistance (min) m2 h °C/kcal | | | | | |
| 29 | Heat Exchanged Gcal/h | 31.1 | | MTD (Corrected) °C | | 01 |
| 30 | Transfer Rate, Service kcal/h-m2-°C | | Clean | Actual | | |
| 31 | **CONSTRUCTION OF ONE SHELL** | **Shell Side** | **Tube Side** | Sketch (Bundle/Nozzle Orientation) | | |
| 32 | Design/Test Pressure kg/cm2g | 8 / CODE | 160 / CODE | FOR EXCHANGER DWGS. SEE SHEETS 5-7 | | |
| 33 | Design Temperature °C | 174 / (3) | 190 / (3) | | | |
| 34 | No Passes per Shell | 1 | 1 | | | |
| 35 | Corrosion Allowance mm | 3.0 (4) | 0.0 | | | |
| 36 | Connections In | | | | | |
| 37 | Connections Out | FOR NOZZLES DETAIL SEE | | | | |

| | | | | |
|---|---|---|---|---|
| 38 | Size and Rating | Intermed. | SHEET 4 | |
| 39 | Tube No 1970 OD 25 mm THK 2.5 (5) mm Length 11.3 (6) m Pitch 36 min mm Layout 30° | | | |
| 40 | Tube Type Seamless Material 25-22-2 (7) | | | |
| 41 | Shell (8) C.S. ID 1810 mm THK (1) mm | | Shell Cover | 01 |
| 42 | Channel or Bonnet C.S. High Strength + 25-22-2 lining (7) (9) | | Channel Cover C.S. HS + 25-22-2 lining (7) (9) | |
| 43 | Tubesheet-Stationary C.S. High Strength + 25-22-2 overlay (7) (10) | | Tubesheet-Float. | |
| 44 | Floating Head Cover | | ImpingementPlate | |
| 45 | Baffles-~~Cross~~ Type Grid %Cut(Diam) Spacing(c/c) 1200 mm Inlet (1) mm | | | |
| 46 | Baffles-Long Seal Type | | | |
| 47 | Supports-Tube U-Bend Type | | | |
| 48 | Bypass Seal Arrangement Tube-Tubesheet Joint Strength weld (tube expansion not allowed) | | | |
| 49 | ExpansionJoint Yes Type Insulation Yes (Heat conservation) | | | |
| 50 | Rho-V2 kg/cm s2 Inlet Nozzle Bundle Entrance Bundle Exit | | | |
| 51 | Gaskets Shell Side Tube Side (11) Floating Head | | | |
| 52 | Code Requirements ASME VIII Div.1/2 TEMA Class R | | Weight Estimat'd/Shell kg | |
| 53 | Radiography XR Shell 100% Heads 100% | | Filled with Water kg | |
| 54 | Stress relieving Shell CODE Heads CODE | | Bundle kg | |
| | | | | |

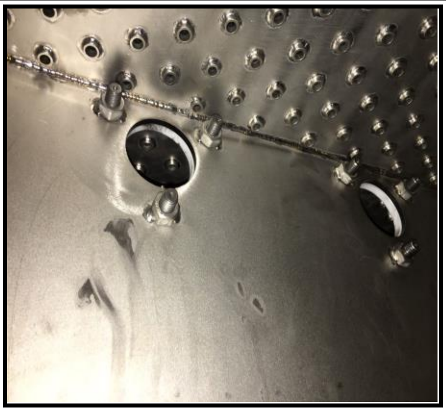
**Procedure for fitting of new internals of top and bottom:**

| Sr. No. | Activity | Detailed procedures |
|---|---|---|
| 1 | Deflector ring installation (internals top part) | • Protect internals positioning fire blanket below support ring.<br>• Insert and position, checking, deglector ring sectors.<br>• Bolt deflector ring sectors to the support ring.<br>• Install the radial plate strips and bolt deflector ring sectors together.<br>• Tack wels all bolts, alla washers and radial plate strips in such position that they can be easily removed by grinder in future. |
| 2 | Overflow Cylinder installation (Internal top part) | • Insert and lay down the overflow cylinder segments on deflector ring.<br>• Adjust the overflow cylinder segments positioning respecting orientation.<br>• Install vertical plate trips (inner side) and bolt overflow cylinder segments together.<br>• Adjust overflow cylinder orientation and bolt the overflow cylinder to deflector ring.<br>• Tack weld bolts and washers and vertical plate strips in such position that they can be easily removed in future.<br>• Tack weld overflow cylinder to deflector ring. |
| 3 | Internal top part cleaning | • Clean internals and remove fire blanket. |

| Sr. No. | Activity | Detailed procedures |
|---|---|---|
| 4 | Work preparation and Bottom internal lifting | • Install a wooden platform below bottom manhole with a central opening to enable access of materials and people.<br>• Central opening shall have a removable cover that allows good support to workman.<br>• Due to weight of tubesheet distributor sectors, lifting will be done by rope cable.<br>• Hnag the sector with rope and pull the sector through bottom manhole.<br>• After insertion of all sectors, push the sectors up to its position by means of two jacks installed underneath tray sector.<br>• Repeat this operation for all the sectors. |
| 5 | Tubesheet distributor tray installation (internals bottom part) | • Perform the trial fit of first tubesheet distributor tray sector checking concentricity of distributor pipes with tubesheet pipes. If required, grind the trays holes for bolting.<br>• Bolt loose first tubesheet distributor tray sector to the support ring.<br>• Check again distributor pipes centering with the tube sheet pipes. If it is not acceptable adjust sector positioning until concentricity of tubes is reached.<br>• Tight the bolts that the distributor sector to its supports.<br>• Perform the trial fit of second distributor tray sector checking concentricity of distributor pipes with tubesheet pipes and fitting with first sector. If required, grind the trays holes for bolting.<br>• Position spacer disk between first and second tray sectors.<br>• Bolt to be loosened of second tray sector to the support and to the first tray sector.<br>• Check distributor pipes centering with the tube sheet pipes.<br>• Tight the bolts that hold the distributor sector to its supports and to the first tray sector.<br>• Check the gap between two distributor tray sectors.<br>• Repeat above operations for remaining sectors.<br>• Install and tack weld the closure plate strip below tray sectprs .<br>• Tack weld of following to be done.<br>• The bolts that join two trays sectors on their vertical walls.<br>• The bolts to relevant washers and the washers to the closure ring sectors on support ring.<br>• Tack weld the closure ring to the distributor tray sectors. |
| 6 | Gas Distributor tray installation | • Install the gas distributor tray (made in No. 3 sectors), bolt the tray sectors together and to the gussets by means of closure plates. |

| Sr. No. | Activity | Detailed procedures |
|---|---|---|
| | | • Install and bolt the gas distributor tray deflector.<br>• Tight the bolt installed and tack weld:<br>• The bolt that join the tray sectors on their vertical walls.<br>• The bolts that join the tray sectors with deflectors.<br>• The bolts to relevant washers and the washers to the closure plates.<br>• Tack weld the closure plates to the tray sectors. |
| 7 | Internal Bottom part cleaning | • Clean internals bottom part. |
| 8 | | • Position bottom manhole gasket and install the cover.<br>• Position top manhole gasket and install the cover. |




- Top and bottom cover were boxed up with new “Kempchen” gasket with new 0.5 mm thick Teflon envelope.
- Tightening pressure for top and bottom cover.

| | |
|---|---|
| $1^{st}$ tightening round | 200 kg/cm2 |
| $2^{nd}$ tightening round | 400 kg/cm2 |
| $3^{rd}$ tightening round | 600 kg/cm2 |
| Final tightening round | 800 kg/cm2 |

Ejector (P-1250) was also installed under ESP-III.

**<u>HP Scrubber H-1203</u> :**

**<u>Lowering of Tube Bundle of HP Scrubber (H-1203):</u>**

Last tube bundle inspection of H-1203 was carried out during annual shutdown 2012. Hence it was decided to lower the tube bundle for inspection during forthcoming shut-down 2017. WO **201004171897** was placed on M/s Skywin Erectors, Ahmedabad for executing the job.

**<u>Preparation before shutdown</u>**:

Load testing of all rigging tools were carried out in the presence of inspection department. During testing of all 4 nos. of 10 ton capacity chain blocks, abnormal sound absorbed in 2 nos. of chain block,. Defective chain blocks were repaired at M/s Technocrats Sales and Services Pvt Ltd, Ahmedabad and Requisition Nr 201001171326 dtd 21.12.2016 had been raised to Procure 4 numbers of Chain block with specific MOC requirement of Load Chain material.

For load testing of 4 nos. of eye bolts in horizontal loading condition as shown in attached figure.

**Lifting of load in eye bolt testing arrangement**

Loading test of all 4 nos. of eye bolts were done at weight 18 ton for 15 mins.

During shutdown, following sequence were followed to lower the tube bundle.

- Removal of top dome
- Lowering and lifting of tube bundle
- Box-up of top dome.

## Removal of top dome

- Removed the insulation for top dome lifting from following portions.
  - Off gas line flange
  - Flange of top dome and shell
  - Steam tracing line
  - Carbamate Inlet flange
  - $CO_2$ purging Inlet
- Cleaned monorail for top dome and applied grease
- Prepared the scaffolding for offgas flange /steam tracing
- Placed the wooden plank on platform for safe working
- Removed the cap of stud of top dome, cleaned by rustolene and wire brush
- Marked the all process and steam line connections and disconnected.
- Disconnected the following flange of top dome
  - Off gas flange (C3-3"x1500#) ** used safety belt
  - Carbamate solution inlet (C6 - 3"x1500#)
  - $CO_2$ purge conn. (1"x1500, 3nos.)
- Cut the steam tracing line
- Prepared the lifting arrangement for top dome (2 nos. of monorail, 2 nos. of 10 ton chain blocks, 2 nos. of 5 ton slings & 2 nos. of hook-chuk) . Mounted these tools on 2 nos. of trunion and tied sling with hook of chain block for safety purpose
- Loosened the nut one by one using bolt tensioner at 750 kg/cm2 g and removed all nuts.
- Disconnected the drain line flange (inside shell, 1/2") after lifting top dome.
- Shifted the top dome towards K-1403-3 , placed on wooden sleeper
- Removed the diaphragm
- Departmental inspection was carried out. Repair work was done as per report. Pneumatic test of liner weld was carried out, leak observed at blind flange weld joint with liner. The same was got repaired (Detailed given in Inspection Shutdown Report).
- Refixed the diaphragm on its position in top dome.

## Lowering and lifting of tube bundle

- Removed the insulation for tube bundle lowering from the following portions.
  - Gas inlet flange
  - CCS-II inlet/outlet flange
  - Condensate flushing line flange
  - Steam tracing line flange
- Cleaned all flange using rustolene.
- Marked the all process and steam line connections, which were to be loosened

- Placed the wooden plank on platform for keeping hydraulic jack safely
- Loosened the following connected flanges
  - Gas inlet (C1 - 4 " x 1500#, 2nos. ) along with spacer and cond. flushing line 1 " x1500, 2nos.
  - CCS-II inlet/outlet (C4/C5-10 " x 150#, 2 nos. )
- Cut the steam tracing line
- Mounted the 4 nos. of 5 ton slinging (in U- shape) on I-beam after placing damaged urea bags
- Mounted the 10 ton chain block (02 nos. new and 02 nos. old) on slinging one by one with help of hook-chuck.
- Tightened the 4 nos. of eye bolt on bottom flange and connected 10 ton chain block with help of 10 ton d-shackle. Took the load on 10 ton chain block
- Loosened all nut one by one using bolt tensioner at 750 kg/cm2 g and removed all except 4 nos of nut of long stud.
- Now loosened the 4 nos. of nut half round and lowered the tube bundle using chain block. Again loosened the 4 nos. of nut half round and lowered the tube bundle using chain block. This activity was required to free the tube bundle inside the shell
- Measured the gap between shell girth flange and bottom dome flange at two position of eye bolt. After ensuring the tube bundle was free inside the shell, lowered the tube bundle 25mm with the help of chain block equally by measuring the gap.
- Inserted the 4 nos. of dowel guides on 4 nos. of stud.
- Again lowered the tube bundle with help of chain block 630mm equally by measuring the gap providing 4 nos. of tube sheet holding bracket.
- Removed the platform grill and channel
- Tightened the 4 nos. of connector with 4 nos. of stud.
- Inserted the Sleeve with washer in opposite 4 nos. holes of bottom flange.
- Inserted the pipe ( 8.00 mtr long ) through bottom flange and welded it with connector
- Lowered tube bundle using chain block equally by measuring the gap between shell flange and bottom dome flange at position of all eye bolts
- Gasket was removed after lowering the tube bundle up to 7 mtr.
- Prepared the scaffolding for inspection
- Departmental inspection was carried out and 10 nos. defects were observed inside the shell on liner. Same were repaired as per report. Pneumatic test of liner weld was carried out and found satisfactory.(Detailed given in Inspection Shutdown Report).
- Placed the gasket on the tube bundle and hold it at platform
- Lifted the tube bundle with help of chain block up to the 4nos. of guide dowel
- Removed the tube sheet holding bracket , pipe, connecter, washer
- Placed the all platform grill and structure

- Cleaned both flange seating area by HNO3 + Acetone + DM water, placed the gasket properly. And applied the antisieze grease on stud
- Lifted the tube bundle with the help of guide and tightened the nut
- Tightened the nut as per procedure.

  (In 4 steps at 300 kg/cm2 g, 500 kg/cm2 g, 700 kg/cm2 g pressure and checked final round at 700 kg/cm2 g using hydraulic bolt tensioner as per sequence)
- Tightened the connected flange and welded the steam tracing flange line for bottom dome.
- Removed the rigging arrangement for tube bundle lowering

**Box-up of top dome**

- Shifted the top dome and kept it up to the studs to tighten the inside drain flange.
- Kept the top dome on its position.
- After clearance from production department, the top dome was boxed up using new "Kempchen" gasket (952 mm OD x 904 mm ID x 4 mm thick) with 0.5 mm thick Teflon envelop.
- Tightening pressure for top dome.

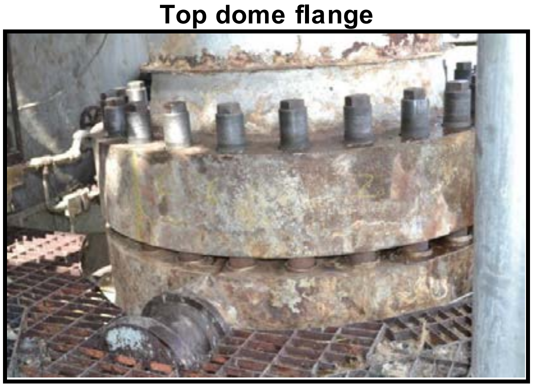
| | |
|---|---|
| 1st tightening round | 300 kg/cm2 |
| 2nd tightening round | 500 kg/cm2 |
| 3rd tightening round | 700 kg/cm2 |
| Final tightening round /checking round | 700 kg/cm2 |

- Connected the all flange and welded the steam tracing line flange and Insulation was done.

**HP Scrubber – Top Dome Removal**

**Top dome flange**

**Top dome flange – after nut removal**



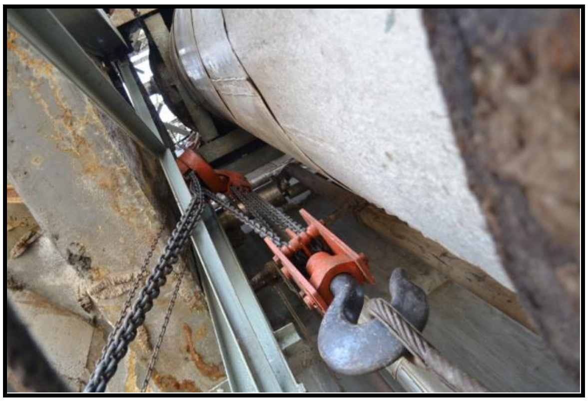
**Lifting of top dome**

**Lifting of top dome - 1**

Lifting of top dome – up to stud

Placing of top dome

## Tube bundle lowering



Rigging arrangement - 1

Rigging arrangement - 2

Bottom dome -1

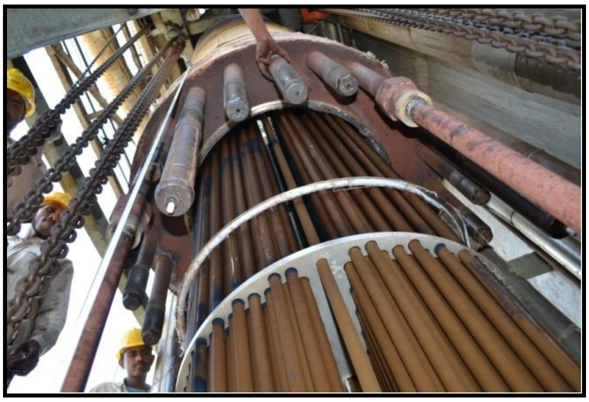
Bottom dome -2

Bottom dome – after removing the nut except 4 nos. of loosened nut

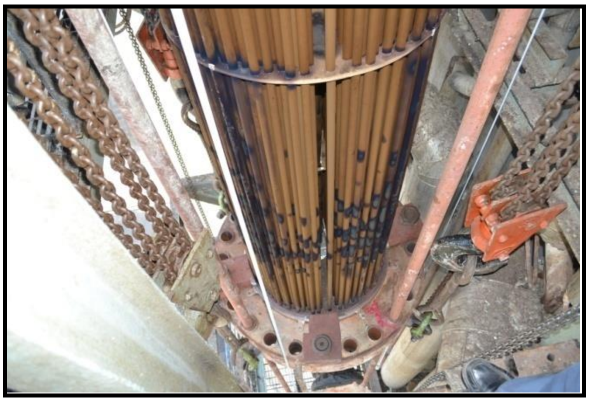
Lowering of tube bundle

**Tube bundle lowering after providing 4 nos. of guide**

**Lowering of tube bundle with help of 4 nos. of guide**



**Lowering of tube bundle with help of 4 nos. of guide pipe -2**



**Lowering of tube bundle with help of 4 nos. of guide pipe -3**

**Lowering of tube bundle with help of 4 nos. of guide pipe -6**

**Lowering of tube bundle with help of 4 nos. of guide pipe -7**

## VAM (Vapour Absorption Machine): SJ 50B series

Steam fired single effect vapour absorption machine was erected and commissioned by M/s Thermax India Ltd. For cooling of $CO_2$ in suction line under ESP-III during annual shutdown-2017.

NOTE:

| | | |
|---|---|---|
| Refrigerant | : | water |
| Absorbent | : | Lithium Bromide (LiBr) |
| Heat Source | : | 4 ata steam |
| Capacity | : | 400 TR |
| Weight | : | 16.4 MT |

Machine was lifting from all the four corners with the help of Kobelco crane.

**Design Basis**

| | | |
|---|---|---|
| No. of Chilling units | : | One |
| Type | : | Vapour Absorption |
| Rated flow of $CO_2$ in $CO_2$ Cooler | : | 30500 $Nm^3/h$ |
| Design Inlet $CO_2$ Temp. | : | 46.5 deg.C |
| Design Inlet $CO_2$ Saturation | : | 100% |
| Design Outlet $CO_2$ Temp. | : | 30 deg.C |
| Design Outlet $CO_2$ Saturation | : | 100% |
| Removed duty @rated condition | : | 1.0 Gcal/h |

Available Utilities:

- **Cooling water**

  Supply Pressure : 3.5 kg/cm2 g

  Return Pressure : 2.5 kg/cm2 g

  Supply Temperature : 34 Deg.C

  Return Temperature : 44 Deg.C

  Fouling Factor : 0.0006 m2 h C / kcal

- **Heat source**

  Pressure Kg/cm2g : LP Steam

  Normal : 3.5 kg/cm2 g

  Actual : ---

  Design : 7.0 kg/cm2 g

  Temperature deg.C : LP Steam

  Normal :

  Actual : 147 Saturated

  Design :

  Overdesign required on removed duty : 20%

- **Service Air**

  Moisture : Saturated

  Pressure normal : 3.0 kg/cm2 g

  Temperature(Normal) : 40°C

- Instrument Air

  Pressure (Minimum) : 5 kg/cm2 g

  Normal : 6.5 kg/cm2 g

  Temperature(Normal) : 40°C

  Dew Point : -40°C@P

- DM water

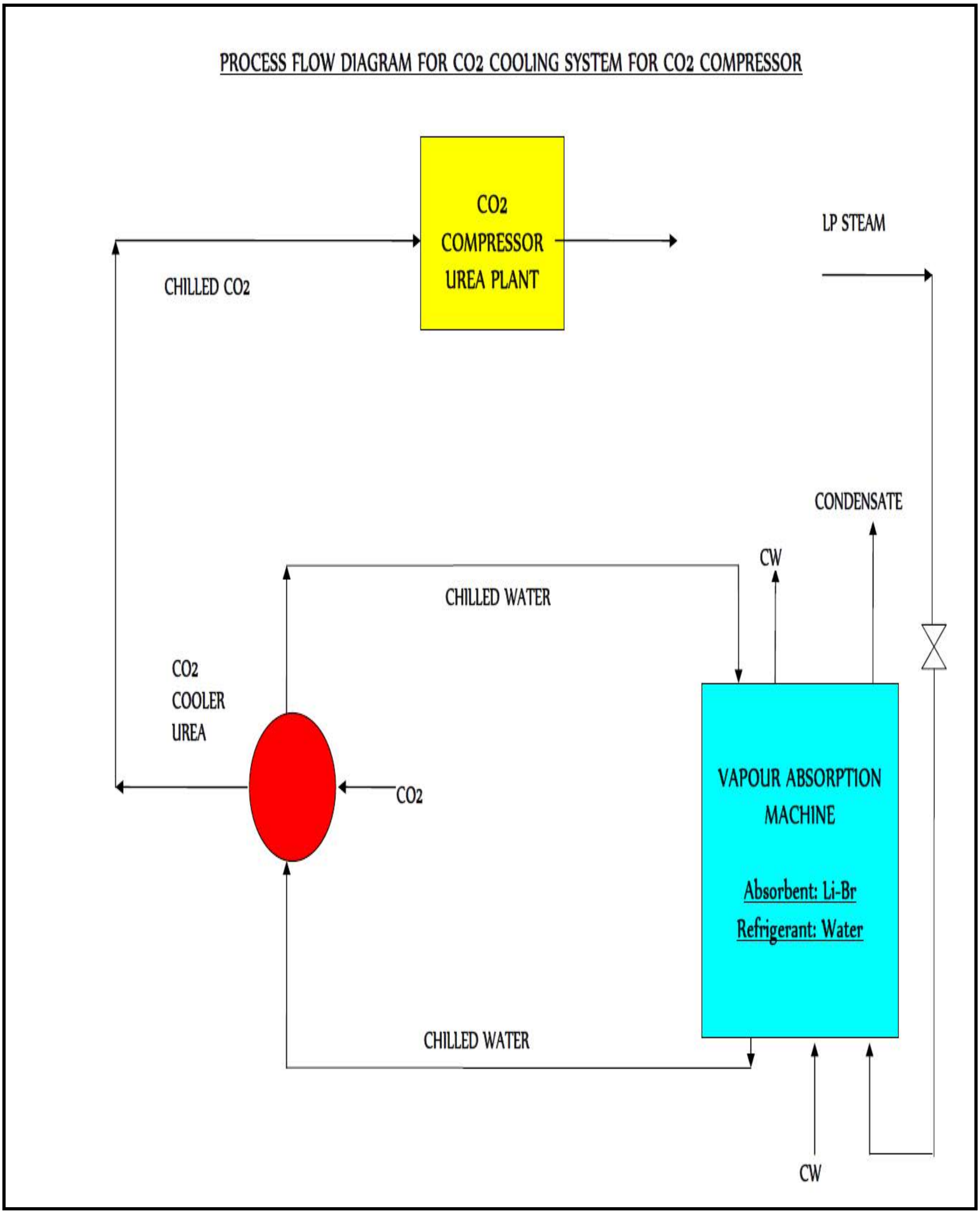
Pressure : 6 kg/cm2 g

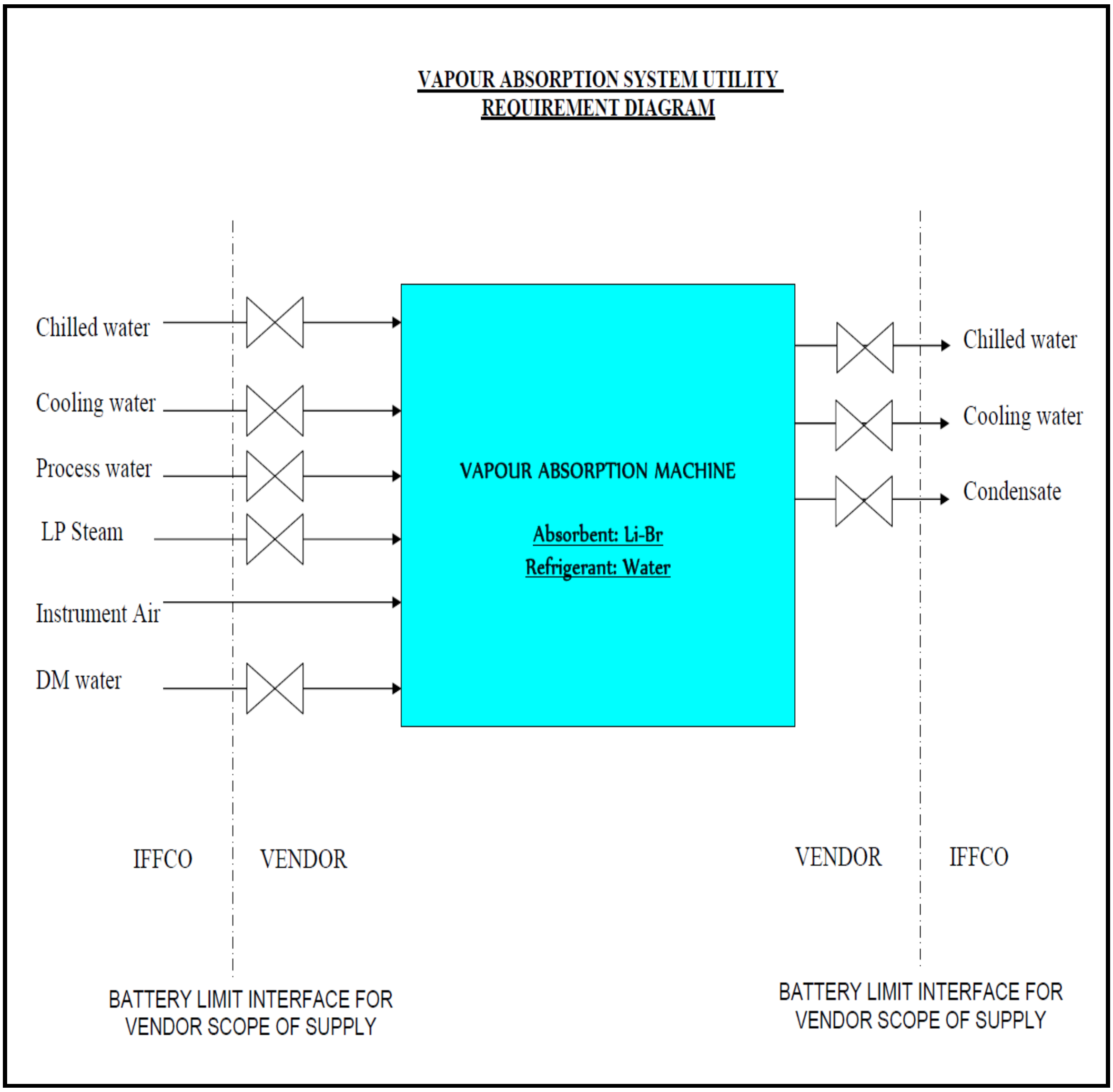
Temperature : 40

Quality:

Silica: Max 0.02 ppm TDS : 0.1 ppm(Max.) pH value: 6.5-7.5

Conductivity, IJS/cm : 0.2 (Max) Iron, Max: 0.01ppm(Max.)






**Basic Principle of machine**:

The boiling point of water is directly proportional to pressure. At atmospheric pressure water boils at 100 deg. Celcius. At lower pressure it boils at lower temperature. At 6 mm Hg absolute pressure the boiling of water is 3.7 deg. Celcius.

To change water from liquid to vapour it has to be heated. The heat is absorbed by the water and its temperature starts rising. However it rises until it reaches a point where the temperature stays constant and it starts boiling, i.e. the liquid water vapourises. This point is called the boiling point. At this point all the heat being absorbed by the water does not change its temperature but only its phase. This heat, required to change the phase of a liquid to vapour, is called the Latent of Vapourisation. Similarly the heat rejected by a vapour when it condenses is called the Latent Heat of Condensation.

Lithium Bromide (LiBr) is a chemical similar to common salt (NaCL). LiBr is soluble in water. The LiBr water solution has a property to absorb water due to its chemical affinity. As the concentration of LiBr solution increases, its affinity towards water increases. Also as the temperature of LiBr solution decreases, its affinity to water increases.

Further there is a large difference between vapour pressure of LiBr and water. This means that if we heat LiBr water solution, the water will vapourise but the LiBr will stay in the solution and become concentrated.

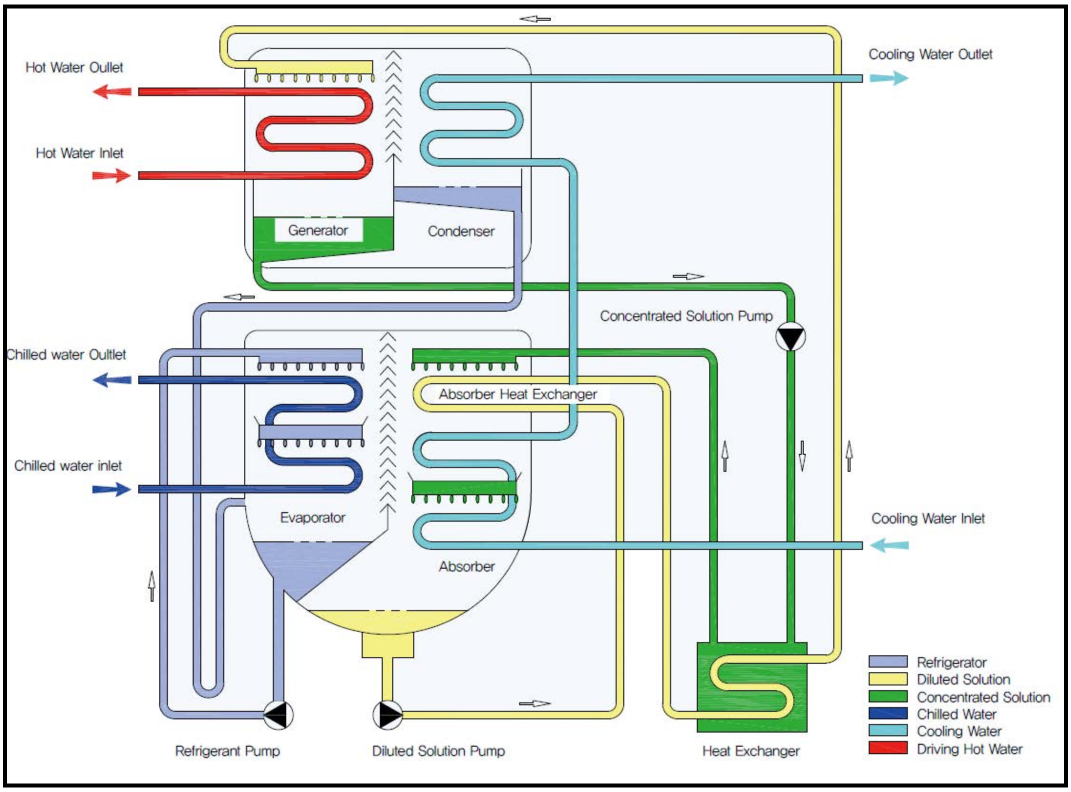
**Absorption Cycle:**

Absorption systems use heat energy to produce a refrigerating effect. In these system the refrigerant, i.e. water, absorbs heat at a low temperature and pressure during evaporation and releases heat at a high temperature and pressure during condensation.

A solution know as absorbent, i.e. Lithium Bromide (LiBr), is used to absorb the vapourised refrigent (after its evaporation at low pressure). This solution, containing the absorbed vapour is heated at a higher pressure. The refrigerant vapourises and the solution is restored to its original concentration for recirculation.

| | | |
|---|---|---|
| Cooling Mode – Schematic Diagram | : | A schematic diagram of the absorption cycle in the Cooling Mode is shown in Figure. |
| Individual Parts | : | The operation of the various parts of the absorption machine is described below. |
| Evaporator | : | The evaporator consist of a tube bundle, an outer shell, distribution trays, and a refrigerant pan. The chilled water flows inside the tubes. A refrigerant pump circulates the refrigerant from the refrigerant pan into distribution trays.From the trays the refrigerant falls on the evaporator tubes. The shell pressure is very low (≈6mmHg). At this pressure the refrigerant evaporates at a low temperature (≈3.7C) and extracts latent heat of evaporation from the water being circulated through the evaporator tubes. Thus the water being circulated through the evaporator tubes. Thus the water being circulated through the tubes become chilled. |
| Absorber | : | The absorber consists of a tube bundle, an outer shell (common with the evaporator), distribution trays, and an absorbent collection sump. Concentrated absorbent solution (≈63.4%) from the low temperature generator is fed into the distribution trays. This solution falls on the absorber tubes. Concentrated absorbent has an affinity to water. Hence the vapourised refrigerant from the vaporized refrigerant from the evaporator section is absorbed. Due to this absorption the vacuum in the shell is maintained at a low pressure and ensures the correct chilled water temperature.The concentrated absorbent becomes diluted. During this dilution the 'Heat of Dilution' is generated. This increased the temperature of the absorbent solution. This heat is removed by the cooling water being circulated in the absorber tubes. As the absorbent solution loses it's heat to the cooling water, it is able to absorb more refrigerant vapour, and gets further diluted. The diluted absorbent (≈58.5%) collects in the bottom of the shell. |

| | | |
|---|---|---|
| Heat exchanger | : | The cool, diluted absorbent is pumped to the generator by the absorbent pump. It first passes through the heat exchanger where it absorbs heat from the concentrated absorbent.The heat exchanger serve to heat up the cool absorbent solution before it enters the generator for re-concentration. This reduces the heat input required in the generator. This reduction in the energy input required increases the efficiency of the cycle. |
| Generator | : | The generator and condenser tube bundles are enclosed in a shell and are separated by an insulation plate. The generator consists of a shell and tube heat exchanger. Heat is supplied to the Generator by means of the Steam. The diluted absorbent surrounds these tubes and is heated. The temperature of the solution increases until it reaches it's boiling point. The refrigerant boils out of the solution. The solution concentration increases (to ≈63%). The concentrated absorbent drains to the absorber to being a new absorbent cycle. The vaporized refrigerant generated passes through the eliminators and goes to the Condenser. |
| Condenser | : | Refrigerant vapourised from the absorbent in the generator passes through the eliminators to the condenser. Cooling water flowing in the condenser tubes condenses all these refrigerant vapours. The refrigerant vapours condenses on the outside of the condenser tubes, heating the cooling water, and collects in the bottom of the condenser. The condensed refrigerant flows back to the evaporators. |




**Vapour Absorption Diagram**

VAM is consisting of Following units:

- VAM unit which consist of evaporator, absorber, condensorand generator.
- Chilled Water pump – 02 Nos.
- Condensate pump – 02 Nos.
- Make up water tank
- Condensate tank

All there were erected and commissioned during Annual shutdown 2017 under ESP III.

All piping works were done under General Engineering Department by M/s Thermax India Ltd.

**Ammonia Pump, P-1102/C :**

Ammonia pump was shifted to new location, adjacent to P-1102/C and under the ammonia preheater H-1250 as per ESP project.

**LP Vessel :**

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

**V-1503 ( 9 ATA STEAM DRUM)**

U-clamp of the steam inlet header was found loosened, so tightening done.

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

Demister pads were found slightly damaged, loosened & lifted at several locations which are rectified.

**V-1203 (L.P. ABSORBER)**

**FROM BOTTOM MANHOLE**

One no of rasching ring holding tray bolt found shifted from its position and nut of few bolts were found missing which were rectified.

**FROM TOP END**

Through Pinholes observed in the flange weld as deposition observed on the outer side of flange weld. Same were repaired.

**V-1207 (L.P. SCRUBBER )**

One no. holding nut was found loose. So, tightened.

**V-1351 (HYDROLYSER)**

**Bottom Compartment (20$^{th}$)**

- Steam inlet line clamping bolt were found missing and its flange bolts found loosened.

  So, repaired the same.
- End cap of the steam Inlet pipe was found detached and lying on the dished end So, End end cap was fitted.

**V-1811 (1ST STAGE SEPARATOR)**

Minor pinholes were observed in Manhole flange seal run welding. So, repaired the same.

**Low Pressure Carbamate Condenser, LPCC (H-1205)**

IRIS inspection of tubes were carried out after hydro jetting of tubes and found ok.Finally, hydrotest was carried out at 11 Kg/cm2 and found OK.

Then top dish end and all connected pipe line, other tracing lines and platform which were removed for lifting the tube bundle were fixed/welded and all blinds provided for hydrotest were removed.

**2nd stage Evaporator Booster Ejector (P-1423)**

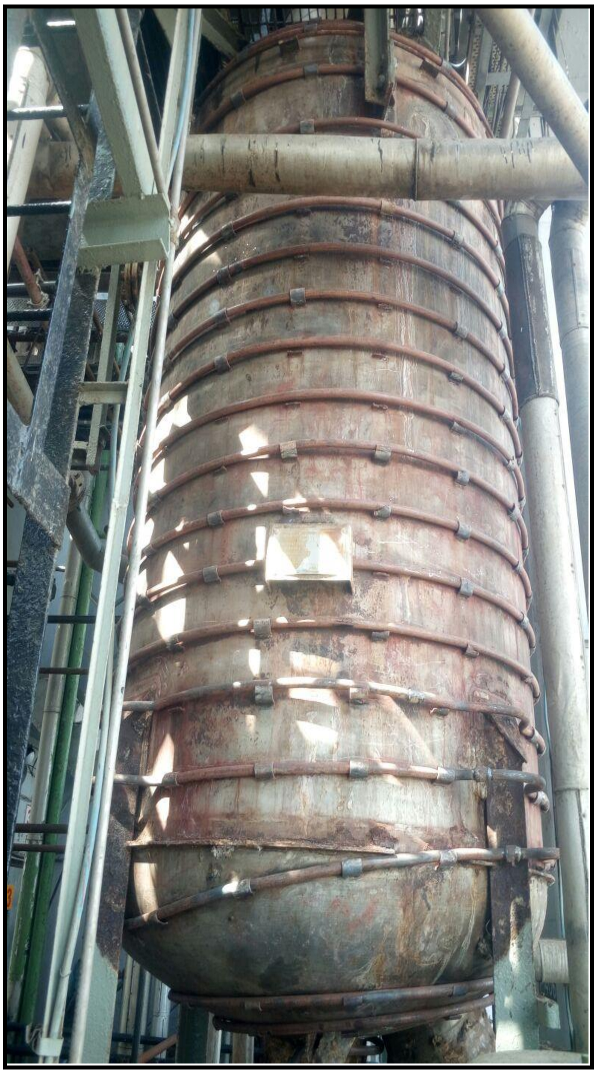
An inspection window was made in ejector pipe at 3.5 floor to check the inner condition during the plant operation.

**VARIOUS FABRICATION JOBS:**

Following fabrication jobs were carried out during shutdown:

**Replacement of existing corroded CS steam tracing lines of V-1406**

All Steam coils were replaced by new one as old one had many holes leak in it.



**K-1401 / 2 / 3 /4 (PT Fan)**

PT Fan no. 2 & 4, Duct were replaced by modified canopy as per production demand.

Height of all canopy were increased by 500 mm as per production requirement.

**Desorber Reflux Condenser (H- 1352)**

4” drain was provided at bottom dome as per production demand.

**Prill Cooling System**

**Inlet Air Fan (K-1701)**

- Visual inspection of both bearing was done. Oil flushing of both bearing was done.
- Alignment of both pulleys was done, Belt tension was checked and guard was provided.
- Back mesh of fan was found damaged. So, replaced with new SS mesh.
- Stanvac anti- adhesive ceramic coating were applied on back body of fan.

**Exhaust Air Fan (K-1702)**

- Visual inspection of both bearing was done. Oil flushing of both bearing was done.
- Alignment of both pulleys was done, Bet tension was checked and guard was provided.

**Conveyor System**

**Prill Tower Conveyors (M-1403-1 / 2 /3)**

**M-1403-1 Conveyor**

- Existing belt was replaced with new HRT2 grade belt.
- All damaged carrying rollers and return rollers were replaced.
- Head pulley and tail pulley bearing was checked and found ok.
- GB teeth were checked, found ok. Oil was flushed.
- Alignment was done between gear box to motor and from gearbox to pulley.

**M-1403-2 Conveyor**

- All damaged carrying rollers and return rollers were replaced.
- 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.
- Gear box oil was flushed.
- Coupling bush were checked.
- Alignment was done between gear box to motor and from gearbox to pulley.

**Link Conveyor (M-1419)**

- All carrying rollers and return rollers were replaced by new HPPE (High Performance Polyethylene) polymer rollers with nonmetallic composite glass fibre shaft and multi labyrinth sealing system for protecting the bearings from dust ingression.
- Existing belt was replaced with new OHR grade belt.
- Gear box oil was flushed.
- 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)**

- Existing belt was replaced with new OHR grade belt.
- All damaged carrying rollers and return rollers were replaced by new HPPE (High Performance Polyethylene) polymer rollers
- Gear box oil was flushed.
- 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)**

- Existing belt was replaced with new HRT2 grade belt.
- All rollers were replaced by new HPPE polymers rollers.
- Gear box oil was flushed
- 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)**

**OVERHAULING OF PRILL TOWER SCRAPER (M-1402)**

It was observed that abnormal sound was coming from scrapper during plant operation.

It was decided to overhaul the scrapper during the annual shutdown -2017.

Following activities were carried out:

**Dismantling of Scrapper**

- Removed Aluminum sheet above scraper.
- Shifted lifting rack inside Prill tower and installed the same.
- Using rack, lifting beam, 2 nos. Mono rail (3 T Capacity) and 2 nos. Chain blocks
- (5 T) were erected above scraper.
- Measured and noted down the gap between floor and bottom of scraper..
- Measured and noted down the gap between scraper end and wall
- Measured and noted down clearance between scraper blades and floor

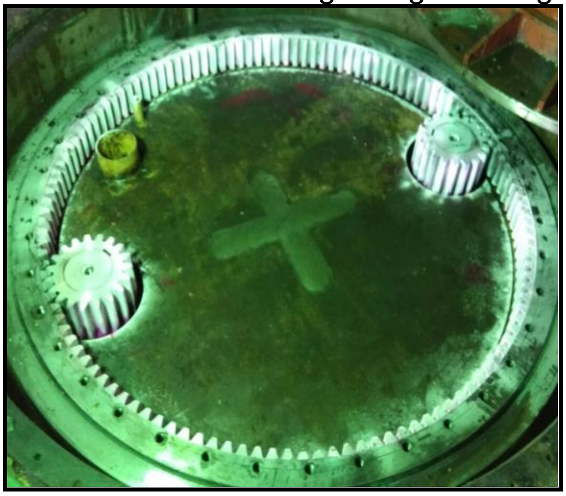
- Marked the position of scraper before dismantling. Scraper arms were to be assembled at the same position.
- Opened the bolts of both side scraper arms and kept the scraper arms crosswise by lifting arrangement.
- Removed the ring clamp (in 2 pieces) by opening bolt.
- Removed the Neoprene band, checked the fitting position & measured the height.
- Opened bolt and nut of split ring.
- Removed the reamed bolt – 4 Nos. of flange and marked the position.
- The surface above split cover was covered with araldite. Araldite was removed to access the counter sunk bolts of split cover.
- Opened the counter sunk bolts ( M 12 X 25 mm lg ) from split cover (split cover is in two half)
- Split cover was removed after lifting split ring (#76) by pin.
- Split ring was removed.
- Opened top bolt between scraper and Gear wheel (M-24 x 70 mm long -40Nos.)
- Lifted scrapper & shifted side ways using monorail.
- Measured and noted down clearance between gear wheel and bottom plate.
- Skew bearing and pinion teeth were checked by DP Test and found ok.
- Checked and noted down backlash between gear and gear wheel.
- Seating surface of gear wheel was cleaned.

**Assembly of Scrapper Arm**

- Scraper arms were assembled at the same position at which it was dismantled.
- Hylomer was applied on seating surface of gear wheel.
- Bolts were fastened after applying Loctite. While fastening the bolts scraper arm was turned to check the smooth running of the arm.
- Installed the split ring.
- Installed split cover with packing on horizontal face and hylomer between vertical flanges.
- Bolts and countersunk bolts were provided and tightened.
- Split ring was lowered and bolts were fastened.
- Neoprene band was provided and its end was joined by cold Rubber compound and ring-clamp was fitted.
- Scraper end parts were installed and bottom and side gap were measured
- Checked scraper blades clearance between scraper blades and floor and found ok.
- Connected air supply to labyrinth
- Scraper was run for approx. 2 hrs. for checking oil tightness of flanges, temperature of gear boxes and couplings etc. Found OK

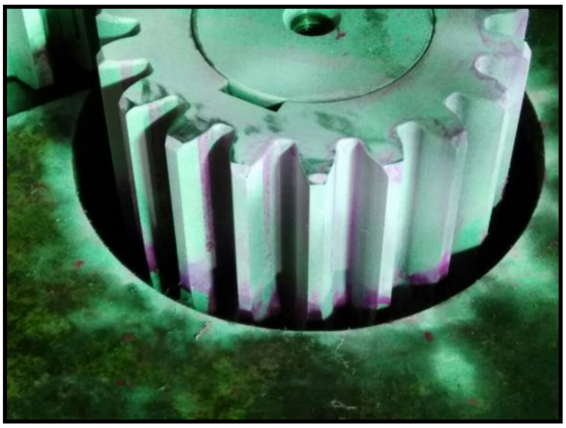
- Stanvac make anti-adhesive coating was applied on scrapper arms instead of aluminum sheets.

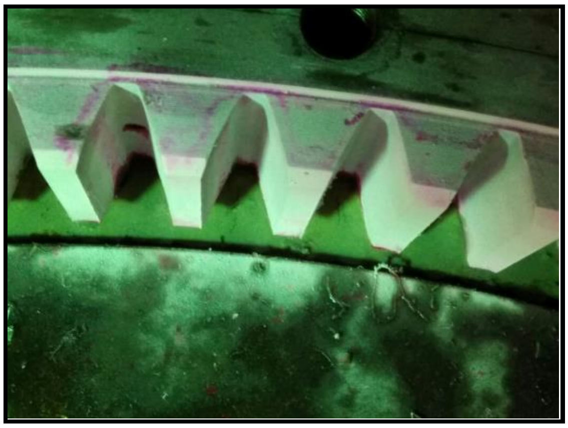
  Pictures of skew bearing and gear are given below:



**Skew bearing mesh with gear**

**Skew bearing teeth**





**Dye penetration test of gear teeth**

## Fluid Coupling

- Both Fluid coupling (Hydroflow make) were replaced by spare one.
- Belts were replaced by new one.
- Alignment of motor and coupling was done.

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

- GB foundation bolts were checked and found ok.
- Oil flushed.

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

## K-1401-1/2/3/4

- Both bearing were checked and found ok.
- Greasing of both bearing was done
- Alignment of motor and fan pulley was corrected.
- The blades angle of all fan were increased from 11 degree to 13 degree as per production requirement for more air flow.

## Replacement of off Gas line RV-1201 A/B

There are total 3 relief valve in off gas line RV-1201 A/B/C. It was decided to check all three relief valves make Tyco Sanmar in annual shutdown for smooth running of plant throughout the year.

All three relief valve which were taken out were found that HVD1 nozzle were cracked.

Later on, It was decided to installed Relief Valve with SS 316L nozzle with new high capacity spring.

## RELIEF VALVE OVERHAULING AND TESTING

Overhauling and testing of RV's were carried out through M/s Flotec Technosmart (India) Private Limited, Surat. Testing of RVs was done on test bench at Urea mechanical works.

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

| Sr. No. | RV No. | Equipment Details | Set Press. (Kg/cm2g) | Reset Press. (Kg/cm2g) |
|---|---|---|---|---|
| 1 | RV-1201 A | V-1201 off gas line | 165 | 150 |
| 2 | RV-1201 B | V-1201 off gas line | 165 | 150 |
| 3 | RV-1201 C | V-1201 off gas line | 165 | 148 |
| 4 | RV-1205 | P-1201 A discharge | 165 | 148 |
| 5 | RV-1206 | P-1201 B discharge | 165 | 148 |
| 6 | RV-1208 | P-1201 C discharge | 165 | 148 |
| 7 | RV-1103 A | P-1102 A discharge | 150 | 135 |
| 8 | RV-1103 B | P-1102 B discharge | 150 | 135 |
| 9 | RV-1103 C | P-1102 C discharge | 150 | 135 |
| 10 | RV-1181 | K-1801 final discharge | 177 | 159 |
| 11 | RV-1903 | K-1801 IIIrd stage discharge | 111 | 100 |
| 12 | RV-1202A | V-1202 off gas line LP System | 6 | 5.5 |
| 13 | RV-1202B | V-1202 off gas line LP System | 5.7 | 5.2 |
| 14 | RV-1202C | V-1202 off gas line LP System | 6 | 5.5 |
| 15 | RV-1203 | P-1201 A Suction line | 8.5 | 7.5 |
| 16 | PSV-1201A | P-1201 A Suction line | 8.5 | 7.5 |
| 17 | PSV-1201B | P-1201 B Suction line | 8.5 | 7.5 |
| 18 | PSV-1201C | P-1201 C Suction line | 8.5 | 7.5 |
| 19 | RV-1101A | Liquid ammonia line from H-1102 to V-1102 | 31 | 29 |
| 20 | RV-1101B | Liquid ammonia line from H-1102 to V-1102 | 31 | 29 |
| 21 | RV-1102 A | Ammonia suc. Vessel (V-1103 ) | 31 | 29 |
| 22 | RV-1102 B | Ammonia suc. Vessel (V-1103 ) | 31 | 29 |
| 23 | RV-1108 A | Cold ammonia line from Amm storage tank to H1102 | 31 | 29 |
| 24 | RV-1108 B | Cold ammonia line from Amm storage tank to H1102 | 31 | 29 |
| 25 | RV-1106 A | Liquid amm, line from amm. Plant to amm. filter. | 31 | 29 |
| 26 | RV-1106 B | Liquid amm, line from amm. Plant to amm. filter. | 31 | 29 |

| Sr. | RV No. | Equipment Details | Set | Reset |
|---|---|---|---|---|
| 27 | RV-1107 A | Liquid ammonia line (hot) before ammonia filter | 31 | 29 |
| 28 | RV-1107 B | Liquid ammonia line (hot) before ammonia filter | 31 | 29 |
| 29 | RV-1110 A | Liquid ammonia line from atm. Amm. storage tank to H-1102 | 31 | 28 |
| 30 | RV-1110 B | Liquid ammonia line from atm. Amm. storage tank to H-1102 | 31 | 28 |
| 31 | RV-1901 | Ist stage discharge of K-1801. | 7 | 6.7 |
| 32 | RV-1902 | IInd stage discharge of K-1801 | 27 | 25.1 |
| 33 | RV-1503 | 23 ata Steam | 25 | 23.8 |
| 34 | RV-1504 | 9 ata Steam Drum | 12 | 11 |
| 35 | RV-1129 A | 4 ata Steam Header | 6 | 5.4 |
| 36 | RV-1129 B | 4 ata Steam Header | 6 | 5.4 |
| 37 | RV-1501 A | 4 ata Steam Drum | 7.5 | 6.8 |
| 38 | RV-1501 B | 4 ata Steam Drum | 7.5 | 6.6 |
| 39 | RV-1506 | 4 ata Steam Main | 6 | 5.4 |
| 40 | RV-1209 | V-1203 Vessel | 10 | 9 |
| 41 | RV-1351 | RV of V-1351 | 24 | 23 |
| 42 | RV-1352 | RV of V-1352 | 6 | 5.4 |
| 43 | RV-1301 | RV of V-1301 | 6 | 5.9 |
| 44 | RV-1184 (CCS-I) | H-1102 outlet NH3 outlet | 6 | 5.5 |
| 45 | RV-1221 (CCS-II) | P-1204 disch. To H-1203 | 16.5 | 15 |
| 46 | RV-1913 | Ejector system of Q-1801 | 0.2 | 0.2 |
| 47 | RV-1914 | Ejector system of Q-1801 | 0.2 | 0.2 |
| 48 | RV-1916 | 23 ata Steam extraction | 28 | 26 |
| 49 | RV-1917 | 4 ata Steam exhaust | 4 | 3.6 |
| 50 | RV-1351 A | RV of P-1351 A | 10 | 9 |
| 51 | RV-1351 B | RV of P-1351 B | 10 | 9 |
| 52 | RV-1130 | 24 ata steam header | 26 | 22.5 |
| 53 | RV-1904 | H-1811 First stage gas cooler | 7 | 6 |
| 54 | RV-1905 | H-1812 Second stage gas cooler | 7 | 6 |
| 55 | RV-1906 | H-1813 Third stage gas cooler | 7 | 6 |
| 56 | RV-1224 | C.W from utilities | 6 | 5.4 |
| 57 | RV-NH3 | RV To NH3 Ammonia Plant | 85 | 77 |

**Note**:

**Ammonia pump, P-1102A/B :**

Old relief valves (Lens gasket type) of discharge line were blinded as new RTJ type relief valve were installed in discharge line.

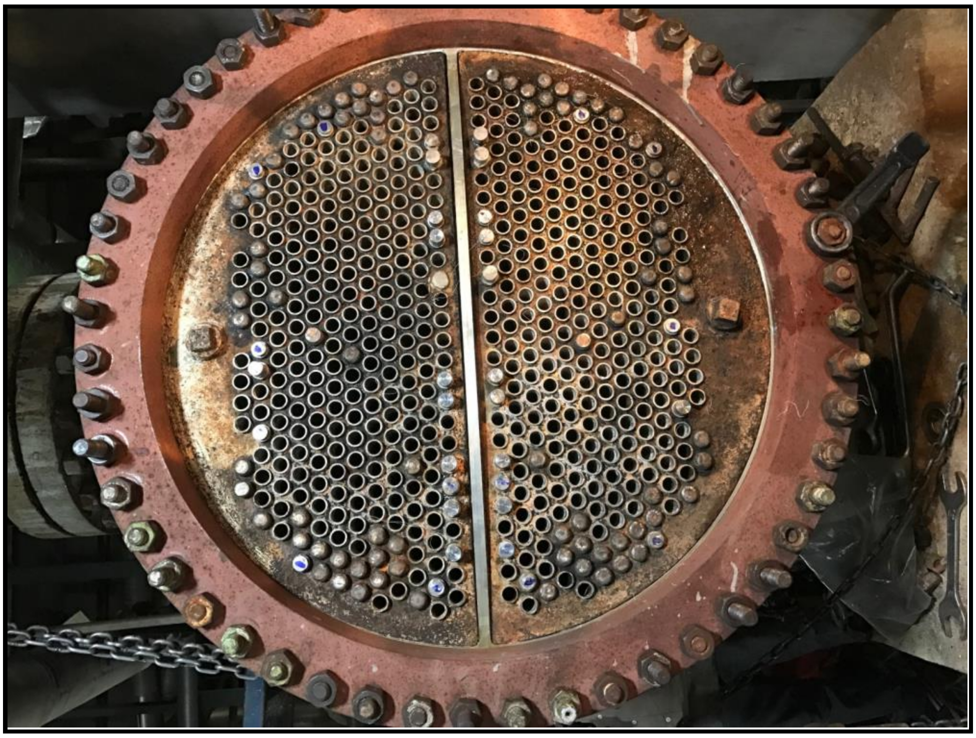
**CLEANING AND HYDROJETTING OF HEAT EXCHANGERS**:

- H-1204 (Recirculation Heater)
- H-1207 (Circulation System - Ii Water Cooler)
- H-1352 (Desorber Reflux Condenser)

- H-1418 (Separator, Pre-Evaporator, Hot Water Part)
- H-1419 (Pre-Evaporator Heat Exchanger)
- H-1424 (Second Stage Evaporator / Condenser)
- H-1425 (Second Stage Evaporator / First Condenser)
- H-1426 (Second Stage Evaporator / Second Condenser)
- H-1814 A/B (Lube Oil Cooler Hitachi Compressor Train)
- H-1815 (Surface Condenser For Hitachi Compressor Turbine)
- Lo Coolers Of P-1102 A/B/C
- Lo Coolers Of P-1201 A/B
- H-1811 - Tube Bundle Removal
- H-1420 (Final Condenser)
- H-1421 (Flash Tank Condenser)
- H-1422 (First Stage Evaporator / Separator)
- H-1423 (First Stage Evaporator / Condenser)
- H-1204 (Recirculation heater)
- H-1427(Circulation cooler for V-1423)
- H-1208 (Ammonia water cooler)
- H-1209
- H-1812
- H-1813

Plugging of tubes of H-1207.

Approx. 60 Numbers of tubes were plugged in H-1207 due to tube leak.



## P-1201/C, Ammonia Pump , Peroni make:

Pump was shifted to new location beneath the ammonia Preheater, H-1250 during the annual shutdown - 2017.

New foundation was made by Civil section and leveling done.

New piping were installed wherever required.

## H-1250, Ammonia Preheater:

New equipment was erected and commissioned by M/s Onshore under ESP-III to preheat the ammonia.

| | HEAT EXCHANGER DATA SHEET | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Service of Unit | Ammonia Pre-heater | | | Item No | 1 | E-101 |
| 2 | Size | (5) 795 x 4000 mm | | Type D E U | Vertical | Connected In | Parallel Series |
| 3 | Surf/Unit(Eff) | (1) 179.5 m2 | | Shell/Unit 1 | | Surf/Shell(Eff) | (1) 179.5 m2 |
| 4 | PERFORMANCE OF ONE UNIT - OPERATING CASE EOR | | | | | | |
| 5 | Fluid Allocation | | | Shell Side | | Tube Side | |
| 6 | Fluid Name | | | CO2, NH3, H2O | | Ammonia | |
| 7 | Fluid Quantity, Total | | kg/h | 23267 | | 67185 | |
| 8 | Total Vapor (In/Out) | | kg/h | 11870 | 2990 | | |
| 9 | Total Liquid | | kg/h | 11397 | 20277 | 67185 | 67185 |
| 10 | Steam | | kg/h | | | | |
| 11 | Water | | kg/h | | | | |
| 12 | Noncondensable | | kg/h | | | | |
| 13 | Temperature (In/Out) | | °C | 109.2 | 67.59 | 18.3 | 75.0 |
| 14 | Density | Vapor | kg/m3 | | | Use Ammonia Properties | |
| 15 | | Liquid | kg/m3 | | | | |
| 16 | Molecular Weight | Vapor | g/mol | | | | |
| 17 | | Nonconden. | g/mol | | | | |
| 18 | Specific Heat | Vapor | kcal/kg K | | | | |
| 19 | | Liquid | kcal/kg K | | | | |
| 20 | Thermal Conductivity | Vapor | W/m K | | | | |
| 21 | | Liquid | W/m K | | | | |
| 22 | Viscosity | Vapor | mPa s | | | | |
| 23 | | Liquid | mPa s | | | | |
| 24 | Latent Heat | | kcal/Kg | | | | |
| 25 | Inlet Pressure | | kg/cm2g | 4.4 | | 234 | |
| 26 | Velocity | | m/s | | | | |
| 27 | Pressure Drop, Allow/Calc | (4) | kg/cm2 | 0.2 | 0.18 | 0.3 | 0.126 |
| 28 | Fouling Resistance (min) | | m2 h °C/kcal | 0.0001 | | 0.0001 | |
| 29 | Heat Exchanged | | Gcal/h | 4.639 | | MTD (Corrected) | 32.1 °C |
| 30 | Transfer Rate, Service | | kcal/h-m2-°C | 805.72 | Clean | Actual | |
| 31 | CONSTRUCTION OF ONE SHELL | | | Shell Side | Tube Side | Sketch (Bundle/Nozzle Orientation) | |
| 32 | Design/Test Pressure | | kg/cm2g | 10 & FV / CODE | 270 / CODE | FOR EXCHANGER DWGS. SEE SHEETS 4-5 | |
| 33 | Design Temperature | | °C | 160 / -1.5 (7) | 130 / -33 (8) | | |
| 34 | No Passes per Shell | | | 1 | 4 | | |
| 35 | Corrosion Allowance | | mm | 0.0 | 0.0 | | |
| 36 | Connections Size and Rating | In | | FOR NOZZLES DETAIL SEE SHEET 5 | | | |
| 37 | | Out | | | | | |
| 38 | | Intermed. | | | | | |
| 39 | Tube No (5)(6) 398 U | OD 19.05 mm | THK 2.108 mm | Length 4 m | | Pitch 23.8 mm | Layout 30° |
| 40 | Tube Type | Seamless | | Material | | (3) | AISI 316L |
| 41 | Shell (3) AISI 316L | ID 795 mm | THK (2) mm | Shell Cover | | (3) | AISI 316L |
| 42 | Channel or Bonnet | (3) | AISI 316L | Channel Cover | | (3) | C.S. |
| 43 | Tubesheet-Stationary | (3) | AISI 316L | Tubesheet-Float. | | (3) | AISI 316L |
| 44 | Floating Head Cover | | | ImpingementPlate | | | None |
| 45 | Baffles-Cross 11 | Type Double Segmental | %Cut(Diam) 26.9 (9) | Spacing(c/c) 274.6 mm | | Inlet 650 mm | |

## H-1424, 2nd Stage Evaporator:

New equipment was installed in place of old equipments by M/s Onshore.

| | HEAT EXCHANGER DATA SHEET | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Service of Unit | 2nd Stage Evaporator | | Item No | 1 | H-1424 | |
| 2 | Size (1) 1060 x 2000 mm | Type B E M Vertical | | Connected In | | Parallel | Series |
| 3 | Surf/Unit(Eff) (2) 296.8 m2 | Shell/Unit 1 | | Surf/Shell(Eff) | (2) | 296.8 | m2 |
| 4 | PERFORMANCE OF ONE UNIT - OPERATING CASE EOR | | | | | | |
| 5 | Fluid Allocation | | | Shell Side | | Tube Side | |
| 6 | Fluid Name | | | Steam and Steam Condensate | | Urea melt | |
| 7 | Fluid Quantity, Total | | kg/h | 4600.0 | | 77931.1 | |
| 8 | Total Vapor (In/Out) | | kg/h | | | | 3069.5 |
| 9 | Total Liquid | | kg/h | | | 77931.1 | 74861.6 |
| 10 | Steam | | kg/h | 4600.0 | | | |
| 11 | Water | | kg/h | | 4600 | | |
| 12 | Noncondensable | | kg/h | | | | |
| 13 | Temperature (In/Out) | | °C | 150.0 | 144.7 | 128.0 | 138.0 |
| 14 | Density | Vapor | kg/m3 | 2.17 | | - | 0.02 |
| 15 | | Liquid | kg/m3 | | 921.9 | 1204.6 | 1220.5 |
| 16 | Molecular Weight | Vapor | g/mol | 18.0 | | - | 20.0 |
| 17 | | Nonconden. | g/mol | | | | |
| 18 | Specific Heat | Vapor | kcal/kg K | 0.535 | | | |
| 19 | | Liquid | kcal/kg K | | 1.026 | | |
| 20 | Thermal Conductivity | Vapor | W/m K | 0.032 | | | |
| 21 | | Liquid | W/m K | | 0.683 | | |
| 22 | Viscosity | Vapor | mPa s | 0.014 | | - | 1.38E-02 |
| 23 | | Liquid | mPa s | | 1.90E-01 | 2.110 | 2.230 |
| 24 | Latent Heat | | kcal/Kg | | | | |
| 25 | Inlet Pressure | | kg/cm2g | 3.2 | | -0.7 | |
| 26 | Velocity | | m/s | | | | |
| 27 | Pressure Drop, Allow/Calc | | kg/cm2 | | 0.02 | | |
| 28 | Fouling Resistance (min) | | m2 h °C/kcal | 0.0001 | | 0.0001 | |
| 29 | Heat Exchanged | | Gcal/h | 2.2 | | MTD (Corrected) 13.3 | °C |
| 30 | Transfer Rate, Service | | kcal/h-m2-°C | | Clean | Actual | 557.3 |
| 31 | CONSTRUCTION OF ONE SHELL | | | Shell Side | Tube Side | Sketch (Bundle/Nozzle Orientation) | |
| 32 | Design/Test Pressure | | kg/cm2g | 6.5 & FV / CODE | 2 & FV / CODE | | |
| 33 | Design Temperature | | °C | 165 / (3) | 165 / (3) | | |
| 34 | No Passes per Shell | | | 1 | 1 | | |
| 35 | Corrosion Allowance | | mm | 3.0 (4) | 0.0 | FOR EXCHANGER DWG. SEE SHEET 5 | |
| 36 | Connections Size and Rating | In | | FOR NOZZLES DETAIL SEE SHEET 4 | | | |
| 37 | | Out | | | | | |
| 38 | | Intermed. | | | | | |
| 39 | Tube No 3719 | OD 12.7 mm | THK 1.25 (5) mm | Length 2000 (6) m | | Pitch 15.875 mm | Layout 60° |
| 40 | Tube Type | Seamless | | Material | (9) | AISI 304L | |
| 41 | Shell (7) C.S. | ID 1060 mm | THK (1) mm | Shell Cover | | | |
| 42 | Channel or Bonnet | - | | Channel Cover | | | |
| 43 | Tubesheet-Stationary (9) | AISI 304L | | Tubesheet-Float. | | | |

**H-1150, $CO_2$ Cooler**

New equipment was installed for cooling of $CO_2$ by M/s Onshore, under ESP-III.

**LIST OF NRV List**

| Sr. NO | DESCRIPTION | LOCATION | TAG NO | REMARKS | STATUS |
|---|---|---|---|---|---|
| 1 | CO2 comp. 3rd suction | hitachi | 190 | NRV 8"X300# (Insulated valve) | Completed |
| 2 | CO2 Comp. final dis. Line | Nr. sump | 189 | NRV (Insulated) Serviced | |
| 3 | 23 ata extraction line | comp. deck floor | 186 | NRV (Insulated) Serviced | Completed |
| 4 | CO2 to Stripper Nr MOV-1201 | GF | 24 | 6"BEL valve type NRV Serviced | Completed |
| 5 | CO2 to H-1203 | 6 th floor | 169 | 1/2"Bel valve replaced | Completed |
| 6 | P-1201 A/B/C carbamate common dis. Line to H-1203 | 6 th floor | 171 | Serviced | Completed |
| 7 | Ammonia to HP condenser | 3.5 floor | 146 | Serviced | Completed |
| 8 | carbamate to HP condenser | 3.5 floor | 147 | Serviced (Due to carbamate valve insulation not opened) | Completed |
| 9 | P-1202 A/B dis. | GF | 14 & 15 | 14 & 15 - 12"x 150# WCB swing check valve passing, Serviced done | Completed |
| 10 | P-1204 A/B dis. | GF | 27 & 28 | 8"x300# NRV Serviced done, Condensate 12 Kg/cm2 | Completed |
| 11 | P-1210 A/B dis. Not holding | 1st floor | 81 & 82 | 81 & 82 both- 6"x150# CF3 NRV swing check valve passing not closing, valves replaced | Completed |
| 12 | Ammonia to Autoclave (PIC-1201 D/S) | 3rd floor | 131 | | Completed |
| 13 | P-1302 A/B/C/D dis. | GF | 16,17, 18,19 | 3"x 150# Swing check valve NRV serviced | Completed |
| 14 | P-1351 A/B dis. And its Leak up line NRV also | GF | 20 & 21 | 100mm x 300# NRV serviced, Amonical water 13kg/cm2 | Completed |
| 15 | P-1352 A/B dis. And its suct. Cond. Flushing line NRV also | GF | 22 & 23 | 2"x 150# NRV serviced, Lean carbamate 13kg/cm2 | Completed |
| 16 | Melt Return line in bucket room | 6th floor | 162 | Sandwitch NRV serviced | Completed |
| 17 | 4 ata steam to H-1352 | hyd. | 26 | 6"x150# Swing Check valve serviced | Completed |
| 18 | 23 ata to V-1351 | GF | 25 | 3"x300# Valve serviced | Completed |
| 19 | 23 ata injection to LT-1351 Level troll (Hydrolyser Section) | V-1351 Top | 29 | NRV serviced | Completed |
| 20 | 2nd Evaporator (H-1424) dome in steam flushing line NRV (new) to be provided to avoid cond. Back flow in steam line | 3rd floor | 197 | Fabrication Job - New NRV provided, line modified (4ataSteam Line) | Completed |

## LIST OF PROCESS JOB:

| Sr. No. | Description of Isolation valves | Line Size | QTY. | Location | Tag No. | Description | Media | Status |
|---|---|---|---|---|---|---|---|---|
| **A-Ammonia System:** | | | | | | | | |
| 1 | Cold ammonia supply in U/S of H-1102 | 6" | 2 | 1st floor | 51 & 52 | 51 - 6"x 300 # Ball Valve & 52 - 6"x 300 # Globe Valve | Liq. NH3 | Completed |
| 2 | Inter connection valve between Hot Ammonia and Cold Ammonia header in U/S of H-1102 | 4" | 2 | 1st floor | 53 & 54 | 53 - 4"x 300 # Gate Valve & 54 - 4"x 300 # Gate Valve | Liq. NH3 18 to 20 Kg/Cm2 | Completed |
| 3 | Isolation Valve in Cold Ammonia line in D/S of H-1102 | 6" | 1 | 1st floor | 55 | 6"x 300 # gate Valve | Liq. NH3 18 to 20 Kg/Cm2 | Completed |
| 4 | Hot Ammonia inlet I/V(D/S of MOV-1101) in Battery limit | 4" | 1 | 1st floor | 56 | 4"x 300 # Globe Valve Welded joint | Liq. NH3 18 to 20 Kg/Cm2 | Completed |
| 5 | 6" isolation valve in U/S Of V-1102 | 6" | 2 | 1st floor | 57 & 58 | 57 - 6"x 300 # Gate Valve Welded Joint & 58 - 6"x 300 # Gate Valve | Liq. NH3 18 to 20 Kg/Cm2 | Completed |
| 6 | U/S I/V of FS-1101A | 4" | 2 | 1st floor | 59 & 60 | 59 - 6"x 300 # Gate Valve & 60 - 6"x 300 # Gate Valve | Liq. NH3 18 to 20 Kg/Cm2 | Completed |
| 7 | D/S I/V of FS-1101A | 4" | 2 | 1st floor | 61 & 62 | 61 - 6"x 300 # Gate Valve & 62 - 6"x 300 # Gate Valve Welded Joint | Liq. NH3 18 to 20 Kg/Cm2 | Completed |
| 8 | Bypass I/V of FS-1101 | 4" | 2 | 1st floor | 63 & 64 | 63 - 6"x 300 # Gate Valve Flanged Joint & 64 - 6"x 300 # Gate Valve Welded Joint | Liq. NH3 18 to 20 Kg/Cm2 | Completed |

| Sr. No. | Description of Isolation valves | Line Size | QTY. | Location | Tag No. | Description | Media | Status |
|---|---|---|---|---|---|---|---|---|
| 9 | I/V in U/S of MOV-1202 | 4" | 1 | 3.5 Floor | 149 | 4" Valve welded joint (Special Type V/v) Welded Joint | NH3 150 Kg/cm2 | Completed |
| 10 | I/V in D/S of PIC-1201 | 3" | 1 | 3rd Floor | 138 | 3"BEL V/v Hard to operate | | Completed |
| 11 | P-1102A suction I/V | 6" | 2 | G' Floor | 43 & 44 | 43 - 6"x 300 # Gate Valve WCB & 44 - 6"x 300 # Gate Valve WCB | NH3 16 Kg/cm2 | Completed |
| 12 | P-1102A Discharge I/V | 4" | 2 | G' Floor | 37 & 38 | 37 - 4"x 900 # Globe Valve & 38 - 4"x 900 # Globe Valve | NH3 150 Kg/cm2 | Completed |
| 13 | P-1102A Recycle I/V | 4" | 2 | G' Floor | 35 & 36 | 35 - 4"x 900 # Globe Valve & 36 - 4"x 900 # Globe Valve | NH3 150 Kg/cm2 | Completed |
| 14 | P-1102B suction 1st I/V | 6" | 1 | G' Floor | 39 | 6"x 300 # Gate Valve WCB | NH3 16 Kg/cm2 | Completed |
| 15 | P-1102B Discharge I/V | 4" | 2 | G' Floor | 40 | 4"x 1500 # Globe Valve | NH3 150 Kg/cm2 | Completed |
| 16 | P-1102B Recycle I/V | 4" | 2 | G' Floor | 41 & 42 | 41 - 4"x 900 # Globe Valve & 42 - 4"x 900 # Globe Valve | NH3 150 Kg/cm2 | Completed |
| 17 | P-1102C suction I/V | 6" | 2 | G' Floor | 33 & 34 | 33 - 6"x 300 # Gate Valve WCB & 34 - 6"x 300 # Gate Valve WCB | NH3 16 Kg/cm2 | Completed |
| 18 | P-1102C Discharge I/V | 4" | 2 | G' Floor | 9 & 30 | 30 - 4"x 900 # Globe Valve | NH3 150 Kg/cm2 | Completed |
| 19 | P-1102C Recycle I/V | 4" | 2 | G' Floor | 31 & 32 | 31 - 4"x 900 # Globe Valve & 32 - 4"x 1500 # Globe Valve | NH3 150 Kg/cm2 | Completed |
| 20 | H-1102 Out let I/V hard to operate | 6" | 1 | 1st floor | 55 | 6"x 300 # gate Valve | Liq. NH3 18 to 20 Kg/Cm2 | Completed |

| Sr. No. | Description of Isolation valves | Line Size | QTY. | Location | Tag No. | Description | Media | Status |
|---|---|---|---|---|---|---|---|---|
| **B-Carbamate System:** | | | | | | | | |
| 1 | P-1201A Suction I/V | 4" | 1 | 1st Floor | 65 | DN 100 x 150 # Gate Valve | Carbamate 3 to 4 Kg/cm2 | Completed |
| 2 | P-1201A Discharge I/V | 3" | 2 | 1st Floor | 66 & 67 | 66 - 3"BEL valve & 67 - BEL valve | Carbamate 150 Kg/cm2 | Completed |
| 3 | P-1201A Recycle I/V | 2" | 1 | 1st Floor | 68 | 2"BEL valve | Carbamate 150 Kg/cm2 | Completed |
| 4 | P-1201B Suction I/V | 4" | 1 | 1st Floor | 69 | DN 100 x 150 # Gate Valve | Carbamate 3 to 4 Kg/cm2 | Completed |
| 5 | P-1201B Discharge I/V | 3" | 2 | 1st Floor | 70 & 71 | 70 - 3"BEL valve & 71 - BEL valve | Carbamate 150 Kg/cm2 | Completed |
| 6 | P-1201B Recycle I/V | 2" | 1 | 1st Floor | 72 | 2"BEL valve | Carbamate 150 Kg/cm2 | Completed |
| 7 | P-1201C Suction I/V | 4" | 1 | 1st Floor | 73 | 4 x 150 # Gate Valve | Carbamate 3 to 4 Kg/cm2 | Completed |
| 8 | P-1201C Discharge I/V | 3" | 2 | 1st Floor | 74 & 75 | 74 - 3"BEL valve & 75 - BEL valve to be replace bcz Stem Welding done | Carbamate 150 Kg/cm2 | Completed |
| 9 | P-1201C Recycle I/V | 2" | 1 | 1st Floor | 76 | 2"BEL valve to be replace bcz of no margine for pressurising | Carbamate 150 Kg/cm2 | Completed |
| 10 | Common Recycle I/V near H-1205 | 2" | 1 | 2nd Floor | 114 | 2"BEL valve | Carbamate 150 Kg/cm2 | Completed |
| 11 | FIC-1204 U/S I/V | 3" | 1 | 3.5 Floor | 148 | 3"BEL Valve | | Completed |
| 12 | Common Suction I/V near V-1205 | 4" | 1 | 3rd Floor | 151 | 4"x150# Gate valve | Carbamate 3 to 3.5 kg/cm2 | Completed |
| **C- HP/LP System** | | | | | | | | |
| 1 | LRCV-1201 U/S I/V | 6" | 2 | G' Floor | 45 | 6"BEL valve | | Completed |
| 2 | MOV-1201 d/S I/V in CO2 line | 6" | 1 | G' Floor | 46 | 6"BEL valve | | Completed |
| 3 | HICV-1202 U/S I/V | 4" | 1 | PT Top | 174 | | | Completed |
| 4 | PRCV-1201 U/S I/V | 4" | 1 | PT Top | 175 | | | Completed |
| 5 | V-1201 Unloading both I/V | 2" | 2 | GF & 3rd | GF 47 & 3rd 136 | 47 - 2"BEL valve & 136 - 2"BEL Valve | | Completed |

| Sr. No. | Description of Isolation valves | Line Size | QTY. | Location | Tag No. | Description | Media | Status |
|---|---|---|---|---|---|---|---|---|
| 6 | V-1201 over flow lineseal fill up both I/V | 3" | 2 | 3rd floor | 137 & 130 | 137 - 3"x 1500# Globe Valve & 130 - 2 1/2"BEL Valve Bonnet leak to be replace | | Completed |
| 7 | FIC-1204 U/S I/V | 4" | 1 | 3 1/2 floor | 148 | 3"BEL valve | | Completed |
| 8 | PIC-1201 D/S 2nd I/V hard to operate | 3" | 1 | 3rd floor | 138 | 3"BEL valve Hard to oeparate / Bonnet to be change | | Completed |
| 9 | V-1201 Passivation both I/V | 3" | 2 | 3rd floor | 139 | 2"BEL valve | | Completed |
| 10 | H-1201 sample point both I/V | 1" | 2 | G.floor | 7 & 8 | 1/2"BEL valve Welded Joint / Both valve passing | | Completed |
| 11 | CO2 to H-1203 U/S of FIC-1202 | 1" | 2 | PT Top | 172/173 | | | Completed |
| 12 | LRC-1201 U/S 1st I/V | 8" | 1 | G floor | 48 | 6"BEL Valve | | Completed |
| 13 | MOV-1201 D/S I/V not full closed | 6" | 1 | G floor | 46 | 6"BEL valve (Repeat As per Sr. No. 2) | | Completed |
| 14 | P-1351B dis. I/V bottom flange leak | 4" | 1 | G floor | 21 | P-1351 A - Dis. NRV 100mm x 300# | Ammonical Water 13 Kg/cm2 | Completed |
| 15 | P-1305 dis. I/V bush broken | 2" | 1 | G floor | | JOB DONE | | Completed |
| 16 | P-1302 D dis. Bypass of H-1208 bush brkn | 3 | 1 | G floor | 49 | DN80x150# Gate valve to be replace (Yoke Bush broken) | | Completed |
| 17 | P-1302C dis. Interconnection I/V is hard to operate | | 1 | G floor | 50 | DN80x150# Globe valve to be replace (Hard to Operate) | | Completed |
| 18 | P-1210A suction/dis. I/V | 6"/3" | 2 | 1st floor | 94, 95, 96, 97 | 94,96,97 - 6"x150# gate valve Servicing, 95- Bonnet gasket leak | | Completed |

| Sr. No. | Description of Isolation valves | Line Size | QTY. | Location | Tag No. | Description | Media | Status |
|---|---|---|---|---|---|---|---|---|
| 19 | P-1401A/B suction I/V hard to operate | 3" | 2 | G floor | 102, 103, 104, 105 | 6"x150# V/v (Urea Line so insulation not openned due to choking prob) | | Completed |
| **D- Cooling water Line** | | | | | | | | |
| 1 | H-1419 inlet and outlet I/V | 18" | 2 | 2nd Floor | 115 & 116 | 18"x 125# Gear operated gate valve (Service water line) | | Completed |
| 2 | H-1421 inlet I/V | 12" | 1 | 3rd Floor | | | | Completed |
| 3 | H-1427 Inlet and Outlet I/V | 6" | 2 | 1st Floor | 98 & 99 | 6"x 150# Gate valve (Service water line) | | Completed |
| 4 | H-1208 Inlet and Outlet I/V | 6" | 2 | 1st Floor | 100 & 101 | 6"x 150# Gate valve | | Completed |
| 5 | H-1207 in & Outlet I/V | 10" | 2 | 2nd Floor | 117 & 118 | 10"x150# butterfly valve gear operated | | Completed |
| 6 | H-1209 In & Out I/V | 6" | 2 | 2nd Floor | 119 & 120 | 6"x 150# Gate valve (Service water line) | | Completed |
| 7 | H-1352 O/L I/V hard to operate | 10" | 1 | hydrolyser | 178 | 10"x150# gate valve hard to operate (Water line) | | Completed |
| 8 | CW Interconnection between old and New in comp. area | | 1 | Ground floor | | | | Completed |
| **E- Steam System** | | | | | | | | |
| 1 | 60 ata main battery I/V | 8" | 1 | G' Floor | 188 | Insulated Line valve size to be confirm after opening | | Completed |
| 2 | PIC-1129 U/S & D/S I/V | 12" | 2 | G' Floor | 192 & 193 | Insulated Line valve size to be confirm after opening | | Completed |

| Sr. No. | Description of Isolation valves | Line Size | QTY. | Location | Tag No. | Description | Media | Status |
|---|---|---|---|---|---|---|---|---|
| 3 | PIC-1129 bypass I/V | 12" | 1 | G' Floor | 194 | Insulated Line valve size to be confirm after opening | | Completed |
| 4 | PRCV-1504 U/S I/V (23 ata) | 12" | 1 | G' Floor | 195 | Insulated Line valve size to be confirm after opening | | Completed |
| 5 | LIC-1502A D/S I/V (cond) | 4" | 1 | 4th Floor | 152 | 4"Globe valve | | Completed |
| 6 | LIC-1501 D/S I/V near V-1501(con) | 3" | 1 | 4th Floor | 214 | | | Completed |
| 7 | TRC-1421 U/S I/V | 10" | 1 | 3rd' Floor | 140 | 10"Valve | | Completed |
| 8 | TRC-1422 U/S I/V | 4" | 1 | 3rd' Floor | 141 | 4"Globe valve | | Completed |
| 9 | FIC-1351U/S I/V(23 ata to V-1351) | 3" | 1 | Hydrolyzer | 177 | 3"x150# Globe Valve (Hard to oeparate) Steam 23 ATA | | Completed |
| 10 | FIC-1302U/S I/V(4 ata to V-1301) | 10" | 1 | 2nd Floor | 196 | Insulated Line valve size to be confirm after opening | | Completed |
| 11 | TIC-1201 U/S I/V (4 ata) | 8" | 1 | 2nd Floor | 121 | 8"Valve | | Completed |
| 12 | 9 ata passivation I/V passing | 3" | 1 | 3rd' Floor | 142 | 2"x150# Gate valve (9ATA Steam) | | Completed |
| 13 | 4 ata steam to V-1202 off gas | 4" | 2 | 3 rd Floor | 143 | 4" Globe valve | | Completed |
| 14 | P-1202B dis. Drain 1st I/V hard to opera | 1" | 1 | G' Floor | 106 | 1"x 800# Globe valve (Condensate Line) | | Completed |
| **CO2 Sysytem** | | | | | | | | |
| 1 | MOV 1501 | 4 ata | 1 | 4th floor | 153 | 12"x150# Valve Steam 4ATA MOV 1501 | | Completed |
| 2 | MOV 1202 | ammonia | 1 | 3.5 floor | | | | Completed |
| 3 | MOV-1203 | carbamate | 1 | 3.5 floor | | | | Completed |

| Sr. No. | Description of Isolation valves | Line Size | QTY. | Location | Tag No. | Description | Media | Status |
|---|---|---|---|---|---|---|---|---|
| 4 | MOV-1101 hot amm. Inlet | Hot ammonia | 1 | 1st floor | 108 | 4"x 300# Gate Valve (MOV-1101) | | Completed |
| 5 | MOV-1102 pumps common suct. | Ammonia | 1 | G. Floor | 107 | 6"x300#Gate Valve (MOV-1102) | | Completed |
| 6 | MOV-1201, MOV-1801, 23 ata Extraction MOV, 60 ata to turbine MOV, Co2 to compressor battery limit | CO2 | 2 | comp. deck floor, Ground, over co2 spray cooler sump | 191 | Butterfly valve MOV-1801 | | Completed |

**9 ata & 4ata steam direct injection to process and jacket of process lines in Urea plant**

| Sr. No | JOB DETAILS | LOCATION | TAG NO. | REMARKS | STATUS |
|---|---|---|---|---|---|
| 1 | 4 ata to PRCV-1201 U/S jacket | PT Top | | | |
| 2 | 9 ata to injection to V-1203/1207 off gas and V-1203 level troll | PT Top | 163 & 164 | 1/2"steam line 9 ata fabricated, Pin hole & flange joint leak were attended | Completed |
| 3 | 4 ata injection to HICV-1424 D/S to V-1206 ( crack open), Near V-1206 | 3rd Floor | 150 | 1"x 300# globe valve welded flange valve | Completed |
| 4 | 9 ata to injection to PRCV-1202 U/S ,D/S & HICV-1208 D/S off gas through Orifice | 3rd Floor | 133 & 134 | 133 - 1 1/2"x150# Gate Valve leakage, valve replaced 134 - 1" flange joint Leakage attended, gasket replaced | Completed |
| 5 | 4 ata injection to LIC-1202 Level troll ( isolated on 16/01/2015) | 3rd Floor | 135 | 1/2"line treaded valve flange joint leakage attended, gasket replaced | Completed |
| 6 | 4 ata injection to P-1201A/B/C suction/dis. RV's | 1st Floor | 87, 88, 89, 90, 91 | 87 to 91 - All 1/2" size Steam Trap replaced | Completed |
| 10 | 9 ata injection to V-1353 off gas | Hydrolyzer | 176 | 1/2"NRV welded joint - Fabrication Job | Completed |
| 11 | 23 ata to injection to LIC-1351 Level Troll | Hydrolyzer | 29 | Top NRV serviced | Completed |

## STEAM / CONDENSATE JOB DURING SD-2017

| SR. NO. | DESCRIPTION | LOCATION | TAG NO | REMARKS | STATUS |
|---|---|---|---|---|---|
| 1 | 4 ATA STEAM PI (LOCAL GAUGE) ROOT I/V GLAND LEAK, NR. V-1301 AT 2ND FLOOR | 2ND FLOOR | 110 | 1/2"Gate valve replaced - fabrication Job | Completed |
| 2 | STEAM TRACING I/V GLAND LEAKING NEAR VENT STACK LINE AT 3.5 FLOOR | 3 .5 FLOOR | 144 | 1/2"Steam tracing valve replaced - fabrication Job | Completed |
| 3 | STEAM TRACING I/V GLAND LEAKING NEAR HIC-1210 AT 3.5 FLOOR | 3.5 FL | | | |
| 4 | H-1418 OFFGAS LINE NECK COND. FLUSHING I/V IS HARD TO OPERATE | 3RD FL | 122 | 1"x 300# forged valve hard to operate, welded joint Valve replace - Fabrication Job | Completed |
| 5 | V-1207 VENT LINE (PICV-1202 D/S) STEAM TRACING PIN HOLE LEAK | 6TH FL | 163 | 1/2"steam line 9 ata fabricated , Pin hole & flange joint leak | |
| 6 | V-1203 TO V-1207 GAS LINE STEAM TRACING PINHOLE LEAK NR. V-1207 | 6TH FL | 164 | | Completed |
| 7 | H-1205 DRAIN LINE STEAM COIL UNION LEAK AT 1ST FLOOR | 1ST FL | 85 | Union replaced | Completed |
| 8 | V-1406 STEAM TRACING PIN HOLE LEAK TO BE ATTENDED | 3RD FL | 123 | Steam tracing line to be fabrictae new (Insulation to be open and check size) - fabrication Job | Completed |
| 9 | 23 ATA TO 9 ATA STEAM DRUM I/V D/S FLANGE LEAK | 3RD FL | 124 | 8"x 300 # gate valve, Flange joint gasket leakage, changed | |
| 10 | 4 ATA STEAM TO L.P SECTION HEATING 2ND I/V IS PASSING (NEAR HICV/PICV-1424) . | 3RD FL | 132 | 6"x 150 # Globe valve - Passing – Serviced done | |
| 11 | V-1409-A STEAM TRACING I/V TO BE REPLACED. | 1ST FL | 79 & 80 | 1/2"tracing line fabricated | Completed |

| SR. NO. | DESCRIPTION | LOCATION | TAG NO | REMARKS | STATUS |
|---|---|---|---|---|---|
| 12 | 60 ATA INLET TO Q-1801 MOV-1811 BYPASS I/V GLAND IS TO BE REPACKED AS IT WAS LEAKING | COMP.DECK FLR | 180 | Steam valve (Insulated ) Gland leakage, gland packing replaced | Completed |
| 13 | 4ATA TO Q-1801 1ST I/V IS PASSING BADLY & ITS VENT I/V IS PASSING ON COMPRESSOR FLOOR. | COMP.DECK FLR | 181,182, 183 | 181 - 2"x 150# globe valve passing replaced. 182 - 16"x 150# gate valve passing-serviced. 182 - 16"x 150# gate valve - serviced | Completed |
| 14 | HICV-1401 U/S I/V G/L AT PRILL BUCKET ROOM | 6TH FL | 161 | 1"welded joint globe valave replaced, steam line - fabrication Job | Completed |
| 15 | TICV -1701-A 4 ata steam to T-1701-A I/V & BPV IS PASSING. | PCS | 2 & 3 | 1 1/2"x 800# welded joint globe valve replaced, Steam 4kg/cm2 - Fabrication job | Completed |

**FURMANITED JOB ATTENDED DURING SHUTDOWN-2017**

| Sr. NO. | DESCRIPTION | LOCATION | TAG NO. | REMARKS | STATUS |
|---|---|---|---|---|---|
| 1 | P-1102-B 2ND DISCHARGE I/V GLAND LEAK HEAVILY. | Ground Floor | 4 | 4"x 900# Globe valve (NH3 Handling) Gland Leakage, gland replaced | Completed |
| 2 | P-1304 C/D DISCHARGE I/V GLAND LEAK. | 1st Floor | 77 & 78 | 77 & 78 - 2"x 300# Gate valve - Gland Leakage, Gland replaced. | Completed |
| 3 | P-1201-C NEAR PILLER STEAM I/V FERMANITE DONE. | 1st Floor | 86 | 1/2"Steam line & Tracing valve replaced | Completed |
| 4 | P-1423 (BOOSTER EJECTOR ) CONDENSATE LINE FLANGE LEAK AT 3.5 FLOOR. | 3.5 Floor | 145 | 1"x 300# Condensate line valve replaced | Completed |
| 5 | P-1201-C PACKING WATER INLET MAIN I/V GLAND LEAK. | Ground Floor | 5 | DN 25 x 1500 # CF8M Gate valve Gland leakage, Gland replaced | Completed |
| 6 | P-1102-B 2ND DISCHARGE I/V FERMANITED PLUG IS LEAKING | Ground Floor | 4 | 4"x 900# Globe valve (NH3 Handling) Gland Leakage, gland replaced | Completed |

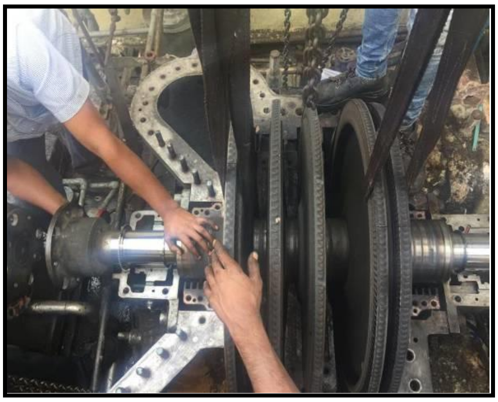
## COOLING TOWER AREA

### Overhauling of Cooling water pump drive Turbine (Q-4411- Elliot make)

Following activities were carried out for complete overhauling of turbine;

- Coupling between the Turbine and Gear box was decoupled.
- Removed Turbine Exhaust line.
- All oil lines, steam and air lines were also removed.
- Governor was removed from the position.
- Removed the carbon seal top housing and carbon seals of both sides.
- Removed all the bolts of the turbine casing and lifted the casing from the position.
- Top half of the bearing housings were also removed.
- Lifted the turbine rotor from the position.
- Turbine diaphragms were checked and found ok.
- Bottom half of both the journal bearings were removed. Thrust bearing were also removed.
- Clearance value of coupling side journal bearing was found higher than design value. Scoring & abrasion marks also observed on bearing. Hence the existing bearing was replaced with new one. Clearance value of new bearing was found higher than design value, however the same was used.
- Clearance value of free end side journal bearing was found higher than design value, however the bearing condition was found satisfactory. The same was used.
- Thrust pad thicknesses were measured & recorded.
- All diaphragms were removed from bottom casing & top casing.
- Shot blasting of rotor (blade area) and all diaphragms was carried out.
- Insert the diaphragms in bottom & top casing.
- Rotor was placed into the bottom casing.
- All gaps and clearances were measured.
- Partition plane levels of all diaphragms were checked.
- Top casing was positioned and tightened.
- Axial float of rotor was measured & found higher than design value. Scoring & abrasion marks were observed on active side pads. Hence the active side pads were replaced with new ones. Final axial float was measured & recorded.
- All new carbon seals were used.

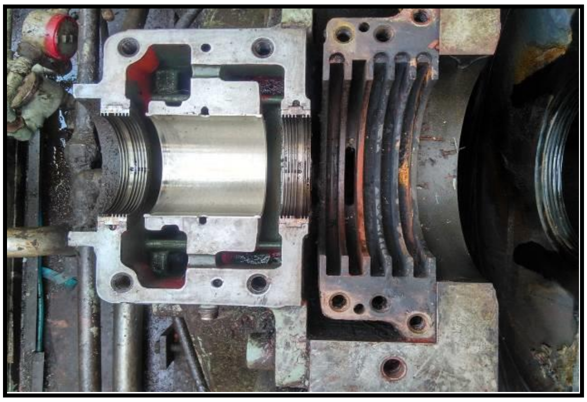
Bottom casing



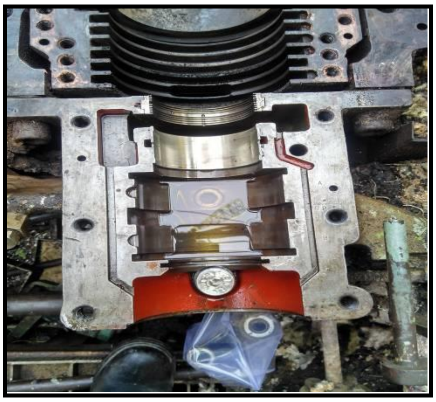
Bottom casing with rotor

Top casing removal

Rotor assembly



Casing – coupling end



Casing – governor end

- Turbine oil seal clearance were also measured and recorded.
- Removed governor was calibrated at test bench and fixed on its position.
- Governor linkages were also made free. Packing of control valve was replaced with new one.
- Oil console was drained; cleaned and fresh oil charged (SERVO-PRIME 32)
- Main oil pump & Auxiliary oil pump suction strainers were cleaned & boxed up.
- Oil leakage observed from trip plunger assembly during oil circulation. The same was replaced with new one.
- OST of turbine was done 6140rpm.

- The surface condenser was opened. Hydro jetting was carried out & then boxed up. Corroded sacrificial rods (8 nos.) were replaced with new one. During box up some of the cover bolts were replaced.

  Final readings for complete overhauling are as under;

| Sr. No. | Description | Design Value | Value after PM |
|---|---|---|---|
| 1 | Front end journal bearing clearance | 0.127mm - 0.18mm | 0.29mm |
| 2 | Coupling end journal bearing clearance (new) | 0.127mm - 0.18mm | 0.26mm / 0.31mm |
| 3 | Axial thrust float ( with new active pads ) | 0.254mm – 0.305mm | 0.25mm |

- **Thrust Pads Thickness**

| Sr. No. | Active (T) | Non – Active (T) |
|---|---|---|
| 1 | 17.49mm | 17.45mm |
| 2 | 17.50mm | 17.43mm |
| 3 | 17.50mm | 17.44mm |
| 4 | 17.49mm | 17.45mm |
| 5 | 17.49mm | 17.45mm |
| 6 | 17.50mm | 17.45mm |

- **Rotor float reading**

| | |
|---|---|
| Rotor free float +ve | 2.04mm |
| Rotor free float -ve | 0.98mm |
| Total free float | 3.02mm |
| Thrust float with all internals | 0.25mm |

- **Carbon Seal ID**

| Sr. No | ID (mm) |
|---|---|
| 1 | 165.32mm |
| 2 | 165.33mm |
| 3 | 165.32mm |
| 4 | 165.32mm |
| 5 | 165.31mm |
| 6 | 165.32mm |
| 7 | 165.32mm |
| 8 | 165.31mm |

- **Oil Gland Radial Clearances**

| | Left | Right | Bottom |
|---|---|---|---|
| Front end | 0.10mm | 0.10mm | 0.00mm |
| Rear end | 0.20mm | 0.25mm | 0.15mm |

- **Bottom Half Diaphragm P.P. Levels & With Respect To Bottom Casing before Overhauling**

| Sr. No. | Description | PP levels | |
|---|---|---|---|
| | | left | right |
| 1 | Diaphragm -1 | +0.5mm | +1.3mm |
| 2 | Diaphragm-2 | +1.4mm | +0.41mm |
| 3 | Diaphragm-3 | +0.51mm | +0.86mm |

- **Top Half Diaphragms P.P. Levels & With Respect To Top Casing after Overhauling**

| Sr. No. | Description | PP levels | |
|---|---|---|---|
| | | left | right |
| 1. | Diaphragm -1 | -0.64mm | -1.5mm |
| 2. | Diaphragm-2 | -1.55mm | -0.53mm |
| 3. | Diaphragm-3 | -0.64mm | -0.92mm |

- **Axial Clearances**

| Sr. No. | Description | Active side | | Non active side | |
|---|---|---|---|---|---|
| | | left | right | left | right |
| 1 | A-Wheel 1 | 3.60mm | 3.50mm | 1.60mm | 1.65mm |
| 2 | A-Wheel 2 | open | open | 1.80mm | 2.15mm |
| 3 | Stage 1 | 4.65mm | 4.75mm | 2.20mm | 1.90mm |
| 4 | Stage | 4.70mm | 4.6mm | 1.90mm | 2.00mm |
| 5 | Stage | open | open | 2.15mm | 2.30mm |

- **Radial Clearance**

| Sr. No. | Description | Labyrinth seal to rotor | |
|---|---|---|---|
| | | Left | Right |
| 1. | Stage 1 | 0.35mm | 0.30mm |
| 2. | Stage 2 | 0.35mm | 0.35mm |
| 3. | Stage 3 | 0.30mm | 0.35mm |

- **Rotor Run-out**

| Sr. No. | Location | Value |
|---|---|---|
| 1 | Trip lever to worm wheel coupling | 0.01mm |
| 2 | Thrust collar | 0.00mm |
| 3 | Front journal | 0.00mm |
| 4 | Front oil seal | 0.00mm |
| 5 | Front carbon seal | 0.01mm |
| 6 | Rear carbon seal | 0.005mm |
| 7 | Rear oil seal (1) | 0.01mm |
| 8 | Rear journal | 0.00mm |
| 9 | Rear oil seal (2) | 0.01mm |
| 10 | Coupling hub | 0.02mm |

**Preventive maintenance of P-4401A**

Following activities were carried out during PM

- Coupling between the pump and GB was decoupled.
- Both the journal bearings were opened, checked and found ok.
- Bearing clearances were measured and recorded.
- During assembly correct positioning of oil splash ring in the bearing housing was ensured.
- Gland cooling water lines was opened, cleaned and boxed up
- After alignment gland was repacked with new 25 MM Sq PTFE gland packings.
- New oil was filled in both bearing housings
- Free rotation of the pump after coupling was ensured
- Final Clearance chart is as under;

| Sr. No. | Description | Design Value | Value after PM |
|---|---|---|---|
| 1 | Front end journal clearance | 0.20-0.30mm | 0.23mm / 0.29mm |
| 2 | Coupling end journal bearing clearance | 0.20-0.30mm | 0.22mm |

**Overhauling of GB-4411:**

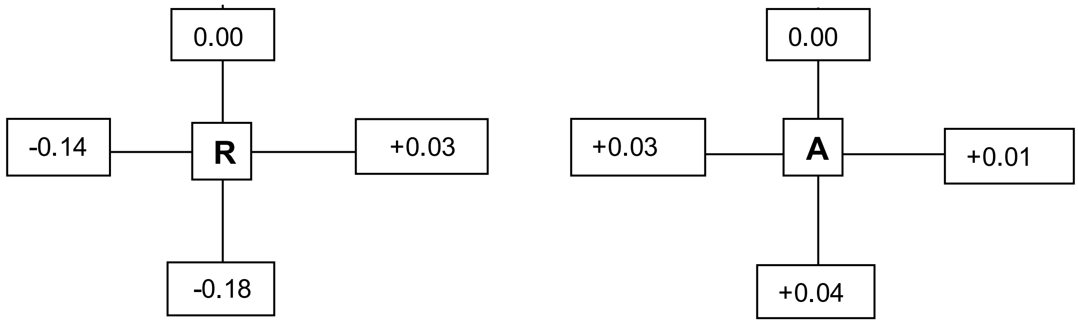
Following activities were carried out during overhauling;

- Gear top cover was opened. GB internals were checked and found OK.
- Checked and recorded DE and NDE bearing clearances and interference
- Checked and recorded gear wheel DE and NDE bearing clearances.
- Top cover was placed on its position.
- Final Clearance chart is as under;

| Sr. No. | Description | Design / Recomm. Value (mm) | Value |
|---|---|---|---|
| 1 | Pinion Front Journal Bearing Clearance | 0.15mm – 0.20mm | 0.24mm/ 0.25mm |
| 2 | Pinion Rear Journal Bearing Clearance | 0.15mm – 0.20mm | 0.25mm |
| 3 | Gear Wheel Front Journal Bearing Clearance | 0.20mm – 0.30mm | 0.32mm |
| 4 | Gear Wheel Rear Journal Bearing Clearance | 0.20mm – 0.30mm | 0.31mm /0.32mm |
| 5 | Back lash between pinion and gearwheel | 0.40mm – 0.45mm | 0.47mm |
| 6 | Gear wheel thrust float | 0.50mm – 0.60mm | 0.51mm |

- Alignment reading between turbine to gear box

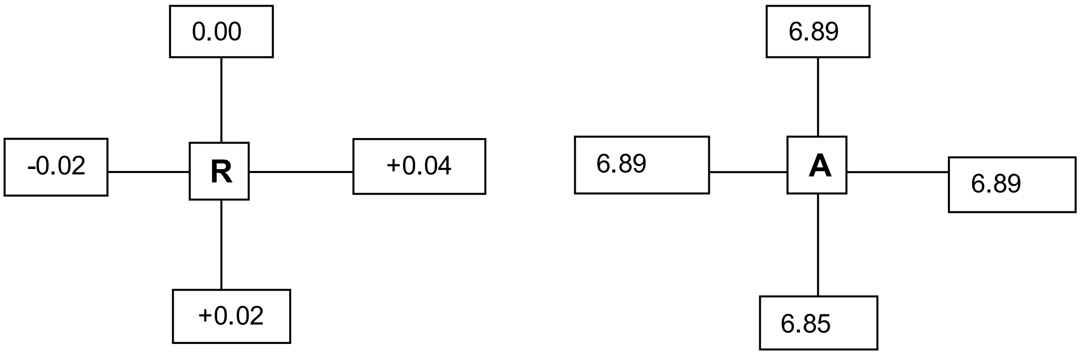
Turbine to Gear Box




Dial on Gear Box
View from turbine front
All readings are in mm

- Alignment reading between gear box to pump

Turbine to Gear Box




Dial on Gear Box
View from turbine front
All readings are in mm

**Overhauling of condensate extraction pump drive steam turbine, Q-4412**

Following activities were carried out for complete overhauling of turbine;

- Coupling between the Turbine and pump was decoupled.
- Governor was removed from the position.
- Removed all the bolts of the turbine casing and lifted the casing from the position.
- Top half of the bearing housings- both side were also removed.
- Lifted the turbine rotor from the position.
- All carbon seals were removed.
- Clearance values of coupling side & free end side were measured and found higher than design value. Scoring & abrasion marks were found on both bearings. Hence, the both bearings were replaced with new ones.
- Thrust bearing (6209 Z) was replaced with new one.

**Rotor with bottom casing**

**Bottom casing – governor end**

- Placed the rotor on bottom casing.
- Top casing was positioned and tightened.
- Thrust float of the Turbine was measured and recorded.

- Turbine oil seal clearance were also measured and recorded.
- Governor was replaced with new tested governor and fresh oil is filled in it. New coupling pad of governor was used.
- Governor linkages were also made free.
- OST of turbine was done at 3429rpm.
- Final readings are as under;

| Sr. No. | Description | Design Value | Value after PM |
|---|---|---|---|
| 1 | Front end journal bearing clearance (new) | 0.15mm - 0.23mm | 0.29mm / 0.34mm |
| 2 | Coupling end journal bearing clearance (new) | 0.15mm - 0.23mm | 0.20mm / 0.25mm |
| 3 | Axial Thrust | - | 0.30mm |

- **Carbon Seal Ring:**

| Sr. No. | ID |
|---|---|
| 1 | 57.34mm |
| 2 | 57.33mm |
| 3 | 57.33mm |
| 4 | 57.33mm |
| 5 | 57.34mm |
| 6 | 57.33mm |
| 7 | 57.33mm |
| 8 | 57.33mm |

- **Oil Gland Clearances:**

| Description | | Left | Right | Bottom |
|---|---|---|---|---|
| Front Oil Gland | Radial Clearance | 0.15mm | 0.15mm | 0.05mm |
| | Axial Clearance | 1.20mm | 1.40mm | 1.30mm |
| Rear Oil Gland 1 | Radial clearance C | 0.15mm | 0.10mm | 0.05mm |
| | Axial Clearance | 1.40mm | 1.20mm | 1.40mm |
| Rear Oil Gland 1 | Radial clearance C | 0.15mm | 0.15mm | 0.06mm |
| | Axial Clearance | 1.00mm | 1.75mm | 1.00mm |

- **Axial Clearances**

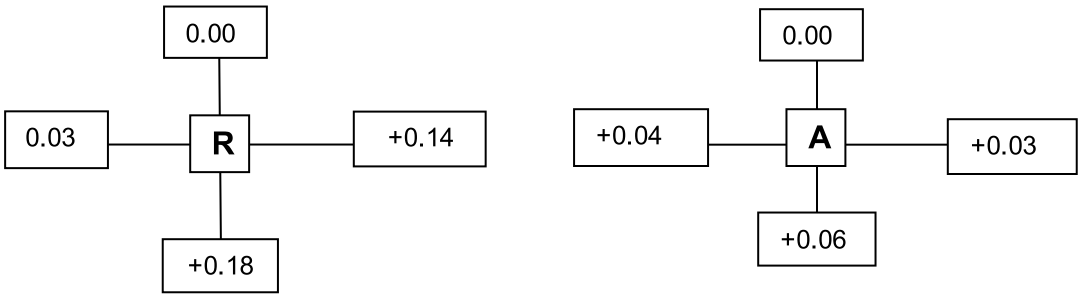
| Sr. No. | Description | Active side | | Non active side | |
|---|---|---|---|---|---|
| | | left | right | left | right |
| 1 | A-Wheel 1 | 2.95mm | 2.90mm | 1.20mm | 1.20mm |
| 2 | Stage 1 | open | open | 2.15mm | 2.10mm |

- **Rotor Run-out**

| Sr. No. | Location | Value |
|---|---|---|
| 1 | Front Journal | 0.005mm |
| 3 | Rear journal | 0.005mm |
| 4 | Coupling hub | 0.05mm |

- <u>Alignment reading between turbine to Pump</u>

  Turbine to pump




  Dial on pump

  All readings are in mm

**<u>Preventive Maintenance of CW Pump, P-4402 & Replacement of existing CS base frame of pump with new SS 304 base frame</u>**

Following activities were carried out;

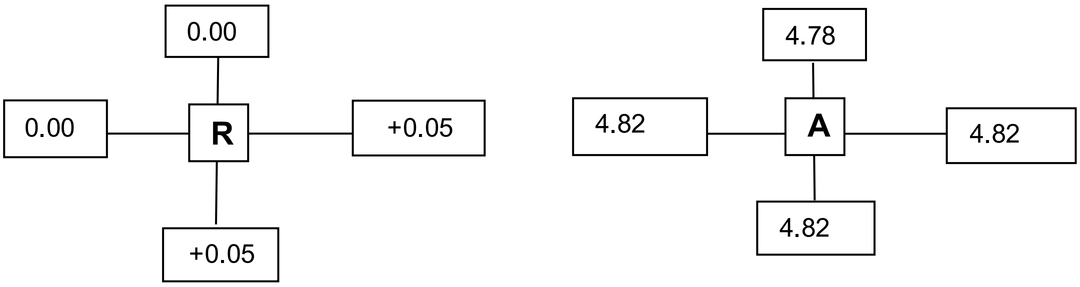
- Coupling between the pump and GB was decoupled.
- Both the journal bearings were opened, checked & found ok.
- Bearing clearances were measured and recorded.
- Suction & discharge bellow of pump were removed.
- Pump foundation bolts were loosened.
- Pump was lifted & shifted to safe location with the help of Kobelco crane and placed on new fabricated SS base frame for marking.
- Old CS base frame was removed after marking reference points at site.
- 4 nos. of 6” dia drilled (425mm length) holes were done at RCC foundation by civil section.
- New SS base frame was placement on its position & fixed it with matching reference points.
- Leveling of base frame was done by providing the shims.
- Grouting of base frame was done along with foundation bolts on position & cured for 4 hrs.
- Pump was placed on new SS base frame.
- Alignment of pump with motor was checked & corrected
- During assembly correct positioning of oil splash ring in the bearing housing was ensured.
- Gland cooling water lines was opened, cleaned and boxed up
- After alignment gland was repacked with new 25 MM Sq PTFE gland packings.
- Finally new oil was filled in both bearing housings.
- Free rotation of the pump after coupling was ensured

- Final Clearance chart is as under;

| Sr. No. | Description | Design Value | Value after PM |
|---|---|---|---|
| 1 | Front end journal clearance | 0.20mm -0.30mm | 0.25mm / 0.30mm |
| 2 | Coupling end journal bearing clearance | 0.2mm -0.30mm | 0.24 / 0.26mm |

- <u>Alignment reading between Pump to motor</u>

  Pump to motor




Dial on Motor

All readings are in mm

**<u>Preventive Maintenance of CW Pump, P-4401C: Replacement of existing CS base frame of pump with new SS 304 base frame</u>**

Following activities were carried out;

- Coupling between the pump and GB was decoupled.
- Both the journal bearings were opened, checked & found ok.
- Bearing clearances were measured and recorded.
- Suction & discharge bellow of pump were removed.
- Pump foundation bolts were loosened.
- Pump was lifted & shifted to safe location with the help of Kobelco crane and placed on new fabricated SS base frame for marking.
- Old CS base frame was removed after marking reference points at site.
- 4 nos. of 6” dia drilled (425mm length) holes were done at RCC foundation by civil section.
- New SS base frame was placement on its position & fixed it with matching reference points.

**Old CS base frame**

**New SS base frame**

- Leveling of base frame was done by providing the shims.
- Grouting of base frame was done along with foundation bolts on position & cured for 4 hrs.
- Pump was placed on new SS base frame.
- Alignment of pump with motor was checked & corrected
- During assembly correct positioning of oil splash ring in the bearing housing was ensured.
- Gland cooling water lines was opened, cleaned and boxed up
- After alignment gland was repacked with new 25 MM Sq PTFE gland packings.
- Finally new oil was filled in both bearing housings.
- Free rotation of the pump after coupling was checked.
- Suction side bellows was replaced with new one.
- Final Clearance chart is as under;

| Sr. No. | Description | Design Value | Value after PM |
|---|---|---|---|
| 1 | Front end journal clearance | 0.20mm - 0.30mm | 0.20mm |
| 2 | Rear end journal bearing clearance | 0.20mm - 0.30mm | 0.23mm |

Motor to Pump


**<u>Replacement of CS impeller with SS impeller in CW pump, P-4401 C</u>**

To improve the reliability of cooling water pumps, it was decided to replace the existing CS impellers with new SS impellers in phased manner.

| Sr. no. | Pump tag no. | Details |
|---|---|---|
| 1 | P-4402 | During SD-2011, existing CS impeller was replaced with new OEM make SS impeller |
| 2 | P-4401A | During SD-2012, existing CS impeller was replaced by new OEM make SS impeller |
| 3 | P-4401D | On 09/11/2015, existing CS impeller was replaced by new Indigenous ( Spaky make ) SS impeller |

In continuation of above job, on 22/02/2017, CS impeller of CW pump P-4401C was replaced with new SS impeller. Current was 226 – 232 amp & cooling water flow to ammonia plant was increased by 400-500 m3/hr. Motor was tripped due to high ampere. Again SS impeller was replaced with CS impeller. Discharge opening width of SS Impeller dimension was 185mm instead of existing 176mm (CS impeller) and diameter was 840mm similar with old one. As discussed with manufacturer, SS impeller diameter was trimmed from 840mm to 830mm and both side shroud thickness was reduced from 12mm to 10mm. Impeller was dynamically balanced. New trimmed impeller was installed on 10/06/2017. Vibration was normal and ampere was 195A. On 13/06/2017, abnormal sound was observed from the pump. Vibration was measured on 13/06/2017 & found normal. And also vibration was monitored on 14/06/2017 & found ok. On 21/06/2017, vibration was on higher side. Pump was taken for maintenance. Normal. Observations are as follows.

- Blackish marks on impeller suction OD & neck ring ID ( free end side )
- Neck ring fitment with casing was loosened – weld filled up in casing groove
- 0.3mm ovality removed from both neck ring ID

Again the pump vibration was on higher side. Pump was taken for maintenance. Thrust bearing replaced with new one. Still pump vibration was on higher side. Pump was kept idle. New SS impeller (840mm impeller) with old shaft was assembled. Dimension of New SS impeller was as per drawing. Balancing of new rotor was checked & found within acceptable limit. New thrust bearing was used. On 06/07/2017, pump assembly completed. Pump vibration came down to normal. Ampere 218 – 224 amp & power consumption was 1040KW.

Removed SS impeller (830mm dia) was dismantled from the shaft. Run-out of sleeves, shaft and impeller were checked. Axial run-out of both sleeves were removed by machining. Light cut was done on sleeve to removed radial run-out. Run out of impeller mounted on mandrill was checked & found within acceptable limit. Final dynamic balancing of rotor assembly was done. On 17/07/2017, SS impeller (830mm dia) was installed in pump. Pump vibration was come down to normal and current was 195amp.

**Preventive Maintenance of CW Pump, P-4401D**

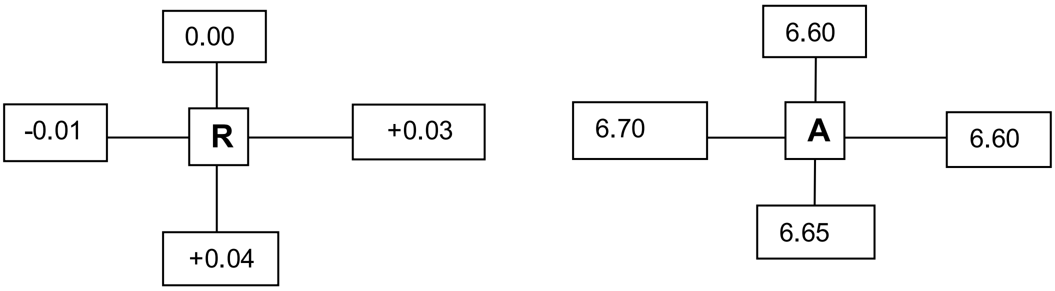
Following activities were carried out during PM

- Coupling between the pump and GB was decoupled.
- Both the journal bearings were opened, checked and found ok.
- Bearing clearances were measured and recorded.
- During assembly correct positioning of oil splash ring in the bearing housing was ensured.
- Gland cooling water lines was opened, cleaned and boxed up
- After alignment gland was repacked with new 25 MM Sq PTFE gland packings.
- New oil was filled in both bearing housings.
- Free rotation of the pump after coupling was ensured
- Final Clearance chart is as under;

| Sr. No. | Description | Design Value | Value after PM |
|---|---|---|---|
| 1 | Front end journal clearance (by lead wire) | 0.20mm -0.30mm | 0.16mm |
| 2 | Coupling end journal bearing clearance (by lead wire) | 0.20mm -0.30mm | 0.15mm |

- Alignment reading between Pump to motor

  Pump to motor




Dial on Motor
All readings are in mm

**BHEL BOILER AREA**

**Preventive Maintenance of BFW Pump, P-5111 Train**

Following activities were carried out during PM:

- All the oil pipe lines were disconnected.
- Both the end covers of the pump were removed
- Bearings were removed on both the sides
- Cleaning of journal on both sides of the pump was carried out.
- Cleaning of bearings and bearing covers was carried out
- DP test was conducted on all the journal bearings & thrust pads and found ok.
- Checked the bearing clearance and found ok.
- Rear side thrust bearing was removed
- Thrust pads were found ok.
- Both the sides bearings and bearing covers were assembled back
- Strainer was removed, cleaned and assembled back.
- Coupling side mechanical seal was replaced due to found leakage during plant start-up.
- Final Clearance chart is as under

| Sr. No. | Description | Design / Recomm. Value | Value after PM |
|---|---|---|---|
| 1 | Axial thrust | 0.28mm - 0.33mm | 0.18mm |
| 2 | Front journal bearing clearance | 0.13mm - 0.18mm | 0.18mm / 0.23mm |
| 3 | Coupling journal bearing clearance | 0.13mm - 0.18mm | 0.18mm |

- Thrust Pads thickness

| Sr. No | Active | Inactive |
|---|---|---|
| 1 | 22.20mm | 22.20mm |
| 2 | 22.19mm | 22.18mm |
| 3 | 22.20mm | 22.21mm |
| 4 | 22.19mm | 22.18mm |
| 5 | 22.20mm | 22.18mm |
| 6 | 22.18mm | 22.21mm |

- All oil lines cleaned and flushed.
- Oil sump cleaned.
- Oil cooler tubes cleaning done.
- Oil Filters cleaned.
- Fresh oil filled in oil sump.

**Preventive Maintenance of BFW Pump drive turbine (Q-5111)**

Following activities were carried out during PM:

- Decoupled the turbine
- Instruments probes were removed
- Governor top cover and liver or are removed
- Thrust bearing & journal bearings top half's were removed.
- Cleaning of rotor shaft was carried out.
- Governing components were removed and found ok.
- Measured the all bearing clearances and found ok.
- Governing control valve stem was stuck up. The same was replaced with new one.
- Final Clearance chart is as under;

| Sr. No. | Description | Design / Recomm. Value | Value after PM |
|---|---|---|---|
| 1 | Axial thrust | 0.20mm – 0.40mm | 0.26mm |
| 2 | Front journal bearing clearance | 0.12mm – 0.17mm | 0.32mm |
| 3 | Rear journal bearing clearance | 0.12mm – 0.17mm | 0.20mm |
| 4 | Mop Gear Backless | - | 0.37mm |
| 5 | Governor Gear Backless | - | 0.18mm |

- Final alignment pump to turbine was done by laser alignment machine. Readings are as under ;

| Position | Parallel offset | Angular offset | Correction required | |
|---|---|---|---|---|
| | | | Foot-1 | Foot-2 |
| Horizontal (H) | -0.26mm | 0.07/100 | -0.85mm | -1.23mm |
| Vertical (V) | 0.09mm | 0.02/100 | 0.21mm | 0.30mm |
| All readings are in mm | | | | |

**Preventive Maintenance of BFW Pump P-5112 (Motor driven)**

Following activities were carried out during PM:

- All the oil pipe lines were disconnected.
- Both the end covers of the pump were removed

- Bearings were removed on both the sides
- Cleaning of journal on both sides of the pump
- Cleaning of bearings and bearing covers was carried out
- DP test was conducted on all the journal bearings & thrust pads and found ok.
- Clearance value of coupling side bearing was measured and found higher than design value. Scoring & abrasion marks were observed on bearing. Hence the existing bearing was replaced with new one.
- Clearance value of free end side bearing was measured & found within design value.
- Thrust bearing was removed. Thrust pads were found ok
- Both side bearings and bearing covers were assembled back.
- Strainer was removed, cleaned and assembled back.
- Both side gear couplings i.e. motor to gear box & gear box to pump were replaced with new euroflex shim-pack coupling.
- Oil leak was observed from deflector of coupling side bearing housing.
- Final Clearance chart is as under;

| Sr. No. | Description | Design / Recomm. Value | Value after PM |
|---|---|---|---|
| 1 | Axial thrust | 0.28mm - 0.33mm | 0.28mm |
| 2 | Front journal bearing clearance | 0.13mm - 0.18mm | 0.14mm / 0.16mm |
| 3 | Rear journal bearing clearance (new) | 0.13mm - 0.18mm | 0.13mm / 0.15mm |

- Thickness of thrust pads were also measured and recorded.

**Thrust Pads thickness**

| Sr. No | Active | Inactive |
|---|---|---|
| 1 | 22.18mm | 22.19mm |
| 2 | 22.19mm | 22.19mm |
| 3 | 22.18mm | 22.18mm |
| 4 | 22.19mm | 22.19mm |
| 5 | 22.19mm | 22.19mm |
| 6 | 22.19mm | 22.19mm |

**Preventive Maintenance of Gear Box for BFW Pump, GB-5112**

Following activities were carried out during PM:

- All the oil pipe lines are disconnected and oil drained from Gear Box.
- Gear Box end covers and MOP removed.
- Gear Box top cover opened and removed.
- Condition of Gear and pinion checked and found OK.
- Bearings of Gear and pinion removed, cleaned, checked and found OK.

- DP test was conducted on all the journal bearings.
- Measured the bearing clearances and found ok.
- Final Clearance chart is as under;

| Sr. No. | Description | Recommended | Value after PM |
|---|---|---|---|
| 1 | Pinion, front journal bearing clearance | 0.15mm – 0.20mm | 0.16mm /0.17mm |
| 2 | Pinion, rear journal bearing clearance | 0.15mm – 0.20mm | 0.15mm /0.16mm |
| 3 | Gear wheel, front journal bearing clearance | 0.15mm – 0.20mm | 0.16mm /0.18mm |
| 4 | Gear wheel, rear journal bearing clearance | 0.15mm – 0.20mm | 0.15mm /0.17mm |
| 9 | Gear backlash | - | 0.30mm |
| 10 | Input Gear Thrust | - | 0.28mm |

- Final alignment motor to gear box was done by laser alignment machine. Readings are as under;

| Position | Parallel offset | Angular offset | Correction required | |
|---|---|---|---|---|
| | | | Foot-1 | Foot-2 |
| Horizontal (H) | -0.09mm | 0.07/100 | -0.45mm | -1.33mm |
| Vertical (V) | 0.14mm | 0.10/100 | 0.66mm | 1.91mm |
| All readings are in mm | | | | |

**<u>Preventive Maintenance of FD Fan (K-5113) / drive turbine (Q-5113)</u>**

Following activities were carried out during PM :

- Decoupled the turbine
- Decoupled Fan from Turbine
- Removed oil lines & Governor
- Gearbox cover was opened and checked the condition of Gears. The same was cleaned; DP test was carried out and assembled back.
- Backlash between gear wheel to pinion was checked.
- Cleaned the Radial bearings.
- Dimensional Inspection, DP test & Gauss measurement of Journal bearings were done. Results were found satisfactory.
- Main oil console was cleaned and recharged with new oil (SERVO PRIME 68).
- MOP was removed from its position & cleaned. Coupling Bush of MOP was replaced.
- Oil cooler was opened and cleaned by Hydro jetting.
- Cleaned Duplex oil filter & replaced O-ring.
- The air dampers were attended for proper working. The Fan inlet air mesh screen was changed.

- Between turbine and fan coupling rubber pads were replaced
- The clutch oil (Servo Trans fluid-A) was replaced.
- The clearances were checked & following are the readings

| Description | | Clearance |
|---|---|---|
| Pinion | Front bearing | 0.17mm |
| | Rear bearing | 0.13mm |
| Gear Wheel | Front bearing | 0.13mm / 0.14mm |
| | Rear bearing | 0.18mm / 0.20mm |
| Fan | Front bearing | 0.12mm |
| | Rear bearing | 0.12mm |
| Gear Backless | | 0.33mm |
| Low Speed Gear Thrust | | 0.22mm |

**BHEL BOILER JOBS**

**Bhel Boiler Inspection/Hydrotest:**

Boiler (GT-2068) was inspected by Boiler Inspector in open condition on **17/03/2017** & Hydro test was carried out at 89.0 kg/cm2 pressure on **22/03/2017** and witnessed by Boiler Inspector.

**Testing of Boiler RV's**

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

RV testing readings are as under:

| RV tag | Location | RV details | Set Pr. (Kg/Cm2 g) | Seat tightness test Pr. (Kg/Cm2 g) |
|---|---|---|---|---|
| RV-F-5111-1 | Steam Drum, Rear BHEL Boiler | Size : 2-1/2" X 6.0"<br>Make : Crosby<br>Model : HCL-56-IBR-IFN-SPL<br>Sr. No. 201120150 | 72.0 | 67.0 |
| RV-F-5111-2 | Steam Drum, Front, BHEL Boiler | Size : 2.0" X 4.0"<br>Make : Crosby<br>Model : HCL-56-IBR-IFN-SPL<br>Sr. No. 201120159 | 70.0 | 65.10 |
| RV-F-5111-3 | Super Heater, BHEL Boiler | Size : 1-1/2" X 3.0"<br>Make : Dresser, BHEL<br>Size : 1.5" X 3"<br>Model: 1717 WD | 64.6 | 61.37 ( Reset pressure during online floating ) |
| RV-Q-5111 | BFW Pump Turbine Exhaust | Size : 4" X 6"<br>Make : Crosby<br>Model: SL-131<br>Sr. No. 12263 | 5.0 | 4.5 |
| RV-Q-5113, | FD Fan Turbine Exhaust | Size : 3" X 4"<br>Make : Crosby | 4.5 | 4.1 |

| RV tag | Location | RV details | Set Pr. (Kg/Cm2 g) | Seat tightness test Pr. (Kg/Cm2 g) |
|---|---|---|---|---|
| RV- CBD Tank | CBD Tank, BHEL Boiler | Size : 1" X 2" Make : Crosby | 6.0 | 5.4 |
| RV-V-5111 | Deaerator | Size : 6" x 8" Make : BHEL | 4.1 | 3.6 |
| RV-Q-4401/B, | 4 Ata exhaust line of Triveni make Turbine Q-4401/B | Size : 4" x 6" Make : Crosby | 5.0 | 4.5 |
| RV-Q-4403, | 4 Ata exhaust line of Triveni make Turbine Q-4403 | Size : 4" x 6" Make : Crosby | 5.0 | 4.5 |
| RV-Q-4412 | 4 Ata Exhaust line of Condensate Extraction Pump Drive Turbine | Size : 2" x 3" Make : Crosby | 5.0 | 4.5 |
| RV-H-4411 | Surface condenser | Size : 1” x 1” Make : Fainger laser | 4.2 | 3.8 |

**Boiler Schedule & Timing SD-2017**

| Sr. no | Description | Date | Time, hrs |
|---|---|---|---|
| 1 | Urea plant shutdown | 11-03-17 | 23.30 |
| 2 | 40 ata to ammonia plant, supply | 11-03-17 | 00.30 |
| 3 | 40 ata to ammonia plant, back-off | 13-03-17 | 08:00 |
| 4 | Boiler bottle-up | 13-03-17 | 08:30 |
| 5 | Boiler force cooling | 13-03-17 | 15.00 |
| 6 | Boiler natural cooling | 14-03-17 | 9:15 |
| 7 | Permit for man power entry | 14-03-17 | 16:30 |
| 8 | IBR open inspection | 17-03-17 | 12:30 |
| 9 | IBR Hydrotest inspection | 22-03-17 | 11 :30 |
| 10 | Boiler start-up | 01-04-17 | 21:30 |
| 11 | 40 ata to ammonia plant | 02-04-17 | 14:00 |
| 12 | SSH RV online testing | 02-04-17 | 10:00 |
| 13 | 40 ata to ammonia plant, back off | 23-04-17 | 09.45 |
| 14 | 60 ata to urea plant | 23-04-17 | 09.15 |
| 15 | Feed cut-in by urea plant | 23-04-17 | 2.00 |

**Boiler Furnace**

All furnace manhole covers were opened. SSH top coil (no. 36) existing ceramic fiber blanket was replaced by new one & calcium silicate coating done on it. New insulation was provided at several locations based on as per thermography survey report and also replaced the damaged insulation with new one. Out of four furnace & burner, two broken sight glasses were replaced with new ones. All manhole covers of furnace were boxed up after completion of IBR Hydrotest

**Air Pre-Heater (APH)**

All manway covers of APH were opened. Air inlet side one deflection plate welding joint was observed in cracked condition. The same was repaired by welding. Stanvac make corrosion resistance was applied on cold flue gas side chamber after thorough cleaning. APH manway covers were boxed-up after completion of IBR Hydrotest

**Deaerator:**

All five tray segments were found satisfactory in its position. Missing holding bolts of 3rd and 4th tray segment (counting from top) were provided.

**Steam Drum / Mud Drum:**

Manhole covers of both side of steam & mud drum were opened. Inside cleaning was done by using SS wire brush. In steam drum, missing fasteners of bottom plate were provided inter connecting found missing and in mud drum, loosened fasteners of blow down line (located at bottom) cover plate were tightened. Manhole covers of steam & mud drum were boxed up after successful IBR open inspection.

**Other Boiler Jobs:**

- All five oil coolers were cleaned by hydrojetting
- Alignment of all AOP pumps & P-5117 A/B, P-5118 A/B, P-5119 A/B & P-5120 was done with overhauled motors respectively.
- All $1^{st}$ & $2^{nd}$ isolation valves of steam drums were gland repacked.
- Leak-off line 1.5” of P-5111/P-5112 was punctured at plant running condition before taking shutdown. Approx 12 meters length of pipe line was replaced with new one.
- Severe external corrosion observed on 1” warm off line of P-5112. Approx 6 meter length of pipe line was replaced with new one.

**COOLING TOWER AREA JOBS**

**Complete revamping of existing wooden Ammonia Cooling Tower Cells (H-4401-7&8) with new pultruded FRP components**

IFFCO-Kalol is operating a total of 14 nos. of cooling tower cells of M/s Paharpur make to cater the total requirement of cooling water in Ammonia, Urea & Offsite plans. In order to enhance the safety of and reliability of these cooling tower cells, it was planned to carry out the revamping of cooling tower cells in phased manner since FY 2004-05. Out of 14 nos. of cells, 12 nos. of cells have already been revamped with wooden structure in phased manner and two cells of ammonia cooling tower cell no. H-4401-7 & H-4401-8 were left for revamping. In the mean time the latest available alternatives of wooden structure were explored. It was found that many industries are opting Pultruded FRP (Fiber reinforced plastic) structure members in place of wooden structural members in place of cooling tower installation due to better quality and longevity expected to be doubled than present life.

In continuation of revamping, it was decided to carry out the complete revamping of the Ammonia Cooling Tower cell H-4401/7 & H-4401/8 by using upgraded material; pultruded FRP structural components. The job was awarded to M/s Southern Cooling towers Pvt. Ltd, Kolkata against the purchase order No.: 6535/201004170653 (supply) dated 16/08/2017 & 6535/201004170654 (service) dated 16/08/2017. Key points of jobs were as under;

- Replacement of existing complete wooden structural members with pultruded FRP structural members on same basin foundations.
- Design basis report (DBR) for structural design of pultruded FRP cross flow cooling tower confirming to CTI standard STD-152 latest edition technically vetted and approved by 3rd party i.e. IIT Kharagpur.
- Replacement of existing herringbone type drift eliniminator with PVC honeycomb type drift eliniminator.
- Modification of fill area i.e. replacement of existing splash type fills with mixed fills (combination of splash type fill & film type fill). Due to modification in fill area, party guaranteed the reduction of design approach from 4.5 degree to 3.5 degree.
- Additional 2 Nos. of transverse braced bent (diagonals) in each cell of cooling tower were provided. To fix the same, additional 4 nos. of new SS base castings in each cell were anchored with RCC pedestal in basin. In remaining RCC pedestal of basin, existing CS base castings were used as found in satisfactory.
- SS torque tubes & SS I-beams (gear box side) were installed in both cells.

Job was started from 13/03/2017 and finished on 10/04/2017

Following activities were carried out.

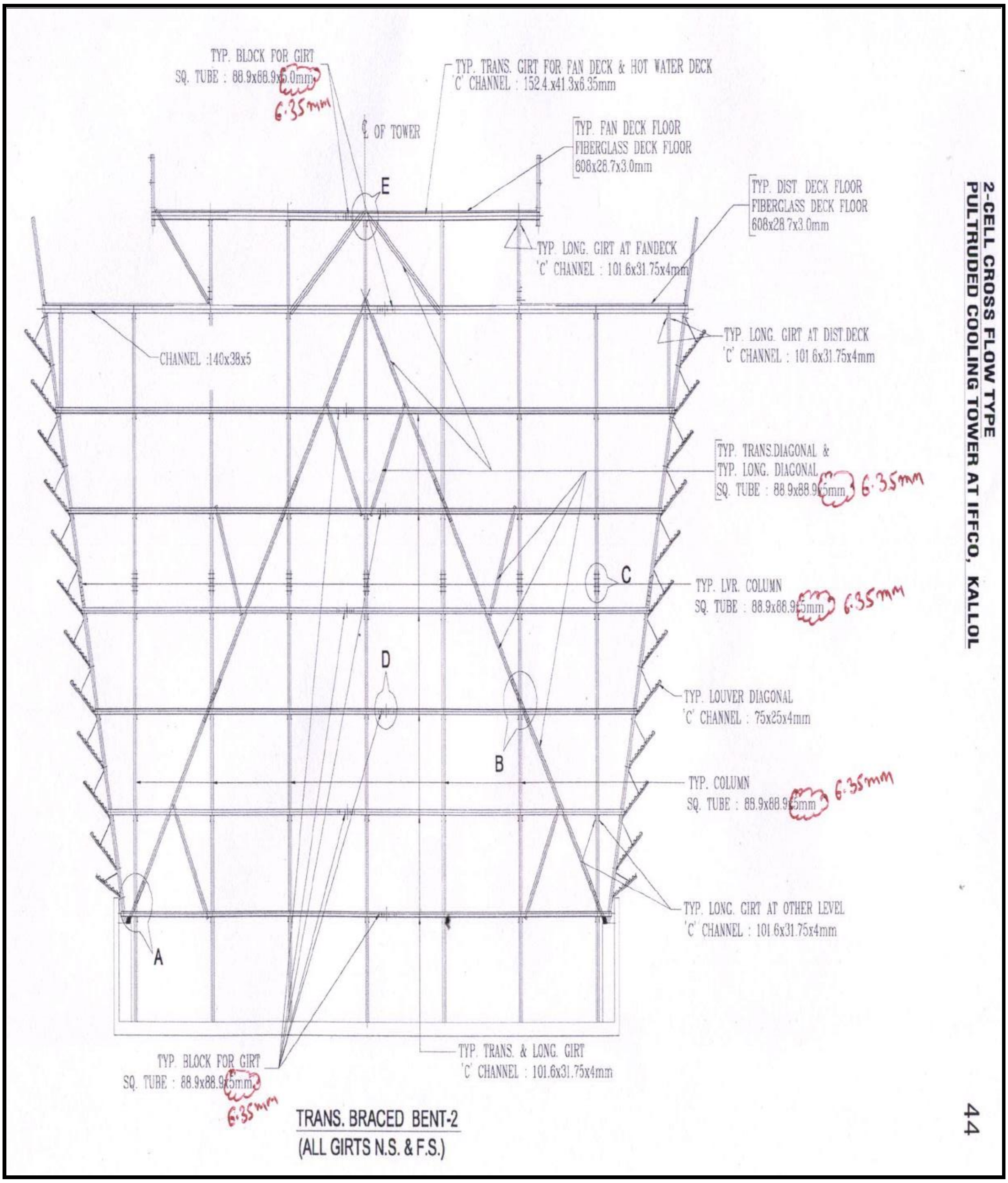
**Dismantling of existing wooden cooling tower**

- Shut down of Cooling Tower
- Motor cable disconnection
- Electrical cable with tray removal
- Removal & lowering of fan blades
- Decoupling, removal & lowering of drive shaft
- Removal & lowering of fan cylinder from cooling tower top
- Removal & lowering of gear box with hub assembly and motor from cooling tower top
- Removal & lowering of torque tube & I-beam support from cooling tower top
- Removal & lowering of hot water distribution valve from cooling tower top
- Removal of hot water distribution cover, nozzle and splash box
- Removal of FRP wall, partition wall, deck cover and louvers, drift eliminator & PVC 'V' bar
- Removal of wooden structure from top to basin along with wooden stair
- Cleaning and checking of RCC cold water basin

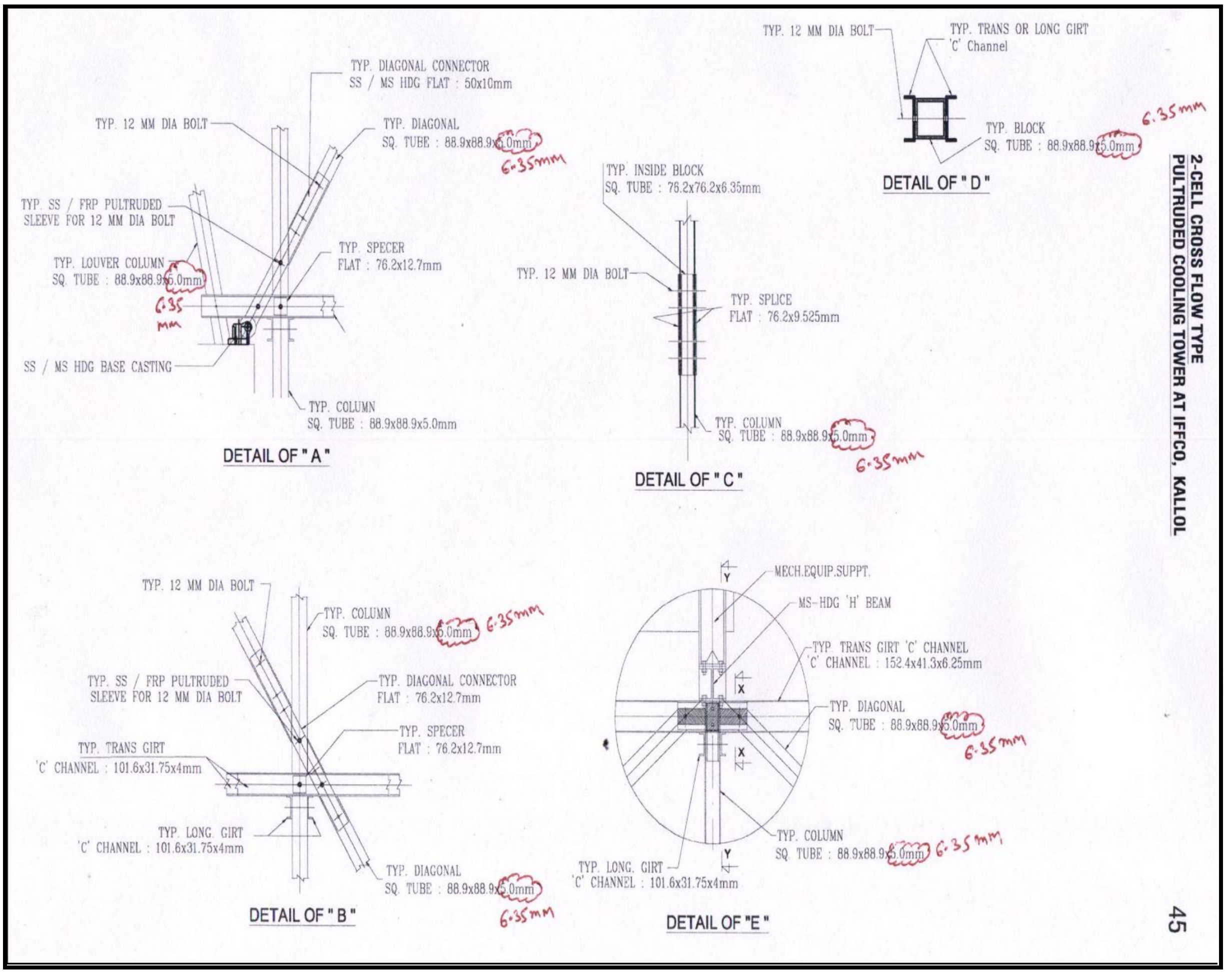
**Erection & Commissioning of new FRP cooling tower**

- Leveling & fixing of base casting along with anchor bolt
- Additional 2 Nos. of transverse braced bent (diagonals) in each cell of cooling tower were provided. To fix the same, additional 4 nos. of new SS base castings in each cell were anchored with RCC pedestal in basin. In remaining RCC pedestal of basin, existing CS base castings were used as found in satisfactory.
- Erection of bottom columns
- Erection of all bottom diagonals
- Erection of final columns
- Erection of balance diagonals
- Erection of louver columns
- Mounting of fen deck & hot water deck
- Erection of end wall casing of cell 8 & partition wall
- Fixing of louvers with louvers bar with diagonal
- Cell 8 - Mounting of splash fill from top to bottom
- Cell 8 - Mounting of film type fill from bottom to top
- Cell 8 - Mounting of drift eliniminator
- Erection of end wall casing of cell 7
- Cell 7 - Mounting of splash fill from top to bottom
- Cell 7 - Mounting of film type fill from bottom to top
- Cell 7 - Mounting of drift eliniminator
- Lifting & installation all 'I' Beam and torque tube at top of fan deck
- SS torque tubes & SS I-beam (gear box side) were installed in both cells.
- Leveling of I-Beam and torque tube
- Lifting & installation of gear box with hub assembly
- Lifting & installation of drive shaft assembly and motor
- Shaft level checking of motor and gear Box
- Lifting, installation & fixing of fan blade
- Lifting & erection of fan cylinder at top of fan deck
- Fan cylinder alignment and tightening of fan cylinder fasteners
- Alignment between gear Box - drive shaft and drive shaft - motor
- Lifting & installation of hot water distribution valve
- Fixing of new FRP splash box
- Nozzle fitting
- Fixing of distributation deck covering
- Fixing of cable tray bellow Fan Deck Level
- Laying of power cable & fixing of light fittings in top of cooling tower & stair case
- Fixing of earthing strip & lightning arrester

- Final checking & any rectification work if required
- Cooling water charge and trial run of fan
- Vibration check and power consumption check
- Job Finish
- Guarantee test run (GTR): Before revamping, on date 06/03/2017, operating parameters of old cooling tower were measured as a base case to establish the Guarantee test run. Based on base case data, capability of tower was 76.6%. After revamping, for guarantee test run, on date 09/06/2017 & 10/06/2017, operating parameters of new FRP cooling tower were measured. Capability of new FRP cooling tower was 111.43 %.




**Transverse view of Cooling tower ( showing Trans Braced Bent )**




**Different types of Joints for FRP Structural Member**

**Dismantling of old wooden cooling tower structure-1**

**Base casting with RCC pedestal in basin**

**Dismantling of old wooden cooling tower structure-2**

**Dismantling of old wooden cooling tower structure-3**

Complete dismantling of old wooden cooling tower structure

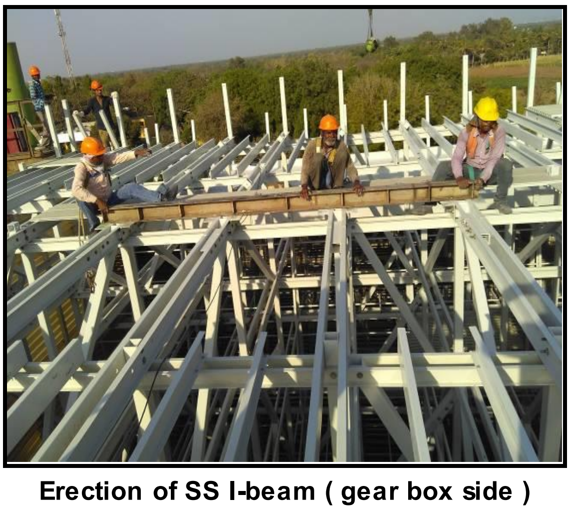
Erection of new FRP cooling tower structure - 1

Erection of new FRP cooling tower structure -2

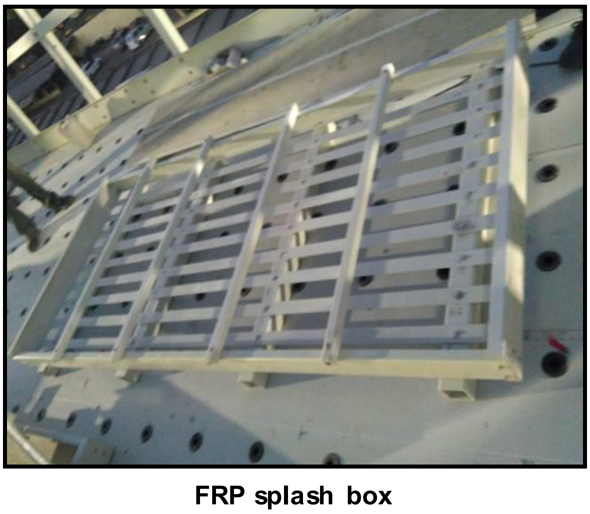
Erection of new FRP cooling tower structure -3

Erection of hot water distribution deck

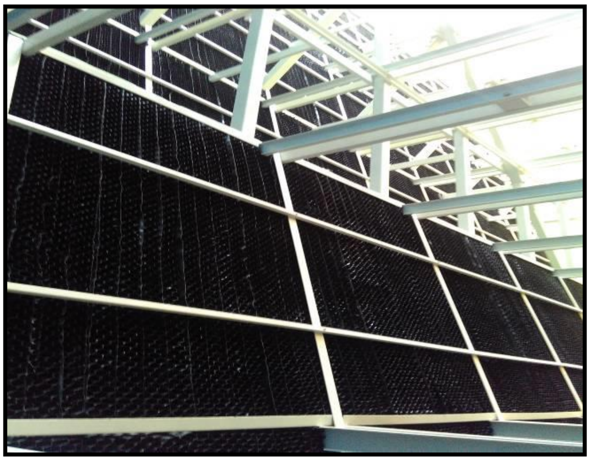
Erection of fen deck



Erection of SS I-beam ( gear box side )



FRP splash box



Erection of SS torque tube

PVC honeycomb drift eliniminator

Plenum area

Completed New FRP Cooling Tower

- Installation of Sintex makes Partition Panel in Urea Cooling Tower (H-4404-1/2/3).

Out of 14 nos. of cells, wooden partition panels of 9 nos. of cells already replaced with Sintex make PVC partition panels in phased manner..

| | |
|---|---|
| Shutdown-2014 | Old ammonia cooling tower cells A1-A2, A2-A3 and A3-A4 |
| Shutdown-2015 | Old ammonia cooling tower cells A4-A5 and A5-A6 |
| Shutdown-2016 | New ammonia cooling tower cells N1-N2 and N2-N3 |
| Shutdown-2017 | Urea cooling tower cells U1-U2 and U2-U3 |

FRP partition panels were erected in new FRP ammonia cooling tower cells along with revamping job. In continuation, during shutdown-2017, existing wooden partition panel of new cooling tower Urea cooling tower cells U1-U2 & U2-U3 were replaced with new Sintex make PVC partition panels. The Job was awarded to M/s Jainam Enterprises, Mehsana against the work order No. Order No.: 6535 / 201004171640 & dated 21/02/2017.

- Insitu refurbishment of following valves was carried out due to passing
- Gate valve, 900mm NB x 150#, at Pump P-4401A, discharge line.
- Check valve, 900mm NB x 150#, at Pump P-4401A, discharge line.
- Gate valve, 900mm NB x 150#, at Pump P-4401C, discharge line.
- Check valve, 900mm NB x 150#, at Pump P-4401C, discharge line.

The above job was awarded to M/s Flotec Technosmart (India) Private Limited, Surat against the contract no. Order No-6535 /201004171816 dated 22/02/2017

- Refurbishing of all Jash make sluice gate (1/2/3/4/5/6) of cooling water pump sumps was carried out. Gear box of all gates were opened, visually inspected and found satisfactory condition. Stem cleaning/ greasing and shutler seat / frame seat facing cleaning & greasing were done. One no. of damaged bottom wedge block of Gate no. 4 was replaced with new one.
- Check valve of cooling water pump P-4401E was replaced with new one (Dual Plate Check Valve, 28" x 150#, Flanged ends, Raised Face) due to passing.

Old Check Valve

New Check Valve

**Replacement of existing Solid FRP fan blades with hollow FRP fan blades in New Ammonia Cooling Tower, (H-4401-7/8)**

Purchase order 201004171138 dated 07/11/2016 was placed on M/s Coolflo, Mumbai to supply the new efficient aerofoil designed hollow FRP fan blades assembly. To provide the more traverse area for fan blade within cylinder, hub diameter was reduced from 2600mm to 1800m. Recirculation of considerable amount of air at the extreme inboard sections of the fan blade subtracts the net airflow. To improve performance, a FRP seal disk was mounted on hub.

Old Fan Blade assembly

New Fan blade assembly with seal disk

First set of blades were installed in H-4401/7 on 10/02/2017. Performance test of the same was carried out under the supervision of Coolflo's Engineer.

31.62% of energy saving was achieved with 9.3% more air flow against the 15%of guaranteed energy saving as per PO. Report for the same is attached below.

Coolflo

COOLFLO ENGINEERS PVT. LTD;
MUMBAI – 400 0065.
AN ISO 9001- 2008 CERTIFIED COMPANY.

## *FAN PERFORMANCE TEST REPORT*

CLIENT: M/S. IFFCO LIMITED, KALOL-UNIT, TEST DATE: 02-02-2017

LOCATION: AMMONIA C.T. FAN MAKE: COOLFLO, (OLD DESIGN FAN) CELL NO.: K4401/7

FAN DIA.: 28 Ft. HUB DIA.: 2630 mm TRAVERSE AREA:76. 66 $M^2$

STACK DIA. 9.88 Mtr. BLADE ANGLE: $13^O$ (PITCH)

01. AIRFLOW MEASUREMENTS: (VELOCITY IN M/SEC.)

| | STN-I | STN-II | STN-III | STN-IV |
|---|---|---|---|---|
| R1 | 4.8 | 3.8 | 3.5 | 2.5 |
| R2 | 9.2 | 8.6 | 7.5 | 6.1 |
| R3 | 9.0 | 9.0 | 9.6 | 8.1 |
| R4 | 7.5 | 4.0 | 8.5 | 9.2 |
| R5 | 1.8 | 5.0 | 1.3 | 1.0 |

AVERAGE VELOCITY = 120/20=6.00 M/SEC

AIR FLOW = AVG. VEL. X TRAVERSE AREA

= 6.00 X 76.66

= 459.96 $M^3$ / SEC

= 16,55,856.00 $M^3$ / HRS.

= 9,73,642.32 CFM

02. POWER MEASUREMENT

| | AMP.(I) | AVG. AMP. | VOLTAGE (V) | POWER FACTOR ( COS $\phi$) |
|---|---|---|---|---|
| R | 89.60 | 90.86 | 429 | 0.743 |
| Y | 94.00 | | | |
| B | 89.00 | | | |

POWER CONSUMPTION @ MOTOR TERMINALS $=\sqrt{3}\ VI\ COS\phi/1000$

$=\sqrt{3}x429x90.89x0.743/1000$

REMARK:

POWER (Cal.) = 50.16 KW
POWER ( Inst.) = 49.44 KW

**Fan Performance Test Report with existing Fan Blades**

Coolflo

COOLFLO ENGINEERS PVT. LTD;
MUMBAI – 400 0065.
AN ISO 9001- 2008 CERTIFIED COMPANY.

## *FAN PERFORMANCE TEST REPORT*

CLIENT: M/S. IFFCO LIMITED, KALOL-UNIT, TEST DATE: 10-02-2017

LOCATION: AMMONIA C.T. FAN MAKE: COOLFLO, CELL NO.: K4401/7

FAN DIA.: 28 Ft. HUB DIA.: 1830 mm TRAVERSE AREA:76. 66 $M^2$

STACK DIA. 9.88 Mtr. BLADE ANGLE: $7^O$ (PITCH)

02. AIRFLOW MEASUREMENTS: (VELOCITY IN M/SEC.)

| | STN-I | STN-II | STN-III | STN-IV |
|---|---|---|---|---|
| R1 | 5.6 | 9.3 | 5.1 | 4.6 |
| R2 | 7.4 | 8.0 | 6.5 | 5.6 |
| R3 | 8.8 | 7.1 | 7.4 | 6.6 |
| R4 | 8.7 | 6.0 | 7.2 | 6.0 |
| R5 | 3.8 | 2.8 | 7.2 | 7.6 |

AVERAGE VELOCITY = 131.3/20=6.56 M/SEC

AIR FLOW = AVG. VEL. X TRAVERSE AREA

= 6.56 X 76.66

= 502.89 $M^3$ / SEC

= 18,10,404.00 $M^3$ / HRS.

= 10,65,422.75 CFM

02. POWER MEASUREMENT

| | AMP.(I) | AVG. AMP. | VOLTAGE (V) | POWER FACTOR ( COS $\phi$) |
|---|---|---|---|---|
| R | 70.00 | 73.33 | 423 | 0.643 |
| Y | 75.00 | | | |
| B | 75.00 | | | |

POWER CONSUMPTION @ MOTOR TERMINALS $=\sqrt{3}\ VI\ COS\phi/1000$

$=\sqrt{3}x423x73.33x0.643/1000$

REMARK: Add: [illegible] /02/2017

POWER (Cal.) = 34.30 KW
POWER ( Inst.) = 37.20 KW

**Fan Performance Test Report with modified Fan Blades**

Coolflo

COOLFLO ENGINEERS PVT.LTD.,
MUMBAI-400 065.
AN ISO 9001- 2008 CERTIFIED COMPANY.

**SUMMARY OF COMPARATIVE PERFORMANCE OF EXISTING COOLFLO FRP FAN & NEW DESIGN COOLFLO FRP BLADE FANS**

CLIENT : M/S. IFFCO LIMITED, KALOL-UNIT,.

ORDER REF.: 6535/201004171138,
DATE.: 07/11/2016

PLANT / LOCATION :CTF-STAGE#III

FAN DIA. : 28 Ft. (8.535 Mtrs.)

STACK DIA. : 9.88 Mtrs.

DATE :10-02-2017

CELL NO. : K-4401/7

BLADE ANGLE AT THE TIP IS 7 Degree.

| | AIR FLOW | | POWER KW (Cal.) | % POWER SAVING | % EXCESS AIR FLOW |
|---|---|---|---|---|---|
| | Cu.M / Sec. | CFM | | | |
| EXISTING FAN COOLFLO HOLLOW FRP (OLD DESIGN FAN) | 459.96 | 9,73,642.32 | 50.16 | BASE | BASE |
| COOLFLO FAN (HOLLOW FRP BLADE) (NEW DESIGN FAN) | 502.89 | 10,65,422..75 | 34.30 | 31.62% | 9.3% |

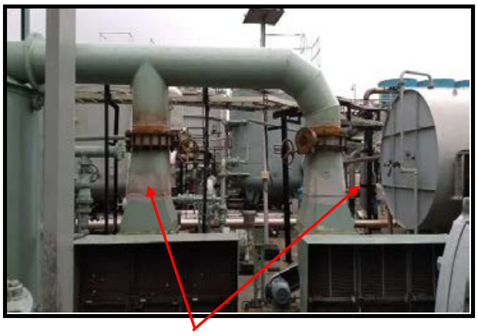
REMARK :
- COOLFLO FAN IS RUNNING SUCCESSFULLY.
- OVER ALL GEAR BOX & MOTOR VIBRATION ARE UNDER LIMIT.
- COOLFLO HAS GIVEN GUARANTEED POWER SAVING OF 15 +/-5% ON NEW DESIGN HOLLOW FRP FAN BLADES.
- COOLFLO FAN HAS ACHIEVED POWER SAVING OF 31.62 % WITH EXCESS AIR FLOW OF 9.3 %

**Summary of comparative performance**

## Misc. DM plant Jobs

- Rerubber lining of SPC unit vessel & HCL unloading tank of was done. The job was carried out by party M/s Unicon Industrial rubber lining, Vadodara at their works.
- Sliding gates in discharge duct of degasser blowers K-4201A/B were replaced by butterfly valves (size: 14” x 150#).

**Old sliding gate valves**



**New butterfly valves**

**Misc. Compressor area jobs**

**Crank shaft replacement of Reciprocating Air Compressor (K-5302)**

Crank shaft of compressor was found jammed. Top cover of crank case and journal bearing (flywheel side) were removed and found the broken crank shaft in two pieces. It was planned to replace the crank shaft. Following activities were carried out.

- All valves of suction side & discharge side were removed.
- Both side piston assemblies were removed.
- Intercooler was removed from its position.
- Flywheel was removed from crankshaft.
- Removed the connection rod from big end bearing at both side.
- Removed the broken crank shaft.
- Removed the connecting rod from small end bearing at both side.
- LP side connecting rod was found bend. Replaced the same with new one.
- Both side connecting rods were assembled. At LP side new small end bearing was used.
- Fixed the reconditioned crank shaft at its position.
- Assembled the both big end bearings (new).
- All main bearing were assembled. At flywheel side & oil pump side new journal bearing were used. All studs (M20) of main bearing were replaced with new ones.
- All bearing clearances measured and recorded.
- Flywheel was fixed at its position.
- Valve & piston assemblies at both sides were carried out.
- Intercooler was placed at its position.
- Coupled the motor with flywheel by V-belts. Alignment between motor & flywheel was corrected. Job was handed over to production department.
- Final readings are as under;

| **Description** | | **Clearance value** |
|---|---|---|
| Main bearing | Fly wheel side | 0.26mm |
| | Middle side | 0.15mm -0.17mm |
| | Oil pump side | 0.30mm |
| Big end bearing | LP side | 0.15mm |
| | HP side | 0.15mm |
| Small end bearing | LP side | 0.15mm |
| | H.P. side | 0.15mm |

# B & MH. PLANT
(MECHANICAL)

## PLANT TRANSFER CONVEYOR-M-2110

Following jobs were carried out.

- Head pulley, Tail Pulley, Bend pulley, Gravity pulley and Snub pulley were inspected and greasing done.
- Replace snub pulley with spare pulley and provided new rubber lagging.
- Repairing of Tega make Tru- Trac- Trough rollers for arresting sway of conveyor belt.
- 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 dismantled and repositioning after serviced.
- All damaged and noisy carrying rollers, Self alignment carrying roller frames, Self alignment return roller frames and Tracking rollers were replaced.
- Kaveri make skirt rubber opened and reposition after cleaning.
- All impact rollers serviced and damage rollers replaced with spare rollers.
- Positioned all return rollers replaced with spare rollers.
- Gear box input and out coupling all bushes are replaced with spares.

## TWO WAY FEED HOPPER CHUTE-M 2111

- Servicing of two way discharge flap valve.
- Servicing of all bearings with cleaning and greasing.

## FRESH UREA SHUTTLE CONVEYOR-M-2112

Following jobs were carried out.

- Preventive maintenance of Gear Box carried out & Coupling done after proper alignment with new rubber bushes.
- Gear box oil flushing and new oil provided. (Servo system-460).
- All noisy carrier, guide and return rollers serviced with oil and damage rollers replaced with spare rollers.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.
- Kaveri make skirt rubber opened and reposition after cleaning.
- Gear box input and out coupling all bushes are replaced with spares.
- Brush pulley dismantled and repositioning after serviced.

- Tripper Gear box oil replaced and coupled the same with motor with new Rubber bushes after alignment.
- Tripper output chain guard opened and boxed up work done after checking of chain cleaning and condition.

**<u>RECLAIM CONVEYOR-M-2117</u>**

Following jobs were carried out

- Preventive maintenance Gear Box and Coupling done after proper alignment with new rubber bushes.
- Gear box oil flushing and new oil provided. (Servo system-460).
- All noisy carrier, guide and return rollers serviced with oil and damage rollers replaced with spare rollers.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.
- Rubber lagging provided on snub Pulley.
- Gear box input and out coupling all bushes are replaced with spares.
- Brush pulley dismantled and repositioning after serviced.

**<u>BAGGING BUILDING FEED CONVEYOR-M-2121</u>**

Following jobs were carried out

- Head pulley of conveyor belts bearing serviced and cleaning, and align pulley with Gearbox at both side.
- Preventive maintenance of Gear Box carried out and Coupling done after proper alignment with new rubber bushes.
- All noisy carrier, guide and return rollers serviced with oil and damage rollers replaced with spare rollers.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.
- Gear box input and out coupling all bushes are replaced with spares.
- Gear box oil flushing and new oil provided. (Servo system-460).

**<u>BAGGING BUILDING HOPPER CONVEYOR-M-2122</u>**

Following jobs were carried out

- All noisy carrier, guide and return rollers serviced with oil and damage rollers replaced with spare rollers.
- Belt conveyor replaced with spare belts with vulcanization joint.
- Kaveri make skirt rubber opened and reposition after cleaning.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley.
- Take up studs were serviced.

- Preventive Maintenance of Gearbox carried out and Coupling done after proper alignment with new rubber bushes.
- Gear box oil flushing and new oil provided. (Servo system-460).

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

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
- Take up studs were serviced.
- All return rollers were modified work done with we uses available rollers standardization.
- Skirt rubber modified work done with we uses available skirt rubber standardization with kaveri rubbers.

**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
- Take up studs were Serviced.
- Repairing of vulcanizing joint.
- Replaced Gearbox oil .(Servo Mesh SP-460).
- All return rollers were modified work done with we uses available rollers standardization.
- Skirt rubber modified work done with we uses available skirt rubber standardization with kaveri rubbers.

**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.
- Tail pulley with gravity structure fabrication and replacement job work done with structure extra strengthening work provided.

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

Following jobs were carried out

- Preventive Maintenance of conveyor belt carried out.
- Complete greasing of all bearings done.
- Preventive Maintenance of Gearbox carried out and Coupling done after proper alignment with new rubber bushes.
- Skirt rubber modified work done with we uses available skirt rubber standardization with Kaveri rubbers.

**BAGGING MACHINE-M-2101/1,2,3,4,7,8, 9A,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 gearbox cleaning and oil flushing with new oil. (Servo system-460)

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

All stitching machines and spare machines were overhauled.

**AIR BLOWER-K-2161**

All lines were opened, checking and inspect, cleaned and boxed up.

**AIR BLOWER-K-2704**

- All lines were opened, checking and inspect, cleaned and boxed up
- At outlet venture flange joint work done.

**CYCLONE SEPARATOR-V-2704**

Separator was opened, cleaned and boxed up.

**UREA SOLUTION TANK-T-2704**

Tank was opened, cleaned and boxed up with new gaskets.

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

- All screens were opened and check wire mesh condition, cleaned and boxed up with new “A” section rubber gasket.
- All clamps bolts serviced and damaged bolts replaced with new bolts.

**New Reclaim Machine HM–470, (M-2116-A)**

- Dismantling of scraper boom and chain from position. Found 4 nos scraper blades are bend that is rectified and completed.
- Removal of buckets and chain from elevator structure and found many links are defective like broken/bent and crack condition in bracket. Replaced 25 nos link by new and other repaired by welding on site.
- Proper checking after fitting of bucket and chain completed.
- Found bucket elevator drive sprocket tooth was wearied out that is rectified by welding and grinding.
- Removed scraper gearbox from main shaft and replaced by new gearbox (NK-KCUH -355S) Ratio 90:1, and competed.
- Checking of king post and slewing bearing rollers are found ok.
- Greasing of slewing bearing and rollers done manually and completed.
- Checking of luffing drum and wheel condition are ok.
- Wire rope condition found also ok.
- Skirt support structure on head pulley of link conveyor rectified and strengthening completed.
- Overhauling of all drive motors like slewing, link conveyor, scraper and elevator are done by electrical department side.
- Alignment done of all motors and completed.
- Replacement of oil from all gearbox, thruster and fluid coupling in machine and completed.
- Link conveyor replacement job work done with 1000mm X 22 mtrs.
- Link conveyor belt alignment completed by adjusting return rollers and checked found ok.
- Checking of all operation like scraper, elevator, Travel, slewing and luffing working found normally.
- Load trial taken and handling 100 ton material and working of reclaim machine found normally.

**Old Reclaim Machine HM–122, (M-2116)**

- Dismantling of slewing gearbox (CVS 280, Ratio 2800:1) and replacing the output oil seals 2 nos. 150X160X12. Old gland packing removed and replaced by new.
- Checking of slewing gearbox after lifting of top cover and removal of worm wheel cum pinion and found all pinion teeth was damaged at bottom contact area. Also found 3 nos. teeth of output wheel was damaged condition.
- Removal of scraper take up unit and replaced broken cone washer and overhauling completed.
- Removal of elevator take up unit and replaced broken cone washer and overhauling completed.
- Replacement of idler gear 1 nos. of train and its over hauling including replacement of bearing (NA 4914) and sleeve.

- Through inspection of slewing gearbox and replacement of slewing gear pinion 12 teeth, hub and shear pin.
- Checking of luffing mechanism and wire rope condition.

  Following alignment of gear box with motor work done.

  - Main Drive
  - Luffing Drive
  - Travel Drive
  - Slewing Drive
  - Link Conveyor
- Lubrication / Greasing and overhauling of reclaim machine.

# INSPECTION

# AMMONIA PLANT

(INSPECTION)

The following major inspection activities were performed in Ammonia Plant.

- Inspection of Primary reformer, catalyst tubes and risers with various NDT Techniques. Details are given at **Annexure-1 to 5.**
- Visual inspection of equipment.
- Ultrasonic flaw detection on selected weld joints and parent metal of elbows of New Converter (S-50) loop and other critical pipelines was carried out. Details are given at **Annexure- 6.**
- Thickness measurement of various equipment and HT/LT Convection coils of primary reformer was carried out. Details are given at **Annexure-7.**
- Thickness measurement of various pipelines was carried out. Details are given at **Annexure-8.**
- Measurement of residual magnetism at various parts of rotating equipment 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 given at **Annexure-10.**
- 01 no. Elbow (E2) was replaced in converter loop line (SG-1303-08-14") during this shutdown. DP test, Radiography, SR and Hardness measurement of these joints before and after Stress Relieving carried out and found satisfactory.
- Inspection of newly fabricated pipelines and fabrication jobs executed by Maintenance and Technical department.
- NDT's viz. DP, RT and UFD 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 tests of welders employed by contractors.
- Various NDT's at the site of M/S Onshore Construction Company Pvt. Limited who were awarded job of piping fabrication and equipment erection under ESP-III scheme.
- 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.

## 101-B, PRIMARY REFORMER

## 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, 90 tubes are placed in B grade and 246 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.**
- Following additional inspection activities were also performed by M/s PDIL along with AUS this year.
    - **Visual inspection of catalyst tubes for general assessment and bowing.**

      Indicate that all the tubes were almost straight. No marked bowing or sagging could be observed in any tube. Visual observation in general showed shining grayish appearance for the lower portion of the tubes whereas upper portion of some tubes were covered with red oxide distributed here and there. Generally the tubes were free from surface deposit.
    - **Diametrical Growth Measurement (DGM)**

      The increase in the outside diameter of the individual reformer tubes & riser tubes were measured using digital micro Vernier caliper. The tubes diameter was checked at various places along the tube length up to approachable height. The measured values of individual tubes are within tolerable limits considering base OD value of 113.6 mm & 124.44 mm Catalyst tubes & Riser tubes respectively.
    - **Ferrite Measurement (FM)**

      Ferrite measurement were taken on the parent metal surface of Reformer tubes & Riser tubes at various places starting from bottom portion up to approachable height. The measured values of individual tubes are observed within tolerable limits.

- DP test of all riser tube to weldolet weld-joints was carried out. No service defects were revealed.

- DP test of random catalyst tube to weldolet 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. Creep was found in the range of 0 - 0.17 % for 335 nos. In 01 no. of tube creep observed in the range of 0.17 to 0.70 %. Creep measurement of the riser tubes at tunnel slab level was also carried out using digital micrometer. Creep in all Riser tubes was observed in the range 0.33 – 1.10 %. The report is attached at **Annexure 3**.

- In-situ Metallography carried out on Catalyst tube parent metal, Riser tube parent metal, Catalyst tube to weldolet weld & Riser tube to weldolet weld joint. The detailed report is attached in Annexure-10.
- Radiography of all 08 nos. weldolet to riser 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 Bottom Manhole**

- 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.
- Refractory at the ceiling in front of 1st& 2nd row tunnel counting from East side (Nr. Man hole) was found fallen hence exposing the holding anchors.

- Rubbing on the coils observed near anchor supports, however no reduction in thickness was noticed. (Also observed in previous inspection)

- Peeling off of top layer of casting was observed on first two rows of east side anchor supports of mixed feed coils. (Also observed in previous inspection)

- Support piece found lying at the bottom floor.
- All Mixed feed coil supports found cracked / damaged at south end. The same was repaired and new supports were provided where ever required.

- Tunnel thermo well pipes were found slightly bent, scaled and eroded. Same was observed during previous inspection.
- Bottom floor refractories found loosen at some places and flooring found sagged at some location. Same was observed during previous inspection.
- Top layer refractory was found peeled off and fallen near west wall.

- Refractory found damaged and fall down at the end of the 4$^{th}$ tunnel (counting from west) towards south side.
- Tunnel slab found fallen in 4$^{th}$ tunnel (counting from west).
- Minor refractory found damaged at scattered locations.
- Insulation of East, West and South wall was found satisfactory.
- Mixed Feed coil found sagged in South-West segment compared to North-East Segment. Same was corrected by providing new supports to the extent possible.
- Some Brick wall segments were found bent.

**<u>HT-LT CONVECTION SECTION FROM TOP MANHOLE</u>**

- HT and LT super heater coils were found in satisfactory condition.
- Supports of LT/HT steam super heater coils were found in satisfactory condition.
- Gap observed between Liners in East wall just above the partition wall.
- HT steam super heater top coil tube fins found damaged in 02 nos. tubes. (5th & 9th tube counting from North)

- Damper condition was satisfactory however liner was found bent and distorted near the damper.
- Thermo well near damper was found slightly bent.
- LT Side, Fiber blanket found fallen near top coil at east side.

**AUXILIARY BOILER FURNACE**

- Thin hard brownish scales were observed on the tubes.
- Metallic draft tubes were found burnt off / thinned inside the furnace.

- Refractory around burner no-5 (topmost) was found severely damaged. Refractory around other burners have minor damages.

- Top header refractory was found having cracks at few locations.
- Top layer of bottom side wall refractory found loose in both East & West side.
- Center partition wall refractory found sagged and some of the refractory bricks found cracked/damaged.

- Tube supported refractory found loose and damaged adjacent to burner no. 4 (counted from bottom) in East wall.

- North side bottom down comer header refractory found damaged in bottom most area towards West direction. Observed in past Inspection also.

- Refractory just above the access door was found loosened.

**<u>VESSELS & OTHER EQUIPMENT</u>**

**<u>101-CA SHELL, PRIMARY WASTE HEAT BOILER</u>**

Visual inspection of Primary Waste Heat Boiler shell was carried out after removal of Shell liner & its tube bundle. Following observations were made:

- All Circumferential and Longitudinal seam of the shell found satisfactory.
- Deep grinding marks observed on all 4 nos of backing strips of the shell.
- Scattered dent marks observed on the shell.
- Liner of the gas inlet nozzle found buckled and detached from its position at several location.
- Gas inlet nozzle liner towards 103-D found bulged with approx height of 2”.

- Thermowell found damaged and detached from its position.

- Thickness measurement of the shell was carried out and found satisfactory.
- Liners and gas distributor were replaced. DP test was carried out during fabrication work and found satisfactory.

**101-CB SHELL, PRIMARY WASTE HEAT BOILER**

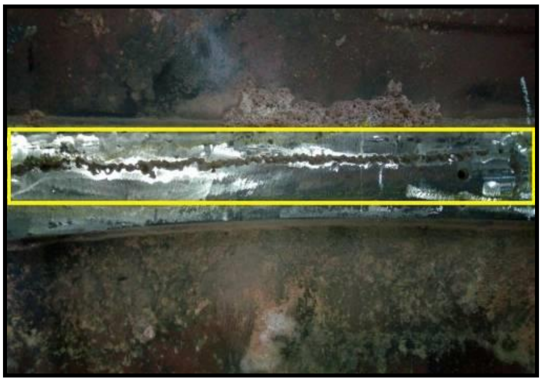
Visual inspection of Primary Waste Heat Boiler shell was carried out after removal of Shell liner & its tube bundle. Following observations were made:

- Erosion observed in entire circumference up to 6” length from top of the shell.

- All Circumferential and Longitudinal weld seam of the shell found satisfactory.
- Deep grinding marks observed on the all backing strips of the shell.

- Welding tack observed above 1st backing strip (Counting from top) at north side. (Need to be remove)
- Superficial cracks were observed on surface of the top backing strip.

- Erosion observed in entire circumference of the 2nd backing strip having approx. depth of 2.0 mm. (Counting from top).



- Dent was observed having approx. size of 10 mm x 15 mm with depth of 4-5 mm at East side. (Need to be repaired)

- Cracks were observed at seven location of bottom last backing strip. (With approx. length of 150 mm to 200 mm each)

- Liner of the gas inlet nozzle found minor buckled at several locations.
- Thickness measurement of the shell was carried out and found satisfactory.
- Liners and gas distributor were replaced. DP test was carried out during fabrication work and found satisfactory.

**<u>102-C (SECONDARY WASTE HEAT EXCHANGER)</u>**

- All tubes of 102-C were inspected by RFET (Remote Field Electromagnetic Technique) to detect, locate and measure the extent of corrosion, erosion if any. No any major abnormality was observed during testing. RFET observation are as under.

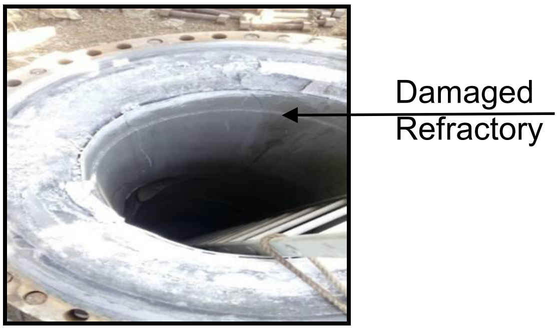
| Date of Inspection | MARCH 25, 2017 |
|---|---|
| <20% Wall Loss | 750 |
| 21-30% Wall Loss | 0 |
| 31-40% Wall Loss | 0 |
| 41-50% Wall Loss | 0 |
| >50% Wall Loss | 0 |
| Blocked Tubes | 0 |
| **Total Tubes Inspected** | **750** |
| Plugged Tubes | 0 |
| **Total Tubes in Unit** | **750** |

- Ultrasonic thickness measurement of shell was carried out and found satisfactory.

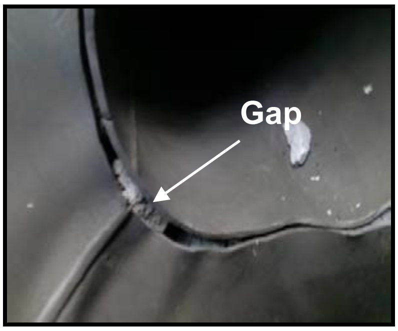
**103-D, SECONDARY REFORMER**

**FROM TOP ENTRY**

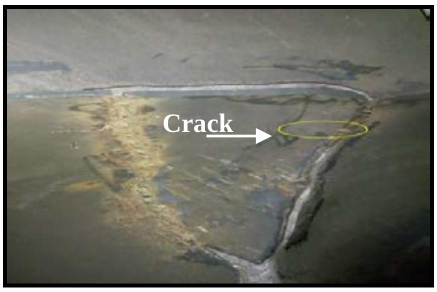
- Near top flange refractory found damaged creating gap between liner and Refractory.




- At scattered locations cracks observed on refractory lining of the shell and cone.
- Thermowell was found intact.
- Approx 1” Gap was observed between shift liners of top shell to transfer line.




- Crack observed in the Patch liner having approx. length of 40 mmon the junction of transfer line.



- Crack observed in the man way bottom peripheral liner having approx. length of 50 mm.

- Inward bulging of approx 1” observed in top shell liner all around the circumference. The ID measured at this location & was found to be approx. 700mm. The location of this bulged location is approx 1990mm from vessel top flange face.


- Refractory found loose in cone portion of the shell at North and East side.

- Refractory found loose in straight portion of the shell at East and West side.

- Gap observed between cone refractory and bottom peripheral liner.

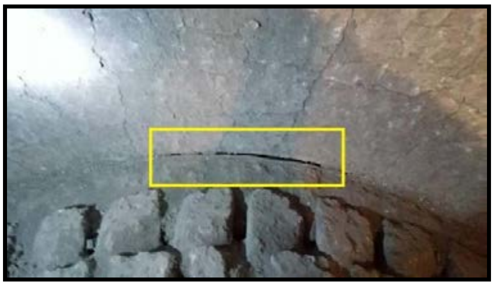
**Visual inspection was carried out after removal of alumina balls catalyst from the vessel.**

- Scattered cracks were observed in entire shell and cone refractory.

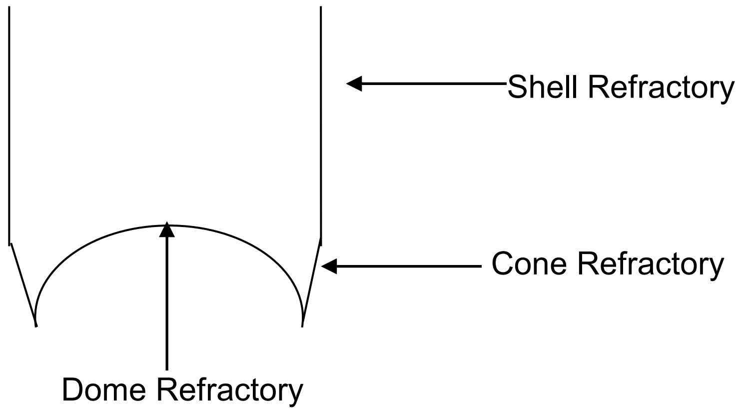
- Dent/Abrasion marks of alumina balls observed with white coloration in prominently in shell refractory and slightly in cone refractory.

- Alumina balls found stuck up between gaps of dome refractory.

- Condition of Thermowells found satisfactory.
- Gap observed having approx. 450 mm x 10 mm area between cone and dome refractory at west side.



- 1st layer of the shell refractory found peeled off at 4 locations.




**From Bottom DOME**

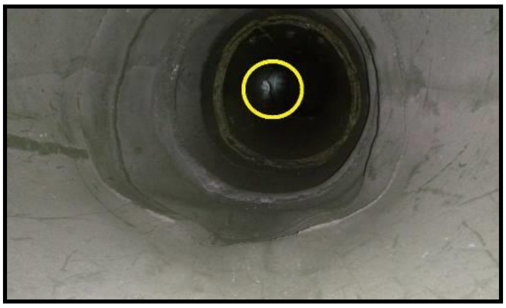
- The refractory around the 101-CA/CB gas inlet nozzles (approx half of the top circumference) was found eroded and loosened. Same was observed during previous inspection also.

**101 CA Nozzle View**

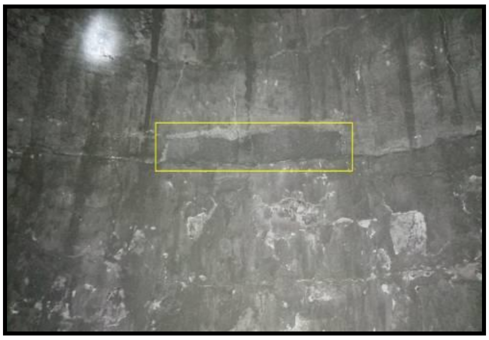
**101 CB Nozzle View**

- Gap was observed between the 101-CA/CB gas inlet nozzle liner and the shell refractory joint. Gap of approx 2" was observed towards the 101-CB nozzle. The same was observed during previous inspection also.

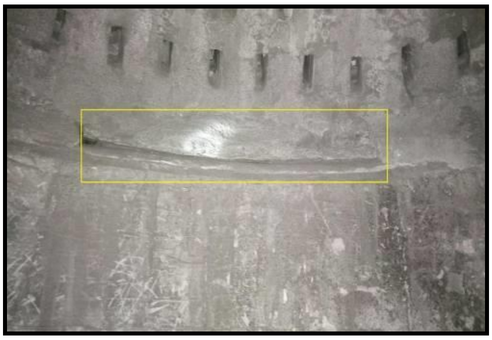

- The liner inside the 101-CB gas inlet nozzle was slightly buckled /distorted. Condition of the thermo well was found satisfactory. Same was observed during previous inspection also.
- The liners inside the 101-CA gas inlet nozzle were found slightly buckled /distorted. Insert liner condition was found satisfactory. Thermowell found dethatched / missing.

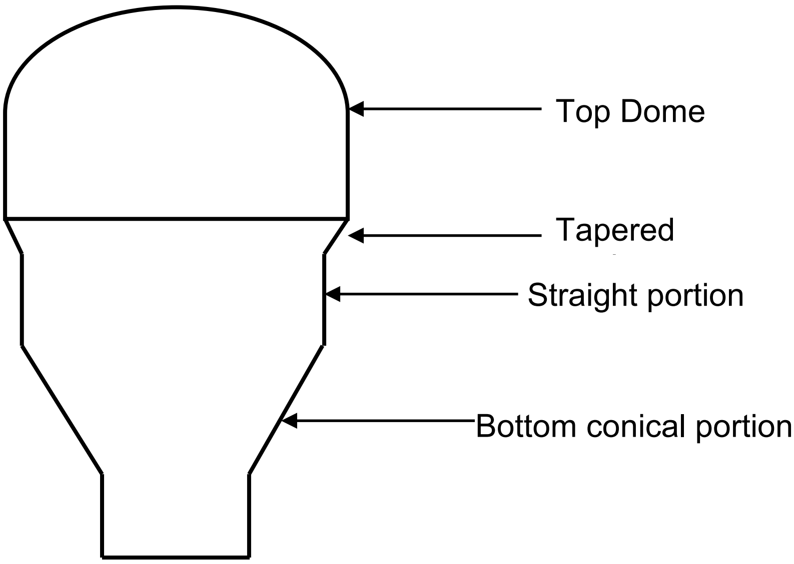


- Top Brick dome refractory condition found satisfactory.
- Bottom conical refractory condition found satisfactory.
- In straight circumferential joint, refractory found fallen down in approx. 450mm x 50 mm area towards north direction.



- Refractories of tapered portion found fallen down in approx. length of 750 mm. above 101-CA nozzle.





**103-D, Air Mixture Nozzle:**

- Circumferential weld of central pipe with top cover liner found eroded.

- Crevice observed on both sides of long seam of old pipe.
- Condition of the perforated plate found satisfactory.
- All stitch weld condition found satisfactory.
- DP test carried out of all weld joints of new air mixture nozzle including bell mouth and found satisfactory.

**1123-C, NEW SYN LOOP BOILER**

**Channel Side**

- The condition of the gas inlet line & the expansion bellow found Satisfactory.
- Channel shell condition was found satisfactory.
- Condition of the tube holes was found satisfactory.
- Overall condition was found satisfactory.

**Shell Side**

- Condition of the weld joints were found satisfactory.
- Rust/ scaling observed on the weld & Dished End.
- Rust / scaling observed on the tube baffles and some of the tubes.

- Rust / scales observed lying on the shell bottom.

**101- EA, $CO_2$ ABSORBER**

**(Manhole no. counting from top of the vessel)**

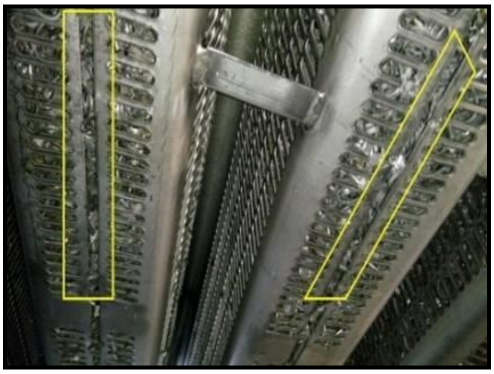
**From Manhole- 3**

- 01 no. Rasching ring holding clamp was found loose at south side.

- Brownish grey coloration was observed on the shell as well as on all the gas risers.
- Sample collectors were found intact in its position.
- Condition of the gas risers was found satisfactory.

**From Manhole- 4**

- Excessive gap as compared to others was observed in several rasching ring holder.(between two half of holder)



- Condition of liquid distributor was found satisfactory.
- Brownish grey coloration was observed on the shell as well as on all the fittings.
- Corrosion cavities and holes were observed on South most liquid distributor collector plate, located just below the liquid distributor. (Visible just from M/H)

- Gas riser holding plate was found eroded/damaged from top edge at west and east side.



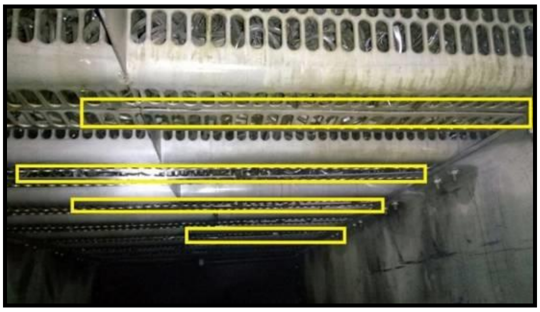
- Sample collector was found twisted.

- Rubber piece was found lying on the gas riser holding plate at west side.

- Liquid distributor bottom nozzle found eroded at bottom edge. (Visible just from M/H)

**<u>From Manhole- 5</u>**

- Excessive gap as compared to others was observed in several rasching ring holder. (Between two half of holder).



- Grey coloration was observed on the shell.
- Sample collector was found detached from its welding.

- Piece of rasching ring was found stuck up between shell and riser plate.

**<u>From Manhole- 6 (Inspected from outside)</u>**

- Condition of gas distributor was found satisfactory.
- Grey coloration was observed on the shell.

**<u>102-EB, $CO_2$ STRIPPER</u>**

**<u>FROM TOP MANHOLE</u>**

- Demister pad supporting strips were observed slightly downward bent (mostly in centre portion) and supporting rods were found satisfactory.
- 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. (Image no.01)

- U-Clamps of North- East and South- West side distribution header were found loose. Need to be tightened. (Image no.02)

- West-South side distributor header found rubbing with U-clamp support causing abrasion in approx. 60 mm X 8 mm area at bottom in cap of header. (same were marked with yellow chalk) (Image no.03)

- East-North side distributor header found rubbing with U-clamp support plate causing dent/slot of 100 mmX20 mm and 50 mmX10 mm area in cap of header at bottom and west side respectively. (same were marked with yellow chalk) (Image no.04)

- Header support pipe at North-West side found cracked/detached. (Image no.05)(Need to be repaired)

- 01 no. bolt and filler wire (approx size of 90 mm in length) were found stucked up between shell liner and trays below distribution header towards South-East corner and East side respectively. (Image no.06 & 07)


- North-East side U-clamp hole found enlarged in bottom plate (need to be repaired) Further with U-clamp nut found missing and same was lying in the bottom channel floor. (Image no.08) (Need to be repaired)


- A crack was observed having approx length of 75 mm in the bottom of the U-clamp support plate at North-West side. (Image no.09) (Need to be repaired)


**<u>103-E1, HP FLASH VESSEL:</u>**

**<u>FROM TOP MANHOLE :</u>**

- Silver gray coloration was observed at top dish end and shell coarse.
- Demister pipe found intact in position.
- Liquid distributor header and its distributor pipes found intact in position, color of the same was observed silver gray with black patches at scattered location and liquid flow marks.
- Distributor pipe holding supports found intact in position.
- Liquid collectors and distributor trays segment were found intact in its position.
- Weld joints found in satisfactory condition without any sign of corrosion.

- Liquid found accumulated in HPFV RV header line.
- Piece of Black polyethylene was found stuck up between shell and liquid collector plate at N-W direction.

- 02 nos. piece of plate found lying in floor of liquid collector trays below 1st liquid distributor header towards West side (Header counting from North).

**FROM BOTTOM MANHOLE :**

- No abnormality observed however lumps of soft black debris found adhered on surface of the shell.

**103-E2, LP FLASH VESSEL**

**FROM TOP MANHOLE COMPARTMENT**

- Demister pad was found intact in its position in satisfactory condition.
- Condition of bubble caps found satisfactory.
- Distributor collectors / drain pipes in West direction was found satisfactory.
- Debris found lying on the surface of bubble cap resting plate.

- Debris found adhered on the bubble cap resting plate stud.

- All weld joints found satisfactory.

**FROM SECOND MANHOLE COMPARTMENT**

- Rectangular riser box and other fittings found intact in position.
- Holding bolts of bottom tray found loose and bent at many locations. 03 nos. bolts are missing from at north side.

- Silver coloration observed at scattered locations. Weld joints observed as if etching has occurred resulting in slightly differing colour in comparison to adjacent shell surface.
- Bubble cap tray drain line was detached from its welding of top plate and support plate.

- 02 nos. plates having approx. size of 10”x36” found lying on the rectangular riser box.

- 03 nos. holding clamp of top bubble tray found missing and 02 nos. clamp of the same found laying near the rectangular riser box.

**BOTTOM MANHOLE COMPARTMENT (FROM OUTSIDE)**

- Vortex plate of the header found intact in position.
- Silver coloration observed at scattered locations.
- aMDEA liquid found accumulated on the bottom floor of the vessel.
- 01 no. filler wire observed lying on the bottom floor of the vessel.

**105-E ,DEHYDRATOR**

**FROM BOTTOM DOME:**

- Bubble cap holding plate found satisfactory.
- Bubble cap surface found oily.
- Distribution header flange bolt found intact.
- Plate piece was observed inside the Gas inlet distribution header having approx. size of 100 mm X 30 mm. Same was removed.

- Loose scaling was observed on shell surface.
- Loose scaling was observed on surface of the gas inlet distribution header.
- Brownish coloration observed inside the shell

**FROM TOP DOME (From Out side)**

- Bubble cap holding plate found satisfactory.
- 01 No. bubble cap found loose towards South side.
- Demister pads found intact in position.
- Loose scaling found at bottom of the manhole manway.
- Debris was found lying on the bubble cap plate.
- Oily surface found on bubble cap.
- Brownish coloration observed inside the shell.

**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 1.0 mm depth was observed at scattered locations.
- One of the holes at south end of phosphate dozing line (1" NB) was found enlarged.
- Few bolts and clamps of Demister Pad holding cover plate were found loose.
- Grill covering the Down Comers were found bent at few locations.
- 6" BFW header found bent from centre and 02 nos. nut-bolts of the flangefound loose at north side near elbow.
- 1" NB blow off line at bottom of the shell found filled with water.
- 02 nos. Demister Pad holding plate bolts found sheared at the top. (Same was observed at previous inspection).
- On East side demister pad stiffener plate fastener was found missing at 04 locations at bottom side of plate.
- On East side, Stiffener plate tack welding of bottom demister pad was found detached at few locations.
- 01 no. stud of the south side man hole found loose. (Need to be tight)
- Erosion of the weld was observed in top demister plate holding stiffener at several locations.
- Down comer no. 2,4,6,7 & 9 counting from south side found filled with water.

**<u>102-F, RAW GAS SEPARATOR</u>**

- Epoxy paint condition was found satisfactory.
- 02 segments of Demister pads were found lifted from its position at East Side.
- Putty applied on the circumferential weld joint of manhole nozzle with shell from inside was found detached approx in top half of the circumference. Marked with yellow chalk.
- Condition of Gas inlet nozzle located at East side was found satisfactory.
- On Dished end soft blackish scales were observed, however the paint behind it was found intact.

**<u>103-F, REFLUX DRUM</u>**

- Demister pads were found intact in its position.
- Top layer of Epoxy paint/primer was found peeled off at scattered locations in bottom half of the vessel.
- Nozzle condition was found satisfactory.
- Soft Blisters filled with liquid matter were observed in complete dish end.

**104-F, SYNTHESIS GAS COMPRESSSOR SUCTION DRUM**

- Grayish black coloration was observed on bottom area, whereas brownish Coloration was observed on remaining surface.
- Thin scales were observed at bottom dish end.
- Blackish coloration was observed inside the inlet hood baffle.
- Condition of the inlet hood baffle was found satisfactory.
- Bottom vortex breaker was clear and its welds were found intact.
- Condition of demister pad was found satisfactory.
- Condition of weld joints was found satisfactory.
- Condition of the nozzle weld joints was satisfactory.

**105-F, SYN. GAS COMPRESSOR 1$^{ST}$ STAGE SEPARATOR**

Visual inspection carried out from outside.

- The coloration of vessel was brownish black from inside.
- Demister pads were found intact in position.
- Scattered minor pitting were observed throughout the shell surface, the same was observed in past also.
- Entire internal surface was found oily.
- The Overall condition of the vessel was found satisfactory.

**106-F, AMMONIA SEPARATOR**

Visual inspection of the separator was carried out from outside.

The following observations were made.

- Brownish black colouration was observed inside the vessel.
- Demister pad was found intact with its fasteners.
- Inlet distributor supports were in satisfactory condition.
- Whitish Oily sludge observed lying on the bottom of the shell.
- Overall condition of the vessel seems to-be satisfactory.

**107-F, PRIMARY AMMONIA SEPARATOR:**

- Blackish brown coloration was found inside the vessel.
- Scattered thin scales were observed on the shell and dished end.
- Internal surface was found oily.
- The condition of all the weld joints of the shell, dished ends and nozzles was found satisfactory.
- Scattered pitting was observed on entire shell surface, more prominent on bottom portion.
- Condition of target plate was found satisfactory.

- Hard scaling observed at manhole man way and same were found peeled off at scattered locations.
- Thermo well found intact in position.

**109-F, REFRIGERANT RECEIVER:**

- The shell had assumed Grayish black coloration in upper half. Bottom half of the shell was having brownish coloration.
- The condition of all the weld joints of the shell, dished ends and nozzles was found to be satisfactory.
- Thin scales were observed on both the dished ends.
- Minor scattered pitting / scales were observed in a width of approx. 250mm throughout the length of vessel at its bottom most portions. The same was observed in past also.
- Entire bottom surface was found oily.
- Thermo-well found intact in its position.
- Overall condition of the vessel was found satisfactory.

**110-F, FIRST STAGE REFRIGERANT FLASH DRUM:**

- Brownish black coloration was observed inside the drum.
- Entire internal surface was found oily.
- The demister pads were found intact in position.
- Scattered scales were observed on the surface of the dish ends and shell.
- Thermowell condition found intact.
- Liquid outlet line weld and vertex plate condition found satisfactory.
- Overall condition of the vessel was found to be satisfactory.

**111-F, SECOND STAGE REFRIGERANT FLASH DRUM:**

- Blackish gray coloration was observed inside the shell surface.
- Entire internal surface was found oily.
- The demister pads were found intact in position.
- Dish ends were found covered with scattered scales.
- Condition of all shell weld joints was found satisfactory.
- Thermo well found intact in position.
- Oil found accumulated behind the make-up nozzle from 109F.

**112-F, THIRD STAGE REFRIGERANT FLASH DRUM:**

- The demister pads were found intact in position.
- The coloration of the inside surface of shell was brownish black.
- Surface of the entire vessel was found oily.

- Scattered hard scales were observed on the shell
- On East dish end thick scales with oily surface were observed.
- Condition of all the nozzles was found satisfactory.
- Condition of all the weld joints was found satisfactory.
- Overall condition of the vessel was found satisfactory.
- Thermowell condition found intact.

**MISCELLANEOUS JOBS**

**ESP-III JOBS:**

- Various activities performed for piping fabrication and equipment erection jobs at M/s ONSHORE site.

  Viz,

  Fit up inspection, root weld/ final weld DP witness, final weld visual, Witness of Hardness measurement for alloy steel pipelines weld joints, review of PWHT & Dehydrogenation charts, witness of PMI for alloy and Stainless steel pipelines, review of radiographs etc.

**WELDER QUALIFICATION TESTS**

- Performance qualification test of 15 Nos. welders offered by M/s General Engg., Bharuch (Mech. Planning) (W.O.No- 201004171161) was carried out. 05 nos. of welders were qualified during the test. These welders were allowed to perform fabrication jobs in ammonia and urea plant during this ESP III.
- Performance qualification test of 15 Nos. welders offered by M/s J & J Engg., (W.O. No. 201004171160) was carried out. 05 nos. of welders were qualified during the test. These welders were allowed to perform fabrication jobs in ammonia and urea plant during this ESP III.
- Performance qualification test of total 95 nos. welders (W.O.No. - 201004171302) offered by M/s ONSHORE CONSTRUCTION COMPANY PVT LTD. was carried out. Total 64 nos. of welders were qualified during the test. These welders were allowed to perform fabrication jobs in ammonia and urea plant under ESP III scheme.
- Performance qualification test of 03 Nos. welders offered by M/s SKYWIN ENGG. (W.O. No.201004171641) was carried out. 03 nos. of welders were qualified during the test. These welders were allowed to perform welding of 101-CA & CB Liner replacement job.
- Performance qualification test of 05 Nos. welders offered by M/s SHREE GANESH ENGG. (W.O. No.201004171642) was carried out. 05 nos. of welders were qualified during the test. These welders were allowed to perform welding of 101-CA & CB Liner replacement job.
- Performance qualification test of 12 Nos. welders offered by M/s J & J ENGINEERS. (W.O. No.201004171900) was carried out. 06 nos. of welders were qualified during the test. These welders were allowed to perform miscellaneous fabrication job in ammonia and urea plant during ESP III.

- Performance qualification test of 02 Nos. welders offered by M/s BASH ENGG. (W.O. No. PNMM/EM-144/P/951B/ICB) was carried out. 02 nos. of welders were qualified during the test. These welders were allowed to perform fabrication job of VAM Cooler steam line in urea plant during ESP III.
- Performance qualification test of 03 Nos. welders offered by M/s EDAC (W.O. No.201004171439) was carried out. 02 nos. of welders were qualified during the test. These welders were allowed to perform fabrication job of Electrical Cable tray support required as per Electrical department during ESP III.
- Performance qualification test of 02 Nos. welders offered by M/s EDAC (W.O. No. PNPM/EM144/E/205K) was carried out. 02 nos. of welders were qualified during the test. These welders were allowed to perform fabrication job of Instrumentation Cable tray support required as per Instrument department during ESP III.

**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.

**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.

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

**ULTRASONIC THICKNESS MEASUREMENT**

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, D.P TEST OF BEARINGS & COUPLING BOLTS OF HIGH SPEED TURBO MACHINARIES**

Measurements of residual magnetism (gauss) on rotary and stationary parts of rotary equipment were 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.**
D.P. Test was carried out on all bearings to check condition of liner and its bonding and all coupling bolts of High Speed rotary equipment.

## INSITU METALLOGRAPHY EXAMINATION

In order to evaluate the condition of certain critical plant equipment and pipelines operating at more than 300 deg. C temperatures, parent metal, HAZ welds , weld joints of dissimilar material, 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

Various pipelines in Ammonia Plant were installed under 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

### 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. |
|---|---|
| 3 | 13 |
| 6 | 9,13 |
| 7 | 4,6 |
| 8 | 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 to 36 |
| 2 | Satisfactory |
| 3 | Near tube no. 25 to29 |
| 4 | Near tube no. 16 to 21, 22 & 23 |
| 5 | Near tube no. 14,15,20,21,23 to 25 & 28 to 31 |
| 6 | Near tube no.7 to 15 & 27 to 42 |
| 7 | Near tube no. 30 to 32 & 35 to 40 |
| 8 | Near tube no. 7 to 14, 17, 18 & 22 to 27 |

### ROOF INSULATION:

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

| **Row No.** | **Location** |
|---|---|
| Burner Row No 1 | Satisfactory |
| Tube Row No 1 | Satisfactory |
| Burner Row No 2 | Near Burner No.2 |
| Tube Row No 2 | Near Tube No.2 to 4 |
| Burner Row No 3 | Near Burner No. 3, 4, 6 |
| Tube Row No 3 | Near Tube No.8,28 to 32, 41 |
| Burner Row No 4 | Near Burner No 6,7 & 14 |
| Tube Row No 4 | Near tube no. 5, 19 & 20 |

| | |
|---|---|
| Burner Row No 5 | Around Burner No. 1, 6, 7, 13 & 14 |
| Tube Row No 5 | Near tube no. 37,38 |
| Burner Row No 6 | Around Burner No. 1, 2, 5, 9, 10 & 11 |
| Tube Row No 6 | Near tube no. 29 |
| Burner Row No 7 | Around Burner No. 2 to 7 |
| Tube Row No 7 | Near tube no. 16 to 20 |
| Burner Row No 8 | Near burner 1, 2, 8, 11 & 13 |
| Tube Row No 8 | Near tube no. 8, 15 & 16 |
| Burner Row No 9 | Near burner 4, 9 & 10 |

**REFRACTORY / INSULATION OF WALLS:**

- **East wall** **:** Found Satisfactory.
- **West wall** **:** Found satisfactory.
- **North wall**:
  **Z-MODULES** : Gap observed between block & modules of Peep hole 2, 3, 5 and 9 (Counting from West).
- **South Wall**:
  **Z-MODULES :**

  1. Gap observed between block & modules of Peep hole 2& 3 (Counting from West).
  2. Gap observed between modules just under peep hole no. 4.
  3. South wall refractory bricks in tube row no. 6 & 8 were observed detached & fallen.

**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 | C | 4 | B | 25 | C |
| 5 | C | 26 | B | 5 | B | 26 | C |
| 6 | C | 27 | C | 6 | C | 27 | B |
| 7 | C | 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 | C | 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 | C | 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 | C |
| 2 | C | 23 | C | 2 | C | 23 | B |
| 3 | C | 24 | C | 3 | C | 24 | C |
| 4 | C | 25 | C | 4 | C | 25 | B |
| 5 | C | 26 | C | 5 | C | 26 | C |
| 6 | C | 27 | C | 6 | C | 27 | B |
| 7 | B | 28 | C | 7 | C | 28 | C |
| 8 | C | 29 | C | 8 | C | 29 | B |
| 9 | C | 30 | C | 9 | C | 30 | C |
| 10 | C | 31 | C | 10 | C | 31 | C |
| 11 | B | 32 | C | 11 | B | 32 | C |
| 12 | C | 33 | C | 12 | C | 33 | C |
| 13 | B | 34 | C | 13 | B | 34 | C |
| 14 | C | 35 | B | 14 | C | 35 | C |
| 15 | C | 36 | C | 15 | C | 36 | B |
| 16 | C | 37 | C | 16 | B | 37 | C |
| 17 | C | 38 | C | 17 | C | 38 | C |
| 18 | C | 39 | C | 18 | C | 39 | C |
| 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 | C | 23 | B | 2 | C | 23 | C |
| 3 | C | 24 | C | 3 | B | 24 | C |
| 4 | C | 25 | C | 4 | C | 25 | B |
| 5 | B | 26 | C | 5 | C | 26 | C |
| 6 | C | 27 | C | 6 | C | 27 | C |
| 7 | C | 28 | C | 7 | C | 28 | C |
| 8 | C | 29 | C | 8 | C | 29 | **C** |
| 9 | C | 30 | B | 9 | C | 30 | C |
| 10 | C | 31 | C | 10 | C | 31 | C |
| 11 | C | 32 | C | 11 | B | 32 | C |
| 12 | C | 33 | C | 12 | C | 33 | C |
| 13 | C | 34 | C | 13 | C | 34 | C |
| 14 | C | 35 | B | 14 | C | 35 | C |
| 15 | C | 36 | C | 15 | C | 36 | C |
| 16 | C | 37 | C | 16 | B | 37 | C |
| 17 | C | 38 | C | 17 | C | 38 | C |
| 18 | B | 39 | C | 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 | C | 42 | C |

| 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 | C | 24 | C | 3 | C | 24 | C |
| 4 | C | 25 | B | 4 | C | 25 | C |
| 5 | C | 26 | C | 5 | C | 26 | C |
| 6 | B | 27 | C | 6 | C | 27 | C |
| 7 | C | 28 | B | 7 | C | 28 | C |
| 8 | C | 29 | C | 8 | C | 29 | C |
| 9 | B | 30 | C | 9 | C | 30 | B |
| 10 | C | 31 | B | 10 | C | 31 | C |
| 11 | C | 32 | C | 11 | C | 32 | C |
| 12 | C | 33 | C | 12 | C | 33 | B |
| 13 | C | 34 | C | 13 | C | 34 | C |
| 14 | C | 35 | C | 14 | C | 35 | C |
| 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 | C | 20 | C | 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 | 125.74 | 125.70 | | X | |
| 2 | 125.02 | 124.93 | | X | |
| 3 | 125.49 | 125.57 | | X | |
| 4 | 125.21 | 125.18 | | X | |
| 5 | 125.82 | 125.76 | | X | |
| 6 | 125.41 | 125.48 | | X | |
| 7 | 125.12 | 125.16 | | X | |
| 8 | 125.09 | 125.14 | | 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:

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

### TRANSFER LINE SPRING HANGER LOAD READINGS

| ROW | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| READINGS | **-28** | **-28** | **-22** | **-31** | **-33** | **-19** | **-18** |

### BOTTOM DRAIN READINGS

| ROW | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| READINGS | **95** | **100** | **105** | **90** | **95** | **100** | **100** | **100** |

### AUXILIARY BOILER SPRING READINGS

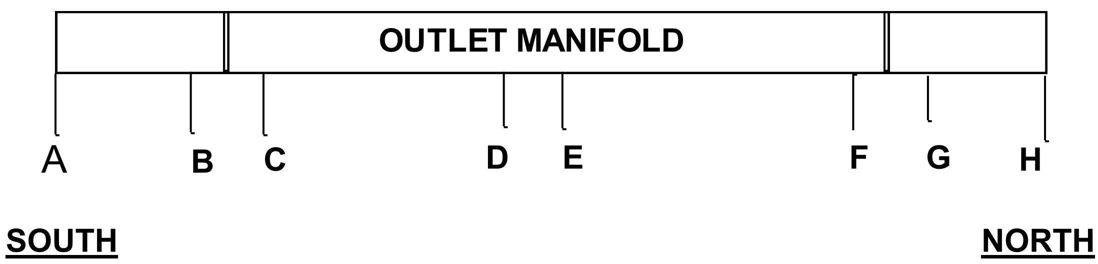
| SPRING | S-E | N-E | S-W | N-W |
|---|---|---|---|---|
| READINGS | **55** | **58** | **56** | **58** |

## Annexure – 5

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

| Header No. | Location of Measurement | | | | | |
|---|---|---|---|---|---|---|
| | B | C | D | E | F | G |
| 1 | | | *240 | *175 | | |
| 2 | | | *200 | *200 | | |
| 3 | | | 290 | 280 | | |
| 4 | | | *160 | *180 | | |
| 5 | | | *200 | 200 | | |
| 6 | | | *210 | *190 | | |
| 7 | | | *225 | *165 | | |
| 8 | | | *185 | 270 | | |

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



## 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 | No. of T-joints | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SG-1303-08-14” | 14” | 120 | 105-D, SG-33-14 | 108-D Inlet (Bottom) | **10** | **05** | **06** | **No significant defect was observed.** |
| 2 | SG-1303-09-10” | 10” | 120 | 105-D, SG-1303.08-14 | 108-D Inlet (Bottom) | **10** | **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 | **12** | **06** | **-** | |
| 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 | **24** | **08** | **-** | |
| 10 | NG-09-12” | 12” | 100 | 101-B | 103-D | **04** | **01** | **-** | |
| 11 | SG-1303-02-14” | 14” | 100 | 121-C | SG-12-14” | **17** | **08** | **03** | |
| 12 | SG-1303-03-08” | 8” | 100 | SG-12-14” | 137-C | **07** | **02** | **-** | |
| 13 | SG-1303-04-8” | 8” | 100 | 137-C | SG-51-8” | **11** | **04** | **-** | |
| 14 | SG.1303.06-14” | 14 | 100 | 121-C | 124-C | **20** | **08** | **-** | |
| 15 | PG-06-18” (103-C Inlet) | 18 | 100 | 104-D Top Outlet | 103-C | **01** | **-** | **-** | |
| 16 | PG-10-18” (104-D Outlet) | 18” | STD | 104-D Bottom Outlet | PG-21-20” | **01** | **-** | **-** | |

## Annexure – 7

## THICKNESS MEASUREMENT SUMMARY OF EQUIPMENT

| Sr. No. | Equip. No. | Equipment Description | Shell | | | Dish End | | | Channel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nom./ Design | Min. Measured | % Red. | Nom./ Design | Min. Measured | % Red | Nom./ Design | Min. Measured | % Red. |
| 1 | 102 - B | Start up Heater(Shell) | 6.35 | 6.40 | | | | | | | |
| 2 | 101-CA | Primary Waste Heat Exchanger | T&B Course- 44.45 M Course- 23.81 | T-45.4 B-45.1 M-24.0 | - | 22.23 | 25.60 | - | 6.70 | 6.40(Liner) | 4.47 |
| 3 | 101-CB | Primary Waste Heat Exchanger | T&B Course- 44.45 M Course- 23.81 | T-46.1 B-45.4 M-23.7 | - | 22.33 | 25.60 | - | 6.70 | 6.60(Liner) | 1.49 |
| 4 | 102 - C | Secondary Waste Heat Excha nger | 66.68 | 60.10 | 9.86 | NA | | | | | |
| 5 | 108 - CA-1 | aMDEA Solution Cooler | 12.70 | 12.20 | 3.93 | 12.70 | 16.20 | - | 12.70 | 13.50 | 1.57 |
| 6 | 108 - CA-2 | aMDEA Solution Cooler | 12.70 | 12.50 | - | 12.70 | 15.70 | - | 12.70 | 13.20 | 1.57 |
| 7 | 116 - C | Synthesis Gas Compressor Interstage Cooler | 11.11 | 10.40 | - | 11.11 | 13.60 | - | 30.72 | 32.60 | - |
| 8 | 121 - C | NH3 Converter Feed/ Converter effluent Exchanger | NA | 38.20 | | | | | | | |
| 9 | 124 - C | Synthesis Gas Compressor After Cooler | 20.00 | 22.20 | - | 16.00 | 19.10 | - | 88.90 | 90.10 | - |
| 10 | 128 - C | Refrigerant Compressor Inter Cooler | 12.00 | 12.20 | - | | | | 12.00 | 11.50 | 4.16 |
| 11 | 101 - JCA | Surface Condenser | NA | 12.50 | | | | | | 10.90 | - |

| Sr. No. | Equip. No. | Equipment Description | Shell | | | Dish End | | | Channel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nom./ Design | Min. Measured | % Red. | Nom./ Design | Min. Measured | % Red | Nom./ Design | Min. Measured | % Red. |
| 12 | 101 - JLC1 (Top) | Lube & Seal Oil Cooler for 101-J & 105-J | 8.00 | 8.20 | - | 6.00 | 7.70 | - | 8.00 | 8.00 | - |
| 13 | 101 - JLC2 (Bottom) | Lube & Seal Oil Cooler for 101-J & 105-J | 8.00 | 8.00 | - | 6.00 | 7.40 | - | 8.00 | 7.90 | 1.25 |
| 14 | 103 - JLT | Lube Oil Tank for Synthesis Gas Compressor | | 8.10 | - | | 6.00 | - | | | |
| 15 | 103 - D | Secondary Reformer | 57.15 | | | 28.58 | | - | 6.35 (Jkt) | 6.60(Jkt)-T 18.9(Jkt)-B | - |
| 16 | 104 - D1 (TOP) | Shift Converter | 80.96 | 85.40 | | 79.37 | | - | | | |
| | 104 - D2 (BOTTTOM) | Shift Converter | 60.32 | 63.30 | - | 58.74 | 65.40 | - | | | |
| 17 | 106 - D | Methanator | 44.50 | 45.10 | - | 48.40 | 48.20 | 0.41 | | | |
| 18 | 102 - EB | CO2 Stripper(Tray 1to11) | 9.53 | 10.90 | - | 11.9(T) | 14.4(T) | - | | | |
| | | Tray 11 to bottom | 15.90 | | - | 15.9(B) | | - | | | |
| 19 | 103-E1HP | HP FLASH Vessel | | 20.80 | - | | 23.30 | - | | | |
| 20 | 101 - F | Stream Drum | 106.40 | 107.71 | - | 106.40 | 104.13 | 2.13 | | | |
| 21 | 102 - F | Raw Gas Separator | 34.93 | 35.30 | - | 33.33 | 36.10 | - | | | |
| 22 | 109 - F | Refrigerant Receiver | 21.40 | 21.40 | - | 18.20 | 19.80 | - | | | |
| 23 | 142-F | New Instrument Air Receiver | NA | 12.20 | - | NA | 12.30 | - | | | |
| 24 | 2002-F | Demineralised Water Storage Tank | 4.8 | 4.8 | - | 4.8 (Roof) | 5.7 | - | | | |

**NOTE:** All readings are in mm.

## THICKNESS MEASUREMENT SUMMARY OF HT/LT COILS.

| SR NO | DESCRIPTION | DESIGN THICKNESS | MEASURED THICKNESS | % REDUCTION |
|---|---|---|---|---|
| | **Thickness Measured From East Side** | | | |
| 1 | HT Convection Zone : New HDS Coil (4th from Bottom) | 8.6 | 9.5 | - |
| 2 | HT Convection Zone : HT Steam Super Heater Coil (3rd from Bottom) | 8.0 | 8.3 | - |
| 3 | HT Convection Zone : New SS Air-Preheater Coil (2nd from Bottom) | 6.1 | 8.0 | - |
| 4 | HT Convection Zone : Mixed Feed Coil (Bottom most) | 8.0 | 11.8 | - |
| 4 | LT Convection Zone : BFW Heater Coil (Bottom most) | 5.54 | 4.6 | 13.35 |
| 5 | LT Convection Zone : BFW Heater Coil (2nd from Bottom) | 5.54 | 4.8 | 13.35 |
| 6 | LT Convection Zone : BFW Heater Coil (3rd from Bottom) | 3.9 | 3.8 | 2.56 |
| 7 | LT Convection Zone : Ammonia BFW Coil (4th from Bottom) | 5.54 | 4.9 | 11.55 |
| 8 | LT Convection Zone : LT Steam Super Heater Coil (5th from Bottom) | 7.01 | 7.0 | 0.14 |
| | **Thickness Measured From West Side** | | | |
| 1 NEW HDS | NEW HDS INLET COIL UPPER (4th from Bottom) (Added in SD-2017) | 8.6 | 7.4 | **13.55** |
| | NEW HDS OUTLET COIL LOWER (4th from Bottom) (Added in SD-2017) | 8.6 | 7.6 | **11.21** |
| | NEW HDS INLET HEADER UPPER (4th from Bottom) (Added in SD-2017) | 10.97 | 10.8 | - |
| | NEW HDS OUTLET HEADER LOWER (4th from Bottom) (Added in SD-2017) | 12.7 | 12.8 | - |
| | | | | |
| 2 HT STEAM SUPER HEATER | HT STEAM SUPER HEATER INLET COIL (3rd from Bottom) | 8.0 | 9.0 | - |
| | HT STEAM SUPER HEATER INLET HEADER(3rd from Bottom) | 47.0 | 51.4 | - |
| | | | | |
| 3 NEW SS AIR PRE HEATER | NEW SS AIR PRE HEATER INLET COIL (Replaced in SD-2017) (2nd from Bottom) | 6.1 | 6.3 | - |
| | NEW SS AIR PRE HEATER OUTLET COIL (Replaced in SD-2017) (2nd from Bottom) | 6.1 | 6.4 | - |
| | NEW SS AIR PRE HEATER INLET HEADER (Replaced in SD-2017) (2nd from Bottom) | 12.7 | 12.9 | - |
| | NEW SS AIR PRE HEATER OUTLET HEADER (Replaced in SD-2017) (2nd from Bottom) | 12.7 | 12.5 | - |

**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-1304-1 | 3 | 160 | 11.13 | CS | 142-CA/CB | 107-C | 10.4 | 6.56 |
| 2 | BO-01 | 1.5 | 80 | 5.1 | CS | BO-1H | BO-21 | 5.0 | 1.96 |
| 3 | BO-1H | 1.5 | XXS | 10.2 | CS | 101-F | BO-1 | 9.6 | 5.88 |
| 4 | BO-02 | 1.5 | XXS | 10.2 | CS | BO-2H | BO-21 | 8.4 | |
| 5 | BO-2H | 1.5 | XXS | 10.2 | CS | 101-F | BO-2 | 10.4 | 27.45 |
| 6 | BO-3H | 1 | 160 | 6.35 | CS | 102-C | BO-3 | 5.9 | |
| 7 | BO-4 | 1 | 80 | 4.55 | CS | BO-6H | BO-14 | 4.9 | - |
| 8 | BO-06 | 1 | 80 | 4.5 | CS | BO-12H | BO-11 | 4.6 | - |
| 9 | BO-6H | 1 | 160 | 6.35 | CS | 103-C | BO-4 | 6.1 | 3.94 |
| 10 | BO-7 | 1 | 80 | 4.5 | CS | BO-14H | BO-11 | 4.6 | - |
| 11 | BO-9 | 1 | 80 | 4.5 | CS | BO-11H | BO-11 | 4.3 | 4.44 |
| 12 | BO-10 | 1 | 80 | 4.5 | CS | BO-10H | BO-11 | 4.4 | 2.22 |
| 13 | BO-12H | 2 | XXS | 11.07 | CS | AUX.BOILER COIL-C | BLOW DOWN BO-6 | 8.6 | 22.31 |
| 14 | BO-13 | 1.5 | 80 | 5.1 | CS | BO-21-1.5" | BO-3H-1" | 4.3 | 17.65 |
| 15 | BO-1304.04 | 2 | 40 | 3.91 | CS | 107- C | 156- F | 3.4 | 13.04 |
| 16 | BO-13AH | 2 | 160 | 9.53 | CS | AUX.BOILER COIL-B | BLOW DOWN BO-8 | 10.7 | - |
| 17 | BO-20H | 1 | 160 | 6.35 | CS | BW-6H | BW-20 | 6.1 | 3.94 |
| 18 | BO-21 | 1.5 | 80 | 5.1 | CS | BO-2 | BO-14 | 4.5 | |
| 19 | aMDEA-06A | 10 | 40S | 9.27 | SS | 109-C1A | aMDEA-61 | 6.3 | 32.04 |
| | | 8 | 40S | 8.18 | SS | | | 8.8 | - |
| 20 | aMDEA-06B | 10 | 40S | 9.27 | SS | 109-C1B | aMDEA-61 | 6.2 | 33.12 |
| | | 8 | 40S | 8.18 | SS | 109C1B/ C2B | MDEA- 7 | 8.1 | 0.98 |
| 21 | aMDEA-07 | 10 | 40S | 9.27 | SS | aMDEA-61 | aMdEA-09A & 09B | 7.9 | 14.78 |
| 22 | aMDEA-16B | 12 | 20 | 6.35 | CS | 108C2B | aMDEA-62 | 5.9 | 7.09 |
| 23 | aMDEA-17 | 16 | 20 | 7.92 | CS | aMDEA-62 | aMDEA-41 | 7.4 | 6.57 |
| 24 | aMDEA-24A | 3 | 40 | 5.5 | CS | 108-J | aMDEA-25 | 5.2 | 5.45 |
| 25 | aMDEA-24B | 3 | 40 | 5.5 | CS | 108-JA | aMDEA-25 | 5.2 | 5.45 |
| 26 | aMDEA-25 | 3 | 40 | 5.5 | CS | aMDEA-24A,B | 102-EB Header | 4.6 | 16.36 |
| | | 2.5 | 40 | 5.16 | CS | aMDEA-24A,B | 102-EB Header | 2.3 | 55.43 |
| 27 | aMDEA-62 | 16 | 20 | 7.92 | CS | HEADER | aMDEA-17 | 7.1 | 10.35 |
| 28 | MDEA-1209.02 | 24 | 40 | 17.48 | CS | 103-E2LP (MDEA-1209-01-24') | 115- JA | 17.6 | - |

| SR. NO. | LINE NO. | N.B. (in.) | SCH. | NOM. THK. (mm) | MAT. | LINE DESCRIPTION | | Min. Thickness Observed (mm) | % RED. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FROM | TO | | |
| 29 | MDEA-1209.02 | 24 | STD | 9.53 | CS | 103-E2LP (MDEA-1209-01-24') | 115- JA | 9.7 | - |
| 30 | MDEA-1209.03 | 24 | 40 | 17.48 | CS | 103-E2LP (MDEA-1209-01-24') | 115- JB | 16.6 | 5.03 |
| 31 | MDEA-1209.03 | 24 | STD | 9.53 | CS | 103-E2LP (MDEA-1209-01-24') | 115- JB | 9.4 | 1.36 |
| 32 | MDEA-1209.06 | 12 | 20 | 6.35 | CS | 103-E2LP (MDEA-1209-01-24') | MDEA-1209.07/08 (116 JA/ JB) | 6.4 | - |
| 33 | MDEA-1209.07 | 12 | 10 S | 4.57 | SS | 103-E2LP (MDEA-1209-01-24') | 116- JB | 5.1 | - |
| 34 | MDEA-1209.08 | 12 | 10 S | 4.57 | SS | 103-E2LP (MDEA-1209-01-24') | 116- JA | 5.1 | - |
| 35 | MDEA-1212.03 | 16 | XS | 12.7 | CS | 115-JA/JB(MDEA-1212-01/02) | 101-EA | 10.1 | 20.47 |
| 36 | MS-1304-03 | 2" | 40 | 3.91 | CS | 107-C Middle Cource | 107-C Top (Header) | 3.7 | |
| 37 | PG-11A | 16 | 40 | 12.7 | SS-304 | PG-21 | 105-CA | 12.5 | 1.57 |
| 38 | PG-11B | 16 | 40 | 12.7 | SS-304 | PG-21 | 105-CB | 12.7 | - |
| 39 | PG-12A | 14 | 30 | 9.525 | SS-304 | 105-CA | PG-26 | 9.5 | 0.26 |
| 40 | PG-12B | 14 | 30 | 9.525 | SS-304 | 105-CB | PG-26 | 9.6 | - |

## 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 | 5.4 | 14.96 |
| 2 | A-22 | 4 | 40 | 6.02 | P-11 | A 20 SPEC.BRK | SPEC. BRK NG-9 | 4.5 | 25.25 |
| 3 | A-32 | 6 | 40 | 7.11 | CS | 101-J LP DISCH. | CV | 6.4 | 9.99 |
| 4 | BD-5 | 0.5 | 160 | 4.75 | CS | 106-F | Drain | 5.7 | - |
| 5 | BD-7 | 0.5 | 160 | 4.75 | CS | 106-F | Drain | 4.8 | - |
| 6 | BD-18 | 0.5 | 160 | 4.75 | CS | 106-F | Drain | 5.5 | - |
| 7 | BD-0050 | 2 | 40 | 3.91 | CS | 1123-C | BD-0051 | 4.0 | - |
| 8 | BD-0051 | 3 | 40 | 5.49 | CS | BD-0050 | Blow Down | 5.0 | 8.93 |
| 9 | BD-0059 | 2 | 40 | 3.91 | CS | 1123-C | BD-0060 | 4.0 | - |
| 10 | BD-0060 | 2 | 40 | 3.91 | CS | BD-0059 | BD-0051 | 4.0 | - |
| 11 | BF-01 | 12 | 20 | 6.35 | CS | 101-U | HEADER | 6.3 | 0.79 |
| 12 | BF-02 | 10 | 20 | 6.35 | CS | BF-1 | 104-J | 6.8 | - |
| 13 | BF-03 | 10 | 20 | 6.35 | CS | BF-1 | 104-JA | 6.2 | 2.36 |
| 14 | BF-04 | 6 | 80 | 10.97 | CS | 104-JA | BF-22 | 10.9 | 0.64 |
| 15 | BF-07 | 6 | 80 | 10.97 | CS | 104-J | BF-22 | 8.1 | 26.16 |
| 16 | BF-22 | 8 | 100 | 15.06 | CS | HEADER | BF-6 | 15.4 | - |
| 17 | BF-35 | 4 | 80 | 8.56 | CS | SPEC.BRK | BF-22 | 8.2 | 4.21 |
| 18 | BO-11 | 1.5 | 80 | 5.1 | CS | JCT BO-G789 | BO-14 | 4.0 | 21.57 |
| 19 | BW-0048 | 3 | 40 | 5.49 | CS | 1123-C | BW-0116 | 5.8 | - |
| | | 2 | 40 | 3.91 | CS | 1123-C | BW-0116 | 4.0 | - |
| 20 | BW-0116 | 3 | 160 | 11.13 | CS | 1123-C | | 10.6 | 4.76 |
| 21 | FIC -8 | 4 | 80 | 8.56 | CS | UP STREAM LINE | | 8.1 | 5.37 |
| 22 | HS-10 | 6 | 100 | 13.0 | P-11 | HS-5 | PIC-13 A | 13.0 | - |
| 23 | HS-11 | 6 | 120 | 14.27 | P-11 | HS-9 | PIC-13 B | 13.1 | 8.20 |
| 24 | HS-12 | 6 | 100 | 13.0 | P-11 | HS-9 | MICA-22 | 11.1 | 14.62 |

| SR. NO. | LINE NO. | N.B. (in.) | SCH. | NOM. THK. (mm) | MAT. | LINE DESCRIPTION | | Minimum Thickness Observed (mm) | % RED. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FROM | TO | | |
| 25 | HW-25 | 10 | 30 | 6.35 | CS | 124-C | HW-5 | 5.4 | 14.96 |
| | | 4 | 40 | 6.02 | CS | 124-C | HW-6 | 5.3 | 11.96 |
| 26 | HW-48 | 6 | 40 | 7.11 | CS | 173-C | HW-5 | 7.4 | - |
| | | 8 | 40 | 8.18 | CS | 173-C | HW-5 | 7.5 | 8.31 |
| 27 | aMDEA-10B | 12 | 20 | 6.35 | CS | 102-EB | aMDEA-11 | 4.7 | 25.98 |
| 28 | aMDEA-12A | 12 | 20 | 6.35 | CS | aMDEA-11 | 109C1A | 6.0 | 5.51 |
| 29 | aMDEA-12B | 12 | 20 | 6.35 | CS | aMDEA-11 | 109C1B | 6.2 | 2.36 |
| 30 | aMDEA-13A | 12 | 20 | 6.35 | CS | 109C2A | aMDEA-60 | 6.3 | 0.79 |
| 31 | aMDEA-13B | 12 | 20 | 6.35 | CS | 109C2B | aMDEA-60 | 8.3 | - |
| 32 | aMDEA-14 | 14 | 20 | 7.92 | CS | aMDEA-16 | aMDEA-15A & B | 8.5 | - |
| 33 | aMDEA-15B | 12 | 20 | 6.35 | CS | aMDEA-14 | 108C1A | 8.3 | - |
| 34 | aMDEA-19C | 8 | 30 | 8.38 | CS | 107-JC | aMDEA-21 | 7.0 | 16.47 |
| 35 | aMDEA-19D | 8 | 30 | 7.04 | CS | 107-JD | aMDEA-21 | 6.9 | 1.99 |
| 36 | aMDEA-20 | 12 | 30 | 8.38 | CS | aMDEA-21 | 101-E | 8.1 | 3.34 |
| 37 | aMDEA-21 | 12 | 30 | 8.38 | CS | aMDEA-19C+D | aMDEA-20 | 6.9 | 17.66 |
| 38 | aMDEA-22 | 4 | 40 | 6.02 | CS | 103-F | MEA-23A,B | 5.5 | 8.64 |
| 39 | aMDEA-23A | 4 | 40 | 6.02 | CS | aMDEA-22 | 108-J | 5.4 | 10.30 |
| 40 | aMDEA-23B | 4 | 40 | 6.02 | CS | aMDEA-22 | 108-JA | 5.8 | 3.65 |
| 41 | aMDEA-41 | 16 | 20 | 7.92 | CS | aMDEA-17 | MEA-18A + B | 6.8 | 14.14 |
| 42 | aMDEA-42 | 16 | 20 | 7.92 | CS | aMDEA-17 | MEA-18C+D | 7.1 | 10.35 |

| SR. NO. | LINE NO. | N.B. (in.) | SCH. | NOM. THK. (mm) | MAT. | LINE DESCRIPTION | | Minimum Thickness Observed (mm) | % RED. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FROM | TO | | |
| 43 | aMDEA-60 | 14 | 20 | 7.92 | CS | HEADER | aMDEA-14 | 7.3 | 7.83 |
| 44 | MS-16 | 2 | 80 | 5.54 | CS | MS-40 | 112-JAT | 4.9 | 11.55 |
| 45 | MS-29 | 12 | 30 | 8.38 | CS | MS-2 | NG-8 | 8.1 | 3.34 |
| 46 | MS-0039 | 8 | 60 | 10.31 | CS | 1123-C | | 9.7 | 5.92 |
| 47 | MS-11 | 16 | 60 | 16.66 | P11 | 103-JT | MS-03 | 9.5 | 42.98 |
| 48 | MS-20 | 2 | 80 | 5.54 | P11 | MS-40 | 101-105 J TURBINE INLET | 4.6 | 16.97 |
| 49 | MS-40 | 12 | 80 | 17.45 | P11 | MS-11 | 101-105 J TURBINE INLET | 14.2 | 18.62 |
| 50 | NG-16 | 8 | 40 | 8.18 | CS | BATT. LIMIT | 151-C | 6.5 | 20.54 |
| 51 | NG-22 | 6 | 40 | 7.11 | CS | NG-16 | NG-30 | 6.6 | 7.17 |
| 52 | NG-50 | 3 | 40 | 5.5 | CS | NG-6 | NG-7 | 5.3 | 3.64 |
| 53 | NH-13 | 2 | 80 | 5.5 | CS | 109-F | 126-C | 5.4 | 1.82 |
| 54 | NH-14 | 6 | 40 | 7.11 | CS | 109-F | NH-25A/B | 6.8 | 4.36 |
| 55 | NH-17 | 6 | 40 | 7.11 | CS | 109-F | NH-15 | 6 | 15.61 |
| 56 | NH-25A | 6 | 40 | 7.11 | CS | 127-C | NH-14 | 10.7 | - |
| 57 | NH-25B | 6 | 40 | 7.11 | CS | 127-C | NH-14 | 10.0 | - |
| 58 | NH-88 | 8 | 40 | 8.18 | CS | 109-F | 121-J | 7.7 | 5.87 |
| | | 4 | 40 | 6.02 | CS | 109-F | 121-J | 5.2 | 13.62 |
| 59 | NH-88A | 8 | 40 | 8.18 | CS | NH-88 | 121-JA | 7.6 | 7.09 |
| | | 4 | 40 | 6.02 | CS | NH-88 | 121-JA | 4.8 | 20.27 |
| 60 | PC-0066 | 6 | 40 | 7.11 | SS | P-1170-C Discharge | 1170-C | 6.4 | 9.99 |
| 61 | PC-0073 | 6 | 40 | 7.11 | SS | 102-F | P-1170-C Suction | 6.4 | 9.99 |
| 62 | PG-04 | 24 | | 38.89 | P11 | MIXING | TEE * | 26.2 | 32.63 |
| 63 | PG-06 | 18 | 20 | 7.93 | P11 | 104-D TOP | 103-C | 14.0 | - |
| 64 | PG-07 | 12 | 30 | 8.38 | P11 | PG-6 | 103-C | 8.6 | - |
| 65 | PG-08 | 20 | STD | 9.525 | CS | 104-C | 112-C | 8.7 | 8.66 |

| SR. NO. | LINE NO. | N.B. (in.) | SCH. | NOM. THK. (mm) | MAT. | LINE DESCRIPTION | | Minimum Thickness Observed (mm) | % RED. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FROM | TO | | |
| 66 | PG-10 | 18 | STD | 9.525 | CS | 104-D BOTTOM | PG-21 | 10.8 | - |
| 67 | PG-13 | 16 | 30 | 9.525 | SS-304 | PG-26 | 106-C | 9.0 | 5.51 |
| 68 | PG-15 | 14 | XS | 12.7 | CS | 102-F | 101-E | 7.6 | 40.16 |
| 69 | PG-16 | 14 | 20 | 7.92 | CS | 101-E | 136-C | 6.2 | 21.72 |
| 70 | PG-20 | 8 | 20 | 6.4 | CS | PG-9 | PG-10 | 5.8 | 9.38 |
| 71 | PG-21 | 20 | 30 | 12.7 | SS-304 | PG-10 | PG-11A&B | 12.2 | 3.94 |
| 72 | PG-26 | 18 | 30 | 11.13 | SS-304 | HEADER | | 11.0 | 1.17 |
| 73 | PG-36 | 1.5 | 40 | 3.68 | CS | PG-21 | PG-34 | 3.6 | 2.17 |
| 74 | RG-03(A-21) | 4 | 40 | 6.02 | | E-4(PGR) | R1/R2(PGR) | 5.4 | 10.30 |
| 75 | PW-02 | 2 | | 3.05 | SS | PW-3 | LC-3 | 3.3 | - |
| 76 | PW-03 | 2 | 160 | 8.7 | CS | SPEC.BRK. | | 5.4 | 37.93 |
| | | 2 | 40S | 3.91 | SS | | | 3.0 | 23.27 |
| 77 | PW-13 | 6 | 80 | 10.97 | CS | PW-12 | SEWER | 7.1 | 35.28 |
| | | 4 | 40 | 6.02 | CS | PW-12 | VENT | 2.5 | 58.47 |
| | | 4 | 120 | 11.13 | CS | LC-3A | 104-E | 6.5 | 41.60 |
| 78 | PW-24 | 4 | 120 | 11.13 | CS | 173-C | CONTROL VALVE | 5.0 | 55.08 |
| 79 | SC-07 | 2.5 | 80 | 7.01 | CS | SC-42 | 101-JC | 5.5 | 21.54 |
| | | 1 | 80 | 4.55 | CS | SC-42 | 101-JCA | 3.4 | 25.27 |
| 80 | SC-17 | 2 | 80 | 5.54 | CS | LC-21 | CVA | 3.5 | 36.82 |
| | | 3 | 80 | 7.62 | CS | 156-F | SEWER | 6.3 | 17.32 |
| 81 | SC-42 | 4 | 40 | 6.02 | CS | SC-41A | CV | 6.7 | -11.30 |
| 82 | SC-47 | 10 | 40 | 9.27 | CS | 101-JC | 112-J | 6.0 | 35.28 |
| 83 | SC-47A | 10 | 40 | 9.27 | CS | 101-JC | 112-JA | 6.1 | 34.20 |
| 84 | SC-51 | 2 | 80 | 5.5 | CS | 150-C | STS-51 | 5.9 | - |
| 85 | SC-52 | 2 | 80 | 5.5 | CS | STS-51 | SC-72 | 5.7 | -3.64 |
| 86 | SC-53 | 2 | 80 | 5.5 | CS | 151-C | STS-53 | 6.0 | -9.09 |

| SR. NO. | LINE NO. | N.B. (in.) | SCH. | NOM. THK. (mm) | MAT. | LINE DESCRIPTION | | Minimum Thickness Observed (mm) | % RED. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FROM | TO | | |
| 87 | SC-54 | 2 | 80 | 5.5 | CS | STS-53 | SC-72 | 6.2 | - |
| 88 | SC-71 | 4 | 80 | 6.02 | CS | SC-20 | 101-CA&B | 8.0 | - |
| 89 | SC-72 | 3 | 40 | 5.49 | CS | SC-45,52,54 | SC-8 | 5.7 | - |
| 90 | SG-09 | 10 | 40 | 9.27 | CS | 116-C | 129-C | 9.0 | 2.91 |
| 91 | SG-13 | 12 | 100 | 21.41 | CS | 124-C | SG-14 | 17.1 | 20.13 |
| 92 | SG-21 | 14 | 120 | 27.76 | CS | 121-C | SG-22 & 23 | 26.0 | 6.34 |
| 93 | SG-23 | 12 | 120 | 25.4 | CS | SG-21 | HEADER | 23.5 | 7.48 |
| 94 | SG-29 | 6 | 120 | 14.27 | CS | SEWDGE | | 13.9 | 2.59 |
| | | 4 | 120 | 11.13 | CS | SG-21 | HEADER | 10.4 | 6.56 |
| 95 | SG-0044 | 14 | 140 | 31.75 | P22 | 1123-C | | 31.6 | 0.47 |
| 96 | SG-0045 | 14 | 140 | 31.75 | P22 | 1123-C | | 30.5 | 3.94 |
| 97 | SG-0047 | 10 | 140 | 25.4 | P22 | SG-0044 | SG-0045 | 24.5 | 3.54 |
| 98 | SG-47 | 1 | 80 | 4.5 | CS | 104F | LC-8DRAIN | 3.8 | 15.56 |
| 99 | SG-51 | 8 | 100 | 15.06 | CS | SG-13 | SG-35 | 13.6 | 9.69 |
| 100 | SG-52 | 3 | 160 | 11.13 | CS | SG-22 | EVPT-DISCH | 9.2 | 17.34 |
| 101 | SG-53 | 3 | 160 | 11.13 | CS | SG-22 | EVPT-DISCH. | 9.4 | 15.54 |
| 102 | SG-55 | 3 | 80 | 7.62 | CS | INST.SEAL VALVE | SG-11 | 8.2 | - |
| 103 | SG-56 | 2 | 160 | 11.07 | CS | 106-F (Level Troll) | | 10.7 | 3.34 |
| 104 | SG-76A | 4 | 120 | 11.1 | CS | SG-25 | 102-B | 10.1 | 9.01 |
| 105 | SG-76B | 4 | 120 | 11.1 | CS | SG-21 | 102-B | 10.4 | 6.31 |
| 106 | SG-77 | 6 | 40 | 7.11 | CS | SG-6 | SG-78 | 6.7 | 5.77 |
| 107 | SG-1303-02 | 14 | 100 | 23.8 | CS | 121-C | SG-12-14" | 21.6 | 9.24 |
| 108 | PIC - 5 | 12 | 40 | 9.53 | CS | V-6 | V-7(SP-73) | 8.7 | 8.71 |
| | | 2 | 80 | 5.54 | CS | | | 5.3 | 4.33 |
| 109 | PRC - 1 | 6 | 40 | 7.11 | CS | 101/102-D INLET | VENT (SP-73) | 5.2 | 26.86 |
| | | 3 | 40 | 5.5 | | | | 9.1 | - |

| SR. NO. | LINE NO. | N.B. (in.) | SCH. | NOM. THK. (mm) | MAT. | LINE DESCRIPTION | | Minimum Thickness Observed (mm) | % RED. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **FROM** | **TO** | | |
| | | 2 | 80 | 5.54 | | | | 6.7 | - |
| 110 | PRC-6 D/S (V-27-6") | 6 | 80 | 10.97 | CS | V-27 | V-29 (SP-75) | 5.7 | 48.04 |

- **Note:** Part replacement in following pipe lines were carried out based on the thickness measurement report.

| SR. NO. | LINE NO. | N.B. (in.) | SCH. | LINE DESCRIPTION | | PART REPLACED |
|---|---|---|---|---|---|---|
| | | | | FROM | TO | |
| 1 | aMDEA-25 | 2.5 | 40 | aMDEA-24A,B | 102-EB Header | One Elbow replaced |

## Annexure-9

## GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| **101-BJT** | | | |
| Journal Bearing Sleeve | CT Side | T-1.2 B-1.0 | |
| | SILO Side | 0.8 | |
| Shaft Journal | CT Side | 1.6 | |
| | SILO Side | 0.9 | |
| **101-BJR** | | | |
| LS Gear Journal Bearing Sleeve | CT Side | T-0.5 B-0.6 | |
| | SILO Side | T-0.7 B-0.8 | |
| LS Gear Shaft Journal | CT Side | 0.6 | |
| | SILO Side | 0.8 | |
| HS Pinion Journal Bearing Sleeve | CT Side | T-0.8 B-1.2 | |
| | SILO Side | T-1.3 B-0.5 | |
| HS Pinion Shaft Journal | CT Side | 0.8 | |
| | SILO Side | 0.8 | |
| **101-BJ** | | | |
| Journal Bearing Sleeve | CT Side | T-0.6 B-1.1 | |
| | SILO Side | T-0.8 B-0.9 | |
| Shaft Journal | CT Side | 1.5 | |
| | SILO Side | 1.3 | |
| **101-JT** | | | |
| Journal Bearing Pad | Thrust End | 1.0 | |
| | Non Thrust End | 0.7 | |
| Journal Bearing Base ring | Thrust End | 0.8 | |
| | Non Thrust End | 0.9 | |
| Thrust Bearing Pads | Active | 1.3 | |
| | Inactive | 0.9 | |
| Thrust Bearing Base ring | Active | 0.6 | |
| | Inactive | 0.5 | |
| Shaft Journal | Thrust End | 2.6 | |
| | Non Thrust End | 2.0 | |
| **101-JLP** | | | |
| Journal Bearing Pads | Thrust End | 0.3 | |
| | Non Thrust End | 0.8 | |
| Journal Bearing Base ring | Thrust End | 0.6 | |
| | Non Thrust End | 0.8 | |
| Thrust Bearing Pads | Active | 0.6 | |
| | Inactive | 0.5 | |
| Thrust Bearing Base ring | Active | 0.8 | |

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| | Inactive | 1.7 | |
| Shaft Journal | Thrust End | 1.7 | |
| | Non Thrust End | 1.8 | |
| Thrust Collar | Active | 1.8 | |
| | Inactive | 1.3 | |
| **101-JR** | | | |
| Gear Journal Bearing (Low Speed) | North | T-0.5 B-0.4 | |
| | South | T-0.5 B-0.3 | |
| Pinion Journal Bearing (High Speed) | North | T-0.6 B-0.4 | |
| | South | T-0.3 B-0.2 | |
| Thrust Bearing (Low Speed) | North | T-0.6 B-0.9 | |
| | South | T-0.8 B-0.4 | |
| Shaft Journal (Low Speed) | North | 1.3 | |
| | South | 1.0 | |
| Shaft Journal (High Speed) | North | 1.2 | |
| | South | 0.6 | |
| **101-JHP** | | | |
| Journal Bearing Pads | Thrust End | 0.6 | |
| | Non Thrust End | 1.4 | |
| Journal Bearing Base ring | Thrust End | 0.8 | |
| | Non Thrust End | 0.5 | |
| Thrust Bearing Pads | Active | 0.9 | |
| | Inactive | 0.8 | |
| Thrust Bearing Base ring | Active | 4.4 | 0.5 |
| | Inactive | 3.6 | 0.3 |
| Shaft Journal | Thrust End | 2.5 | |
| | Non Thrust End | 2.2 | |
| Thrust Collar | Active | 1.7 | |
| | Inactive | 1.3 | |
| **104-JT** | | | |
| Journal Bearing Sleeve | Thrust End | T-0.5 B-0.6 | |
| | Non Thrust End | T-1.0 B-1.0 | |
| Shaft Journal | Thrust End | 1.3 | |
| | Non Thrust End | 1.1 | |
| **104-JA** | | | |
| Journal Bearing Sleeve | Thrust End | T-0.5 B-0.6 | |
| | Non Thrust End | T-0.9 B-0.8 | |
| Thrust Bearing Pads | Active | 0.7 | |
| | Inactive | 0.9 | |
| Thrust Bearing Base Ring | Active | 1.6 | |
| | Inactive | 1.8 | |
| Shaft Journal | Thrust End | 2.2 | |
| | Non Thrust End | 1.5 | |

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| Thrust Collar | Active | 1.3 | |
| | In Active | 0.6 | |
| **104-JAT** | | | |
| Journal Bearing Sleeve | Thrust End | T-0.4 B-0.9 | |
| | Non Thrust End | T-0.7 B-0.6 | |
| Thrust Bearing Pads | Active | 0.6 | All Thrust Bearing Pads replaced with new as thrust found excess. |
| | Inactive | 0.9 | |
| Thrust Bearing Base Ring | Active | 4.0 | **0.5** |
| | Inactive | 3.5 | **0.4** |
| Thrust Collar | Active | 0.7 | |
| | In Active | 0.9 | |
| Shaft Journal | Thrust End | 2.3 | |
| | Non Thrust End | 1.4 | |
| **107-JT** | | | |
| Journal Bearing Sleeve | Thrust End | T-0.4 B-0.5 | |
| | Non Thrust End | T-09 B-0.6 | |
| Shaft Journal | Thrust End | 1.0 | |
| | Non Thrust End | 1.6 | |
| Thrust Bearing Pads | Active | 0.8 | |
| | In Active | 0.6 | |
| Thrust Collar | Active | 1.2 | |
| | In Active | 1.6 | |
| **103-JLP** | | | |
| Journal Bearing Sleeve | Thrust End | T-0.4 B-0.3 | |
| | Non Thrust End | T-0.4 B-0.5 | |
| Journal Bearing Pads | Thrust End | 0.9 | |
| | Non Thrust End | 0.9 | |
| Thrust Bearing Pads | Active | 1.3 | |
| | Inactive | 1.1 | |
| Thrust Bearing Base ring | Active | 0.6 | |
| | Inactive | 0.5 | |
| Shaft Journal | Thrust End | 2.2 | |
| | Non Thrust End | 2.0 | |
| Thrust Collar | Active | 1.2 | |
| | Inactive | 1.0 | |
| **103-JHP** | | | |
| Journal Bearing Sleeve | Thrust End | T-0.5 B-0.6 | |
| | Non Thrust End | T-1.3 B-1.0 | |
| Journal Bearing Pads | Thrust End | 0.8 | |
| | Non Thrust End | 1.0 | |
| Thrust Bearing Pads | Active | 0.8 | |

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| | Inactive | 0.9 | |
| Thrust Bearing Base ring | Active | 1.7 | |
| | Inactive | 1.4 | |
| Thrust Collar | Active | 1.8 | |
| | Inactive | 1.2 | |
| Shaft Journal | Thrust End | 1.5 | |
| | Non Thrust End | 1.3 | |
| **105-JT** | | | |
| Journal Bearing Pad | Thrust End | 0.4 | |
| | Non Thrust End | 0.6 | |
| Journal Bearing Base ring | Thrust End | 0.7 | |
| | Non Thrust End | 0.9 | |
| Thrust Bearing Pads | Active | 0.6 | |
| | Inactive | 0.5 | |
| Thrust Bearing Base ring | Active | 0.6 | |
| | Inactive | 0.8 | |
| Shaft Journal | Thrust End | 1.0 | |
| | Non Thrust End | 0.9 | |
| **105-JLP** | | | |
| Thrust Bearing Pads | Active | 1.0 | |
| | Inactive | 0.7 | |
| Thrust Bearing Base ring | Active | 0.9 | |
| | Inactive | 0.6 | |
| Thrust Collar | Active | 0.6 | |
| | Inactive | 0.7 | |
| Shaft Journal | Thrust End | 0.6 | |
| | Non Thrust End | 1.3 | |
| **105-JR** | | | |
| LS Gear Journal Bearing | North side | T-0.6 B-0.9 | |
| | South Side | T-0.3 B-0.8 | |
| HS Pinion Journal Bearing | North side | T-0.3 B-0.2 | |
| | South Side | T-0.3 B-0.5 | |
| Thrust Bearing | Active | T-0.5 B-0.9 | |
| | Inactive | T-0.5 B-0.6 | |
| Shaft Journal | Low Speed Gear | N-0.6 S-0.4 | |
| | High Speed Pinion | N-0.6 S-0.9 | |
| **105-JHP** | | | |
| Thrust Bearing Pads | Active | 0.7 | |
| | Inactive | 0.6 | |
| Thrust Bearing Base ring | Active | 0.6 | |
| | Inactive | 0.6 | |
| Thrust Collar | Active | 0.8 | |
| | Inactive | 1.4 | |

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| **115-JAT** | | | |
| Journal Bearing Liner | Thrust End | T-0.5 B-1.6 | |
| | Non Thrust End | T-0.6 B-1.4 | |
| Thrust Bearing Pads | Active | 0.7 | |
| | Inactive | 0.6 | |
| Thrust Bearing Base ring | Active | 1.3 | |
| | Inactive | 0.9 | |
| Shaft Journal | Thrust End | 3.2 | |
| | Non Thrust End | 1.7 | |
| **115-JA** | | | |
| Journal Bearing Sleeve | Thrust End | T-0.8 B-0.9 | |
| | Non Thrust End | T-0.4 B-0.7 | |
| Thrust Bearing Pads | Active | 1.0 | |
| | Inactive | 0.8 | |
| Thrust Collar | Active | 1.9 | |
| | Inactive | 1.5 | |
| Shaft Journal | Thrust End | 1.2 | |
| | Non Thrust End | 1.3 | |
| **115-JR** | | | |
| Gear Journal Bearing | Front (West) | T-0.9 B-0.9 | |
| | Rear (East) | T-0.6 B-1.6 | |
| Pinion Journal Bearing | Front (West) | T-0.7 B-1.0 | |
| | Rear (East) | T-1.1 B-1.2 | |
| Gear Shaft Journal | Front (West) | 1.4 | |
| | Rear (East) | 1.9 | |
| Pinion Shaft Journal | Front (West) | 1.8 | |
| | Rear (East) | 0.9 | |
| **115-HT** | | | |
| Journal Bearing Sleeve | Thrust End | T-0.4 B-0.2 | |
| | Non Thrust End | T-0.7 B-0.5 | |
| Thrust Bearing Pads | Active | 0.7 | |
| | Inactive | 0.8 | |
| Thrust Collar | Active | 0.9 | |
| | Inactive | 0.7 | |
| Shaft Journal | Thrust End | 0.8 | |
| | Non Thrust End | 0.7 | |
| **115-JBT** | | | |
| Journal Bearing Liner | Thrust End | T-1.3 B-0.6 | |
| | Non Thrust End | T-0.7 B-1.0 | |
| Thrust Bearing Pads | Active | 0.7 | |
| | Inactive | 0.5 | |
| Thrust Bearing Base ring | Active | 1.0 | |
| | Inactive | 0.9 | |

| DESCRIPTION | POSITION | INITIAL (Gauss) | AFTER DEGAUSSING (Gauss) |
|---|---|---|---|
| Shaft Journal | Thrust End | 1.8 | |
| | Non Thrust End | 2.1 | |
| Thrust Collar | Active | 1.5 | |
| | Inactive | 1.7 | |
| **115-JB** | | | |
| Journal Bearing Liner | Thrust End | T-0.7 B-0.5 | |
| | Non Thrust End | T-0.6 B-0.4 | |
| Thrust Bearing Pads | Active | 0.8 | |
| | Inactive | 1.0 | |
| Thrust Bearing Base ring | Active | 1.3 | |
| | Inactive | 1.7 | |
| Shaft Journal | Thrust End | 0.6 | |
| | Non Thrust End | 0.3 | |
| **115-JR** | | | |
| Gear Journal Bearing | Front (West) | T-0.6 B-0.7 | |
| | Rear (East) | T-0.5 B-0.9 | |
| Pinion Journal Bearing | Front (West) | T-0.5 B-0.3 | |
| | Rear (East) | T-0.3 B-0.4 | |
| Gear Shaft Journal | Front (West) | 0.5 | |
| | Rear (East) | 0.6 | |
| Pinion Shaft Journal | Front (West) | 0.7 | |
| | Rear (East) | 0.3 | |
| **116-JAT (Turbine)** | | | |
| Journal Bearing Sleeve | Non drive - Top | 0.6 | |
| | Non drive - Bottom | 1.3 | |
| Journal Bearing Sleeve | Drive - Top | 1.1 | |
| | Drive - Bottom | 1.6 | |
| Shaft Journal | Drive side | 1.9 | |
| | Non Drive side | 0.7 | |

## ANNEXURE-10

## DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 1 | Location: 1 (Weld/HAZ/PM) SG-1303, 10-14 (H-36) On 108D converter Outlet nozzle, HAZ of nozzle | P-22 | Weld microstructure shows tempered bainite and ferrites in dendrite form, whereas at HAZ microstructure shows fine tempered bainite & ferrite structure. Parent metal microstructure shows fine-grained ferrite and bainite structure. In-situ spheroidization of bainite is observed. | IInd stage of creep degradations. Monitor after 2 years of service. |
| 2 | Location: 2 (Weld/HAZ of Elbow) SG-1303, 10-14 (H-36) On 108D converter Outlet nozzle of bend at top | P-22 | Weld microstructure shows tempered bainite in dendrite form, whereas at HAZ microstructure shows fine tempered bainite & ferrite structure. Parent metal microstructure shows fine tempered bainite structure. In-situ spheroidization of bainite is observed. | IInd stage of creep degradations. Monitor after 1 year of service. |
| 3 | Location: 3 (Weld/HAZ of Nozzle) SG-1303, 9-10” (H-36) On 108D converter inlet nozzle | P-22 | Weld microstructure shows tempered bainite in dendrite form, Whereas at HAZ microstructure shows fine tempered bainite & ferrite structure. Parent metal microstructure shows fine tempered bainite structure. Onset of in-situ spheroidization of bainite is observed. | Initial stage of degradation is observed. Monitor after 2 years of service |
| 4 | Location: 4 (Weld/HAZ of Elbow) SG-1303, 9-10” (H-36) On 108D converter inlet nozzle & elbow at bottom | P-22 | Weld microstructure shows tempered bainite in dendrite form, Whereas at HAZ microstructure shows fine tempered bainite & ferrite structure. Parent metal microstructure shows fine tempered bainite structure. Onset of in-situ spheroidization of bainite is observed. | Initial stage of degradation is observed. Monitor after 2 years of service. |
| 5 | Location: 5 (Parent Metal) SG-1303, 9-10” (H-36) On 108D converter inlet last elbow at bottom | P-22 | Microstructure shows fine-grained ferrite & bainite structure. In-situ spheroidization of bainite is observed at the grain boundaries. | IInd stage of creep degradations. Monitor after 1 year of service. |
| 6 | Location: 6 (Parent Metal) SG-1303, 10-14” (H-36) On 108D Outlet to 107-C gas inlet elbow-5 | P-11 | Microstructure shows coarse-grained non-uniformly distributed ferrite and pearlite/bainite structure. | No significant degradation observed. Monitor after 2 years of service. |
| 7 | Location: 7 (Weld/HAZ/PM) SG-1303, 11-14” (H-36) On 107C Gas Outlet nozzle & HAZ of nozzle | P-11 | Weld microstructure shows dendritic structure of ferrite and carbides, Whereas at HAZ microstructure shows fine-grained ferrite & pearlite/bainite structure. Fusion is normal. Parent metal microstructure shows fine-grained ferrite and pearlite/bainite structure. Onset of in-situ spherodization of pearlite/bainite is observed. | IInd stage of creep degradations. Monitor after 1 year of service. |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 8 | Location: 8 (Weld/HAZ/PM) SG-1303, 11-14” (H-34) On 107-C Gas Outlet nozzle & HAZ of elbow | P-11 | Weld microstructure shows dendritic structure of ferrite and carbides, Whereas at HAZ microstructure shows fine-grained ferrite & pearlite/bainite structure. Fusion is normal.<br>Parent metal microstructure shows fine-grained ferrite and pearlite/bainite structure. | No significant degradation observed. Monitor after 2 years of service. |
| 9 | Location: 9 (Parent Metal) SG-1303, 11-14” (H-34) On 107-C gas outlet elbow-01 | P-11 | Microstructure shows fine-grained ferrite and pearlite structure. In-situ spherodization of pearlite is observed at the grain boundaries. | IInd stage of creep degradations. Monitor after 1 year of service. |
| 10 | Location: 10 (Weld/HAZ/PM) 106-D 1st elbow of gas outlet to 114-C | CS | Microstructure shows non-uniformly distributed fine & coarse-grained ferrite and pearlite structure. | No significant degradation observed. Monitor after 2 years of service. |
| 11 | Location: 11 (Parent Metal) 106-D 2nd elbow of gas outlet to 114-C | CS | Microstructure shows fine & coarse-grained widmanstatten ferrite and pearlite structure. Ferrite is observed at prior austenite grain boundaries. | No significant degradation observed. Monitor after 2 years of service. |
| 12 | Location: 12 (Parent Metal) SG-1303-10-14” (H-36) On 108-D Converter outlet to 107-C gas inlet elbow-01 | P-22 | Microstructure shows essentially fine-grained ferrite & carbides. Initial stage of degradations in terms of carbide formation at bainite regions are observed however prior bainite regions are maintained. Presence of cavities are suspected. | Approaching third stage of creep degradations. |
| 13 | Location: 13 (Parent Metal) SG-1303-10-14” (H-36) On 108-D Converter outlet to 107-C gas inlet elbow-04 | P-22 | Microstructure shows fine & coarse-grained ferrite and bainite structure. Ferrite is observed at prior austenite grain boundaries. | No significant degradation observed. Monitor after 2 years of service. |
| 14 | Location: 14 (Parent Metal) PIC-13A Drain PI No.1 Weldolet | CS | Microstructure shows coarse widmanstatten ferrite and pearlite structure. Ferrite is observed at prior austenite grain boundaries. | No significant degradation observed. Monitor after 2 years of service. |
| 15 | Location: 15 (Parent Metal) MIC-22 Drain PI No.2 On Elbow | CS | Microstructure shows coarse widmanstatten ferrite and pearlite structure. Ferrite is observed at prior austenite grain boundaries. | No significant degradation observed. Monitor after 2 years of service. |
| 16 | Location: 16 (Parent Metal) 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/bainite structure.<br>Onset of in-situ degradation of pearlite/bainite observed in terms of spherodization.<br>Possibilities of isolated creep cavities are observed. | Approaching third stage of creep degradations. |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 17 | Location: 17 (Weld/HAZ/PM) On weld betn. Pipe & Elbow (elbow side) of NG-9-12” (101B-mixed feed coil outlet to NG-11) | P-11 | Weld microstructure shows dendritic structure of ferrite & carbides, Whereas at HAZ shows fine-grained ferrite and pearlite/bainite structure. Parent metal microstructure shows fine & coarse-grained few widmanstatten ferrite and pearlite/bainite structure. Onset of in-situ degradation of pearlite/bainite observed in terms of spherodization. | IInd stage of creep degradations. Monitor after 1 year of service. |
| 18 | Location: 18 (Weld/HAZ/PM) On dissimilar Weld Between pipe piece & Nozzle of Header towards PM of P11, NG-9-12” (101B-mixed feed coil outlet to NG-11) | P-11 to SS304 | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix, Fusion is normal. Parent metal microstructure shows fine-grained ferrite and pearlite/bainite structure. Onset of in-situ spherodization of pearlite/bainite is observed. | IInd stage of creep degradations. Monitor after 1 year of service. |
| 19 | (Weld/HAZ/PM) On dissimilar Weld Between pipe piece & Nozzle of Header towards HAZ of SS304, NG-9-12” (101B-mixed feed coil outlet to NG-11) | SS304 | Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix, Whereas at HAZ & parent metal microstructure shows fine-grained worked austenite structure with twins. Second phase precipitates including carbide are observed at grain boundaries. | IInd stage of creep degradations. Monitor after 1 year of service. |
| 20 | Location: 20 (Parent Metal) aux. boiler (east side) tube no.40 from south side | CS | Microstructure shows fine-grained ferrite & pearlite structure. | No significant degradation observed. Monitor after 2 years of service. |
| 21 | Location: 21 (Parent Metal) aux. boiler (west side) tube no.25 from south side | CS | Microstructure shows fine-grained ferrite and pearlite structure. Few widmanstatten ferrite is observed. | No significant degradation observed. Monitor after 2 years of service. |
| 22 | Location: 22 (Weld/HAZ/PM) HT steam supper heater coil header (Inlet) west side | P11 | Weld microstructure shows dendritic structure of ferrite & carbides, Whereas at HAZ shows fine-grained bainite and ferrite structure. Parent metal microstructure shows fine tempered bainite with few ferrite. | No significant degradation observed. Monitor after 2 years of service. |
| 23 | Location: 23 (Parent Metal) HT coil header (Outlet) west side | P11 | Microstructure shows fine-grained ferrite & pearlite structure. In-situ spherodization of pearlite is observed. | IInd stage of creep degradations. Monitor after 1 year of service. |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 24 | Location: 24 (Weld/HAZ/PM) Riser No.01, Riser 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 austenite. 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.** |
| 25 | Location: 25 (Weld/HAZ/PM) Riser No.02, Riser 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 austenite. 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 filled with scale observed at HAZ & parent metal region. | Inter-granular cracks are observed at HAZ & parent metal region. **Needs attention.** |
| 26 | Location: 26 (Weld/HAZ/PM) Riser No.03, Riser 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 austenite. 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 micro cracks observed at HAZ region. | Inter-granular micro cracks are observed at HAZ region. **Needs attention.** |
| 27 | Location: 27 (Weld/HAZ/PM) Riser No.04, Riser 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 austenite. 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 filled with scale observed at HAZ region. | Inter-granular cracks are observed at HAZ region. **Needs attention.** |
| 28 | Location: 28 (Weld/HAZ/PM) Riser No.05, Riser 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 austenite. 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.** |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 29 | Location: 29 (Weld/HAZ/PM) Riser No.06, Riser 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 austenite. 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 filled with scale observed at HAZ region. | Inter-granular cracks are observed at HAZ region. **Needs attention.** |
| 30 | Location: 30 (Weld/HAZ/PM) Riser No.07, Riser 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 austenite. 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.** |
| 31 | Location: 31 (Parent Metal) Riser No.07 | Tube-G-4852M Weldolet 800HT | Microstructure shows network 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. Monitor after 2 years of service. |
| 32 | Location: 32 (Weld/HAZ/PM) Row No.06, Tube no.18, Tube to weldolet weld joint | Tube-G-4852M Weldolet 800HT | Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins. Presence of heavy inter-granular cracks observed at HAZ region. | Inter-granular cracks are observed at HAZ region. **Needs attention.** |
| 33 | Location: 33 (Weld/HAZ/PM) Row No.07, 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 coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. | Microstructure is free from any micro cracks. Monitor after 1 year of service. |
| 34 | Location: 34 (Weld/HAZ/PM) Row No.05, Tube no.11, Tube to tube weld joint top side | Tube-G-4852M Weldolet 800HT | Weld microstructure shows dendritic structure of primary carbides along with secondary precipitation including carbides in the austenite matrix. Fusion is normal. HAZ & Parent metal microstructure shows network of coarse primary carbides including coarsened secondary carbides in the matrix of austenite in a cast structure. | Microstructure is free from any micro cracks. Monitor after 2 years of service. |

| SR. NO. | LOCATION | MOC | MICROSTRUCTURE OBSERVATION | REMARK |
|---|---|---|---|---|
| 35 | Location: 35 (Weld/HAZ/PM) Row No.03, Tube no.12, Tube to tube weld joint top side | Tube-G-4852M Weldolet 800HT | Weld microstructure shows dendritic structure of primary carbides along with secondary precipitation including carbides in the austenite matrix. Fusion is normal. HAZ & Parent metal microstructure shows network of coarse primary carbides including coarsened secondary carbides in the matrix of austenite in a cast structure. | Microstructure is free from any micro cracks. Monitor after 2 years of service. |
| 36 | Location: 36 (Weld/HAZ/PM) Row No.03, Tube no.29, Tube to tube weld joint top side | Tube-G-4852M Weldolet 800HT | Weld microstructure shows dendritic structure of primary carbides along with secondary precipitation including carbides in the austenite matrix. Fusion is normal. HAZ & Parent metal microstructure shows network of coarse primary carbides including coarsened secondary carbides in the matrix of austenite in a cast structure. | Microstructure is free from any micro cracks. Monitor after 2 years of service. |
| 37 | Location: 37 (Weld/HAZ/PM) Row No.03, Tube no.31, Tube to tube weld joint top side | Tube-G-4852M Weldolet 800HT | Weld microstructure shows dendritic structure of primary carbides along with secondary precipitation including carbides in the austenite matrix. Fusion is normal. HAZ & Parent metal microstructure shows network of coarse primary carbides including coarsened secondary carbides in the matrix of austenite in a cast structure. | Microstructure is free from any micro cracks. Monitor after 2 years of service. |

**Note:** Location no. 1, 2, 5, 7, 9, 17, 18, 19, 23, 24, 25, 26, 27, 28, 29, 30, 32, and 33 shall be monitored during next turnaround in detail as recommended by M/S TCR.

# Annexure - 11

## UFD & RT STATUS OF CONVERTER LOOP

| JOINT NO. | 2014 | | 2015 | | 2016 | | 2017 | |
|---|---|---|---|---|---|---|---|---|
| | UFD | RT | UFD | RT | UFD | RT | UFD | RT |
| **FROM 108D TO 107C,**<br>**LINE NO: SG-1303-10-14**", SCH-120 (27.79MM NOM THICK.) | | | | | | | | |
| Elbows 1 to 5 | NSD | -- | NSD | -- | NSD | -- | Indication observed in E4 Elbow | Confirmed by RT and found satisfactory |
| J-1 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-2 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-3 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-4 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-5 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-6 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-7 | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-8 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-9 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-10 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-11 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-12 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| **FROM 105D TO 108D,**<br>**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 | E-2 Elbow replaced |
| J-1 | NSD | -- | NSD | -- | NSD | -- | -- | -- |
| J-2 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-3 | NSD | -- | NSD | -- | Indication observed | Confirmed by RT and found satisfactory | NSD | New joint of elbow replaced |
| J-4 | NSD | -- | NSD | -- | NSD | -- | NSD | New joint of elbow replaced |
| J-5 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-6 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-7 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-8 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-9 | NSD | -- | NSD | -- | NSD | New joint,after SR ,NSD | NSD | -- |
| J-9A | NSD | -- | NSD | -- | NSD | New joint,after SR ,NSD | NSD | -- |
| J-9B | NSD | -- | NSD | -- | NSD | -- | -- | -- |
| J-10 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |

| JOINT NO. | 2014 | | 2015 | | 2016 | | 2017 | |
|---|---|---|---|---|---|---|---|---|
| | UFD | RT | UFD | RT | UFD | RT | UFD | RT |
| J-11 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-12 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-13 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-14 | 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-17B | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-17C | NSD | -- | NSD | -- | NSD | NSD | NSD | -- |
| J-18 | NSD | -- | NSD | NSD | NSD | NSD | NSD | -- |
| J-19 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-20 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-21 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-22 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-23 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-24 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-25 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-26 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-27 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-28 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-29 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-30 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-T1 | NSD | -- | NSD | -- | NSD | -- | NSD | New joint of Tee replaced |
| J-T2 | NSD | -- | NSD | -- | NSD | -- | NSD | New joint of Tee replaced |
| J-T3 | NSD | -- | NSD | -- | NSD | -- | NSD | New joint of Tee replaced |
| J-T4 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-T5 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-T6 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| **FROM : 107-C TO 123-C,**<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 | -- | NSD | -- |
| J-4 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-5 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-6 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-7 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-8 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |

| JOINT NO. | 2014 | | 2015 | | 2016 | | 2017 | |
|---|---|---|---|---|---|---|---|---|
| | UFD | RT | UFD | RT | UFD | RT | UFD | RT |
| J-9 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-10 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-11 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| J-12 | NSD | -- | NSD | -- | NSD | -- | NSD | -- |
| **FROM : 105-D TO 1123-C,** **LINE NO: SG-0044-H-36-14**”, SCH-140 (31.75MM NOM THICK.) | | | | | | | | |
| Elbows 1 to 5 | -- | -- | -- | -- | -- | -- | -- | -- |
| J-1 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-2 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-3 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-4 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-5 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-6 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-7 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-8 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-9 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-10 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-11 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-12 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-13 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-14 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-15 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-16 | -- | -- | -- | -- | -- | -- | -- | NSD |
| **FROM : 1123-C TO 108-D,** **LINE NO: SG-0045-H-36-14**”, SCH-140 (31.75MM NOM THICK.) | | | | | | | | |
| Elbows 1 to 4 | -- | -- | -- | -- | -- | -- | -- | -- |
| J-1 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-2 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-3 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-4 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-5 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-6 | -- | -- | -- | -- | -- | -- | -- | NSD |
| TJ-7 | -- | -- | -- | -- | -- | -- | -- | NSD |
| TJ-8 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-9 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-10 | -- | -- | -- | -- | -- | -- | -- | NSD |
| TJ-11 | -- | -- | -- | -- | -- | -- | -- | NSD |
| TJ-12 | -- | -- | -- | -- | -- | -- | -- | NSD |
| TJ-13 | -- | -- | -- | -- | -- | -- | -- | NSD |
| **FROM : SG-0044 TO SG-0045,** **LINE NO: SG-0047-H-36-10**”, SCH-140 (25.4 MM NOM THICK.) | | | | | | | | |
| Elbows 1 to 4 | -- | -- | -- | -- | -- | -- | -- | -- |

| JOINT NO. | 2014 | | 2015 | | 2016 | | 2017 | |
|---|---|---|---|---|---|---|---|---|
| | UFD | RT | UFD | RT | UFD | RT | UFD | RT |
| J-1 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-2 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-3 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-4 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-5 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-6 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-7 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-8 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-9 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-10 | -- | -- | -- | -- | -- | -- | -- | NSD |
| J-11 | -- | -- | -- | -- | -- | -- | -- | NSD |
| TJ-12 | -- | -- | -- | -- | -- | -- | -- | NSD |

**NSD: No Significant Defect**

# UREA PLANT

(INSPECTION)

During Annual Shutdown 2017, 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 Scrubber (H-1203).
- Eddy Current Testing of H.P. Stripper (H-1201) tubes carried out by M/sTesTex NDT India Pvt. Limited.
- Inspection of L.P. Carbamate Condenser (H-1205) tubes by Internal Rotating Inspection System (IRIS) technique carried out by M/s TesTex NDT India Pvt. Limited.
- Internal inspection of other vessels.
- Ultrasonic thickness measurement of **HP Lines.** Detailed report is attached at **Annexure-1.**
- Ultrasonic thickness measurement of **SC and ST Lines.** Detailed report is attached at **Annexure-2.**
- Ultrasonic thickness measurement of various **Equipments**. Detailed report is attached at **Annexure-3.**
- Qualification test of welders employed by contractors.
- Residual magnetism measurement and demagnetization, wherever required of Hitachi Compressor (K-1801) Train. Detailed report is attached at **Annexure-4**.
- Inspection of H.P. Line tapping. List is attached at **Annexure-5.**
- In S/D 2017 ESP-III related major activities carried out i.e. Erection and commissioning of equipment like H-1202, H-1250 , H-1424, VAM Package,30''NB $CO_2$ line modification and erection commissioning of its connecting new / modifications of piping and its NDT activities.
- Re location of P-1102-C pump and modification in suction – discharge piping and its NDT activities.
- Modification in P-1102-A/B/C pumps common discharge, Suction and Recycle line and its NDT activities.
- The detailed observations and recommendations and 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 equipment were inspected. The observations are listed below:

## AUTOCLAVE (V-1201)

## VISUAL INSPECTION

Thorough visual inspection of the liner, its welds, trays and internals were carried out. Observations made on each compartments are mentioned below.

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

- Roughening /corrosion of dome liner were observed and grayish oxide layer was observed on dome and man way surface.

- Just above man way liner's top circumferential seam having high corrosion attack in all circumferences, it was observed in previous inspection also.

- Liner plate piece just below dome liner was found silver bright in colour throughout in circumference.
- Bulging of 5 to 8 mm height and 75mm width observed 600 mm above tray level in South –West corner
- Previously repaired defects found satisfactory.
- "C" Seam and "L" seam welding found satisfactory.
- 01 nos. of old tray holding clits (total-14) was found black and observed sever corrosion attack including its welding, same observed in last inspection.
- Down-comer cone (Funnel) observed silver shiny in colour and its pipe observed brown in colour. Its welding was highly corroded / etched as razor sharp edges of welding observed.

**Compartment No.2**

- All new cleats (Total-14 No's) and its welding observed satisfactory.
- Down comer found dark brown in colour and rough in surface and it welding was corroded / etched.
- Sharp welding edges due to down comer erosion observed.

- Previously repaired defects found satisfactory.
- “C” Seam and “L” seam welding found satisfactory

**Compartment No.3**

- Bulging of approx. 8mm depth and 2.5” width was observed in SW to South direction just above “C” seam near insert liner, same was observed during previous inspection.
- 04 nos. of tray holding clits were observed blackish in color and having severe corrosion attack including its welding, same observed in last inspection
- Circumferentially provided Insert liner (Size 3.5Ft long x 4 Inch width approx.) observed silver shiny in color.
- Previously repaired defects found satisfactory.
- “C” Seam and “L” seam welding found satisfactory.
- Half down comer observed brown and half observed silver shiny, sharp edges of welding observed due to erosion of down comer.
- Above “C” seam approx. 75mm of “L” seam observed rough / porous in S-W direction which may be repaired ,marked as D3-1
- Above “C” seam in west direction near cleats Pitting /erosion of approx. 0.3 to 0.5mm and 5 to 6mm dia. observed, Marked as D3-2

**Compartment No.4**

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

- 03 nos. of tray holding cleats (11 Old + 09 New=20) were found black and observed sever corrosion attack including its welding, same observed in last inspection.
- Circumferentially provided Insert liner (Size 3.0 Ft long x 4 Inch width approx.) observed silver shiny in color.
- Previously repaired defects found satisfactory.
- “C” Seam and “L” seam welding found satisfactory.
- Half down comer observed brown and half observed silver shiny.
- 03 No’s of tray fixing bolts were missing.(Except dismantled trays)

**Compartment No.5**

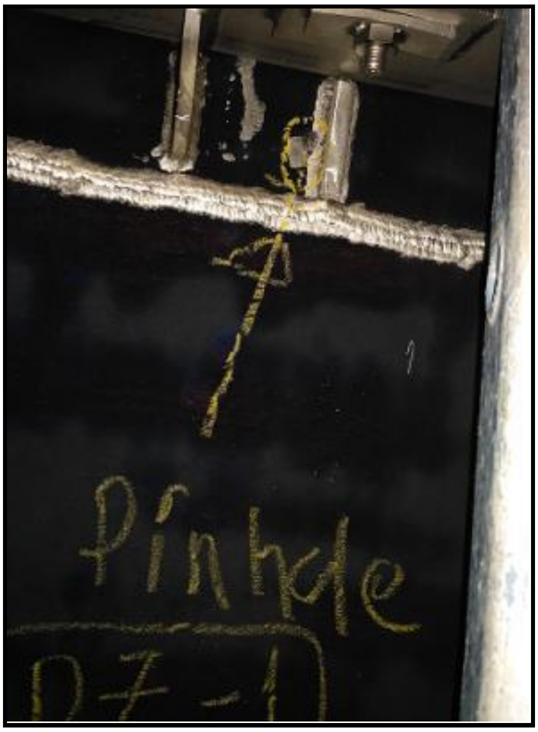
- Convex bulging of liner plate was observed just above the circumferential weld joint by approx. 3 to 9 mm height in almost all the periphery. The same was observed during last inspection.
- Concave depression of approx. 2-6 mm was observed at approx. 500 mm below the C-weld seam in full periphery. The same was observed during last inspection.
- In south direction above ”C” seam previously repaired defects having pitting /pinhole, Marked as defect D5-1
- Adjacent to defect D5-1 minor pinhole observed in “C” seam, marked as defect D5-2
- In west direction minor pinhole observed in “C” seam, marked as defect D5-3
- “C” Seam and “L” seam welding found satisfactory.

**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 also observed during last inspection.
- 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 also observed during last inspection.
- New welding was done on circumferential weld seam and long seam by M/s. Dowel Erectors in 2012.
- Previously repaired defects found satisfactory.
- “C” Seam and “L” seam welding found satisfactory.
- 12 old cleats having minor corrosion whereas 11new cleats and its welding observed satisfactory.
- 03 No’s of tray fixing bolts were missing.(Except dismantled trays)
- In south - east direction minor pinhole like indication observed in “C” seam, marked as defect D6-1


**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, prominent in manway.
- 03 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.
- New welding was done on circumferential weld seam and long seam by M/s. Shree Ganesh Engg. in 2014.
- "C" Seam and "L" seam welding found satisfactory.
- In north side 01 cleat was cut out, however its welding with shell liner having pinhole like indication, Marked as D7-1




- 11 old cleats having minor corrosion whereas 10 new cleats and its welding observed satisfactory.

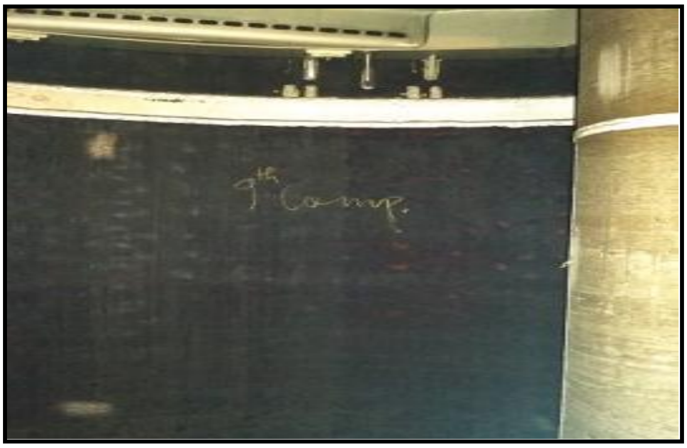
## Compartment No.8

- 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.
- 04 nos. of tray holding clits were found blackish in colour and having corrosion attack including its welding, same observed in last inspection.
- Insert liner found silver shiny in color and Shell liner observed brownish black in colour.
- New welding was done on both long seams by M/s. Shree Ganesh Engg. in 2014.
- “C” Seam and “L” seam welding found satisfactory.
- Gap between tray segment and tray holding ring observes.

- 04 old cleats (out of 10) having minor corrosion whereas 10 new cleats and its welding observed satisfactory.
- Down comer was observed brown in colour with corrosion in its welding.

## Compartment No.9

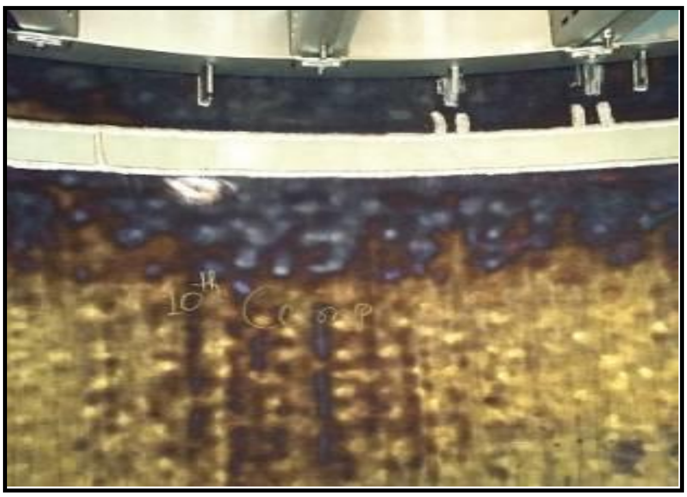
- 02 no. of tray holding cleats were found blackish in colour and having corrosion attack including its welding, same observed in last inspection.
- No noticeable bulging observed in liners.
- Insert liner found silver shiny, Shell liner observed brownish black in colour.
- New welding was done on two no’s of “C” seam and on both “L” seam of the compartment by M/S Shree Ganesh Engg. In 2015.
- “C” Seam and “L” seam welding found satisfactory.




- 10 New and 11 Old cleats and its welding observed satisfactory.
- Down comer was observed brown in colour with corrosion in its welding.

**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 as last Inspection.
- Concave depression of approx. 9 mm depth just above the C-weld seam towards the south side and adjacent to L-seam in approx. 100 mm dia. was observed. Same as last Inspection.
- Vertical bulging of approx. 2-3 mm height 25mm wide was observed from the C-weld seam to the bottom of the compartment in north side of the shell. 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.
- Pinhole was found in Helium leak detection test of approx. 1.0 mm in Dia. which was repaired by welding after grinding in S/D 2015.
- Insert liner found silver shiny.
- New welding was done on two no's of "C" seam and on both "L" seam of the compartment by M/S Shree Ganesh Engg. In 2015.
- "C" Seam and "L" seam welding found satisfactory.



- Shell liner observed brownish in colour
- Previously repaired defects were observed satisfactory.
- 10 New and 11 Old cleats and its welding observed satisfactory.
- Down comer was observed brown in colour with corrosion in its welding.

**Compartment No.11**

- Just below circumferential weld concave depression of approx. 10 to 12 mm depth in approx. 100mm dia. in North-West direction was observed. The same was observed during last inspection also.
- On insert liner segment convex bulging up to max. 5 to 8 mm height having width approx. 20-25 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.
- New welding was done on both "L" seam of the compartment by M/S Shree Ganesh Engg and found satisfactory in DP test.

- Shell liner observed brownish black in colour.
- 11 New and 11 Old cleats and its welding observed satisfactory.
- Down comer was observed brown in colour with corrosion in its welding.

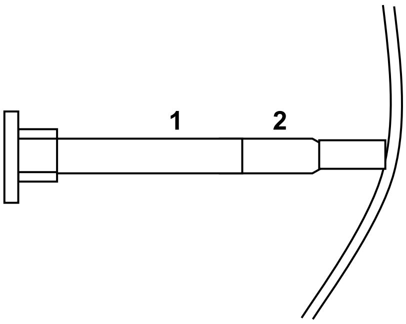
**Compartment No.12 (Bottom Compartment)**

- Down comer nozzle with dish end liner weld joint edges were observed exposed. The same was observed during last inspection also.
- Reducer of 10''x8'' observed silver shiny in colour.
- Dark brown coloration on dish end observed.

- 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.
- All old tray holding cleats (15 no's) were found blackish in color and having corrosion attack, however all new cleats (14 no's), its welding observed satisfactory.
- Tray orientation is in North –South direction.
- Two no's of Long seams observed satisfactory.(North – South Direction)
- Petal welds condition observed satisfactory.(Total 12 Seams)
- New tray cleats and its welding found satisfactory.(14 no's)
- All nozzles welding D.P test carried out and at few locations indications observed which were repaired and found satisfactory in DP test.




- Thickness measurement on Carbamate inlet nozzle (8''NB) from H-1202 carried out and readings are mentioned below.




| Meas. Location | North | South | Top | Bottom |
|---|---|---|---|---|
| 1 | 8.19 | 9.47 | 8.91 | 8.55 |
| 2 | 4.25 | 4.13 | 4.31 | 4.47 |

**NOTE**

- Severe etching observed on down comer and on its welding in almost all the compartment
- NE-North East, SW-South West, NW-North West, SE- South East, 'L'- Long seam, 'C'- Circumferential seam.
- Helium leak detection test was carried out by M/S Gulachi Engineers and pinhole observed in 10th compartment lower "C" seam of Insert liner in 2015.
- All compartments new Trays installed by M/S Ganesh Engg. & Co in 2016 and designed by Casale.These trays is in 6 segments.

**THICKNESS MEASUREMENT:**

| 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 (TOP) COMPARTMENT | Shell Liner (New) | 6.50 | 8.54 | 7.30 | 7.38 | 7.27 | 750mm Section Replaced in Yr. 2002 by BC-05. |
| | Shell Liner Old (Top) | 5.00 | 3.75 | 4.07 | 4.29 | 3.87 | |
| | Shell Liner (Middle) | 5.00 | 3.88 | 3.85 | 4.47 | 4.07 | |
| | Shell Liner (Bottom) | 5.00 | 3.68 | 3.51 | 4.32 | 4.05 | Overall Min. Liner Thickness |
| | Top-Dome | 6.50 | 6.42 | 6.69 | 6.52 | 6.70 | Replaced in Yr. 2002 by BC-05. |
| | Tray Segment -1 | 5.0 | 5.44 | 5.45 | 5.41 | 5.39 | |
| | Tray Segment -2 | | 5.42 | 5.45 | 5.45 | 5.47 | |
| | Tray Segment -3 | | 5.52 | 5.44 | 5.49 | 5.47 | |
| | Tray Segment -4 | | 5.63 | 5.67 | 5.59 | 5.61 | |
| | Tray Segment -5 | | 5.32 | 5.30 | 5.40 | 5.32 | |

| DETAILED THICKNESS REPORT OF AUTOCLAVE (V-1201) | | | | | | | |
|---|---|---|---|---|---|---|---|
| COMPARTMENT NO. | LOCATION OF MEASUREMENT | NOM. THK. (mm.) | OBSERVED THICKNESS (in mm.) | | | | REMARK |
| | | | EAST (1) | WEST (2) | NORTH (3) | SOUTH (4) | |
| | Tray Segment -6 | | 5.34 | 5.42 | 5.36 | 5.40 | |
| | Down Comer | 9.50 | 5.15 | 4.89 | 4.68 | 4.09 | Overall Min. Down Corner Thickness |
| | Manway Liner | 6.50 | 6.66 | 6.87 | 6.76 | 6.86 | Replaced in Yr. 2002 by BC-05. |
| 02 | Shell Liner (Top) | 5.00 | 4.23 | 4.37 | 4.62 | 4.15 | |
| | Shell Liner (Middle) | 5.00 | 3.92 | 4.32 | 4.53 | 4.26 | |
| | Shell Liner (Bottom) | 5.00 | 4.16 | 4.39 | 4.42 | 4.14 | |
| | Tray Segment-1 | | 5.17 | 5.45 | 5.41 | 5.38 | Overall Min. tray thick. |
| | Tray Segment-2 | | 5.38 | 5.34 | 5.28 | 5.34 | |
| | Tray Segment-3 | | 5.49 | 5.42 | 5.49 | 5.52 | |
| | Tray Segment-4 | | 5.31 | 5.32 | 5.38 | 5.32 | |
| | Tray Segment-5 | | 5.33 | 5.37 | 5.45 | 5.49 | |
| | Tray Segment-6 | | 5.39 | 5.48 | 5.45 | 5.78 | |
| | Down-Comer | 10.00 | 4.55 | 5.45 | 5.22 | 4.72 | |
| 03 | Shell Liner (Top) | 5.00 | 4.10 | 4.34 | 4.07 | 3.88 | |
| | Shell Liner (Middle) | 5.00 | 4.22 | 4.44 | 4.16 | 3.94 | |
| | Shell Liner (Bottom) | 5.00 | 4.44 | 4.12 | 4.12 | 4.20 | |
| | Tray Segment-1 | | 5.48 | 5.58 | 5.55 | 5.60 | |
| | Tray Segment-2 | | 5.54 | 5.49 | 5.55 | 5.57 | |
| | Tray Segment-3 | | 5.49 | 5.45 | 5.53 | 5.47 | |
| | Tray Segment-4 | | 5.59 | 5.60 | 5.54 | 5.47 | |
| | Tray Segment-5 | | 5.52 | 5.56 | 5.54 | 5.55 | |
| | Tray Segment-6 | | 5.54 | 5.56 | 5.53 | 5.59 | |
| | Insert Liner | 6.50 | 6.67 | 6.69 | 6.58 | 6.57 | Replaced in Yr. 1997 |
| | Down-Comer (Shiny) | 10.00 | 9.00 | 9.15 | 8.50 | 9.28 | |
| | Down-Comer | 10.00 | 4.64 | 5.15 | 4.95 | 5.76 | |
| 04 | Shell Liner (Top) | 5.00 | 4.25 | 3.87 | 4.10 | 4.28 | |
| | Shell Liner (Middle) | 5.00 | 4.23 | 4.20 | 4.12 | 4.54 | |
| | Shell Liner (Bottom) | 5.00 | 4.36 | 4.33 | 4.24 | 4.40 | |
| | Tray Segment-1 | | 5.52 | 5.68 | 5.60 | 5.58 | |
| | Tray Segment-2 | | 5.52 | 5.48 | 5.50 | 5.40 | |
| | Tray Segment-3 | | 5.58 | 5.67 | 5.60 | 5.67 | |
| | Tray Segment-4 | | 5.60 | 5.59 | 5.67 | 5.69 | |

| 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-5 | | 5.57 | 5.52 | 5.57 | 5.55 | |
| | Tray Segment-6 | | 5.70 | 5.72 | 5.27 | 5.72 | |
| | Insert Liner | 6.50 | 6.22 | 6.81 | 6.87 | 6.21 | Replaced in Yr.1999 |
| | Down-Comer | 10.00 | 5.26 | 4.80 | 5.80 | 4.98 | |
| 05 | Shell Liner (Top) | 5.00 | 5.23 | 4.90 | 4.62 | 4.67 | |
| | Shell Liner (Middle) | 5.00 | 5.50 | 4.80 | 4.54 | 4.74 | |
| | Shell Liner (Bottom) | 5.00 | 5.65 | 4.70 | 4.38 | 4.83 | |
| | Tray Segment-1 | | 5.44 | 5.47 | 5.45 | 5.55 | |
| | Tray Segment-2 | | 5.55 | 5.56 | 5.51 | 5.55 | |
| | Tray Segment-3 | | 5.48 | 5.53 | 5.54 | 5.60 | |
| | Tray Segment-4 | | 5.69 | 5.57 | 5.57 | 5.54 | |
| | Tray Segment-5 | | 5.46 | 5.44 | 5.47 | 5.47 | |
| | Tray Segment-6 | | 5.60 | 5.56 | 5.55 | 5.64 | |
| | Down-Comer | 10.00 | 5.19 | 5.09 | 5.07 | 5.41 | |
| | Down-Comer (Shiny) | 10.00 | 8.93 | 9.01 | 9.06 | 8.56 | |
| 06 | Shell Liner (Top) | 5.00 | 4.76 | 4.03 | 4.02 | 4.41 | |
| | Shell Liner (Middle) | 5.00 | 4.80 | 4.16 | 4.08 | 4.27 | |
| | Shell Liner (Bottom) | 5.00 | 4.38 | 4.35 | 4.07 | 4.42 | |
| | Tray Segment-1 | | 5.65 | 5.64 | 5.59 | 5.57 | |
| | Tray Segment-2 | | 5.53 | 5.61 | 5.70 | 5.55 | |
| | Tray Segment-3 | | 5.54 | 5.55 | 5.59 | 5.64 | |
| | Tray Segment-4 | | 5.57 | 5.61 | 5.65 | 5.77 | |
| | Tray Segment-5 | | 5.54 | 5.57 | 5.59 | 5.57 | |
| | Tray Segment-6 | | 5.59 | 5.54 | 5.68 | 5.67 | |
| | Down-Comer | 10.00 | 5.54 | 5.57 | 5.59 | 5.57 | |
| 07 | Shell Liner (Top) | 5.00 | 4.45 | 4.38 | 4.18 | 4.39 | |
| | Shell Liner (Middle) | 5.00 | 4.59 | 4.66 | 4.39 | 4.32 | |
| | Shell Liner (Bottom) | 5.00 | 4.53 | 4.81 | 4.46 | 4.30 | |
| | Tray Segment-1 | | 5.31 | 5.21 | 5.39 | 5.64 | |
| | Tray Segment-2 | | 5.25 | 5.24 | 5.23 | 5.26 | |
| | Tray Segment-3 | | 5.59 | 5.45 | 5.46 | 5.41 | |
| | Tray Segment-4 | | 5.65 | 5.61 | 5.57 | 5.55 | |
| | Tray Segment-5 | | 5.57 | 5.53 | 5.52 | 5.59 | |
| | Tray Segment-6 | | 5.61 | 5.60 | 5.70 | 5.67 | |
| | Down-Comer | 10.00 | 5.29 | 5.42 | 5.73 | 5.68 | |
| 08 | Shell Liner (Top) | 5.00 | 4.55 | 4.59 | 4.39 | 4.37 | |
| | Shell Liner (Middle) | 5.00 | 4.82 | 4.72 | 4.65 | 4.42 | |
| | Shell Liner (Bottom) | 5.00 | 4.38 | 4.55 | 4.60 | 4.46 | |

| 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 | 5.79 | 5.72 | 5.68 | 5.70 | |
| | Tray Segment-2 | 8.00 | 5.77 | 5.70 | 5.62 | 5.64 | |
| | Tray Segment-3 | 8.00 | 5.72 | 5.73 | 5.82 | 5.88 | |
| | Tray Segment-4 | 8.00 | 5.69 | 5.72 | 5.71 | 5.96 | |
| | Tray Segment-5 | | 5.64 | 5.62 | 5.64 | 5.64 | |
| | Tray Segment-6 | | 5.73 | 5.70 | 5.68 | 5.59 | |
| | Insert Liner | 6.50 | 6.89 | 6.43 | 6.62 | 6.97 | Replaced in Yr. 2000 |
| | Down-Comer | 10.00 | 5.91 | 6.30 | 5.78 | 5.80 | |
| 09 | Shell Liner (Top) | 5.00 | 4.47 | 4.61 | 4.90 | 4.48 | |
| | Shell Liner (Middle) | 5.00 | 4.58 | 4.43 | 4.66 | 4.72 | |
| | Shell Liner (Bottom) | 5.00 | 4.57 | 4.51 | 4.57 | 4.76 | |
| | Tray Segment-1 | 8.00 | 5.55 | 5.57 | 5.68 | 5.64 | |
| | Tray Segment-2 | 8.00 | 5.53 | 5.49 | 5.52 | 5.47 | |
| | Tray Segment-3 | 8.00 | 5.54 | 5.62 | 5.65 | 5.53 | |
| | Tray Segment-4 | 8.00 | 5.53 | 5.46 | 5.31 | 5.42 | |
| | Tray Segment-5 | | 5.79 | 5.29 | 5.22 | 5.29 | |
| | Tray Segment-6 | | 5.32 | 5.40 | 5.43 | 5.41 | |
| | Insert Liner | 6.50 | 6.52 | 6.70 | 6.65 | 6.85 | Replaced in Yr. 2001 |
| | Down-Comer | 10.00 | 6.30 | 6.33 | 6.50 | 6.44 | |
| 10 | Shell Liner (Top) | 5.00 | 4.79 | 5.25 | 5.16 | 4.97 | |
| | Shell Liner (Middle) | 5.00 | 4.97 | 5.30 | 5.31 | 5.09 | |
| | Shell Liner (Bottom) | 5.00 | 4.90 | 5.46 | 5.34 | 5.02 | |
| | Tray Segment-1 | 8.00 | 5.72 | 5.64 | 5.75 | 5.69 | |
| | Tray Segment-2 | 8.00 | 5.80 | 5.61 | 5.56 | 5.57 | |
| | Tray Segment-3 | 8.00 | 5.62 | 5.53 | 5.59 | 5.64 | |
| | Tray Segment-4 | 8.00 | 5.52 | 5.59 | 5.59 | 5.68 | |
| | Tray Segment-5 | | 5.62 | 5.49 | 5.61 | 5.54 | |
| | Tray Segment-6 | | 5.76 | 5.71 | 5.64 | 5.61 | |
| | Insert Liner | 6.50 | 6.62 | 6.52 | 6.51 | 6.55 | Replaced in Yr. 2002 |
| | Down-Comer | 10.00 | 6.94 | 6.82 | 6.62 | 6.82 | |
| 11 | Shell Liner (Top) | 5.00 | 4.49 | 4.53 | 4.51 | 4.74 | |
| | Shell Liner (Middle) | 5.00 | 4.62 | 4.69 | 4.68 | 4.50 | |
| | Shell Liner (Bottom) | 5.00 | 4.74 | 4.72 | 4.74 | 4.62 | |
| | Tray Segment-1 | 8.00 | 5.51 | 5.52 | 5.55 | 5.57 | |
| | Tray Segment-2 | 8.00 | 5.52 | 5.43 | 5.48 | 5.42 | |
| | Tray Segment-3 | 8.00 | 5.56 | 5.47 | 5.51 | 5.45 | |
| | Tray Segment-4 | 8.00 | 5.49 | 5.59 | 5.61 | 5.61 | |
| | Tray Segment-5 | | 5.64 | 5.61 | 5.57 | 5.58 | |

| 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-6 | | 5.65 | 5.70 | 5.78 | 5.84 | |
| | INSERT LINER | 6.50 | 6.64 | 6.65 | 6.74 | 6.74 | Replaced in Yr. 2002 |
| | DOWN-COMER | 10.00 | 7.18 | 7.14 | 7.15 | 7.68 | |
| 12 BOTTOM COMPARTMENT | SHELL LINER | 5.00 | 4.72 | 4.79 | 4.68 | 4.68 | |
| | PETAL PLATE | 7.00 | 6.11 | 6.20 | 6.32 | 6.26 | |
| | BOTTOM DOME | 7.00 | 6.44 | 6.17 | 6.56 | 6.02 | Replaced in Yr. 1993 |
| | REDUCER- 10" X 8" | 10.00 | 9.28 | 9.29 | 9.32 | 9.39 | Replaced in Yr. 1997 |
| | 10" - PIPE | 10.00 | 7.62 | 7.48 | 7.48 | 7.52 | |
| | 8" - PIPE (DISTANCE PIECE) | 6.00 | 4.09 | 5.47 | 4.39 | 4.80 | Replaced in Yr. 2000 |
| | NOZZLE-8" | 6.00 | 3.59 | 3.50 | 3.36 | 4.01 | |

**Note:**

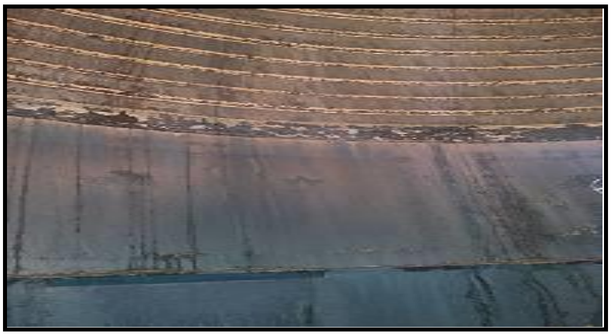
- North - South orientation of trays- Tray No-01 counting from East side and Measurement Location-01 counting from North side.
- East - West orientation of trays- Tray No-01 counting from North side and Measurement Location-01countin from West side.
- The Complete down-comer was replaced in 1997.
- All the Trays were replaced in 1997 by H.E. Trays supplied by Scholler & Blackman, Austria, then after in S/D 2016 New Trays installed by M/S Ganesh Engg. & Co and designed by Casale Urea in all Compartments. These trays are in 6 segments. Tray Material is UNS-S31050 (25 Cr-22Ni-2Mo Alloy)

**H-1201 (HP STRIPPER)**

**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.



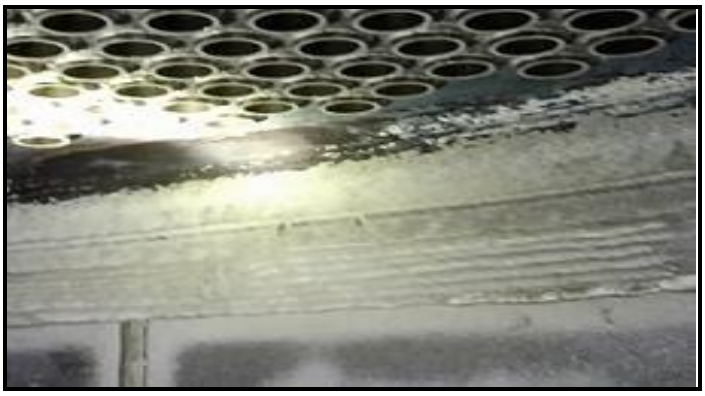
- The overlay welding on the tube sheet was grey and slightly etched.
- The tube welds were bright and smooth. Thick & hard oxide deposition was observed, more prominent in center of tube sheet East - West direction on tube sheet area. Needs Cleaning.

- The tubes were found smooth and brownish in colour from inside.
- Minor pitting was observed in ID of tubes 5 to 8mm from stub end edge in many tubes.

**<u>BOTTOM CHANNEL</u>**

- The condition of sealing face was found satisfactory.
- The overlay welds in the man way observed silver and slightly etched.
- The overlay welds in the hemi-head were silver and etched. Many patches of approx. 2”x2” size on the hemi-head overlay welds were observed which were more etched than the surrounding areas in North and East direction; same was observed in previous inspection also.
- The tube sheet was covered with a thin grey oxide layer. This layer observed more hard & bonded on tube-sheet to shell weld joint.

- Dark brown patches were observed at periphery of tube sheet at scattered locations, same was observed in previous inspection also.



- The tubes from inside were smooth.
- Minor pitting was observed in ID of tubes 5 to 8 mm from stub end edge in many tubes.
- The liquid outlet pipe and the gas inlet pipe were bright, shiny and few bolts were found loose of its flanges. Their nozzles and welds were in satisfactory condition.

- 01 no. Impingement plate bolt found loose of $CO_2$ Inlet line.

**BOTTOM COVER**

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

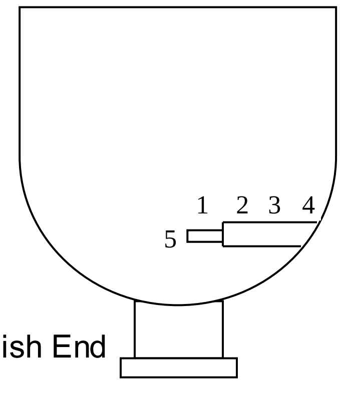
**TOP DOME**

| | Minimum Thickness (mm) | Maximum Thickness (mm) | Design Thickness, mm (Minimum) |
|---|---|---|---|
| Man way (Overlay) | 19.00 | 22.82 | 8.00 |
| Dome area (Overlay) | 11.60 | 14.40 | 8.00 |
| Cylindrical area (Liner)-Gas phase | 7.88 | 8.37 | 8.00 |
| Cylindrical area (Liner)-Liquid phase | 8.23 | 8.88 | 8.00 |
| Tube sheet-Overlay weld | 13.66 (Machined) | 14.01 (Machined) | 8.00 |

**BOTTOM DOME**

| | Minimum Thickness (mm) | Maximum Thickness (mm) | Design Thickness, mm (Minimum) |
|---|---|---|---|
| Man way (Overlay) | 19.58 | 23.64 | 8.0 |
| Dome area (Overlay) | 12.90 | 14.36 | 8.0 |
| Cylindrical area (Liner) | 8.07 | 8.35 | 8.0 |
| Tube sheet-Overlay weld | 14.71 (Machined) | 15.52 (Machined) | 8.0 |
| Bottom Cover (Overlay) | 17.22 | 17.71 | 8.0 |

**RADIOACTIVE SOURCE WELL**




Bottom Dish End

| POINT NO. | DESIGN THK. | MEASURED THICKNESS (Minimum) |
|---|---|---|
| 1 | 7.5 | 8.82 |
| 2 | 19.0 | 18.81 |
| 3 | 19.0 | 18.72 |
| 4 | 19.0 | 18.40 |
| 5 | 7.5 | 9.66 |

All measurements are in mm.

## 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/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: 0.86mm to 0.90 mm observed in 047 tubes
- Wall loss: 0.91mm to 0.95 mm observed in 134 tubes
- Wall loss: 0.96mm to 1.00 mm observed in 519 tubes
- Wall loss: 1.01mm to 1.05 mm observed in 719 tubes
- Wall loss: 1.06mm to 1.10 mm observed in 712 tubes
- Wall loss: 1.11mm to 1.15 mm observed in 311 tubes
- Wall loss: 1.16mm to 1.20 mm observed in 117 tubes
- Wall loss: 1.21mm to 1.25 mm observed in 040 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-1202 (H.P. CONDENSER)

New H.P Condenser Designed by Urea Casale and manufactured By ISGEC Dahej was installed during this shutdown.

Fit up, DP, Final weld visual, Radiography of all new / modified piping joints was carried out.

All internal components tacking / welding were ferrite tested and found satisfactory.

## H.P.SCRUBBER (H-1203)

## VISUAL INSPECTION

## TOP SHELL

- Shell internal surface was found brownish in coloration and top hemi head observed silver shiny in colour.
- $CO_2$ inlet nozzle flange (3/4”NB) located at west side found corroded same was observed in previous inspection also.
- Condition of liquid inlet and gas outlet pipe found satisfactory.
- $Co_2$ Inlet line in south side was found intact.
- Shell liner weld joint below the diaphragm plate found satisfactory.
- Bulging of approx. 3.0 to 4.0mm height and size of 25mm x 250mm observed in top course just 1200mm approx. above 1st “C”seam in East direction.

- Pneumatic testing of all liner welds and nozzle welds were carried out at 0.2 $Kg/Cm^2$ and leak observed in ¾''NB Nozzle (blind) in seal welding. (North-East Direction.)

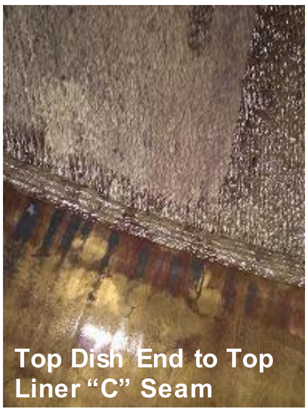

- This leak point was repaired and finally found satisfactory in DP Test.
- Also Pneumatic test carried out after repair and found satisfactory.

After Grinding

After Welding

After final welding D.P.

- In pneumatic testing shell liner "C" seams, "L" seams, Carbamate inlet nozzle, Co2 Inlet Nozzle, Off gas line Nozzle found satisfactory.

**Note**

- Directions mentioned in report are with respect to top dome's position at rest. (After Dis-assembling from its bottom shell)

**TUBE BUNDLE**

After complete lowering of the tube bundle, visual inspection of bundle was carried out. The followings were the observations.

- Coloration of tubes external surface assumed to be brownish black above 1st baffle from top and light golden at the rest of area. Peacock Blue Colour marks were observed at scattered locations on the tube surface, predominant at top half of the tube bundle.

- Tie rods and lock nut tack weld found satisfactory.
- Mechanical abrasion/impact mark seen on the four tubes just above the topmost baffle plate at East side. Abrasion mark size on one tube is approx. 150 to 300 mm x6 to 7mm x (0.1-0.2 mm depth).

- 1st and 3rd baffle plate counting from top were found smooth and shiny whereas other baffle plates were observed rough and brownish black in coloration same was observed in last inspection also.
- Thickness measurement on 5 nos. of tubes was carried out above the top baffle plate readings are as under.

## VISUAL INSPECTION OF BOTTOM SHELL

- Abrasion marks due to the lowering of tube bundle were observed at scattered locations on the liner including those caused in the past.
- Top two courses found to have brownish gold coloration whereas bottom course was silver grey in colour.
- Liquid over flow basket weld & Carbamate inlet line nozzle weld found satisfactory.
- (¾" NB $CO_2$ inlet line holding clit weld was found in to have minor crevice, in south bottom corner as observed in previous inspection also, however welding of its holding pad was found satisfactory.
- Circumferential weld joints (04 nos.) and longitudinal weld joints (03) observations are as under.
- 125 mm above 1st "C" seam in south direction crack /opening of 0.25mm depth x 30mm length observed in shell liner. Marked as defect 1 and defect 2

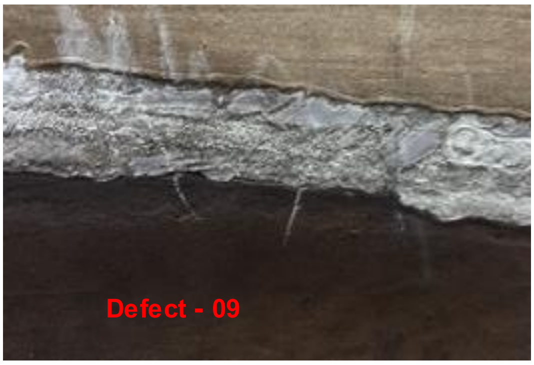


- Near welding Tee intersection of 1st "C" seam and 2nd Long seam in north direction scattered cracks and weld roughening observed, Marked as defect 3, defect 4 and defect 5.


- In "L" seam of 2nd course approx. 200mm below of 1st "C"seam welding crevices / cavities and under flushed welding observed which were marked as Defect 06, 07.

- In 1st “C” Seam welding observed flushed out and crevice, pin holes observed. Marked as defect 8.


- 2nd “C” seam in East direction weld crevices / weld roughening observed. Marked as defect 09.




- In 3rd course “L”seam, weld crevices and under flushed welding observed in series. Marked as defect 10.


**<u>Thickness measurement of liner was carried out and readings are as under:</u>**

| Course No | North | South | East | West | Design Thk. (mm) |
|---|---|---|---|---|---|
| 1 | 5.43,5.61,5.38 | 5.47,5.58,5.53 | 5.41,5.42,5.41 | 5.50,5.49,5.33 | 5.0 |
| 2 | 5.47,5.77,5.30 | 5.52,5.67,5.50 | 5.73,5.38,5.39 | 5.43,5.72,5.55, | 5.0 |
| 3 | 5.10,5.21,5.10 | 5.11,5.12,4.92 | 5.06,5.16,5.02 | 5.36,5.21,5.05 | 5.0 |

**Note**

- Course nos. are counted from top to bottom
- All defects were attended by shallow grinding, followed by welding D.P test.
- Pneumatic leak detection test of all weld joints [Circumferential weld joints (04 No's.) and longitudinal weld joints (03 No's)] of main shell liner & nozzles carried out at 0.2 Kg/Cm$^2$ and found satisfactory.

**H-1205 (LP CARBAMATE CONDENSER**

Tubes were inspected by M/s TesTex NDT India Pvt. Ltd, Mumbai by Internal Rotating Inspection System (IRIS).Total No. of U-tubes are 581 Nos. or 1162 tube holes, 04 nos of tubes(08 tube holes) were plugged during previous inspection. Observations of IRIS are as under:

| % Wall Loss | No. of Tubes (Total Inspected 1154 Holes.) |
|---|---|
| 0-10 | 778 |
| 11-20 | 252 |
| 21-30 | 36 |
| 31-40 | 04 |
| 41-55 | Nil |
| Not Interpreted | 84 |

**Note:**

- Row No. East to West
- Tube No. North to South

  The tube sheet layout is attached at **Annexure-7.**

**INSPECTION OF OTHER VESSELS / EQUIPMENT**

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

- Thick scales observed inside the tubes.
- Thick deposition was observed on the channel area, tube sheet & baffle plate.

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

- Thick scales were observed inside the tubes.
- Thick brownish scales were observed on the tube sheet. Epoxy layer is satisfactory.
- Deep cavities and scales were observed on the tube-sheet area (West Side).

**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 almost all the tubes.
- Overall condition of the coolers was found satisfactory.

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

- Thin creamy scales were observed inside almost all the tubes.
- Condition of tube to tube sheet weld was found satisfactory.

**H-1204 (RECIRCULATION HEATER)**

- Hard blackish scaling at bottom side observed inside the tubes.
- Brownish scaling was observed on both top and bottom tube sheet.
- Tube to tube sheet welding found satisfactory.
- Foreign particles, Glass wool wastages observed lying on the top tube sheet. Cleaning carried out.

**H-1208 (PROCESS WATER COOLER)**

- Tube to tube sheet welding was found satisfactory.
- Thin milky scales observed inside the tubes.
- Brownish deposition observed on East side Channel.

**H-1352 (REFLUX CONDENSER)**

**TOP TUBE SHEET:**

- Tube to tube sheet welding found satisfactory.
- Scaling was observed on the inside surface of all the tubes and on tube-sheet area.
- Insulation of top portion of shell is badly damaged, need to be re lined.

**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, scaling was observed inside the tubes and outlet Line elbow. It may be cleaned by re-hydro jetting.
- After re-hydro jetting observed satisfactory.
- Epoxy primer paint inside the channel cover area may be applied
- Thermo well were found intact in position; however CW outlet side Thermo well observed covered with thick scaling.

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

**TOP TUBESHEET**

- Tube to tube sheet weld found satisfactory.
- Thin milky scaling was observed inside the tubes.
- Thin scaling was observed on North half of the tube sheet area whereas the South half of the tube sheet area is free from any scaling.
- Overall condition of heat exchanger found satisfactory.

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

- Tube to tube sheet welding found satisfactory.
- Scaling observed in ID of the tubes.

**H-1421 - FLASH TANK CONDENSER**

- Tube to tube sheet welding was found satisfactory.
- Minor scaling observed inside most of the tubes.
- All the tubes were found filled with water.
- Overall condition was found satisfactory.

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

- Tube to tube sheet welding was found satisfactory.
- Minor scaling was observed on the tube to tube sheet weld joints.
- Minor scales were observed inside few tubes.
- All the tubes were found filled with water.

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

- Tube to tube sheet welding was found satisfactory.
- Whitish scale was observed inside the tubes. Re hydro jetting is suggested.
- Overall condition of heat exchanger was found satisfactory.
- Re-hydro jetting of tubes carried out and found satisfactory.

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

- Tube to tube sheet welding was found satisfactory.
- Thick brownish scales were observed on the tube sheet.
- Scales were observed inside many tubes. Re-hydro jetting may be done.
- Two no. tubes were found empty, other tubes were found filled with water , both were checked and found satisfactory
- Re-hydro jetting of tubes were carried out and observed satisfactory.

**H-1427 (CIRCULATION COOLER FOR V-1423)**

- Tube to tube sheet welding was found satisfactory.
- Thin milky scales observed inside the tubes.
- Brownish deposition observed on East side Channel.
- Thin Scaling observed on tubes.

**H-1811, 1$^{st}$ INTER STAGE COOLER OF HITACHI COMPRESSOR**

- Condition of tubes and tube sheet was found satisfactory.
- Brownish scaling on tube-sheet half.

- Thin scattered scaling observed on tubes.
- Rust & deep erosion marks observed on baffle plates.
- Near the baffle location scales/rust observed on OD of the tubes.

**H-1812, 2nd INTER STAGE COOLER OF HITACHI COMPRESSOR**

- Condition of tubes and tube sheet was found satisfactory.
- Thin scattered scaling observed on tubes.
- Baffle tie rods were slightly bent & rusted.

**H-1813, 3rd INTER STAGE COOLER OF HITACHI COMPRESSOR**

- Condition of tubes and tube sheet was found satisfactory.
- Heavy erosion/ corrosion observed on baffles.
- After further Hydro jet cleaning OD of tubes observed satisfactory.

**H-1814-A , L.O. COOLER OF HITACHI COMPRESSOR**

- Epoxy layer was found peeled off at several locations on channel shell & partition plates.
- Scaling was observed inside the tubes, after cleaning found satisfactory.

**H-1814-B, L.O. COOLER OF HITACHI COMPRESSOR**

- Condition of tubes and tube sheet was found satisfactory.
- Thin scaling was observed inside the tubes.
- Epoxy layer was found peeled off at several locations on channel shell & partition plates.

**H-1815 (SURFACE CONDENSER)**

**NORTHSIDE HALF (EAST SIDE CHANNEL)**

**TOP HALF**

- Tube sheet was found in satisfactory condition.
- Epoxy coating layer was found peeled off and cracked at several locations.

- Thermo well was found intact.
- Minor scaling / debris / rust flakes were observed at ID of few tubes.

**BOTTOM HALF**

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

**NORTHSIDE 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 at partition plate.

**BOTTOM HALF**

- Tube sheet was found in satisfactory condition.
- Thermo well was found intact.
- Debris found accumulated at bottom corner.

**V-1103 (NH3 SUCTION VESSEL)**

- Vessel from inside observed brownish.
- The condition of longitudinal and circumferential weld joints observed satisfactory.
- Oily layer was found on the bottom dish end, shell and man way.
- Level troll nozzles found satisfactory.
- Foreign element (half cut metallic ring) observed near NH3 liquid outlet line.

- Overall condition was found satisfactory.

**V-1202 (RECTIFYING COLUMN)**

**FROM TOP MANHOLE**

- Grey hard scales were observed on entire shell portion.

- Tray holding cleats holes observed elongated.
- Tray support / Mesh Grid support strips found satisfactory and they were covered with grayish hard scales.

**FROM BOTTOM MANHOLE**

- Coloration of top cone was brownish with white solution like layer observed.

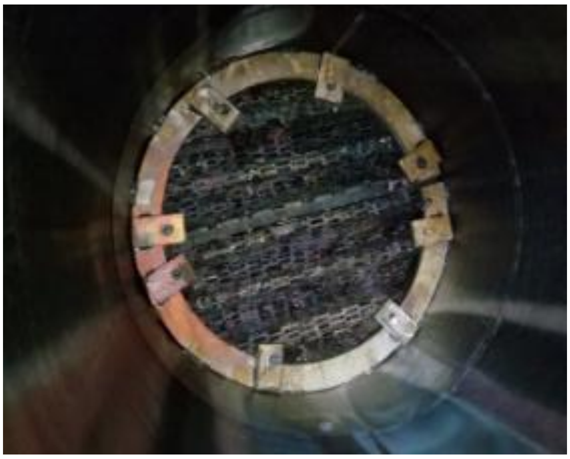
- Shell observed reddish in colour.
- Deposition of dust / scale observed on solution inlet nozzle from H-1204.

- Overall condition of vessel is satisfactory.

**V-1203 (L.P. ABSORBER)**

**FROM BOTTOM MANHOLE**

- Shell observed silver shiny in colour.
- One no. of rasching ring tray support clit bolt found shifted from its position and nut of two bolts were found missing which were provided.



- Depression of approx. 1” was observed on Shell opposite to the liquid inlet line, just above the circumferential weld.
- Vortex Breaker was found intact in its position.

**FROM TOP END**

- Shell observed brownish in colour.
- Perforated support grid & its stool were found intact in position. However, it is not free in the shell.
- Through Pinholes observed in the flange weld as shown in the figure, as deposition observed on the outer side of flange weld.

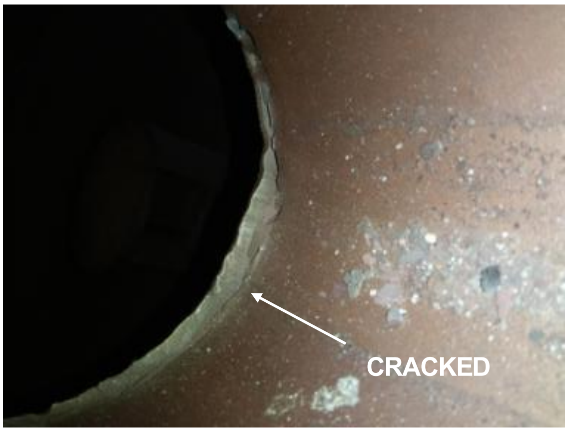
- This pin hole was repaired by welding.

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

- Demister pads were found intact and satisfactory in position.
- Shell observed brownish red in color from inside.
- All bolts of liquid inlet flange found satisfactory.
- Overall condition was found satisfactory.

**V-1207 (L.P. SCRUBBER)**

- Inspection carried from top cover.
- Shell portion observed brownish black from inside
- Grating condition was satisfactory. One no. holding nut was found loose.
- Condition of the top cover was found satisfactory.
- Thermowell was found intact.
- Bottom Hand-hole nozzle with shell seems to be cracked. It's surrounding Insulation need to be opened and to be checked.




- After removing insulation near nozzle weld, seal run welding carried out.
- Overall condition of the tank found satisfactory

**V-1301 ( 2ND DESORBER ):**

**Top COMPARTMENT:**

- Shell Internal surface found rusty / brownish in colour.
- Nozzle found satisfactory.
- Fasteners and clamp of trays observed in satisfactory condition, However one bolt observed missing and its washer and nut found lying on perforated tray.

**BOTTOM COMPARTMENT**

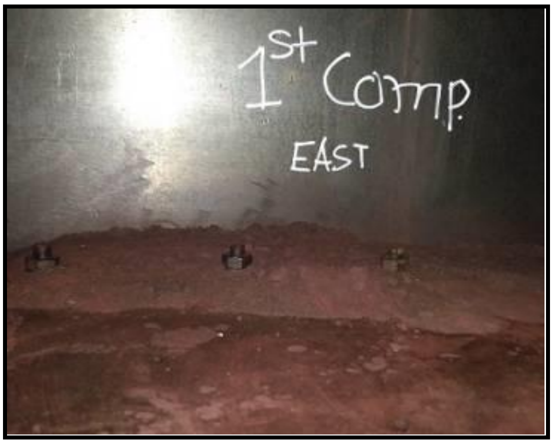
- Shell observed brownish in colour from inside.
- Nozzle condition was found satisfactory.

- Thermo well was found intact.
- Overall condition was found satisfactory.

**V-1351 (HYDROLYSER)**

**1st COMPARTMENT (Counting from Top)**

- Brownish coloration was observed on Top dish end and shell.
- Trays also observed reddish in color and lots of accumulated debris / sludge observed most prominent in east corner.




- Fasteners of sieve tray were found intact in position.
- Trays and its supporting ring observed satisfactory in condition.
- Accumulated sludge / debris observed in sampling and level indicator nozzles.


**2nd COMPARTMENT**

- Thick layer of sludge/debris observed on entire periphery.

- Fasteners of sieve tray were found intact in position.
- Trays and its supporting ring observed satisfactory in condition.
- Brownish coloration was observed.

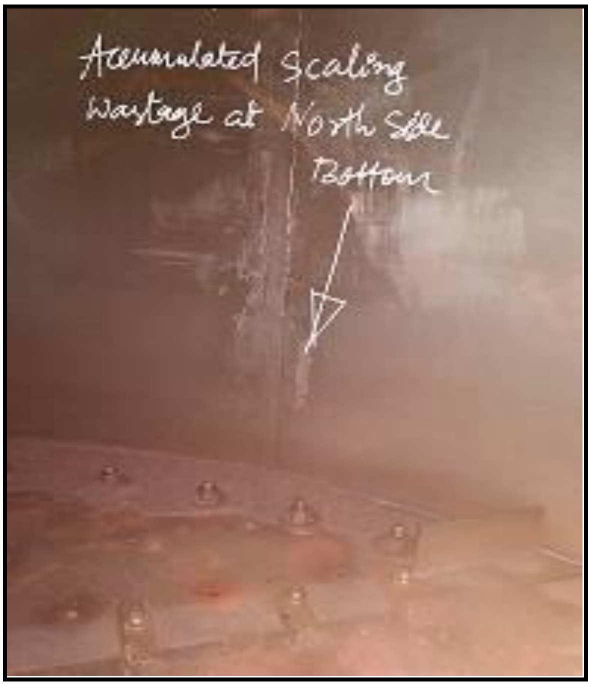
**3rd COMPARTMENT**

- Thick layer of sludge/debris observed on North –East corner.


- Brownish coloration was observed.
- Fasteners of sieve tray were found intact in position.
- Trays and its supporting ring observed satisfactory in condition.

**4th COMPARTMENT**

- Accumulated sludge / debris observed north side.
- "L" Seam condition found satisfactory.




- Brownish coloration was observed.
- Fasteners of sieve tray were found intact in position.
- Trays and its supporting ring observed satisfactory in condition.

**5th COMPARTMENT**

- Thermowell condition found satisfactory.

- Brownish coloration was observed.
- Fasteners of sieve tray were found intact in position.
- Trays and its supporting ring observed satisfactory in condition.

**6th COMPARTMENT**

- “C” Seam condition found satisfactory.


- Brownish coloration was observed.
- Fasteners of sieve tray were found intact in position.
- Trays and its supporting ring observed satisfactory in condition.

**7th COMPARTMENT**

- Brownish coloration was observed.
- Fasteners of sieve tray were found intact in position.
- Trays and its supporting ring observed satisfactory in condition.

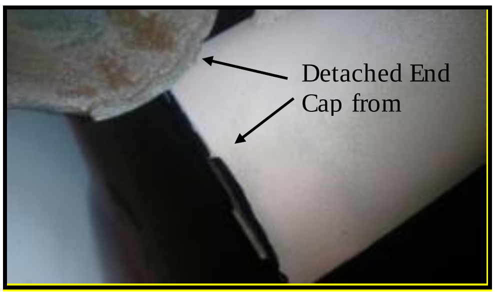
**BOTTOM COMPARTMENT (20th)**

- Thermowell condition found satisfactory.


- Steam inlet line clamping bolt missing and its flange bolts found loose.



- Reddish coloration was observed from inside.
- Tray clamps & steam inlet pipe found satisfactory
- End cap of the steam Inlet pipe was found detached and lying on the dished end which was repaired by welding and found satisfactory.
- Clamping bolts provided and flange bolts were tightened.



**Note**

- In Top 5 compartment amount of accumulated sludge/debris observed more, cleaning suggested.
- From 7th to 20th compartment scattered minor sludge/debris observed on trays in periphery.
- In general all compartments having similar observations as below, however any other specific observations were described compartment wise in this report.
  - Trays and its supporting ring observed satisfactory in condition.
  - Brownish coloration was observed inside of shell.
  - Fasteners of sieve tray were found intact in position, however in few Compartment lock nuts, bolts were observed lying on trays.
- Overall condition of vessel found satisfactory.

**V-1352 (FIRST DESORBER)**

**FROM BOTTOM MANHOLE**

- Brownish coloration was observed inside the vessel.
- Thin minor scaling was observed on the shell surface.
- Condition of the perforated trays found satisfactory.
- Weld joint condition was found satisfactory.
- Condition of the vortex breaker was found satisfactory.
- Overall condition of the vessel was found satisfactory.

**V-1352 (FIRST DESORBER)**

**FROM TOP MANHOLE**

- Vessel inside surface observed blackish in colour.
- Fasteners were found satisfactory in its position.
- Weld joint condition was found satisfactory.
- Manhole gasket seating face observed eroded / corroded at several locations.
- Thick blackish deposition observed on M/H cover and on M/H flange.

**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 most prominent in South-East direction.
- Support channels and outer ring of demister pads were found lifted in South-East direction, tied by metallic wires.

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

- Grayish coloration observed on dish ends
- Distribution sparger was found intact in position.
- Demister pads were found intact in its position.
- Condition of all the weld joints found satisfactory.
- Minor pitting were observed on bottom of the shell.
- Two bolts of Steam inlet saturation box cover were found missing. (South side East face).
- Hard scaling observed on both dished ends.

**V-1502 (23 ATA STEAM DRUM):**

- Grayish black coloration observed inside the vessel.
- Minor scaling observed at both dished ends.
- Weld joints condition found satisfactory.
- Distributor Pipe, Nozzles and Thermo Well condition found satisfactory.
- Overall condition found satisfactory.

**V-1503 (9 ATA STEAM DRUM)**

- Grayish black coloration was observed inside the vessel.
- U-clamp of the steam inlet header was found loose.
- I.D. of 1” bottom nozzle for Level controller at center portion of the shell having pitting/cavities up to 1.5mm depth. This was observed in previous inspections also.
- Overall condition of the vessel was found satisfactory.

**V-1811 (1ST STAGE SEPARATOR)**

- Demister pads were found intact in position.
- Vortex breaker was found intact in position.
- Condition of the weld joints was found satisfactory.
- Nozzles found clear from inside.
- M/H flange seal run welding observed with 04.nos of minor pinholes as shown in pic, which were repaired by grinding / welding.

- Overall condition of the vessel was found satisfactory.

**V-1812 (2ND STAGE SEPARATOR)**

- Demister pads were found intact in position.
- Vortex breaker was found intact in position.
- Condition of the weld joints was found satisfactory.
- Demister drain pipe was found intact in position.
- All Nozzles found clear from inside.
- Overall condition of the vessel was found satisfactory.

**V-1813 (3RD STAGE SEPARATOR) Thru Hand Hole**

- Demister drain pipe (1" NB) seems to be detached from its weld joint and lying freely inside the vessel (in vertical condition).This was observed during previous inspections also.
- Vessel from inside was found silver grayish in colour.
- Overall condition of the vessel was found satisfactory.

**T-1301 (AMMONIA WATER TANK)**

- Bottom plate and bottom half of shell observed brownish in colour.
- Silver bright colour 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 (STRONG AMMONICAL WATER TANK)**

- Brownish coloration was observed on bottom plate & bottom half of shell and silver bright coloration was observed on top half of the shell.
- All the weld joints and nozzle condition was found satisfactory.
- Thermo-well was found intact.
- Overall condition of the tank 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 upward bulging at center and wavy at entire Circumference, more prominent near the man-way (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.
- Pinholes observed in the 6" pipe support cleat weld with shell. (2nd from bottom). Marked with Yellow chalk.

**T-1501 (CONDENSATE TANK)**

- Inside surface of tank observed reddish brown in colour.
- Weld joints condition found satisfactory.
- Supports of 6"NB (2 No's) and 8''NB condensate inlet found satisfactory.
- 2''NB DM water makeup line sparger observed satisfactory.

**MISCELLANEOUS JOBS**

**ESP-III JOBS**

Various activities performed for piping fabrication and equipment erection jobs at M/s ONSHORE site.

Viz. Fit up inspection, Root weld/ Final weld DP witness, Random Ferrite Measurement, Metallography, Witness of PMI for Urea grade pipelines, Final weld visual, Review of Radiographs etc.

**WELDER QUALIFICATION TESTS**

- Performance qualification test of 15 Nos. welders offered by M/s General Engg., Bharuch (Mech. Planning) (W.O.No- 201004171161) was carried out. 05 nos. of welders were qualified during the test. These welders were allowed to perform fabrication jobs in ammonia and urea plant during this ESP III.

- Performance qualification test of 15 Nos. welders offered by M/s J & J Engg., (W.O. No. 201004171160) was carried out. 05 nos. of welders were qualified during the test. These welders were allowed to perform fabrication jobs in ammonia and urea plant during this ESP III.
- Performance qualification test of total 95 nos. welders (W.O.No. - 201004171302) offered by M/s ONSHORE CONSTRUCTION COMPANY PVT LTD. was carried out. Total 64 nos. of welders were qualified during the test. These welders were allowed to perform fabrication jobs in ammonia and urea plant under ESP III scheme.
- Performance qualification test of 05 Nos. welders offered by M/s SHREE GANESH ENGG. (W.O. No.201004171642) was carried out. 05 nos. of welders were qualified during the test. These welders were allowed to perform H-1203, Scrubber main shell liner longitudinal and circumferential weld joint repair work.
- Performance qualification test of 12 Nos. welders offered by M/s J & J ENGINEERS. (W.O. No.201004171900) was carried out. 06 nos. of welders were qualified during the test. These welders were allowed to perform 30 " NB CO2 line and miscellaneous fabrication job in urea plant during ESP III
- Performance qualification test of 02 Nos. welders offered by M/s BASH ENGG. (W.O. No. PNMM/EM-144/P/951B/ICB) was carried out. 02 nos. of welders were qualified during the test. These welders were allowed to perform fabrication job of VAM Cooler steam line in urea plant during ESP III.
- Performance qualification test of 03 Nos. welders offered by M/s EDAC (W.O. No.201004171439) was carried out. 02 nos. of welders were qualified during the test. These welders were allowed to perform fabrication job of Electrical Cable tray support required as per Electrical department during ESP III.
- Performance qualification test of 02 Nos. welders offered by M/s EDAC (W.O. No. PNPM/EM144/E/205K) was carried out. 02 nos. of welders were qualified during the test. These welders were allowed to perform fabrication job of Instrumentation Cable tray support required as per Instrument department during ESP III.

**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.

D.P. test of all white metal bearings and pads, coupling bolts of Hitachi compressor train, Turbine rotor journal portion carried out and found satisfactory.

**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.

## VARIOUS MODIFICATION / REPLACEMENT JOBS

During this shutdown, various modifications/replacement jobs were carried out by Technical and Urea Mechanical Group. Inspection activities viz. DP Test, Radiography review and repairs etc. Piping joint fit up review, Final weld visual etc was carried out as per the fabrication procedure.

## ANNEXURE-1

## PIPELINE THICKNESS MEASUREMENT SUMMARY OF HP LINES

| SR. NO. | LINE NO. | NB (inch) | SCH. | NOM. THK. (MM) | LINE DESCRIPTION FROM | TO | MIN. THK. OBSERVED | %AGE RED. |
|---|---|---|---|---|---|---|---|---|
| 1 | CO-F10-2119-PP25 | 8 | 160 | 23.01 | K-1801, III | H-1813 | 22.03 | 4.26 |
| 1A | CO-F10-2119-PP25 | 1.5 | 160 | 7.14 | K-1801, III | H-1813 | 6.86 | 3.92 |
| 1B | CO-F10-2119-PP25 | 0.75 | 160 | 5.54 | K-1801, III | H-1813 | 5.18 | 6.50 |
| 2 | CO-F10-2124 | 8 | 160 | 23.01 | K-1801, DIS. | GA-1112 | 22.16 | 3.69 |
| 2A | CO-F10-2124 | 0.75 | 160 | 5.54 | K-1801, DIS. | GA-1112 | 5.02 | 9.39 |
| 3 | CO-E10-2139-PP25 | 4 | 80 | 8.56 | CO-F10-2140-4” (TV-1808) | CO-E10-2122-6” | 7.00 | 18.22 |
| 4 | CO-F10-2140 | 4 | 160 | 13.49 | K-1801,III | V-1813 | 12.05 | 10.67 |
| 4A | CO-F10-2140 | 0.75 | 160 | 5.54 | CO-F10-2140-PP25 | DRAIN | 4.91 | 11.37 |
| 5 | CO-E10-2122 | 6 | 80 | 10.97 | H-1813 | V-1813 | 9.67 | 11.85 |
| * 6 | GA-1112 | 6 | F2 | 14.27 | K-1101-2 | GA-1201 | 9.27 | 35.04 |
| 6A | GA-1112 | 1.5 | X1 | 5.08 | FROM GA-1112 | TO BYPASS | 3.82 | 24.80 |
| 6B | GA-1112 | 1 | F2 | 6.35 | Drain | | 5.86 | 7.72 |
| 7 | GA-1201 | 6 | X4 | 13.33 | GA-1112 | H-1201 | 13.47 | -- |
| 7A | GA-1201 | 1.5 | X4 | 5.08 | GA-1112 | H-1201 | 5.16 | -- |
| 8 | GA-1202 | 1 | F2 | 6.35 | GA-1112-6" | Control-Valve | 4.02 | 36.69 |
| 9 | GA-1203 | 1 | X1 | 4.55 | GA-1202 | H-1203 | 3.22 | 29.23 |
| 9A | GA-1203 DRAIN | 0.5 | X1 | 3.73 | GA-1202 | H-1203 | 3.54 | 5.09 |

| SR. NO. | LINE NO. | NB (inch) | SCH. | NOM. THK. (MM) | LINE DESCRIPTION FROM | TO | MIN. THK. OBSERVED | %AGE RED. |
|---|---|---|---|---|---|---|---|---|
| 10 | GA-1204 | 1 | X1 | 4.55 | H-1203 | PR-1231 | 3.48 | 23.52 |
| 10A | GA-1204 DRAIN | 0.5 | X1 | 3.73 | H-1203 | PR-1231 | 2.87 | 23.06 |
| 11 | GA-1602 | 8 | F2 | 22.83 | K-1801 | GA-1112 | 21.74 | 4.77 |
| 11A | GA-1602 | 4 | 160 | 13.49 | K-1801 | GA-1112 | 11.94 | 11.49 |
| 11B | GA-1602 | 0.75 | 160 | 5.54 | K-1801 | GA-1112 | 5.23 | 5.60 |
| 11C | GA-1602 | 0.5 | 80 | 3.73 | K-1801 | GA-1112 | 3.87 | -- |
| 12 | GA-1603 | 4 | F2 | 11.13 | GA-1602 | GA-1604 | 9.86 | 11.41 |
| 13 | GA-1606 | 1 | B3 | 3.38 | GA-1607-0.75” | GA-1350-1” | 2.86 | 15.38 |
| 14 | GA-1607 | 0.75 | X3 | 2.87 | K-1801 | GA-1606-1” | 3.01 | -- |
| 15 | PR-1201 | 8 | X1 | 19.58 | V-1201 | H-1201 | 16.61 | 15.17 |
| 16 | PR-1205 | 6 | X1 | 15.24 | PR-1205-8" | V-1202 | 10.35 | 32.09 |
| 17A | PR-1205 | 1.5 | X1 | 5.08 | PR-1205-8" | V-1202 | 4.44 | 12.60 |
| 17B | PR-1205 | 0.75 | X1 | 3.91 | PR-1205-8" | V-1202 | 2.69 | 31.20 |
| 18 | PR-1205 | 8 | X1 | 19.58 | H-1201 Bottom | V-1202 | 16.48 | 15.83 |
| 18A | PR-1205 | 6 | X1 | 15.24 | H-1201 Bottom | V-1202 | 11.43 | 25.00 |
| ** 18B | PR-1205 (TR1210) | 1.5 | X1 | 5.08 | H-1201 Bottom | V-1202 | 4.85 | 4.53 |
| 19 | PR-1206 | 4 | X1 | 10.4 | PR-1210-10” | H-1203 | 12.1 | -- |
| 20 | PR-1208 | 4 | X1 | 10.4 | V-1201 Top | PR-1206-4" | 10.97 | -- |
| 20A | PR-1208 (TR-1206) | 1.5 | X1 | 5.08 | V-1201 Top | PR-1206-4" | 6.34 | -- |
| 21 | PR-1211 | 1.5 | X1 | 5.08 | PR-1208-4” | PR-1212-4" | 4.14 | 18.50 |
| 22 | PR-1212 | 4 | X1 | 10.4 | H-1203 | V-1201Bottom | 8.18 | 21.35 |
| 23 | PR-1213 | 2 | X4 | 5.54 | PR-1201 | PR-1205-6" | 3.92 | 29.24 |
| 24 | PR-1224 | 3 | X4 | 7.62 | P-1201B | PR-1638-4" | 6.39 | 16.14 |
| 25 | PR-1225 | 3 | X4 | 7.62 | P-1201A/B, PR1638-4" | H-1203 | 6.38 | 16.27 |
| 26 | PR-1226 | 2 | X4 | 5.54 | PR-1224 | H-1205 | 4.44 | 19.86 |

| SR. NO. | LINE NO. | NB (inch) | SCH. | NOM. THK. (MM) | LINE DESCRIPTION FROM | TO | MIN. THK. OBSERVED | %AGE RED. |
|---|---|---|---|---|---|---|---|---|
| 27 | PR-1230 | 6 | X1 | 15.24 | MA-1203-4" | H-1202 | 12.91 | 15.28 |
| 27A | PR-1230 (TR-1205) | 1.5 | X1 | 5.08 | MA-1203-4" | H-1203 | 4.25 | 16.33 |
| 28 | PR-1231 | 3 | X1 | 7.62 | H-1203 | PRCV-1201 | 6.81 | 10.63 |
| 29 | PR-1232 (JACKET) | 6 | - | 3.05 | PRCV-1201 (RV-1209) | ATMOS | 3.07 | -- |
| 30 | PR-1234 | 4 | X4 | 10.41 | PRC-1201 (H-1203) | V-1203 | 10.3 | 1.06 |
| 31 | PR-1234 | 3 | X4 | 7.62 | P-1201A | PR-1638-4" | 6.09 | 20.08 |
| 32 | PR-1637 | 3 | X4 | 7.62 | P-1201C | PR-1638-4" | 7.07 | 7.22 |
| 33 | PR-1638 | 4 | X4A | 9.14 | P-1201 A/B/C | PR-1230-6" | 12.36 | -- |
| 33A | PR-1638 | 1.5 | X4A | 5.08 | P-1201 A/B/C | PR-1230-6" | 5.79 | -- |
| 34 | PR-1666 | 2 | X4A | 5.54 | PR-1637 | PR-1226 | 4.29 | 22.56 |

* Sr No-06 GA-1112-6’’-F2 minimum measured thickness is 9.27 mm against Nominal thickness of 14.20 mm. (corrosion under support), necessary action suggested

.** Sr No-18B PR-1205 1.5’’-X1(TR-1210) Straight Piece with flange replaced due to weld crevice observed in RT.

## ANNEXURE-2

## PIPELINE THICKNESS MEASUREMENT SUMMARY

## (SC, ST LINES)

| Sr. No | LINE NO. | NB (inch) | SCH | NOM. THK. (MM) | LINE DESCRIPTION FROM | TO | Min. Thk. Observed | %Age red. |
|---|---|---|---|---|---|---|---|---|
| **SC-LINES** | | | | | | | | |
| 1 | SC-1101 | 14 | B1 | 9.525 | H-1102 | H-1206 | 6.00 | 37.04 |
| 2 | SC-1102 | 6 | B1 | 7.11 | SC-1228 | SC-1101 | 6.20 | 12.80 |
| 3 | SC-1102 | 12 | B1 | 9.52 | SC-1228 | SC-1101 | 9.10 | 4.41 |
| 4 | SC-1210 | 8 | B4 | 8.18 | P-1204 | SC-1210 | 8.90 | -- |
| 5 | SC-1210 | 10 | C2 | 9.27 | P-1204 | H-1207 | 8.40 | 9.39 |
| 6 | SC-1211 | 8 | B4 | 8.18 | H-1203 | P-1204 | 8.20 | -- |
| 7 | SC-1211 | 10 | B4 | 9.27 | H-1203 | P-1204 | 8.40 | 9.39 |
| 8 | SC-1212 | 10 | B4 | 8.18 | SC-1210 | SC-1209 | 8.20 | -- |
| 9 | SC-1213 | 6 | C1 | 7.11 | H-1201 | V-1502 | 6.10 | 14.21 |
| 10 | SC-1213 | 4 | B4 | 6.02 | LCV-1501 | V-1503 | 4.93 | 18.10 |
| 11 | SC-1216 | 4 | B4 | 6.02 | V-1204 | SC-1407 | 4.20 | 30.23 |
| 12 | SC-1216 | 2 | B4 | 3.91 | V-1204 | SC-1216-4" | 4.90 | -- |
| 13 | SC-1220 | 14 | 10S | 4.78 | H-1206 | H-1205 | 4.00 | 16.32 |
| 14 | SC-1222 | 14 | 10S | 4.78 | H-1205 | P-1202 A/B | 4.20 | 12.13 |
| 15 | SC-1228 | 10 | B4 | 9.27 | P-1202 | H-1102 | 9.00 | 2.91 |
| *15A | SC-1228 | 8 | B4 | 8.18 | P-1202 | H-1102 | 4.3 | 47.5 |
| 16 | SC-1233 I FROM N | 12 | B4 | 9.53 | V-1501 | H-1202 | 8.50 | 10.76 |
| 17 | SC-1234 II FROM N | 12 | B4 | 9.53 | V-1501 | H-1202 | 9.40 | 1.31 |
| 18 | SC-1235 III FROM N | 12 | B4 | 9.53 | V-1501 | H-1202 | 8.20 | 13.91 |
| 19 | SC-1236 IV FROM N | 12 | B4 | 9.53 | V-1501 | H-1202 | 9.40 | 1.31 |
| 20 | SC-1237 I FROM NE | 16 | B4 | 9.53 | H-1202 | V-1501 | 8.60 | 9.71 |
| 21 | SC-1238 II FROM NE | 16 | B4 | 9.53 | H-1202 | V-1501 | 10.30 | -- |
| 22 | SC-1239 III FROM NE | 16 | B4 | 9.53 | H-1202 | V-1501 | 8.30 | 12.91 |
| 23 | SC-1240 IV FROM NE | 16 | B4 | 9.53 | H-1202 | V-1501 | 10.00 | -- |
| 24 | SC-1241 I FROM NW | 16 | B4 | 9.53 | H-1202 | V-1501 | 9.40 | 1.31 |
| 25 | SC-1242 II FROM NW | 16 | B4 | 9.53 | H-1202 | V-1501 | 9.40 | 1.36 |

| Sr. No | LINE NO. | NB (inch) | SCH | NOM. THK. (MM) | LINE DESCRIPTION | | Min. Thk. Observed | %Age red. |
|---|---|---|---|---|---|---|---|---|
| | | | | | FROM | TO | | |
| 26 | SC-1243 III FROM NW | 16 | B4 | 9.53 | H-1202 | V-1501 | 10.20 | -- |
| 27 | SC-1244 IV FROM NW | 16 | B4 | 9.53 | H-1202 | V-1501 | 10.50 | -- |
| 28 | SC-1407 | 3 | B4 | 5.49 | H-1422 | T-1501 | 4.30 | 21.68 |
| 29 | SC-1407 | 8 | B4 | 8.18 | H-1422 | T-1501 | 7.70 | 5.87 |
| 30 | SC-1409 | 4 | B4 | 6.02 | H-1424 | T-1501 | 4.90 | 18.60 |
| 31 | SC-1501 | 4 | B4 | 6.02 | T-1501 | P-1501/6 | 5.40 | 10.30 |
| 32 | SC-1502 | 3 | B4 | 5.45 | P-1501/6 | V-1501 | 5.30 | 2.75 |
| 33 | SC-1502 | 2 | B4 | 3.91 | P-1501/6 | V-1501 | 5.50 | -- |
| 34 | SC-1503 | 1 | B4 | 4.56 | SC-1502 | V-1503 | 3.20 | 29.82 |
| 35 | SC-1504 | 4 | B4 | 6.02 | V-1503 | V-1501 | 5.20 | 13.62 |
| 36 | SC-1504 | 6 | B4 | 7.11 | V-1503 | V-1501 | 6.00 | 15.61 |
| 37 | SC-1505 | 6 | B4 | 7.11 | V-1505 | T-1501 | 5.60 | 21.24 |
| 38 | SC-1506 | 3 | B4 | 5.49 | T-1501 | P-1505 | 4.10 | 25.32 |
| 39 | SC-1506 | 4 | B4 | 6.02 | T-1501 | P-1505 | 4.90 | 18.60 |
| 40 | SC-1507 | 3 | B4 | 5.49 | P-1505 A/B | T-1501 | 4.80 | 12.57 |
| 41 | SC-1511 | 1.5 | B4 | 5.08 | PICV-1221-B | T-1501 | 4.00 | 21.26 |
| 42 | SC-1512 | 4 | C1 | 6.02 | SC-1213 | LCV-1501 | 5.90 | 1.99 |
| 43 | SC-1513 | 4 | B4 | 6.02 | LCV-1501 | V-1503 | 2.40s.s/ 5.00c.s | 60.13/ 16.94 |
| 44 | SC-1514 | 4 | B4 | 6.02 | T-1501 | SEAL POT | 4.50 | 25.25 |
| 45 | SC-1514 | 3 | B4 | 5.49 | T-1501 | SEAL POT | 4.40 | 19.85 |
| 46 | SC-1522 | 2 | B4 | 3.91 | SC-1529 | SC-1409 | 4.10 | -- |
| 47 | SC-1522 | 3 | B4 | 5.49 | SC-1529 | SC-1409 | 5.00 | 8.93 |
| 48 | SC-1523 | 3 | B4 | 5.49 | HEADER | SC-1409 | 4.00 | 27.14 |
| 49 | SC-1525 | 3 | B4 | 5.49 | SC-1536/7/8 | SC-1522 | 5.10 | 7.10 |
| 50 | SC-1530 | 3 | B4 | 5.49 | HEADER | SC-1407 | 3.30 | 39.89 |
| 51 | SC-1607 | 1 | B4 | 4.55 | SC-1226 | PR-1636 | 3.60 | 20.88 |
| 52 | CW-0037 (New Line) | 14 | SCH 20 | 7.92 | CW-1118-14" | H-1250 | 8.80 | -- |
| 53 | CW-0038 (New Line) | 12 | SCH 20 | 6.35 | CW-1119-12" | H-1250 | 7.10 | -- |
| 54 | CW-0047 (New Line) | 12 | SCH 20 | 6.35 | CW-1119-12" | H-1250 | 6.80 | -- |
| **ST-LINES** | | | | | | | | |
| 1 | ST-1123 | 14 | B4 | 9.525 | PICV-1129 | ST-1106 | 8.40 | 11.81 |
| 2 | ST-1128 | 20 | B4 | 9.525 | ST-1106 | PICV-1130 | 10.10 | -- |
| 3 | ST-1206 | 8 | B4 | 8.18 | ST-1506 4 ATA | H-1204 | 7.10 | 13.20 |

| Sr. No | LINE NO. | NB (inch) | SCH | NOM. THK. (MM) | LINE DESCRIPTION FROM | TO | Min. Thk. Observed | %Age red. |
|---|---|---|---|---|---|---|---|---|
| 4 | ST-1206 | 10 | B4 | 9.27 | ST-1506 4 ATA | H-1204 | 7.90 | 14.78 |
| 5 | ST-1352 | 3 | B4 | 5.49 | 23 ATA HEADER | HYDROLYS ER | 3.10 | 43.53 |
| 6 | ST-1409 | 4 | B4 | 6.02 | ST-1504 (9 ATA) | H-1424 | 4.20 | 30.23 |
| 7 | ST-1409 | 6 | B4 | 7.11 | ST-1504 (9 ATA) | H-1424 | 6.20 | 12.80 |
| 8 | ST-1409 | 8 | B4 | 8.18 | ST-1504 (9 ATA) | H-1424 | 9.20 | -- |
| 9 | ST-1502 | 2 | B4 | 3.91 | PICV-1502 | V-1503 | 4.80 | -- |
| 10 | ST-1502 | 8 | C1 | 8.18 | ST-1116 | PICV-1502A | 7.30 | 10.76 |
| 11 | ST-1502 | 3 | B4 | 5.49 | ST-1502 | V-1503 | 5.40 | 1.64 |
| 12 | ST-1503 | 3 | B4 | 5.49 | PICV-1502A | V-1503 | 4.60 | 16.21 |
| 13 | ST-1503 | 12 | B4 | 9.52 | PICV-1502A | V-1503 | 9.00 | 5.46 |
| 14 | ST-1505 | 14 | B4 | 9.52 | PICV-1502B | ST-1506 | 9.80 | -- |
| 15 | ST-1506 | 14 | B4 | 9.52 | V-1501 | ST-1106 | 8.80 | 7.56 |
| 16 | ST-1506 | 18 | B4 | 9.52 | V-1501 | ST-1106 | 9.40 | 1.26 |
| 17 | ST-1507 | 6 | B4 | 7.11 | ST-1506 | ST-1302 | 5.40 | 24.05 |
| 18 | ST-1508 | 2 | B4 | 3.91 | ST-1506 | PCV-1502 | 2.40 | 38.62 |
| 19 | ST-1508 | 3 | B4 | 5.49 | ST-1506 | PCV-1502 | 5.80 | -- |
| 20 | ST-1509 | 10 | B4 | 9.27 | H-1502 | T-1501 | 8.60 | 7.23 |
| 21 | ST-1510 | 10 | B4 | 9.27 | T-1501 | H-1502 | 8.30 | 10.46 |
| 22 | ST-0041 New line | 6 | B4 | 7.11 | V-1501 4ATA O/L HEADER | H-1424 | 6.40 | 9.90 |

* Sr No-15A SC-1228-8’’ minimum measured thickness is 4.3mm against Nominal thickness of 8.18mm.(8’’x12’’ NB reducer), necessary action suggested.

## ANNEXURE-3
## UREA PLANT VESSEL THICKNESS MEASUREMENT SUMMARY

| Sr. No | Equip. No. | Equip. Description | Shell | | | Dish End | | | Channel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nom / Desig. | Min. / Meas | % Red. | Nom. / Desig. | Min. Meas. | % Red | Nom. / Desig. | Min./ Meas | % Red |
| 1 | H-1102 | L.P. AMMONIA PREHEATER | 8.0 | 9.8 | -- | 8.0/10.0 | 11.5 | 8.0 | | | -- |
| 2 | H-1204 | RECICULATION HEATER | 11.0 | 10.7 | 2.7 | 7.0 (MIN) | 9.4 | 3.9 | | | -- |
| 3 | H-1207 | CONDENSATE CIRCULATION SYSTEM-II WATER COOLER | 10.0 | 10.2 | -- | D1-13.0 /10.0 D2-10.0 /8.0 | D1-12.1, D2-8.0 | -- | 8.0 | 7.2 | 7.0 |
| 4 | H-1207-A | CCS-II SURFACE CONDENSATE HEAT EXCHANGER | 8.0 | 8.5 | -- | 10.0/8.0 | 8.7 | 8.46/-- | | 10.3-10.4 | -- |
| 5 | H-1209 | LP ABSORBER CIRCULATION COOLER | 10.0 | 9.2 | 8.0 | 7.5/11.0 | 7.9 / 10.7 | -- | 6.0 | 6.6 | -- |
| 6 | H-1303 | EFFLUENT COOLER | 10.0 | 10.2 | -- | 10/12 | 10.6 | 1.6/-- | 10.0 | 10.5 | 7.7 |
| 7 | H-1418 | PRE-EVAPORATOR SEPERATOR | 8.0/12.0 | 8.3/12.4 | -- | 10.0 | 9.2 | -- | | | -- |
| 8 | H-1419 | PRE-EVAPORATOR CONDENSER | 9.5 | 10.3 | -- | 12.7 | 12.2 | 1.1 | 12.7 | 13.0 | 0.0 |
| 9 | H-1420 | FINAL CONDENSER | 8.0 | 7.6 | 5.0 | 10.0/8.0 | 8.6 | -- | 10.0 | 9.3 | 17.0 |
| 10 | H-1421 | FLASH TANK CONDENSER | 8.0 | 7.2 | 10.0 | D1-13.0 D2-9.0 | D1-11.9, D2-10.6 | 6.0 | | | -- |
| 11 | H-1422 | FIRST STAGE EVAOPARETOR SEPRATOR | 12.0 | 11.6 | 3.3 | 8.0 | 8.2 | 1.7 | | | -- |
| 12 | H-1423 | 1ST STAGE EVAPARATOR CONDENSER | 10.0(T)/7 (B) | 11.0(T) / 7.8(B) | -- | 12/15 (T) / 7/10(B) | 11.8 (T) / 10.7 (B) | -- | 13.0 | 12.0 | -- |
| 13 | H-1424 (New in ESP-III) | 2ND STAGE EVAPORATOR SEPERATOR) | 14.0 | 14.4 | -- | 10.0 | 11.3 | 8.0 | | | -- |
| 14 | H-1425 | 2ND STAGE EVAPARATOR I CONDENSER | 14.0 | 14.3 | -- | 18.0 | 17.8 | 3.9 | 15.0 | 15.0 | -- |
| 15 | H-1426 | 2ND STAGE EVAPARATOR II CONDENSER | 10.0(T) / 7.0 (B) | 10.9(T) / 8.0 (B) | -- | 10(T) / 7.0(B) | 12.7 (T) / 9.0(B) | -- | 10.0 | 8.3 | 7.0 |
| 16 | H-1502 | VENT CONDENSER | 10.0 | 9.8 | 2.0 | 10/13.0 | 9.4 | 8.46/-- | 10.0 | 10.2 | -- |
| 17 | H-1811 | 1ST STAGE GAS COOLER OF K-1801 | 12.0 | 12.5 | -- | 12.0 | 11.8 | -- | 12.0 | 12.9 | -- |
| 18 | H-1812 | 2ND STAGE GAS COOLER OF K- | 10.0 | 10.9 | -- | 10.0 | 11.7 | 1.6/-- | 21.0 | 22.2 | 7.7 |

| Sr. No | Equip. No. | Equip. Description | Shell | | | Dish End | | | Channel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nom / Desig. | Min. / Meas | % Red. | Nom. / Desig. | Min. Meas. | % Red | Nom. / Desig. | Min./ Meas | % Red |
| | | 1801 | | | | | | | | | |
| 19 | H-1813 | 3RD STAGE GAS COOLER OF K-1801 | 10.0 | 9.0 | 10.0 | 10(S) 20.0(N) | 9.0(S) /19.7 (N) | 10/1.5 | 30(N) 10(S) | 30.7 (N) / 9.1 (S) | -- /9.0 |
| 20 | H-1814 A | MAIN LUB OIL COOLER FOR K-1801 | 12.0 | 11.3 | 5.8 | N.A | N.A | -- | 12.0 | 11.5 | 4.2 |
| 21 | H-1814 B | MAIN LUB OIL COOLER FOR K-1801 | 12.0 | 11.3 | 5.8 | N.A | N.A | -- | 12.0 | 11.1 | 7.5 |
| 22 | H-1815 | SURFACE CONDENSER | 15.0 | 14.9 | 0.7 | | | -- | -- | -- | -- |
| 23 | T-1501 | STEAM CONDENSATE TANK | 10.0 | 9.9 | 1.0 | 12.0 | 12.6 | -- | -- | -- | -- |
| 24 | T-1814 | MAIN LUB OIL TANK FOR K-1801 | 6.0 | 5.7 (NORTH FACE) | 5.0 | | | -- | -- | -- | -- |
| 25 | V-1101 | CO2 KNOCKOUT DRUM | 10.0 | 10.0 | 0.0 | 13.0 | 12.7 | 2.3 | -- | -- | -- |
| 26 | V-1202 | RECTIFYING COLUMN | 9.0 | 10.0 | -- | 11.0 | 10.3 | 6.4 | -- | -- | -- |
| 27 | V-1204 | STEAM CONDENSATE POT FOR H-1204 | 8.0 | 8.4 | -- | 10.0/8.0 | 8.4 | -- | -- | -- | -- |
| 28 | V-1301 | SECOND DESORBER | 6.0 | 6.2 | -- | 6.0 | 8.8 | -- | -- | -- | -- |
| 29 | V-1351 | HYDROLYSER | 28.0 | 29.6 | -- | 32.0/28.0 | -- | -- | -- | -- | -- |
| 30 | V-1352 | FIRST DESORBER | 8.0 | 7.8 | 2.5 | 10.0 | 9.3 | 7.0 | -- | -- | -- |
| 31 | V-1353 | LEVEL TANK FOR REFLUX CONDENSER | 6.0 | 6.0 | 0.0 | 6.0/4.5 | 5.2 | -- | -- | -- | -- |
| 32 | V-1406 | FLASH TANK SEPERATOR | 8.0 | 8.6 | -- | 10.0 | 104.0 | -- | -- | -- | -- |
| 33 | V-1409 A | UREA SOLUTION FILTER | 6.0 | 6.5 | -- | -- | -- | -- | -- | -- | -- |
| 34 | V-1409 B | UREA SOLUTION FILTER | 6.0 | 6.3 | -- | -- | -- | -- | -- | -- | -- |
| 35 | V-1420 | LEVEL POT FOR 1ST STAGE EVAPORATOR | 6.0 | 8.4 | -- | 8.0 | 7.9 | 1.3 | -- | -- | -- |
| 36 | V-1502 | 23 ATA STEAM SATURATOR | 30.0 | 31.1 | -- | 37.0/34.0 | 37.3 | -- | -- | -- | -- |
| 37 | V-1811 | 1ST STAGE SEPARATOR | 6.0 | 6.2 | -- | 6.0 | 6.0 | 0.0 | -- | -- | -- |
| 38 | V-1812 | 2ND STAGE SEPARATOR | 10.0 | 10.3 | -- | 10.0 | 11.9 | -- | -- | -- | -- |
| 39 | V-1813 | 3RD STAGE SEPARATOR | 30.0 | 30.2 | -- | 30.0 | 28.7 | 4.3 | -- | -- | -- |
| 40 | | 35 M3 New Instrument Air Receiver | 12.0 | 12.2 | -- | 12.0 | 13.2 | -- | -- | -- | -- |

**ANNEXURE-4**

**GAUSS MEASUREMENT & DEMAGNETIZATION REPORT**

**K-1801 (HITACHI COMPRESSOR)**

| DESCRIPTION | POSITION | BEFORE (Gauss-max.) | AFTER (Gauss max.) |
|---|---|---|---|
| **TURBINE (FREE ENDSIDE)** | | | |
| Journal Bearing Pads | Governor side | 0.6 | Within limits |
| Journal Bearing Base Ring | Governor side | Top–0.8<br>Bottom–0.6 | |
| Shaft Journal | Governor side | 0.9 | |
| Thrust Collar | Governor side | 1.6 | |
| Thrust Bearing | Governor side | 0.8 | |
| Thrust Base Ring | Governor side | Top–0.6<br>Bottom–0.4 | |
| Thrust Bearing Pads | Governor side | Active-0.6<br>Inactive-0.3 | |
| Collar | Active | 0.6 | |
| | Inactive | 0.3 | |
| **TURBINE (NORTH END)** | | | |
| Journal Bearing Pads | Top Half | 0.8 | Within limits |
| | Bottom half | 0.8 | |
| Shaft Journal | | 0.6 | |
| Journal Bearing Base Ring | Top Half | 1.2 | |
| | Bottom half | 1.5 | |
| **L.P. CASE (TURBINE END)** | | | |
| Shaft Journal | | 0.8 | Within limits |
| Journal Bearing Pads | | Top– 0.4<br>Bottom–0.8 | |
| Journal Bearing Base Ring | Top | 0.7 | |
| | Bottom | 0.8 | |
| Shaft Journal | | 1.3 | |
| **L.P. CASE (G.B. END)** | | | |
| Shaft Journal | | 1.6 | Within limits |
| Journal Bearing Pads | | 0.6 Max | |
| Thrust Bearing Pads | Active | 0.7 | |
| | Non active | 0.4 | |
| Thrust Collar | | 1.2 | |
| Thrust Shaft | | 1.7 | |
| **GEAR BOX** | | | |
| L.S. Shaft Journal Bearing L.P. Side | Top half | 0.7 | Within limits |
| | Bottom half | 0.8 | |
| 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 | 0.7 | |
| | Bottom half | 0.6 | |
| H.S. Shaft Journal Bearing H.P. Side | Top half | 0.8 | |
| | Bottom half | 0.5 | |

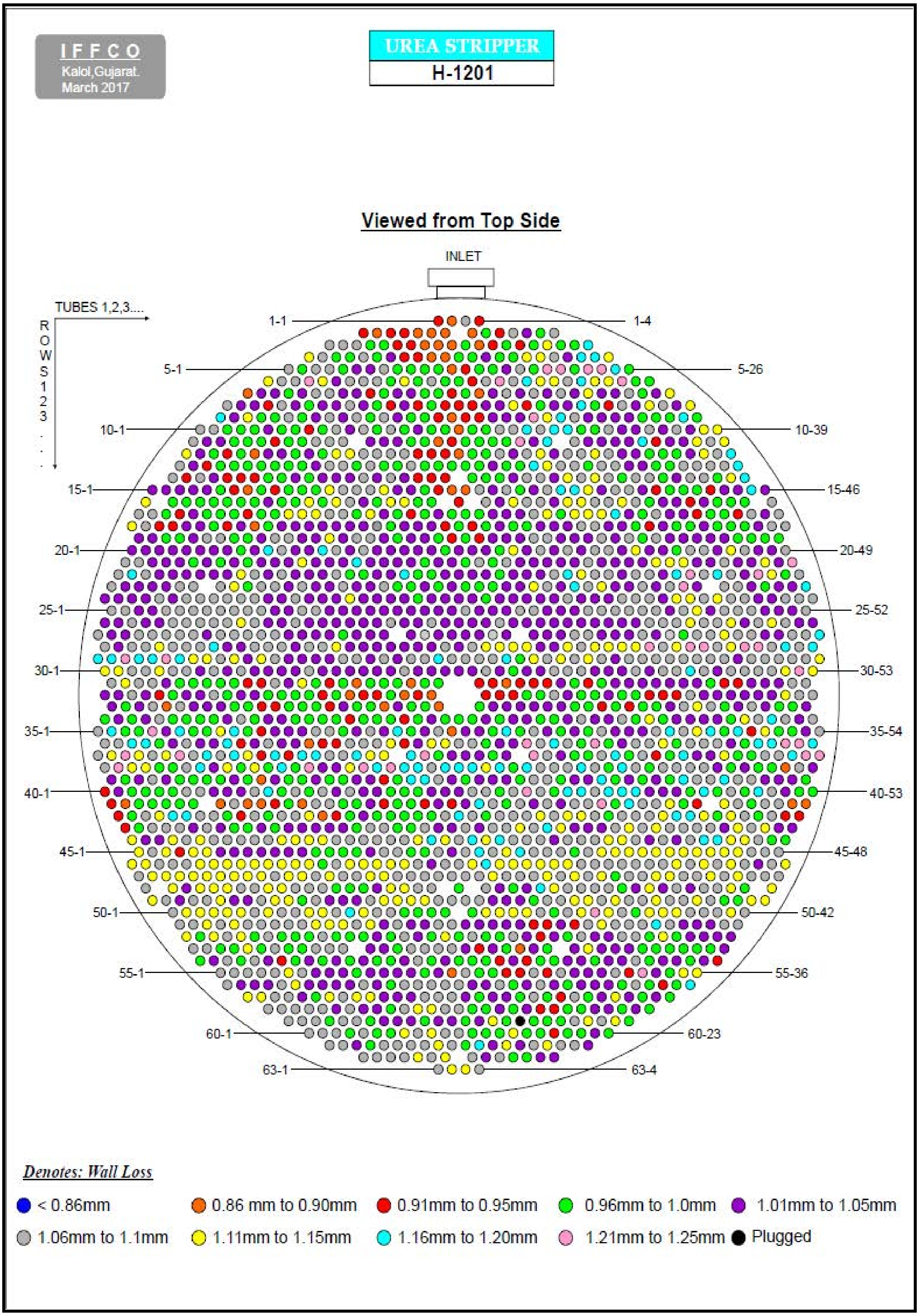
| DESCRIPTION | POSITION | BEFORE (Gauss-max.) | AFTER (Gauss max.) |
|---|---|---|---|
| Thrust Base Ring | Inboard side Active | Top–0.5 Bottom–0.5 | Within limits |
| | Outboard side Non Active | Top– 0.8 Bottom–0.9 | |
| Thrust Pads | Inboard side | 0.5 | |
| | Outboard side | 0.6 | |
| Thrust Collar | | Active-0.6 Inactive-0.4 | |
| High Speed Shaft Journal | L.P. Side | 0.8 | |
| | H.P Side | 0.7 | |
| Low Speed Shaft Journal | L.P. Side | 0.5 | |
| | H.P Side | 0.4 | |
| **H.P. CASE (FREE END SIDE)** | | | |
| Shaft Journal | | 0.7 | Within limits |
| Journal Bearing Pads | | Top– 0.6 Bottom–0.5 | |
| Journal Bearing Base Ring | Top | 0.5 | |
| | Bottom | 0.7 | |
| Thrust Base Ring | Inboard side Active | Top-0.3 Bottom-0.4 | |
| | Outboard side Non Active | Top-0.3 Bottom-0.6 | |
| Thrust Pads | Inboard Active | 0.6 | |
| | Outboard Non Active | 0.5 | |
| Thrust Collar | | Active-0.9 Inactive-0.6 | |
| **H.P. CASE (G.B.SIDE)** | | | |
| Shaft Journal | | 1.1 | Within limits |
| Journal Bearing Pads | | Top– 0.6 Bottom–0.4 | |
| Journal Bearing Base Ring | Top | 0.8 | |
| | Bottom | 0.9 | |
| Thrust Pads | Inboard | 0.8 | |
| | Outboard | 0.7 | |
| Thrust Collar | | 1.2 | |
| Thrust Collar Journal | | 0.9 | |

## ANNEXURE- 5

## RADIOGRAPHIC EXAMINATION OF HP LINE/HPF FITTINGS

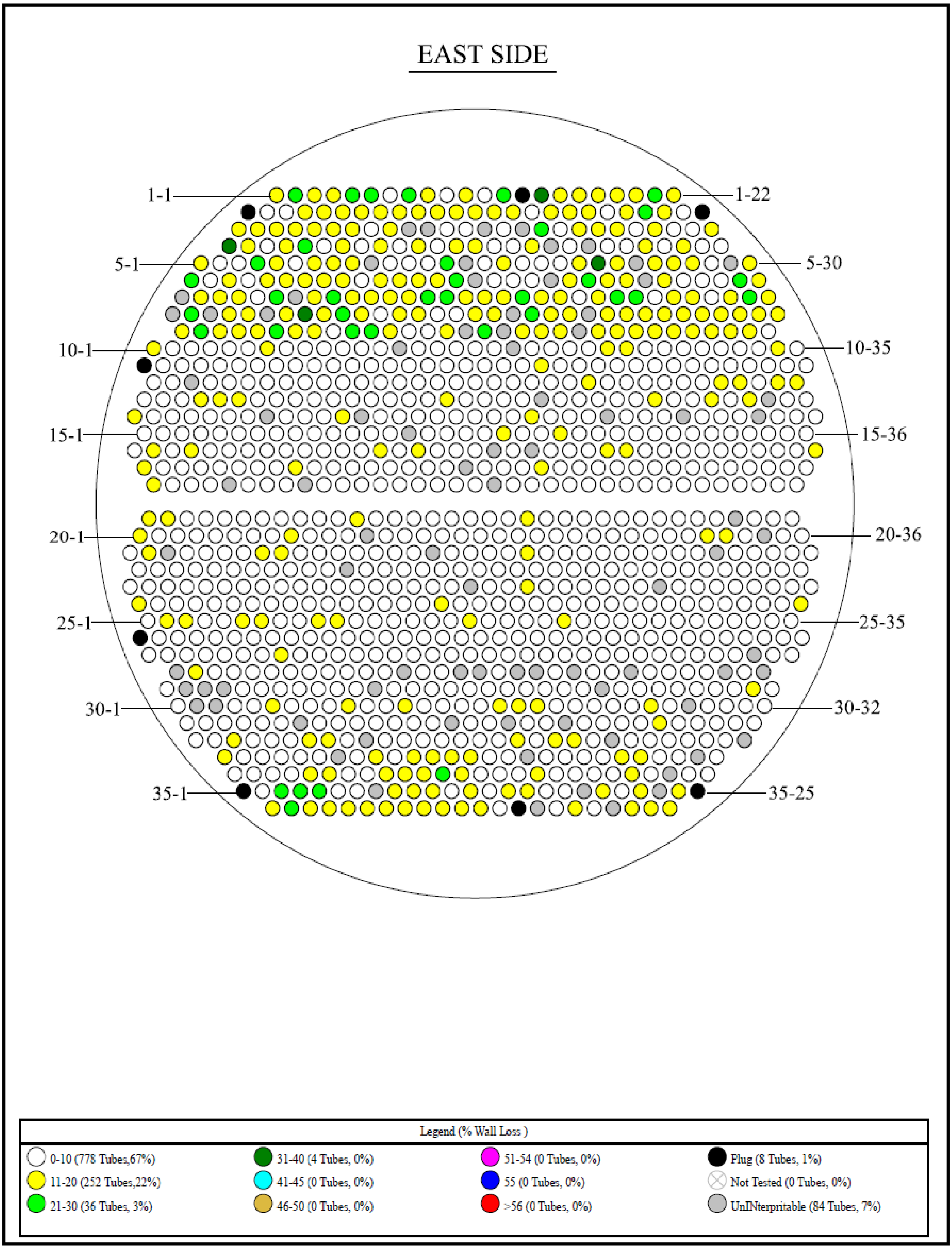
| **Sr No.** | **Fitting Identif-No.** | **Line where Installed** | **Location** | | **Size (OD)** | **Nom. Thick. (mm)** | **RT Result** |
|---|---|---|---|---|---|---|---|
| 1 | TR-1201 | V-1201 to H-1201 | 1st | Adj. to Stripper | 1.5" Sch. 80 | 5.08 | Satisfactory |
| 2 | TR-1206 | V-1201 Offgas line | 5th | Above V-1201 | 1.5" Sch.80 | 5.08 | Satisfactory |
| 3 | TR-1207 | CO2 to H-1201 | GF | Near Stripper Bottom | 1.5" Sch.80 | 5.08 | Satisfactory |
| 4 | **TR-1210** | H-1201 O/L Line | GF | Near Stripper Bottom | 1.5" Sch.80 | 5.08 | Weld crevice observed **(Replaced in S/D 2017)** |
| 5 | HPF to Seal-Iso. Valve | Liquid Outlet from V-1201 | GF | Near P-1102-C N-E side | 2" Sch.80 | 5.54 | Satisfactory |
| 6 | HPF to FICV-1204 | Carb. Pump Discharge to H-1203 | 3.5$^{th}$ | South/West corner of floor | 1" Sch.80 | 4.55 | Satisfactory |
| 7 | HPF to PRCV-1201 | H-1203 Offgas to V-1203 | 6$^{th}$ | East side from PRCV-1201 | 1" Sch.80 | 4.55 | Satisfactory |
| 8 | HPF to HICV-1202 | V-1201 Offgas to H-1203 | 6$^{th}$ | North side from HICV 1202 | 1" Sch.80 | 4.55 | Satisfactory |
| 9 | HPF V-1201 Liquid O/L | V-1201 Unloading Line (Sample Point) | GF | --- | 1" Sch.80 | 4.55 | Satisfactory |
| 10 | SEAL FILL V-1201 | V-1201 (Bottom) | 3$^{rd}$ | --- | 2" Sch.80 | 5.54 | Satisfactory |

## ANNEXURE- 6
## TUBE SHEET LAY OUT OF H-1201 (VIEWED FROM TOP)



## ANNEXURE- 7

## TUBE SHEET LAY OUT OF H-1205 (VIEWED FROM TOP)



# UTILITY PLANT

(INSPECTION)

The following inspection activities were performed in Utility Plant during Annual Shut-down 2017.

- Inspection of Deaerator.
- Inspection of Steam Drums.
- Inspection of Mud Drum
- Inspection of BHEL Boiler Furnace
- Inspection of Air Preheater (APH)
- Inspection of Continuous Blow Down Drum
- Inspection of Intermediate Blow Down Drum
- Inspection of 52" NB CW Inter connection line of P-4405 and P-4401 C/D sump.
- Gauss measurement.
- Thickness measurement of lines.

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

**BHEL BOILER (GT-2068)**

Visual inspection and ultrasonic thickness measurement of Steam Drum, Mud Drum and furnace tubes were carried out.

**STEAM DRUM**

- The internal surface of the drum observed brownish black in colour.
- All the weld joints found satisfactory.
- 01 Nos of fastener of bottom plate found missing. (1st bolt counting from west to east).
- 01Nos of bottom plate inter connecting fastener found missing. (3rd interconnection joint counting from west to east).
- The tube stub ends were free from any defect.
- Overall condition of the steam drum found satisfactory.
- Minimum thickness of 100.93 mm and 79.03 mm was observed on shell and dished end respectively against the nominal thickness of 97.0 mm and 77.0 mm.

**MUD DRUM**

- The internal surface of the drum observed brownish black in colour.
- The condition of the weld joints found satisfactory.

- The tube stub ends were free from any defect.
- Phosphate dozing pipe (Located at top 1''NB) holding ''U" clamps found satisfactory.
- Blow down line (located at bottom) cover plate bolts found loose.

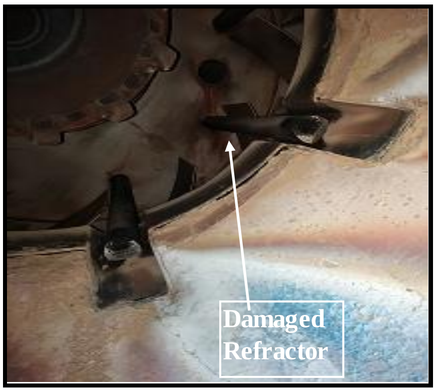
  Counting from West to East 1st pair south side bolt.

  Counting from West to East 3rd pair north side bolt.
- Overall condition of the mud drum found satisfactory.
- Minimum thickness of 81.25 mm and 55.20 mm was observed on shell and dished end respectively against the nominal thickness of 78.0 mm and 54.00 mm.

**BHEL Boiler Furnace**

**From South Wall Access Door**

- Previously repaired refractory found Satisfactory just above the access door.
- Minor rust and scaling was observed on South wall, Front panel, Rear panel, Cut corner tubes and baffle wall tubes.
- Floor refractory was found damaged and lifted upwards at centre of furnace floor. Previously repaired floor refractory found damaged.
- Condition of thermo-wells in cut-corner wall found satisfactory.
- Condition of refractory around the bottom burner was found damaged at 5 locations which were marked with yellow chalk and carbon deposition observed on all 8 nozzles of top and bottom burners.

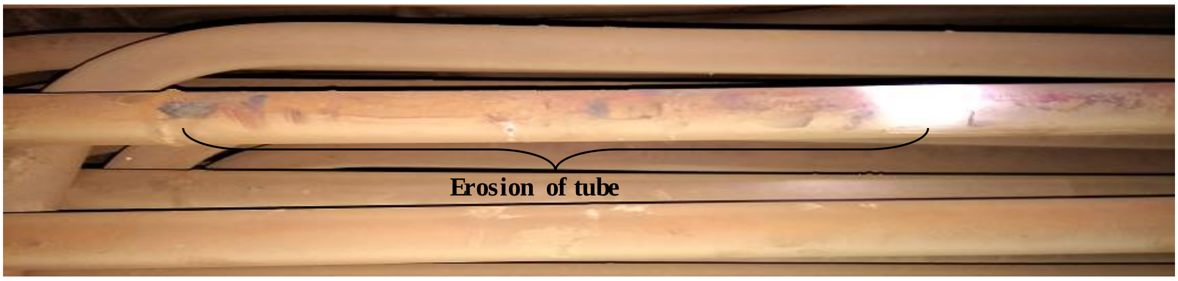




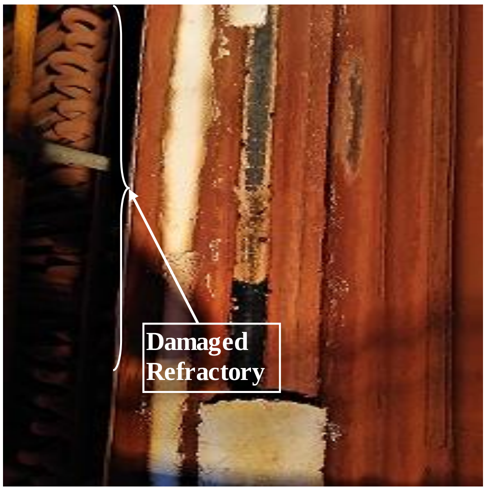
- Condition of refractory around the top burner was found satisfactory.
- Minor scaling was observed on Primary Super heater tubes.
- Insulation fiber blankets placed on top of the Secondary super heater coil was found satisfactory.
- Refractory found loosened on above secondary super heater coil.

- Baffle wall refractory fell down at few locations.


- Refractory found loosed on above secondary super heater coil.
- Erosion observed on top tube of primary super heater coil however thickness measurement carried out and found satisfactory.

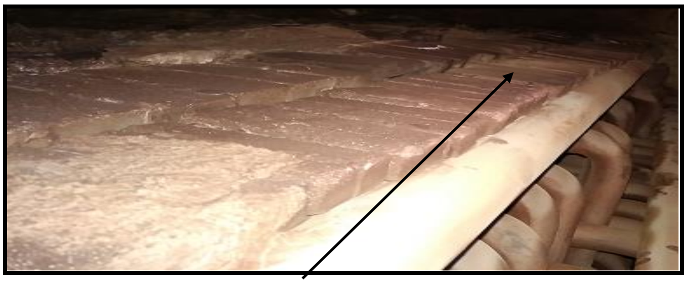



- Refractory on west wall above primary super heater tubes found loosened.

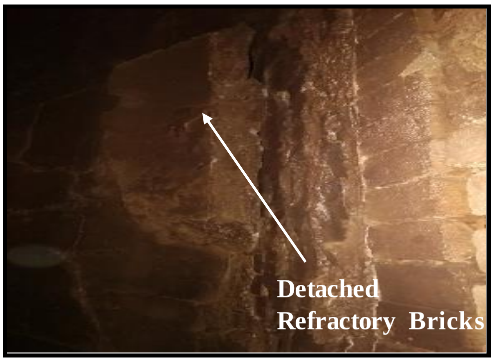



**<u>From North Wall Access Door</u>**

- Refractory found satisfactory on roof just above the access door.
- Minor rust and scaling was observed on boiler bank tubes.
- Condition of Secondary super heater coils was found satisfactory.
- Refractory bricks were observed slightly detached from baffle wall at top portion.



- Refractory lining was found slightly detached from its position in super heater furnace zone.





- Thick scaling observed on boiler bank tubes (1.5 to 2.0 mm approx) prominent on East side tubes.
- In general, the condition of the furnace tubes and super heater tubes exposed to flue gases was satisfactory. The thickness measurement of Stage-I & Stage-II Primary and Secondary Super heater tubes, Bank tubes, Sidewall tubes, Baffle wall tubes, D-Panel tubes, Cut corner tubes, Rear wall tubes and Front wall tubes was carried out. The Summary indicating the thickness of individual type of the tubes is given below:

| Sr. No. | DESCRIPTION | MIN. THK. (MM) | DESIGN THK.(MM) |
|---|---|---|---|
| 1 | SOUTH MANHOLE | | |
| (A) | BAFFLE WALL TUBES | 4.89 | 4.5 |
| (B) | D-PANEL TUBES | 4.91 | 4.5 |
| (C) | CUT CORNER TUBES | 4.82 | 4.5 |
| (D) | REAR WALL TUBES | 4.90 | 4.5 |
| (E) | FRONT WALL TUBES | 4.66 | 4.5 |
| 2 | NORTH MANHOLE: | | |
| (A) | BANK TUBES | 3.44 | 3.6 |
| (C) | NORTH SIDE WALL TUBES | 4.86 | 4.5 |
| 3 | PRIMARY SUPERHEATER TUBES INSIDE FURNACE(STAGE-I) | 5.96 | 7.1 |
| 4 | SECONDARY SUPERHEATER TUBES INSIDE FURNACE (STAGE-II) | 4.55 | 5.6 |

## DEAERATOR

Inspection of the Deaerator Head and the Storage Shell carried out and observations are as under

### Deaerator Head

- All five tray segments were found satisfactory in its position. However, holding bolts of 3rd and 4th tray segment (counting from top) were found missing.
- Silver 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.
- Minor rusting observed at both dish ends.
- Overall condition of shell observed satisfactory.

**Air Preheater (APH)**

**From Air Entry side (North side) Manhole**

- Air Inlet duct was found in satisfactory condition.
- Condition of painting/coating was found satisfactory.
- Air Inlet flow diverter plate tack welding found satisfactory.
- Flue gas duct condition observed satisfactory.

**From Air Outlet (East side) Manhole**

- Air outlet duct was found in satisfactory condition, however the surface of old duct was found with Rust and scales & loose debris were found lying at the bottom of the duct.
- Thermowell was found intact in its position.

**From Flue Gas Exit side (South side) Manhole**

- Painting/ Primer of middle compartment roof area was found peeled off.

- Minor Peeling off of paint/ primer was observed in top compartment also.
- At rest of the location the Painting/ coating quality is satisfactory.
- Bottom duct bottom surface paint /primer peeled off at several locations.

**CONTINIOUS BLOW DOWN DRUM**

- Shell and Dish end observed brownish in colour.
- Steam expander condition observed satisfactory.

- Dish end welding and long seam welding observed satisfactory.
- Thickness measurement carried out. Minimum thickness observed on shell 13.91 mm and dished end 13.01 mm.
- Overall condition of vessel observed satisfactory.

**INTERMEDIATE BLOW DOWN DRUM**

- Shell and Dish end observed brownish in colour.
- Steam expander condition observed satisfactory.

- Dish end welding and long seam welding observed satisfactory.
- Thickness measurement carried out. Minimum thickness observed on shell 14.21 mm and dished end 12.17 mm.
- Overall condition of vessel observed satisfactory.

**52" NB CW INTERCONNECTION LINE**

- Condition of Epoxy paint was found satisfactory in general however rusting marks were observed at scattered locations.
- All circumferential and long seam welds found satisfactory.
- Rusting and blistering of paint was observed at scattered locations on suction pipe of P-2205 A/B, repainting is suggested after cleaning.

**MISCELLANEOUS JOBS:**

- P-4411/ B Turbine OST was carried out at 3480 rpm.
- P-4401/ A Turbine OST was carried out at 6140 rpm.
- DP Test of BFW pumps white metal bearings and coupling bolts.

**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.

**GAUSS MEASUREMENT OF EQUIPMENT**

| | | |
|---|---|---|
| **BFW Turbine (Q-5111)** | | |
| Journal Bearing Coupling Side | Top | 0.9 |
| | Bottom | 0.6 |
| Journal + Thrust Bearing Governor Side | Top | 0.4 |
| | Bottom | 0.7 |
| | Thrust Face | 0.9 |
| Shaft Journal | Thrust End | 1.0 |
| | Non Thrust End | 1.2 |
| **BFW Pump (P-5111)** | | |
| Journal Bearing Free End | Top | 0.6 |
| | Bottom | 1.1 |
| Journal Bearing Coupling side | Top | 0.8 |
| | Bottom | 1.2 |
| Thrust Bearing Pads | Active | 0.9 |
| | Inactive | 0.8 |
| Shaft Journal | Thrust End | 1.3 |
| | Non Thrust End | 1.2 |

**THICKNESS MEASUREMENT OF LINES**

Thickness measurement of BFW Pump leak off line, minimum flow line and warm off line was carried out. Results are summarized as mentioned below.

| SR. NO. | LINE DESCRIPTION | SIZE | DESIGN THICKNESS (MM) | MINIMUM THICKNESS (MM) |
|---|---|---|---|---|
| 1 | 1.5”NB Leak off line FROM:-P-5111 T0 P-5112 | 1.5” NB | 5.08 | 2.5* |
| 2 | 2’’/3”NB Minimum flow line FROM:-P-5111 T0 P-5112 | 2’’NB / 3”NB | 5.54/ 7.62 | 3.7 / 4.9* |
| 3 | P-5111 Warm Off line | 1”NB | 4.55 | 5.7 |
| 4 | P-5112 Warm Off line | 1”NB | 4.55 | 5.7 |

* Portion of pipeline was replaced by new one where reduction in thickness / external corrosion was observed.

# INSTRUMENTATION

# AMMONIA PLANT

(INSTRUMENTATION)

## Control Valve Maintenance jobs:

### FICV-14

Control valve was dropped from line for flow restriction problem diagnosis. All parts of valve were inspected & plug was found in broken condition, so it was replaced with new one. Air filter regulator & gland packing were replaced with new one. After complete overhauling of control valve, box-up was done. Finally valve operation was checked & found ok.

### FRCV-485

Old control was replaced with new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable connection work were carried out. Finally control valve stroke was checked and found ok.

### FRCV-3

Control valve was opened from bonnet. Trim was checked & found in healthy condition. All parts of valve were cleaned and overhauled. Actuator diaphragm was inspected & found in good condition. New gland packing was provided. Finally stroke was checked & found ok.

### LCV-490

Control valve was open from bonnet for trim inspection. Cleaning of trim was carried out. Control valve was checked for tight shutoff. Actuator diaphragm was inspected & found ok. Complete overhauling of control valve was carried out. New gland packing & bottom gasket were provided. Finally stroke was checked & found ok.

### KV-120-1, 2, 3 & 4

Old control valves were replaced with new control valves. Related signal cable connection & air supply tubing work were carried out. Finally control valves opening & closing were checked and found ok.

**PICV-5**

Control valve was dropped from line for complete overhauling purpose. Plug & seat parts were inspected & found ok. Actuator diaphragm was checked & found in damaged condition, so it was replaced with new one. General cleaning of all parts of control valve was done. New gland packing was provided. Finally control valve stroke was checked & found ok.

**PICV-11A/B**

Control valve was opened from bonnet for complete overhauling purpose. Plug & seat parts were inspected & found ok. General cleaning of all parts of valve was done. New gland packing was provided. Finally control valve stroke was checked & found ok.

**PRCV-25**

Control valve was opened from bonnet for complete overhauling purpose. Plug & seat parts were inspected & found ok. General cleaning of all parts of valve was done. New gland packing was provided. Finally control valve stroke was checked & found ok.

**FICV-14A**

Valve was dropped from the line and replaced by spare valve which was already overhauled. Air supply tubing & signal cable connection work were carried out. Finally control valve stroke was checked and found ok.

**PRCV-6**

Control valve was open from bonnet for complete overhauling purpose. Actuator diaphragm was replaced with new one, as old diaphragm was found in punctured condition. Plug, seat inspection was carried out & both were found in damaged condition, so same were replaced with new one. General cleaning of air filter regulator was carried out. Gland packing was replaced with new one. Finally control valve stroke was checked & found ok.

**FRCV-5**

Control valve was opened from bonnet for trim inspection. Plug& seat were inspected & found ok. Plug seat lapping work was performed. Actuator diaphragm checked, found ok. Air filter regulator & gland packing were replaced with new one. Valve Box-up job was completed & stroke was checked, found ok.

**PRCV-18**

Control valve was opened from bonnet for complete overhauling purpose. Actuator diaphragm was checked & found ok. Plug and seat were inspected & found in good condition. General cleaning & checking of air regulator & valve Positioner was done. Valve bonnet gasket was replaced with new one. Finally stroke was checked & found ok.

**PICV-002**

Control valve was opened from actuator for diaphragm inspection. Actuator diaphragm was found in good condition. Air filter regulator & gland packing were replaced with new one. Finally stroke was checked & found ok.

**PICV-137**

Control valve was opened from bonnet for complete overhauling. Plug & seat were inspected & found in good condition. Actuator diaphragm was checked & found ok. General cleaning of all parts of valve was done. New gland packing was provided. Finally control valve stroke was checked & found ok.

**LCV-23**

Control valve I/P was found faulty, so it was replaced with new one. Valve general cleaning & calibration work was performed & found ok.

**PRCV-24**

Control valve was opened from bonnet for complete overhauling purpose. Actuator diaphragm was checked & found in good condition. Plug & seat were inspected & found ok. General cleaning & checking of air regulator & valve Positioner were done. Valve gasket was replaced with new one. Finally stroke was checked & found ok.

**V-7A**

Control valve was opened from actuator for diaphragm inspection. Actuator diaphragm was found in good condition. Air filter regulator & gland packing were replaced with new one. Finally stroke was checked & found ok.

**PRCV-23**

Damper control valve assembly was removed to facilitate mechanical maintenance job. Overhauling work was carried out. Air filter regulator was replaced with new one. Finally stroke was checked & found ok.

**LCV-485**

Control valve was dropped from line for complete overhauling purpose. Actuator diaphragm was checked & found ok. Plug & seat were inspected & found in good condition. General cleaning & checking of air regulator & valve Positioner was done. Valve gasket was replaced with new one. Finally stroke was checked & found ok.

**MICV-24**

New control valve was installed at 106-D inlet vent as per EWR. Related tubing & wiring work for Positioner & Air filter regulator was done. Finally control valve stroke was checked & found ok.

**PRCV-4**

Control valve was opened from actuator for diaphragm inspection. Actuator diaphragm was found in good condition. Air filter regulator & gland packing were replaced with new one. Finally stroke was checked & found ok.

**PICV-006 A/B**

Control valve was opened from bonnet for complete overhauling purpose. Actuator diaphragm was checked & found ok. Plug seat were inspected & found in good condition. General cleaning & checking of air regulator & valve positioner were done. Valve gasket was replaced with new one. Finally stroke was checked & found ok.

**LICV-480-1 & 2**

Control valves were dropped from line for complete overhauling purpose. Plug, seat inspection work was carried out & found plug in damage condition for both the valves, so plugs were replaced with new one. Actuator diaphragms were checked & found in healthy condition. Positioners & air filter regulators were cleaned. Gland packings were replaced with new one. Valves were taken back in line, stroke checked & found ok.

**TRCV-10**

Actuator diaphragm was checked & found ok. General cleaning of air filter regulator was carried out. Gland packing was replaced with new one. Finally control valve stroke was checked & was found ok.

**LICV-503**

Control valve was opened from bonnet for overhauling purpose. Actuator upper dome was found in damaged condition, so it was send to central workshop for repairing purpose. Actuator diaphragm was checked & found in good condition. Plug was inspected & found in damaged condition, so it was replaced with repaired one. Finally box-up job completed & stroke checked & found ok.

**V-18**

Control valve was opened from actuator for diaphragm inspection. Actuator diaphragm was found in good condition. Air filter regulator & gland packing was replaced with new one. Finally stroke was checked & was found ok.

**PICV-2001**

Actuator diaphragm was checked & found ok. General cleaning of air filter regulator carried out. Gland packing was replaced with new one. Finally control valve stroke was checked & was found ok.

**V-4**

Control valve was opened from actuator for diaphragm inspection. Actuator diaphragm was found in good condition. Air filter regulator & gland packing was replaced with new one. Finally stroke was checked & was found ok.

**General Maintenance & stroke checking of control valves :**

Following control valves general /cleaning/ greasing was carried out. New gland packing was provided wherever required. Valve Positioner was cleaned and air header & regulators were flushed. Stroke checking was carried out:

| | | | | | |
|---|---|---|---|---|---|
| **1.** | PRCV-1 | **8.** | MICV-11 | **15.** | LCV-25 |
| **2.** | TRCV-11 | **9.** | MICV-16 | **16.** | LICV-27 |
| **3.** | TRCV-12 | **10.** | MICV-17 | | |
| **4.** | FICV-11 | **11.** | FICV-100B | | |
| **5.** | PICV-44 | **12.** | LICV-13 | | |
| **6.** | MICV 1 to 9 | **13.** | LICV-16 | | |
| **7.** | MICV 1A to 9A | **14.** | LICV-18 | | |

**COMPRESSOR HOUSE JOBS:**

**Air Compressor (101J):**

Removed all radial, axial and key-phasor probes along with relevant junction boxes, speed pick-ups, bearing pad temperature thermocouple& RTD, pressure gauges and local THI to facilitate Mechanical Maintenance jobs. All Junction boxes of proximitor were cleaned. After completion of M/M jobs all instruments and probes/pick-ups were fixed back after cleaning &functional checking. Gap voltage adjustments for radial and axial probes were carried out.

**HIC-101J**

Pneumatic governor actuator was removed from its location for complete overhauling purpose. New lip seal of Piston/Cylinder was provided. Calibration of I/P Converter was carried out. New pressure gauge was provided for I/P converter & air supply regulator. Finally governor actuator stroke was checked& found ok.

**TRIP-101J**

Mechanical trip feedback limit switch was overhauled and checked its operation, found ok.

**VS-101J**

Trip Solenoid valve was overhauled. Coil of trip solenoid valve was checked & found in good condition. Finally its operation was checked & found ok.

**101J (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, found ok.

**Ammonia Refrigeration Compressor (105J):**

Removed all radial, axial and key-phasor probes along with relevant junction boxes, speed pick-ups, bearing pad temperature thermocouple & RTD, pressure gauges and local THI to facilitate Mechanical Maintenance jobs. All Junction boxes of proximitor were cleaned. After completion of M/M jobs the instruments and probes/pick-ups were re-fixed back after cleaning & functional checking. Gap voltage adjustments for radial and axial probes were carried out.

**PRC-9**

General cleaning and overhauling of pneumatic governor actuator was carried out. 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 re-fixed back and stroke checking was performed, found ok.

**TRIP-105J**

Mechanical trip feedback limit switch was overhauled and its operation was checked.

**VS-105J**

Trip Solenoid valve was overhauled. Coil of trip solenoid valve was checked & found in good condition. Finally its operation was checked & found ok.

**105J (Trip logic)**

Checked the setting for alarm and trip logic.

**Synthesis Gas Compressor (103J)**

**103-JT Turbine replacement job under Energy saving project-III**

All radial, axial and key-phasor probes along with relevant junction boxes, speed pick-ups, pneumatic governor actuators, bearing pad temperature thermocouple & RTD, transmitters, Pressure switches, pressure gauges and local THI were removed from old turbine.

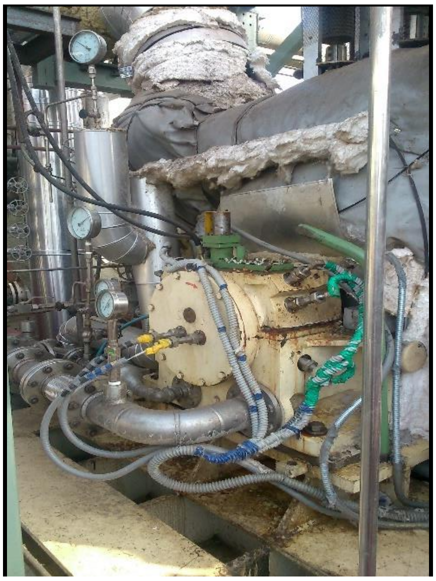
HP oil tank had inbuilt instruments along with junction box. Multi-Pair cables were laid from junction box to DCS Marshalling cabinet. Wiring termination work was carried out in junction box & cabinet end with proper ferrule at both side. Loop checking of all instruments were carried out & found ok.

**HP Oil Tank System Accumulator System**

HP control oil & recirculation oil motorized pump on-off & ready to start indication in DCS work was done, related wiring work was carried out in contactor box & at PLC marshalling cabinet end.

Local instrument racks containing different type of transmitters & junction boxes were installed in proper location in turbine area. Cable tray fabrication work from field to control room done & multi-pair cables were laid from racks to control room. Single pair cables from field instruments to junction box laid & termination with proper ferrule work was done in both junction box & cabinet end. Loop testing of all instruments were carried out & found ok.

Vibration probes (Four radial, two axial & one key-phasor) were mounted in its location with proper gap voltage & wiring with conduit was done up to junction box. Multi-pair cable termination between junction box & M/S Bentaly Nevada make Vibration monitoring rack was done. Rack module cards were re-programmed as per new trip& alarm setting.



**Speed Pick Up Units (MPU'S)**

Five numbers of MPU's were installed in turbine & direct dedicated cables was terminated between MPU's& TCC Panel.

M/S Hydac make Turbine Turning gear system was installed for barring purpose. Related instruments were installed & wiring work was done. Logic for turning gear was made in DCS system, checked & found working satisfactory.

**Turning Gear System**

Drain valves were installed in its proper location & SOV wirings were provided. Checked its operation & found ok. Two new Air distribution port were installed in turbine area for providing air in valves & SOV.

Instruments (Level transmitters & Level switch) related to rundown tank of 103-JT was installed & wiring, termination & ferruling work done in junction box & cabinet end.

Turbine Control Cubic (TCC) panel wasinstalled in new marshalling room. Power of 110Vac provided from UPSS power distribution board. All wiring related work between TCC Panel to ESD & DCS Cabinet was done.Five dedicated cables from MPU's of turbine to TCC cabinet were laid & terminated in its location.


**TCC Panel**

M/S Siemens make dedicated special cables (BALUF Cables) from HPCV & LPCV valves to TCC cabinet were laid & terminated in its location inside cabinet. West module cards for controlling of HPCV & LPCV valves were programmed by M/S Siemens engineer. Stroke of all valves was checked & found ok.

Turbine HIS was installed in control room & Ethernet cables were laid & terminated between CPU card of TCC cabinet & HIS. All related software were loaded & HIS was given in service.

Turbine various logics were made in ESD & DCS system & checked by production people & were found satisfactory.

**103-J Compressor**

103-J Compressor related all radial, axial and key-phasor probes along with relevant junction boxes, speed pick-ups, bearing pad temperature thermocouple & RTD, pressure gauges and local THI were removed to facilitate Mechanical Maintenance jobs. All Junction boxes of proximitor were cleaned. After completion of M/M jobs all instruments and probes/pick-ups were re-fixed back after cleaning & functional checking. Gap voltage adjustments for radial and axial probes were carried out.

## Field Instrument jobs

## Contactor Box

Contactor box was installed in new marshalling room for ESP-III related all motor running, start & stop indication in DCS. 110V ac power was provided by UPSS power distribution board. Multi-pair cable was connected between contactor box & interfacing junction box of MCC.


## 115-JAT

Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 115-JAT to facilitate Mechanical Maintenance jobs. Checked both MPUs of electronic Governor. One RTD of 115-JA was replaced with new one as old one found in damaged condition.

## 101-BJT

Removed different instruments (RTD, MPU, SV etc.) at 101-BJT to facilitate Mechanical Maintenance jobs. Checked all MPUs of electronic governor. After completion of job all instruments were fixed back. Trip switch was relocated at new place.

## 104-JA

Removed different instruments (RTD, MPU, SV etc.) at 104-JA to facilitate Mechanical Maintenance jobs. Re-routing of instrument SS tubing was done. Checked both MPUs of electronic Governor for 104-JA. After completion of job all instruments were fixed back.

## 115-JBT

Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 115-JBT to facilitate Mechanical Maintenance jobs. Checked both MPUs of electronic Governor. After completion of job all instruments were fixed back in its location.

Low range pressure gauges were provided at different locations in plant as per requirement of production department for purging & maintenance purpose.

Draft point Manometer tubing was removed & re-fixed to facilitate Mechanical. Maintenance jobs.

**109-CA/CB**

Thermocouples & local PI were removed from its location to facilitate M/M, after completion of job all instruments were re-fixed back in its location.

**TI-0085**

Thermo-well was removed from its location & found in broken condition, so it was replaced with new one.

**Boiler Inspection**

Provided standard 10" dial size pressure gauges on steam drum 101-F, 112-C, 107-C& 1123-C. 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.

All Metal temperature thermocouples (MTI-105, MTI-106, MTI-107 & MTI-108) were removed & re-fixed to facilitate mechanical maintenance.

**PT-485**

Transmitter range was changed from 0-60 kg/cm2 to 0-80 kg/cm2 as per requirement of boiler inspector.

**PT-100**

Transmitter was replaced with new one. Related tubing & wiring related work was carried out.

110-VAC floating power supply from UPSS to Power Distribution Board & 24V DC supply in all ESD system & marshalling cabinet SCS0107 was checked & found ok.

**Steam Drum (101F)**

Following instruments of steam drum were checked:

- Level monitoring system- Level State.
- Level transmitter.
- Pressure transmitter.
- Level switches.

Following ISO related Quality/Safety affecting instruments were calibrated:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1.** | PT-7 | **7.** | TRC-12 | **13.** | TI -0117 | **19.** | PT-36 |
| **2.** | PT-150 | **8.** | PT-501 | **14.** | TI-0039 | **20.** | FT-100 |
| **3.** | PT-62 | **9.** | PT-8 | **15.** | PT-503 | **21.** | TRC-10 |
| **4.** | PT-80 | **10.** | PT-5 | **16.** | PT-10 | **22.** | TI-0036 |
| **5.** | AR-1 | **11.** | PT-9 | **17.** | PT-4 | **23.** | TI-0011 |
| **6.** | PIC-1A | **12.** | FT-3 | **18.** | PT-28 | | |

## Annual Maintenance Jobs for DCS/ESD, UPSS & Gas Analyzers

### YIL DCS:

DCS shutdown maintenance activities were carried out as per the AMC procedure. Following activities were carried out in Ammonia plant.

- Before starting preventive maintenance activities, 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 detail display and found Normal.
- AC/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, Engineering station and HIS consoles were cleaned thoroughly. PCBs were inspected and inspection of data bus and connectors was done. No abnormality was observed.
- Printers were cleaned & overhauled, wherever applicable. CPU back-up battery voltage and grounding were checked and same were found within specified limiting 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, Power Supply cards 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 ok.
- One analog & one digital marshalling cabinet erection & commissioning work was carried out. Supervision of pre-fab cable laying & termination work was done. Two new nodes were installed in FCS 0103 & loop checked for the same.
- Erection & commissioning work for new HIS in shift-in charge room was carried out. V-net IP bus & Ethernet cable were laid. Software were loaded & 110V ac power was provided. Finally HIS was given in service.
- Centum VP revision updated to R5.04.68 in all HIS of ammonia plant.
- Graphic modification & new graphic implementation work under ESP-III scheme was carried out. ESP-III related all tags were assigned in trend & control group as per requirement of M/S IFFCO person.
- DCS related logic modification & new logic implementation work was carried out as per ESP-III scheme.
- Modbus communication was established between engineering station of DCS & M/S Siemens system & related tags were configured in DCS.
- Modbus communication was established between engineering station of DCS & M/S Quester system (Mass Spectrometer) & related tags were configured in DCS.

- Logic checking of existing & new logic was performed in presence of M/S IFFCO person & same were found satisfactory.
- Data was collected for all HIS & FCS in Project backup for reference.
- All Operator stations & engineering station Anti-virus was updated.
- Control room dust level & temperature was observed & found within limit.
- Cooling fan for HIS 0161, Cabinet C-101 & C103 were replaced with new one.

**Prosafe-RS ESDS (PLC)**

Prosafe-RS ESDS preventive maintenance activities were carried out as per the AMC procedure.

- Cleaning of filters, fans, cabinets were carried out for all the three SCS.
- Redundancy of all the CPU, Power Supply cards, V net / IP Buses and IO cards were checked and found ok.
- Latest Back up was taken on DVD media.
- New logic implementation & old logic modification work was carried out under ESP-III scheme. Total 44 numbers of new logic implementation / old logic modification in ESD system was done.
- New logic was developed for Instrument header pressure low 2oo3 trip logic; Tags PA-47, PAL-47A & PAL-47B were made in PLC station. Logic was implemented in I-47 Block. Finally logic was tested & found ok.
- New analog PLC card SAI533 were installed in SCS0107 & analog board was installed in marshaling cabinet C-271. Pre-fab cables were laid from marshaling cabinet to SCS0107.
- Pro-Safe RS revision updated to R3.02.68 in engineering station of ammonia plant.

**UPSS Battery Bank**

- Preventive Maintenance of M/S AMCO Shaft make UPSS Battery Bank was carried out in shutdown. Cleaning & greasing work of all 175 Nos. of batteries was carried out. Electrolyte level in each battery was checked & electrolyte was filled wherever required. Finally total load of UPSS was transferred to Battery bank & was sustained for around 45 minutes.

**CAPITAL JOBS**

Energy Saving Project-III scheme was implemented in shutdown. Various new Instruments were installed in new vessels & lines, old line modification work was also carried out. Junction boxes installed in different location along with cable tray. Multi-Pair cables were laid between junction box & new analog & digital marshalling cabinets. Single pair cables laid from instruments to junction box. Termination with proper ferruling work was carried out at both end. Finally loop checking from DCS faceplate to field instruments were carried out & found ok.

Flow elements (Orifice) & Flow nozzle were installed in line for flow measurement. As per Hook-Up drawing installation & commissioning work of flow transmitter was carried out. Total 20 numbers of flow orifices & 1 number of flow nozzle were installed in different pipelines. Loop checking of all the flow transmitters were done from DCS faceplate & found ok.

Level transmitters were installed in various new vessel / old vessel under ESP-III Project as per Hook-Up drawing. Total 12 numbers of level transmitters were commissioned in new / old vessels. Loop checking of all the tags were done from DCS faceplate & found ok.

Pressure & Differential Pressure transmitters were installed in various new vessel / old vessel & pipe lines under ESP-III Project as per Hook-Up drawing, Total 22 numbers of pressure & differential pressure transmitters were installed in different line & new / old vessels. Loop checking of all the tags were done from DCS faceplate & found ok.

Thermocouples with Thermo-wells were installed in various new vessel / old vessel & pipe lines under ESP-III Project as per Hook-Up drawing. Total 27 numbers of thermocouples with thermo-wells were commissioned in new / old vessels & pipeline. Loop checking of all the tags were done from DCS faceplate & found ok.

New control valves erection & commissioning work in new / old lines were done during annual shutdown under energy saving project in ammonia plant. Total 31 new valves were installed & 5 numbers of old valves were replaced with new one in shutdown. Related signal cable connection & air tubing work were carried out. Stroke of all valves were checked & found ok.

Local Pressure Gauges & THI were installed in various process pipe lines as per P & ID.

**New DCS Cabinet Installation Work**

One analog & one digital marshalling cabinet were installed in new marshalling room. 110 VAC Power supply connection were provided from power distribution cabinet (C-121). Two new nodes were installed in FCS 0103 as node number 5 & 6. Pre-fab cables were laid & terminated between DCS cards & marshalling cabinet board. Finally power supply was provided & voltage at different points were checked & found satisfactory.

**LT-3006**

M/S Hi-Tech System make Hydra-Step level transmitter was installed in 1123-C new MP Boiler for level measurement. Housing assembly with conductivity probes were installed at relevant place. Local & remote display unit was mounted in field & control room respectively. Special cable connection between probes & PCB of electronic unit was done. Finally taken in line & found satisfactory reading.

## Mass Spectrometer

M/S Extrel make Mass Spectrometer was installed in ammonia plant for analysis of different composition of gases in percentage at different streams of plant. Total 10 stream samples were taken 1) Natural Gas 2) Primary Reformer Outlet 3) Secondary Reformer Outlet 4) LTS Outlet 5) Methanator Outlet 6) Ammonia Convertor Inlet 7) Ammonia Convertor Outlet 8) S-50 Inlet 9) Hydrogen Recovery PGR 10) Tail gas PGR. Primary Sample System were installed in every stream to take sample from sample point. Primary sample system contains cooling system / steam tracing system. All stream samples were taken to secondary sample system installed at backside of Mass spectrometer room via 1/2" SS tube. Mass spectrometer was installed & 110 V ac power supply provided from UPSS via transformer with proper grounding. 1/16" SS tubes laid from secondary sample system to Mass spectrometer. Modbus communication cable connection was established between mass spectrometer & Modbus card of DCS & all parameters were configured in DCS. Finally power on the mass spectrometer & all samples were taken in-line in mass spectrometer & found satisfactory reading in all stream.

## HIS0153

New HIS was installed in shift-in charge room. 110V ac power supply was provided from power distribution board (C-121). V-net IP bus & Ethernet cable were laid from L2 switch & Ethernet Hub to HIS. Related Software were loaded in HIS by M/S YIL engineer. Finally HIS was taken in line & found ok.

**HIS0162 & HIS0163**

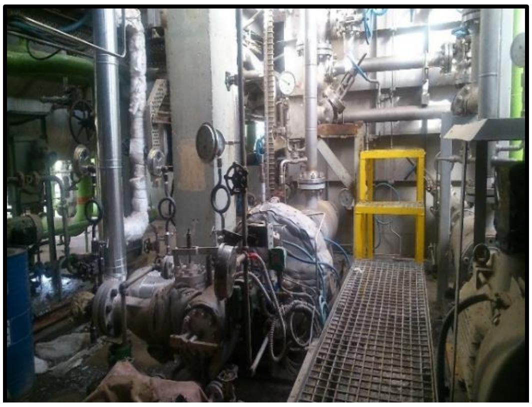
Operating keyboard of both the HIS were replaced with new 64-key keyboard.

**KV-120-1, 2, 3 & 4**

Old control valves was replaced with new control valves. Related signal cable connection & air supply tubing work were carried out. Finally control valves opening & closing were checked and found ok.

**101-J/105-J Lube Oil Console Replacement Job**

101-J/105-J lube oil console replacement job was carried out in annual shutdown. Multi-pair cables with cable tray were laid from marshalling cabinet to lube oil console junction boxes. Cable termination with proper ferruling work was done at junction box & marshalling cabinet end. M/S wood ward make Peak-150 Governor was replaced with new one. MPU's connections were done. Local speed display unit was installed near console. Loop checking of all tags were done & found ok.



**FRC-485**

Old control valve was replaced with new one. Line modification work was done by mechanical maintenance. Air supply tubing & signal cable work were carried out. Finally control valve stroke was checked and found ok.

**Instrument Header Low Pressure Trip 2003 Logic**

Pressure transmitters were installed for providing 2003 logic for Instrument header low pressure trip system

**New Vent Valve at Methanator inlet line**

New vent valve was installed at inlet line of Methanator. Related tubing & wiring related work were carried out. Finally Valve stroke was checked & found ok.

**EWR / SUGGESTION SCHEME / RECOMMENDATION COMMITTEE AND TECHNICAL DEPT. RELATED JOBS:**

**Instrument Header Low Pressure Trip 2003 Logic**

As per EWR A-292 pressure transmitters were installed in its location for providing 2003 logic for instrument air low pressure trip system. Cable laying, dressing, ferruling & termination work was done at junction box &PLC cabinet end. Trip amplifiers were installed in PLC cabinet for digital tag PSL47A& PSL47B.Programming of trip amplifiers were done. PI-47 DCS tag was taken in PLC engineering station Logic was made by YIL Person in I-47 Block. Finally logic was tested & found ok.

**DCS Indication of DM Water pump discharge Pressure**

As per EWR A-275 DM water pump discharge pressure indication was provided in DCS. Related cable laying, dressing, ferruling & termination work done at junction box & cabinet end. Tag was defined in IOM & relevant graphic pages in DCS. Loop was tested & found ok.

**DCS Indication of Lube oil Pressure & gas discharge temperature for Recycle gas Compressor 117-J**

As per EWR A-311lube oil pressure & gas discharge temperature for Recycle gas Compressor 117-J were provided in DCS. Related cable laying, dressing, ferruling & termination work done at junction box & cabinet end. Tags were defined in IOM & relevant graphic pages in DCS. Loops were tested & found ok.

**New Vent Valve at Methanator inlet line**

As per EWR A-317 new vent valve was installed at inlet line of Methanator. Related tubing & wiring related work were carried out. Finally Valve stroke was checked & found ok.

**CONTINUAL IMPROVEMENT**

**KV-120-1, 2, 3 & 4**

Old control valves was replaced with new control valves. Related signal cable connection & air supply tubing work were carried out. Finally control valves opening & closing were checked and found ok.

**Instrument Header Low Pressure Trip 2003 Logic**

Pressure transmitters were installed for providing 2003 logic for Instrument header low pressure trip system.

**Mass Spectrometer**

M/S Extrel makeMass Spectrometer was installed in ammonia Plant for analysis of various compositions in ten different stream in ammonia plant. All stream were taken in line via primary & secondary sampling system. Data were fetch by DCS via Modbus communication& displayed in graphic page of DCS.

**HIS0162 & HIS0163**

Operating keyboard of both the HIS were replaced with new 64-key keyboard.

# UREA PLANT

(INSTRUMENTATION)

## CONTROL VALVES:

### HICV-1421
Valve was dropped from the line and replaced by spare overhauled valve with new Teflon seat. Also replaced its SOV and two position feedback proximity switches. Carried out control valve operation checking.

### HICV-1201
Valve was opened from the bonnet and done compete overhauling. Boxed up the valve with new bottom guide bush, gland packing set and bonnet seal rings set. Carried out stroke checking and calibration of position transmitter.

### LRCV-1201
Valve was dropped from the line. Cleaned and checked its body and trim parts. Replaced its damaged plug with spare one and boxed up the valve with new bottom guide bush, gland packing set and bonnet seal rings set. Carried out stroke checking and calibration of position transmitter.

### HICV-1202
Valve was dropped from the line and overhaul complete valve with actuator. Replaced its plug and seat with spare ones and box with new guide bush. Also changed its actuator diaphragm with new one. Carried out valve operation and stroke checking.

### PICV-1130
Control valve was opened from the bonnet. The obstructing metal parts found stuck up in cage were removed and trim parts were overhauled. The valve was boxed up with new piston seal ring and bonnet gasket. Replaced its valve positioner and carried out valve operation and stroke checking.

### FRCV-1421
Valve was dropped from line. Its plug was found damaged due to a stud found stuck up in trim. Replaced its plug with spare one and done lapping on seat. After complete overhauling boxed up valve with new bonnet gasket and gland packing. Carried out valve operation and stroke checking.

### PICV-1202, PICV-1105 & HICV-1422
Valve was dropped from the line. Lapping was done on plug and seat. Control valve was overhauled, boxed up with new gland packing and done hydro test. Control valve was installed in line and carried out valve operation and stroke checking.

### PRCV-1201, FICV-128, HICV-1206, HICV-1207, LICV-1235 & LICV-1352
Valve was dropped from the line. Overhauled the trim parts, box up the valve with new gland packing. Control valve was installed in line and carried out valve operation and stroke checking.

**LRCV-1421 & TICV-1201**

Control valve was dropped from the line. Overhauled the trim parts and box up the valve with new plug, seat, gaskets and gland packing. Also overhaul actuator and replaced diaphragm with new one. Control valve was installed in line and carried out valve operation and stroke checking.

**HICV-1422B**

Its piston cylinder type actuator was open for passing issue. Done overhauling of actuator and box up with new piston seal ring. Actuator was installed back on valve. I to P converter replaced with new one and carried out valve operation and stroke checking.

**PICV-1979B**

Control valve was dropped from the line. Overhauled its trim parts and box valve with new plug, seat, gaskets and gland packing's. After hydro test, installed back valve in line, calibrated valve positioner and carried out stroke checking.

**HICV-1221A**

Valve was dropped from the line. Complete overhauling was done for its actuator. Checked its operation and stroke and valve installed back in line.

For Following control valves, I to P converter was replaced by spare one as performance of installed converter was not satisfactory.

**PRCV-1481, TICV-1481, HICV-1208, TICV-1808 & PRCV-1202.**

Positioner/Electro-pneumatic positioner were replaced by new one and stroke checked for the following control valves:

**TICV-1353, PICV-1422**

General checking & stroke checking of following control valves were carried out:

**PICV-1128, PICV-1129, FICV-1302, FICV-1385, LICV-1281& FICV-1203**

Following control valves were permanently removed as per ESP-III scheme.

**FRCV-1201, PICV-1201, MICV-1101, TRCV-1422, FICV-1102, & HICV-1102**

New SOV was installed for control valve FICV-1204 for implementation of new trip logics as per ESP scheme.

Control valve PICV-1101 was shifted to a new location due to line modification.

As per process requirements a new control valve FICV-1850 was installed in condensate export line to DM plant.

**COMPRESSOR HOUSE JOBS**

All local temperature and pressure gauges were removed to facilitate mechanical jobs. All were checked and fixed back after the completion of the jobs. Faulty temperature and pressure gauges were replaced with new one.

- All bearing RTDs in turbine, HP case, LP case & gear box were removed to facilitate mechanical jobs. All were checked and re-fixed on completion of jobs.

- TI-1817 damaged RTD fixed on journal bearing pad was replaced with new.
- TI-1819 RTD was found damaged, repaired its wires by soldering and re-fixed.
- For following RTD, damaged wire portion was removed and rewired:

  TI-1821/22, TI-1823/24, TI-1829/30 & TI-1831/32

- All vibration probes for radial, axial and key-phasor points in turbine, HP case, LP case and gear box were removed to facilitate mechanical jobs. Physical condition of probe tips and end connector of all vibration probes were checked. Also checked extension cable and proxy-meter for all vibration probes. After completion of mech. maintenance jobs, all probes were re-fixed with proper gap voltage adjustments.
- Following pressure switches for alarm and trip function were cleaned, checked and calibrated. Replaced the pressure switch PSLL-1801C with spare one.

  PSLL-1818C, PSLL-1838C, PSHH-1839C, PSHH-1843C, PSL-1816, PSL-1812, PSL-1813, PSLL-1844

- Following low level and high level switches of separators & surface condenser cleaned, checked and calibrated.

  LSHH-1804, LSHH-1806, LSHH-1808, LSL-1824, LSHH-1822 & LSL- 1823

- Following level-troll for separators & surface condenser were cleaned, checked and calibrated.

  LICT-1803, LICT-1805, LICT-1807 & LIC-1821

- All the limit switches for admission steam valves and barring were removed to facilitate mechanical jobs and re-fixed after completion of the jobs.
- All the 3 MPUs for Woodward governor's turbine speed measurement were removed to facilitate mechanical job and re-fixed after the completion of the job.
- Replaced the faulty local indicator of FI-1803 with spare one with required range configuration.
- All the field Junction Boxes, Local Control Panel and turbine local control box were Cleaned, all wiring connections were tightened.
- Mock up test carried out for Woodward governor for CO2 Compressor for HP and LP Valves stroke checking. Also checked the stroking for admission steam valve. Turbine Over speed trip test was carried out.
- Two no. of multi pair cables were laid and terminated from Local control panel (LCP) to Digital Marshaling Cabinet C211 & to Analog marshalling cabinet C211.
- Two no. of multi pair cables were laid and terminated from Local control panel (LCP) to Turbine control panel.
- General cleaning & stroke checking and air filter regulators were cleaned and checked for following control valves:

  HICV-1801, HICV-1802, HICV-1803, LICV-1803, LICV-1805, LICV-1807, LICV-1821A/B, PICV-1979A & TICV-1808

## 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.
- Radioactive source of LR-1201 were removed from its mounting at Autoclave to facilitate mechanical maintenance jobs. After completion of mechanical maintenance jobs radioactive source was installed back.
- Empty counts reading were taken and calibrated radiac relay unit and its spare unit for LR-1201 (Autoclave level).
- Radioactive source and scintillation counter of nucleonic level gauge of HP Stripper (LRC-1201) were removed to facilitate mechanical maintenance jobs and installed back after completion of mechanical maintenance jobs.
- Berthold level measurement system for Autoclave (LR-1201) and HP stripper (LRC-1201 & LH-1201) were checked and calibrated by Berthold service engineer. Also checked set of spares for same and updated its configuration. Backup battery cells in all online level monitoring units and spare units were replaced with new ones.
- Following HP Thermo-Well were removed and hydro tested. Thermo wells TR-1202, TR-1203 & TR-1209 were removed due to vessel and line modifications.

  TR-1201, TR-1202, TR-1203, TR-1205, TR-1206, TR-1207, TR-1209 & TR-1210
- Mass Flow meter FS-1101 was removed from line and sent to EQDC for calibration. After receiving duly calibrated the same was mounted back in line.
- Inspection of following magnetic flow meters was done:

  FICT-1203, FICT-1435, FRCT-1421, FICT-1352 & FIT-1353
- Following extended pad type transmitters were checked and calibrated:

  LICT-1201, LICT-1202, LIC-1421, LRCT-1481, LICT-1353, LICT-1282 and LRCT-1421
- Following quality affecting instruments declared in ISO were calibrated:

  PT-5303, PT-4405, PT-1121, PT-1145, PT-1802, PT-1105, PT-1201, PT-1202, PT-1421, PT-1422, SI-1401A, SI- 1401B, FR-1201, PICT-1202
- Level-troll LICV-1235, LRCT-1501 and LICT-1203 were cleaned and calibrated.
- Two no. of 12 inch dial pressure gauges were checked and calibrated and mounted at HPF pump discharge and at 4 ata steam drum for hydro test purpose.
- A Stripper ferrule testing hook up/set up with pressure gauge, rotameter and digital pressure indication was reconditioned and provided for differential pressure measurement of HP stripper ferrules.
- Cleaned the I to P convertor panel at prill bucket room and general checking of the I to P converters and their associated tubing for leakage were carried out.
- Provided arrangement of air pressure regulators and pressure gauges for HPCC shell side as per production requirement.
- Painting and earthing on all Prill Tower top control valves were done.
- The instrument air header at all floors was flushed for any foreign particles accumulation.

- Weep holes related tubing's were done at H-1202 New HP Condenser. Also weep holes for HP scrubber were checked.
- Air Distribution Ports (ADP) were provided at all required point of air supply at all floors of plant and lined up following control valves with new tubing for air supply with new air regulators of SMC make.

  LICV-1821A/B, PICV-1181,FICV-1850, PICV-1128, PRCV-1504, FICV-1303, LICV-1282, PICV-1130, LICV-1504B, FICV-1435, PICV-1221A, HICV-1406, HICV-1221A/B, TRCV-1201, TICV-1201, HICV-1201, FRCV-1421, LICV-1430, LRCV-1201, PICV-1101, PRCV-1202, HICV-1208, LICV-1203, PRCV-1481, TRCV-1421.
- Extended diaphragm remote seal capillary type pressure transmitter PRC-1201 was removed and installed back in new modified line.
- New SS JB (for prill divert proxy cable) installed and proximity switches for prill divert logic ZAH-1421 & ZAL-1421 were replaced by new ones (two wire type). New branch cables were laid from junction box JBS-55 to the proxy switches JB.
- General inspection and checking was carried out for N/C ratio meter mono block valve and pressure reducing capillary.
- Two no. of 12 pair signal cables were laid from Hydrolyser to Marshalling room and one no. of 12 pair signal cable from Neem oil panel to Marshalling room.
- Old and damaged TBs were replaced with new one for power junction box PJB-01.
- Ammonia pump P-1102C was relocated to new location. For that following instruments were also shifted and new branch cables and power cables were laid.

  PT-1137, TSH-1194, FAL-1185, PDAH-1196, SI-1102C, SIC-1102C
- New SS junction box were installed for housing F to I converters for speed monitoring of Ammonia pumps P-1102B and P-1102C.
- Following field instruments were removed and relocated after implementation of ESP jobs. New branch cables were laid instruments to field JBs.

  TIH-1101, TI-1103, LICT-1425, PICT-1101 & FR-1101
- MOV junction box was replaced by new SS JB.

**DCS RELATED CONTROL/ MARSHALLING ROOM JOBS**

- Centum CS part of DCS is upgraded with Centum-VP. Annual shutdown preventive maintenance activities were carried out for old Centum-VP DCS System with one FCS0201, two marshalling cabinets(C201 and C202), Operator station HIS0260 to HIS0263 and Engineering station EWS0264. Following activities were carried out as per AMC procedure in Urea plant.
- Before starting preventive maintenance activities / AMC jobs, tuning parameters of all control stations were saved on EWS0264 and 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 cleaned and operating conditions like dust, moisture and temperature were checked. All parameter were checked and found within limits.

- 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 voltages and grounding were checked and the same were found within specified limits 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.

- Wiring terminal of all cabinet was checked and tight, also checked fuse in all fuse TB and changed the fuses of critical Trip related IO terminals.

- McAfee AV antivirus software of all HIS & EWS was upgraded to latest update.

- Data was collected for all HIS & FCS in Project backup for reference. Latest project backup was taken on DVD media.

- Vibration monitoring system was cleaned, checked and tightened all wiring terminals.

**CAPITAL JOBS**

- Existing very old Serck make butterfly type control valve HICV-1222A, HICV-1222B &TRCV-1202 of CCS-I were replaced with MASCOT make butterfly type control valves procured with technical specification as per updated process data.

- Existing very old Serck make control valve LICV-1504B and LICV-1204 were replaced with MASCOT make new control valves procured with new technical specifications and with updated process data.

**Control valves TRCV-1202 & HICV-1222B Neem oil Mass Flow meter**

- For neem oil flow measurement, existing rotamater was replaced with Micro motion, Emerson make Mass Flow meter FI-1901 with accurate measurement and remote indication in DCS.
- Five (5 No.) traditional DP cell type level transmitters and impulse tubing with steam tracing of Neem oil Tanks LT-1901A/B/C/D and ammonical water tank LT-1302 were replaced with non-contact type Ultrasonic level transmitters.
- In NC Ratiometer, old Metal tube Rotameter with only local analog Indicator was replaced with KROHNE make new metal tube Rota meter with local Indicator and also having 4-20mA current output for remote indication in DCS, which is essential for automatic divert to flushing operation from DCS logic.
- Old Instrument signal cables, power cables and Thermocouple extension cables connected to DCS marshalling room from HITACHI compressor area, Hydrolyser area, from MCC14 and MCC15 and other plant areas were replaced with new Instrumentation cables of same type.

**ESP-DCS JOB: CENTUM CS DCS UP-GRADATION**

Existing Yokogawa DCS system was having two domain 02 (Centum VP FCS0201) and Domain 05 (CentumCS FCS0501 and bus Convertor). Due to requirement of higher IO capacity for additional IO of ESP-III, the older Centum CS part was upgraded to CentumVP DCS system with higher IO capacity by adding two FCS (FCS0202 & FCS0203) on existing Domain 02 which was already having one FCS (FCS0201). As all three Control stations after upgradation are now in same domain and connected with redundant V-Net/IP communication bus, there is no need of bus convertor, hence it was removed. New CentumVP system is having IO Card level redundancy for close loop, trip logic related analog input and Digital Input & output. Following work carried out for DCS up-gradation.

- Existing DCS System Domain 05 Centum CS related cabinet (FCS0501 with Bus Convertor), two analog marshalling cabinet s(C101 & C102), four Digital Marshalling cabinets (C111, C112, C113, & C114), and Power Distribution cabinet (PDB121 & ACDB) were removed after removing all earthling wires, power cables, communication cable and instrument signal cables.

- Installed two new Centum VP System cabinets (FCS0202 & FCS0203), two Analog Marshalling cabinets (AIC-221 & AIC-222), two Digital marshalling cabinets (DIC-211 with interposing discrete relay for MCC and MOV related digital IOs and DIC-221 for Field digital IOs) and one Power distribution cabinet PDB (PDB230). All Prefab signal cables were connected to IO cards in new system cabinets. New redundant Cat5e cables laid from FCS0202, FCS0203, HIS0259 and STN0258 to old existing FCS0201 for control bus communication via Ethernet hubs. Also connected all old & new field cables in appropriate Marshalling cabinet for all old instruments and new instruments related to ESP.
- One New Operator Station HIS0259 was installed and line up in Shift Engineer office at Urea plant control room.
- One New SOE Station/ Server STN0258 was installed and line up in Urea plant control room. Four No. digital Input cards ADV151 of FCS0201 were changed with ADV151e, to enable data capturing for SOE Server.
- HIS0262 32 key Keyboard was changed with 64 Key keyboard with 8set of Control key. Changed the base frame installed key board and updated the driver for new keyboard and configured necessary HIS utilities
- Installed New Power Distribution cabinet, line up 110V source input from UPSS, laid 110V AC and 24VDC cable for all new DCS cabinets, VAM PLC cabinet new Operator station HIS0259 and SOE Station STN0258. Also connected power cable from old cabinet of FCS0201 and related Marshalling cabinets and all field power JB and field instrument.
- System Earth and Panel Earth wiring of all new cabinet were done and finally connected System Earth and Panel Earth to earthing points. System earth and panel earth of all new panels were checked and found ok.
- Power up the system and redundancy checks were performed on for Power supply, Control Bus, communication bus and for IO modules wherever applicable. As per redundancy feature, control transfer took place properly.
- Centum VP software was upgraded to R5.04.68 in all HIS and Engineering Stationafter that the project was downloaded off-line to all FCS one by one.

- Loop testing, Logic and Interlock testing for all old existing instruments and new instruments related to ESP were done.
- For PCS fan K-1701 VFD in MCC14, Fan speed monitoring and setting facility provided from DCS with necessary wiring in MCC14 and at DCS end.
- Four No. 12 pair power cable laid from MCC15 to DCS marshalling room, to line Motor status & trip command for motor feeder shifted from MCC6 to MCC15.
- Auxiliary Console AUX-95 having Lamp, Push button and selector switches related to MOVs, solenoid operated ON-OFF valve and prill bucket. As the MOV involved in trip logic, operation of all MOV, solenoid operated ON-OFF valve and prill bucket made available from DCS also. So all existing cables from AUX-95 connected to MOV-JB shifted to DCS Marshalling cabinet and five new 12 pair power cables laid from DCS to MOV-JB. MOVs, solenoid operated utility On-OFF valve and prill bucket normal and interlock related logic operation was checked from DCS.

**ESP FIELD JOBS**

**VAPOUR ABSORBING MACHINE (VAM)**

- 110V ac UPS power was provided to VAM PLC panel from PDB and Instrument air header provision were done at VAM area.
- Necessary power cable, single pair and 12 pair instrument signal cable laying were done from DCS marshalling room and MCC15 to VAM Panel. Also installed necessary Junction box in VAM area for VAM package Instrument.
- VAM PLC panel, package field instrument and control valve installation done by vendor M/s Thermax Ltd., were checked. Also done loop, interlock and functional checking of all instrument items up to local HMI on PLC panel.
- VAM PLC was connected to DCS through MOSBUS cable and necessary MODBUS Tag data mapping and monitoring graphic configuration were done in DCS. Also done instrument loop checking & interlock checking from DCS.

**VAM PLC Panel front VAM PLC Panel Rear Hydrogen Analyzer**

**Hydrogen Analyzer (ANR-1150)**

To measure Hydrogen traces in CO2 gas received from Ammonia plant a Fuji Electric, make Thermal conductivity type, Hydrogen analyzer (Model : ZAFE) was installed with necessary sample tubing from sample tapping, sample conditioning system and calibration arrangement. Analyzer was line up in DCS with and calibrated with Std. gas sample.

- **Following field instrument, control valve and Junction box installed and line up with necessary tubing, cabling and with instrument accessories.**
  Local Pressure & Temperature Gauge: 2 No. PG & 2 No. TG with Thermo-Well.

  Temperature Instrument: 10 No. Thermocouple with Thermo-Well

  Flow Instrument : 3 No. of orifice with DPT.

  Level Instrument : 4 No. of extended diaphragm remote seal type DPT.

  Pressure Instrument : 4 No. extended diaphragm remote seal type 9 No. of PT.

  JUNCTION BOX : 11 No. Junction boxes were installed and lineup with necessarybranch cable for field instrument and multi-pair instrument cables for DCS marshalling room connectivity.

Control Valve: 10 No. Control valve were installed and line up with I to P convertors and necessary tubing arrangement. And control valve accessories.

**Flow element & DPT for FI-1206**

**PT-1213 HP Thermowell**

**LT-1206 Extended diaphragm remote seal (4” 2500# type DPT with capillary**

**EWR JOBS**

**EWR-U-292: Auto steam flushing of Prill bucket with prill divert by opening steam flushing valve HICV-1401**

Necessary logic added in Prill divert logic configuration of DCS to force Steam control valve HICV-1401 MV to 100% with actuation of Prill divert . Also provide provision to bypass the logic and Manualclosing operation once it is opened through logic. Also updated the DCS graphics for Prill divert logic for same.

**EWR-U293: Flushing OF NC Ratiometer from DCS**

NC Ratio meter local panel in field having complete instrumentation hardware and DCS having only status Indication. To transfer NC Ratio meter logic in DCS, installed and line up few Instrument like sample pressure transmitter and metal tube rotameter with current output, for sample flow indication in DCS. All required IO were transferred to DCS through a new JB and multi-pair signal cable. Necessary logic configured in DCS for operation of NC radiometer to put In line with necessary process condition interlock and AUTO Divert of sample and start Flushing of sample path with high pressure condensate on event of plant abnormality in sample pressure or flow. Also prepared required DCS interlock graphic (I-8) for operation and monitoring of NC Ratio meter.

**CONTINUOUS IMPROVEMENT**

- Old and obsolete control valves were replaced with new control valve with technical specification as per updated process data
- Old and obsolete Metal tube Rotameter of sample flow measurement in NC Ratio meter was replaced with KROHNE make Metal tube rotameter with current output which make possible the AUTO inline/flushing operation from DCS.
- Old and obsolete Level measurement system of Neem oil tank with tradition DP cell type level transmitter and impulse tubing with steam tracing where replaced with Non-contact type Ultrasonic Level transmitters. As the Neem oil is thick and viscous, old DP cell type level transmitter having frequent chocking of impulse line and abnormal level indication problem. Also it requires steam tracing over impulse line which continuously consume steam. New Ultrasonic Level transmitters are non-contact type, showing proper level without any additional requirement.
- Old analogue temperature transmitter for temp correction input TR-1207 in flow computer for $CO_2$ Flow computer FR-1201, was changed with P&F make two wire type temperature transmitter Model No. KFDO-TT-Ex1.

# OFFSITE & UTILITY PLANT

(INSTRUMENTATION)

## CONTROL VALVES

Following control valve's preventive maintenance was carried out after removing valve from bonnet. Trim set was checked & necessary actions were taken followed by stroke checking.

| Sr. No. | Tag | Description | Area | Job done |
|---|---|---|---|---|
| 1. | PCV-42 | Syn gas to burner pressure C/V | Boiler | Lapping done for plug & seat. |
| 2. | FCV-42 | Syn gas to burner flow C/V | Boiler | Lapping done for plug & seat.<br>Plug stem adjusted down for tight shut-off.<br>2 gland packing replaced. |
| 3. | LCV-3 | Blow down Valve | Boiler | Lapping done for plug & seat. |

Following control valve's preventive maintenance was carried out. General cleaning was done & gland packing were replaced followed by stroke checking.

| Sr. No. | Tag | Description | Area |
|---|---|---|---|
| 1. | LCV-4 | De-aerator level control valve | Boiler |
| 2. | TICV-25 | 4-ata steam to RLNG heater C/V | Boiler |
| 3. | LCV-2311 | De-gasser level control valve | DM Plant |

**Following Rail Gantry valve actuators were removed, preventive maintenance carried out &damaged gland packing were replaced.**

| Sr. No. | Tag | Area | No. of gland packing replaced |
|---|---|---|---|
| 1. | PV-3101-1 | NH3 Storage | 3 gland packing replaced. |
| 2. | PV-3101-2 | NH3 Storage | 1 gland packing replaced. |
| 3. | PV-3101-3 | NH3 Storage | 1 gland packing replaced. |
| 4. | PV-3101-4 | NH3 Storage | 1 gland packing replaced. |
| 5. | PV-3101-5 | NH3 Storage | 1 gland packing replaced. |

Following control valve's preventive maintenance was carried out. General cleaning and control valve stroke checking:

| Sr. No. | Tag | Description | Area |
|---|---|---|---|
| 1. | FRC-22 | Main Gas Flow control | Boiler |
| 2. | PCV-25 | Main Gas Pressure control | Boiler |
| 3. | TCV-1 | De-super heater Temperature control | Boiler |
| 4. | PIC-3 | 4 Ata Steam vent | Boiler |
| 5. | MICV-5153 | 40 Ata Steam to Ammonia plant | Cooling Tower |
| 6. | MICV-5154 | 4 Ata steam Inlet | Cooling Tower |
| 7. | HICV-4401B | Steam to Q-4402 Turbine | Cooling Tower |
| 8. | PIC-5501 | Crack Gas Pressure control | IG |
| 9. | FICV-4502 | Combine Effluent Flow control | ETP |

| Sr. No. | Tag | Description | Area |
|---|---|---|---|
| 10. | PHICV-4502 | Combine Effluent pH control | ETP |
| 11. | FCV-2201 | Anion 1 outlet flow control | DM |
| 12. | FCV-2202 | Anion 2 outlet flow control | DM |
| 13. | FCV-2203 | Anion 3 outlet flow control | DM |
| 14. | FCV-2204 | Anion 4 outlet flow control | DM |
| 15. | FCV-2205 | Anion 5 outlet flow control | DM |
| 16. | LCV-2905 | DM Water Buffer tank Level control | DM |
| 17. | PCV-3008 | T-3301 Tank Pressure Control | Ammonia Storage |
| 18. | PICV-3009 | $NH_3$ Vapor to Stack Pressure control | Ammonia Storage |
| 19. | PCV-3055A/B | Receiver Pressure control | Ammonia Storage |
| 20. | PCV-3064A/B | Condenser Pressure control | Ammonia Storage |
| 21. | LCV-3051A/B | Saturator Inlet Level control | Ammonia Storage |
| 22. | LCV-3055A/B | Receiver Level control | Ammonia Storage |
| 23. | LCV-3058A/B | Inter stage cooler Level control | Ammonia Storage |
| 24. | LCV-3065A/B | Gas Separator Level control | Ammonia Storage |

**FRCV-22**

New I/P convertor was provided.

**PICV-50**

4-ata steam to De-aerator control valve was found stuck up. So, positioner was checked and slight adjustment was made. Stem was lubricated and cleaned. Stroke checking performed and proper operation was ensured.

**GHTV**

Fuel Gas header ON/OFF valve was stuck up during boiler shut down. It was found that air exhaust did not work properly & air was trapped that kept the valve open. So DCV was removed, cleaned &re-fixed. Valve operation was checked after that.

**In Cooling tower Plant Condensate export valve LCV-02**

General cleaning was done. Positioner was replaced with a new one as desired stem travel could not be achieved with old one. Stroke checking was done.

**Surface Condenser level make-up Valve LCV-01 :**

General cleaning was done. Adjustments were made in positioner setting for properStem travel. Stroke checking was done.

**FIELD JOBS BOILER**

**Q-5113 & P-5111**

F.D. Fan turbine side &BFW pump related field instruments (Switches, probe, Temperature & pressure gauges) were removed to facilitate Mechanical maintenance job and re-fixed back.

**TI-13 & 13A**

Boiler furnace temperature thermocouple replaced with new one.
TI-13A new thermocouple was provided with extra flange to reduce insertion length into the furnace as damage to element has been continuously observed every year.

**SI-5111**

FD fan speed probe DPM power wiring removed from JB & given directly.

**TJB-1**

Old JB removed as it was not accessible earlier. PT-1A was shifted to make Space for TJB-1.New JB has been mounted at more accessible location. Cable gland, Ferruling & termination done in new JB.

**$O_2$ Analyzer**

Flue Gas O2 analyzer sensor was removed from location for complete Overhauling. Sensor was checked & cleaned properly. All parts were inspected & Found in healthy condition. Finally sensor was re-fixed back in its location.

**Igniter**

Burner 1 & 2 Igniter gun was taken out for inspection. General cleaning & Overhauling was done. Small crack was observed on earth electrode on BNR-2 gun. Crack was sealed by welding. Spark was checked & found satisfactory. Finally igniter Was re-fixed back in its location & found ok.

**Flame Scanner**

All four flame scanner general cleaning & checking was done.

Furnace draft points were checked & cleaned properly.

Steam drum level indicator electrodes were checked, cleaned & tighten all terminals.

One electrode probe No. 7 was found faulty. So, it was replaced by a new one.

All pressure gauges (PI-2, PI-3, PI-4 and PI-5) were calibrated as required for boiler inspection.

Syn. Gas all BTV operation was checked & found ok.

All old unused thermocouple cables removed from boiler area.

**MCC-11**

Re-wiring was done as per requirement of the electrical section.

**FI-5151**

Old transmitter was replaced with high range transmitter as per process Requirement.

Following Critical field switches set value were checked & found ok:

| | | | | | |
|---|---|---|---|---|---|
| 1. | PSH-11 | 2. | PSH-12 | 3. | PSL-24 |
| 4. | PSL-25 | 5. | PSN-26 | 6. | PSH-26 |
| 7. | PSL-27 | 8. | PSL-8 | 9. | PSL-30 |
| 10. | LSLL-1 | 11. | PAL-Q-5112 | 12. | PLCI-Q-5112 |
| 13. | PLCO-Q-5111 | 14. | PLCI-P-5113 | 15. | PLCO-P-5112 |
| 16. | PAL-M-5113 | 17. | PLCO-P-5113 | 18. | LLCO-5111 |
| 19. | LLCI-5111 | 20. | LAHH-5111 | 21. | DPAH-5111 |
| 22. | PSL-42 | 23. | PSH-42 | | |

Following Critical transmitters were calibrated:

| | | | | | |
|---|---|---|---|---|---|
| 1. | FT-1 | 2. | FT-2 | 3. | FT-3 |
| 4. | FT-4 | 5. | FT-11 | 6. | FT-22A |
| 7. | FT-22B | 8. | FT-42 | 9. | PT-1 |
| 10. | PT-3 | 11. | PT-4 | 12. | PT-5 |
| 13. | PT-6 | 14. | PT-7 | 15. | PT-15 |
| 16. | PT-22 | 17. | PT-42 | 18. | LT-1 |
| 19. | LT-2 | 20. | DPT-1 | 21. | DPT-12 |
| 22. | DPT-14 | | | | |

Following ISO related Quality/Safety affecting instruments were calibrated:

| | | | | | |
|---|---|---|---|---|---|
| 1. | PI -2 | 2. | PI -3 | 3. | PI -4 |
| 4. | PI -5 | 5. | PT-3A | 6. | TRC-5 |
| 7. | LI -1 | 8. | PSH-11 | 9. | PSH-12 |
| 10. | LSLL-1 | 11. | LT-1 | 12. | LT-4 |

Following BTV Limit Switches operation were checked & found ok:

| | | | | | |
|---|---|---|---|---|---|
| 1. | IGTV | 2. | GHTV | 3. | GBTV-1 |
| 4. | GBTV-2 | 5. | FCV-22 | 6. | SGHTV |
| 7. | SGBTV-1 | 8. | SGBTV-2 | 9. | SGFCV-41 |

## FIELD JOBS COOLING TOWER:

### Control room jobs

A fire broke out in CT marshalling room on 23.03.2017 around 20:30 PM**.** So,UPS power supply to marshalling cabinet was turned off. All the components were removed & cleaned one by one. All wiring terminating in marshalling cabinet was checked for continuity from JB. UPS power supply was turned ON after that.

DCS control was bypassed for K-5501(IG Compressor) & K-5306(Air compressor) from MCC-13 interfacing JB till UPS power supply to cooling tower marshalling cabinet was off.

### LT-1

Surface Condenser Level troll was replaced by new radar level transmitter. Proper calibration was done & correct measurement was ensured.

### Q-4411

Elliott Turbine all radial vibration probes, Trip SOV, speed pick-up probes; local temperature & pressure gauges were removed & reinstalled to facilitate mechanical maintenance.

### Q-4402 & Q-4403

Turbine side speed pick-up probes, local temperature & pressure gauges were removed & reinstalled to facilitate mechanical maintenance. Old obsolete tachometer was removed from its location & blind was provided.

Following Level switches of surface condenser were cleaned & calibrated:

| | | | |
|---|---|---|---|
| 1. | LSLSHH-1 | 2. | LSLSAH-2 |
| 3. | LSLSAL-3 | 4. | PSPSH-1 |

Following ISO related Quality/Safety affecting instruments were checked:

| | | | |
|---|---|---|---|
| 1. | PI - 4401 | 2. | PI - 4405 |
| 3. | AR - 4401 | 4. | AR - 4402 |

Following Critical transmitters were calibrated:

| | | | |
|---|---|---|---|
| 1. | PT-1 | 2. | FT-1090 |
| 3. | FT-1091 | 4. | LT-01 |

Cleaning of control panel & tightening of all terminals inside panel was carried out.

**FIELD JOBS I.G. PLANT**

**G-5401**

Old IG combustion chamber flame scanner was removed from installation & photovoltaic sensor was cleaned as faulty “FLAME OFF” indication appeared.

**P-4302 A/B**

RO water transfer pump: Pump Stop signal was routed through DCS logic upon low level of RO water tank. Single pair power cable were laid for both pumps from MCC-1 interfacing JB.

Following ISO related Quality/Safety affecting instruments were checked:

| | | | |
|---|---|---|---|
| 1. | PI - 5301 | 2. | PI - 5302 |
| 3. | PI - 5401 | | |

**FIELD JOBS DM PLANT**

**NaOH tank (M-5)**

V1 valve not operating. So, it was dismantled & overhauling was done.

**SBA-3**

V-3 valve air diaphragm was replaced with new one as it was reported Punctured.

**LI-2601 & LI-2602**

Radar level transmitters installed for HCL tanks S-I & S-II respectively.

Following Critical transmitters were cleaned & checked:

| | | | | | |
|---|---|---|---|---|---|
| 1. | FT-2003 | 2. | FT-2906 | 3. | FT-2005 |
| 4. | FT-2001 | 5. | FT-2008 | 6. | FT-2101 |
| 7. | FT-2102 | 8. | FT-2103 | 9. | FT-2104 |
| 10. | FT-2105 | 11. | FT-2201 | 12. | FT-2202 |
| 13. | FT-2203 | 14. | FT-2204 | 15. | FT-2205 |

**FIELD JOBS E.T. PLANT**

**AI-4500**

Cleaning of sampling system and calibration of Ammonia analyzer were carried out

**PHI-4502 & PHI-4502A**

Combined effluent pH meter was cleaned & calibrated.
Branch cable laid from all field instrument to ETP-JB1 in order to replace old JB.

**FIELD JOBS AMMONIA STORAGE AREA**

Following Critical field switches were calibrated & found ok:

| | | | | | |
|---|---|---|---|---|---|
| 1. | PSL-3053A | 2. | PSL-3052B | 3. | PALL-3004 |
| 4. | PAL-3055A | 5. | PAL-3006 | 6. | PSHH-3007 |
| 7. | PSH-3063A | 8. | PSH-3063B | 9. | PAL-3067A |
| 10. | PAL-3057B | 11. | FSL-3050A | 12. | FSL-3050B |

Following Critical transmitters were calibrated:

| | | | | | |
|---|---|---|---|---|---|
| 1. | PIC-3008 | 2. | PT-3103 | 3. | PIC-3103 |
| 4. | LT-3103 | 5. | LT-3001 | | |

**PIC-3065A & PIC-3065B**

Pneumatic pr. transmitter & controller were replaced with electronicpressure transmitter & controller defined in DCS. New signal cable was laid for both the transmitters from field JB to transmitter. New I/P convertor were installed for both the control valves &signal cable was laid for both I/P.

**PCV-3065A & PCV-3065B**

Both control valves were opened from bonnet. Plug & seat were checked, cleaned & positioner adjustment was done for proper stem travel.

# B & MH PLANT

(INSTRUMENTATION)

## ASHBEE MAKE 40 MT 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 and weighbridge pit was also carried out.

## POWER BUILD MAKE AUTOMATIC BAGGING MACHINE:

- Following activities were carried out for the Packer scale number 1, 2, 3, 4, 7, 8, 9A, 9B, 10 A &10B and Mettler-Toledo make weighing scales:
- Cleaning and tightening of terminals in local, load cell junction box and proximity Switch junction box of all the packer scales were carried out. Provided lugs in solenoid box where ever were required.
- Diverter 1 & 2: Cleaned solenoid, relay & limit switch and checked its function.
- Checked wiring terminals in the main panel, local panel, Solenoid boxes, and load cell box.
- 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.
- Maintenance & calibration of new reclaim machine belt was done.
- Cleaned all field instruments (Control valve, Transmitter) related to DES
- Control valve stroke checking for Dust Extraction System Area 1.
- Maintenance and functionality checking of level switches in Hopper for P/S–9A/B and P/S –10 A/B.
- Checking of level transmitter after removal from tank in Dust Extraction System Area 2.
- Checking and maintenance of a Level transmitter Fiber Tank in P/S floor.
- Checked wiring terminal in the Belt Conveyor Logic panels and its related JB.
- Cleaning & Painting of all the Mettler-Toledo make weigh scale’s platform was done.
- Modification of the control panel for the Dust Extraction plant. The old control panel (MOC MS) replaced with MOC SS 304. Also replaced all the instruments of the panel.
- Modification of the Conveyor belt control system for the conveyor belts M-2121, M-2122, M-2122A1 and M-2122A2. Replaced the old system comprised of 16 relays and PLC with only 4 relays. Also replaced its bulky MS cabinet with compact SS cabinet and installed the same at a proper place.

**Annual Maintenance Jobs for DCS & PLC:**

- DCS shutdown maintenance activities were carried out as per the AMC procedure.

  Following activities were carried out in Boiler, DM, IG/CT & Ammonia Storage, Narmada WTP, ETP & DG Set, and Fire& Safety.

- 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 card wherever applicable. As per redundancy feature, control transfer took place to the standby module properly.
- HIS to HIS communication was checked by pinging and found normal. After cleaning functionality of all HIS were checked and found working ok.
- Data was collected for all HIS & FCS in Project backup for reference.
- All Operator stations & engineering station Anti-virus was updated.
- Control room dust level & temperature was observed & found within limit.
- Marshalling Cabinet fans were replaced wherever found faulty.
- New logic was implemented in Boiler for RO water transfer pump P-4302A/B to trip the pump on low level.
- In cooling Tower, UPS power supply to marshalling cabinet was turned off. All the components were removed & cleaned one by one. All wiring terminating in marshalling cabinet was checked for continuity from JB. UPS power supply was turned ON after that.
- In Fire & safety DCS, Left side CPU in FCS failed & was replaced by a new one.
- Stardom PLC engineering station disk defragmentation done & PC operation speed has improved. One spare Engineering station has been prepared for use in case of future emergency.
- HIS 0663 in IG plant got really slow in operation post AMC. So, graphics card was replaced by a new one, Windows, Centum VP & Linx were installed again & smooth HIS operation was ensured.

- HIS 0361 in Boiler could not equalize upon download from Engineering Station HIS 0364. So, Ethernet cable RJ45 connector was crimped again on both ends to counter Loose connection.
- V-Net/IP BUS-2 provided for communication to urea-loose connection found & connector crimped again on both ends.
- Two tags from DM plant & two tags from Ammonia storage were added to a control group in IG plant through LINX. Function key no 27 is assigned to the Control group.

**Annual Maintenance Jobs for UPSS SYSTEM:**

**EMERSON make 2 X 60 KVA**

- AMC jobs for 'EMERSON' make 2 x 60 KVA UPSS and AMCO battery bank by M/S EMERSON NETWORK POWER and M/s Syntech Power System respectively was carried out.
- Performance of UPS was checked with draining of battery for about 45 Minutes. Redundancy & functionality of UPS was checked. Load was transferred to AVR for 15 minutes by failing both the UPS manually.
- Four battery cells No-91, 121, 238, & 239 were replaced by new cells.
- Checked the Battery voltage/performance during charging & discharging & found ok.

**DB make 2 X 10 KVA UPSS NARMADA**

- AMC Jobs for 2 X 10 KVA DB Make UPSS was carried out.
- Redundancy & functionality of UPS was checked. Load was transferred to AVR for 15 minutes by failing both the UPS manually.
- Load was transferred manually on the battery for 4-5 hours to check battery performance.
- Checked tightness of all power cables, control cables, PCB Mounting & found ok.
- Cleaning of both UPSS one by one was done with blower.

**EMERSON make 2 X 10 KVA AMMONIA STORAGE**

- AMC jobs for 'EMERSON' make 2 x 10 KVA UPS and AMCO battery bank by M/S EMERSON NETWORK POWER and M/s Santech Power System respectively was carried out.
- Performance of UPS was checked with draining of battery for about 4hours.

  Redundancy Functionality of UPS checked. Load Taken on AVR for 15 minutes.
- Load was transferred manually on the battery for 1 hour to check battery performance.
- Checked tightness of all power cables, control cables, PCB Mounting & found ok.
- Cleaning of both UPSS one by one was done with blower.

## CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND

- **LT-1**

  Surface Condenser Level troll (LT-01) was replaced by new radar level transmitter. Programming & calibration was carried out & correct measurement was ensured.

- **LI-2601 & LI-2602**

  In DM Plant, Radar level transmitters installed for HCL storage tanks S-I & S-II respectively.

## MODIFICATION JOB :

- As per approval note dated 24.04.2017 regarding modification of BHEL utility boiler load control scheme for improved load ramp up, following changes were carried out in DCS.

  A new control drawing & graphic were created for incorporating the changes mentioned in the note. Now, combustion air flow controller FRC-11 control signal is diverted to FD fan speed governor in place of FD fan suction damper which is now made independent from FRC-11 & is now controlled by manual loader HIC-11.

# ELECTRICAL

# AMMONIA PLANT

(ELECTRICAL)

## MAJOR JOBS

- **Installation, testing & commissioning of new actuators MOV-8101**

  Rotork make IQ2 series latest motor operated actuators for MOV**-8101** in ammonia plant. is installed & commissioned successfully during ATA-17. The same is also tested for operation & indications from Local as well as DCS as per process requirement.

- **Installation, testing & commissioning of new critical motors under ESP-III.**

| Sr. No. | Equipment No. | Equipment Name | Motor Rating |
|---|---|---|---|
| | **ESP III Ammonia** | | |
| 1 | 1170 JM | Condensate Stripper Feed Pump | 90 KW, 2 pole |
| 2 | 1170 JAM | Condensate Stripper Feed Pump | 90 KW, 2 pole |
| 3 | 106 EJ1AM | DM water Pump | 11 KW , 4 pole |
| 4 | 106 EJ 1BM | DM water Pump | 11 KW, 4 pole |
| 5 | 106 EJ2 AM | Ammonical water Pump | 5.5 KW, 4 pole |
| 6 | 106 EJ2 BM | Ammonical water Pump | 5.5 KW, 4 pole |
| | **101J/105J LUBE OIL SYSTEM** | | |
| 7 | 101J/ 105 J LOP | Lube oil Pump | 75 KW, 2 pole |
| | **HP Control Oil System (1 x 14.8 MW, IFFCO Footprint Replacement Project).** | | |
| 8 | M8503 | Control Oil Pump#1 | 18.5 KW, 4 pole |
| 9 | M8504 | Control oil Pump #2 | 18.5 KW, 4 pole |
| 10 | M8551 | Gear Pump#1 (For Turning Gear) | 0.37 KW, 4 pole |
| 11 | M8501 | Control Oil Recirculation Pump#1 | 2.2 KW, 2 Pole |
| 12 | M8502 | Control Oil Recirculation Pump#1 | 2.2 KW, 2 Pole |
| 13 | M8552 | Electrostatic Oil Cleaner Pump Motor | 0.37 W, 4 pole |

- **Installation, testing & commissioning of new 1000KVA transformer to enhance the capacity of MCC#5 to accommodate the loads added due to ESP-III.**

- **Retrofitting of conventional electro mechanical relays with latest technology based, communicable numerical relays in MCC#16 to improve reliability & monitoring the electrical parameters in ammonia plant.**

## Scheduled Preventive Maintenance

- **Preventive maintenance of transformer**

  Most of the equipment of ammonia plant is getting electric power from MCC- 16. TR-21 & 22 feeding power to these MCC.

  Startup heater is also part of ammonia plant and same is getting power from TR-start up.

  Common activity carried out during transformer maintenance is as under:

  - Isolation of transformer from both side (LT & HT)
  - Dismantling of HV & LV terminal box.
  - Visual inspection about any leakage of oil from any part and any heated terminal.
  - Measurement of earthing resistance, IR value, PI value and oil BDV.
  - Testing of Buchholz relay about its function of tripping and alarm.
  - Condition of silica gel was checked. Accordingly discharged silica gel was replaced
  - Tightening of loose parts.

- **Preventive maintenance of MCC**

  Preventive maintenance carried out on all the feeder compartments in MCC-5, & MCC-16 and the job details are as under.

  Common activity carried out during MCC maintenance:

  - Isolation of MCC from power source.
  - General cleaning of all feeders.
  - Tightness checking of all power and control cable connection.
  - Checking & cleaning of contactors.
  - Checking of operation of breaker in test position.
  - Checking continuity and IR valve of bus bar.
  - Lamp test.
  - Normalization of MCC.

- **Overhauling of critical motors**

  Overhauling of following motors was carried out in Ammonia plant.

| Equipment Name | Description |
|---|---|
| 117JM AOP | AOP for 117JM |
| 104JA | AOP for 104J |
| 104J | AOP for 104J |
| 104JT | AOP for 104J |
| 104JTA | AOP for 104J |
| 101BJT | AOP for 101BJ |
| 101BJ | AOP for 101BJ |
| 115JB | AOP for 115J |
| 170J | Scrapped condensate pump |
| 170JA | Scrapped condensate pump |
| 2001LJA | Hydrazine solution pump |
| 117J | Recycle gas compressor motor |

- **4.Preventive maintenance of actuators carried out for the following MOVs and tested with their interlocks:**

  SP1, SP3, SP4, SP5, SP70, SP151, SP152, SP 154, SP 156 and SP 158 & SP 159.

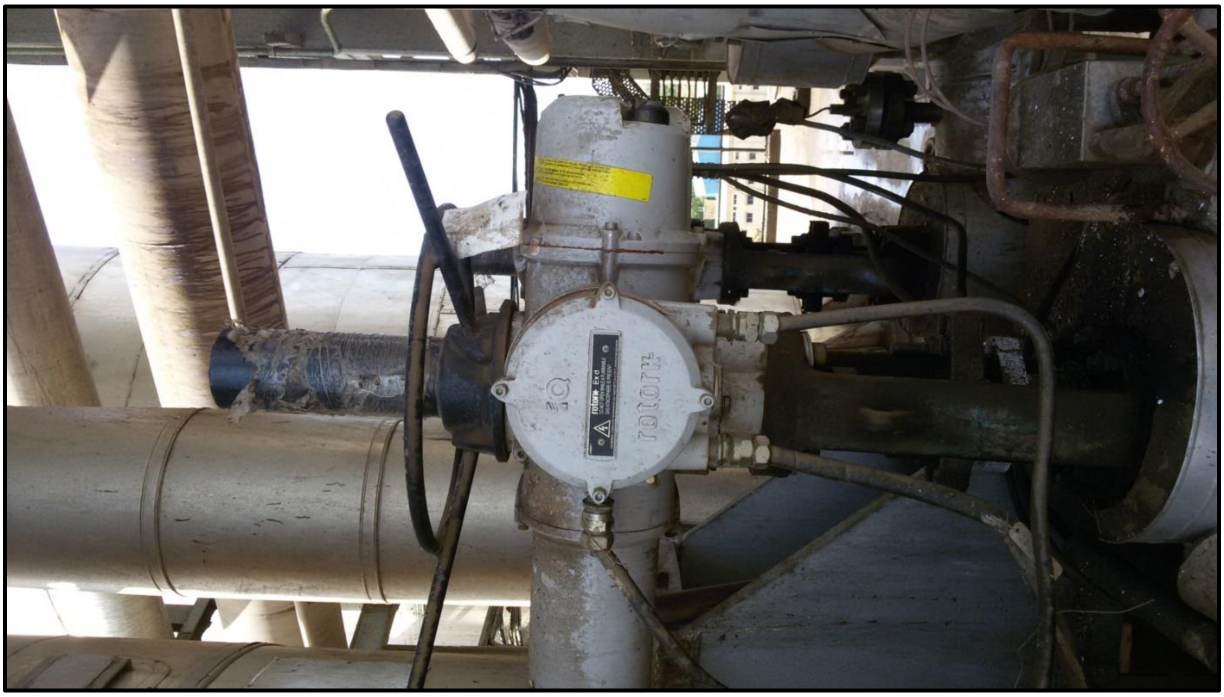
# UREA PLANT

(ELECTRICAL)

## MAJOR JOBS

- **Installation, testing & commissioning of new actuators.**

  Similarly MOV 1202, MOV1203 are replaced with Rotork make IQ2 series latest motor operated actuators successfully. The same is also tested for operation & indications from Local as well as DCS as per process requirement.



- **Shifting of MCC-6 feeders feeding urea plant to MCC-15.**
  - Extension of MCC trench in MCC-15 room for accommodating extension panel of MCC-15 panel.
  - Installation , commissioning and testing of extension panel of MCC-15
  - Installation of new cable tray from MCC15 to Urea plant.
  - Shifting of motor load connected in MCC-6 to new panel of MCC-15.
  - Laying of new cables from MCC-15 feeder panel to motor end and, glanding & termination of cables at both ends for shifting of Load connected in MCC-6 to MCC-15.
  - Removing of existing panel and cables from MCC-6 room.
  - All the lighting load Urea plant were shifted to lighting Distribution board installed in MCC-15.

- **Installation, testing & commissioning of Extension of MCC_15 under ESP-III.**

- **<u>Installation, testing & commissioning of VAM motors under ESP-III as listed below-</u>**

| | |
|---|---|
| Refrigerant Pump-A | 0.3 KW |
| Refrigerant Pump-B | 0.3 KW |
| Condensate Pump-1 | 1.8 KW |
| Condensate Pump-2 | 1.8 KW |
| Absorbent Pump Pump-1 | 5.5 KW |
| Absorbent Pump Pump-2 | 5.5 KW |
| Vaccum Pump | 0.75 KW |
| Chilled Water pump-1 | 22 KW |
| Chilled Water pump-2 | 22 KW |

**<u>Scheduled Preventive Maintenance</u>**

- **<u>Preventive maintenance of transformer</u>**

  Most of the equipment of urea plant is getting electric power from MCC, 14, & 15. TR-17, 18, 19 & 20 feeding power to theses MCC.

  <u>Common activity carried out during transformer maintenance is as under</u>:

  - Isolation of transformer from both side (LT & HT)
  - Dismantling of HV & LV terminal box.
  - Visual inspection about any leakage of oil from any part and any heated terminal.
  - Measurement of earthing resistance, IR value, PI value and oil BDV.
  - Testing of Buchholz relay about its function of tripping and alarm.
  - Condition of silica gel was checked. Accordingly discharged silica gel was replaced
  - Tightening of loose parts.
  - Cleaning and washing.

- **<u>Preventive maintenance of MCC</u>**

  Preventive maintenance of the all feeder compartment in, MCC 14, and MCC 15 were carried out and the job details are as under:

  <u>Common activity carried out during MCC maintenance</u>**:**

  - Isolation of MCC from power source.
  - General cleaning of all feeders.
  - Tightness checking of all power and control cable connection.
  - Checking & cleaning of contactors.
  - Checking of operation of breaker in test position.
  - Checking continuity and IR valve of bus bar.
  - Lamp test.
  - Normalization of MCC.

- **<u>Overhauling of critical motors</u>**

  Overhauling of following motor was carried out in urea plant.

| | | | |
|---|---|---|---|
| M-1403/1 | 3 part conveyor | M-1421 | Cool urea Conveyor |
| M-1403/3 | 3 part conveyor | P-1408 | Melt pump |
| M-1402/2 | Scrapper motor | K-1401/1 | PT fan |
| M-1401/B | Prill bucket | K-1401/2 | PT fan |
| M-1403/1 | 3 part conveyor | K-1401/4 | PT fan |
| P-1815/B | Condensate pump | P-1501 | BFW pump motor |
| M-1401/A | Vibro pillar | P-1815/A | Condensate pump |
| P-1817 | LOP hitachi | M-1402/1 | Scrapper Motor |
| M-1419 | Link Conveyor | P-1202/A | CCS-I motor |

- **Preventive maintenance of actuator of following MOV's was carried out**:

  MOV 1101, 1102, 1201, 1202, 1203, 1501 & 1801

# OFFSITE & UTILITY PLANT

(ELECTRICAL)

## Scheduled Preventive Maintenance

- **Preventive maintenance of transformer**

  Preventive maintenance of transformer TR-2A, 2B, 3A, 3B, 8, 11, 12, 13, 14, 16 and 23 were carried out. Detail is given as below:

  Common activity carried out during transformer maintenance is as under:

  - Isolation of transformer from both side (LT & HT)
  - Dismantling of HV & LV terminal box.
  - Visual inspection about any leakage of oil from any part and any heated terminal.
  - Measurement of earthing resistance, IR value, PI value and oil BDV.
  - Testing of Buchholz relay about its function of tripping and alarm.
  - Condition of silica gel was checked. Accordingly discharged silica gel was replaced
  - Tightening of loose parts.
  - Cleaning and washing.

- **Preventive maintenance of MCC**

  Preventive maintenance of the all feeder compartment in MCC 1, MCC 2B & 2E, MCC-11 and MCC 13 were carried out and the job details are as under:

  Common activity carried out during MCC maintenance:

  - Isolation of MCC from power source.
  - General cleaning of all feeders.
  - Tightness checking of all power and control cable connection.
  - Checking & cleaning of contactors.
  - Checking of operation of breaker in test position.
  - Checking continuity and IR valve of bus bar.
  - Lamp test.
  - Normalization of MCC.

- **Overhauling of critical motors**

  Overhauling of following motors was carried out in utility

| | | | |
|---|---|---|---|
| P-4412 | LOP of Q-4401 A | P-5118 A | Phosphate dosing pump |
| P-4405 | LOP of Q-4401 B | P-5118 B | Phosphate dosing pump |
| P-4403 | LOP of Q-4403 | P-5111 B | A O P FOR PUMP Q -5111 |
| P-5119 | Ammonia Dosing Pump | P-5120 | condensate Pump |
| P-5111A | A O P FOR PUMP P-5111 | P-5113 | AOP of E-5113 |
| P-5112 A | AOP for PUMP 5112 | P-4411 A | Condensate pump C.T area |
| P-5112 B | AOP for Motor 5112 | P-4405/A | Cooling water pump motor |
| P-5117 | Hydrazine dosing pump | | |

- **Servicing of following Rotork make actuators installed in utility plant was 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

**<u>Replacement of motor control Centre-11</u>**

<u>Existing MCC is in two parts & New MCC is one part only)</u>

- **<u>Removal of old MCC</u>**
  - Noted existing feeder's position: ON, OFF, Energise, Deenergise etc.
  - Noted existing feeder's power & control cable connection.
  - Cut off the power of incomer of existing MCC-11 from MCC-2F, MCC-15 & MCC 2B/E.
  - Disconnect the all power & control connection.
  - Dismantled the MCC in four parts as per its design.
  - Remove all panel of existing MCC from room.
  - All cable removed from trench.

- **<u>New cable trench</u>**
  - Old cable trench width done increased as per requirement by help of civil section.
  - Measured & prepared a new M.S. channel frame for new MCC as per foundation drawing.
  - Frame grouted with leveling on the cable trench.
  - In cable trench made M.S. channel structure for installation of cable tray 2 tire.
  - Installed 2 tire cable tray 600mm each in the cable trench.

- **<u>New MCC panel installation</u>**
  - New panel put on frame in 3 parts.
  - Connect the panel each other.
  - New panel installed on the frame with proper leveling.
  - IR value taken of panel found o.k.
  - IR value taken of all power & control cable found all are O.K.
  - All power & control cable laying on the cable trench systematically

- **<u>Testing of panel</u>**
  - Incoming power cable connection done of all 3 Nos. incomer feeder. Energized the same and checked the scheme as per drawing.
  - All out going feeder's power & control cable connection done. BMR setting done as per existing.

## Offsite Plant

### Scheduled Preventive Maintenance

- **Preventive maintenance of transformer**

  Preventive maintenance of transformers Tr-1A, 1B, 15, 4A and TR-4B was carried out. As per detail given below:

  Common activity carried out during transformer maintenance is as under:

  - Isolation of transformer from both side (LT & HT)
  - Dismantling of HV & LV terminal box.
  - Visual inspection about any leakage of oil from any part and any heated terminal.
  - Measurement of earthing resistance, IR value, PI value and oil BDV.
  - Testing of Buchholz relay about its function of tripping and alarm.
  - Condition of silica gel was checked. Accordingly discharged silica gel was replaced
  - Tightening of loose parts.
  - Cleaning and washing.

- **Preventive maintenance of MCC**

  Preventive maintenance of all the feeder compartment of in MCC-DG set, MCC-3, MCC-10& 10A and MCC-Jaspur was carried out and the job detail is as under**:**

  Common activity carried out during MCC maintenance

  - Isolation of MCC from power source.
  - General cleaning of all feeders.
  - Tightness checking of all power and control cable connection.
  - Checking & cleaning of contactors.
  - Checking of operation of breaker in test position.
  - Checking continuity and IR valve of bus bar.
  - Lamp test.
  - Normalization of MCC.

- **Preventive maintenance of actuators carried out for the following MOVs and tested with their interlocks (If any)**

  6001,6002,6003,6004,6201,6202,6203,6204,6205,6206,6207,6208, 6101 , 6102, 6103

- **Preventive maintenance /Servicing of 11 KV Siemens Breakers were carried at MPSS and 66KV yard as per detail given below:**

  Common activity carried out during maintenance:

  - Visual inspection of breakers for any abnormality.
  - Thorough cleaning of breakers was carried out

- Checked power & control circuit connections in the breaker for tightness. RE 300-relays are replaced in defective feeders.
- 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.

**Preventive maintenance jobs were carried out in 66 KV switch Yard:**

**Common activity carried out during maintenance:**

- All insulators of isolator, breaker and CTs and PTs are cleaned.
- Cleaned the contacts and oiling &greasing donein all isolators in yard.
- Operation of all isolator is checked & found OK.
- I R Value of all CT's and PT's are noted & found OK.
- Contact resistance of all isolator are noted

**Special activity carried out during total power**

- During total power shutdown in spite of routine maintenance following special maintenance are carried those are usually not available for maintenance during normal running hours and even in shutdown also.
- Checking & maintenance of bus coupler & Incomer feeders in MCC-1,2,2F,6,4,15,16 are done without feeding Emergency (DG) power to those MCC for early 3 Hrs.
- Checking & maintenance of all incomers & bus couplers in 11KV MPSS by load sharing & load management.
- Checking & maintenance of bus bars in 11KV MPSS & all MCCs incomers & bus couplers by load sharing & load management.

**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 Jyoti breaker contacts.
- Checking of operation of breakers with all interlocks.
- Tightness checking of all control connection.
- Checking of continuity & IR value of bus by lamp test.
- 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.

## MAJOR JOBS

- **Replacement of Existing isolators with motorized isolators**

  The existing isolators are replaced with motorized isolators for safe & reliable operation of the electrical network. it is very critical for electrical network reliability. The new isolators are safe & reliable with latest design to operate the electrical network from LMS also.

- **Installation, testing & commissioning of new universal make Battery charger**

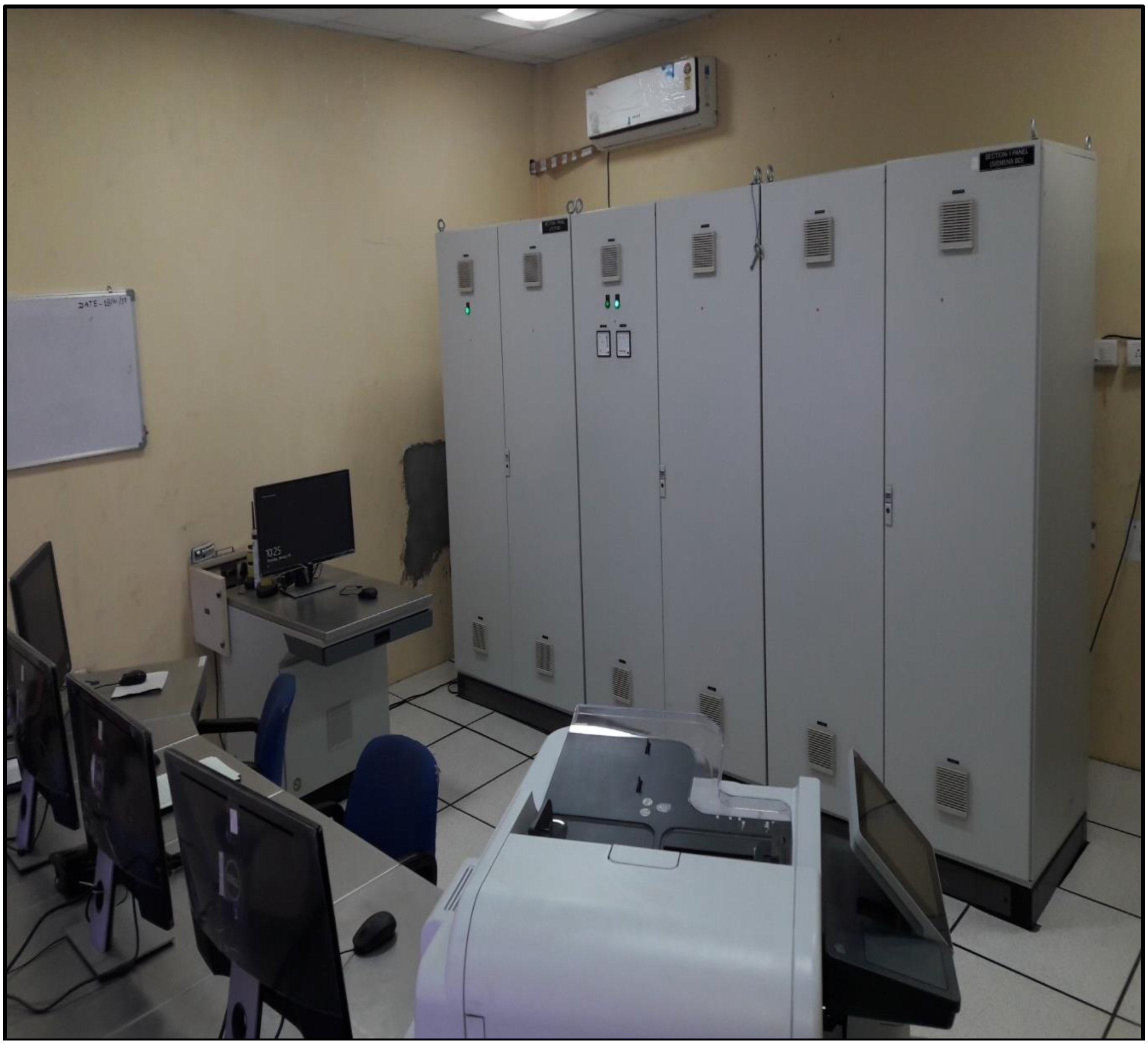
  Installation of Nitrogen injection fire protection & extinguishing system for main transformers Tr-1A & TR-1B at switch yard

- **Erection of overhead cable rack from 11KV MPSS to MCC-13**

  Replacement and modification in MCC-15, 16 & fire MCC panels to upgrade changeover scheme and feeder module

- **Installation, testing & commissioning of load management system**

  The new load management system was installed in electrical substation for control & monitoring of electrical network for safe & reliable operation of plant. The picture of installed SCADA and its control room is given below-



# B & MH. PLANT

(ELECTRICAL)

## Schedule maintenance:

### Preventive maintenance of Transformer

Preventive maintenance of transformer Tr-5A & Tr-5B was carried out.

Common activity carried out during transformer maintenance is as under:

- Isolation of transformer from both side (LT & HT)
- Dismantling of HV & LV terminal box.
- Visual inspection about any leakage of oil from any part and any heated terminal.
- Measurement of earthing resistance, IR value, PI value and oil BDV.
- Testing of Buchholz relay about its function of tripping and alarm.
- Condition of silica gel was checked. Accordingly discharged silica gel was replaced
- Tightening of loose parts.
- Cleaning and washing.

### Preventive maintenance of MCC

Preventive maintenance of all the feeder compartment in MCC 4 and 4A (Old & New) was carried out.

Common activity carried out during MCC maintenance:

- Isolation of MCC from power source.
- General cleaning of all feeders.
- Tightness checking of all power and control cable connection.
- Checking & cleaning of contactors.
- Checking of operation of breaker in test position.
- Checking continuity and IR valve of bus bar.
- Lamp test.
- Normalization of MCC.

### Overhauling of critical motors

Following motors were overhauled in B & MH plant:

| | |
|---|---|
| P-2704/A | Dust solution pump |
| P-2704/B | Dust solution pump |
| K-2161 | Dust blower B&MH |
| K-2704/3 | Dust blower B&MH |
| M-2122 | Conveyor |
| M-2122 A1 | Conveyor |

| | |
|---|---|
| M-2122 A2 | Conveyor |
| M-2112 | Conveyor |
| M-2121(New) | Conveyor |
| M-2110 | Conveyor |
| M-2117 | Conveyor |
| M-2137 | Conveyor |
| Link Conveyor | Reclaimer link conveyor |
| Slewing | Reclaimer slewing |
| Luffing | Reclaimer Luffing |

**Non plant**

**Schedule maintenance:**

**Preventive maintenance of transformer**

Preventive maintenance of TR-10A, 10B, T/S-1 and T/S-2 was carried out as per detail given below:

Common activity carried out during transformer maintenance is as under:

- Isolation of transformer from both side (LT & HT)
- Dismantling of HV & LV terminal box.
- Visual inspection about any leakage of oil from any part and any heated terminal.
- Measurement of earthing resistance, IR value, PI value and oil BDV.
- Testing of Buchholz relay about its function of tripping and alarm.
- Condition of silica gel was checked. Accordingly discharged silica gel was replaced
- Tightening of loose parts.
- Cleaning and washing.

**Preventive maintenance of MCC**

Preventive maintenance of all the feeder compartment fire MCC-7 was carried out.

Common activity carried out during MCC maintenance**:**

- Isolation of MCC from power source.
- General cleaning of all feeders.
- Tightness checking of all power and control cable connection.
- Checking & cleaning of contactors.
- Checking of operation of breaker in test position.
- Checking continuity and IR valve of bus bar.
- Lamp test.
- Normalization of MCC.

# AMMONIA PLANT

(CIVIL)

## Construction of foundations for ESP III

Following civil foundations were constructed during Energy Saving Project III.

| Sr. No. | Equipment No. | Equipment Name |
|---|---|---|
| 1 | 1170-J/JA | CONDENSATE STRIPPER FEED PUMPS |
| 2 | 114-D | HYDROGENATOR |
| 3 | 1170-CA/CB | STRIPPER FEED / EFFLUENT EXCHANGER |
| 4 | 1104-E | PROCESS CONDENSATE (MP) STRIPPER |
| 5 | 115-C | METHANATOR EFFLUENT WATER COOLER |
| 6 | 1123-C | M P BOILER |
| 7 | 1115-C | METHANATOR TRIM HEATER Support Platform STRUCTURE |
| 8 | 1114-C | METHANATOR FEED EFF. EXCHANGERS |
| 9 | 106-E | FLASH GAS WASHING COLUMN |
| 10 | 106-EJ-1A/1B, | DM WATER PUMPS |
| 11 | 106-EJ-2A/2B | AMMONIACAL WATER PUMPS |
| 12 | 1104-C1/2/3 | HTS BFW PREHEATER |
| 13 | 103-J Auxiliaries | HP Oil Console, Accumulators station foundation |

Most of the foundations were constructed before the start of shutdown, however foundation of 101-J and 105J (lube oil console) were constructed during shutdown.

## Refractory repairing jobs in primary reformer (HT & LT zone), Auxillary boiler and secondary reformer

The refractory repairing in primary reformer & auxiliary boiler was carried out. The 22 no. of tunnel blocks in primary reformer were replaced. The casting of auxiliary boiler side panels was carried out by civil section using the refractory material ‘’Insulyte-11’’.

Primary Reformer

**Construction of pipe supports and grouting of base plate:**

More than 150 pipe supports were casted during the shutdown related to ESP III work.

Mechanical and chemical anchoring was done to support the base plates of pipes.

# UREA PLANT

(CIVIL)

## Anti corrosive treatment of prill tower inside:

Anti corrosive treatment of prill tower inside was done by M/S Deewan Enterprises, Bareilly. The total height of the prill tower is 72 meters and diameter of the prill tower is 18 meter.

The inside surface of prilling tower was badly corroded, so epoxy painting was necessary for life of prill tower. The lift walls, columns, beams and soffit of prill tower were also painted using epoxy paint and apex paint.

The party purchase special working arrangement for painting as per the directives of fire & safety department. The painting was done using high pressure pump.

## Construction of foundations for ESP III

Following civil foundations were constructed during Energy Saving Project III in urea plant.

| Sr. No. | Equipment No. | Equipment Name |
|---|---|---|
| 1 | P-1102/C | H P AMMONIA PUMP-C |
| 2 | X-101 | VAM PACKAGE |
| 3 | X-102 | CO2 COOLER |
| 4 | H-1250 | AMMONIA PREHEATER |
| 5 | RETAINING WALL | CONSTRUCTION OF RETAINING WALL FOR CRANE MOVEMENT AREA |

## Low viscosity chemical injection grouting of bucket room at prill tower top

Urea seepage is observed in bucket room at prill tower top, it was decided to inject low viscosity chemical to control the seepage of urea. Total 250 injections were grouted inside and outside wall of bucket room.

# OFFSITE & UTILITY PLANT

(CIVIL)

## Construction of new cable trench & concrete flooring in MCC-11

New cable trench was constructed in MCC-11 accommodate new panel & concrete flooring was done inside the room. Existing door of the MCC-11 was removed and space was closed by brick masonry.

## Provision of cut out and construction of wall in cooling tower channel.

The Existing cooling tower channel was closed by construction of brick masonry. The opening inside the existing sump was also closed by brick masonry. New cutouts were made in cooling tower sump during the shutdown.

## Construction of foundation for P-4401 C & P-4402 in cooling tower basin

There was a problem of vibrations in the existing foundation of pump in the cooling tower basin. It was decided to replace the MS base frame with new SS base frame. The foundation retrofitting was done and new base frame was grouted to accommodate P-4401C and P-4402.

## Replacement of damaged plywood at cooling tower deck

It was observed that various plywood were damaged at cooling tower deck, same were replaced by using 19 mm thick water proof plywood.

## Construction of foundation for nitrogen injection fire extinguishing system

Two nitrogen injection fire extinguishing system were installed in 66 KV area. Foundations for nitrogen injection fire extinguishing system were constructed during shut down.

## B & MH PLANT

(CIVIL)

**Epoxy painting of conveyor gallery (beams, columns & soffit), transfer tower, silo and other areas of B & MH plant**

The condition of the concrete structure in silo, conveyor gallery & transfer tower area is deteriorated. To rehabilitate the concrete condition, epoxy painting was carried out in B & Mh plant. M/S Vidya Shanker Upadhyay did the epoxy painting job.

**Epoxy screeding on the floor of urea silo**

The condition of urea silo floor is deteriorated due to urea penetration. 5 mm thick epoxy screeding was done in urea silo as rehabilitation measure of silo floor. The job was carried out by M/S Maruti Refractories, Ankaleshwar.

# CIVIL

# TECHNICAL

# AMMONIA PLANT

(TECHNICAL)

**Following Jobs have been carried out in Ammonia Plant**

**EWR JOBS CARRIED OUT IN AMMONIA PLANT**

| Sr. No. | EWR No. | EWR Date | Description |
|---|---|---|---|
| 1 | EWR A 314 | 09/02/2015 | Provision of line from 115-JA/JB discharge to 116-JA/JB discharge with control valve |
| 2 | EWR A 339 | 07/07/2016 | Provision of drain valve at downstream of 107-C |
| 3 | EWR A 288/ TM/02/1200dt.28/03/2016 | 01/08/2013 | Provision of new control valve LICV-5A in reflux solution line going to LPFV. |
| 4 | EWR A 317/ Suggestion No. 1415000095 / Scheme TM/02/1200dt. 29/05/2015 | 09/02/2015 | Provision of control valve at Methanator inlet vent line. |
| 5 | EWR A 340 | 07/06/2016 | To provide a new temperature measurement and indication point at air compressor suction |
| 6 | Scheme TM/02/1200 | 17.06.2016 | 130JC CW in/out Piping size to be increased to 8" from 6" |
| 7 | Scheme TM/02/1200 | 11.05.2016 | By pass line with Control valve across FICV-14 and U/S and D/S isolation valve of FICV-14 |
| 8 | Scheme TM/02/1200 | 20/12/2016 | LP Steam heater (E-110)for Fuel gas heating after letdown to avoid fuel lines sweating |

**ESP-III JOBS**

Hook up of ESP Piping system have been carried out as per below Tie-In Points

| Tie In No | P&ID | Existing line No. | Existing Line Description | New Line No | New line Description | Remarks |
|---|---|---|---|---|---|---|
| 001 | A00710A-E-PDI-823 | NG-7-8" (3P10) | Mixed feed Preheat coil inlet | 10"-NG-0007-F34-H | 114D outlet line | At Mixed Feed Preheat Coil inlet U/S of I/V (Nearest location) |
| 002 | A00710A-E-PDI-825 | PG-17-14" (3P10) | 136-C shell outlet to 104-C Shell Inlet. | 14"-PG-0019-D34-H | 1114-C T/S inlet | |
| 003 | A00710A-E-PDI-840 | BF-2H-6"(15S1U) | Line from Boiler preheat coil to 101-F | 3"-BW-0024-H24S-H # | BFW from 1104-C | |

| Tie In No | P&ID | Existing line No. | Existing Line Description | New Line No | New line Description | Remarks |
|---|---|---|---|---|---|---|
| 004 | A00710A-E-PDI-840 | BF-18-3" | Line from 104-J to 114-C | 3" CAP | Cap welding after removal of 114-C S/S inlet | After 123-C line branch (6"-BF-6) |
| 007 | A00710A-E-PDI-824 | 103-C (TUBE OUTLET) | 18"- 103-C Outlet line to 104-C (T/S) | 18"-PG-0026-F34-H | 18"-PG Line to new 1104-C (shell side) | 103-C Tube side outlet line |
| 008 | A00710A-E-PDI-824 | PG-8-18" (3P10) | 104-C Tube side outlet | 18"-PG-0022-F34-H | 1104-C shell side outlet | 104-C Tube side Outlet line |
| 009 | A00710A-E-PDI-824 | SG-2-14" (3P10) | 115-C Shell inlet line | 14"-SG-0020-D34-H | 1114-C Shell outlet line | 115-C shell inlet line at a point before split |
| 010 | A00710A-E-PDI-824 | SG-1-12" (3P1C) | Methanator outlet to 114-C | 12"-SG-0021-D34-H | Line to 1114-C shell inlet | Methanator outlet line as close as New 1114-C (S/S) |
| 011 | A00710A-E-PDI-824 | PG-18-12" (3P1C) | 104-C shell outlet to Methanator | 14"-PG-0018-D34-H | 1115 (T/S) outlet (14") to (12") Methanator Inlet | As close as 104-C area |
| 012 | A00710A-E-PDI-824 | PG 1201.01 20" (D24) | K. O. drum U/s of LTS Guard 155-F Inlet | TT-3086 | For TV 11A at 1104 Shell outlet | |
| 015 | A00710A-E-PDI-826 | SG-1303.08-14" (H36) | 108-D Converter Inlet at U/S of HV-487 | 14"-SG-0045-H34-H | 1123-C T/S outlet line | |
| 016 | A00710A-E-PDI-826 | SG-33-14" (15P2C) | 122-C top outlet line | 14"-SG-0044-H34-H | New boiler 1123-C T/s Inlet | |
| 017 | A00710A-E-PDI-826 | MS-1304.02-8" (F24S) | 107-C Boiler outlet steam line | 8"-MS-0046-F24S-H | New MP steam header (8") | |
| 018 | A00710A-E-PDI-824 | BF 1203.01 6" (H24S) | 142 CA/CB T/s outlet | 6"-BW-0049-H24S-H | 1104 c T/s inlet | Tapping at U/S of I/V & sp. blind |
| 019 | A00710A-E-PDI-840 | BO-14-3" | 156-F Blow down drum Inlet Header | 2"-BD-0051-D24S-P | 1123-C blow down line | Near 156-F in existing header one new branch |

| Tie In No | P&ID | Existing line No. | Existing Line Description | New Line No | New line Description | Remarks |
|---|---|---|---|---|---|---|
| 020 | A00710A-E-PDI-842 | MS 1201.01 8" (F24S) | 8"-MS-header near 115 JT A/B | 2"-MS-0054-F24S-H | Start up line to 1123-C | on the rack nearest to 1123-C |
| 021 | A00710A-E-PDI-823 | MS-29-12"(4S1) | MS to mixed feed preheat D/S of FRC-2 | 10"-MS-0058-F40-H | MS from 1104-E | After 1st elbow on Vertical Line |
| 022 | A00710A-E-PDI-833 | PW-20-6" | 173-C shell inlet from 170-C shell O/L | 6"-PC-0068-B24-P | 1170 CA/CB shell outlet | U/S to PI on the line |
| 023 | A00710A-E-PDI-824 | PW-1-6" (3P50) | 102-F (Raw gas separator) outlet line (Bottom) | 6"-PC-0074-D44-N | Line to 1170 J/JA | Existing line as close to the pump be retained |
| 024 | A00710A-E-PDI-824 | 102-F | At 102-F (Nozzle) | 2"-PC-0075-D44-T | Min. flow line from 1170 J/JA | Line pref. to be connected to a new Nozzle at about 1 mtr lower to top TL. |
| 025 | A00710A-E-PDI-836 | NH-120-2" (1P10) | Line to HP purge gas line SG-39-4" | 2"-SG-0077-B24-N | Purge gas to Arch burner from 106-E | |
| 026 | A00710A-E-PDI-831 | NH-120-2" | Tapping point at 126-C (PIC-7 D/S) | 2"-SG-0080-D24-C | New line with 2" I/V D 24 to 106-E | |
| 027 | A00710A-E-PDI-855 | 3"-EL-102.01-B24 | Treated effluent to CT basin (line connected with tee to H44 shell inlet) | 2"-AW-0103-B24-N | New line with CV & bypass valve assy. Of 3" EF-100-01 shifted in this line | |
| 028 | A00710A-E-PDI-833 | PW-43-50 | Header connected to 2.5" line to Amm. Recovery & stripping | 2"-NH-0085-D24-P | Ammonia Water from106 EJ2 | |
| 029 | A00710A-E-PDI-823 | NG-6-8"(3P10) | 150-C Outlet line | 2"-SG-0088-F24-P | Recycle syn gas line D/S of new FSV 3022 | |

| Tie In No | P&ID | Existing line No. | Existing Line Description | New Line No | New line Description | Remarks |
|---|---|---|---|---|---|---|
| 030 | A00710A-E-PDI-823 | NG-6-8”(3P10) | 150-C outlet line | TI-3082 | New TI | at U/s of existing FT-3021 |
| 032 | A00710A-E-PDI-825 | SG-8-10" (6P1) 3"-HG-160.01# | 103-J discharge line to 136-C (Branch 3") | 2"-SG-0088-F24-P | Recycle syn gas line | connection u/s of existing FT-1 & d/s of 150-C |
| 033 | A00710A-E-PDI-823 | 6" SCH-40 | Feed preheat coil o/l | 8"-NG-0090-F34-H | New line to new coil HDS-II inlet | |
| 035 | A00710A-E-PDI-823 | NG-15-4" (3P10) | 4" feed line to 104-D LTS S/O | CAP | cap with disconnection of line NG-15-4" | |
| 036 | A00710A-E-PDI-823 | NG-1-6" | LNG from RIL / GSPCL at d/s of vent to SP-73 line | 6"-NG-0105-D24-P | new line segment with i/v at end and expanded to 8" for 150-C inlet | |
| 039 | A00710A-E-PDI-823 | NG-6-8" (3P10) | 150-C inlet line T/S | 8"-NG-0093-D24-N | 8" -150-C by pass line | 150-C bypass line U/S connection |
| 040 | A00710A-E-PDI-823 | NG-6-8" (3P10) | 150-C T/S outlet line | 8"-NG-0093-D24-N | 8" -150-C by pass line | 150-C bypass line D/S connection |
| 041 | A00710A-E-PDI-823 | NG-6-8" (3P10) | 150-C T/S inlet line | 8"-NG-0093-D24-N | 8" -150-C by pass line | 150-C U/S (Inlet) I/V |
| 042 | A00710A-E-PDI-823 | NG-6-8" (3P10) | 150-C T/S outlet line | 8"-NG-0093-D24-N | 8" -150-C by pass line | 150-C D/S (outlet) I/V |
| 043 | A00710A-E-PDI-823 | NG-6-8" (3P10) | 150-C T/S outlet line | HOLD VENT | Provision of vent U/S of outlet I/V | U/S of Outlet I/V of 150-C |
| 044 | A00710A-E-PDI-833 | PW-25-4" 1P50 | line to H 4401 from line shell side 173-C | 4"-PW-0094-B24-N | USV-322B provision with U/s & D/s I/V | As per P & ID. No Routing change |
| 045 | A00710A-E-PDI-833 | PW-25-4" 1P50 | | 4"-PW-0094-B24-N | | As per P & ID. No Routing change |
| 047 | A00710A-E-PDI-833 | PW-100-100 | 173-shell side to 2011 U | 4"-PW-0095-B24-N | Removal of LCV-20 with | Only Pipe spool with |

| Tie In No | P&ID | Existing line No. | Existing Line Description | New Line No | New line Description | Remarks |
|---|---|---|---|---|---|---|
| | | | SPC polisher | | u/s, d/s i/v, welding of pipe spool but retaining "THI 505" | removal of LCV-20. Tapping point may need to be changed at u/s of new Control valve with R.O. |
| 049 | A00710A-E-PDI-833 | Thl-505 | Existing branch for THI 505 | 4"-PW-0095-B24-N | | |
| 051 | A00710A-E-PDI-833 | PW-24-4" 1P50 | same as TI 47 (U/P of TI 47) | 4"-PW-0095-B24-N | | |
| 052 | A00710A-E-PDI-833 | PW-103-100 | same as TI 47 | 4"-PW-0096-B24-N | d/s of CV assy. Of USV 3022 A | Same as TI 47 |
| 053 | A00710A-E-PDI-833 | PW-100-100 | same as TI 47 | 4"-PW-0096-B24-N | u/s of CV assy. Of USV 3022 A | |
| 054 | A00710A-E-PDI-833 | LS-76-4" | LP steam from Urea Plant | BLIND FLANGE | Only blind flange at D/s of I/V | |
| 055 | A00710A-E-PDI-833 | LS-76-4" | LP steam from Urea Plant | BLIND FLANGE | Only blind flange at D/s of I/V | |
| 056 | A00710A-E-PDI-833 | PW-21-4" | 170-C by pass | 4" CAP | Remove line & install cap at d/s line , u/s of i/v | |
| 058 | A00710A-E-PDI-830 | CO-15-30" | 103-F CO2 stripper reflux drum to CO2 compressor | X”-CO-0207-B24-P | Vent line PSV 3021-A provision | |
| 061 | A00710A-E-PDI-824 | PG 1201.01 20" (D24) | Existing 112-C line to 155-f; K O U/S LTS | 18"-PG-0099-D34-H | Line connecting 18" inlet to 20" outlet of 112-C | |
| 062 | A00710A-E-PDI-824 | PG-8-18" (3P10) | 112-C T/s inlet line | 18"-PG-0099-D34-H | | |
| 069 | A00710A-E-PDI-855 | 3"-EF-101.01-B24 | 3" eff. Line u/s of i/v at shell of HE-4 | 3/4"-AW-0102-D24-N | line for new 106 EJ-1 | |
| 072 | A00710A-E-PDI-824 | PG 11 20" (3P50-B) | 143-C to 105 CA/CB common shell inlet line | 4"-PG-0107-D44-H | 4" bypass line of 105 CA/CB | |
| 074 | A00710A-E-PDI-824 | PG-13-16" (3P50-B) | 105 CA/CB common shell outlet line to 106 C | TT-3087 | Additional TI at inlet of 106 C | |

| Tie In No | P&ID | Existing line No. | Existing Line Description | New Line No | New line Description | Remarks |
|---|---|---|---|---|---|---|
| 075 | A00710A-E-PDI-824 | PG-13-16" (3P50-B) | 105 CA/CB common shell outlet line to 106 C | 4"-PG-0107-D44-H | 4" bypass line of 105 CA/CB | |
| 076 | A00710A-E-PDI-833 | PW-100-100 | same as TI 47 & u/s of TI 53 | 4"-PW-0108-B24-N | New header to eff. Treatment | |
| 077 | A00710A-E-PDI-833 | DM-103-100 | DMW for PW-101-150 | CAP | new cap at d/s of i/v | |
| 078 | A00710A-E-PDI-833 | PW-26-2" IP50 | connection of jacket water line to LCV-20 b/p line | 2" CAP | line disconnected & cap provided | |
| 079 | A00710A-E-PDI-833 | PW-43-50 | same as TI 28 | 2" CAP | only cap provision-2" | |
| 080 | A00710A-E-PDI-855 | 3"-EF-100.01-B24 | Direct pipe connection u/s | 3"-AW-0113-B24-N | new line after removal of CV assy. LV 503 | |
| 081 | A00710A-E-PDI-855 | 3"-EF-100.01-B24 | Direct pipe connection d/s | 3"-AW-0113-B24-N | | |
| 082 | A00710A-E-PDI-855 | 3"-EL-102.01-B24 | same as TI 27 | 3"-AW-0114-B24-N | u/s conn. | |
| 083 | A00710A-E-PDI-855 | 3"-EL-102.01-B24 | same as TI 27 | 3"-AW-0114-B24-N | d/s conn. | |
| 085 | A00710A-E-PDI-823 | A-20-10" (3P10) | new steam and air heating coil inlet | STEAM & AIR HEATER | new coil | Coil inlet pipe |
| 086 | A00710A-E-PDI-824 | 103-D A-21-10" (9P1) | 101-J to 103-D Secondary reformer | 10"-A-0110-F64-H | Same line being changed to MOC F64 | 103-D (Sec. ref.) top nozzle (10"-600#) |
| 087 | A00710A-E-PDI-841 | STEAM SUPERHEATER | | 12"-HS-0111-J36S-H | 103 JT Steam Inlet lines | |
| 088 | A00710A-E-PDI-842 | 103-JAT | | 12"-HS-0111-J36S-H | | |
| 089 | A00710A-E-PDI-823 | A-20-10" (3P10) | line inlet or by pass 4" size | 10" CAP/4"?? | by pass connection to be reviewed | at root location closest to A 20-10" |

| Tie In No | P&ID | Existing line No. | Existing Line Description | New Line No | New line Description | Remarks |
|---|---|---|---|---|---|---|
| 090 | A00710A-E-PDI-841 | BF-15-8” | 123-C shell o/l connection to 142 CA/CB o/l | 8”-BF-0118-H24S-H | u/s line connection from 1123-C (S/S) D/s line connection | Supply Line of BFW to 1123-C |
| 091 | A00710A-E-PDI-841 | BF-15-8” | 123-C shell o/l connection to 142 CA/CB o/l | 8”-BF-0118-H24S-H | | |
| 092 | A00710A-E-PDI-855 | 2”-AW-100.01-F24 | FR 504 d/s line to SR-3 | 2”-NH-0085-D24-P | Amm. Water from 106 EJ2 | |
| 094 | A00710A-E-PDI-840 | BF-2H-6" or BF-3H-3" | from boiler pre-heat coil 101-B to steam drum (101-F) | 6”-BW-0024-H24S-H | 114-C line removal & new line from 1104-C to old quench connection | |
| 096 | A00710A-E-PDI-843 | MS-1304.02-8” | MP steam from 107-C to line going to 101-B | 8”-MS-0038-F24S-H | New 8" header from sat. Steam header | Tapping at d/s of I/V in MP steam from 107-C |
| 097 | A00710A-E-PDI-831 | 126-C SHELL OUTLET | Flash gas chiller o/l to LP purge gas line NH-120-2" | PV-7/N | increased cv control valve at same location | |
| 098 | A00710A-E-PDI-833 | PW-43-50 | same as TI-28 | 2"-CAP | only cap provision | |
| 102 | A00710A-E-PDI-823 | NG-6-8” | 150-C inlet line | 8”-NG-0092-D24-P | J/O connection with 6" 150-C inlet line | towards 150-C u/s of 1" line conn. To 103 E |
| 103 | A00710A-E-PDI-823 | NG-6-8” | 150-C outlet line | FT-3021 | New FT | location to be seen at site |
| 104 | A00710A-E-PDI-823 | NG-6-8” | 150-C outlet line | PT-3063 | New PT | d/s of new FT |
| 105 | A00710A-E-PDI-855 | 1”-PV-103.01-D24 | SR-1 vent line | 1”-PV-0212-D24-P | connection to 106-E | |
| 106 | A00710A-E-PDI-855 | 1”-PV-103.01-D24 | SR-1 vent line | ISOLATION VALVE | u/s of i/v | |
| 107 | A00710A-E-PDI-855 | 1”-PV-103.01-D24 | SR-1 vent line | ISOLATION VALVE | d/s of i/v | |
| 108 | A00710A-E-PDI-823 | MS-49-2” | 2" purge line connec. at NG-6-8" | CAP | additional cap welding and line removal | closest point near NG-6-8" |

| Tie In No | P&ID | Existing line No. | Existing Line Description | New Line No | New line Description | Remarks |
|---|---|---|---|---|---|---|
| 109 | A00710A-E-PDI-823 | MS-49-2” | 2" purge line connec. At MS- 29-12" | CAP | additional cap welding and line removal | closest point near MS-29-12" |
| 110 | A00710A-E-PDI-824 | BF-1203.016”(H24S) | BFW to E 105 coil | ISOLATION VALVE | Additional valve (H-245) only | Additional 6" I/V in existing line at d/S of connection to 107-C |
| 111 | A00710A-E-PDI-855 | 2”-AW-100.01-F24 | same as TI-92 | 2”-NGH-0085-D24-P | additional check valve at u/s to TI 92 | |
| 112 | A00710A-E-PDI-824 | BF 1202. 01 6"(H24S) | BF outlet from 143-C (T/s) to 142 CA/CB T/s | 6"-BW-0217-H24S-H | line size to be increased to 6" from 4" at connection to 142-CA/CB outlet | |
| 113 | A00710A-E-PDI-826 (841) | BF-6-6" | BFW INLET TO 123-C | 4"-BW-0219-H24S-H | 4" by-pass conn. Of 123-C with 2 I/Vs | |
| 114 | A00710A-E-PDI-826 (841) | BF-15-8" | BFW OUTLET TO 123-C | 4"-BW-0219-H24S-H | | |
| 115 | A00710A-E-PDI-824 | SG-2-14" (3P10) | 1114 shell outlet coming to 115-C | 14"-SG-0221-D34-H | Split entry to two shell nozzles | |
| 116 | A00710A-E-PDI-824 | SG-5-14" (3P10) | 1115-C outlet to 104-F Syn Gas suction drum | 14"-SG-0222-D34-H | Split exit from two shell nozzles | |
| 117 | A00710A-E-PDI-824 | COOLING WATER INLET TO 115-C | 10" CW inlet at T/S nozzle T1 | 115-C_T1 | Connection at new nozzle T1 | Line to be extended & connected to new location |
| 118 | A00710A-E-PDI-824 | COOLING WATER OUTLET TO 115-C | 10" CW inlet at T/S nozzle T2 | 115-C_T2 | Connection at new nozzle T2 | Line to be extended & connected to new location |

| Tie In No | P&ID | Existing line No. | Existing Line Description | New Line No | New line Description | Remarks |
|---|---|---|---|---|---|---|
| 119 | A00710A-E-PDI-824 | PW 1201.01 2"(D24) | Control valve U/S 155-F drain line | 2"-PW-0224-D24-P | By pass Line for USV-3030 | |
| 120 | A00710A-E-PDI-824 | PW 1201.01 2"(B24) | 155-F drain line D/S of control valve | 2"-PW-0224-B24-P | | |
| 121 | A00710A-E-PDI-824 | PW 1201.01 2"(D24) | 155-F bottom drain line | USV-3030 | Provision of additional control valve in 2" 155-F drain line | |
| 122 | A00710A-E-PDI-824 | PW 1201.01 2"(D24) | 155-F bottom drain line | USV-3030 | | |
| 123 | A00710A-E-PDI-824 | BF 1203. 01 6"(H24S) | 142 CA/CB T/s outlet line | 6"-BW-0217-H24S-H | Connection to 143 C (T/S) with 6" line | |

**TOTAL SCOPE OF PIPING FABRICATION IN ESP-III JOBS**

| INCH -DIA SCOPE OF WELDING IN ESP-III | | | |
|---|---|---|---|
| **Sl No** | **AREA (FABRICATION/ ERECTION)** | **Scope (ID)** | **Erection (IM)** |
| 1 | AMMONIA -SS-Piping | 2096 | 2332 |
| 2 | AMMONIA -CS- Piping | 3039 | 2318 |
| 3 | AMMONIA -AS- Piping | 6242 | 5967.02 |
| 4 | AMMONIA -IBR- Piping | 3951 | 3975 |
| 5 | SIEMENS (IBR)-Piping | 792 | 122 |
| 6 | SIEMENS (N-IBR)-Piping | 2138 | 742 |
| 7 | UREA GRADE PIPING | 1092 | 686 |
| 8 | UREA CS PIPING | 2399 | 1307 |
| 9 | UREA SS PIPING | 153 | 15 |
| 10 | UREA IBR PIPING | 563 | 891 |
| 11 | Impulse (U+A) | 1176 | 577 |
| 12 | ADDITIONAL,TIE-IN AND MODIFICATION UREA | 2000 | 920 |
| **Total>>>>>** | | **25641** | **19851** |

## LOI/ PO PLACED FOR PIPING MATERIAL ARE AS UNDER

## DETAILS OF ESP- KALOL PIPING MATERIAL

| SR. NO. | Name of Supplier | Item Description | PDIL P.O. NO. | IFFCO P.O. No. |
|---|---|---|---|---|
| 1 | MAITRI PIPE CENTRE | PIPES - SEAMLESS (CS/ AS/ LTCS) | PNMM/EM-144/P/6151C/ICB | 201004170820 |
| 2 | RATNAMANI METALS & TUBES LTD. | PIPES- SEAMLESS (SS) | PNMM/EM 144-6251A | 201004170895 |
| 3 | M/S TUBE PRODUCTS INCORPORATE | PIPE FITTINGS - (CS/ AS/ SS/LTCS ) | PNMM/EM 144-6351E/NCB | 201004171321 |
| 4 | M/S GAUTAM INDUSTRIAL CORPORATION LTD | PIPES SEAMLESS (CS/ AS/ LTCS) | PNMM/EM-144/6151/B/ICB | 201004171076 |
| 5 | MAITRI PIPE CENTRE | PIPES - SEAMLESS (CS/ AS/ LTCS) | PNMM/EM-144/P/6151C/ICB | 201004170820 |
| 6 | MB METALLIC BELLOWS PVT LTD | UNIVERSAL EXPANSION JOINT | PNMM/EM-144/P/6802/ICB | 201004171089 |
| 7 | NITON VALVE INDUSTRIES PVT LTD. | PIPING-GATE/GLOBE/CHECK /NEEDLE VALVE | PNMM/EM-144/P/6751/A/NCB | 201004171190 |
| 8 | CHW FORGE PRIVATE LIMITED | PIPING FLANGES (CS/ AS/ SS/ LTCS) | PNMM/EM-144/6451/B/NCB | 201004171127 |
| 9 | DEE DEVELOPMENT ENGINEERS LIMITED | PIPING- FITTINGS - (CS/ AS/ SS/LTCS ) | PNMM/EM-144/P/6351/B/NCB | 201004171178 |
| 10 | FIX FIT FASTNERS | STUS AND NUTS | PNMM/EM-144/P/6651B/NCB | 201004171300 |
| 11 | GAUTAM INDUSTRIAL CORPORATION PVT.LTD. | FITTINGS( CS/SS/AS/LTCS) | PNMM/EM-144/P/6351/C/NCB | 201004171036 |
| 12 | GAUTAM INDUSTRIAL CORPORATION PVT.LTD. | FITTINGS( CS/SS/AS/LTCS) | PNMM/EM-144/P/6451/C/NCB | 201004171329 |
| 13 | M/s Oswal Industries | Gate / globe / check /needle /valves | PNMM/EM-144/P/6751/B/NCB | 201004171250 |
| 14 | M/s Anil Metal Corporation | Pipes- Seamless(CS, AS & LTCS) | PNMM/EM-144/P/6151/A/ICB | 201004171134 |
| 15 | M/s Anil Metal Corporation | Pipes- Seamless(CS, AS & LTCS) | PNMM/EM-144/P/6171/A/NCB | 201004171417 |
| 16 | M/s C D ENGINEERING | FLANGES | PNMM/EM-144/P/6451/A/NCB | 201004171336 |
| 17 | M/s SANGHVI FORGINGS & ENGINEERING LTD, VADODARA | Flanges(CS/AS/SS/LTCS) | PNMM/EM-144/P/6451/D/NCB | 201004171261 |

| SR. NO. | Name of Supplier | Item Description | PDIL P.O. NO. | IFFCO P.O. No. |
|---|---|---|---|---|
| 18 | Mls SANGHVI FORGINGS & ENGINEERING LTD, VADODARA | Fittings(CS/AS/SS/LTCS) | PNMM/EM-144/P/6351/D/NCB | 201004171124 |
| 19 | M/s KEYTECH ENGINEERING | PIPES (UREA GRADE PIPES) | PNMM/EM-144/P/6253/ICB | 201004171317 |
| 20 | M/s KEYTECH ENGINEERING | Urea grade pipe fittings | PNMM/EM-144/P/6355/ICB | 201004171370 |
| 21 | M/s KEYTECH ENGINEERING | UREA GRADE FITTINGS | PNMM/EM-144/P/6353A/ICB | 201004171499 |
| 22 | M/s GOODRICH GASKET PVT LTD | GASKET | PNMM/EM-144/P/6652A/NCB | 201004171218 |
| 23 | M/s S A Engineers | Gate / globe / check /needle /valves | PNMM/EM-144/P/6752 /B/ICB | 201004171162 |
| 24 | M/s Xomox Sanmar Ltd | Gate / globe / check /needle /valves | PNMM/EM-144/P/6752/C/ICB | 201004171119 |
| 25 | M/s Tube Produts Incorporate | Fittings | PNMM/EM-144/P/6371/C/NCB | 201004171591 |
| 26 | M/s Tube Products Incorporate | Flanges | PNMM/EM-144/P/6471/C/NCB | 201004171469 |
| 27 | M/s ADVANCE VALVES | BUTTERFLY VALVES | PNMM/EM-144/P/6754/A/NCB | 201004171371 |
| 28 | M/s Tube Products Incorporate | Fittings | PNMM/EM-144/P/6371/C/NCB | 201004171591 |
| 29 | M/s Ratnamani metals & tubes Ltd | SS Pipes | PNMM/EM-144/P/6271/B/NCB | 201004171435 |
| 30 | M/s Dee DEVELOPMENT ENGINEERS LTD. | Fittings | PNMM/EM-144/P/6371/B/NCB | 201004171459 |
| 31 | M/s Tube products | Fittings | PNMM/EM-144/P/6351/C/ICB | 201004171591 |
| 32 | M/s Niton valve Industries | Gate/Globe/Check valves | PNMM/EM-144/P/6771 /A/NCB | 201004171422 |
| 33 | M/s C D Engineering Company | Flanges | PNMM/EM-144/P/6471 /A/NCB | 201004171433 |
| 34 | M/s Tube products | Flanges | PNMM/EM-144/P/6471 /C/NCB | 201004171469 |
| 35 | M/s CHW Forge Pvt Ltd | Flanges | PNMM/EM-144/P/6471/B/NCB | 201004171434 |
| 36 | M/s Anil Metal Corporation | Pipes | PNMM/EM-144/P/7K96/A/ICB | 201004171604 |
| 37 | M/s DOUGLAS CHERO SPA,ITALY | UREA GRADE VALVE | PNMM/EM-144/P/6759/ICB | 201004171450 |
| 38 | M/s EVERGREEN SEAMLESS PIPES & TUBES PVT.LTD. | CS/ AS Pipes | PNMM/EM-144/P/6171/B/NCB | 201004171669 |
| 39 | M/s Raccortubi Valve, ITALY | Urea Grade Fittings | PNMM/EM-144/P/6353/B/ICB | 201004171307 |

| SR. NO. | Name of Supplier | Item Description | PDIL P.O. NO. | IFFCO P.O. No. |
|---|---|---|---|---|
| 40 | M/s .Oswal Industries | Gate/Globe/Check valves | PNMM/EM-144/P/6771/B/NCB | 201004171461 |
| 41 | M/s Jindal Quality Tubular Ltd | SS Pipes | PNMM/EM-144/P/6271/A | 201004171436 |
| 42 | M/s KSB pumps Ltd, Noida | Gate/Globe/Check valves | PNMM/EM-144/P/6772/A | 201004171620 |
| 43 | M/s Tube Products Incorporate | Fittings | PNMM/EM-144/P/6371/C/NCB | 201004171591 |
| 44 | M/s Xomox Sanmar Ltd | Gate/Globe/Check valves | PNMM/EM-144/P/6771/C/NCB | 201004171422 |
| 45 | M/s Anil Metal Corporation | Fittings | PNMM/EM-144/P/6371/A/NCB | 201004171415 |
| 46 | M/s CHW Forge Pvt Ltd | Flanges | PNMM/EM-144/P/6471/B/NCB | 201004171434 |
| 47 | M/s CONSOLE ENGG. & FASTENERS INDUSTRIES | STUDS & NUTS | PNMM/EM-144/P/6651/A | 201004171177 |
| 48 | M/s SANGHVI FORGING & ENGG. LTD | Fittings(CS/AS/SS/LTCS) | PNMM/EM-144/P/6451/D/NCB | 201004171261 |
| 49 | M/s Maitri Pipe centre | Fittings | | 20104171771 |
| 50 | M/s Tube Products Incorporate | Fittings | PNMM/EM-144/P/6371/C/NCB | 201004171591 |
| 51 | M/s Jindal Quality Tubular Ltd | SS Pipes | PNMM/EM-144/P/6271/A/NCB | 201004171436 |
| 52 | M/s Mech-well fittings pvt ltd | Fittings | | 201004171770 |
| 53 | M/s Maitri pipe centre | Pipes | PNMM/EM-144/P/7k96/B | 201004171605 |
| 54 | M/s Pentair Sanmar Ltd. | SAFETY VALVE | PNMM/EM-144/P/7322/B | 201004171533 |
| 55 | M/s Tube Products Incorporate | Fittings | PNMM/EM-144/P/6371/C/NCB | 201004171591 |
| 56 | M/s IGP ENGINEERS | GASKET | PNMM/EM-144/P/6652B | 201004171442 |
| 57 | M/s Tube Products Incorporate | Fittings | PNMM/EM-144/P/6371/C/ | 201004171591 |
| 58 | M/s Fix fit fasteners Mfg Pvt Ltd | Stud and Nuts | PNMM/EM-144/P/6671/B | 201004171840 |
| 59 | Mls SANGHVI FORGINGS & ENGINEERING LTD, VADODARA | Flanges(CS/AS/SS/LTCS) | PNMM/EM-144/P/6451/D/NCB | 201004171261 |
| 60 | Mls SANGHVI FORGINGS & ENGINEERING LTD, VADODARA | Flanges(CS/AS/SS/LTCS) | PNMM/EM-144/P/6451/D/NCB | 201004171261 |

| SR. NO. | Name of Supplier | Item Description | PDIL P.O. NO. | IFFCO P.O. No. |
|---|---|---|---|---|
| 61 | M/s Weir BDK Valves | Gate / globe / check /needle /valves | PNMM/EM-144/P/6751/C | 201004171136 |
| 62 | M/s Uniklingers Ltd | Gaskets | PNMM/EM-144/P/6672/C/NCB | 201004171671 |
| 63 | M/s IGP Engineers | Gaskets | PNMM/EM-144/P/6672/B | 201004171748 |
| 64 | M/s Pentair Sanmar Ltd. | SAFETY VALVE | PNMM/EM-144/P/7322/B | 201004171533 |
| 65 | M/s BS&B Safety India Ltd | Rupture Disc | PNMM/EM-144/P/7024 | 201004171368 |
| 66 | M/s Xomox Sanmar Ltd | Gate/Globe/Check valves | PNMM/EM-144/P/6772/C | 201004171622 |
| 67 | M/s S A Engineers | Gate / globe / check /needle /valves | PNMM/EM-144/P/6752/B | 201004171162 |
| 68 | M/s Nisan Scientific Process Equipments Pvt Ltd | Level gauge | PNMM/EM-144/P/7k46 | 201004171907 |
| 69 | Mls SANGHVI FORGINGS & ENGINEERING LTD, VADODARA | Flanges(CS/AS/SS/LTCS) | PNMM/EM-144/P/6451/D/NCB | 201004171261 |
| 70 | M/s Advance Valves Limited | Supply of Butterfly valves | PNMM/EM-144/P/6774/A | 201004171598 |
| 71 | M/s PENNANT ENGINEERING PVT LTD. | Co2 Traps | PNNM/EM-144/6809 | 201004171673 |
| 72 | M/s CONSOL ENGG. & FASTENERS INDUSTRIES | Stud and Nuts | PNMM/EM-144/P/6671/A | 201004171841 |
| 73 | M/s Bliss Anand | SAFETY VALVE | PNMM/EM-144/P/7322/A | 201004171393 |
| 74 | M/s S A Engineers | Gate / globe / check /needle /valves | PNMM/EM-144/P/6752/B | 201004171162 |
| 75 | M/s Xomox Sanmar Ltd | Gate/Globe/Check valves | PNMM/EM-144/P/6771/C/NCB | 201004171432 |
| 76 | M/s INTERVALVE POONAWALLA LIMITED | Valves | PNMM/EM-144/P/6774/B | 201004171670 |
| 77 | M/s GOODRICH GASKET PVT LTD | Gaskets | PNMM/EM-144/P/6672/A | 201004171625 |

**UREA PLANT**

(TECHNICAL)

## FOLLOWING EWR JOBS HAVE BEEN CARRIED OUT IN UREA PLANT

| Sr. No. | EWR No. | EWR Date | Description |
|---|---|---|---|
| 1 | EWR U 281 | 07/06/2016 | Provision of drain in upstream of LICV-1353 and main isolation valve. |
| 2 | EWR U 282 | 07/06/2016 | Provision of drain between control valve FICV-1352 & main Isolation valve. |
| 3 | EWR U 283 | 07/06/2016 | To provide level glass in CO2 recovery system oil separator. |
| 4 | EWR U 284 | 07/06/2016 | Provision of NRV on low pressure condensate flushing line in downstream of LRCV-1201 |
| 5 | EWR U 286 | 07/06/2016 | To provide strainer in liquid line at inlet of H-1209 |
| 6 | EWR U 287 | 07/06/2016 | To provide I/V at downstream side of HICV-1422. |
| 7 | EWR U 289 | 07/06/2016 | Provision of condensate flushing cum drain point in common recycle line of HP Carbamate Pumps (P-1201 A/B/C) |
| 8 | EWR U 290 | 07/06/2016 | P-1408 drain line size to be increased to drain out flushed condensate in H-1424 along with polymer crystals. |
| 9 | EWR U 291 | 07/06/2016 | Provision of venting for P-1201 C packing water filters. (EWR U 291) |
| 10 | EWR U 294 | 07/06/2016 | Re-Routing of the N/C ratio meter HP& LP sample lines |
| 11 | Scheme | 18/01/2017 | Scheme for make up water requirement of Utility boiler with implementation of Energy saving Project. |

## TIE-IN LIST OF UREA PLANT FOR ESP-III

| Tie-in | P&ID No. | DETAILS | | |
|---|---|---|---|---|
| 001 | -PDI-0021/11-PI-02/801 | MA-1127-1.5"-B2 | 3/4"-MA-0001-11A-V | ¾" Drain for Discharge with one Extra Globe valve and Two additional tapping with Globe Valve at U/s and D/s of NRV ( 1102-A) |
| 002 | -PDI-0021/11-PI-02/801 | P-1102A | 4-MA-0002-77V-V | P-1102A Discharge Dampner D/s Line to New 6" Header |
| 003 | -PDI-0021/11-PI-02/801 | P-1102B | 4"-MA-0003-77A-V | P-1102B Discharge Dampner D/s Line to New 6" Header |

| Tie-in | P&ID No. | DETAILS | | |
|---|---|---|---|---|
| 004 | -PDI-0021/11-PI-02/801 | MA-1127-1.5"-B2 | 4"-MA-0003-77A-V | ¾" Drain for Discharge with one Extra Globe valve and Two additional tapping with Globe Valve at U/s and D/s of NRV ( 1102- B) |
| 005 | -PDI-0021/11-PI-02/801 | MA-1127-1.5"-B2 | 2"-MA-0103-77A-V | Drain of Recycle Line to Common Header |
| 007 | -PDI-0021/11-PI-02/801 | MA-1127-2"-B2 | 3/4"-MA-0005-11A-V | ¾" Drain for Discharge with one Extra Globe valve and Two additional tapping with Globe Valve at U/s and D/s of NRV ( 1102-C) |
| 008 | -PDI-0021/11-PI-02/801 | P-1102C | 3"-MA-0006-77A-V | P-1102 C Disch Dampner D/s Line direct Welding & Expander near Dampner |
| 009 | -PDI-0021/11-PI-02/801 | MA-1608-1.5"-11A | 2"-MA-0104-77A-V | Drain of Recycle Line to Common Header |
| 012 | -PDI-0021/11-PI-02/801 | MA-1123-2"-B2 | 2"-MA-0008-77A-V | 2" Line from Common Header to Ammonia for Cold Start up. |
| 014 | -PDI-0023/11-PI-03/803 | GA-1102-30"-B3 | 30" CAP | End Cap on existing CO2 line |
| 016 | -PDI-0023/11-PI-03/803 | CWS-4412-8"-B13 | 8" CAP | End Cap on existing CW line |
| 019 | -PDI-0023/11-PI-03/803 | CWS-4412-8"-B13 | 8"-CW-0010-11L-V | End Cap on existing CW line |
| 020 | -PDI-0023/11-PI-03/803 | GA-1101-30"-B3 | 30"-GA-0011-31A-N | VAM Inlet |
| 021 | -PDI-0023/11-PI-03/803 | GA-1102-30"-B3 | 30"-GA-0012-31A-N | To V1101 |
| 022 | -PDI-0023/11-PI-03/803 | GA-1101-30"-B3 | 30" CAP | End Cap on existing CO2 line |
| 023 | -PDI-0025/12-PI-01 /805 | SC-1201-1"-X8 | 1"-PR-0017-99A-T | HP Flush line for Amm Line to Ejector at D/s of MOV 1201 |
| 024 | -PDI-0025/12-PI-01 /805 | SC-1201-1"-X8 | 1/2"-SC-0018-87A-P | HP Flush line for HPCC 10" Liq Outlet Overflow line |
| 025 | -PDI-0025/12-PI-01 /805 | PR-1204-8"-X1 | 8"-PR-0019-99A-T | Autoclave Bottom at D/s of first Existing Elbow |
| 026 | -PDI-0025/12-PI-01 /805 | PR-1638-4"-X4A | 4"-PR-0021-99A-T | Carbamate Piump Discharge(4") line Connection with Ejector d/s line to HPCC |
| 027 | -PDI-0025/12-PI-01 /805 | PR-1206-4"-X1 | 4"-PR-0022-99A-T | 4" Tee Conn. On Line from AUTOCLAVE at about 6 mtr height |
| 028 | -PDI-0025/12-PI-01 /805 | PR-1212-4"-X1 | 4"-PR-0023-99A-T | Scrubber Overflow line to Ejector Suction |

| Tie-in | P&ID No. | DETAILS | | |
|---|---|---|---|---|
| 029 | -PDI-0025/12-PI-01 /805 | PR-1213-2"-X4 | 2"-PR-0024-99A-T | HP Flush line for flushing AUTOCLAVE Drain line at U/S side ( about 3m additional pipe) |
| 030 | -PDI-0025/12-PI-01 /805 | SC-1201-1"-X8 | 1"-SC-0025-87A-P | HP Flush line for flushing Carbamate inlet line at Ejector. |
| 031 | -PDI-0025/12-PI-01 /805 | H-1201_N4 | 10"-PR-0026-99A-T | H1201 off gas line at N4 Nozzle (existing Parting Flange Nozzle flanges-10" ) to be used. |
| 033 | -PDI-0025/12-PI-01 /805 | SC-1201-2"-X8 | 1"-SC-0028-99A-T | HP Flush line 3" CO2 line for HV 1213 connected at D/s of HV 1212 8" line |
| 035 | -PDI-0025/12-PI-01 /805 | GA-1418-6"-F2 | 3"-GA-0029-77A-SJ | 3" CO2 line tapping for HV 1213 from 6" CO2 header at D/s of FT 1201. |
| 036 | -PDI-0025/12-PI-01 /805 | SC-1206-1"-87A | 1"-PR-0030-99A-T | Double valve HP Flushing connection at u/s of HV 1205. |
| 037 | -PDI-0025/12-PI-01 /805 | GA-1418-6"-F2 | TI-1224 | Tapping for TI1224 & PT 1201 / N for CO2 discharge line at u/s of FT-1201 |
| 039 | -PDI-0025/12-PI-01 /805 | MA-1201-3"-E2 | 6"-MA-0015-77A-P | Autoclave Bottom Amm Inlet .. FV-1205 D/s line |
| 040 | -PDI-0025/12-PI-01 /805 | PR-1213-2"-99A | 2" CAP | Autocalve drain line being retained with 4" x 2" reducer. No Cap required |
| 041 | -PDI-0025/12-PI-01 /805 | V-1201_C5 | BLIND FLANGE | Nozzle 4" reduced to 2" used as drain line as at TI 40 . |
| 045 | -PDI-0025/12-PI-01 /805 | PR-1212-4"-X1 | LT-1205 | Scrubber Overflow line at 4 mtr Lower elevation from Nozzle. |
| 046 | -PDI-0025/12-PI-01 /805 | SC-1245-10"-B4 | PSE-1201/N | New Rupture Disk- 10" Size |
| 047 | -PDI-0025/12-PI-01 /805 | SC-1237-16"-B4 | H-1202_C5 | 8 Nos. – 16 " Riser Pipes – (Reuse of Spools – Extra Pipe length in BOQ) |
| 048 | -PDI-0025/12-PI-01 /805 | SC-1233-12"-B4 | H-1202_C4 | 4 Nos.- 12" Downcomer Pipes (Reuse of Spools – Extra Pipe length in BOQ) |
| 049 | -PDI-0025/12-PI-01 /805 | ST-1211-2"-B4 | H-1202_C6 | 9 ata injection line connection to H1202 |
| 050 | -PDI-0025/12-PI-01 /805 | SC-1256-1"-B4 | H-1201_C8 | 1" Blow dine line to Sump. |
| 051 | -PDI-0025/12-PI-01 /805 | PR-1201-8" X1 | PDT-1212 | At 8 " Nozzle N1 of Stripper inlet ( U/s of HIC 1201 tapping presently in 3 " size) |
| 052 | -PDI-0025/12-PI-01 /805 | PR-1201-8" X1 | PDT-1212 | At d/s of HIC 1201 tapping presently in 3 " size) |

| Tie-in | P&ID No. | DETAILS | | |
|---|---|---|---|---|
| 053 | -PDI-0026/13-PI-02/806 | PR-1309-20"-B1 | 1"-MA-0031-11A-P | Tail Pipe of PSV 1101 A/B at H1250 outlet. |
| 054 | -PDI-0031/11-PI-01/811 | CW-1118-14"-B13 | 14"-CW-0037-11L-V | CW line with TEE in place of Elbow at Outlet of H-1102. ( CCS-1 line) |
| 055 | -PDI-0031/11-PI-01/811 | CW-1210-14"-B13 | 14"-CW-0038-11L-V | CW line with TEE in place of Elbow at Inlet of H-1102. ( CCS-1 line) |
| 056 | -PDI-0030/15-PI-03/810 | ST-1128-20"-B4 | 6"-ST-0039-11E-H | STEAM INLET TO VAM. |
| 057 | -PDI-0029/15-PI-02/809 | SC-1409-4"-B4 | 1 1/2"-SC-0040-11E-P | Cond. Outlet from VAM Machine.. |
| 059 | -PDI-0028/15-PI-01/808 | ST-1506-18"-B4 | 18"-ST-0042-11E-H | Installation of Butterfly Control, valve PV-1501/N at 4 ata Drain outlet Header. |
| 060 | -PDI-0028/15-PI-01/808 | ST-1506-18"-B4 | 18"-ST-0042-11E-H | 6” Tapping from 4 ata – 18” Header at u/s of PV-1501/N |
| 061 | -PDI-0027/14-PI-02/807 | PR-1405-6"-X10 | 6"-PR-0043-87A-T | Urea Solution Inlet to II-Evaporator H-1424 at C1 Nozzle – 6 “ Line Modification |
| 062 | -PDI-0027/14-PI-02/807 | SC-1409-1.5"-B4 | 1 1/2"-SC-0044-11E-P | 3” Drain Nozzle connection to existing 1-1/2” line |
| 063 | -PDI-0027/14-PI-02/807 | ST-1409-4"-B4 | 4" CAP | Blind Cap of 4” 9 ata Header near V-1503 after ½” tapping. |
| 064 | -PDI-0027/14-PI-02/807 | 1/2" EXISTING LINE | 1/2"-ST-0045-11E-H | ½ “ Steam line connection at Nozzle of H1424. |
| 065 | -PDI-0027/14-PI-02/807 | SC-1454-4"-B4 | 4" CAP | Cap at 4” Line at Root of Condensate to H1422 from Cond to T-1501 line. |
| 066 | -PDI-0029/15-PI-02/809 | ST-1607-12"-C1 | 8"-ST-0046-13A-H | 8” Size MP Steam Header from AmmoniaPlant |
| 067 | -PDI-0025/12-PI-01 /805 | PR-1213-2"-X4 | 1"-PR-0050-99A-T | 1” Drain from HPCC bottom line to Autoclave Common Drain Header |
| 068 | -PDI-0025/12-PI-01 /805 | PR-1213-2"-X4 | 1 1/2"-PR-0051-99A-T | 1-1/2” Drain from U/s of CV HV-1212 Line (Goose Neck inside) to Autoclave Common Drain Header |
| 069 | -PDI-0025/12-PI-01 /805 | SC-1201-1"-X8 | 1/2"-SC-0052-87A-P | |
| 070 | -PDI-0026/13-PI-02/806 | PR-1309-20"-B1 | 1"-MA-0053-11A-P | Tail Pipe at D/s of PSV 1106 A/B at H1250 Inlet |
| 071 | -PDI-0023/11-PI-03/803 | DRAIN FROM T-1101 | HOLD " CAP | Line Removal. No Connection at SUMP Remains. |

| Tie-in | P&ID No. | DETAILS | | |
|---|---|---|---|---|
| 073 | -PDI-0021/11-PI-02/801 | MA-1116-4"-C2 | 4"-MA-0007-77A-V | Recycle to V-1103 ( Same Route with New Piping Class 77A ) |
| 074 | -PDI-0021/11-PI-02/801 | MA-1127-1.5"-B2 | 2"-MA-0102-77A-V | Drain of Recycle Line to Common Header |
| 101 | -PDI-0026/13-PI-02/806 | 3"-PR-0134-33C-N | PR-1309-20"-B1 | |
| 102 | -PDI-0024/-/804 | VAM OUTLET | 6"-CH-0125-11L-V | Chilled Water Supply to CO2 Cooler |
| 103 | -PDI-0024/-/804 | 6"-CH-0125-11L-V | CO2 COOLER INLET | Chilled Water Supply to CO2 Cooler (Excluding Thermax Scope Supplies) |
| 104 | -PDI-0024/-/804 | CO2 COOLER OUTLET | 6"-CH-0126-11L-V | Chilled Water Return from CO2 Cooler |
| 105 | -PDI-0024/-/804 | 6"-CH-0126-11L-V | VAM INLET/ P-1150A/B IN | Chilled Water Return from CO2 Cooler (Excluding Thermax Scope Supplies) |
| 106 | V-1103 | Bottom Outlet | --- | 6" to 8" Line Size Change |
| 107 | P-1102 A | Suction | --- | 8" Common Header to 6 " Pump Suction |
| 108 | P-1102 B | Suction | --- | 8" Common Header to 6 " Pump Suction |
| 109 | P-1102 C | Suction | --- | 8" Common Header to 6 " Pump Suction |
| 110 | P-1102 A/B/C Common Discharge | --- | --- | ¾ " Line with 2 PSVs & 5 I/Vs with 1" Tail Pipe to Closed Header in 77 A |
| 111 | P-1102-A Recycle Line | --- | --- | 2" Line for MIC 1101A/N from Between Two I/Vs |
| 112 | P-1102- B Recycle Line | --- | --- | 2" Line for MIC 1101 B from Between Two I/Vs |
| 113 | P-1102- C Recycle Line | --- | --- | 2" Line for MIC 1101 C from Between Two I/Vs |
| 114 | Rupture Disc | 3"-PR-0034-33C-N | 3" PR-0036-33C-N | Rupture Disc Inlet and Outlet Line |
| 115 | P-1102-A | Discharge PSV Inlet | --- | PSV Size 1-1/2" x 2-1/2" |
| 116 | P-1102-A | Discharge PSV Outlet | --- | PSV Size 1-1/2" x 2-1/2" |
| 117 | P-1102-B | Discharge PSV Inlet | --- | PSV Size 1-1/2" x 2-1/2" |
| 118 | P-1102-B | Discharge PSV Outlet | --- | PSV Size 1-1/2" x 2-1/2" |

| Tie-in | P&ID No. | DETAILS | | |
|---|---|---|---|---|
| 119 | P-1102-C | Discharge PSV Inlet | --- | PSV Size 1-1/2” x 2-1/2” ( As of Existing) |
| 120 | P-1102-B | Discharge PSV Outlet | --- | PSV Size 1-1/2” x 2-1/2” ( As of Existing) |
| 121 | CO2 Cooler CO2 Outlet Temp. Control | --- | --- | CO2 Cooler Chilled Water Inlet to Outlet Connection with a Bypass Control Valve for Temperature Control |
| 122 | Excess Capacity Use of Chilled Water | --- | --- | One / Two additional 4 “ size or 3” size Tappings in Chilled Water for use of available 100 TR |