MTC / REPORT / 01

REPORT NO. 34 / 2014

IFFCO

KALOL UNIT

PLANT TURNAROUND REPORT

(MARCH – APRIL – 2014)

INDIAN FARMERS FERTILISER CO – OPERATIVE LIMITED

INDEX

PREFACE

The Annual Plant Turnaround for the year 2014 was taken from 26th of March, 2014 to 24th of April, 2014. In addition to routine Preventive maintenance jobs of Static & Rotary equipments, Statutory IBR inspection, maintenance of Electrical & Instrument systems, Civil related jobs, several major Retrofitting and Replacement jobs in plant were carried out during shutdown.

This was Longest Annual Turnaround of 29 days since inception of plant and was possible only due to whole hearted sincere efforts of whole IFFCO Kalol team and supports extended by our other units.

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 26th March 2014. This shutdown report contains Plant wise and section wise details of the jobs carried out. Ammonia plant was re started and regular production was lined up at 15.30 Hrs. on 28th April, 2014. Similarly Urea plant also restarted and production was resumed at 21.50 Hrs. on 23rd April, 2014.

Major jobs like Ammonia Convertor retrofitting 105-D, Replacement of ID fan Turbine 101-BJT, Replacement of Waste Heat Boiler 101-CA, Overhauling of Hydraulic turbine115-HT –CA and preventive maintenance of other rotary equipment was carried out in Ammonia Plant. In Urea plant LPCC H-1205 and Carbamate separator V-1205 were replaced with new one. In Offsite/Utility plants RAH of BHEL boiler was replaced with Plate type Air Preheater. RLA study of four Boilers was also done during Shutdown.

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

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

Major jobs carried out during shutdown are as under.

MECHANICAL

❖ AMMONIA

- Ammonia Convertor 105-D retrofitting by M/S. Ammonia Casale.
- New Lube Oil, Seal Oil system for 103-J Train.
- Replacement of ID Fan turbine 101-BJT & Gear Box.
- Major overhauling of Air Compressor HP case.
- Major overhauling of Hydraulic Turbine 115-HT.
- Replacement of Refractory of East and West side wall of Auxiliary Boiler.

- RLA study of 101-F Boiler and IBR inspection.
- Major overhauling of Re-cycle gas compressor, 117-J was carried.
- 15 No of damaged Burner Blocks of Primary Reformer were replaced by new upgraded burner blocks.
- Phosphate dosing pump 2002-LJ / 2002-LJA was replaced by new one
- Process condensate stripper 171-C was replaced by new one
- New tube bundle was installed in 103-JAT/JBT gland condenser.
- IN PGR the CS inlet & outlet lines of R1/R2 vessels were replaced by SS lines

❖ **UREA**

- Replacement of existing LP carbamate condenser H-1205 with new one.
- Replacement of exisiting LP Carbamate separator V-1205 with new.
- Preventive Maintenance of LP Case (K-1801-1) & HP case (K-1801-2) of CO2 compressor, Gear Box and minor overhauling Governing System and NRV of drive turbine (Q-1801) Siemens make,
- Routine inspection of Autoclave (V-1201) & Eddy current testing of tubes of H-1201 & H-1202.
- RLA study and IBR inspection of 4 ata steam drum V-1501
- Replacement of existing piping of RVs (RV-1201 A/B/C) station of off gas line (PR-1208-4”-X1 & P-1206-4”-X1) for V-1201 was replaced due to thickness reduction.
- Replacement of corroded MS platform of H-1203 at PT top near K-1401-3, staircase railing of prill tower from ground floor to PT top and round railing at PT top with SS structures.
- Replacement of existing base frame of K-1701, P-1701 A/B, P-1202 A & P-1204 A with new one.
- Replacement of existing belt of conveyor M-1403-1/2 , M-1419 & M-1421.
- LP Vessels inspection and necessary repairs as per inspection findings.

❖ **OFFSITE & UTILITY**

❖ Preventive Maintenance of Cooling Water Pumps and Turbines, BFW Pumps and Turbines.

❖ Preventive Maintenance of FD Fan (K-5113) Train with replacement of oil pump and governor drive gear set.

❖ Replacement of RAH with new Plate type APH.

❖ Checking & overhauling of FD Fan Dampers.

❖ IBR inspection of BHEL Boiler (GT-2068)

❖ RLA Study of BHEL Boiler (GT-2068)

❖ Installation of New Knife Edge Gate Valve in the suction line of CWP P-4401/D.

❖ Overhauling of 900 MM Discharge I/V of P-4403 and P-4401/C.

- ❖ Overhauling of all cooling tower distribution valves.
- ❖ Inspection & Repairing of 52'' inch CW interconnection tunnel.
- ❖ Replacement of Fan Deck and stair case of Cooling Tower H-4401/7 & 8
- ❖ Replacement of Sintex make partition wall in Ammonia 1-2, 2-3 and 3-4 cooling tower cells.
- ❖ Repairing of structural members of cooling towers.
- ❖ Patching of All Cooling tower Riser pipes with SS-304 plate.
- ❖ Spray Galvanizing of Cooling Tower pipes and structures.

Pre Shutdown Activities

Following jobs have been carried out during Pre-shutdown activities:

- ➢ **Maintenance of Air Compressors**
  - K-5301, Preventive Maintenance was carried out.
  - K-5302, Overhauling was carried out.
  - K-5305, Preventive Maintenance was carried out.
  - K-5401, Preventive Maintenance was carried out.
  - K-5501 Preventive Maintenance was carried out

- ➢ **Preventive Maintenance of Cooling Tower Fans**
  - Preventive maintenance of All 14 Cooling tower fans were carried out.

- ❖ **B&MH**

  Following jobs were carried out in B&MH.

  - Replaced the Complete length of conveyor belt with new oil & heat resistance Conveyor belt in M 2112. Provided three Nos of tru trac trough rollers for arresting off centering of conveyor belt.
  - Installation of New two Nos of tru trac trough rollers for arresting off centering of conveyor belt in M-2110 Conveyor belt. Replaced compete tail end side MS chute with new SS material chute. Also modified two way feed hopper chute (M-2111) by increasing it's neck width size to avoid frequent chocking at neck.
  - Replaced complete conveyor belt & Gearbox in M-2122.
  - Preventive maintenance of all the conveyor gear boxes, weighing machines, packer scales, stitching machines & New Reclaim machine.
  - Preventive Maintenance of all Conveyor and Drive Gear boxes.
  - Preventive Maintenance of all Packer Scales and Stitching Machines.

INSTRUMENTATION

- ❖ **AMMONIA:**
  - Major Instrumentation jobs were carried out for Instrumentation related with new ID fan turbine and new Oil console of 103-J including Woodward 505 Speed Governor and Protech-GII Ovespeed Tripping system for ID fan turbine and 02 nos. Woodward PEAK-150 speed governors for LO/SO turbines of 103-J. Trip

and Interlock logics for ID fan turbine and LO/SO turbines were developed and implemented with associated field instruments.

- 2oo3 logics were developed and implemented with associated field instruments for BFW pump trip on Dearator low level, overspeed trip of MDEA pump 107-J and MDEA pump 107-J trip on Stripper low level as a part of EWR/suggestions implementation.
- Replaced old control valves FRCV-5, PICV-14, TRCV-142A, MICV-003, LCV-26 and PICV-178 with new control valves of contemporary design.
- AMC services of DCS/PLC and UPSS Batteries were carried out with the help of supplier's service engineers. Preventive maintenance of UPSS and CH4/CO2 NDIR Analyzer was done. Preventive maintenance of control valves was done. Calibration of all quality affecting instruments was carried out.

❖ **UREA:**

- Trim of Autoclave level control valve HICV-1201 was replaced with trim made of Safurex material to improve corrosion resistance.
- Trips on high discharge pressure and Ampere indication in control room were provided for Ammonia and carbamate pumps, start permissive interlock for MOV-1801 was implemented and MOV-1842 operation from DCS and closing interlock with compressor tripping were developed and implemented as a part of EWR/suggestion implementation.
- AMC services of DCS and Nucleonic Level Gauges were carried out with the help of supplier's service engineers.
- Calibration of FS-1101(Ammonia mass flow meter) was carried out at EQDC, Gandhinagar, as per ISO and CDM requirements.
- Servicing and overhauling of the control valves was done. PICV-1130 and PRCV-1504 control valves were replaced with new control valves of contemporary design.Calibration of all quality affecting instruments was carried out.

❖ **UTILITY AND OFFSITE:**

- AMC services of DCS / PLC and UPSS were carried out with the help of supplier's service engineers.
- Preventive maintenance of control valves was done. TCV-1 and MICV-4401B control valves were replaced with new control valves. Calibration of all quality affecting instruments was carried out.

❖ **BAGGING PLANT:**

- Road Weigh Bridges and weighing machines were overhauled and calibrated.

ELECTRICAL

Brief summary of job carried out during ATA-14

➢ **Critical job/ new installation**

- Replacement of MCC-2F Sec-B
- Replacement of RTCC panel of transformer Tr-1A & Tr-1B
- Overhauling of transformer Tr-1B & Tr-12

- **Scheduled preventive maintenance and modification work**
  - Servicing of L & T make LT Air circuit breaker (ACB) (Total: Nos 39)
  - Servicing of Siemens make LT Air circuit breaker (ACB) (Total: Nos 41)
  - Servicing of Siemens make 11 KV HT Vacuum circuit breaker (VCB) (Total: Nos 30)
  - Servicing of Chhabi make battery charger
  - Servicing of Rotork make valve actuators (Total: Nos 47)
  - Servicing of HHE make On Load tap changer of Transformer TR-1A
  - Maintenance of transformers (Total: Nos 32)
  - Overhauling of critical motors (Total: Nos 91)
  - Maintenance of Motor control centre MCCs
  - Maintenance of 66 KV switch yard
  - PGR heater replacement and checking
  - Installation, commissioning & testing of new 103JLO/SO pumps motors
  - Installation, commissioning & testing of new 101BJT AOP motors
  - Replacement of carbon earthing brush of compressor
  - Testing and calibration of power analyzer in Recycle gas compressor.

CIVIL

- **AMMONIA**
  - Construction of foundation, core cutting foundation were carried out for synthesis gas compressor new lube oil console system in ammonia plant
  - Required chipping of concrete, construction of new footings, grouting of pockets etc. were carried outfor foundation of I D Fan turbine assembly (101-BJT)
  - Refractory repairing jobs in primary reformer, Secondary reformer & Primary waste heat exchanger. The casting of auxiliary boiler side panels was carried out by M/s Ace Calderys using the refractory material ''Whytheat''.
  - For modification in synthesis gas convertor, job of removal of the existing refractory from fourth bed & bottom bed was carried out.
  - The modification was carried out in Phosphate dosing pumps in ammonia plant. The subsequent changes in the foundation had been carried out to accommodate the new system.

- **UREA**
  - Repairing of scrapper floor in prilling tower by providing elastomeric lining & replacing acid/ alkali proof bricks carried out.
  - Repairing of prill tower top floor by providing elastomeric lining & replacing acid/ alkali proof bricks carried out.

- Rehabilitation is carried out for bucket room (outside) at prill tower top by providing elastomeric lining.
- The existing corroded mild steel hand rails of the prill tower top and staircase were replaced with SS railing with use of Hilti make Anchors.
- Demolishing job of floor behind urea plant for crane approach was carried out to replace LPCC in urea plant.

❖ OFFSITES & UTILITY

- The bye pass channel was constructed in ammonia cooling tower to isolate the cell No. 7 & 8 for maintenance purpose during running plant.
- Damaged plywood sheets of the cooling tower deck were replaced with new marine plywood sheets.
- The surrounding area of cooling water return headers was excavated for the preventive maintenance including wrapping & coating of the headers.
- Fixing of anchor fasteners on the circumference of clarriflocculator to replace the rail.

❖ B & MH

- IP Net coating was provided as a rehabilitation measures in Silo, transfer tower sieving floor & conveyor gallery (M-2112).
- Rehabilitation of stitching floor (beams & columns) of B & MH plant by providing elastomeric lining was carried out.
- Job of providing Kota stone in transfer tower floors in B& MH after removing old bitumastic lining was carried out.

TECHNICAL

- The annual turnaround of about 20 days, provide opportunity to Technical Department to undertake execution of jobs related to EWRs and various modification schemes which require isolation.
- Various modification jobs were carried out by Technical Department in Ammonia, Urea and Utility Plants in Annual Turnaround – 2014. These include major jobs of “Replacement of ID Fan turbine”, “installation of APH + BFW coil in BHEL boiler’s flue gas duct” and “IBR piping jobs related to various EWRs.

PLANT TURNAROUND MARCH - APRIL - 2014

GENERAL - DETAILS

SR. NO.	CATEGORY	QUANTITY

(A) EQUIPMENT UTILIZED :

IFFCO :

135 T	Kobelco	01 No
100 T	Kobelco	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

(B) MANPOWER UTILIZED :

(I) IFFCO MANPOWER :

1	Mechanical	}
2	Mechanical Services	} Existing
3	Electrical	} strength
4	Instrument	}
5	Inspection	}
6	Civil	}

(II) HIRED - CONTRACT MANPOWER :

Sr. No.	Category	Man days
1	General Fitter	924
3	Rigger	983
4	S.S. Rigger	2415
5	Fabricator	180
6	Grinder	201
7	Gas Cutter	111
8	IBR Welder	36
9	Non-IBR Welder	135
10	Carpenter	83
11	Mason	63
12	Machinist	17

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**

SHUT DOWN RELATED CONTRACTS

SR. NO.	PLANT	WO NO. & DATE	DESCRIPTION OF JOB	VENDOR'S NAME
1	MECH AMMONIA	201004141085 24-12-2013	RLA STUDY OF WASTE HEAT BOILER NO. GT-1632 & BHEL BOILER NO. GT-2068	NTPC ALSTOM POWER SERVICES PVT LTD, Delhi
2	MECH AMMONIA	201004141160 03/01/14	REFURBISHMENT OF AMMONIA CONVERTER INTERNALS	SKYWIN ERECTORS, AHMEDABAD
3	MECH AMMONIA	201004141232 17/01/14	MINI-RLA STUDY OF112-C & V-1501	NTPC ALSTOM POWER SERVICES PVT LTD, Delhi
4	MECH AMMONIA	201004140868 06/11/13	Ovehauling of Re-cycle gas compressor, 117-J	MALHAN ENTERPRISES PVT. LTD.
5	MECH AMMONIA	201004140937 18-11-2013	Scaffolding & Blinding / De-blinding jobs during Shut Down-2014 as per specification given in Annexure-I.	TMK ENGINEERING, VADODARA
6	MECH AMMONIA	201004141072	Overhauling and Preventive Maintenance of Rotating Equipments	BVL POWER SYSTEMS PVT LTD, HYDERABAD
7	MECH AMMONIA	201004141208 07/02/13	Supply & Application of Refractory on both side walls of Auxiliary Boiler	CALDERYS INDIA REFRACTORIES LTD.,AHMEDABAD
8	MECH AMMONIA	21004141231 07/02/13		CALDERYS INDIA REFRACTORIES LTD.,AHMEDABAD
9	MECH AMMONIA	201004150184 02.06.2014	Various fabrication jobs for shutdown-2014 in Ammonia plant	J & J Engineer
10	MECH AMMONIA	201004141498 12-03-2014	Erection and commissioning of various rotating equipment train/system in Ammonia Plant	BVL POWER SYSTEMS PVT LTD, HYDERABAD
11	MECH AMMONIA	201004141577 24.03.2014	Various IBR & Non IBR fabrication jobs for Ammonia Plant	SHRI GANESH
12	MECH UREA	201004141584 08/05/2014	Replacement of Existing MS structures with new SS and MS structures at prill tower top and other areas (at elevation of 50 to 70 mtr from ground level) in urea plant	General Engg Works, Bharuch
13	MECH UREA	201004141421 01/03/2014	Fabrication Job for Urea and Offsite Plant	Shree Ganesh Engg Co., Ahmedabad
14	MECH UREA	201004141513 19/03/2014	Contract For Overhauling, Re-Conditioning And	Flotec Technosmart (India) Private Limited, Surat

SR. NO.	PLANT	WO NO. & DATE	DESCRIPTION OF JOB	VENDOR'S NAME
			Testing Of Valves	
15	MECH UREA	201004131506 29-03-2013	Contract Job for Erection of New LP Carbamate Condenser (H-1205) in Urea Plant	Asian Engg & Construction Co., Vadodara
16	MECH OFFSITE	201004131237 08/02/2013	Repairing of Cooling Tower	M/s Paharpur
17	MECH. OFFSITE	201004141283 & 31/01/2014	Servicing/Repairing of Jash make Sluice Gates	M/s Jash Engineering, Indore
18	MECH. OFFSITE	201004141085 24/12/2014	RLA Study of BHEL Boiler	M/s Alstom Power, New Delhi
19	MECH. OFFSITE	201004140975 26/11/2013	Insitu Gland Repacking of Valves	M/s Flotec Technosmart, Surat
20	MECH. OFFSITE	201004140950 20/11/2013	Insitu Repairing of Gate Valve	M/s Flotec Technosmart, Surat
21	B&MH	20110834 07/12/2011	Rubber ling of pulleys in Bagging and urea plant	M/s J.K.Ruubber works, Ahmedabad
22	B&MH	201004131272 12/02/2013	Annual maintenance rate contract for splicing & hot vulcanizing of conveyor belts	M/s J.K.Ruubber works, Ahmedabad
23	B&MH	201004141314 04/03/2014	Annual contract for overhauling of Gabbar make stitching machines	M/s Gabbar Engg. Co., Ahmedabad
24	INSPECTION	201004140590	DP TEST	S.R. TECHNICAL SERVICES, MUMBAI
25	INSPECTION	201004140794	THICKNESS MEASUREMENT	S.R. TECHNICAL SERVICES, MUMBAI
26	INSPECTION	201004140793	ULTRASONIC FLAW DETECTION	S.R. TECHNICAL SERVICES, MUMBAI
27	INSPECTION AMMONIA	201004140767	MAGNETIC PARTICLE INSPECTION	NDT SERVICES, AHMEDABAD
28	INSPECTION	201004130578	RADIOGRAPHY WORK	NDT SERVICES, AHMEDABAD
29	INSPECTION AMMONIA - UREA	201004130854	METALLOGRAPHY WORK	TCR ADVANCED ENGGINEERING, VADODARA
30	INSPECTION UREA	201004130740	EDDY CURRENT TESTING OH HP STRIPPER AND HP CONDENSER TUBES	TESTEX NDT9I) PVT., LTD., MUMBAI

SR. NO.	PLANT	WO NO. & DATE	DESCRIPTION OF JOB	VENDOR'S NAME
31	INSTRUMENT AMMONIA	201004141301 03-FEB-14	Maintenance of Control valves	FLOTEC TECHNOSMART (INDIA) PRIVATE LIMITED
32	INSTRUMENT AMMONIA	201004141593 28-MAR-14	Painting of DCS/ESDS Marshalling Cabinets of Urea & Ammonia Plant	ARMATE CORPORATION
33	INSTRUMENT UREA	201004141191 16-JAN-14	Checking and calibration of Ammonia Mass Flow meter	ELECTRONICS & QUALITY DEVELOPMENT CENTRE
34	INSTRUMENT UREA	201004140992 02-DEC-13	Hiring of skilled instrument manpower	A-Z INSTRUMENTS SERVICES
35	INSTRUMENT UREA	201004131190 08-FEB-13	AMC For Autoclave/Stripper level Measurement system	BERTHOLD TECHNOLOGIES (INDIA) PVT LTD
36	INSTRUMENT UTILITY/ OFFSITE	201004131332 22.02.2013	AMC for 40 MT Weigh Bridge	ASHBEE SYSTEMS PVT. LTD.
37	INSTRUMENT UTILITY/ OFFSITE	201004130937 27.11.2012	AMC For Emerson UPSS	M.S EMERSON NETWORK POWER
38	INSTRUMENT UTILITY/ OFFSITE	201004130813 22.10.2012	AMC For UPSS Batteries	M/s SYNTECH POWER SYSTEMS
39	INSTRUMENT UTILITY/ OFFSITE	201004131357 05.03.2013	AMC for weighing scales	M.S METTLER TOLEDO INDIA PVT.LTD
40	ELECTRICAL	201004141022 09/12/2013	Servicing of L&T make LT ACB duirng ATA-14	L&T
41	ELECTRICAL	201004141001 07/03/2014	Servicing/repairing of SIEMENS make 11KV HT vacuum circuit breakers during Annual Shutdown 2014.	Siemens Ltd
42	ELECTRICAL	201004140699 03/1013	Servicing of Chhabi make battery charger during scheduled Annual Turn around2014	CHHABI ELECTRICALS PVT. LTD
43	ELECTRICAL	201004140869 10/12/2013	Servicing and testing of Rotork make valve actuators at IFFCO plant site during annual Shutdown 2014.	ROTORK CONTROLS (INDIA) PVT LTD
44	ELECTRICAL	201004141176 23/01/2014	Services of Service Engineer / Technician for servicing of HHE make On Load Tap Changer during upcoming Shutdown	Easun-MR tap changers
45	ELECTRICAL	201004141182 03/01/2014	Upgradation of ON load tap changer control panel of	A K transcharger

SR. NO.	PLANT	WO NO. & DATE	DESCRIPTION OF JOB	VENDOR'S NAME
			transformers	
46	ELECTRICAL	201004140712 29/10/13	Installation of MCC-2F sec-B	Siemens Ltd
47	ELECTRICAL	201004140881 06/11/2013	Servicing of Siemens make LT ACB duirng ATA-14	Pradip powertech pvt ltd
48	ELECTRICAL	201004141267 03/03/2014	Maintenance of Transformers at Plant during ATA-14	M/S Shrikunj electrical enterprise
49	ELECTRICAL	20100414116 29/01/2014	Services of Electricians required for Shut-Down Jobs in 2014.	A N Electricals
50	ELECTRICAL	201004141643 10/04/2014	Maintenance of 66 KV yard	Akron energy solution
51	PLANNING	201004141131 01/01/2014	Assisting IFFCO during plant turnaround / Breakdown jobs	TMK Engineering Vadodara - 390016
52	PLANNING	201004141129 01/01/2014	Assisting IFFCO During Plant Turnaround / Breakdown jobs	Ram Bahadur & Co pali- Babuganj – 212404 Dist: Allahabad [Up]
53	PLANNING	201004141212 25/01/2014	Opening & Boxed up of heat exchangers	J&J Engineers, Shertha – 382423, Dist:Gandhinagar
54	PLANNING	201004141043 01/03/2014	Hydrojetting Cleaning of Heat Exchangers tubes	Hydro jetting services Bapunagar Ahmadabad - 380024
55	PLANNING	201004131273 13/02/2013	Overhauling & Testing of HP/MP Steam / Gas / Liquid services Safety valves / Relief valves / Pilot operated valves	Flotec Engg services Adajan Surat - 394509
56	PLANNING	201004141069 16/12/2013	Overhauling and Testing of various Safety valves in plant site	Flotec Techno smart (India) Private Limited, Adajan Surat - 395009
57	PLANNING	201004141552 19/03/2014	Supply and Application of Aluminizing	Steel Blasting & Metalspraying co Mumbai - 400054
58	PLANNING	201004141309 13/02/2014	Arc for on line leak Sealilng Job.	Dynamic Meta Sealing Engineers, Thane - 401303 india
59	PLANNING	201004130560 01/09/2012	Arc for Painting Jobs.	Shree Ramdev Paints & contract, Ahmadabad-380060, India
60	PLANNING	201004120253 12/03/2012	Arc for Painting Jobs.	P.M. Patel, Ahmadabad - 380061
61	PLANNING	201004141171 24/01/2014	Arc for Carrying out Various hot & cold	Khandelwal Insulations Pvt ltd, Mumbai - 400083

SR. NO.	PLANT	WO NO. & DATE	DESCRIPTION OF JOB	VENDOR'S NAME
			Insulation Jobs	
62	PLANNING	201004141170 24/01/2014	Arc for Carrying out Various Hot & cold Insulation Jobs	Balaji Insulation India Pvt ltd Thane-west - 400607
63	PLANNING	201004140005 09/06/2013	Arc For Various Fabrication Work In Plant	General Engg works Bharuch – 392002, India
64	PLANNING	201004140006 09/06/2013	Arc For Various Fabrication Work In Plant	J&J Engineers Shertha – 382423, India
65	PLANNING	201004131192 25/01/2013	Arc for Petty Maint. Jobs.	J&J Engineers Shertha – 382423, India
66	CIVIL Urea plant	201004141515 27/03/2014	Repairing of the scrapper floor of prill-tower by providing elastomeric lining and replacement of acid / alkali proof bricks.	M/s Greensboro Polychem Pvt Ltd.
67	CIVIL B & MH Plant	201004141517 27/03/2014	Repairing of damaged RCC structure of B & MH plant .	M/s Greensboro Polychem Pvt Ltd.
68	CIVIL B & MH Plant	201004141486 24/03/2014	Providing and applying IP net protective coating on RCC structures of Silo, B & MH plant area, Conveyor Gallery, Prill-Tower and others area in plant	M/s KRISHNA CONCHEM PRODUCTS PVT LTD
69	CIVIL Utility Plant	201004141512 27/03/2014	Maintenance of damaged water proof plywood sheet in cooling tower deck .	M/s SUDAMA FURNITURE PRODUCTS PVT. LTD
70	CIVIL Ammonia, Urea, Offsite, Utility & B & MH plant	201004141397 15/03/2014	Miscellaneous Civil work in plant during shutdown 2014-15	M/s RAKESH S PRAJAPATI
71	CIVIL Urea & offsite	201004141363 13-02-2014	Fixing charges of HILTI made anchor fastners for the strengthening of platform in urea plant .	M/s Nine Projects Pvt. Ltd.

MECHANICAL

AMMONIA PLANT
(MECHANICAL)

AIR COMPRESSOR TRAIN (101-J)

101-JT ,Air Compressor Drive Turbine

Turbine was decoupled and both ends Journal bearings and Thrust bearings were removed for inspection. The bearings were visually inspected & found in good condition. Dye penetration was also carried out and governor end journal bearing housing was found to be having cracks in end white metal lining. This housing was replaced by new one. Gauss readings of the bearing pads & shaft journal were measured and found within limits. Bearing clearances were taken and found within the design range.

The thrust bearing axial probe readings was showing high displacement values of around 14-15 mills where as the rotor end thrust was set at only 11 mills. It was observed that the probes were mounted on bearing end seal. This seal had end play of 4-5 mills. Hence these seal was locked with the housing using bracket as shown in the photograph. The thrust bearing axial probe was maintained at 10 mills after running of the equipment.

New shaft riding magnetic brushes were installed on the coupling guard. The brush was targeted on the coupling centre transmission unit.

MAGNETIC BRUSH

AXIAL PROBE LOCKING ARRANGEMENT

101-JLP, Air Compressor

101-JLP was decoupled from both ends. Journal bearings and Thrust bearings were visually inspected and dye penetration tested Dye penetration was also carried out and drive end journal bearing housing was found to be having cracks in end white metal lining. This oil guard was replaced by new one. 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. The entire bag filters as well as Roll-O-Matic filters were replaced by new one.

101-JR, Gear Box

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

101-JHP ,Air Compressor major overhauling

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

Couplings Inspection

All the couplings were visually inspected. Wherever coupling hub locknuts have been provided, the nuts were found intact. The flexible elements were also found to be in good condition.

CLEARANCE CHART -101-JT

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
JLP End				
Journal Bearing	Mandrel	0.007-0.009	0.007	0.007
Oil Guard For Jr. Brg Housing	South	0.015-0.021	0.016	0.016
Shaft Diameter	Jr. Brg.	4.993	4.992	4.992
Governor End				
Journal Bearing	Mandrel	0.007-0.009	0.008	0.008
Axial Thrust.	With Top Housing	0.008-0.012	0.010	0.010

Journal Bearing Pads Thickness - 101 – JT

PAD	NORTH SIDE BEARING		SOUTH SIDE BEARING	
	Before (inch)	After (inch)	Before (inch)	After (inch)
No 1	0.8110	0.8110	0.8110	0.8110
No 2	0.8110	0.8110	0.8110	0.8110
No 3	0.8110	0.8110	0.8110	0.8110
No 4	0.8110	0.8110	0.8110	0.8110
No 5	0.8110	0.8110	0.8110	0.8110

Thrust Bearing Pad Thickness - 101 – JT

Pad	ACTIVE		INACTIVE	
	Before (inch)	After (inch)	Before (inch)	After (inch)
No 1	0.938	0.938	0.4996 (Top)	0.4996 (Top)
No 2	0.938	0.938	0.50 (Bottom)	0.50 (Bottom)
No 3	0.938	0.938	NA	NA
No 4	0.938	0.938	NA	NA
No 5	0.938	0.938	NA	NA

CLEARANCE CHART - 101 – JLP

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
101-JT END				
Journal Bearing Clearance	Mandrel	0.005-0.008	0.008	0.008
Shaft Dia.	Journal Bearing	4.493	4.491	4.491
Oil Guard (For Journal Bearing)	North	0.013-0.015	0.1014	0.014
	South	0.013-0.015	0.014	0.014
Oil Guard (For Outer Housing)	North	0.021-0.027	0.023	0.023
	South	0.021-0.027	0.023	0.023
Gear Box End				
Journal Bearing Clearance	Mandrel	0.005-0.008	0.008	0.008
Shaft Dia	Journal bearing	4.493	4.491	4.491
Oil Guard (For Journal Bearing)	North	0.013-0.015	0.014	0.014
	South	0.013-0.015	0.014	0.014
Oil Guard (For Thrust bearing)	North	0.002-0.004	0.002	0.002
	South	0.002-0.04	0.002	0.002
Axial Thrust	With Top Housing	0.010 - 0.015	0.0115	0.0114

Journal Bearing Pads Thickness - 101 – JLP

PAD	NORTH SIDE BEARING		SOUTH SIDE BEARING	
	Before (inch)	After (inch)	Before (inch)	After (inch)
No 1	0.7496	0.7496	0.7503	0.7503
No 2	0.7462	0.7462	0.750	0.750
No 3	0.7496	0.7496	0.7503	0.7503
No 4	0.7496	0.7496	0.7505	0.7505
No 5	0.7492	0.7492	0.7503	0.7503

Thrust Bearing Pad Thickness - 101 – JLP

Pad	ACTIVE		INACTIVE	
	Before (inch)	After (inch)	Before (inch)	After (inch)
No 1	0.7814	0.7814	0.7830	0.7830
No 2	0.7812	0.7812	0.7814	0.7814
No 3	0.7822	0.7822	0.7814	0.7814
No 4	0.7812	0.7812	0.7814	0.7814
No 5	0.7807	0.7807	0.7834	0.7834
No 6	0.7822	0.7822	0.7814	0.7814
No 7	0.8106	0.8106	0.7830	0.7830
No 8	0.8106	0.8106	0.8106	0.8106

CLEARANCE CHART - 101-JR

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
Journal Bearing (Low Speed drive gear)	North	0.008-0.010	0.010	0.010
	South	0.008-0.010	0.010	0.010
Axial Thrust	---	0.014-0.024	0.014	0.014
Journal Bearing (High Speed driven Pinion)	North	0.009-0.011	0.010	0.010
	South	0.009-0.011	0.011	0.011
Backlash	---	---	0.0145	0.0145
Shaft Diameter (Low Speed drive Gear)	North Side Bearing.	---	4.4913	4.4913
	South Side Bearing.	---	4.4913	4.4913
Shaft Diameter (High Speed drive Gear)	North Side Bearing.	---	3.4950	3.4950
	South Side Bearing.	---	3.4950	3.4950

CLEARANCE RECORDS – 101JHP

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
GB End				
Journal Bearing Clearance	Mandrel	0.004-0.007	0.007	0.007
Shaft Dia.	Journal Bearing	2.996	3.002	3.002
Oil Guard (For Journal Bearing)	North	0.013-0.016	0.13	0.13
	South	0.013-0.016	0.014	0.014
Oil Guard (For Top Housing)	North	0.015-0.022	0.016	0.016
	South	0.015-0.022	0.016	0.016
Non Drive End				
Journal Bearing Clearance	Mandrel	0.004-0.007	0.0066	0.0066
Shaft Dia	Journal bearing	2.996	2.9948	2.9948
Oil Guard (For Journal Bearing)	North	0.013-0.016	0.014	0.014
	South	0.013-0.016	0.014	0.014
Oil Guard (For Thrust bearing)	North	0.002-0.004	0.002	0.002
	South	0.002-0.04	0.002	0.002
Oil Guard (For Top Housing)	North	------	------	------
	South	0.015-0.022	0.015	0.015
Axial Thrust	With Top Housing	0.008 - 0.012	0.012	0.012

Journal Bearing Pads Thickness - 101 – JHP

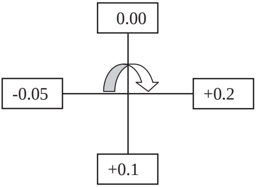
PAD	NORTH SIDE BEARING (inch)		SOUTH SIDE BEARING (inch)	
	Before	After	Before	After
No 1	0.561	0.561	0.561	0.561
No 2	0.561	0.561	0.560	0.560
No 3	0.561	0.561	0.561	0.561
No 4	0.561	0.561	0.561	0.561
No 5	0.561	0.561	0.561	0.561

Thrust Bearing Pad Thickness - 101 – JHP

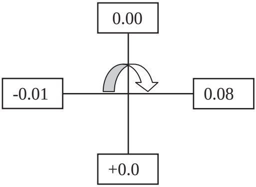
Pad	ACTIVE		INACTIVE	
	Before (inch)	After (inch)	Before (inch)	After (inch)
No 1	0.50	0.50	0.4990	0.4990
No 2	0.501	0.501	0.4984	0.4984
No 3	0.4998	0.4998	0.4990	0.4990
No 4	0.5003	0.5003	0.4994	0.4994
No 5	0.4998	0.4998	0.4994	0.4994
	0.5005	0.5005	0.4990	0.4990

101-JT TO 101-JLP

RADIAL



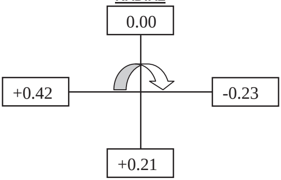
AXIAL



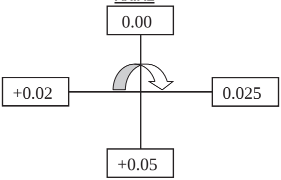
NOTE : Fixture mounted on JT, Dial reading on JLP, All Readings are in mm.

101-JLP TO 101-JR

RADIAL



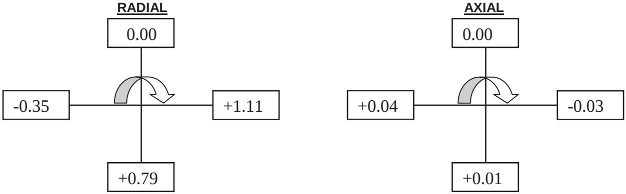
AXIAL



NOTE: Fixture mounted on JLP, Dial reading on Gearbox, All Readings in mm.

101-JR TO 101-JHP

AFTER



NOTE : Fixture mounted on JHP, Dial reading on Gearbox, All Readings in mm.

SYNTHESIS GAS COMPRESSOR TRAIN, 103-J

103-JBT, Condensing turbine

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

103-JLP, Synthesis Gas Compressor

The non thrust end journal bearing was removed and the clearance was measured and found to be within limit. Both ends journal bearing pads were inspected and found to be satisfactory.

The axial thrust measured and found at 0.27 mm. This was increased to 0.3 mm by providing gasket of 0.1 mm at end cover. Magnetism level check of the removed bearings was carried out and found to be satisfactory. Dye penetration test was performed and the result was found to be OK.

103-JHP, Synthesis Gas Compressor

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

103-JAT, Backpressure turbine

The turbine was decoupled and thrust bearing and both end Journal bearing were visually inspected and dye penetration checked. Dye penetration was also carried out and 103-JLP end end journal bearing housing was found to be having cracks in end white metal lining. Cracks were observed in the pad’s white metal lining as well. Hence the complete journal bearing was replaced by new one. Magnetism level of end journal bearing pad and base ring, shaft journal area, thrust bearing and thrust collar was measured and found within limit. The governor linkages were grease

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

PREVENTIVE MAINTENANCE RECORDS: 103 – JBT

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

PREVENTIVE MAINTENANCE RECORDS: 103 - JAT

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

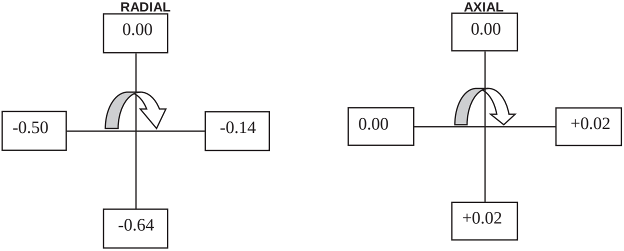
PREVENTIVE MAINTENANCE RECORDS: 103 – JLP

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

PREVENTIVE MAINTENANCE RECORDS: 103 – JHP

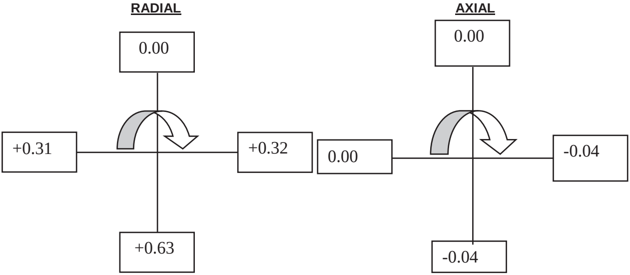
Description	Position	Clr. Chart Ref.	Design Clearances (Inch)	Before (Inch)	After (Inch)
NON THRUST END					
Journal Bearing Clearance	Mandrill	A1	0.0023”-0.0033”	0.003	0.003
Oil Guard (For Journal Bearing)	North	A2	0.0085”- 0.0115”	0.011	0.011
	South	A2	0.0085”- 0.0115”	0.011	0.011
THRUST END					
Journal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

ALIGNMENT VALUE 103 JBT TO 103 JAT



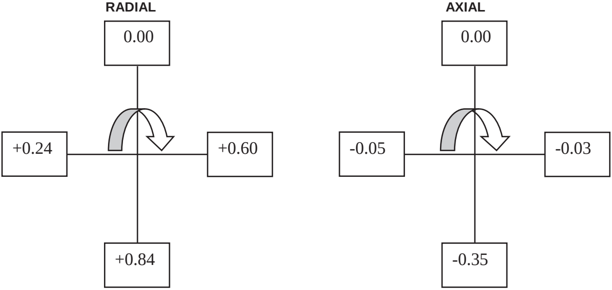
Note: Fixture mounted on JBT, Dial mounted on JAT., All Readings are in mm.

103 JAT TO JLP



Note: Fixture mounted on JAT, Dial mounted on JLP, All Readings are in mm.

103 JLP TO JHP



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

REFRIGERATION COMPRESSOR TRAIN 105-J

105-JT, Refrigeration Compressor Drive Turbine Preventive Maintenence

Turbine was decoupled and both ends Journal bearings and Thrust bearings were taken for inspection. Gauss readings of the bearing pads were measured and found within limits. The pads were visually inspected as well as dye penetration tested and found OK. Bearing clearances were taken and found within the design range. The governor drive gear assembly and bearings were also inspected and found OK. New shaft riding magnetic brushes were installed on the coupling guard. The brush was targeted on the coupling centre transmission unit.

105-JLP Refrigeration Compressor

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

105-JR Gear Box

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

105-JHP Refrigeration Compressor Preventive Maintenance

101-JHP, gear box end was decoupled. Journal bearings clearances were measured and found within limit.
All couplings were visually inspected. No damage in flexible elements was observed all the hubs were found to be in their position intact.

105-JT CLEARANCES

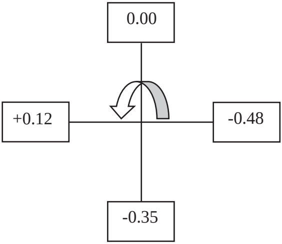
Description	Position	Design clearance	Actual Clearance
JLP End			
Journal Bearing	Lead wire	0.07”-0.009”	0.0084”
Oil Guard (For Jr. Brg Housing**)**	South	0.015”-0.021”	0.0086”
	North	0.058”-0.097”	0.0017”
Oil Guard (For Seal Housing**)**	***	0.077”-0.109”	0.0018”
Governor End			
Journal Bearing	Lead wire	0.07”-0.009”	0.0086”

105-JR CLEARANCES

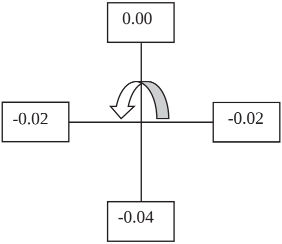
Description	Position	Design clearance	Actual Clearance
Journal Bearing	North	0.014”-0.016”	0.0141”
	South	-do-	0.0141”
Axial thrust		0.014”-0.024”	0.0141”
Journal Bearing	North	0.013”	0.015”
	South	-do-	0.014”
Free Float		--	0.060”
Backlash		--	0.020”
Shaft diameter	North	--	5.031”
	South	--	5.031”
Shaft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

ALIGNMENT VALUES – 105-JT TO 105-JLP

RADIAL

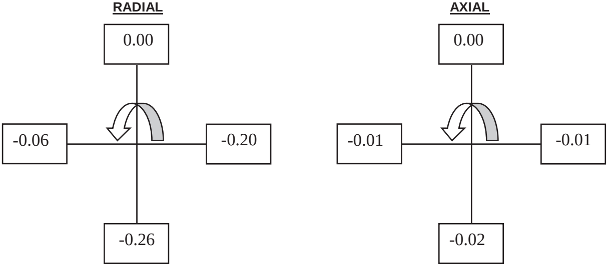


AXIAL



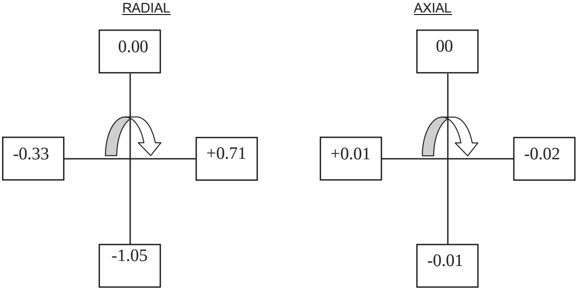
Note: Fixture mounted on Turbine Rotor, Dial reading on JLP. , All Readings are in mm.

105-JLP TO 105-JR



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

105-JR TO 101-JHP



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

INDUCED DRAFT FAN 101-BJ TRAIN

101- BJ Fan

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

BEARING CLEARANCES : 101-BJ

Description	Position	Design clearance	Actual Clearance
Gear Box End-BJT			
Gear Box End-BJ			
Journal Bearing	Lead wire	0.008”-0.012”	0.0128”
Shaft Diameter	Jr.Brg	***	6.999”
Free End-BJ			
Journal Bearing	Lead wire	0.008”-0.012”	0.0126”
Shaft Diameter	Jr.Brg		6.996”

SEMILEAN SOLUTION PUMP115-JA TRAIN

115- JAT

115-JA Semilean Solution Pump

The pump was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. The suction strainer was cleaned. Actuator filter was clean and the actuator was flushed with oil. New TB woods coupling spacer was used and the actuator installed.

115-JAR Gear Box

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

Hydraulic Turbine 115-HT Major Overhauling

The hydraulic turbine was taken for overhauling due to rise in flushing fluid pressure suspecting increase in internal wear ring clearances. The turbine was decoupled and both ends bearing housing opened and bearing clearances measured for records.Both end bearings were removed along with the housing. Both ends mechanical seals were locked and removed. The casing was unbolted and the top casing removed.

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 wear rings and throat bush clearances were measured. The throat bush clearances as well as DE & NDE wear ring clearances were found on higher side. Hence the throat bushes and DE as well as NDE casing wear ring were replaced by new ones.

The rotor was placed inside the casing. The casing was lowered and a new 0.4 mm parting plane gasket was provided. While cutting of gasket care was taken to keep gasket end portion (in contact with mechanical seal & around it) was kept extended by around 5 mm. The casing was tightened and this extended portion of gaskets at both ends was cut using a blade. Both ends new refurbished mechanical seals installed. The mating faces o ring/u cup were available in two materials i.e. duraflon & viton. It was observed that on installation duraflon seal, the mechanical seals were leaking while being tested in workshop using testing tool. Hence the mechanical seals were assembled with viton seals. The seal were tested using DM water and no leakage was observed.

Both end bearing housing along with housings were also installed. The bearing clearances were measured and noted. The hydraulic turbine to clutch alignment readings were measured and recorded. Turbine to clutch coupling was done.

COLD CLEARANCE TOLERANCES – 115-JAT

Sr. No	DESCRIPTION	DESIGN		ACTUAL	
		MIN	MAX		
1.	CARBON RING DIAMETRAL	.0070	0.0085	STM. END	EXT. END
				0.007	0.007
2.	JOURNAL BEARING DIAMETRAL	.0035	.0080	STM. END	EXT. END
				0.010	0.011
3.	TRIP PIN/ PLUNGER	.0620	.0650	0.062	
4.	END THRUST	0.010	0.012	0.010	

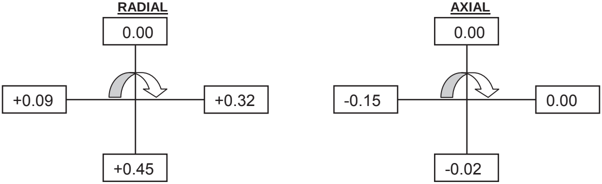
CLEARANCE RECORD: 115-JA

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

CLEARANCE CHART: 115-HT

Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
Thrust end bearing	0.0048-0.0058	0.006	0.006
Opp Thrust end bearing	0.0048-0.0058	0.006	0.006
Axial Thrust	0.010-0.011	0.012	0.011
DE throat bush		2.03 – 4 mm	2.0 mm
NDE throat bush		2.03 -4 mm	2.0 mm
DE impeller wear ring		0.84 mm	0.80 mm
NDE impeller wear ring		0.86	0.75 mm

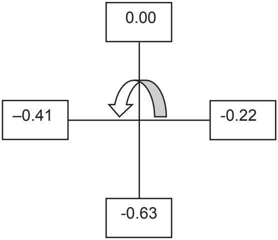
115-JAT TO 115-GB



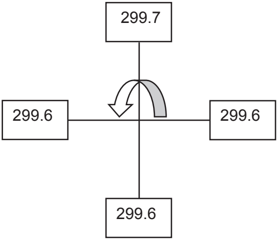
Note : Fixture mounted on Turbine, Dial reading on Gear box, All Readings in mm.

115-GB TO 115-JA

RADIAL



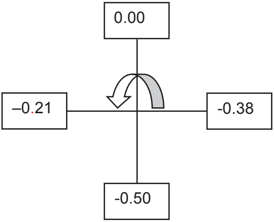
AXIAL



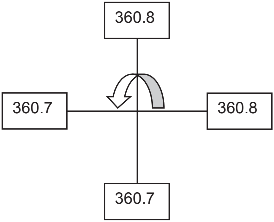
Note: Fixture mounted on GB, Dial reading on Pump. All Readings are in mm.

115- PUMP TO CLUTCH

RADIAL



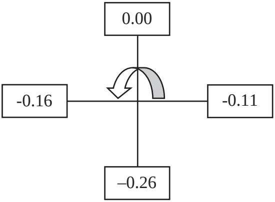
AXIAL

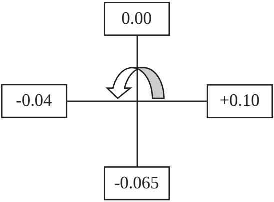


(By using, slip gauge)

Note : Fixture mounted on pump, Dial reading on Clutch , All Readings are in mm.

115- CLUTCH TO HT





Note: Fixture mounted on pump, Dial reading on Clutch, All Readings are in mm.

SEMILEAN SOLUTION PUMP115-JB TRAIN

PREVENTIVE MAINTENANCE Of SEMILEAN PUMP 115-JB

The pump was decoupled and both ends bearing housing opened. The thrust bearing and both ends radial bearings clearance were measured and found within limit. The bearing pads were visually inspected and DP inspected and found OK. The gauss measurement was taken and found within acceptable limit. The suction strainer was cleaned. The mechanical seal flushing line strainer was cleaned. The bearing shell & housing were found to be having rust. Hence the oil console was cleaned and filled with new oil.

115-JBT Drive Steam Turbine

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

115-JBR Gear Box

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

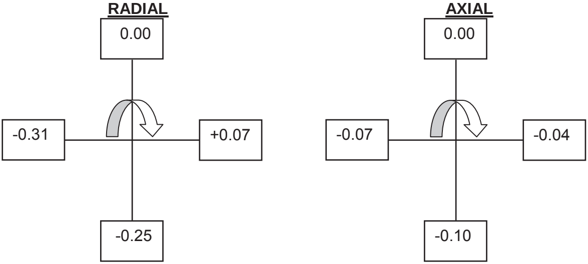
CLEARANCE RECORDS – 115-JB

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

CLEARANCE RECORDS – 115-JBT

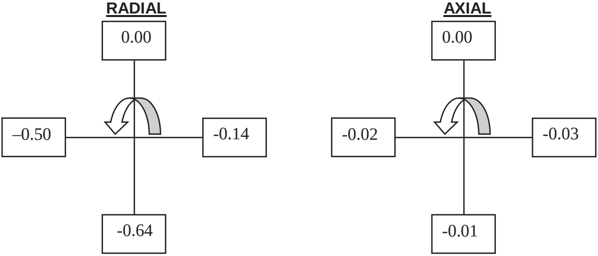
Description		Design Clearances (Inch)	Before	After
Axial Thrust		0.010 – 0.012	0.011	0.011
Coupling side bearing		0.0055-0.008	0.007	0.008
Governor side bearing		-- do --	0.008	0.008
Oil Guard Coupling side (inboard)	Radial	0.0100-0.0125	0.01	0.01
	Axial	0.040-0.050	0.06	0.05
Oil Guard Coupling side (outboard)	Radial	0.0100-0.0125	0.013	0.012
	Axial	0.080-0.090	0.09	0.09
Oil Guard Governor side	Radial	0.0100-0.0125	0.013	0.013
	Axial	0.030-0.040	0.04	0.04

115-JBT TO 115-JR



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

115-JR TO 115-JB



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

BOILER FEED WATER PUMP, TRAIN 104-JA

104-JA Boiler Feed Water Pump

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

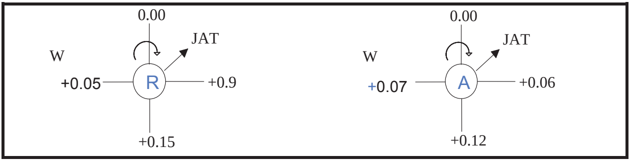
104-JAT Drive Turbine

The turbine was taken for preventive maintenance.

CLEARANCE CHART: 104-JA

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

ALIGNMENT : 104-JAT to 104-JA



a-MDEA PUMP 107-J Train

107-JT Drive Turbine

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

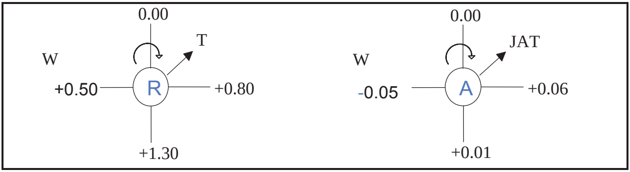
107-J aMDEA Pump

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

CLEARANCE CHART: 107-JT (MURRY TURBINE)

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

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



116-JAT Drive Steam Turbine

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

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

RECIPROCATING CO_2-GAS COMPRESSOR TRAIN (117-J)

LP Cylinders Overhauling

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

HP Cylinders Overhauling

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

Crank case assembly Overhauling

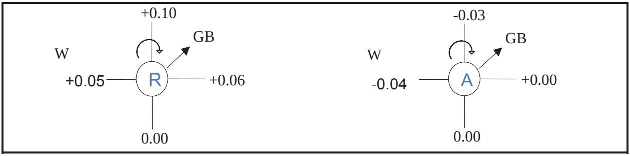
Opened the crank case cover for the inspection of the bearings and other internals. Clearances of all the big end bearings were found on higher side and the white metal lining had worn out. These bearings were replaced by new ones. All other components were visually inspected and found OK. All the clearances were measured and found within limit. All critical nuts were tightened at respective design torque. The AOP was run and oil flow inside the crank case was checked and found OK. The oil scrapper rings were replaced by new one.

The tube bundle of the 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.

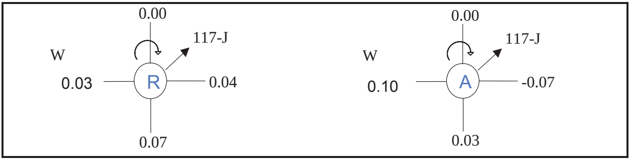
CLEARANCE CHART : 117-J TRAIN

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

117-JM to Gear Box - (After PM) in "mm"



Gear Box to 117-J - (After PM) in "mm"



COPPUS TURBINES

101 / 105-JLOPT

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

112-JAT

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

NEW PHOSPHATE DOSING PUMP 2002-LJ/LJA

The existing phosphate dosing pumps were showing various mechanical maintenance problems like, gland leak, oil seal failure, linkage damage etc. These pumps had become obsolete and spare support for them was not available Hence it was decided to replace these pumps by new ones.

SPECIFICTAIONS

SR NO	SPECIFICATION	
1.0	**SERVICE CONDITION**	
1.1	Fluid pumped	1% Phosphate Solution
1.2	Inlet temperature	60 Deg F
1.3	Specific Gravity at inlet temperature	1.0
1.4	Capacity at inlet temperature design	12 GPH

SR NO	SPECIFICATION	
1.5	Discharge pressure	1800 PSIG
1.6	Inlet pressure	0 PSIG
1.7	Differential pressure	1800 PSIG
1.8	NPSH at top of pump foundation	20 feet
2.0	**MECHANICAL DATA**	
2.1	No of cylinders	1
2.2	Liquid end design pressure	1800 PSIG
3.0	**PROPORTIONING PUMP DATA**	
3.1	Capacity of cylinder (max.)	12 GPH
3.2	Type of capacity adjustment	Manual while stopped
3.3	Range of adjustment	0 – 100 %
4.0	**MATERIAL OF CONSTRUCTION**	
4.1	Cylinder	SS 316
4.2	Plunger	SS 316 suitably hard coated
4.3	Valve	SS 316
4.4	Valve seat	SS 316
4.5	Valve springs	Suitable for above conditions
4.6	Packing	Suitable for above conditions
5.0	**MOTOR DATA**	
5.1	HP	1.5
5.2	Voltage	415 V
5.3	Phase	3
5.4	Cycle	50 Hz
5.6	Enclosure	Totally enclosed , Fan cooled
5.7	Explosion proof	Yes- Ex(d)
5.8	Insulation Class	F, Temp rise limited to class B
5.9	Degree of Protection	IP55
5.10	Duty	S1
5.11	Make	BBL/ SIEMENS/CG
5.12	Coupling type	Flexible

ERECTION & COMMISSIONING

- Both the existing pumps pipings were removed.
- Both the pumps were removed after unbolting
- New foundation was prepared.
- Base plate was installed along with the foundation bolts.
- The base plate was leveled and locked in position.
- The foundation bolts were grouted and cured.
- The base plate was tightened.
- Both the new pumps were erected.
- All pipings were fabricated and connected to the pumps.
- The motors were connected.
- DOR was confirmed and the pumps taken in line.

NOTE : It was observed that the motors supplied were having non explosion proof type junction box. The same were replaced by the new motors supplied by the vendor later as free replacement.

NEW LUBE OIL / SEAL SYSTEM FOR 103-J TRAIN

On 25th of June 2012, EWR No 266 was raised for installation of independent turbine & motor driven lube oil and seal oil pumps for 103-J Lube oil system with motor and turbine drives to achieve operational flexibility, safety and reliability by overcoming the following problems :

- Since both Seal oil & Lube Oil pump was having single drive, during changeover from motor to turbine seal oil pressure was getting increased upto 100-120 kg/cm^2 from 84 kg/cm^2. To avoid the above problem bypass valve was operated manually and pressure rise was kept under control. But sometimes during the operation turbine get tripped by OST.
- Maintenance problems of equipments due to single drive trains
- Insufficient capacity of console considering the rundown volume
- LOP were not having flooded suction.
- There was very less margin for governor oil pressure control.
- The control valves were obsolete.
- Accumulators not designed for minimum 8 sec changeover time.
- Oil contamination due to carbon steel console and pipings.

A final decision was taken to replace the complete skid mounted lube oil / seal oil system including new console, control valves, PSVs, filters, accumulators etc and excluding cooler and purifier.

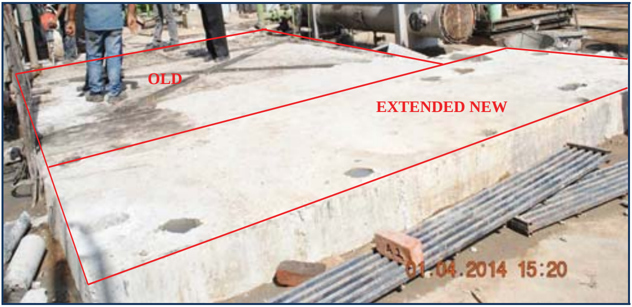
UPGRADATIONS DURING THE COURSE OF PROCUREMENT

- Stainless steel oil console.
- Capacity of console increased as per API 614 to 13000 liters from 4000 liters
- Console having oil mist eliminator.
- Accumulator's capacity was designed for '8 Seconds' change-over time.
- Both turbines designed with electronic solenoid tripping system. The solenoid of ASCO make & having mechanical type Ex-proof limit switch in place of Proximity switch (go type) on trip lever
- Both the drive turbine having Electronic governing system.
- LOP capacity was increased from 175 US GPM to 200 US GPM. This was done for the special condition i.e. both SOP pump running or taking suction from one LOP and 103-J train running with normal Lube/Gov oil requirement. Lube oil pump discharge pressure was finalized at 11.7 kg/cm^2 at 200 GPM. Originally this pressure is 150 PSI (10.6 kg/cm^2). The increased discharge pressure & volume shall ensure margin for governor oil pressure also.
- Direction of rotation of SOP was kept clockwise i.e. same as that of LOP, so as to keep the direction of rotation of both turbines same & both motors same. The turbines rotor and sector was kept interchangeable.
- SOP housing was kept same as that of the existing pumps.
- Safety relief valve added for both the lube oil pump's discharge. Originally PSV was provided only on auxiliary motor operated LOP discharge.
- New dump valve provided for lube oil common discharge header (PCV 301). Originally no dump valve was there.

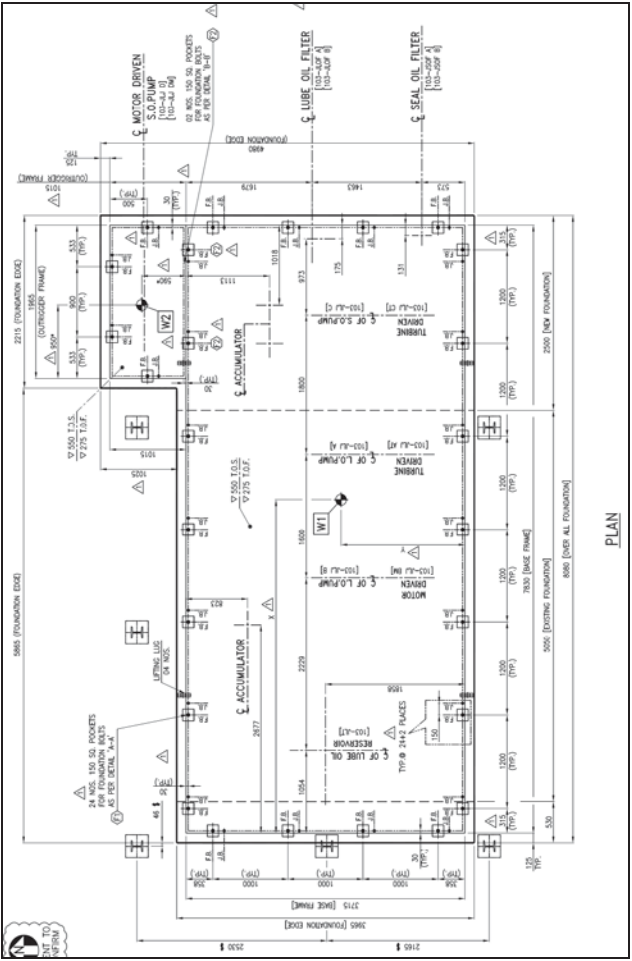
- Control valve was opted for seal oil discharge header dumping instead of mechanical type self actuated valve (PCV 302). Original valve is mechanical type self actuated valve. Seal oil dump valve maximum capacity was increased to 45 US GPM. Original valve capacity was 38 GPM. This was done because original gear pumps capacity was 23 US GPM while new screw pumps capacity was 29 US GPM. The maximum capacity was designed on the following logic :
- MAX CAPACITY = 2 X SOP CAPACITY – NORMAL SEAL OIL FLOW
- For LO temperature at downstream of Cooler additional TI shall be provided with K-type thermocouple. One PT provided at the downstream of the filter for PCV 302 on seal oil header.
- For low suction pressure at inlet of SOP, 3 PT provided to achieve 2oo3 trip logic.
- GWR type level troll provided for console.

ERECTION OF THE NEW SYSTEM

- The centrifuge was disconnected and removed from location
- The existing foundation was extended as per drawing
- The top platform/shed was removed.
- The flange joints connecting the existing console to the existing pumps skid were unbolted
- The flange joints at the battery limit connecting to the 103-J train were unbolted
- The steam inlet & outlet lines were unbolted / cut and removed.
- The console was completely drained using centrifuge and the oil fill up pump.
- The existing console was removed after unbolting the foundation bolts.
- The pumps skid was removed after unbolting the foundation bolts.
- The old foundation bolts were removed by gas cutting.
- The new foundation holes were cut on the existing foundation by using a core cutter.



FOUNDATION

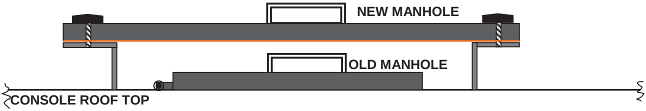


FOUNDATION PLAN

- The foundation bolts were inserted inside the foundation holes.
- The new system was installed on the foundation.
- Leveling of the skid was done using water level and jackscrews provided on the skid.
- The foundation bolts were grouted and allowed to cure.
- Leveling of the skid was done again.
- Auxiliary seal oil pump skid was supplied loose. The same was installed and leveled.
- Additional grouting holes & vent holes were made on the skid to ensure better grouting.
- Foundation bolts were tightened and the grouting of the complete skid was carried out.
- Mixture of grouting cement along with small chips was used grouting of the skid.
- For console only grouting cement was used.
- All loose lube oil & seal oil pipings were installed.
- The control valves were removed and replaced by spool pieces for flushing.

NEW SYSTEM BEING ERECTED ON FOUNDATION

- Alignment of the motor operated pumps was carried out.
- Alignments of turbine operated pumps were carried out.
- The accumulators were charged and pressure gauge installed on the top.
- Seal oil accumulator : 59.5 kg/cm^2
- Lube oil accumulator : 9 kg/cm^2
- The console manhole was not designed to make the console water tight. The man hole was redesigned, fabricated & installed over the old manhole as shown below.

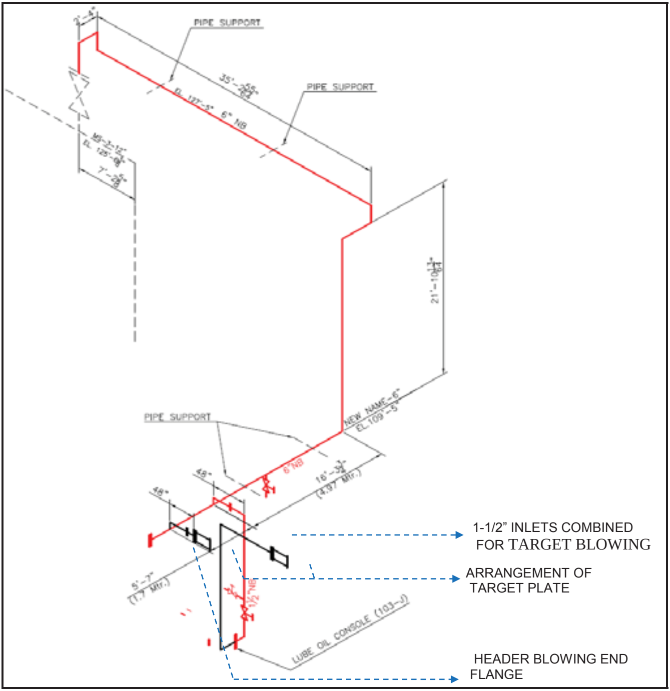


- Bearing housing of turbine & pump were flushed with oil and new oil was filled up.
- The actuators were also flushed with oil and new oil was filled up.
- The solenoid for turbine tripping was having open type junction and explosion proof. The same was replaced by explosion proof solenoid.
- All instrumentation jobs were carried out.
- Trip logics for turbine was also programmed
- The over speed trip lever latching/delatching was checked from DCS.
- All electrical jobs were carried out.
- The motor were solo run. High vibrations were reported. It was observed that there were voids in the grouting of the motor-pump base frame. The frames were welded to the skid frame at eight locations only. The frame was welded all around and re-grouting was done to remove voids.
- The motors were coupled to the pumps.
- Flushing of the lube/seal oil system & fabricated pipelines was done as per procedure.
- Meanwhile fabrication of the following new lines was carried out. Ref Dwg. No P1-DS-13073 Sheet 1 to 11 of 11 :
    - Steam turbine inlet lines. (6” NB & 1 ½” NB)
    - Steam turbine exhausts lines. (6” NB & 4” NB)
    - Steam Exhaust relief valve lines (1-½” NB & 3” NB)

- Blinding of inlet line of old turbine. (1 ½” NB)
- Both turbine drains with steam traps. (3/4” NB)
- Both turbine bearing jacket cooling water lines. (3/4” NB)
- Lube oil inlet line (3” NB)
- Governor oil inlet line (2” NB)
- Seal oil inlet line (1” NB)
- Oil outlet header to console (8” NB)
- Oil inlet & outlet lines from skid to the cooler. (3” NB)
- Relocating of de gassing tank. (Structural)
- De gassing tank inlet & outlet line. (1” NB)
- Steam inlet & outlet lines to de-gassing tank. (3/4” NB)
- Re orientation of de-gassing tank vent (2” NB)
- Oil mist eliminator exhaust (4” NB)
- Motor operated SOP inlet & outlet flange joint for alignment.
- Platform around the skid.
- Spring supports were installed turbine steam inlet & outlet lines.
- New re-designed console manhole welded at position.
- All hanging LO & SO pipes towards cooling tower side were supported.

BLOWING OF STEAM LINES

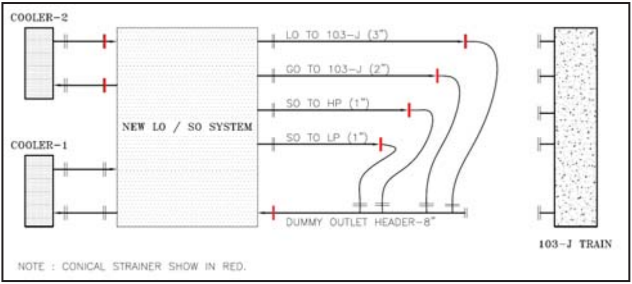
- Blowing of the steam inlet line was done as below :
  - The 6” header blowing was carried out for 30 min & cooling done for 4 hours.
  - The header blowing cycle lasted for 36 hours.
  - Arrangement of target blowing of the 1-½” steam inlet line was done as per sketch
  - Target blowing was carried out for 30 min & cooling done for 1.5 hours.
  - The target blowing was continued till the target plate surface appeared smooth.
- Blowing of the steam exhaust lines was done as follows :
  - The 6” header blowing was carried out for 30 min & cooling done for 4 hours.
  - The header blowing cycle lasted for 24 hours.
  - Blowing of the exhaust 4” steam exhaust line was also done.



BLOWING ARRANGEMENT FOR STEAM INLET LINE

<u>OIL LINES PASSIVATION & FLUSHING PROCEDURE</u>

1. The fabricated lines were cleaned mechanically using file/wire brush followed by air.
2. Passivation of the lines was done by filling the lines with 10% HNO_3 solution for 1 hour.
3. The lines were connected at site.
4. Jump over hose were connected in between the oil inlet lines & dummy outlet header as shown in sketch below to **bypass 103-J train.**



FLUSHING ARRANGEMENT

- All 5 Nos control valves were replaced by spool pieces.
- Filled oil level in console enough to ensure flooded suction for motor operated lube oil pump
- Removed lube oil and seal oil filter elements.
- The accumulator inlet flanges were blinded.
- Installed strainer of **mesh size 120** (Conical) at the following location as shown in above sketch

  Seal oil to LP – Jump over (1")
  Seal oil to HP – Jump over (1")
  Lube oil inlet – Jump over (3")
  Governor oil inlet – Jump over (2")
  Discharge header – Console (8")
  Lube oil coolers inlet (3")

- The motor operated lube oil pump discharge PSV bypass valve was opened. Vent / bleed air from filter , pump suction / discharge, etc
- The motor operated lube oil pump was run to start oil circulation.
- Heating of oil was done by keeping the cooling water isolated. Oil was heated upto to 70-80^{0}C.
- Cooling of oil was done by charging cooling water / DM through cooler.
- Tapped the fabricated lines using nylon / wooden hammer to free the debris.
- The motor operated seal oil pump was also taken in line.
- All conical strainers were cleaned when filter's downstream pressure increased by 1-2 kg/cm^2.
- The pump suction strainer was cleaned every 12 hours.
- Meanwhile when the turbines were ready after OST & alignment, the turbine operated pumps were run and the motor operated pumps were stopped.

- All the filters and coolers were taken in line one by one. It may be noted that the flushing of top cooler consumed a lot of time. This was because the cooler had been kept isolated for a long period.
- Oil was also circulated through the lube oil & seal oil dump valves inlet/outlet lines.
- When the 120 mesh strainer was found clean, 200 mesh strainers was installed and the above steps were followed. Flushing was continued till this 200 mesh strainers was found clean.
- The above flushing cycle lasted 160 Hours.

NOTE:
After the 120 mesh strainers were found clean, one lube oil & one seal oil filter element was installed and oil circulated through it. On removing the filters it was observed that the smaller dia. seal oil filters were intact but the larger dia. lube oil filter's core had burst. This filter element's core was made of plastic which was replaced by SS perforated sheet. The filter element's end seals were o rings which were replaced by rubber gasket

- All the journal bearings top halves were removed from 103-JAT, 103-JBT, 103-JLP & 103-JHP.
- After flushing was complete, lube oil inlet lines were connected to the 103-J train. The dummy outlet header was removed and the outlet header was connected.
- The seal oil lines & the governor oil lines were kept isolated.
- ¾" NB, 200 mesh conical strainer were installed at the inlet of each bearing.
- Oil was circulated for 20 hours and strainers removed & found clean.
- Flushing was stopped & the removed bearing top halves of 103-JAT, 103-JBT, 103-JLP & 103-JHP were reinstalled.

OVER SPEED TEST OF TURBINES & COMMISSIONING OF SYSTEM

- All removed control valves were installed at location after removal of spool pieces.
- Instrumentation jobs for all control valves was carried out.
- Blinds were removed at accumulator inlet.
- Lube oil and seal oil filter elements were installed.
- OST of turbines were checked.

  Lube oil pump drive turbine electronic OST : 3321 RPM

  Lube oil pump drive turbine mechanical OST 3521 RPM (4^{th} trial)

  Seal oil pump drive turbine electronic OST: 3321RPM

  Seal oil pump drive turbine mechanical OST : 3460 RPM (1^{st} trial)
- All logics for trip and auto start were checked and found to be working perfectly.
- All dump valve were found to be working. PCV 301 pilot valve drain tubing was found missing. The same was done and connected to the nozzle TP 18 i.e purifier return.
- The system was taken in line at around 02.00 hours on 25-05-2014.

NEW 103-J LUBE OIL / SEAL OIL SYSTEM

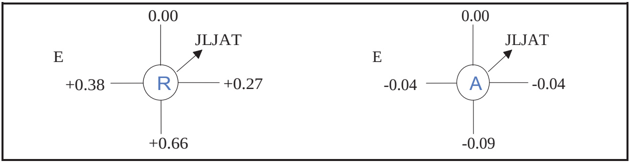
NEW EQUIPMENT TAGS & ALIGNMENT READINGS

The new tags for various equipments are as under

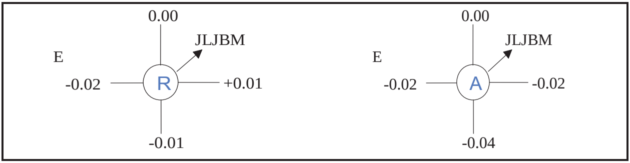
Main LO pump	:	103-JLJ A
Main lube oil pump drive turbine	:	103-JLJ AT
Standby LO pump	:	103-JLJ B
Standby lube oil pump drive motor	:	103-JLJ BM
Main seal oil pump	:	103-JLJ C
Main seal oil pump drive turbine	:	103-JLJ CT
Standby seal oil pump	:	103-JLJ D
Standby seal oil pump drive motor	:	103-JLJ DM
Lube oil coolers	:	103-JLC 1/2
Lube oil filter	:	103-JLOF A/B
Seal oil Filter	:	103-JSOF A/B
Lube oil header pressure control dump valve	:	PCV 301
Seal oil header pressure control dump valve	:	PCV 302
Lube oil pressure control valve	:	PCV 303
HP seal oil control valve	:	LIC 42
LP seal oil control valve	:	LIC 41
Lube oil pump discharge PSV (Motor driven)	:	PSV 302
Lube oil pump discharge PSV (Turbine driven)	:	PSV 301
Seal oil pump discharge PSV (Motor driven)	:	PSV 303
Seal oil pump discharge PSV (Turbine driven)	:	PSV 304

FINAL ALIGNMENT READINGS

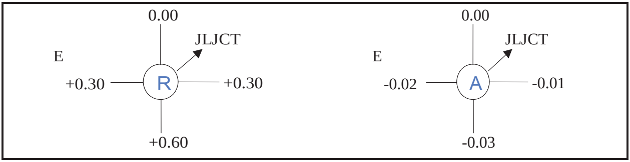
103JLJA to 103JLJAT



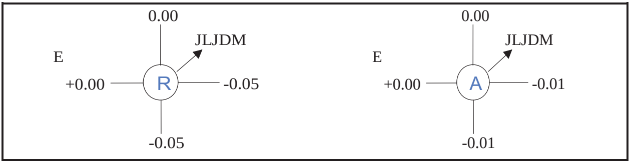
103JLJB to 103JLJBM



103JLJC to 103JLJCT



103JLJD to 103JLJDM



REPLACEMENT OF ID FAN DRIVE TURBINE & GEAR BOX

Originally ID fan drive, turbine was driven by superheated MP steam to LP letdown (back pressure turbine). This turbine was retrofitted into condensing type to close the Ammonia Plant Steam balance as part of energy saving scheme in the year 2006-2007. Post conversion to condensing turbine, the exhaust steam temperature remained high at about 100-110 ^{0}C which resulted in higher condenser load and loss of vacuum.

Possibility of using DM water De-superheating station to control exhaust steam temperature was not viable since it required running of condensate pump 112-J/JA.

Further as per latest KBR's base case study the turbine was running at 20.5 % efficiency consuming 5.6 ton/Hr steam for producing 300 kW of power. At the same time the gearbox had become obsolete and inefficient.

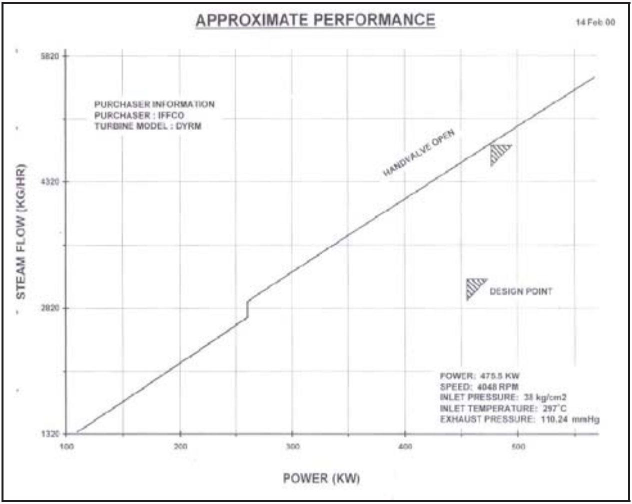
To overcome the above problems it was finalised to replace the turbine by new condensing turbine suitable for the existing operating conditions and at the same time replace the existing gear box. The brief specification of the turbine, gear box and their lube oil system is as follows :

NEW TURBINE SPECIFICATION

Rated power	:	475.5 kw
Normal power	:	306.1 kw
Rated speed	:	4048 RPM
Maximum continuous speed	:	4500 RPM
First calculated critical speed	:	9100 RPM
Inlet steam pressure	:	42.2 kg/cm^2
Inlet steam temperature	:	399 ^{0}C
Exhaust steam pressure	:	0.15 kg/cm^2
Relief valve set pressure	:	0.35 kg/cm^2
Sentinel valve set	:	0.35 kg/cm^2
Lubrication system	:	External pressurised, SERVO T 46
Steam sealing system	:	Carbon ring
Governor type	:	Woodward 505 & PGPL actuator
Shaft rotation	:	CCW viewed from governor end.

Additional up gradations finalized to improve the reliability of the system:

- Separate lube oil system with console, Motor driven AOP, Filters.
- Turbine-GB DBSE increased from 5 mm to 150 mm for easy decoupling.
- New flexible disc coupling in between gear box and fan. (Dropped later)
- Bearing temperature monitoring system for gearbox.
- Woodward protech turbine safety system for improved reliability.
- New control valve at inlet of turbine.
- Electronic solenoid operated trip system for the turbine
- Magnetic speed pick up unit for speed display and governing system



TURBINE PERFORMANCE CURVE

NEW GEARBOX SPECIFICATION

Rated power	:	476 kw
Torque at max continuous speed	:	464.74 kgm @ 997 RPM output
Maximum torque	:	514.83 kgm @ 900 RPM output
Rated speed - Input	:	4061 RPM
Rated speed - Output	:	900 RPM
Maximum continuous speed	:	4500 RPM
Gear type	:	Double helical
Gear ratio	:	4.5122
No of teeth on pinion	:	41
No of teeth on gear	:	185
Pitch diameter - Pinion	:	184.32
Pitch diameter - Gear	:	831.68
Lubrication system	:	Forced feed / ISO VG 44
LS Shaft rotation	:	CCW facing coupling end
HS Shaft rotation	:	CCW facing coupling end

NEW LUBE OIL SYSTEM SPECIFICATION

Outlet flow	**:**	42 LPM @ 45 ^{0}C
Outlet pressure	**:**	2 kg/cm^2
Working fluid	**:**	ISO VG 46
AOP details	**:**	Gear pump 7 kg/cm^2 discharge pressure 42 LPM flow
AOP motor details	**:**	2.2 kw 1430 RPM 415 V AC 50 Hz , 3 Phase Encl Flame proof , Ex D , IIC , IP55
Cooler details	**:**	AEW TEMA C Heat load - 11 kw Oil in/out - 53.63 / 45^{0}C Water in/out - 33 / 34.6^{0}C Shell – 6” A 106 Gr. B Tube – 3/8” X 20 BWG SS 304 Tube sheet – SS 304 Design pressure Shell/Tube : 10 / 7 kg/cm^2
Filter details	**:**	Basket type 10 micron mesh
Console capacity	**:**	530 Ltrs

ERECTION OF THE TURBINE & GEARBOX

- Lube oil coolers removed after removal of oil and cooling water pipings
- AOP removed along with the motor and base frame.
- Gearbox to Fan was decoupled
- Fouling structures above turbine were removed.
- Inlet & outlet flange of turbine was unbolted.
- Sealing steam/oil piping & casing drains were removed
- Instrumentation cable & actuator were removed
- Turbine & gearbox with common base plate was removed

NOTE : New turbine & gearbox was procured with base frame whose thickness/height was around 200 mm more than that of the existing base plate. Foundation bolt PCD was same as that of the existing. Hence erection of new equipments required reduction of foundation height by 200 mm, while same foundation bolt were to be used.

- Existing foundation height reduced by 200 mm as shown in photograph.
- The bend foundation bolts were straightened by heating.
- Base frame was lowered and position of leveling plates marked on foundation.
- Leveling plates were installed at marked location, leveled and cemented.
- The new base frame along with the gear box was placed on the leveling plates. Leveling of the frame was carried out using packing plates.

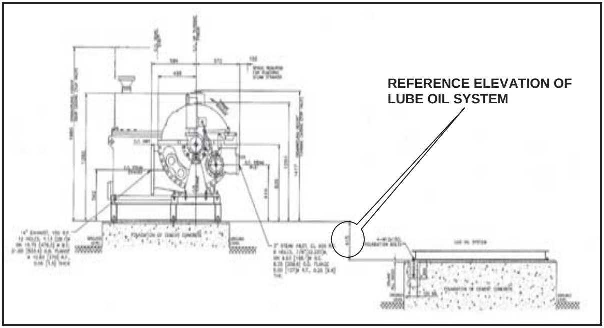
BASE FRAME BEING LOWERED TO MARK POSITION OF LEVELLING PLATE

- Gear box was aligned to fan as per design values.
- DBSE measured & found 8 MM as against requirement of 13 mm for coupling installation. The base frame bolt holes were enlarged to increase the DBSE.
- Realignment of gearbox to fan was carried out while maintaining DBSE of 13 mm.
- Due to delay in supply of disc coupling for gearbox to fan, it was decided to use the existing gear coupling. The gearbox side coupling hub was removed from the existing gearbox shaft and it's inside diameter was increased to $119.95^{+0.00,-0.02}$ and keyway machined as per new key.
- To mount the coupling hub, the gearbox was removed from base frame and lowered to ground. Coupling hub was installed after heating the hub in oil bath to a temperature of 150^0C
- Gearbox was reinstalled on the base and aligned with the fan.
- The turbine was installed on the base frame.

- Turbine's loose shipped bearings were installed inside the bearing housing.
- Alignment of the turbine to gearbox was carried out as per design values.
- The base frame was grouted.
- Meanwhile all instrumentation jobs were carried out.

FABRICATION OF PIPINGS & ERECTION OF LUBE OIL SYSTEM

- The lube oil system skid was erected on temporary structures to a height shown in the general assembly drawing.



- The loose shipped prefabricated interconnecting lube oil lines were connected to the turbine & gear box.
- Permanent structures were erected beneath the skid. Temporary structures removed.
- The prefabricated interconnecting oil lines were removed and all tack welded joints were final welded. Passivation of the lines was carried out with 10 % HNO_3 solution.
- Flushing of lube oil system :
  - The interconnecting lube oil lines were re-installed in a loop so as to bypass the turbine & gearbox.
  - A 3" X 150 #, 120 mesh conical strainer was installed on the console.
  - Console was cleaned and filled with servo VG 46.
  - Oil circulation was started by running the AOP.
  - The oil lines were continuously tapped using wooden hammer to free the debris.
  - Electric heater installed inside the console was used to heat the oil up to 60 ^{0}C
  - Cooling of oil was done naturally.
  - Each heating & cooling of oil cycle lasted for 4-5 hours.
  - The conical strainer was cleaned every 8-12 hours.

- ➢ The AOP inlet strainer was cleaned every 24 hours.
- ➢ Flushing was stopped when no debris was observed. Cycle time was 120 hours
- ➢ The interconnecting lines were connected to the turbine & gearbox.
- ➢ Oil flushing was started with turbine and gearbox in line.
- ➢ Flushing was continued till no debris was observed. Cycle time was 48 hours.

ERECTED LUBE OIL SYSTEM

- The inlet & outlet lines of the turbine were fabricated. New inlet control valve was installed. Blowing of the inlet lines was carried out to clean the same.
- All drains were fabricated.
- The sealing steam lines were also fabricated

NEW ERECTED ID FAN DRIVE TURBINE & GEAR BOX

COMMISSIONING OF SYSTEM AND OST

- The 505 governor settings are as follows :
  - Min Gov Speed : 1500 RPM
  - Max Gov Speed: 4000 RPM
  - OST: 4250 RPM
- Protech G-II OST speed : 4250 RPM
- The turbine was taken in line for solo run & OST carried out. Speed was increased as follows :

  1000RPM for 15 min

  1500 RPM for 150 min

  3000 RPM for 30 min

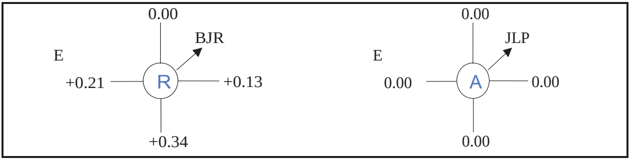
  3250 RPM for 30 min

  OST at 4250 RPM

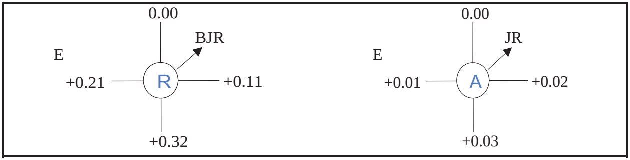
<u>FINAL ALIGNMENT READINGS</u>

<u>101-BJT to 101-BJR</u>

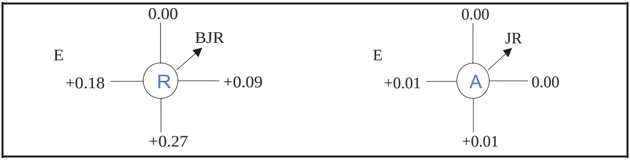
Design Alignment (in mm)



Achieved Alignment (in mm) without piping

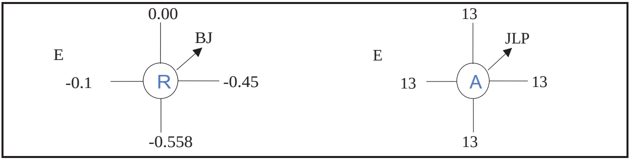


Final Alignment (in mm) with piping

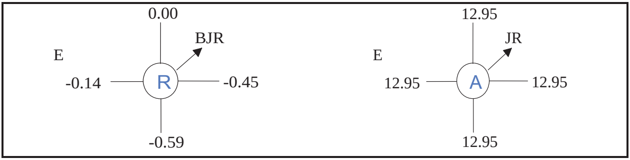


101-BJ to 101-BJR

Design Alignment (in mm)



Final Alignment (in mm)



POST COMMISSIONING PROBLEMS

The turbine and gearbox was taken to full load. Soon after plant start up, when the AOP was shut down, it was observed that the MOP discharge pressure dropped to 5-6 kg/cm^2 as against requirement of 8.5 $kg.cm^2$.The lube oil filter started to choke every 2-3 days. On 9th of May it was observed that the oil drained from the filter had very fine metal dust particles. Using a magnet it was confirmed that the particles were magnetic.

On 12th of May very high vibrations were observed in the oil inlet & outlet line of the MOP. The end cover of the MOP was found loose and the inlet & outlet supports had slipped. The inlet & outlet line supports was reinstalled and the same were reinforced. The MOP end cover was tightened. The discharge pressure immediately increased to 7 kg/cm$^{2.}$ Meanwhile the oil samples were collected and sent to M/s Predict technologies for study. The reports indicated rubbing in MOP gears and bronze bush bearings.

On 19th of May, the MOP suddenly stopped running and the AOP started on low lube oil pressure. On observations it was confirmed that the MOP had failed. To keep the ID Fan train running, the following course of action was decided:

- Install the spare motor operated pump in parallel and run the same as MOP.
- The original AOP will remain as standby as the same had been programmed to start on low lube oil pressure.
- Emergency power was provided for both the motors.
- Overhead rundown tank (As per API 614) was provided as shown in the sketch

New Motor Operated Pump was taken in line on 09/06/2014 & after that system is running smoothly.

IFFCO
KALOL UNIT

12th June 2014

Technical Department

GUARANTEE TEST RUN OF ID FAN DRIVE TURBINE (101-BJT)

New ID fan drive turbine (101-BJT) was installed during 2014 turnaround. Before stoppage of Ammonia Plant, a set of ID fan plant data were collected to establish the base Case of ID fan. After turnaround, a set of plant parameters ID fan drive turbine is collected to establish the guaranteed performance.

Guarantee test was carried out from 10.00 hrs to 16.00 hrs on 12th June 2014 after turnaround and test results are as under:

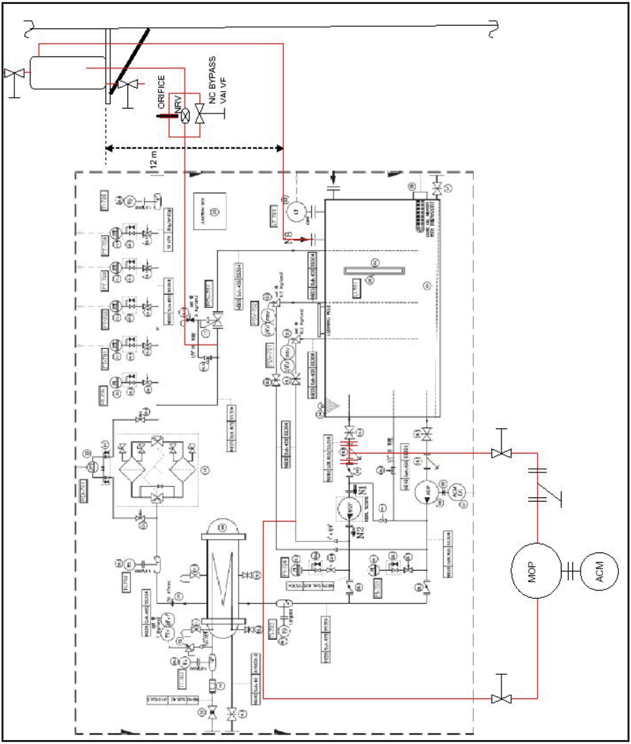
Particulars	Unit	Before	After TA
Ammonia Plant load	%	103	103
ID fan turbine -MP steam consumption	kg/hr	4387	3027
Fuel in Arch+ tunnel burners	SM3/hr	12819	11911
Tail gas in Arch burners	NM3/hr	3366	3201
Fuel consumption in Auxiliary boiler	SM3/hr	2432	3179
ID fan speed	rpm	2894	2842
Differenctial haed of ID fan	mm WC	-169.9	-157.4
Flue gas temperature at ID fan suction	degc	161.5	160.5
Flue gas analysis			
ID fan suction O2	% v/v	7.16	5.40
ID fan suction CO2	% v/v	8.40	8.70
Flue gas flow at ID fan suction	NM3/hr	269580	248768
Power of ID fan	kW	382.98	327.41
Actual Water rate (WR)	kg/KW.hr	11.46	9.31
Certified steam rate	kg/KW.hr	-------	12.3
Rated/normal steam rate	kg/KW.hr	-------	10.2

In view of above, it is established that actual WR is well within KEPL guaranteed figures and IFFCO accepts the same.

Sandeep Ghosh, CM(Ammonia)
BPS Mehta, CM(Process)
Sanjay Kulshreshtha, CM(GE)
IFFCO Kalol

P.J. Chaudhari
Pralhad Deshpande
KEPL

GUARANTEE TEST RUN REPORT



ARRANGEMENT FOR NEW MOTOR DRIVEN MOP & RUNDOWN TANK

PROVISION OF OVERHEAD RUNDOWN TANK

AMMONIA CONVERTOR RETROFIT DURING ANNUAL TURNAROUND APRIL 2014

Ammonia plant of IFFCO-Kalol was commissioned in 1974. After 19 years of its commissioning, a revamp of Kellogg-design Ammonia Converter (105-D) Basket was carried out in Sept- Oct 1993 by M/s Ammonia Casale by converting the 4-bed axial flow basket to a modified 4-bed axial-radial flow Casale-design Basket.

Now the catalyst was in service for over 20 years. Hence it was planned to replace the existing charge of catalyst. Due to severe operating conditions inside the Converter, the catalyst retaining wire mesh, other internals like screens, expansion joints, etc and the feed-effluent exchanger (122-C) get nitrided extensively over a period of time and there are chances of breakage. Hence it was decided to carry out retrofit of basket with upgraded internals along with catalyst replacement job to enhance the reliability.

IFFCO planned to carry out the job during the Annual Turnaround planned in March-April, 2014. Design, supply of material and supervision was carried out by M/s Ammonia Casale, SA. The retrofit job was executed by M/s Skywin Erectors, Ahmedabad. Catalyst loading and unloading was executed by M/s Plant Tech, Mangalore.

Replacement of wire mesh of Inner collectors and Outer collectors all beds with slotted plates

Slotted plates consist in stainless steel (AISI 321) solid plates with cuts (slots) disposed in parallel rows. The geometry of the cuts allows an optimal flow of the gas although keeping the catalyst inside the bed. The main advantages of slotted plates are summarized below:

- Slotted plates are solid, monolithic plates (high reliability), since slotted plates are monolithic, they have sufficient thickness to allow making them in the same material of the rest of the internals (AISI 321); therefore the welds to the rest of the internals are homogeneous. For most cases of inconel wire screens, the weld to the rest of the internals is dissimilar. Which further reduces the reliability of mesh due to thermal stresses + nitriding and hydrogen attack in dissimilar welds.

Wire mesh

Slotted plates

Modified support for 4th bed bottom and Removal of refractory from the bottom of 4th bed

Presently the support of the outer collector of 4th bed is obtained through radial ribs. However this support is not sufficiently rigid, causing distortions of the outer collector support ring. Hence in new design, the support was taken from bottom of the cartridge.

Refractory was removed and a new thermal insulation installed as well on the bottom of the cartridge.

This modification has the following advantages:

- Higher reliability of the internals.
- Increase the catalyst volume of 4th bed of about 1 m^3.

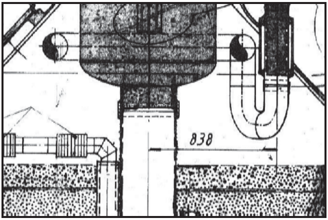
Modification of inner collector 4th bed for catalyst unloading

The modification of the bottom part of the 4th bed inner collector allows discharging the catalyst from the existing drop out nozzle at converter bottom. The advantage of this modification is easy and fast unloading of 4th bed which is the biggest in volume.

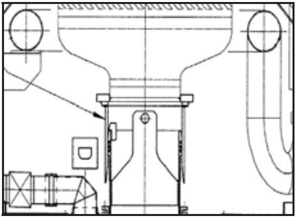
Replacement of welded joint between 122-C and gas return pipe

Welded joint between 122-C and gas return pipe was replaced with Casale patented elastic seal ring which allows to connect / disconnect 122-C from the outside, without performing any grinding during disassembly and welding or bolting during assembly. This modification has the following advantages:

- Easy removal / installation of 122-C without entering the cartridge. This allows saving time while operating in safe conditions.
- The removal of 122-C gives an easy and wide access to the converter through the relevant shell, so that the lateral manhole can be used only for auxiliaries. This means save in time and operating in safer conditions.
- Increase in reliability. In fact, the elastic ring seal joint is sliding without any deformation or stress on the parts.



Existing welded joint



Elastic seal ring joint

Additional manholes on 1st, 2nd and 3rd bed

This modification allows easier access to the beds. The main advantage is to increase the safety and speed-up works during turnarounds.

Modification of the catalyst protection screens on all beds

The new protection screens have been calculated with the latest fluid dynamic simulations; they are provided with top covers to avoid gas direct impingement on the catalyst bed. The purpose of this design is to reduce the speed of the gas entering the bed through the screens, avoiding any possibility of catalyst fluidization, increasing the converter reliability.

Installation of New Thermowell in Gas Exit of 122-C and new sliding joints for themowell supports

New thermowell was installed for measurement of shell outlet temperature of 122-C.
New sliding joints for thermowell supports have higher reliability against seizing. Seizing of thermowells supports may cause damage to the collectors. This new design increases the reliability of the converter.

Replacement of flexible hoses between the pressure shell and the existing cartridge with expansion joints

Flexible hoses are subject to failure due to vibrations. Replacing the flexible hoses (connecting pressure vessel with cartridge) with expansion joints increases considerably the reliability especially at high loads.

Expansion joints of 3 nos quench pipe lines were replaced with new one.

PRE-SHUTDOWN ACTIVITIES

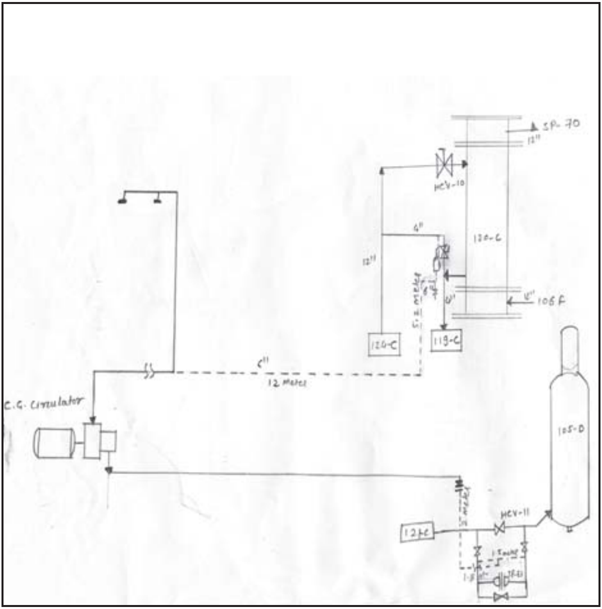
The following activities were carried out prior to shut down:

- For cooling of catalyst after shutdown a temporary line for connecting CG circulator with convertor was prefabricated and made ready. (Ref sketch below)
- Temporary line for connecting nitrogen tanker with converter during cooling and catalyst unloading and loading of 1st bed, was prefabricated and kept ready.
- A Manhole cover was pre-fabricated as per drawing given below for covering top of Pressure shell during catalyst unloading after removal of 122- C. (Ref drg below)
- Plumber Plugs for Nitrogen Purging was made as per Casale Drg no - 5239-00-E-FDE-001
- Outer Collector Slotted Plates Pushing Device for positioning and installation of outer collector was made ready.
- Wooden Pieces for Outer Collector New Slotted Plates Installation was made as per Casale Drg. No - 5239-00-E-FDE-003.
- Blind for gas outlet line of 105-D to 108-D was made for fixing after removal of gas outlet line.
- Lifting cover for removal of pressure shell issued from Stores (Store code – 2010115059916100, Drg No-01-CS-05043). For erection of pressure shell after retrofit, a taper plug was welded on lifting cover for properly guiding pressure shell.
- Site Layout plan of Ammonia convertor area was made indicating the location of positioning of Crane etc.
- Spreader bar for erection of 122-C was fabricated as per Kellogg Drg No- B52-B2 and kept at store.

- New vacuum blower was procured (PO No-201004141286) for circulation of fresh air inside Convertor while carrying out the job. Arrangement for connection of blower and wooden door was made.
- 4" PVC / HDPE pipe was cut and kept ready for Protection of pressure shell studs during retrofit job.

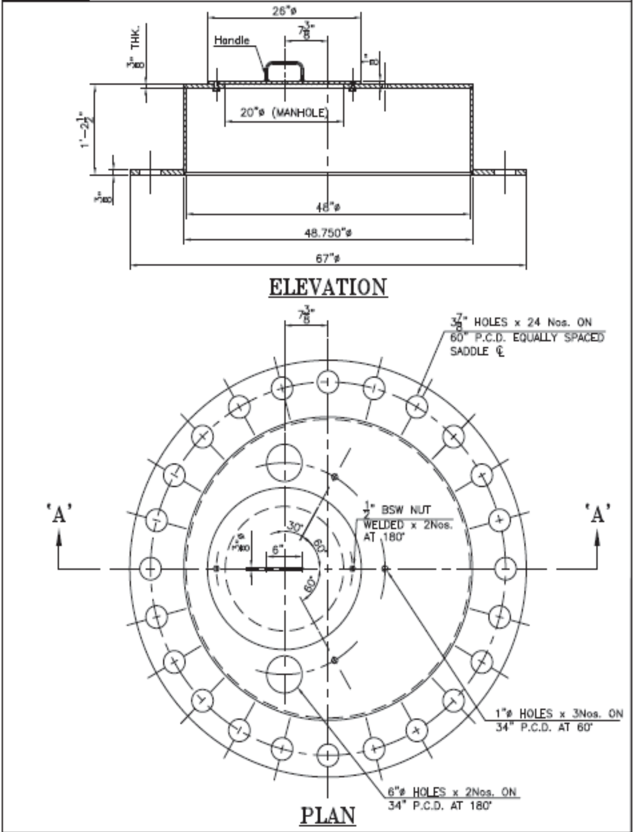
The following items were fabricated during assembly jobs:

- For center marking of Cartridge of Convertor, Piano wire is to be positioned from Pressure shell flange and bottom dump out manhole. Fabrication of fixture for centering of Piano wire at top and bottom was made.
- Additional support structure for supporting the existing support ring to facilitate removal of temporary support at bottom during installation of bottom outer collector.
- Additional support ring was provided at centre of outer collector to prevent distortion of plate during full welding.
- Jack for supporting inner collector at each bed after installation of inner collector assembly.



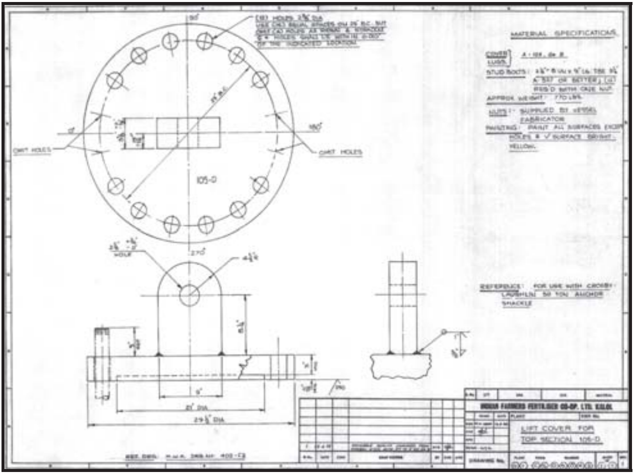
Dotted line shown was prefabricated and connected with convertor for circulation

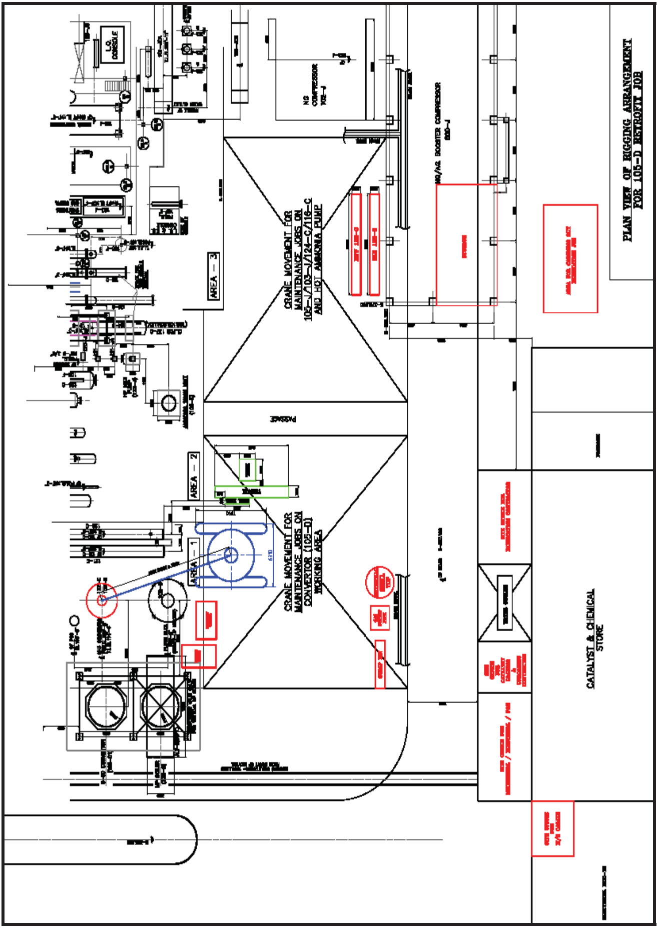
IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL



	NAME	DATE	TITLE – MANHOLE COVER FOR CONVERTER					EWR No.
DRN	N.V. PANCHAL	11.02.2014						SCALE :
CHD	Akhilesh Maurya	11.02.2014	DRAWING No.	PLANT	FROM	NUMBER	SHEET	REV.
APD	---	---	CODE AMM-625	P 1	E S	0 5 P P P	1 OF 1	0

Manhole cover was pre fabricated as per drawing given below for covering top of Pressure shell




PLAN VIEW OF RIGGING ARRANGEMENT FOR 105-D RETROFIT JOB
CRANE MOVEMENT FOR MAINTENANCE JOBS ON 105-J/103-J/124-C/116-C AND HOT AMMONIA PUMP
CRANE MOVEMENT FOR MAINTENANCE JOBS ON CONVERTOR (105-D) WORKING AREA
AREA - 1
AREA - 2
AREA - 3
PASSAGE
CATALYST & CHEMICAL STORE
NG COMPRESSOR 102-J
L.O. CONSOLE

SHUT DOWN ACTIVITIES

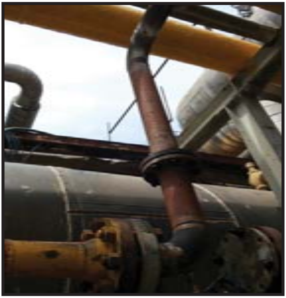
Ammonia Plant was shut down at 07.00 hrs on 26.03.14. The following activities were carried out:

- Blinding jobs was started as per clearance from Production. Blind list attached below
- De-blinding job of CG circulator loop.

SR. NO.	SHORT LOOP BLIND LOCATION	SIZE
01	SP-1 U/S FIG 8	12” X 900#
02	SP-70 D/S FIG 8	12” X 900#
03	H2 FROM PGR D/S OF I/V	4”X 300#
04	103-J CASING DRAIN LINE COMMON FLANGE	
05	103-J SUCTION VALVE D/S FIG 8.	12” X 300#
06	103-J SOUR OIL OFF GAS TO FUEL	
SR. NO.	**SYNTHESIS LOOP BLIND LOCATION**	**SIZE**
01	122-C OUTLET TO S-50 FLANGE AT TOP OF 105-D.	14” X 1500#
02	MICV-12 U/S LINE COMMON FLANGE NEAR RCC PILLER, FICV13.	1”X 900#
03	V-25 D/S FLANGE.	3” X 900#
04	RECYCLE RVs D/S FLANGE (TWO).	4”X 300#
05	103-J DISCH. RVs D/S FLANGE (TWO).	4”X 300#
06	PURGE GAS TO PGR I/V D/S.	3”X 900#
07	FICV-13 U/S ORIFICE FLANGE.	2-1/2” X 900#
08	NH3 FROM 106-F TO 107-F INLET VESSEL FLANGE	4” X 150#
09	NH3 FROM 106-F TO 107-F INLET LINE RV D/S	4”X 300#
10	NH3 FROM 106-F TO 105-E ORIFICE FLANGE.	2-1/2”X 600#
11	NH3 FROM 105-E TO 107-F	3”X600#
12	NH3 FROM 105-E TO 109-F	3”X600#
13	105-E NH3 INLET BYPASS VALVE D/S	3”X 600#

- Hook up of CG circulator with Convertor loop by providing the lines which were Pre-fabricated.

Rupture disc was dropped and line was provided



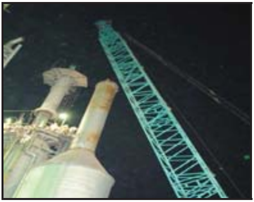
120-C bypass valve was dropped and line was provided

- Alternate bolt opening of following flanges :
  - Manhole cover (Nozzle – MH-1)
  - Gas outlet line flange (Nozzle – G)
  - Pressure shell flange (44” ID Flange)
  - Bottom manhole (Nozzle-H)
- At 10.00 hrs on 29.03.14, manhole cover was removed and permit for entry to Convertor was given to M/s Plant tech at 11.00 hrs.
- After entry, M/s Plant Tech started the following jobs inside Convertor :
  - Opened cartridge manhole cover and kept the gasket safely inside and entered inside cartridge.
  - Welding joint of 122-C and gas return pipe was cut.
  - 1^{st} bed protection screen mesh was cut and removed and catalyst unloading started at 16.45 hrs on 29.03.14.
- Gas outlet line of convertor was removed and 122-C outlet was covered using balloon.

Removal of gas outlet line

122-C outlet was covered using balloon.

- Bolts connecting Pressure shell top and 122-C were removed and also ring was removed.
- Lifting cover was bolted at pressure shell. (For placing lifting cover above pressure shell, 4 studs are required to be removed. It was not possible to remove one of them. Hence it was cut and removed)
- Pressure shell was lifted at 20.00 hrs on 29.03.14. Crane hook was directly put on D-shackle w/o sling. (Reading on Crane during lifting of Pressure shell – 17 MT, Boom radius was 17m, Max capacity-25MT)

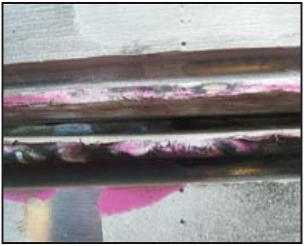


Removal of Pressure shell

122-C to basket lip seal joint

- Gap between shell and basket was sealed by ~~providing~~ inserting hose pipe.
- 122-C shell side gas inlet portion and gas outlet pipe at top was covered to prevent any loss of nitrogen.
- 122-C to basket lip seal joint grinding done on full circumference. Care was taken not to cut lip seal area of basket.

Lip seal joint



Lip seal joint area after cutting

- 122-C was lifted and kept in horizontal position at 11.00 hrs on 30.03.14

122- C shell side gas inlet portion and gas outlet pipe was covered at top

Removal of 122-C

- After removal of 122-C M/s Plant tech entered convertor through top for unloading of catalyst of second bed after providing the temporary manhole cover.
- Catalyst unloading of 4th bed was completed at 02.00 hrs on 03.04.14. (For catalyst unloading details ref table below)

CATALYST UNLOADING JOB

Sr. No.	Description	Starting		End		Duration	Remarks
		Time (Hrs)	**date**	**Date**	**Time (Hrs)**		
1	Vessel Entry	29.03.14	11:00	-	-		-
2	1st bed Catalyst U/L (Vol- 9 m3)	29.03.14	15:00	30.03.14	04:00	13 hrs	
3	2nd bed Catalyst U/L (Vol- 14 m3)	30.03.14	06:45	30.03.14	10:00	23 hrs 15 min	Lumps formation more in this bed
		30.03.14	16:00	31.03.14	12:00		
4	3rd bed Catalyst U/L (Vol- 19.25 m3)	31.03.14	14:30	01.04.14	15:30	25 hrs	Lumps formation at bottom
5	4th bed Catalyst U/L (Vol- 30.5 m3)	01.04.14	18:00	03.04.14	02:00	32 hrs	

- At 08.00 hrs on 03.04.14, bottom manhole cover was removed.
- Air hose provided at all beds.
- Vacuum blower at primary reformer was started and suction was taken from top by providing 3" size hose.
- Portable vacuum blower was started after making connections as shown in Fig below

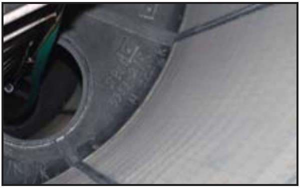
The suction of portable blower was taken from opening at skirt at convertor bottom

A wooden door was made to cover the opening of skirt

- At 14.00 hrs on 03.04.14, permit for entry to convertor was given.
- The conditions of internals were found Ok.

1st bed outer collector

Expansion joint of quench line at 1st bed



2nd bed outer collector and bottom manhole

2nd bed outer collector

3rd bed outer collector

3rd bed inner collector

4th bed outer collector

4th bed bottom

- The dismantling job in all beds was started by 16.00 hrs on 03.04.14.
- Scaffoldings made in 2nd, 3rd and 4th beds.
- Cut and removed the quench line expansion joint assemblies “D, E and F”.
- Inner collector of 1st, 2nd and 3rd bed with relevant central pipe was removed in 3 sections. The inner collector was cut leaving approximately 50 mm from bottom of 1st, 2nd and 3rd bed.
- After removal of collectors and center marking (as per the procedure given below), the ID of 1st and 2nd bed was cut as per required dimension. Dia of 1st bed inner collector support ring – 870 mm. Dia of 2nd bed inner collector support ring – 840 mm. Dia of 3rd bed inner collector support ring was to be kept the same.
- Inner collector of 4th bed was removed.


Removed Inner collector top piece


Removal of Inner collector 2nd piece


Removal of inner collector 3rd piece


Removal of 4th bed Inner collector

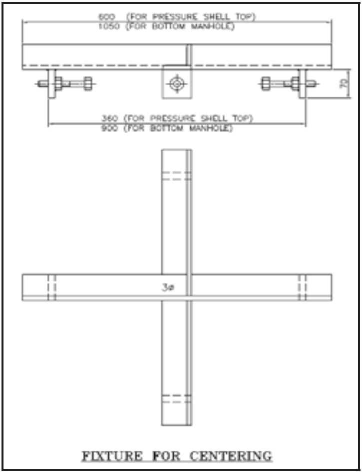
- For modification of supports of 4th bed bottom, temporary supports (4 nos) was required to be provided at bottom and additional 4 nos at 4th bed top before cutting and removal of bottom outlet collector.
- 4 pockets were cut by cutting mesh and perforated plates below existing rings and temporary supports were welded.
- On top of 4th bed, a clit was welded on protection screen and supported with basket shell

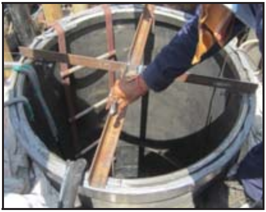
Marking for cutting of mesh and perforated plates below existing rings

Temporary support provided at bottom of existing outer collector support ring

Clit was welded on protection screen support ring and supported with basket shell

- Center of the Basket was marked for proper alignment of new collectors. The following procedure was adopted:
  - ➢ Piano wire was dropped from top Pressure shell flange through central hole upto bottom manhole of convertor.
  - ➢ It was centered from top and 4th bed bottom using fixture.
  - ➢ Centre of 1st, 2nd and 3rd bed ring was checked. However 2nd and 3rd rings were found off centre.
  - ➢ Hence piano wire was centered wr to top Pressure shell flange and 3rd bottom and accordingly centre of 1st and 2nd center were measured. It was found ok.
  - ➢ Reference dimensions were written in all beds.





Piano wire was dropped from top Pressure shell flange

upto bottom manhole of convertor

Fixture at 4th bed bottom for adjusting piano wire

1st, 2nd and 3rd bed ring centre was checked by using notch plate of required dimension

Dismantling and assembly jobs in 4th bed

- After making provision of temporary support for 4th bed, bottom outer collector was completely removed.
- 4th bed scaffolding was supported temporarily from existing support ring of outer collector and then dismantling of the 4th bed bottom portion and refractory (by Civil) was started.
- After removal of refractory, anchors and 6 nos pipe supports were removed.
- The extended portion of drop out nozzle pipe was cut upto 10 mm below and then seal welding was done.

4th bed Bottom after removal of refractory

Extended portion of of drop out nozzle pipe (after removal of refractory)

- Position of new 4th bed outer collector support ring was marked. Nitriding layer removed by grinding & to ensure removal of nitriding layer 5% concentrated Nitric acid (HNO3) solution applied on grounded surface, if surface not become blackish that confirm nitriding layer has been removed. Welding was done after removal of nitride layer and baking upto 500^{0}C.The ring was in 3 pieces with 100 mm extra length. Extra length was cut. Welding and DP test was done. Stitch welding was done at bottom side of ring to avoid distortion.

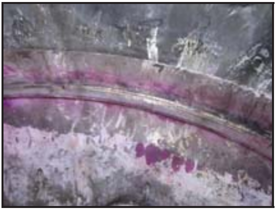
Removal of nitriding layer by grinding

Baking by gas cutting set

- Then fit up and tack welding of new 4th bed outer collector lower part was started.
- Additional support structure was made by providing channels for supporting the existing support ring to facilitate removal of temporary support at bottom during installation of bottom outer collector. Temporary support was removed one by one for installation of outer collector. Additional support structure was removed only after complete welding of other areas.
- Outer collectors were positioned one by one on support ring. Jacks were used for

holding the panels. Temporary clits were also welded for installation which were removed later

- Outer collector ID was checked and then tack welding was done.



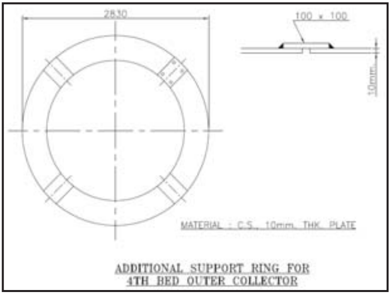
4th bed bottom support ring after completion of welding

Additional support structure was made by providing channels

Additional support structure was made by providing channels

Additional support structure was made by providing channels

- Additional support ring was provided at centre of outer collector (Ref fig below) to prevent distortion of plate during full welding.



- Then full welding of horizontal and vertical joints was done in staggered manner.
- Cracks were observed in stitch weld between perforated plate of top outer collector bottom portion and the existing support ring. Hence the welding joint between perforated plate and support ring at the back side was inspected. Cracks were observed at that portion also. Hence it was decided to carry out full welding from the front side to strengthen the joint.

Cracks were observed in stitch weld between perforated plate of top outer collector bottom portion and the existing support ring

Cracks observed at back side portion

<u>For 4th bed, the following activities were carried out in parallel</u>

- Existing wire mesh of top outer collector of 4th bed was removed.
- Nitrated layer was Grinded off and the area was baked upto 500^{0}C on existing parts where the new parts are to be welded
- For installation of 4th bed outer collector upper part new panels, the position of inspection hole was taken and marked in one new panel. Panel was cut as per marking.
- Marking also done on all panels for stitch welding.
- Then panels were positioned one by one on perforated plates. Jacks were used for holding the panels. Temporary clits were also welded for installation which were removed later
- Outer collector ID was checked and then welding was done.
- Sealing strips was provided to remove any gap bigger than 1 mm size between slotted plates and perforated plates by welding bars/ strips.
- Final DP was done.

4th bed bottom outer collectors after replacement of bottom outer collector and perforated plates of top portion

- For installation of new protection screen, position of new support ring was marked. Welding was done after removing nitride layer and baking upto 500deg C.

New support ring for protection screen which is below the existing support ring

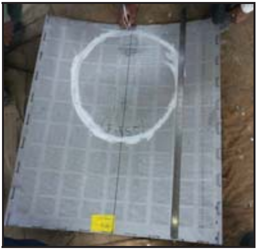
Dismantling and assembly jobs in 1st bed

Installation of new slotted panels

- Existing wire mesh was removed by grinding.

Perforated plates of 1st bed after removal of wire mesh

- Nitrated layer was Grinded off and the area was baked upto 500^0C on existing parts where the new parts are to be welded
- For installation of the new panels, the position of inspection hole was taken and marked in one new panel. Panel was cut as per marking.
- Marking also done on all panels for stitch welding.



Marking done for panel on inspection hole. Marking for stitch welding was done on all panels

Installation of first panel

- Then panels were positioned one by one on perforated plates. Jacks were used for holding the panels. Temporary clits were also welded for installation which was removed later.
- After installing all the panels, ID of outer collector was checked again and then final welding was done. Welding was done in staggered manner to prevent any distortion.
- Sealing strips was provided to remove any gap bigger than 1 mm size between slotted plates and perforated plates by welding bars/ strips.
- Final DP was done.

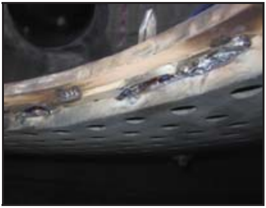
<u>Installation of new manhole</u>

- Cut the new bottom manhole opening in 1st bed after marking
- Nitrated layer was Grinded off and the area was baked upto 500^0C on existing parts where the new frame is to be welded
- Installed and welded the new frame for new bottom manhole in 1st bed.

New manhole at 1st bed bottom

- It was observed that there was gap between 1st bed bottom dish end and cover plate (installed during Convertor Retrofit- 1993). The gap was filled by welding. Plates were inserted and welded wherever gap was more.

Gap between 1st bed bottom dish end and cover



Gap was filled by welding. Plates were inserted and welded wherever gap was more.

<u>Dismantling and assembly jobs in 2nd bed</u>

<u>Installation of new slotted panels</u>

- New panels were installed as per the same procedure as done in 1st bed.

<u>Installation of new manhole</u>

- New manhole was installed as per the same procedure as done in 1st bed.
- It was observed that there was gap between 2nd bed bottom dish end and cover plate (installed during Convertor Retrofit - 1993). The gap was filled by welding. Plates were inserted and welded wherever gap was more.

<u>Dismantling and assembly jobs in 3rd bed</u>

<u>Installation of new slotted panels</u>

- New panels were installed as per the same procedure as done in 1st bed.

<u>Installation of new manhole</u>

- New manhole was installed as per the same procedure as done in 1st bed.
- It was observed that there was gap between 3rd bed bottom dish end and cover plate (installed during Convertor Retrofit - 1993). The gap was filled by welding. Plates were inserted and welded wherever gap was more.

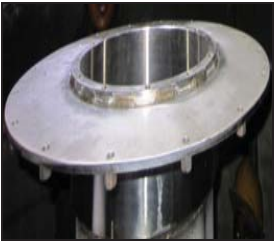
<u>Erection of Inner collector</u>

- Piano wire was put again at centre and ID of 1st & 2nd bed inner collector support ring was checked and grinded to the required size. Centre of 3rd bed bottom support ring was checked.
- Guide plates were welded at 1st bed at 894 OD for proper guiding of inner collector during installation
- Guide plates welded at 3rd bed at 794 OD for proper guiding of inner collector during installation
- 4th bed inner collector erection done. Centered at bottom. At top 4 nos jacks were provided and tack welded for proper centering of inner collector.

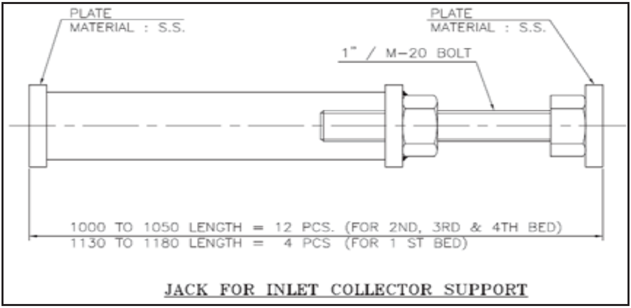
4th bed inner collector lifted

- Stuffing box housing lifted and kept above 4th bed inner collector and centered wr to inner collector and tack welded.

Jacks provided at 4th bed



Stuffing box housing kept above 4th bed inner collector



- Top portion of inner collector lifted and positioned. At top of inner collector in each bed, 4 nos jacks were provided and tack welded for proper centering of inner collector.

Top portion of inner collector lifted

- After centering of inner collector, tack welding with bottom support ring done on all bed at 4 points.
- Gaps of approx. 3 to 5 mm were observed between support ring and inner collector bottom in all three beds after centering and alignment. The gap was closed by inserting rings and full welding after final alignment of inner collector.

Gaps of 3-5 mm observed between support ring and collector bottom

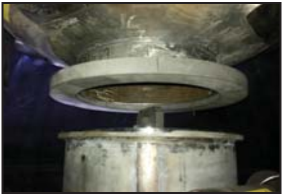
After full welding

- 4th bed Inner collector and the stuffing box assembly were welded and packing was installed.

Stuffing box after installation of packing

Trial Fit of 122-C

- Measurement from top of inner collector and lip seal was taken.
- 100mm extra length cut from bottom end of 122-C.
- Ring plate was tack welded.
- 122-C was lifted and positioned above Pressure shell (without piston assembly). Load on Crane released completely. Gap between inner collector top and end of 122-C was measured = 133 mm



Gap between inner collector top and end of 122-C

- Then 122-C was removed and kept at ground floor.

Modification of 122-C as per site requirements

- New expansion bellow supplied by M/s ISGEC was having following problems.
  - Supplied material was SS 321 against the Drawing spec. of Incoloy 600.
  - Weld metal PMI was checked and it was SS 304.
- One expansion bellow which was available in store was not suitable.
- It was finally decided to use the expansion bellow supplied by M/s ISGEC after making following modifications:
  - Grinded and removed the weld metal and welding was done with ER 347.
  - Existing inner plate was replaced with Incoloy 800 HT plate.
- The job was carried out after consulting with M/s Casale.

- New expansion bellow was then welded with 122-C
- Total length of 122-C assembly was checked. Required length of 122-C was 6815mm. New 122-C was having length of 6853mm. End was cut and length made as per requirement.
- Welding of new Insulation sleeve on top end of new 122-C was done.
- Insulation of shell of 122-C was done.
- The following were observed in old removed 122-C:
  - Some of the tubes were found broken at bottom tube sheet area.
  - Existing bellow of 122-C was found damaged.

Trial fit of screen and insulation job in 4th bed

- Trial fit of top protection screen of 4th bed was done and then it was removed and kept at top of 4th bed in hanging position.
- Hanging scaffolding for loading of catalyst was made.
- Scaffolding at bottom was supported on bottom support ring.
- 4th bed bottom new insulation was installed.
- Scaffolding at 4th bed was removed.

View of hanging scaffolding from 4th bed bottom

At centre scaffolding was bolted with stuffing box ring plate

At outer end it was supported at 4th bed outer collector

4th bed bottom after providing insulation

Trial fit of Screen of other beds

- Trial fit of top protection screen of 3rd bed was done and then it was removed and kept at top of 3rd bed in hanging position.
- Trial fit of top protection screen of 2nd bed was done and then it was removed and kept at top of 2nd bed in hanging position.
- Trial fit of top protection screen of 1st bed was done and then it was removed and kept outside.
- Grinding and removal of nitriding layer of protection screen of 1st, 2nd and 3rd bed wherever welding required was done

Protection screen kept at top of bed in hanging position

Modification done in gas outlet pipe and Pressure shell

- Earlier the joint between 122-C and pressure shell (Nozzle G) was by providing a ring which was bolted. In new 122-C this design was modified and a special gasket was provided and was welded with the outer insulation sleeve. So it was required to make chamfer in the existing gas outlet pipe flange with pressure shell. The ID of flange at face was made 340 mm dia (Ref Casale drg 5239-00-E-MMR-215)
- Chamfer was also made in existing pressure shell as per above drawing.

Removal of broken stud in Pressure shell

- It was not possible to remove one stud of Pressure shell top for fixing of lifting cover. Hence this was cut.
- After keeping the pressure shell in horizontal position it was tried to loosen the stud. But still it was unable to remove it.
- Hence the stud was drilled and removed. The body thread of pressure shell top flange (existing 2¼" UN) was made to 2½" UN by drilling and tapping.
- A new stud having size of 2½" for body and 2¼" for nut was made. The job was done at site by M/s Chinmaya Enterprises, Ahmedabad.

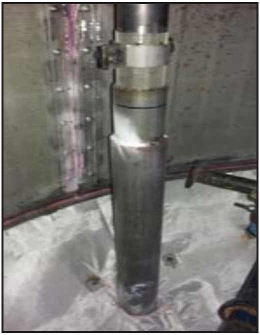
<u>**Modification of thermowell**</u>

<u>Installation of new thermocouple bundles AT and BT and new supports</u>

- Removed the thermocouple bundles “AT & BT”.
- Thermowell pipe AT was cut at top of 4th bed and new one was provided. New sliding support was provided and it was supported at inner collector bottom
- A new support was provided for thermocouple pipe of BT at bottom of 4th bed.

Sliding support of AT thermowell pipe

Bottom support of AT thermowell pipe



Bottom support of BT thermowell pipe

- Stuffing box packing for thermocouples at 1st, 2nd and 3rd bed were replaced with new one and all fasteners were replaced with new one.
- In 3rd bed the flange of stuffing box was required to cut slightly as there was no gap. Also the slotted plate which was damaged at that area was covered by providing plate.

Stuffing box packing for thermocouples at 1st, 2nd and 3rd bed was replaced

In 3rd bed the flange of stuffing box was required to cut slightly as there was no gap. Also the slotted plate which was damaged at that area was covered by providing plate.

New thermocouple for measurement of 122-C shell outlet gas

- New thermocouple was provided for measurement of 122-C shell outlet gas. The location of the thermocouple well was modified to suite at site.
- As the thermocouple was coming exactly above the 1st bed bypass line, thermocouple was bent upwards for accurate measurement of temperature of 122-C shell outlet gases and a plate was provided for supporting the thermocouple.

Location of thermocouple

Thermocouple was bent upwards and a plate was provided for supporting the thermocouple.

- Flexible hose between Pressure vessel and basket (3 Nos) were replaced with new expansion joints

Expansion joint between Pressure vessel and basket

<u>Catalyst loading of 4th, 3rd and 2nd bed</u>

<u>Loading of catalyst of 4th bed</u>

Final Inspection of convertor basket was made on 17.04.14 and after removal of scaffolding and box up of dump out manhole flange catalyst loading started at 16:00 hrs.

- New alumina balls were filled inside drop out flange pipe and insulation was provided above it.
- Catalyst loading of 4th bed was started.
- Bottom manhole box up done.
- On 19.04.14 catalyst loading stopped for removal of temporary scaffolding at 4th bed and for removal of jacks (4 nos) provided at top (10:30 hrs to 12:00 hrs).

Catalyst filled below temporary scaffolding

4 nos Protection screen were fixed in position and others were kept over this

- Protection screen which was kept hanging on 4th bed top was removed and 4 nos screens fixed in position and others were kept over this in proper sequence so that they can be removed easily for installation.

- Protection cover fixing on 20.04.14 (01:45 hrs to 05:00hrs)
  - ➢ Protection cover of 4th bed fixed.
  - ➢ Covering plate near thermowell AT and BT was cut as per requirement
  - ➢ All required tack welding done
  - ➢ 6 nos angle provided and welded.
  - ➢ Cleaning of protection cover done (by Plant tech)
  - ➢ Hose provided between the collector plate and shell gap was removed
- Manhole cover welding (05:00 hrs to 07:45 hrs)
  - ➢ New and old manholes of 3rd bed bottom were placed and welded.
  - ➢ Root and final DP done.

Loading of catalyst of 3rd bed

- Loading of 3rd bed started at 09:00 hrs on 20.04.14.
- On 21.04.14, (02:25 to 02:50 hrs) catalyst loading stopped for removal of temporary supports of inner collector provided at top (4 nos).


3rd bed protection screen after installation

Old manhole at 3rd bed bottom

New manhole at 3rd bed bottom

- Protection screen which was kept hanging on 3rd bed top was removed and 4 nos screens fixed in position and others were kept over this in proper sequence so that they can be removed easily for installation.
- On 21.04.14, protection screen fit up started after clearance from Production.
- Protection cover fixing (21.04.14, 09:00 hrs to 12:30 hrs)
  - Protection cover of 3rd bed fixed.
  - Covering plate near thermowell AT and BT was cut as per requirement
  - All required tack welding done
  - 6 nos angle provided and welded.
  - Cleaning of protection cover done (by Plant tech) (09:00 hrs to 12:30 hrs)
  - Hose provided between the collector plate and shell gap was removed
- Manhole cover welding (21.04.14,12:30 hrs to15:30 hrs)
  - New and old manholes were placed and welded.
  - Root and final DP done.

Loading of catalyst of 2nd bed

- 2nd bed catalyst loading started on 21.04.14, 16:30 hrs.
- On 22.04.14, (00:30 to 01:00 hrs) catalyst loading stopped for removal of temporary supports of inner collector provided at top (4 nos).
- Protection screen which was kept hanging on 2nd bed top was removed and 4 nos screens fixed in position and others were kept over this in proper sequence so that they can be removed easily for installation.
- On 22.04.14, 16:00 hrs, protection screen fit up started after clearance from Production.
  - Protection cover fixing
  - Protection cover of 2nd bed fixed.
  - Covering plate near thermowell AT and BT was cut as per requirement
  - All required tack welding done
  - 6 nos angle provided and welded.
  - Cleaning of protection cover done (by Plant tech)
  - Hose provided between the collector plate and shell gap was removed
- Manhole cover welding
  - New and old manholes were placed and welded.
  - Root and final DP done.

Replacement of Expansion joints of quench pipes with new one

- Extra length of quench line pipes were cut after marking. Expansion joints of 1st, 2nd and 3rd quench "D, E, F" fit-up and welding was done.

Expansion joint of quench line pipe

- Packing installation on central stuffing box was done.
- During trial fitting of screen in 1st bed, it was observed that there was no gap between expansion bellow E and one protection screen. Hence the screen at that area was cut and a pocket was made below the bellow.

  Note – centre height of all bellows were 85 mm from protection cover (as per drg – 100 mm)

<u>Installation of 122-C</u>

- Pressure shell gasket was cleaned in position
- Sleeve of Elastic seal ring was positioned on inner collector (w/o seal rings).
- 122-C was lifted using spreader bar and positioned on Pressure shell.
- Load on Crane released completely.
- It was observed that the sleeve was fouling with gland packing bolts.
- Hence 122- C was again taken outside
- Sleeve removed and 30 mm length was cut (Final length of sleeve- 300 mm)
- Then again same procedure done. Sleeve positioned and tack weld done.

Sleeve positioned and tack weld done.

- 122-C taken outside and sleeve welding done from Ground floor.
- One gland packing was removed from stuffing box and length of all bolts of stuffing box reduced by 10 mm and then it was boxed up.
- Before final assembly of 122-C,3 nos Sealing rings were positioned on elastic seal joint and masking tape and molykote was provided.

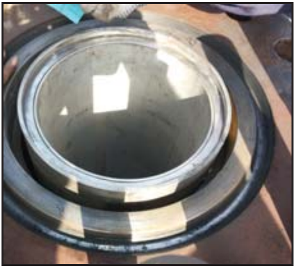
- Before lifting 122-C, wooden plug and hose for provision of nitrogen was provided at top. After installation it was removed and masking tape was provided and blinded.
- 122-C was lifted, positioned and lip seal welding and DP done. (time taken for seal welding - 1 hr)
- 10 nos Protection cover of 1st bed fixed and tack welding done.
- Covering plate near thermowell AT and BT was cut as per requirement & tack welded.
- On 23.04.14, 09:00 hrs, handed over to Production for catalyst loading of 1st bed. (Pre reduced catalyst)
- Pressure shell (17 MT) lifted and kept in position using 135 T Kobelco crane. (Boom radius – 15 m, Max load- 25 MT). The pressure shell was lifted by providing lifting cover inside which taper plug was provided for guiding so that it is centered wr to 122-C.

Lifting cover inside which taper plug was welded

- Lifting cover removed
- Tightened pressure shell flange
- Special gasket provided at Pressure shell top and welded with outlet insulation sleeve.
- Top insulation sleeve provided and welded with outlet insulation sleeve

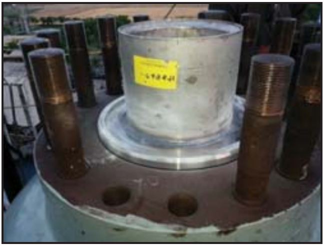
122-C after completion of seal welding

Presure shell lifted



Pressure shell installed in position.

Special gasket & outlet insulation sleeve in position



Special gasket welded with outlet insulation sleeve and top insulation sleeve welded with outlet insulation sleeve

- Gas outlet pipe lifted and positioned. Blind plate provided between flanges of gas outlet pipe. (To prevent nitrogen removal from S 50. After completion of catalyst loading of 1st bed and Nitrogen purging of 105- D convertor, this was removed)
- Catalyst loading of 1st bed completed on 23.04.14, 20:15 hrs.
- 2 nos remaining protection screen provided and tack welded
- Cleaning done by M/s Plant tech
- Cartridge manhole boxed up by M/s Plant tech using the existing gasket
- Pipe provided in annular space was removed after cleaning
- Pressure shell manhole box up done
- Nitrogen purging of convertor done till O_2 is below 0.5 %.
- Blind provided at gas outlet pipe was removed.
- Deblinding jobs done

CATALYST LOADING JOB

Sr. No	Description	Starting		End		Duration	Remarks
		Time (Hrs)	date	Date	Time (Hrs)		
1	Handed over to Production	17.04.14	16:00	-	-		-
2	4^{th} bed Catalyst (Vol-32.25 m3)	17.04.14	23:00	20.04.14	01:45	50 hrs 45 min	ρ = 2.905 318 drums 31.741 m3
3	3^{rd} bed Catalyst (Vol- 19.25 m3)	20.04.14	09:00	21.04.14	08:30	19 hrs (Excluding delay of 4 hrs 30 min due to rain)	ρ = 2.794 182 drums 19.201 m3
4	2^{nd} bed Catalyst (Vol- 14 m3)	21.04.14	16:00	22.04.14	16:00	24 hrs	ρ = 2.941 140 drums 13.899 m3
5	1^{st} bed Catalyst (Vol- 9 m3)	23.04.14	09:00	23.04.14	22:00	13 hrs	ρ = 2.197 90 drums 8.81 m3

Ammonia Syn. Converter - 4 Beds Kellogg Converter "Casale Insert" Drawing List

Sr. No.	Description	Drg. No.
	New Ammonia Synthesis Converter	
1	General Layout & Details	5239-00-E-MMR-201
2	1^{st} Bed New Inner Collector Details	5239-00-E-MMR-202
3	1^{st} Bed New Plates for Outer Collector & Bottom Modification	5239-00-E-MMR-203
4	2^{nd} Bed New Inner Collector Details	5239-00-E-MMR-204
5	2^{nd} Bed New Plates for Outer Collector & Bottom Modification	5239-00-E-MMR-205
6	3^{rd} Bed New Inner Collector Details	5239-00-E-MMR-206
7	3^{rd} Bed New Plates for Outer Collector & Bottom Modification	5239-00-E-MMR-207
8	4^{th} Bed New Inner Collector Details	5239-00-E-MMR-208
9	4^{th} Bed New Plates for Outer Collector	5239-00-E-MMR-209
10	4^{th} Bed Bottom Modification	5239-00-E-MMR-210
11	New Expansion Joints Between Pressure Vessels & Basket	5239-00-E-MMR-211
12	Thermowell Pipes Modification	5239-00-E-MMR-212
13	1^{st}, 2^{nd}, 3^{rd} & 4^{th} Bed New Protection Screens	5239-00-E-MMR-213

Sr. No.	Description	Drg. No.
14	New Central Pipe with Elastic Ring Seal for connection with 122-C & New Expansion Joints for Quench Gas Inlet Pipes	5239-00-E-MMR-214
15	New Gas Outlet Insulation Sleeve	5239-00-E-MMR-215
16	**Bar Chart**	5239-00-E-FXE-001
	Tools for Refurbishment Activities	
1	Frame for Catalyst Screening	0000-00-FDC-001-00
2	Catalyst Loading Tool	0000-00-FDC-003-00
3	Hopper 1.5 m3 Capacity for Catalyst Loading	0000-00-FDC-016
4	Template for Catalyst Vibration Upper Part of 2nd Bed	0000-00-FDC-022-01
5	Template for Catalyst Vibration Upper Part of 3rd Bed	0000-00-FDC-022-02
6	Template for Catalyst Vibration Upper Part of 1st Bed	0000-00-FDC-023
7	Funnel for Catalyst Loading	0000-00-FDC-047
8	Plumber Plugs for Nitrogen Purging	5239-00-E-FDE-001
9	Outer Collector Slotted Plates Pushing Device for Installation	5239-00-E-FDE-002
10	Wooden Pieces for Outer Collector New Slotted Plates Installation	5239-00-E-FDE-003
	Drgs of Tools - IFFCO	
11	Lifting Cover for External Shell	01-CS-05043
12	Spreader Bar for Interchanger 122-C	B52-B2
	Old Ammonia Synthesis Converter	
1	General Layout & Details	4157K-R-003
2	1st Bed Inner & Outer Collector	5353_1-K_1
3	1st Bed Inner & Outer Collector	5353_1-K_2
4	2nd Bed Inner & Outer Collector	5353_2-K_1
5	2nd Bed Inner & Outer Collector	5353_2-K_2
6	3rd Bed Inner & Outer Collector	5353_3-K_1
7	3rd Bed Inner & Outer Collector	5353_3-K_2
8	4th Bed Inner & Outer Collector	5353_4-K_1
9	4th Bed Inner & Outer Collector	5353_4-K_2

Sr. No.	Description	Drg. No.
10	Quench Pipes	5353_5-K
11	Protection Screens	5353_7-K
12	New Baffle for Mixing Improvement & Insulation Sleeve	5353_8-K
13	General Layout & Thermowell Details	5353-K
	Ammonia Interchanger 122-C	
1	New Ammonia Interchanger 122-C	2013-PE1680-S1 R3
2	Old Ammonia Interchanger 122-C	301D122
	Site Plan & Rigging Arrangement	
1	Site Plan	1
2	Rigging Arrangement of External Shell	1 & 2
3	Rigging Arrangement of 122-C	1 & 2
1	KELLOGG Converter Drawing	105-D
	Chicago Bridge Pressure Shell Drawings	
1	General Plan of 125" ID Converter 105-D	1
2	125" ID Shell Assembly Drawing	2
3	Shell End Flange & Head for 44" Dia. Top Section	3
4	44" ID Top Head & Connection G for 44" Dia. Section	4
5	44" ID Flange	7
6	Special RTJ Gaskets for 125-1/2" ID Converter	8
7	Nozzles D, E & F	10
8	Assembly & Details of Basket	27
9	Datasheet	DS

GASKET LIST FOR CONVERTOR 105-D

Sr. No.	Store Code	Description	Qty. Reqd.	Installed Location
1	2010115059924740	Special Ring Joint Gasket for 44" ID flange, MOC: Iron or Soft Steel (120 BHN), Drg. No. P1-ES-05071 For 105-D	1	44" ID flange of 44" Vessel section
2	2010115059924770	Special Ring Joint Gasket for 27" ID flange, MOC: Iron or Soft Steel (120 BHN), Drg. No. P1-ES-05071 for 105-D	1	Catalyst Drop out Nozzle H
3	2010115059924730	Corrugated Double Jacketed Gasket	1	

Sr. No.	Store Code	Description	Qty. Reqd.	Installed Location
		Asbestos filled, Full Annealed, MOC SS321, 21-1/2" X 18-1/2" X 1/8", FOR 105-D		
4	993510361010	Low Carbon Steel (BHN-120) Oval Size & Rating R71 (18"X1500#)	1	MH1 Manhole Gasket
5	2010115050124700	Gasket Special, Size: 14" X 1500# RTJ, MOC: ASTM A 240 Gr. SS321, Item No. 10, Drg. No. 5239-00-E-MMR-215 for 105-D	1	Ring Joint Gasket for Nozzle G
6	993500686200	Gasket Spiral Wound SS-304 Asbestos Filled 18" X 150# With Outer CS Center Ring	1	Inner Cartridge Manhole
7	993510417010	Gasket Ring Joint, Soft Iron, Octagonal Size & Rating R27(2-1/2" X 1500#)	2	AT & BT Thermocouple

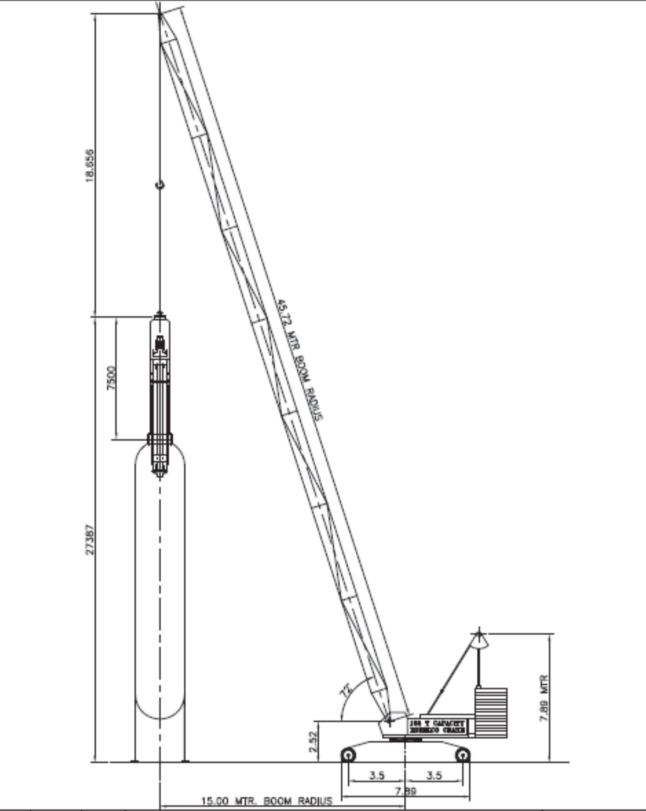
List of Studs for converter 105-D

Sr. No.	Installed Location	Stud Size	Qty. Reqd.	Store Code	Spanner Size
1	44" Flange	Stud, Size: 3-1/2" - 8 UN X 21-1/2" Long, Type: 2, Sr. No. 1 of Drg. No. P1-DS-05072	24	20101150599546D0	137/138
4	Nozzle H - 27" Flange	Stud, Size: 2-1/2" - 8 UN X 14-7/8" Long, Type: 3, Sr. No. 2 of Drg. No. P1-DS-05072	12	2010115059954630	95
6		Stud with 2 Nuts, Size: 2-1/2" - 8 UN X 16" Long, Thread Length Both end: 4-7/8"	4	2010115059954640	
8	Nozzle G	Stud, Size: 2-1/4" - 8 UN X 12-3/4" Long, Type:3, Sr. No. 4 of Drg. No. P1-DS-05072	12	2010115059954510	90
11		Stud with 2 Nuts, Size: 2-1/4" - 8 UN X 14" Long, Thread Length Both end: 4-7/8"	4	2010115059954620	
13	18" Manhole	Stud, Size: 2-3/4" - 8 UN X 19" Long, Sr. No. 6 of Drg. No. P1-DS-05072	16	0000993125635510	105 / 98 - 1 no.
14	AT & BT	Stud with 2 Nuts, Size: 1" - 8 UN X 9-1/2" Long, Thread Length: Full Threaded	32	0000993125613800	
15	Cartridge Manhole	Stud - Full Threaded with One Nut, Size: 1-1/8" X 4-3/4" Long, Thread - 8N, MOC: Stud - ASTM A193 B8,Nut - ASTM A194 GR.8	16	20101150599546E0	
16	Drop out Flange,	Stud – Full Threaded with Two Nuts, Size: 1-1/8" X 150MM Long,	16	20101150599546F0	

Sr. No.	Installed Location	Stud Size	Qty. Reqd.	Store Code	Spanner Size
	Size: 18" X 150#	Thread - 8UN, MOC: Stud- ASTM A193 B8, Nut- ASTM A194 GR.8			

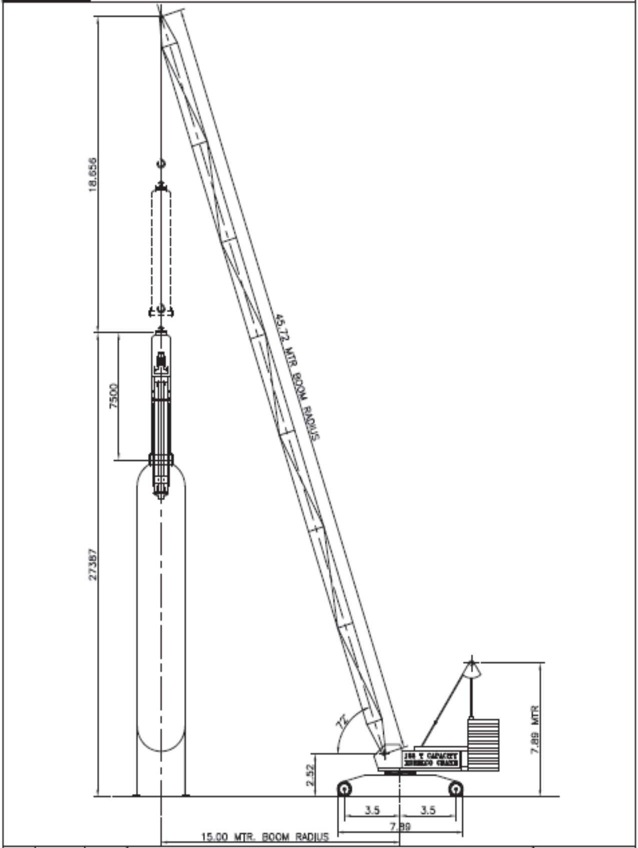
RIGGING ARRANGEMENT DRAWINGS FOR ERECTION

IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL



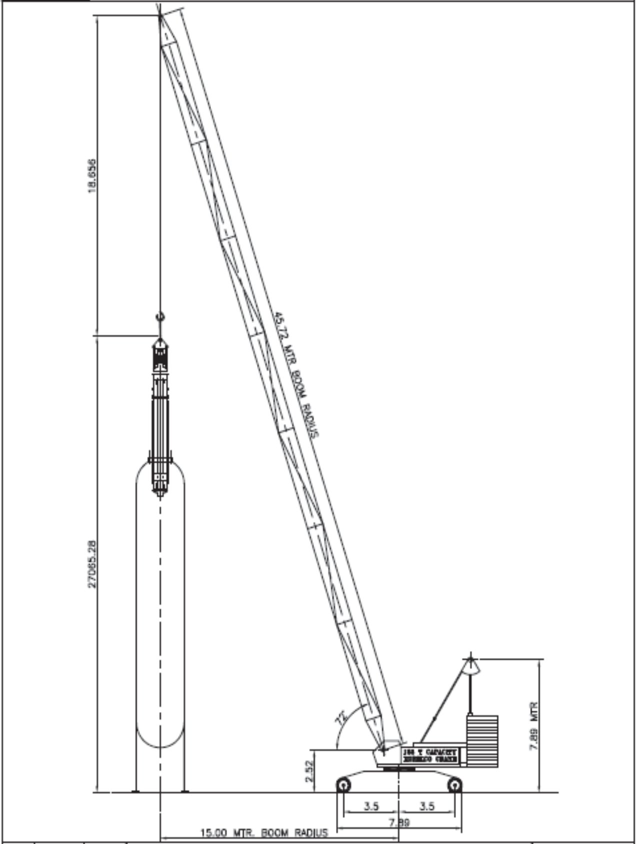
	NAME	DATE	TITLE – RIGGING ARRANGEMENT OF TOP COVER FOR 105-D RETROFIT JOB	EWR No.
DRN	N.V. PANCHAL	09.07.2013		SCALE : N. T. S.
CHD			DRAWING No. CODE AMM-000 / PLANT P 1 / FROM E S / NUMBER 0 4 – – –	SHEET 1 OF 1 / REV. 0
APD				

IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL



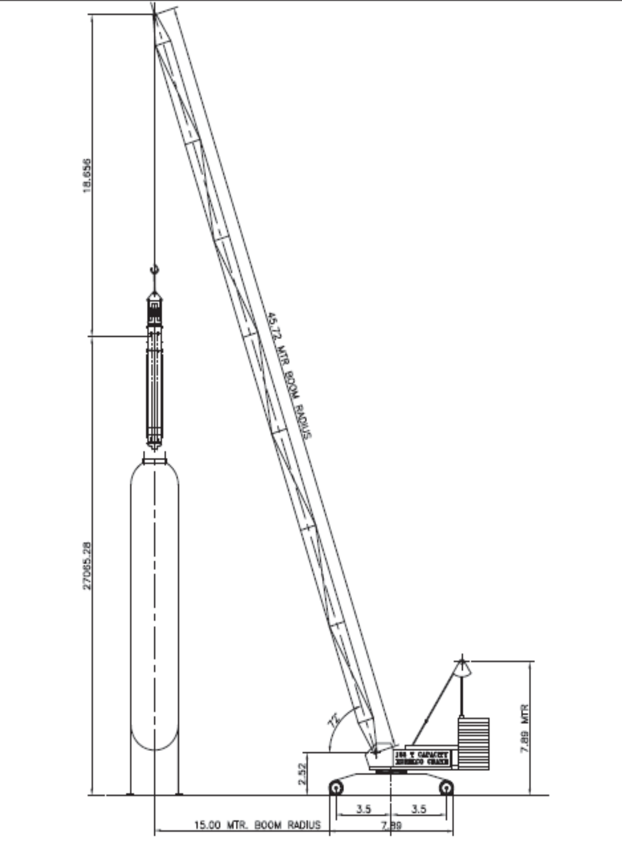
	NAME	DATE	TITLE – RIGGING ARRANGEMENT OF TOP COVR FOR 105-D RETROFIT JOB	EWR No.
DRN	N.V. PANCHAL	09.07.2013		SCALE : N. T. S.
CHD			DRAWING No. CODE AMM-000 · PLANT P 1 · FROM E S · NUMBER 0 4 – – –	SHEET 1 OF 1 · REV. 0
APD				

IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL



	NAME	DATE	TITLE –	EWR No.
DRN	N.V. PANCHAL	09.07.2013	RIGGING ARRANGEMENT OF 122–C REPLACEMENT OF 105–D RETROFIT JOB	SCALE : N. T. S.
CHD			DRAWING No. CODE AMM–000 — PLANT: P 1 — FROM: E S — NUMBER: 0 4 – – –	SHEET 1 OF 1 — REV. 0
APD				

INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL



	NAME	DATE	TITLE – RIGGING ARRANGEMENT OF 122-C REPLACEMENT OF 105-D RETROFIT JOB	EWR No.
DRN	N.V. PANCHAL	09.07.2013		SCALE : N. T. S.
CHD			DRAWING No. CODE AMM-000 PLANT P 1 FROM E S NUMBER 0 4 – – –	SHEET 1 OF 1 REV. 0
APD				

PO / WO DETAILS FOR 105-D RETROFIT

Sr. No.	PO/WO No	PO Description	Value
1	201004131471	Supply of Internals for Refurbishment of 105-D and Supervision of site work (1 Euro = Rs.81.00)	1011410.7 Euro = Rs.81924267
2	201004140177	Supply of Ammonia Converter Interchanger	Rs.10510557
3	201004141160	Refurbishment of 105-D	Rs.7000000
4	201004141067	Catalyst loading and Unloading of 105-D	Rs. 6345000
5	201004141348	Supply of Liquid Nitrogen	Rs. 2113240
6	201004141285	Electric Operated Torque Wrench Pump, Model:ZU-4208BI-QH, Hyd. Torque Wrench Pump Suitable 208-240v,Single Phase,50hz Supply	Rs. 286560
7	201004141413	Hydraulic Torque Wrench with twin hose	Rs. 831794
8	201004141286	Portable Centrifugal Air Blower with Motor & Complete Accessories, Capacity.: 6000CFM @ 200 mm WC	Rs. 210000
Total Amount			Rs.109221418

PROCUREMENT DETAILS OF GENERAL CONSUMABLES & NON CONSUMABLES FOR 105-D RETROFIT

SR. NO.	ITEM DESCRIPTION	STORE CODE	QTY.	PO NO.	PO RATE
1	#6030 - Pen Oil, Packing : Spray Can of 500 ml	0000998250100250	30 Ltr.	201004140804	126707
2	#Z5205 Water Works, Packing: Spray Can of 700 ml	2010119980167000	30 Ltr.		
3	PROTEC CU-HT, Packing : Tin of 2 Kg	2010119980167210	20 KG		
4	3M Rigid Grinding Disc, Size: 100 X 6 X 16 MM	2010912311433010	50 Nos.	201004140707	260600
5	3M Rigid Grinding Disc, Size:125 X 6 X 22 MM	2010912311433020	300 Nos.		
6	3M Rigid Grinding Disc, Size:180 X 6 X 22.23 MM	2010912311433030	300 Nos.		
7	3M Flexible Grinding Disc, Size: 100 X 3 X 16 MM	2010912311432010	50 Nos.		
8	3m Flexible Grinding Disc, Size: 125 X 3 X 22 MM	2010912311432020	50 Nos.		
9	3M Flexible Grinding Disc, Size: 180 X 3.7 X 22 MM	2010912311432030	200 Nos.		
10	RUTOX-A(ST), AWS E-347-16 ,A 5.4 / SFA 5.4, SIZE :2.5 X 350 MM	2010912523702040	4000 Nos.	201004141204	44480
11	RUTOX-A(ST), AWS E347-16, A 5.4 / SFA - 5.4, Size: 3.15 X 350 MM	2010912523703040	3000 Nos.		46080
12	RUTOX-A(ST), AWS E347-16, A 5.4 / SFA - 5.4, SIZE :4.00 X 350 MM	2010912525804040	440 Nos.		10766.8
13	Sheet - SS, Size: 1.5 Mtr. X 3 Mtr. X 3 MM Thick, MOC: ASTM A 240 Type SS 321	0000995280124010	115 KG	201004140550	25875
14	Plate - SS, Size: 1.5 Mtr. X 3 Mtr. X 5 MM Thick, MOC: ASTM A	0000995140100A80	180 KG		40500

	240 Type SS 321				
15	Plate-SS, Size: 1.0 Mtr. X 1.0 Mtr. X 10 MM Thick, MOC: ASTM A 240 Type SS 321	0000995140100C80	80 KG		18000
16	Special RTJ Gasket For 27" ID Flange, Item No.2 of Attached Drg. No. P1-ES-05071, MOC: Iron or Soft Steel With 120 BHN Max., Max. out of Roundness = 1/8"	2010115059924770	1 No.	201004140659	34151
17	Stud With Two Hvy. Hex. Nut & Two Washer, Stud Size: 3-1/2" X 21-1/2" Long, Thread: 8UN, Stud MOC: SA193 B16, Nut MOC:SA194 GR. 2H, Washer MOC: AISI C-1040	20101150599546D0	8 Nos.	201004140735	168000
18	Stud With Two Hvy. Hex. Nut & Two Washer, Stud Size: 2-1/4" X 12-3/4" Long, Thread: 8 UN, Stud MOC: SA193 GR.B7, Nut MOC: SA194 GR.2H, Washer MOC: AISI C-1040	2010115059954510	4 Nos.	201004140734	6400
19	Stud With Two Hvy. Hex. Nut & Two Washer, Stud Size: 2-1/2" X 14-7/8" Long, Thread: 8 UN, Stud MOC: SA193 Gr.B7, Nut MOC: SA194 Gr.2H, Washer MOC: AISI C-1040	2010115059954630	4 Nos.		7200
20	Stud - Full Threaded With One Nut, Size: 1-1/8" X 4-3/4" Long, Thread -8UN, MOC : Stud - ASTM A193 B8, Nut - ASTM A194 GR.8	20101150599546E0	20 Nos.	201004141195	5500
21	Stud - Full Threaded With Two Nuts, Size: 1-1/8" X 150mm Long, Thread – 8UN, MOC: Stud - ASTM A193 B8, Nut- ASTM A194 GR.8	20101150599546F0	20 Nos.		8500
22	Special Ring Joint Gasket for 27" ID flange, MOC: Iron or Soft Steel (120 BHN), Drg. No. P1-ES-05071 for 105-D	2010115059924770	1 No.		34151
23	Aluminium Wall Reclining Single Ladder, Size:10' Long X 1.5' Wide		5 Nos.	201004141227	12500
24	Aluminium Wall Reclining Single Ladder, Size: 15' Long X 1.5' Wide		4 Nos.		15000
25	Aluminium Wall Reclining Single Ladder, Size: 22' Long X 1.5' Wide		3 Nos.		19380
26	Scaffolding Material			201004140979	253650
27	Plasma Torch			201004140855	44500
28	TIG Torch			201004140591	57000
29	Pneumatic Jack Hammer		2 Nos.	201004141109	91320
30	Taps			201004141016	183070
31	Dies			201004141015	45515
	Total Amount				RS.1558846

Waste Heat Boiler, 101-CA

Liner of 101-CA was found damaged during inspection in Short Shut down-August 2013. Hence it was decided to carry out repairing jobs during Shutdown.

After getting clearance from Production, all steam side flanges i.e. Downcomer flange, T1; Top Channel Cover flange, F1; Riser Flanges, T2A & T2B & gas side flange i.e. Outer Tube Sheet to Shell Flange, F3 were disconnected by opening respective studs.

Down comer elbow was removed from top by lifting it through the trolley mounted 30 Ton chain block & brought to the ground by the help of Kobelco crane. Lifting cover was taken to the top by the help of crane & placed over the Top Channel Cover flange, F1 & tightened all the studs.

3 nos D-shackles of 50 Tonne each (for lifting) & 2 nos D-shackles of 50 Tonne each & one sling of 16 tonne (for bundle transferring on crane) were fixed on Lifting cover & after that Tube Bundle was lifted by trolley mounted chain block.

On 31-03-2014 when the bundle was removed from the shell and was lifted little more for shifting, all of a sudden the tube bundle fell down in it's shell without causing any kind of man injury.

Due to the impact of falling the following damages were observed:

- Shell flange was found bent and face was damaged at several places
- Shell to outer tube sheet studs got bent and broken
- Tubes at outer periphery was found badly damaged,
- Crack was developed in foundation column

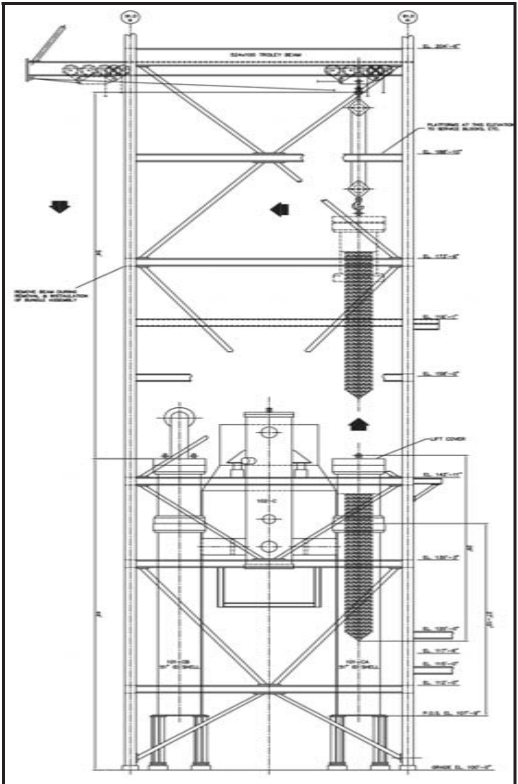
Following actions were taken:

- The tube bundle was removed by Kobelco crane without using chain block. (Ref incident report below for detail rigging arrangement)
- It was decided to replace top shell flange with new flange. The size of Flange was 53" dia x 45 mm thick. It was replaced by M/s A M Erectors, Ahmedabad who were available at site.

Repairing of the damaged 6mm thick Incoloy 800H liner of 101-CA shell was carried out by M/s J&J.

Erection of Tube bundle

Erection of tube bundle was always carried out with the help of 30 T capacity chain pulley block as per rigging plan given below.



REFORMER STRUCTURE
VIEW LOOKING EAST

Earlier, IFFCO was not having higher capacity crane to carry out this job by crane.

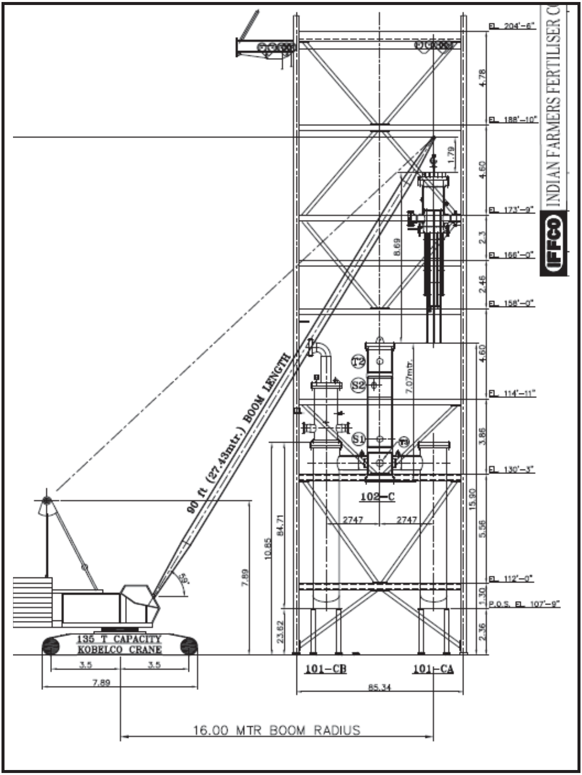
After this failure, the possibility of using 135 T Kobelco crane was explored.

There was limitation of head room, as there was fouling of boom due to structure above 101-CB and 101-CB top cover with down comer elbow . After detailed study, the following arrangement was made to perform the job safely.

- Rigging arrangement was made as given below.

- Fouling structural members were removed.
- 101-CB top cover with down comer elbow was opened and removed
- Ramp was made to raise the crane elevation by using sand & ½" thk MS plate (Photograph attached below.)

RIGGING PLAN WITH CRANE



ACTUAL PHOTO OF CRANE WITH RAMP

Even after the above arrangement, still head room was not sufficient to lift the bundle and hence tube was tilted little bit to remove the same. To overcome this and use the crane in future to carry out the job safely the following actions have been taken.

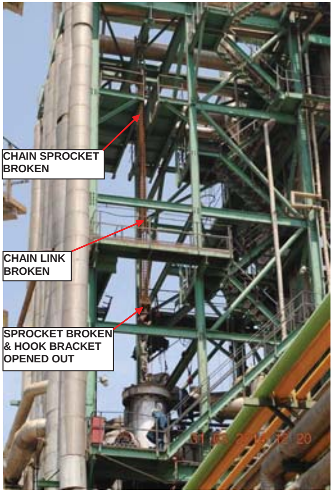
- To procure a new boom section of 5' length.
- Removal of existing monorail structure.

The exchanger was boxed up with spare Tube bundle No-2, (No-1-71-04-31049-2) which was repaired departmentally by replacing 7 nos tube.

The Incident report of failure of chain block is given below

Observations at site

- Sprockets, hook holding plates was found opened out which had resulted in detachment of Hook of chain pulley block along with its holding pin.
- One of the links of load chain was found broken.
- Some of the chain guide sprockets were found broken.
- Tube bundle was found fallen inside its shell and when it was removed from the shell several tubes of this bundle as well as tube sheet seal face were found damage.
- Gasket sealing face of shell and tube bundle was found damaged.
- Top layer of cement plaster of two structural column support of the heat exchanger was observed cracked.



Detail of Chain Pulley Block

Capacity: 30 T

Make: Elephant

Date of Testing: 20-03-2014

Load lifted for testing: 45 T

Chain pulley block was found satisfactory during above testing and no abnormality observed.

TEST CERTIFICATE

FORM NO. 10
(Prescribed under Rule-60)

Prescribed for report of examination of the lifting machines,ropes and lifting tackles :

PARTICULARS

1. Name of occupier of factory	:	JGM (P & A) ,IFFCO Kalol Unit
2. Address of factory	:	Indian Farmers Fertiliser Co-operative Limited P.O. Kasturinagar,pin-382423, Dist. Gandhinagar,Gujarat
3. Distinguishing number or mark (if any) and description sufficient to identify the lifting machine,chain,rope or the lifting tackle	:	Chain Pulley Block, Sr. No : AMM56 Make : ELEPHANT SWL : 30.000 Tonnes
4. Date when the lifting machine,chain,rope or the lifting tackle was first used in factory	:	N.A.
5. Date of each examination made under section 29(1) (a)(iii) and by whom it was carried out	:	Load lifted : 45.00 Tonnes Date of Test : 20-03-2014
6. Date and number of certificate relating to any test and examination made under subrule (1) of Rule 60 together with the name of person who issued the certificate	:	NONE
7. Date of annealing or other heat treatment on the chain and lifting tackle carried out under subrule(5) of Rule 60 and by whom it was carried out	:	N.A.
8. Particulars of any defect found at any such examination or after annealing and affecting the safe working load and of the steps taken to remedy such defect	:	No Defect observed during testing

I/We certify that on 20-03-2014,I/We thoroughly examined the above mentioned lifting machine/chain/rope lifting tackle and that the above is the correct report of the result.

Signature : ______________ Counter Signature : Akhilesh 20/03/14
(S Y Mehta)

Qualification : B.E.(MECH.)

Address : Sr Manager (Inspection),IFFCO,Kalol Unit,
Competent Person under factories ACT
Cert. No. : GUJ/DISH/CPT/A/0214/20.13

Date

S.Y. MEHTA
B.E.(MECHANICAL)
IFFCO KALOL UNIT
COMPETENT PERSON
UNDER FACTORIES ACT.

Investigation Report of Committee

A committee was constituted vide office order ED/05-01/14 dated 10th June 2014 by competent authority to investigate the reasons for falling of 101CA tube bundle in ammonia plant. The findings and recommendations of the committee is given below:

Findings of test report by M/S Met Heat of the failed chain link:

The failed chain link was sent to M/S Met Heat for test on 5th June 2014.

a. It is mentioned that brittle failure has first occurred in the heat affected zone of the failed link.
b. Elongated sulphide inclusions were observed.
c. Welding defects were observed on the failed chain link which might have worked as stress raisers.
d. Material of construction of the chain link was plain low carbon grade steel.

Observations of the committee on the damaged chain pulley block:

a. The chain pulley block in use is more than 20 years old.
b. The load chain links were found in dry condition and other moving parts like gear and sprockets insufficiently lubricated.
c. After testing, the load chain of chain pulley block was cleaned with Rustolene before storing in the enclosure.
d. Representative DP test was carried out on some of the chain links to find defects. No such defect has been observed.
e. Bottom hook assembly found damaged with sprocket teeth broken which is the after effect of falling down of the assembly.
f. Only one link of load chain was found broken.
g. Some of the chain guide sprockets were found broken.
h. IS 3832 2005 Hand Operated Chain Pulley Block Specification point no. 9.2 regarding operation proof test is not being followed in totality.
i. Elongation check is not being done by Inspection Section.

Root cause analysis of the accident :

a. There was no overloading as the lifting load was 26 MT while safe working load (SWL) is 30 MT and it was tested (test report as Annexure 2 attached) at 45 MT (1.5 times of SWL).
b. Test report submitted by Met Heat has not mentioned failure due to any torsional forces which eliminates chances of twisting of the load chain links.
c. Persons operating the chain pulley block were alert hence human error is ruled out.
d. Only one link of the chain had failed which is possibly due to brittle fracture in heat affected zone near weld fusion which caused the whole assembly to fall down. The reasons may be due to the following:
   i. Weld defects.
   ii. Excessive elongated sulphide inclusions in the material which may have acted as stress concentration sites during cyclic stretching loads exerted on the link. This may be a factor in origination and propagation of fatigue cracks.

iii. MOC of the load chain being low grade of carbon steel which does not have adequate fatigue properties.

iv. Dry (un-lubricated) use of the chain links might have reduced the life of the chain and caused fatigue.

Recommendations

- Chain Pulley Blocks more than 15 years old with MOC of the load chain being low grade of carbon steel which does not have adequate fatigue properties should be scrapped / replaced with latest Alloy steel load chains Grade 80 or 100.
- Third party Inspection to be got done after every five years for capacities above 5 MT
- Load Chain shall be kept well lubricated as per manufacturers recommendations across the whole length especially at the contact point between the links & kept in dust proof boxes.
- While testing of chain pulley block, lifting & lowering of test load should be through a length of lift which will ensure that every part of the block mechanism and each tooth of the gears come under load.
- Provision of digital load display system should be included for new procurements of load chains.
- Use of crane in place of chain pulley block may be preferred wherever possible for lifting loads above 5 MT.
- Inspection should check elongation of the chain links every year as per OEM's procedure.
- Necessary structural / piping modifications may be done for easier reach of Kobelco 135 MT crane boom for lifting 101-CA and thus avoiding use of chain pulley block.

PRIMARY REFORMER, SECONDARY REFORMER & AUXILIARY BOILER JOBS

The Primary Reformer Radiant Zone

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

Row No.	Burner Nos.
3	302, 304
4	404
5	503, 504, 505, 506, 512
6	601, 604, 605, 606, 611, 612
7	702, 705, 712, 713
8	801, 806, 813
9	901, 911

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

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

Damaged header insulation were replaced / repaired.

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 plugs were opened for replacement of catalyst of top half portion & then boxed up.

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

All burners air resistor overhauling done.

The Primary Reformer Convection Zone

“Cercoat ZL“ coating which was applied on eroded surface of Z section modules during Annual Turnaround-2012 was found intact. New ceramic Z section modules were found to be having erosion on the protective coating. New layer of “Cercoat ZL" was provided on damaged areas by the Civil Section using brush.

Refractory which was having crack were repaired & fallen ones were replaced at the ceiling after providing new holding clits against burnt off clits at such locations. Insulation of East, West & South wall was found satisfactory.

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 except BFW coil in the duct.HT & LT panels were boxed up with new gasket.

The transfer line end cover was opened for inspection and then boxed up.

The Secondary Reformer

Bottom cover was opened for inspection. Minor damage of refractory was observed and the same was repaired. Refractory material lying in pipe line towards 101-CA side was removed. Bottom cover boxed up with new gasket.
Top cover with Air distributer was opened & removed. Refractory of Air distributer was found peeled off. Also, erosion/corrosion was observed in the Air distributer nozzle. Damaged refractory (Cracks & peeled off) was repaired. Top cover with Air distributer boxed up with new gasket.

Auxiliary Boiler

Replacement of Refractory of East & West Side Wall

During operation, the east and west side wall of Auxiliary Boiler was having higher temperature on external surface. It also had hot spots at various points. Hence, it was decided to repair the refractory in this area. The side panels of the Auxiliary Boiler are of welded construction and have less clearance between the water wall and the refractory wall (about 6"). Therefore, it was not possible to carry out repair without cutting the panels. Hence, it was decided to cut and remove the complete side panel of East and West wall of the Auxiliary Boiler and carry out the casting.

At the time of execution, a mesh was found welded on V-type anchors having triangular pitch of length 125 mm on both side walls. This time, Y -type anchors having square pitch of length 140 mm were used instead of mesh welded on V-type anchors.

The supply cum erection contract was awarded to M/s Calderys India Refractories LTD., Ahmedabad against CPA No. 21004141231. As per the contract party had supplied Insulyte-11 refractory & Y-type anchors for the job & carried out the refractory replacement job along with welding of Y-type anchors (SS 304) on new plates whereas the panel cutting and re-welding of new panels (5mm thick. M.S Plate) was carried out by M/s J&J as per the WO No. 201004150184. The I-beam and channels were retained in position and were not removed during the execution of job.

The following activities were carried out for the purpose:

- Cooled down the furnace.
- Shifted all the fabricated panels to the site.
- Removed Insulation of the purge gas line and Instruments mounted on the panel.
- Scaffolding made at outside walls on both sides.
- Removed 4 nos. bolted panels of 1st row from top on both sides & breaking of refractory was carried out with the help of heavy Duty Pneumatic Chisel and debris was removed.
- From 2nd to 9th row onwards from top on both sides, panels were successively removed by gas cutting, refractory was broken & debris was removed.

REFRACTORY REMOVED PANELS WITH DAMAGED BRICKS

OLD PANEL

- Damaged MK-26 bricks were replaced by new one by using mortar on both sides.
- Damaged ceramic blanket was replaced on both sides
- New panels were cut as per measurement of old plates. Y-shaped anchors were welded on new panels on 140mm square pitch length.

NEW Y-TYPE ANCHOR WELDED ON NEW MS PLATE

- Panels of 9th row from top fixed by welding.
- Shuttering material fixed on 9th panel from top (the shuttering was made out of commercial plywood).

SHUTTERING ARRANGEMENT

- Pouring of the castable refractory was carried out.
- Curing time of six to eight hours was given to the castable refractory before next pouring.

NEW REFRACTORY 165 MM THICK AS SHOWN IN SKETCH

GAP SHOWN BETWEEN TUBES AND PANELS

- Panels welded, Shuttering material fixed, Castable refractory poured & cured for six to eight hours respectively & successively from 8th to 2nd panel from top. After curing, shuttering was removed and shifted.
- Pouring of refractory of 1st row of panels was carried out at Ground floor and then panels fixed bolted on its position.
- Scaffolding was removed from both sides.
- Fixing back the removed instrument panels.
- Manhole was closed by putting bricks and ceramic blanket.

HEAT EXCHANGERS AND COOLER JOBS

Condensate Stripper Exchanger, 171-C Replacement

Due to severe corrosion observed on carbon steel Shell of Condensate Stripper Exchanger, 171-C, it was completely replaced along with U-tube bundle by new upgraded MOC SS 304 exchanger. This exchanger was procured from M/s Aero Engineers, Ahmedabad vide PO No 201004140575 dated 12/09/2013.

The following activities were carried out for the replacement during shutdown:

- Disconnected all the shell & tube side inlet & outlet nozzles, vent & drain connections.
- Unbolting of Foundation bolts done.
- Removed old Exchanger using Hydra.
- Existing foundation bolts were not matching with the new exchanger holes, hence, old foundation bolts were cut, foundation RCC block was extended & new foundation bolts were grouted.
- Installed new exchanger using Hydra.
- Connected all the shell & tube side inlet & outlet nozzles, vent & drain connections.

114-C North side channel cover leak

North side channel cover was opened & removed. Grooves were found in shell gasket seating area which was repaired by weld deposition & then leveling done by filing. Channel cover & shell gasket seating area were cleaned properly and boxed up with new gasket.

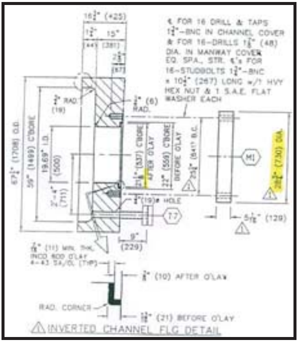
NH3 Converter Feed Water Exchanger,123-C

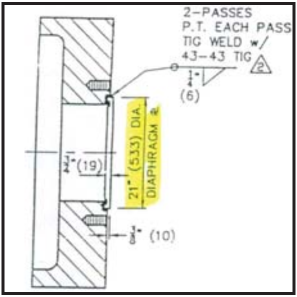
Non condensable gases & ammonia content were detected in the samples of BFW water outlet from 123-C. Hence, leakage was suspected from 123-C either by tube leakage or from tube to tube sheet seal weld joint.

The following activities were carried out during shutdown:

DIAPHRAGM CUTTING USING MATRA MACHINE

- Removed all nuts & washers of Top Manhole cover M1. Removed cover & all studs from the tapped holes in the channel body.
- Cut the diaphragm closure plate (MOC: SB-168 Incolloy 600) using Matra machine.
- Plugged Gas inlet nozzle T1 by wooden plug.
- Unbolted Channel pass partition plate cover bolts.



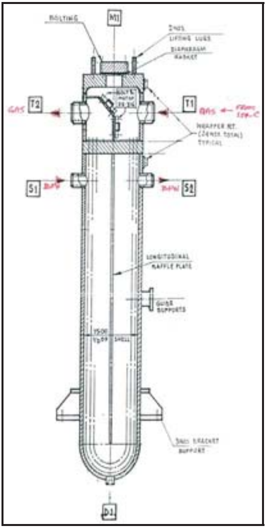


DIMENSIONAL DETAILS FOR DIAPHRAGM CUTTING

- Arrangement for Pneumatic test done & pressurize the shell side upto 5.3 kg/cm2g.

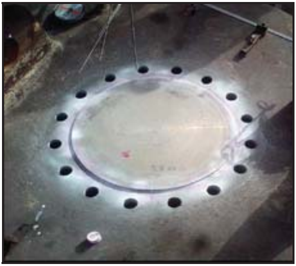
  Checked by soap solution, no any tube leakage detected.

- Arrangement for hydrotest was done & pressurized the shell side, at 70.0 kg/cm2g pressure leakage observed from the edge of the tube to tubesheet joint.
- Leakage was repaired as per the following procedure:
  - ➢ Cleaned the joint properly.
  - ➢ Preheat upto 150 ^{0}C.
  - ➢ Buttering was done by ER 309L Electrode.
  - ➢ DP checked. Found OK.
  - ➢ Fill-up & Final welding was done by ERNiCr3 Electrode.
  - ➢ Final weld DP was done. Found OK.
- After repairing, again Hydrotest was carried out upto 120 kg/cm2g. No leakage was found.
- Boxed up the Channel pass partition plate cover with new gasket & tightened all the bolts.
- Edge preparation done & welding of Diaphragm plate was done by ERNiCr3 filler wire after preheating. Final weld DP checked, found OK.
- Manhole cover boxed-up.



GENERAL ARRANGEMENT

LEAK DETECTED AFTER HYDROTEST



DP CHECK OF FINAL WELDING

ARRANGEMENT MADE FOR TACK WELD DIAPHRAGM

DP CHECK AFTER FINAL WELDING

OTHER EXCHANGERS

EQP TAG		HYDROJETTING		HYDRO TEST	Remarks
		TUBE SIDE	SHELL SIDE (Tube bundle pull out)		
101-JCA		✓			
101-JCA	I/A COOLER	✓			
101-JCB		✓			
101-JCB	I/A COOLER	✓			
101-JLC1	LUBE OIL COOLER	✓			
101-JLC2	LUBE OIL COOLER	✓			
103-JLC1	LUBE OIL COOLER	✓			
103-JLC2	LUBE OIL COOLER	✓			
103-JBT	GLAND CONDENSER			✓	Replaced by new Duplex steel tube bundle
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		✓		✓	Tube Bundle pulled out for gasket replacement
105-CB		✓		✓	
107-JT	LUBE OIL COOLER	✓			
107-JAT	LUBE OIL COOLER	✓			Cleaning done before shutdown
108-C1A		✓		✓	
108-C2A		✓		✓	
109-C1B	REFORMER SIDE	✓		✓	
109-C2B	REFORMER SIDE	✓		✓	
110-CA		✓			

EQP TAG		HYDROJETTING		HYDRO TEST	Remarks
		TUBE SIDE	SHELL SIDE (Tube bundle pull out)		
110-CB		✓			
114-C				✓	Channel cover Gasket replaced
115-C			✓	✓	Shell side: 2004-J Discharge pressure
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	✓			
124-C			✓	✓	Shell side : 8.0 Kg/cm2g
127-CA		✓		✓	Shell side : 26.0 Kg/cm2g
127-CB		✓		✓	Shell side : 26.0 Kg/cm2g
128-C		✓			
129-JC	101-J INTERCOOLER	✓			
130-JC	101-J INTERCOOLER	✓			
131-JC	101-J INTERCOOLER	✓	✓		
150-C		✓			
173-C		✓			
HE-2	PGR	✓			
HE-4	PGR	✓			

VESSEL INSPECTION / REPAIR JOBS

- 102-EB, CO2 Stripper: Top Manhole opened & boxed up after inspection, cleaning, tightening loose North/South side U-Clamps of East/West side distribution header & providing new fasteners against missing fasteners of top tray.
- 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 tightened in flange joint of 6" BFW header.
- 104-F, Synthesis Gas Compressor Suction Drum: Manhole opened & boxed up after inspection & cleaning. No repairing was required.
- 104-D1, HTS Shift Converter: Support of steam inlet header and its distributor branches were found broken at many places. Repaired the broken supports by welding. New fasteners provided with support against missing one. Replaced damaged wire mesh provided around dump out nozzle.

- 103-E1, HP Flash Vessel: Top manhole opened for inspection and then boxed up. No repair was carried out.
- 102-F & 103-F manhole opened for inspection and then boxed up. No repair was carried out.
- SR-1, Ammonia Accumulator: Manhole opened for inspection and then boxed up. No repair was carried out.
- 107-F, Primary Ammonia Separator: Manhole opened for inspection and then boxed up. No repair was carried out.
- 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 repair was carried out.
- 109-F, Refrigerant Receiver: Manhole opened for inspection, cleaning done and then boxed up. No repair was carried out.
- 101-U, Deaerator: Manhole opened for inspection, cleaning done and then boxed up. No repair was carried out.
- 102-B, Start-up Heater: Manhole opened for inspection, cleaning done, damaged refractory repaired and then boxed up.
- 102-D, Desulphuriser: Manhole opened for inspection, cleaning done, circumferential cracks in Gas outlet nozzle screen, top stiffener plate weld was repaired & then boxed up.
- 106-D, Methanator: Top Manhole & bottom elbow opened for carrying out catalyst & internals replacement. Boxed up after the job was over.
- E1, Cold Box: Manhole opened for inspection, cleaning done & boxed up.

RLA STUDY OF BOILERS:

101-F (Boiler No. GT-1632)

RLA study of all pressure parts and components of Boiler system was carried out by M/s NTPC-Alstom Power services (P) Ltd against WO No. 201004141085 dated 24/12/2013.

112-C (Boiler No. GT-1631)

Mini RLA Study of Waste Heat Boiler No GT-1631 was carried out by M/s NTPC-Alstom Power services (P) Ltd against CPA No. 201004141232.

OPEN INSPECTION & HYDROTEST OF BOILERS:

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

Sr. No.	Tag No.	Identification No.	Hydrotest Pressure (kg/cm^2)
1	112-C	Boiler NO GT-1631	15.9
2	101-F	Boiler No. GT-1632	146.0
3	107-C	Boiler No.GT-5217	67.5

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 (3.6) X 6”	111.80
5	PSV-986 (107-C)	4 L 6	45.00
6	PSV-987 (107-C)	4 L 6	46.30
7	RV-104-D1	6 Q 8	35.00
8	RV-103-J	3 K 4	159.00
9	RV-103-JA	3 J 4	158.90
10	RV-105-D	3 K 4	153.00
11	RV-105-D-A	3 J 4	152.90
12	RV-106-F	1.5” X 2”	158.00
13	RV-102-F	6 R 8	29.60
14	RV-123-CA	3 J 6	122.00
15	RV-123-CB	3 J 6	122.00
16	RV-MS-9	4 P 6	43.00
17	RV-BFW-1	1-1/2 G 2-1/2	92.10
18	RV-112-CA	1-1/2 H 3	10.50
19	RV-112-CB	1-1/2 H 3	10.50
20	RV-109-F	6 Q 8	19.00
21	RV-110-F (N)	3 L 4	7.00
22	RV-110-F (S)	3 L 4	7.00
23	RV-111-F	4 P 6	6.30
24	RV-112-F	4 M 6	6.30
25	RV-104-D2	1-1/2 F 2	34.10
26	RV 101-J	4 M 6	36.90
27	RV-S-7	4 P 6	14.80
28	RV-LS-1	4 N 6	12.70
29	RV-S-26	2-1/2 J 4	14.60
30	RV-103-JAT	4 P 6	46.41
31	RV-170-C (Shell side)	3 K 4	5.30
32	RV-170-C (Tube side)	¾” X 1”	30.60
33	RV-129-C	1 E 2	8.40
34	RV-101-E	1 D 2	30.60
35	RV-PG-39	4 M 6	5.30
36	PSV - 180	0.5” X 0.5”	6.13
37	PSV -167	0.5” X 0.5”	4.00
38	RV-181	3” X 4”	6.13
39	PSV – 935 (RV 116-JAT)	3 K 4	6.10
40	RV-117-J	1.5” X 2.5”	15.80
41	PSV-977 (Absorber Inlet)	4 P 6	32.20

Sr. No.	RV Tag NO	Valve Size	Set Pressure (kg/cm^2) g
42	PSV-976 (Absorber Inlet)	4" X 6"	30.60
43	105-F (103-J 1st stage separator)	1" X 2"	73.80
44	104-F (Syn. Gas Comp. Suction separator)	1" X 2"	29.90
45	RV-105-JLO	2 J 3	5.30
46	RV 115-JA-01	1 E 2	11.00
47	RV 115-JA-02	1 E 2	11.00
48	RV 115-JB-01	1 E 2	11.00
49	RV 115-JB-02	1 E 2	11.00
50	PSV-502	3" X 600 4" X 150	20.00
51	RV-101-L	1-1/2" X 2-1/2"	30.94
52	RV-141-F (Instrument Air Receiver)	1 D 2	7.70
53	101-JT	3/4" X 1"	5.27
54	101-U (Deaerator RV)	4 L 6	3.50
55	RV-175-J	1-1/2 F 2	7.00
56	RV-172-F	8" X 8"	Positive: +375 mmwc, Vacuum: Nil
57	RV-172-F/B	2" X 2"	Positive: +35 mmwc, Vacuum: -35 mmwc
58	RV-175-F	1-1/2" X 2"	4.03
59	PSV-919	6" X 10"	10.00
60	PSV-920	6" X 10"	10.50
61	PSV-921	6" X 10"	10.50
62	103-JBT Exhaust	¾" X 1-1/2"	0.35
63	RV-197-J-3 (PSV-914)	1 E 2	30.60
64	RV-101-JT	1-1/2 H 3	0.70
65	RV-104-JT	8 T 10	0.35
66	SV-01 (117-J)	1-1/2" X 3"	5.80
67	RV-103-JAT Sentinel	1 G 1-1/2	46.40

FABRICATION JOBS:

SR. NO.	JOBS
1	LC-8 passing valve replaced
2	Replaced passing drain valve of CG circulation to LTS inlet drain line (28 kg/cm2g pressure)
3	11 kg/cm2g steam trap I/V gland leakage near 101-D steam header - Replaced both valves from root
4	Replaced 115-JA Silo side LO filter vent isolation valve
5	116-JAT TTV D/S trap not working properly – Replaced Trap

6	Replaced SP-73 drain pot I/L I/V which was not working.
7	116-JAT trap bypass valve wheel free – Replaced valve
8	MS header trap near 108-J/JA pump : Nipple weld joint leak – Reweld after grinding, Union leak - Replaced union
9	Replaced leaky union of 101-JT gland condenser O/L condensate line.
10	HS sample cooler CW inlet valve bush broken (Near BVD of Aux boiler) – Replaced valve
11	Ameral charging line to HPFV elbow joint leak (4^{th} elbow from top of ball valve) – Repaired by welding
12	Replaced passing 107-JAT drain valve
13	115-JB Silo Side LO filter bypass line nozzle leak – Repaired by welding
14	Replaced LIC-8 strainer U/S valve
15	115-JB discharge recirculation line joint leak – Repaired by welding
16	4” X 900# plug valve of 120-C bypass line replaced by 4” X 1500# flanged globe valve.
17	Both 101-CA & CB Shell side drain size increased to 2” X 1500#
18	Pin hole leakage of 11 kg steam line behind 2002-LJ attended.
19	Replaced 104-JA seal cooler damaged cooling water inlet line
20	Replaced badly passing LCV-8 strainer upstream valve
21	Fabrication jobs for 2002-LJ & LJA installation carried out
22	103-D thermocouple TI-0118 & TI-0119 pad leakage repaired by welding
23	102-EB shell leakage repaired by patch welding.
24	Replacement of complete piping of 101-BJT steam inlet to stack carried out
25	Corroded and hanging FRC-2 block valve platform was repaired.
26	Platform made for 115-JAT butterfly valve.

SR. NO.	JOBS
CONTRACTOR – J & J (SD CONTRACT)	
1	Replaced carbon steel inlet & outlet line of R1 & R2 vessel in PGR area by SS line.
2	Repairing of damaged 6mm thick Incolloy 800H liner of 101-CA shell carried out.
3	Removed gear operated globe valve in LTS outlet line & installed a spool piece with provision of 2" vent.
4	Removed existing HTS vent control valve MIC-003 of size: 6”X900#. 2 nos. flanges of size: 6”X600# were welded for replacement of control valve.
5	PICV 178 control valve replacement

CONTRACTOR – SHREE GANESH (CONTRACT)	
1	101-F blow down line leak repaired
2	RLA sampling done
3	103-J New LO / SO system

VALVE GLAND REPACKING JOBS:

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

- All adjoining valves of 101-F & 107-C
- HCV-13 South side
- 106-F LVL troll bottom I/V
- 120-C south end, tube side drain I/V
- HCV-12
- 113-J discharge valve
- 104-J outlet valve
- C2 steam line I/V
- PIC-13 South Side
- MIC-9A bypass isolation valve
- LIC-490 u/s isolation valve
- SP-1 bypass valve
- V-6 u/s steam trap I/V
- 105-CA condensate line drain valve
- 103-JAT I/V MOV SP-154 bypass valve
- 104-JAT Inlet I/V by-pass valve
- HS header drain valves
- PC- 2A pump balance line I/V
- 111-F drain valve
- 101-JLT steam inlet line 1st drain valve
- PI -100 root valve
- 2004-JT inlet & exhaust isolation valve
- V-6 Steam trap I/V
- PIC-502 D/S PI I/V

MISCELLENEOUS JOBS:

SR. NO.	JOB
1	C1 third platform flange leak-Gasket replaced
2	115-JB flushing fluid strainer drop-wise leakage – Teflon Gasket replaced.
3	101-D gas inlet vessel nozzle flange leak – Gasket (6”x 300#) replaced.
4	107-C drain flange leak - RTJ Gasket (1-1/2”X 600# - 3nos.) replaced
5	LIC- 8 U/S strainer cleaned.
6	MS to LTS bottom I/V bonnet leak - Gasket (6”x 150#) replaced
7	Drop wise leakage from 115-J discharge USV U/S drain valve bolt attended.

8	103-JAT leak off steam line RV u/s flange leak - Gasket replaced
9	Fire hydrant valve flange leakage at GAIL MTR Station - Gasket replaced
10	115-JA suction line vent union leak attended
11	115-J Discharge USV u/s drain valve thread leak attended
12	HCV-10 D/S Flange leak – Gasket replaced
13	38 ata steam to HTS line I/V Bonnet leak – Bonnet gasket replaced.
14	107-C Manhole Flange leak – Gasket replaced
15	Antifoamer charging to LPFV Ball valve bonnet leak attended
16	LIC-503 Bypass valve near C-2 bottom in ARU – Valve replaced
17	101-B BR NO 305 bottom union leak – union replaced
18	Ameral charging line to 102-EB above 116-JB Suction furmanited flange joint – Cleaned & gasket replaced.

INSPECTION OF CHECK VALVES

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

- 103-D air inlet NRV FRC-2 NRV (Steam inlet NRV)
- 103-J (short loop) HP Case suction
- 103-J final discharge u/s of SP-1.
- 101-J discharge
- PICV-139 downstream.
- PGR E-3 outlet gas line to K-1
- FRCV-1 d/s check valve

PAINTING OF SILENCER SP-73

For Aluminising of silencer,SP-73, it was removed from position by Kobelco crane and kept on ground floor. It was found that the internals were damaged. It was repaired. Aluminising was done and installed back in position by Kobelco crane.

UREA PLANT
(MECHANICAL)

ROTATING EQUIPMENT

In Annual Turnaround 2014, M/s. BVL POWER SYSTEMS PVT LTD carried out the following jobs in “Hitachi” compressor train, Hyderabad from date 26/03/2014 to 11/04/2014 against BPA 201004141115 dated 24-12-2013.

- Preventive maintenance of steam turbine (Q-1801)
- Preventive maintenance of LP case (K-1801-1)
- Preventive maintenance of HP case (K-1801-2)
- Preventive maintenance of Gear Box (M-1801)
- Overhauling of governing system of main steam (60 ata), extraction steam (23 ata) & (4 ata) induction steam

Preventive Maintenance of CO_2 Compressor drive Turbine (Q-1801)

Turbine was taken for preventive maintenance. Following activities were carried out:

- Decoupled the Turbine from LP case.
- Alignment of Turbine and LP case was checked and found disturbed.
- Journal bearing assembly on free end side was opened for inspection. Found clearance values within acceptable limit. (Ref Table-1).
- Journal bearing assembly on LP case side was opened for inspection. Found clearance values within acceptable limit. (Ref Table-1).
- Thrust bearing was opened for inspection. Clearances value found within acceptable limits.
- Turbine float: 0.20mm; Net float = Total float – Housing play = 0.32mm - 0.12mm (Design float: 0.25mm to 0.35mm)
- Gauss measurement of Journal and thrust bearing pads, base rings, shaft journal, thrust collar were carried out, found within acceptable limit.
- DP testing of pads, thrust collar and journal shaft was done and the same were found acceptable.
- Final alignment readings were taken and corrected as per OEM reference values. Details are given in this report.
- LP case and Turbine was coupled at the required tightening torque 53.2 kgf.m **(521.36 N. m).** The Coupling spacer between LP casing & Turbine was assembled.

Table 1-Bearing clearance for Turbine

Description	Front End Journal bearing	Rear End Journal Bearing
Journal diameter, mm	Ø124.81	Ø159.73
Bearing bore, mm	Ø125.08	Ø160.02
Shell bore, mm	Ø160.00	Ø204.98
Pad thickness, mm	17.46	22.48
Clearance, mm	0.27	0.29
Design Clearance, mm	0.18 to 0.31	0.24 to 0.35
Interference, mm	0.02	0.01

Preventive Maintenance of CO_2 Compressor LP case (K-1801-1)

LP compressor was taken for preventive maintenance. Following activities were carried out:

- Decoupled the LP case from gearbox and Turbine.
- Alignment of LP case with gear box and turbine was checked and found disturbed.
- Journal bearing assembly on GB side was opened for inspection. Found clearance values within acceptable limit. (Ref Table-2)
- Journal bearing assembly on Turbine side was opened for inspection. Found clearance values within acceptable limit. (Ref Table-2).
- Thrust bearing assembly was opened for inspection. Clearances value found within acceptable limits.
- Axial thrust : 0.38 mm (design value : 0.28mm to 0.38mm)
- Gauss measurement of Journal and thrust bearing pads, base rings, shaft journal, thrust collar were carried out, found within acceptable limit.
- DP testing of thrust pads, thrust collar and shaft journal was done and the same found acceptable.
- Alignment of Turbine - LP Case and LP case – Gear Box was corrected as per OEM reference values. Details are given in this report.
- LP case with Gear box was coupled at required tightening torque 20 kgf.m (196 Nm) and with turbine was coupled at the required tightening torque 53.2 kgf.m (521.36 N. m). Finally spacers between Turbine - LP case and LP case - Gear box were assembled after alignment correction.

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

Description	Turbine side Journal Bearing	Gear box side Journal Bearing
Journal diameter, mm	Ø119.98	Ø119.98
Bearing bore, mm	Ø120.12	Ø120.13
Shell bore, mm	Ø185.00	Ø185.01
Pad thickness, mm	32.44	32.44
Clearance, mm	0.14	0.15
Design Clearance, mm	0.11 to 0.15	0.11 to 0.15
Interference, mm	0.07	0.11

Preventive Maintenance of CO_2 Compressor HP case (K-1801-2):

HP compressor was taken for preventive maintenance. Following activities were carried out:

- Decoupled the HP case from Gear box
- Alignment readings were checked and found disturbed.
- Journal bearing assembly on Gearbox side was opened for inspection. Step marks were observed in top bearing pads. Replaced the same with new bearing pads. (Clearance values measured are given in Table-3)
- Journal bearing assembly on free end side was opened for inspection. Step marks were observed in top bearing pads. Replaced the same with new bearing pads. (Clearance values measured are given in Table-3)
- Thrust bearing was opened for inspection. Clearances values found within acceptable limits.
- Axial thrust: 0.30mm (design value : 0.25 to 0.35)
- Gauss measurement of Journal and thrust bearing pads, base rings, shaft journal, thrust collar were carried out, 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 (Diametrical Clearance) Details for HP case

Description	Gear side Journal bearing	Rear end Journal bearing
Journal diameter, mm	Ø79.99	Ø132.00
Bearing bore, mm	Ø80.12	Ø131.87
Shell bore, mm	Ø132.00	Ø132.00
Pad thickness, mm	25.94	25.94
Clearance, mm	0.13 (new bearing)	0.13 (new bearing)
Design Clearance, mm	0.11 to 0.14	0.11 to 0.14
Interference, mm	0.10	0.06

Preventive Maintenance of GEAR BOX M-1801

Gear Box was taken up for major overhauling. Following activities were carried out:

- Decoupled the Gear box from LP case and HP case
- Alignment of Gear box with LP case and HP case was checked and found disturbed.

Low-speed Gear Shaft and Bearings:

- Both Low speed shaft bearings (Elliptical Type) were inspected and clearances values found within acceptable limit. (Clearance values measured are given in Table-4).

- Gauss measurement of pads, journal shaft, thrust collar and bearing was carried out by Inspection section. Gauss value of thrust bearing base ring (inboard side) was 3.2-3.6. It was reduced to the acceptable limit by demagnetization.
- DP checking of thrust bearing pads, thrust collar, journal shaft and bearing was done and found satisfactory.

High-speed Pinion Shaft and Bearings:

- Both Pinion shaft bearings (Offset Halves Type) were opened for inspection. Clearance values found above design clearance. Both side bearing were replaced with new ones.
- Gauss measurement of shaft journal and bearing was carried out by Inspection section and found within acceptable limit.
- DP testing of shaft journal & bearing was done and the same was found acceptable.
- Assembly was done using the same bearings.
- Alignment between LP case – Gear box and Gear box – HP case was corrected as per OEM reference values. Details are given in this report.
- Gear Box with HP case was coupled at the required tightening torque 9.7 kgf.m (95.06 Nm) and with LP case was coupled at required tightening torque 20 kgf.m (196 Nm)

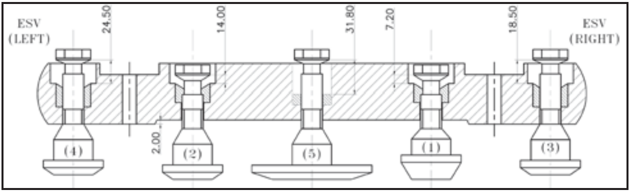
Table 4- Bearing clearance for Gear Box

Description		Before O/H (mm)	Design Value (mm)	After O/H (mm)
Low speed shaft	Journal bearing clearance on LP side (Front)	0.15	0.125 to 0.185	0.15
	Journal bearing clearance on HP side (Rear)	0.15	0.125 to 0.185	0.15
	Thrust bearing clearance	0.40	0.38 to 0.61	0.40
High speed shaft	Journal bearing clearance on LP side (Front)	0.18	0.15 to 0.21	0.18
	Journal bearing clearance on HP side (Rear)	0.24	0.15 to 0.21	0.24
Gear backlash		0.47	0.383 to 0.608	0.47

Overhauling of governing system of main steam (60 ata), extraction steam (23 ata) & (4 ata) induction steam

Main Steam (60 ata) Control valve

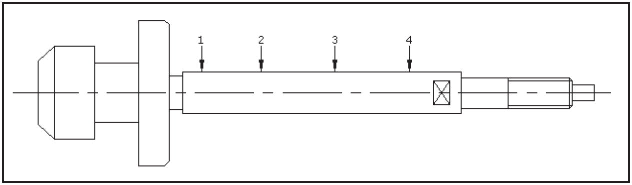
- Dismantled the 60 ATA control valve assembly (Drawing no. 0-0006-0802-04).
- Left side spindle was worn out at bottom gland bush area. Replaced the spindle with new one
- Valve cones blue matching and lapping was carried out.
- Boxed up assembly using new side gland packing rings in left and right side



All values are in mm

Description	Valve Cone No-4	Valve Cone No-2	Valve Cone No-5	Valve Cone No-1	Valve Cone No-3
Total lift, mm	24.50	14.60	31.80	7.20	18.50
Yoke step (-)	------	2.00	2.00	2.00	------
Actual lift	24.50	12.60	29.80	5.20	18.50

- **<u>Control valve spindle run-out readings</u>**:



Spindle Run-out								
Position	Left Side (mm)				Right Side (mm)			
	1	2	3	4	1	2	3	4
0º	0	0	0	0	0	0	0	0
90º	0	0.08	0.02	0.02	0	0.02	0.00	0.01
180º	0	0.06	0.02	0.03	0	0.08	0.02	0.01
270º	0	0.06	0.02	0.01	0	0.05	0.03	0.01

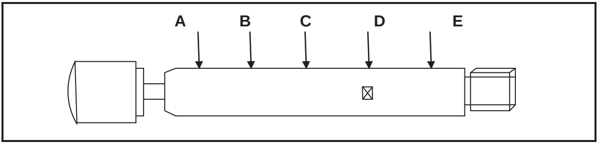
<u>Main Steam (60 ata) Pilot Valve</u>

- Pilot assembly was dismantled
- Axial bearing (51100) was replaced with new one.
- All parts were thoroughly cleaned
- Boxed up the pilot valve assembly using new sealing set

Main Steam (60 ata) Emergency Stop Valve:

- Steam and hydraulic side assembly of both ESV was dismantled.
- Both strainers were found satisfactory condition.
- Both valve seat lapping and blue matching were carried out.
- All parts were thoroughly cleaned
- Boxed up the both ESV using new seal kit.

RHS ESV Spindle Run-out readings:



Position	A, mm	B, mm	C, mm	D, mm	E, mm
0º	0	0	0	0	0
90º	0	0.01	0	0.01	0.02
180º	0	0.01	0	0.01	0.02
270º	0	0.01	0	0.01	0.02

Extraction Steam (23 ata) Control valve

- Dismantled the extraction steam (23 ata) control valve assembly (Drawing no. 0-0006-0840-21).
- Spindle run-out was checked and found higher side. Spindle was replaced with new one.
- All parts were thoroughly cleaned
- valve seat lapping and blue matching were carried out
- Boxed up the assembly using new gland packing.

Extraction Steam (23 ata) Servo cylinder

- Servo cylinder assembly was dismantled. (Drawing no. 0-0006-1900-08)
- All parts were thoroughly cleaned
- Boxed up the assembly after using new seal kit.

Extraction Steam (23 ata) Pilot Valve

- Pilot valve assembly was dismantled. (Drawing no. 0-0006-1910-07)
- Axial bearing (51100) was replaced with new one.
- All parts were thoroughly cleaned
- Boxed up the pilot valve assembly using new sealing set.

Extraction Steam (23 ata) NRV

- Top cover of NRV was removed. (Drawing no. 0-0006-2352-04)
- NRV flap (jointing disc) blue matching was checked with seating area. Found satisfactory.
- Gland packing was replaced by new one. (5 Nos)
- NRV Condition was checked after assembling back.
- All parts were thoroughly cleaned
- Top Cover bolts were tightened.

Induction Steam (4 ata) Control valve

- Dismantled the induction steam (4 ata) control valve assembly (Drawing no. 0-0006-0840-22).
- All parts were thoroughly cleaned
- valve seat lapping and blue matching were carried out
- Boxed up the assembly using new gland packing.

Induction Steam (4 ata) Emergency stop Valve

- Steam and hydraulic side assembly of ESV was dismantled.
- All parts were thoroughly cleaned
- Main cone and diffuser blue matching and lapping was carried out.
- Boxed up the ESV using new seal kit.

DBSE at outward position of each shaft

Description	Top, mm	Left, mm	Right, mm	Bottom, mm
Turbine - LP case	737.91	737.91	737.91	737.91
LP case - Gear box	337.46	337.45	337.46	337.45
Gearbox - HP	674.95	674.96	674.96	674.92


Turbine - front side


Turbine – rear side


Gear box – top cover removed


Gear box – thrust bearing assembly


Gear box – high speed bearing (lower half)


Gear box – high speed bearing (lower half)


4 ata control valve – removal of stem

4 ata control valve – removal of stem

Pilot valve


Pilot valve removal


60 ata ESV – spindle assembly mounting

23 ata control valve – stem


60 ata chest valve – lift bar

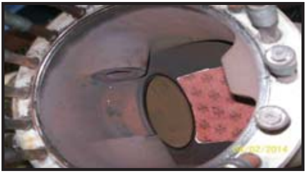

60 ata chest valve – lift bar

60 ata chest valve Lift bar with both spindle


Step marks observed in spindle (L) - area shown by white marker

23 ata check valve


23 ata check valve – removed top cover


23 ata check valve- removal of internals

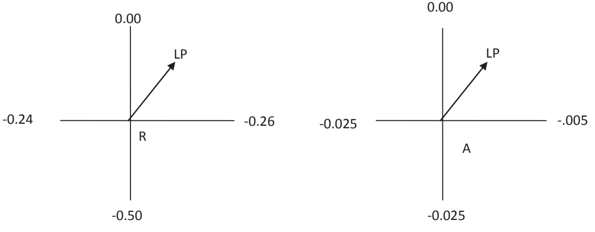
Pilot valve & servo cylinder

60 ata ESV – Strainer

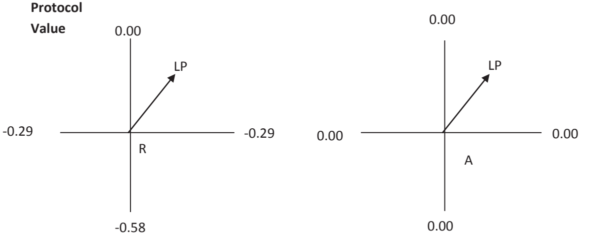
Pilot valve – after removal of top cover

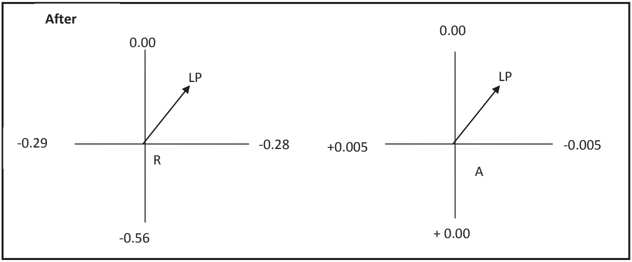
Alignment between Turbine and LP Case

Before

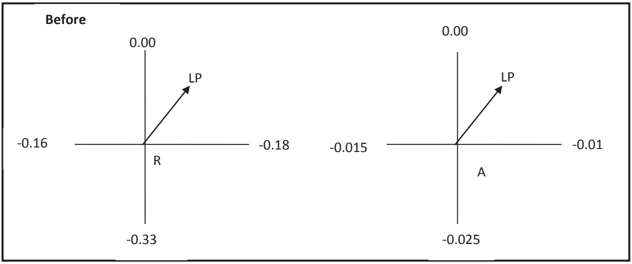


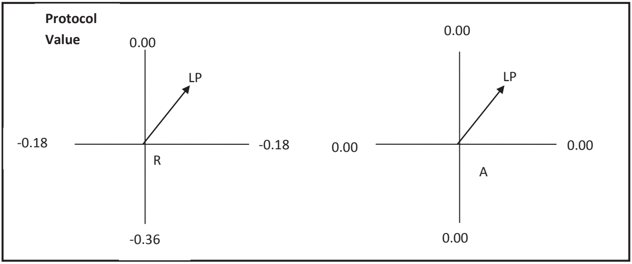
Protocol Value

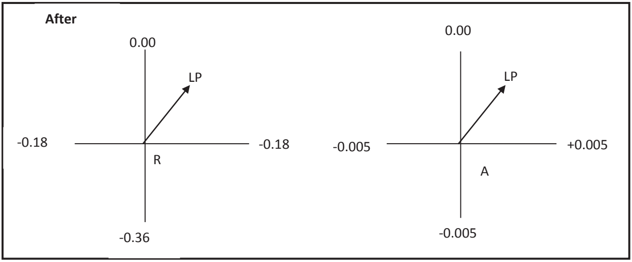




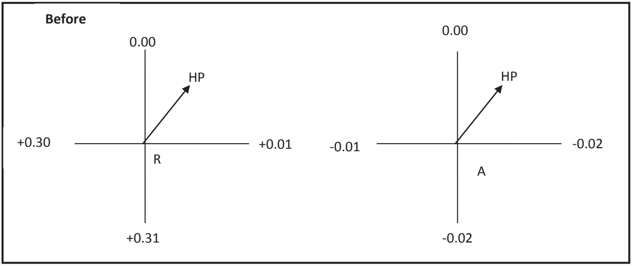
Alignment between LP Case and Gear Box

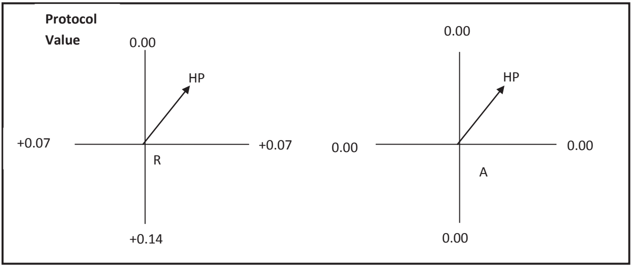


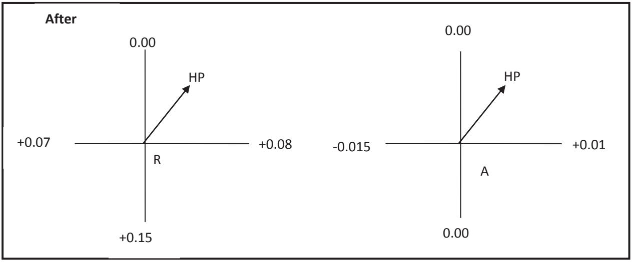




Alignment between Gear Box and HP Case







Calibration of control valve lift w.r.t secondary oil pressure:

After assembly of governing system, calibration of control valve lift for 60 ata, 23 ata & 4 ata steam was done with variation of secondary oil pressure respectively in the presence of production and instrument department.

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)	Secondary oil Pressure	Valve Lift (Div)
1	0	1.5	0	1.5	0	1.5	0
2	10	1.7	4	1.7	1	1.7	3
3	20	1.94	9.2	1.96	1.8	1.99	10
4	30	2.2	12.5	2.21	3.1	2.25	17
5	40	2.5	16	2.5	5	2.52	25.5
6	50	2.8	19.8	2.81	6.8	2.84	34.5
7	60	3.11	23.4	3.1	8.6	3.14	39
8	70	3.46	27.3	3.43	10.5	3.45	44
9	80	3.8	32	3.8	12.5	3.8	49.2
10	90	4.17	36.1	4.15	15	4.15	54
11	95	-	-	4.31	17.1	-	-
12	100	4.51	40.5	4.5	31	4.51	63.5

Pre - charging of Nitrogen in oil accumulator of control oil system:

Nitrogen pressure was checked in oil accumulator of control oil system of turbine. Pressure was 0.6 kg/cm2 g. Nitrogen was filled in accumulator bladder up to 2.6 kg/cm2 g with the help of Kit supplied by OEM.

HP VESSEL:

Autoclave V-1201

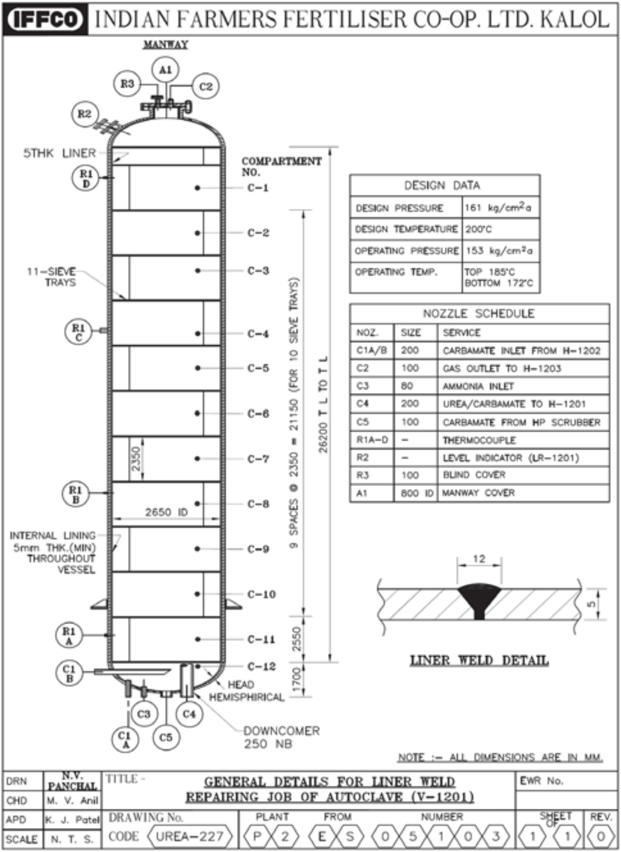
Repair of Liner weld joints of Autoclave

Liner welds of each compartment of V-1201 were most affected by corrosion. It was decided to repair liner weld one by one during shutdown.

1. During shutdown 2009 liner welds of 1st and 3rd compartment were repaired
2. During shutdown 2010, liner welds of 2nd and 4th compartment were repaired

3. During shutdown 2011, liner welds of 5th compartment were repaired.
4. During shutdown 2012, liner welds of 6th compartment were repaired.

During shutdown 2014, repairing of liner weld of 7th & 8th compartment was carried out. Contract was awarded to M/s Shree Ganesh Engineering, Ahmedabad against the CPA 201004141421 for executing the job.



DESIGN DATA	
DESIGN PRESSURE	161 kg/cm²a
DESIGN TEMPERATURE	200°C
OPERATING PRESSURE	153 kg/cm²a
OPERATING TEMP.	TOP 185°C BOTTOM 172°C

NOZZLE SCHEDULE		
NOZ.	SIZE	SERVICE
C1A/B	200	CARBAMATE INLET FROM H-1202
C2	100	GAS OUTLET TO H-1203
C3	80	AMMONIA INLET
C4	200	UREA/CARBAMATE TO H-1201
C5	100	CARBAMATE FROM HP SCRUBBER
R1A-D	–	THERMOCOUPLE
R2	–	LEVEL INDICATOR (LR-1201)
R3	100	BLIND COVER
A1	800 ID	MANWAY COVER

DRN	N.V. PANCHAL	TITLE - GENERAL DETAILS FOR LINER WELD REPAIRING JOB OF AUTOCLAVE (V-1201)				EWR No.
CHD	M. V. Anil					
APD	K. J. Patel	DRAWING No.	PLANT	FROM	NUMBER	SHEET OF / REV.
SCALE	N. T. S.	CODE UREA-227	P 2	E S	0 5 1 0 3	1 1 / 0

The following repair procedure was followed:

- Weld area was cleaned by SS wire brush.
- Welding joint was ground and flushed. Visible pitting / pores were removed with Grinder and surface was made smooth. It was ensured that grinding was not done deeper than 2 mm below the surface of liner.
- Corroded area of Heat Affected Zone of joints was also grinded and removed.
- DP of grinded portion was carried out. Porosity observed was removed. However if the porosity extends deeper than 2 mm below the surface of liner, it was fused while performing welding.
- Welding was done by TIG using 25-22-2LMn filler wire size-2.4 mm dia with low heat input.
- Inter pass temperature kept below 150 deg. C.
- Minimum three layer of weld was required. At some portions where the width was increased due to removal of corroded portion, an additional layer of welding was applied.
- It was ensured that no area was left ground without welding
- Final DP was carried out.
- Ferrite content was checked. It was found within acceptable limit (Max 0.6 %)
- Finally weld was cleaned and passivated by washing with 10 % HNO_3 and rinsing with DM water.

Repairing jobs as per Inspection Report

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

Compartment No.1 (Top Compartment)

Loose fasteners of tray segments were tightened. 4 nos. of missing tray segment bolts and 1 nos. of "J" bolt were provided.

Compartment No.2

Pits/localized erosion of 2 to 3 mm depth, 10-12 mm long observed In South side shell liner, 2'' above C-seam near tray clit were repaired.

Compartment No.3

Pits/Localized erosion of 1.5mm depth, 4-5 mm width, 20 -25 mm long were repaired.

Compartment No.7

Pits/Localized erosion of 1.5- 2.0 mm depth, 3-4 mm width, 30-35 mm long were repaired.

Compartment No.8

Pits/Localized erosion of 1.5- 2.0 mm depth,4-5 mm width,20 -25 mm long were repaired.

No repair work was required in other remaining compartments. All repairing jobs were done using TIG welding method and 25-22-2 L Mn filler wires. Repaired areas were passivated by 10% HNO_3 and washed with DM water.

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

- Tightening pressure for top cover.

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

HP 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.
- New fasteners for urea solution outlet line flanges (both flanges) were provided.
- 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. No repair work was required to be carried out.
- The ferrules were fixed in position with new PTFE gaskets (2600 nos).
- After the bottom cover was boxed up, pressure drop measurement was carried out by production department for each tube and the same was found within limit.
- Exchanger was thoroughly cleaned with compressed air and then with DM water.
- Top and bottom cover were boxed up with reconditioned “Kempchen” gasket (839 mm OD x 800 mm ID x 4 mm thick) with new 0.5 mm thick Teflon envelope.
- Tightening pressure for top and bottom cover.

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

HP Condenser (H-1202)

- Top flange of off gas lines was opened.
- Bottom flange (H-1202 to V-1201 pipe line) was opened.

- Fasteners of Top cover and bottom cover were loosened using bolt tensioner at 700 kg/cm^2. Bottom covers were shifted using 2 nos. of 3 ton capacity chain block and top cover was shifted using 1 no. of 5 ton chain block.
- Internals from the top dome were removed.
- Eddy current testing of tubes was carried out.
- Tube No. 10 x 22 was found having ovality in ID however no thinning was observed in this area. This tube was plugged as a precautionary measure.
- Tube no 31 x 19 having Burn thru and visible cavity from ID, this tube was plugged as a precautionary measure
- Hence total 02 tubes were plugged. **(Tube plugging details given in UREA INSPECTION Report Annexure-8, Page no. : 295)**
- Tube layout drawing for showing the plugged tube location is attached in shutdown report of inspection department. The Stamicarbon and actual procedure for tube plugging in top tube sheet is given below.

Sr. No.	Stamicarbon procedure	Actual procedure for Plugging in top tube sheet
1	Puncture the tube. Confirm by DP test. (At top or bottom end)	Punctured at the top end of tube (approx 60mm from the tube end) and marked its location in bottom tube sheet also using wire.
2	Grind and remove the tube end down until 50% of the tube to tube sheet weld metal is removed.	Grinding of tube end was done until 50% of tube using barring cutter in flexible grinder machine.
3	Clean the tube inside by reaming or by grinding at the location where the plug will be positioned.	Cleaning of tube inside was done using barring cutter in flexible grinder machine.
4	Determine the inner tube diameter	Inner tube diameter was 20.00mm
5	Machine the plugs, material quality equal to material of heat exchanger tube. Dimension shall be maintained as per the sketch given below. L= 25 mm.	Machine the plug as show in figure – 19[4]. Dimension ØD was kept 20.00mm and L was 25.00mm
6	Clean and degrease the plug and the inner tube hole	Cleaned the plug and inner tube hole by acetone
7	Insert the plug	Punched at 7mm from the end of plug in four direction of plug to hold it at tube. Refer figure- 19[3].
8	Protect the surrounding tube ends very carefully with help of the old PTFE bushing.	
9	Weld the plug in two layers, GTAW (material quality filler wire equal to material of heat exchanger tube; rod diameter 1.2 mm to 2.0 mm); start / stop points staggered to each other After each layer of welding perform a penetrate test and a ferrite check	Root welding was done using TIG welding (filler wire 25 22 2 LMn, 2.0mm dia.). DP check and ferrite check of root welding done. Found satisfactory. Further 2 run of welding was done. DP and ferrite check was done, found ok. Passivation was done using 10 %HNO3 solution and rinsing with DM water After welding

Tube Plugging Sketch of HP Condenser

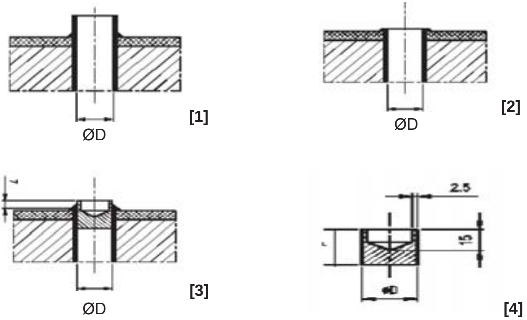


Figure – 19

Note: The Procedure for Plugging in bottom tube sheet was similar to that of top tube sheet.

- Confirmation Hydro test of Shell side was carried out at 11 kg/cm^2 g.
- Pneumatic test was carried out to detect any leakage from the tube or tube to tube-sheet weld joints. The shell side was pressurized at 5.0 Kg/cm^2. No leakage was observed from any tube or tube to tube-sheet welds. The H.P. Condenser was hydro-tested and found satisfactory.
- After inspection, internals were placed on top dome. Top and bottom cover Boxed up with new Kempchen make gasket (839 mm OD x 800 mm ID x 4 mm thick) with 0.5 mm thick Teflon envelop.
- Tightening pressure for top and bottom cover

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

LP Vessel

Repairing was done in following equipments after manhole opening:

H-1104 (Co$_2$ Spray Cooler)

One pin hole in fillet weld of Demister pad support ring with shell was repaired

V-1101 (CO_2 Knock Out Drum)

New epoxy paint inside of the shell was done. Two nos. of loosened segments of demister pads were tightened.

V-1351 (Hydrolyser) - Bottom Compartment

Loosened steam inlet pipe flange fasteners were tightened.

V-1423 (1st Stage Evaporator Scrubber)

Loosened segments of demister pads were found slightly damaged, & lifted at several locations.

Replacement of existing LP carbamate condenser (H-1205) with new one

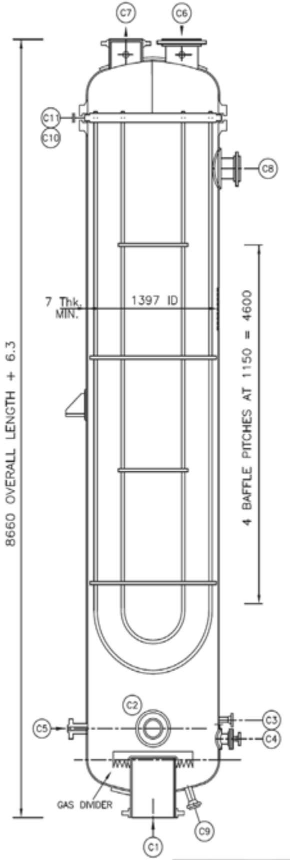
The existing LP carbamate condenser (H-1205) was having frequent tube leakages and total 88 nos. of tubes were plugged out of 581 “U” tubes which was approximately 15% of total tubes. Tubes plugged were due to leakage or based upon NDT / IRIS inspection.

Hence, the new LP carbamate condenser (H-1205) was procured from M/s Gansons Limited, Nagpur against the PO 201004131373 dated 14 / 03 / 2014. And the Contract for replacing existing LP carbamate condenser (H-1205) with new one was awarded to M/s Asian Engineering; Vadodara against the WO 201004131506 dated 29 / 03 / 2014.

Technical Details of New LP Carbamate Condenser (H-1205)

The details of New LP Carbamate condenser (H-1205) are as under:

Designed & Manufactured By	:	M/s Gansons Limited, Nagpur
Item No	:	H-1205
Manufacturing year	:	2013-14
Design Pressure	:	Shell Side : 6 Kg / Cm^2 Tube Side : 6 Kg / Cm^2
Design Temperature (in Degree Centigrade)	:	Shell Side : 150 C Tube Side : 90 C
Hydrotest Pressure	:	Shell side : 11.8 Kg / Cm^2 Tube side : 9.0 Kg / Cm^2
Operating Fluid	:	Shell side : Carbamate solution along with NH_3, CO_2 & H_2O Water & Steam Tube side : Steam condensate
Total Empty Weight (Approx.)	:	16 Tons
Overall Dimension (Approx.)	:	1.410 mtr. Dia X 8.7 mtr. long



NOZZLE SCHEDULE		
NOZ.	SIZE	SERVICE
C11	15	VENT
C10	15	DRAIN
C9	50	DRAIN
C8	200	CARBAMATE SOL. OUTLET TO V-1205
C7	350	CCS I OUTLET
C6	350	CCS I INLET
C5	50	CARBAMATE INLET (P-1201 REC.)
C4	25	LIQ. NH_3 INLET
C3	40	NH_3 SOL. INLET
C2	200	CARBAMATE SOL. INLET FROM V-1205
C1	450	$NH_3/CO_2/H_2O$ VAP. INLET

DESIGN DATA			
	UNIT	SHELL	TUBE
DESIGN PRESSURE	kg/cm^2a	6.0	6.0
DESIGN TEMPERATURE.	°C	150	90
OPERATING PRESSURE	kg/cm^2a	4.2	5.0
OPER. TEMP. IN/OUT	°C	94.5/74.2	53.2/61.4
HYD. TEST PRESSURE	kg/cm^2a	11.8	9

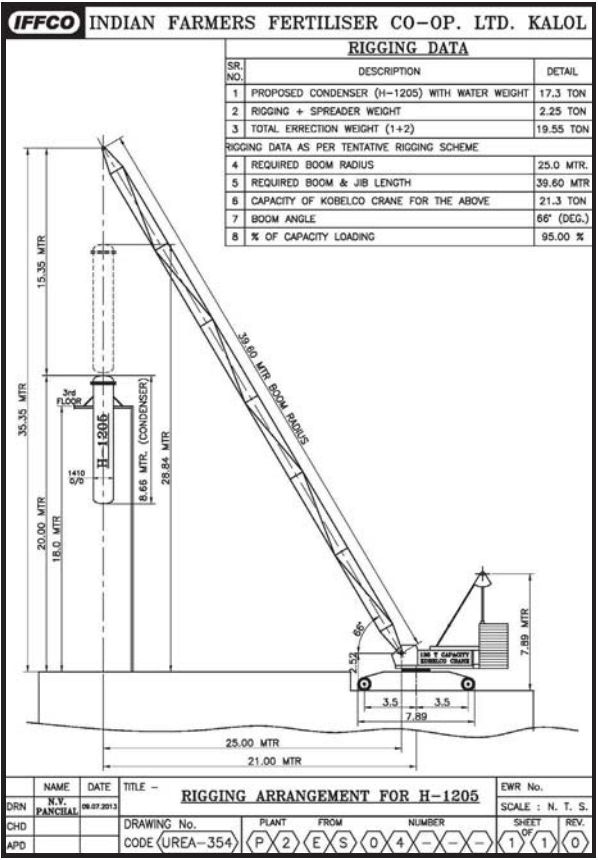
ALL DIMENSIONS ARE IN mm.

L.P. CARBAMATE CONDENSER (H-1205)

Fig. No. : 02-E-06-210

Pre-shutdown activities:

Capacity of kobelco crane for lifting the existing H-1205 was not sufficient in available approach. Ground was leveled towards north side with the help of civil section to make approach for lifting H-1205. Final rigging arrangement is attached for reference. Spreader beam is fabricated to ensure the safe rigging jobs.



Replacement of Existing H-1205:

Following activities were carried out for dismantling the existing, H-1205;

- Insulation of H-1205 and connected flanges & valves were provided
- Scaffolding for V-1301 line flange (2 nos, 8 " x 150#) was made
- Marked the all process and steam line connections, which were to be loosened
- Removed the condensate inlet line / outlet line of H-1205 with the help of kobelco crane (135 ton) .
- Disconnected the following nozzle flanges of H-1205 :
    - ➢ NH3/CO2/H2O inlet (C1) : 18” x 150#, RF
    - ➢ Carbamate solution inlet (C2) : 8” x 150#, RF
    - ➢ Discharge from P-1352 A/B & P-1302 C/D : 3” x 150# , RF (End blind flange was used for blinding the nozzle)
- To clear the space around old H-1205 removed the following items
    - ➢ Control valve PICV-1202 (2 " x 150#)
    - ➢ Control valve HICV-1208 (6 " x 150 & 4 " x 150#)
    - ➢ V-1301 offgas line was removed by disconnect the 3 nos. of line flanges (8"x150#)
    - ➢ Removed the offgas line of V-1205 (connected to vent line / connected to V-1206) by cutting of line conneteced to vent line, 3 " x 40 sch, SS 304 L, by cutting of steam inlet to 3 " offgas line of V-1205
    - ➢ Removed the platform / railings / MS structures above the H-1205
- After clearing the space above the H-1205, mounted the 2 nos. of 10 ton slinging (In U- shape) along with Spreader beam on 2 nos. of trunion, 5 meter long
- Loosened the all 8 nos. of foundation bolts and location plate bolts at 2nd floor
- Lifted the old H-1205 with help of Kobelco crane (135 ton) as per attached drawing of rigging arrangement and placed at ground on wooden sleepers
- Placed the new H-1205 at existing foundation with the help of kobelco crane (135 ton) and tightened the foundation bolts.
- Tightened the all connected flanges
- Re-welded the all cut lines and removed platform / railing / MS structure
- Condensate inlet / outlet line were mounted in new H-1205
- New insulation were provided.


Removal of old LPCC (1)


Removal of old LPCC (2)


Removal of old LPCC (3)


Removal of old LPCC (4)

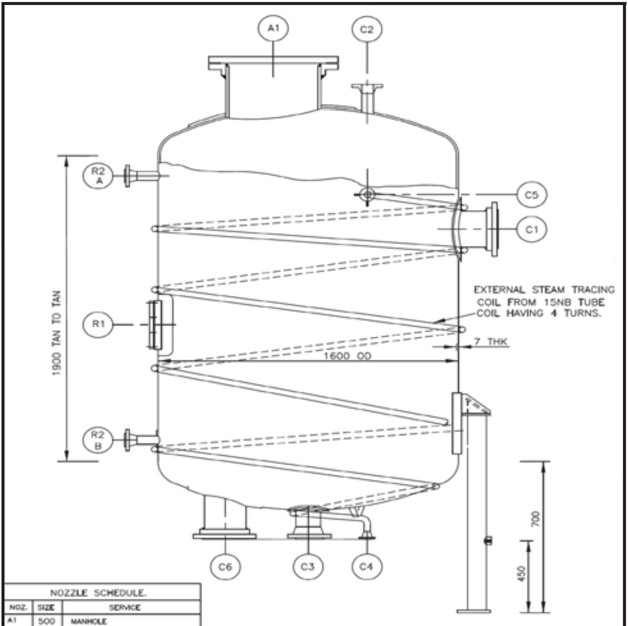

Erection of new LPCC (1)


Erection of new LPCC (2)

Replacement of existing LP carbamate separator (V-1205) with new one

During running condition, gasket of level gauge glass was leaked. SS Jacket box was fabricated and welded it with shell of V-1205 by covering the level gauge to attend the leak. During welding of SS jacket with shell, approx 1” linear crack horizontally appeared in shell body at just below the welding. During shutdown – 2012, to prevent the leak, caulking was done on crack area and magna compound applied on the crack. Finally Hydrotest of V-1205 was done at 6.0 kg/cm2 g. No leak observed.

To ensure the trouble free operation of V-1205, it is recommended to replace the existing vessel with new one. New V-1205 was fabricated in IFFCO’s mechanical workshop and replacement of existing V-1205 was done departmentally.



NOZZLE SCHEDULE.		
NOZ.	SIZE	SERVICE
A1	500	MANHOLE
R2 B	80	LIC 1202 BOTTOM TAPPING
R2 A	40	LIC 1202 TOP TAPPING
R1	40	LEVEL GLASS
C6	200	LIQUID TO L.P. CONDENSER
C5	15	STEAM TRACING INLET
C4	15	STEAM TRACING OUTLET
C3	100	CARBAMATE LIQUID OUT
C2	50	VAPOUR TO H-1352/V-1206
C1	200	INLET FROM H-1205

ALL DIMENSIONS ARE IN mm.

DESIGN DATA			
	UNIT	VESSEL	ST. TRACING
DESIGN PRESSURE	kg/cm²a	6	6
DESIGN TEMPERATURE	°C	100	160
OPERATING PRESSURE	kg/cm²a	3.3	4.0
OPERATING TEMPERATURE	°C	74.2	147
HYDROTEST PRESSURE	kg/cm²g	7.5	7.5

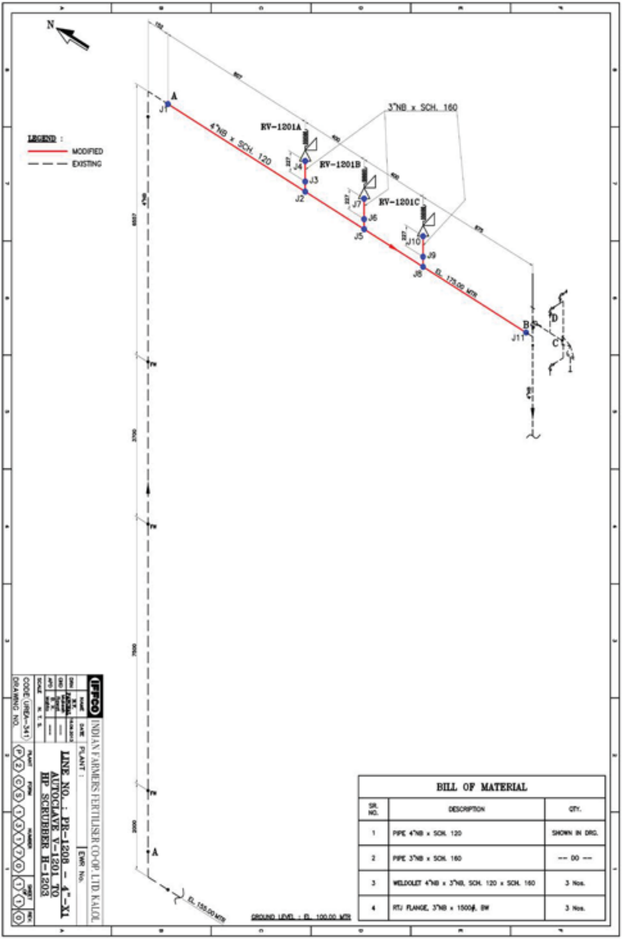
L.P. CARBAMATE SEPARATOR (V-1205)

Fig. No.: 02-E-06-211

Following activities were carried out for replacing the existing V-1205

- Insulation of V-1205 and connected flanges & valves were removed.
- Marked the all process and steam line connections, which were to be loosened
- To clear the space around old V-1205 removed the following items
  - Control valve PICV-1202 (2 " x 150#)
  - Control valve HICV-1208 (6 " x 150 & 4 " x 150#)
  - V-1301 offgas line was removed by disconnect the 3 nos. of line flanges (8 " x 150#)
  - Removed the offgas line of V-1205 (connected to vent line / connected to V-1206) by cutting of line conneteced to vent line, 3 “x 40 Sch. SS304L, by cutting of steam inlet to 3 " offgas line of V-1205
  - Removed the platform / railing / MS structure above the V-1205
- Loosened the foundation bolts.
- Lifted the old V-1205 with help of Kobelco crane (135 ton) and placed at ground on wooden sleepers.
- Placed the new V-1205 at existing foundation with the help of kobelco crane (135 ton) and tightened the foundation bolts
- All flanges were found in position with matching flanges and tightened the all flange bolts.
- Re-welded the all removed platforms / railings / MS structure
- For hydro testing of V-1205, blinding of following flanges (shown in attached drawing) was done.
  - C3 – 4” x 150#
  - R2 B- 3” x 150#
  - A1 – Manhole
  - C2 - 3 nos. of flanges (not shown in drawing), 3”x150# (2 nos.) & 1”x150# (1 no.)
- Flanges C5 and C6 were connected to H-1205. Blinding of both lines (C5 & C6) was done in the shell side of H-1205. Nozzle R2 A was used for water filling and to pressurize the shell up to 6kg/ cm2 g. No leakage was observed.
- Deblinding was done and boxed up the vessel.
- Vessel handed over to production department.

Replacement of Offgas line of V-1201:
Fabrication job to replace the offgas line of Autoclave (PR-1206-4”-X1, shown by red color in drawing) were awarded to M/s Shree Ganesh Engineering Co., Ahmedabad against CPA 201004141421.



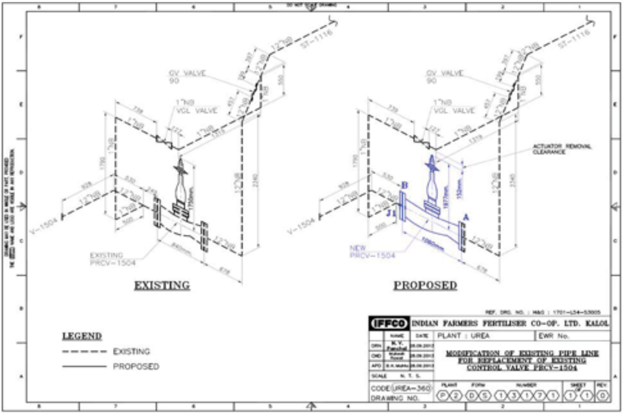
BILL OF MATERIAL		
SR. NO.	DESCRIPTION	QTY.
1	PIPE 4"NB x SCH. 120	SHOWN IN DRG.
2	PIPE 3"NB x SCH. 160	-- DO --
3	WELDOLET 4"NB x 3"NB, SCH. 120 x SCH. 160	3 Nos.
4	RTJ FLANGE, 3"NB x 1500#, BW	3 Nos.

Following activities were carried out:

- Removed the RV-1201 A, B, B & C
- Existing piping was cut by grinding at marked A & as shown in attached Drg. No. P2-CS-13170 Sheet 1 of 1 Rev. 0 & removed cut pipe along with fittings.
- Prefabrication of pipe portion from joint J1 to joint J11 was carried out at workshop before shutdown.
- Erection of piping was done with the help of Kobelco crane it was erected at site.
- Edge preparation of field joints were done for carrying out welding.
- Root and final welding of joints J2, J3, J4, J5, J6, J7, J8, J9 & J10 were carried out at workshop by GTAW using 25-22-2LMn filler wire – 2.4mm dia and joints.
- Root and final welding of joints J1 & J11 were carried out at site by GTAW using 25-22-2LMn filler wire – 2.4mm dia.
- Stage wise Inspection of all weld joints i.e. Weld edge DP, Root weld & final weld DP and 100% radiography (except flange joint) was carried out to maintain quality of welding.
- Approx. 2.5 meter long pipe (4” x 160 Sch, SS 316L Urea Grade), 3 nos. of weldolet (4”x120 sch x 3”x160 sch, SS 316L Urea Grade) & 3 nos. of flange (3” x 1500#, RTJ, SS 316L Urea Grade) were consumed.

<u>Modification in Piping for Replacement of Control valve PRCV-1504</u>

Modification in the orientation of pipe loop was required for installation of newly procured LRCV-1201 in place of existing one. Fabrication Job involved in replacement of PRCV-1504 was carried out by M/s Shree Ganesh Engineering Co., Ahmedabad against CPA 201004141421.



Following activities shall be carried out.

- Existing control valve PRCV-1504 was removed.
- Existing flange B was cut by grinding as shown in attached Drg. No. P2-ES-13171 Sheet 1 of 1 Rev.0 and existing position of Flange A will remain same.

  Fitment of flange B (Size: 12" x 300#, 40 sch, CS) was done as per attached Drg. No. P2-ES-13171 Sheet 1 of 1 Rev.0
- Root & final welding by GTAW using ER 70S-2.
- Stage wise Inspection of all weld joints i.e. Weld edge DP, Root weld & final weld DP and 100% radiography (except flange joint) was carried out to maintain quality of welding.
- Installed new control valve PRCV-1504 along with gasket in the modified line as shown below in picture

Replacement of Equipment's base frame:

Following equipment's base frame was replaced with new one.

- P-1202 A
- P-1204 A
- P-1701 A/B
- K-1701

Base frame was pre-fabricated at urea mechanical workshop.

New base frame of P-1202 A

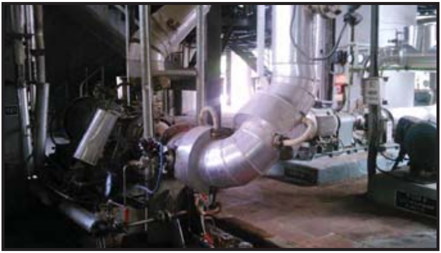
New base frame of P-1202 A

New base frame of P-1701 A/B

New base frame of K-1701

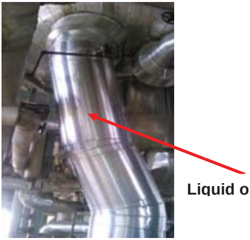
Replacement of Melt Pump (P-1408) suction line

Flanges of suction line (6” x 10 sch line jacketed with 8” x 10 sch line) connected to melt pump (P-1408) was disconnected. Suction line was found in totally collapsed condition. New jacketed suction line was fabricated departmentally and mounted at existing position as shown in below picture.



Jacket provision in Melt Pump (P-1408) suction line (liquid outlet of H-1424 to P-1408)

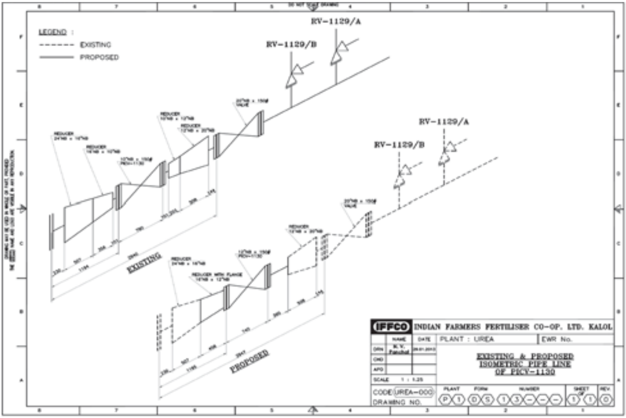
In existing condition, steam tracing was provided at liquid outlet line of H-1424. Steam tracing line was removed. New jacked was fabricated departmentally at site (as shown in below picture)



Liquid outlet of H-1424

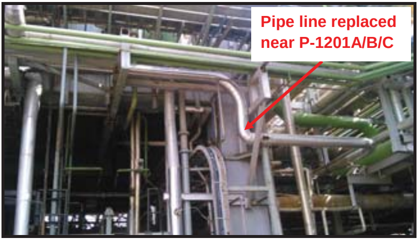
Modification in Piping for Replacement of Control valve PRCV-1130

Size of existing piping of control valve PRCV-1104 was 10”. Line was modified to 12” for erection of new control valve.

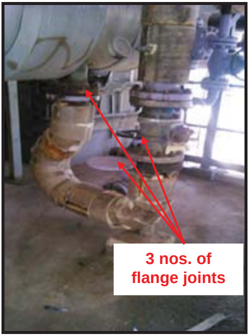


Fabrication jobs based on thickness report by inspection report

- Pipe line (ASTM A106 Grade B, Size: 6" x 160 Sch) from CO_2 compressor to HP stripper (H-1201) was replaced due to the thickness reduction at 3 nos. of pipe clamp support. Pipe line is shown below in picture.

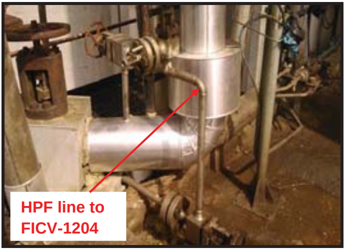


- One no. of CS elbow in SC-1407-3"-B4 was replaced due to thickness reduction with new SS 304 elbow (3" x 80 sch, LR, BW)
- High External corrosion/Pitting on 45 deg and 90 deg elbows in pipe line MA-1101-6'' were observed. Existing piping was removed by loosening the all three flange joints. New piping of SS 304 was fabricated and mounted on its position by all three flange joints as shown below in picture



Cold ammonia inlet to Ammonia Pre-heater

- Thermo-well nozzle (TR-1210) in HP stripper (H-1201) outlet line at ground floor was replaced with new one (seamless pipe, 1-1/2" x 80 sch, SS316L Urea Grade) due to thickness reduction.
- HPF line to control valve FICV-1204 (in carbamate pump discharge line to HP scrubber H-1203) was replaced with new one (seamless pipe, 1" x 80 sch, SS316L Urea Grade) due to thickness reduction as shown below in picture.



HPF inlet to FICV-1204

Replacement of Corroded MS Structure with SS Structure

Contract to replace the corroded MS structure with SS structure was awarded to M/s General Engineering Works, Baruch against the BPA 201004141584.

Following fabrication jobs were included in the contract .

- **Replacement of MS platform HP Scrubber (H-1203) at prill tower top near ID fan (K-1401-3)**

  Existing MS structure of platform was removed by gas cutting in small pieces. Prefabrication of half platform (south side) was fabricated in urea mechanical workshop. North side platform was fabricated at site. Required SS 304 channels and angles were fabricated from 6mm SS 304 plate.

  20mm thick SS 304 plate was supported on concrete beam with 16mm grouting bolts (**Hilti make**). SS 304 channel was welded with 20mm thick SS 304 plate. SS 304 platform was placed on SS 304 channels and angles and welded. Erection of pre-fabricated SS 304 platform was done by Kobelco crane. Finally SS 304 railings (ERW pipe 1-1/2" x 10 sch & 1" x 10 sch) were welded with platform. Existing and new platform were shown below in picture.


Existing MS Platform -1


Existing MS Platform -2

Existing MS Platform -3

Existing MS Platform -4

New SS 304 Platform -1

New SS 304 Platform -2

New SS 304 Platform -3

New SS 304 Platform – 4

- **<u>Replacement of stair case MS railing of Prill tower and PT top MS railings with SS 304 railings</u>**

  Existing MS railings were removed by gas cutting in small pieces. 5mm thick SS 304 plate (150mm long x 75 mm wide) was supported on concrete floor with 10mm grouting bolts (Hilti) in between of existing MS supporting plate. Vertical segment of SS 304 railing (ERW pipe 1-1/2" x 10 sch) was welded with the 5mm thick SS 304 plate. Complete stair case railings of prill tower from ground floor to 6th floor and prill tower top railing were replaced. Existing and new railings were shown below in picture.

Existing MS prill tower top railing

New SS 304 prill tower top railing

New SS 304 prill tower stair case railing at ground floor

New SS 304 prill tower stair case railing at PT top

- **<u>Structural strengthening of Platform (radioactive source) of Autoclave Reactor (V-1201)</u>**

  CS Grating of existing platform was in corroded condition. New SS 304 Grating with SS 304 railings were provided after strengthening the existing structure of platform as shown below in picture

Existing platform

Modified platform

Prill Cooling System

Inlet Air Fan (K-1701):

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

Exhaust Air Fan (K-1702):

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

Dust silo (V-1702-1 & 3)

Additional flange joint was provided at dust silo (V-1702-2 & 3) for easy replacement of rotary valve as shown in below picture

Existing dust silo : V-1702-1

Modification in V-1702-2/3 : additional flange provided

Conveyor System:

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

M-1403-1 conveyor:

- Existing belt was replaced with new HRT2 grade belt.
- All damaged carrying rollers and return rollers were replaced with reconditioned ones.
- Additional drive through direct coupling with head pulley (other side of chain drive) was provided. A 10 HP motor along with new pembrill make fluid coupling and ingeco make gear box were used as shown below in picture

Additional through pembrill make fluid coupling

Pin-bush coupling from ingeco make gear box to head pulley

- Gear box oil (chain drive) was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.

M-1403-2 conveyor:

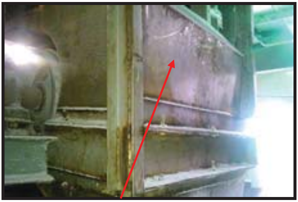
- Existing belt was replaced with new HRT2 grade belt.
- All damaged carrying rollers and return rollers were replaced with reconditioned ones.
- Gear box oil was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from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

M-1403-3 conveyor:

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

Link Conveyor (M-1419):

- Existing belt was replaced with new OHR grade belt.
- All damaged carrying rollers and return rollers were replaced with reconditioned ones.



SS discharge hopper (from M-1403-2 to M-1419)

SS discharge hopper (from M-1421 to M-1419)

- Both bearings of head pulley and snub pulley were replaced.
- Gear box oil was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.

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 with reconditioned ones.

- Both bearing of head pulley & tail pulley were replaced
- Gear box oil was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.

<u>Dust Conveyor System (M-1702):</u>

- All damaged carrying rollers and return rollers were replaced with reconditioned ones.
- Gear box oil was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.
- MS discharge hopper and MS skirt block holding system with MS cover were replaced with SS as shown below in picture

SS discharge hopper

SS skirt block holding system with SS Cover

<u>Prill Tower Scraper (M-1402-1/2):</u>

<u>Scraper (M-1402)</u>

Scraper oil was flushed.

<u>Fluid Coupling</u>

- Oil of both fluid coupling M-1402-1/2 was flushed.
- Alignment of motor and coupling was done.

<u>Gear Box of Scraper, M-1402-1/2</u>

- Oil flushed.

<u>Prill Tower ID Fan K-1401-1/2/3/4</u>

<u>K-1401-1/2/3/4</u>

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

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

On 05-04-2014, Hydrotest of V-1501 was carried out at 11.10 Kg/Cm2g in presence of Boiler Inspector.

RELIEF VALVE OVERHAULING AND TESTING

Overhauling and testing of RV was done by M/s Flotec Technosmart (India) Private Limited, Surat against the CPA 201004141513. 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.	Description	Test Medium	Set Pressure Kg/cm2 g	Reset Pressure Kg/cm2 g
1	RV-1201 A	V-1201 off gas line	Nitrogen	165	150
2	RV-1201 B	V-1201 off gas line	Nitrogen	165	150
3	RV-1201 C	V-1201 off gas line	Nitrogen	165	148
4	RV-1205	P-1201 A discharge	Water	165	148
5	RV-1206	P-1201 B discharge	Water	165	148
6	RV-1208	P-1201 C discharge	Water	170	148
7	RV-1103 A	P-1102 A discharge	Water	150	135
8	RV-1103 B	P-1102 B discharge	Water	150	135
9	RV-1103 C	P-1102 C discharge	Water	150	135
10	RV-1181	K-1801 final discharge	Nitrogen	177	159
11	RV-1903	K-1801 3rd stage discharge	Nitrogen	111	100
12	RV-1202A	V-1202 off gas line LP System	Nitrogen	6	5.5
13	RV-1202B	V-1202 off gas line LP System	Nitrogen	6	5.5
14	RV-1202C	V-1202 off gas line LP System	Nitrogen	6	5.5
15	PSV-1201A	P-1201 A Suction line	Water	8.5	7.5
16	PSV-1201B	P-1201 B Suction line	Water	8.5	7.5
17	PSV-1201C	P-1201 C Suction line	Water	8.5	7.5
18	RV-1101A	Liquid ammonia line from H-1102 to V-1102	Water	31	29
19	RV-1101B	Liquid ammonia line from H-1102 to V-1102	Water	31	29
20	RV-1102 A	Ammonia Suc. Vessel (V-1103)	Water	31	29
21	RV-1102 B	Ammonia Suc. Vessel (V-1103)	Water	31	29
22	RV-1107 A	Liquid anmmonia line(hot) before ammonia filter	Water	31	29
23	RV-1107 B	Liquid anmmonia line(hot) before ammonia filter	Water	31	29
24	RV-1901	1st stage discharge of K-1801.	Nitrogen	7	6.7
25	RV-1902	2nd stage discharge of K-1801	Nitrogen	27	25.1
26	RV-1503	23 ata Steam	Nitrogen	25	23.8
27	RV-1504	9 ata Steam Drum	Nitrogen	12	11

Sr. No.	RV No.	Description	Test Medium	Set Pressure Kg/cm2 g	Reset Pressure Kg/cm2 g
28	RV-1129 A	4 ata Steam Header	Nitrogen	6	5.4
29	RV-1129 B	4 ata Steam Header	Nitrogen	6	5.4
30	RV-1501	4 ata Steam Drum	Nitrogen	7.5	6.8
31	RV-1502	4 ata Steam Drum	Nitrogen	7.5	6.6
32	RV-1506	4 ata Steam Main	Nitrogen	6	5.4
33	RV-1209	V-1203 Vessel	Nitrogen	10	9
34	RV-1351	RV of V-1351	Nitrogen	24	23
35	RV-1352	RV of V-1352	Water	6	5.4
36	RV-1301	RV of V-1301	Nitrogen	6	5.9
37	RV-1184 (CCS-I)	H-1102 outlet NH3 outlet	Water	6	5.5
38	RV-1221 (CCS-II)	P-1204 disch. To H-1203	Water	16.5	15
39	RV-1913	Ejector system of Q-1801	Nitrogen	0.20	0.20
40	RV-1914	Ejector system of Q-1801	Nitrogen	0.20	0.20
41	RV-1916	23 ata Steam extraction	Nitrogen	28	26
42	RV-1917	4 ata Steam exhaust	Nitrogen	4	3.6
43	RV-1351 A	RV of P-1351 A	Water	10	9
44	RV-1351 B	RV of P-1351 B	Water	10	9
45	RV-1130	24 ata steam header	Nitrogen	26	22.5
46	RV-1904	H-1811 1st stage gas cooler	Water	7	6
47	RV-1905	H-1812 2nd stage gas cooler	Water	7	6
48	RV-1906	H-1813 3rd stage gas cooler	Water	7	6
49	RV-1224	C.W from utilities	Water	6	5.4

CLEANING AND HYDROJETTING OF HEAT EXCHANGERS :

The Hydrojetting job was awarded to M/s. Deluxe Hydroblasting Services, Mumbai vide BPA 201004131367. Following heat exchangers were opened for cleaning by hydrojetting. After cleaning, exchangers were boxed up with new gaskets.

- Surface Condenser (H-1815)
- Main Lube Oil Coolers (H-1814-A/B)
- Condenser Pre-evaporator (H-1419)
- First Evaporator (H-1422) with DM water.
- First Evaporator Condenser (H-1423)
- Second Evaporator (H-1424) with D.M. water
- Flash Tank Condenser (H-1421)
- Second Evaporator I Condenser (H-1425)
- Second Evaporator II Condenser (H-1426)

- First Evaporator Final Condenser (H-1420)
- Recirculation Heater (H-1204) with D.M. Water
- L.O. Coolers of P-1102-A/B/C
- L.O. Coolers of P-1201-A/B
- Reflux Condenser (H-1352)
- CCS - II cooler (H-1207)

NRV Inspection

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

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

Sr. No.	Description	Location	remarks
1	60 ata main header I/V U/S drain passing	G Floor	Valve replaced
2	60 ata header to 40 ata, PT-1145 I/V gland leak	1st Floor in front of C R	valve replaced
3	PIC-1130 U/S trap not working, to be replaced and its bypass I/V passing	1stFloor near Control room	Valve and trap replaced
4	PICV-1128 U/S drain both I/V passing	G'Floor	Both valve replaced
5	60 ata steam trap passing in front of Boiler foundation stone	G'Floor	Overhauled the trap, lapping of seat was done. Finally boxed up
6	60 ata both trap near seal leak drain are passing	G'Floor	

Sr. No.	Description	Location	remarks
7	Steam trap behind operator cabin is passing.	G'floor	Trap was replaced
11	Tracing pin hole leakage at V-1202 off gas line	3rd floor	Tracing line replaced
12	V-1202 bottom steam trap is passing	1st floor	Trap was replaced
13	V-1418 steam tracing leakage at bottom.	3rd floor	Tracing line was replaced
14	23 ata Extraction header 1st I/V from C/R side G/L.	1ST floor	Valve was replaced
15	Tracing trap nr.CO2 suction u/s line drain I/V to K-1801 is not working.	G' floor	Steam tracing line trap was replaced
16	PICV-1129 U/S I/V fermanite job.	G' floor	Valve was replaced
18	PICV-1502/A U/S main I/V g/l leak at 3rd floor (9ata steam drum).	G' floor	Valve was replaced
19	Drain I/V(u/s of 4ata i/v) at 4 ata header at lube oil turbine (Q-1814) is passing to be changed.	G' floor	Valve was replaced
20	Gland leak of steam tracing line of H-1424	3rd floor	Tracing line was replaced
21	Steam inlet flange of P-1424 (H-1425 ejector) leak.	3rd floor	Flange gasket was replaced
22	Steam trap leak nr.V-1409/B	1st floor	Trap was replaced
Compressor Section:			
1	PIC-1810 tracing drain to be replaced.	G'floor	Tracing line was replaced
6	23 ata extraction line root I/V for PI tapping (3rd nos)gland leak on ejector floor	Ejector floor	Valve was replaced
7	23 ata MOV I/V bypass gland leak on Compressor floor.	1st floor	Valve was replaced
11	K-1102A/C discharge NRV overhauling	G' floor	Overhauling of NRV was done
Synthesis Section:			
1	HPF at PT top bleeder I/V passing	PT top	Bonnet of bel valve was replaced after seat lapping
2	PRC-1201 (transmitter) both I/V passing	3rd floor	Bonnet of both bel valve was replaced after seat lapping
3	H-1201 sample point 1st I/V for passing	G'floor	Bonnet of bel valve was replaced after seat lapping
4	P-1305A dish. I/V gland to be repacked.	G' floor	Gland packing was replaced with new one
5	P-1202A dish. I/V gland no margin	G' floor	Gland packing was replaced with new one

Sr. No.	Description	Location	remarks
6	PRCV-1504 U/S I/V gland no margin	G' floor	Gland packing was replaced with new one
8	Autoclave unloading line near LRCV-1201 HPF I/V gland no margin	G' floor	Gland packing was replaced with new one
10	CCS-I to H-1102 in/ out I/V service	1st floor	Valve was replaced
11	H-1207 CW vent support to be provided		New support was provided
12	9 ata to 4 ata to H-1202 I/V gland no margin	3rd floor	Gland packing was replaced with new one
14	CO2 to H-1203 (FIC-1202) U/S drain is not operable	PT top near H-1203	Bonnet of bel valve was replaced after seat lapping
15	CO2 to H-1203 (FIC-1202) D/S drain I /V is passing	PT top near H-1203	
16	FIC-1204 1ST AND 2ND HPF valve and its bleeder valve passing	3.5 floor	Bonnet of bel valve was replaced after seat lapping
17	H-1203 both HPF valve passing	5th floor	Bonnet of both bel valve was replaced after seat lapping
18	H-1203 both drain I/V is passing	5th floor	Bonnet of both bel valve was replaced after seat lapping
19	V-1103 vent (atm) 1st I/V passing.	2nd floor	Valve was replaced
22	V-1201 unloading I/V is passing 3rd floor	3rd floor	Bonnet of bel valve was replaced after seat lapping
24	P-1210 dis. I/V fermanite job to be attended		Valve was replaced
27	P-1210 Suction I/V passing.	1st floor	Valve was replaced
28	H-1203 bottom gland to be repacked (Gas inlet nozzle) as it is leaking.	5th floor	Gland packing was replaced with new one
30	N/C ratio meter HPF line root I/V passing (u/s of mono block valve) at 1st floor	1st floor	Bonnet of bel valve was replaced after seat lapping
31	V-1201 9ata passivation (seal filling) of both I/V are passing / bonnet leak at 3rd floor	3rd floor	Bonnet of bel valve was replaced after seat lapping
32	H-1205 drain to T-1301 I/V hard to operate & valve to be replaced.	1st floor	Valve was replaced
33	9 ata CCS-I 2nd I/V to be re-routed or platform to be relocated,nr.P-1202/A at G' floor.	G' floor	
34	4 ata to V-1202 offgas 2nd I/V to be replaced for passing & hard to operate , it's bonnet / gland leaking at 3rd floor	3rd floor	
35	P- 1201 A -lube oil cooler CW line I/V	G' floor	Valve was replaced

Sr. No.	Description	Location	remarks
	is not operable.		
36	LICV-1282 u/s drain I/V passing heavily at 1st floor	1st floor	
37	FIC-1203 u/s I/V g/l at 1st floor.	1st floor	Gland repacking was done
38	P-1201C dis. drain 2nd I/V wheel is free at ground floor	1st floor	Valve was replaced
41	P-1506/1 discharge cond. I/V to PT top.	PT top	Valve was replaced
Evaporation and Prilling:			
1	H-1419 CW inlet I/V not closing 100%	2nd floor	Valve was replaced
2	V-1409 A/B suction & discharge I/V's gland leak	Ist floor	Gland repacking was done
3	P-1426B dish. I/V gland no margin	G' floor	Gland repacking was done
4	P-1302 C recycle I/V gland leak and no margin left to tight.	G' floor	Gland repacking was done
5	P-1302C & D dish. Interconnection I/V gland leak and no margin left to tight.	G' floor	Gland repacking was done
6	H-1425 condensate flushing 2nd I/V gland leak and no margin left to tight.	3rd floor	Gland repacking was done
7	FI-1436 d/s I/V gland leak.	1st floor	Gland repacking was done
8	H-1426 outlet leg I/V gland leak.	2nd floor	Gland repacking was done
9	H-1427 cooler Ammonical waterI/V G/L	1st floor	Gland repacking was done
10	TRCV-1422 u/s I/V g/l at 3rd floor	3rd floor	Gland repacking was done
11	V-1409-A/B both drain I/V to be replaced	1st floor	Both valve was replaced
12	T-1401 to P-1401-A/B betweenn new sample drain I/V leak (nr.T-1401/A)	G' floor	Valve was replaced
13	H-1422 top dome steam tracing leak at 3rd floor.	3rd floor	Steam tracing line was replaced
14	H-1421 bottom drain root I/V g/l. (hose connected at 2nd floor)	2nd floor	Gland repacking was done
15	Rotameter d/s I/V to V-1423 g/l.	1st floor	Gland repacking was done
16	FI-1435 both I/V g/l.	1st floor	Gland repacking was done
17	P-1304-c/d dis i/v g/l.	1st floor	Gland repacking was done
18	HIC-1401 bypass I/V bush is broken.	3rd floor	Valve was replaced
19	Drain I/V wheel free at condensate line nr. T-1401A.	G' floor	Valve was replaced

Sr. No.	Description	Location	remarks
20	H-1421 liquid out line drain I/V near vessel g/l	2nd floor	Gland repacking was done
Hydrolyser Section			
1	P-1351 A dish I/V G/L	G' floor	Gland repacking was done
2	T-1301 outlet I/V to P1305 gland leak.	G' floor	Gland repacking was done
3	P-1302A suction I/V gland leak.	G' floor	Gland repacking was done
5	LICV-1353 u/s d/s I/V gland leaking.	G' floor	Gland repacking was done
6	V-1301 effluent flange leaking (clamp provided)	G' floor	
8	P-1302/C dis. to hydrolyser near V-1409 A/B, ¾" line tapping with ball valve to be cut.	G' floor	
10	HICV-1352 u/s I/V flange leak (hydrolyser section)	1st floor	Flang gaske was replaced

PREVENTIVE MAINTENANCE OF ROTARY EQUIPMENTS

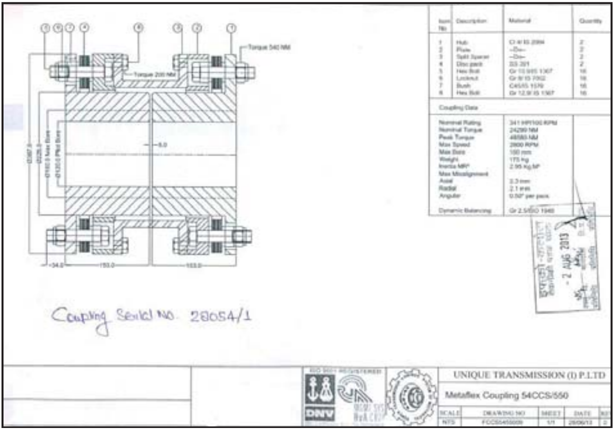
COOLING WATER PUMP (P-4401/A)

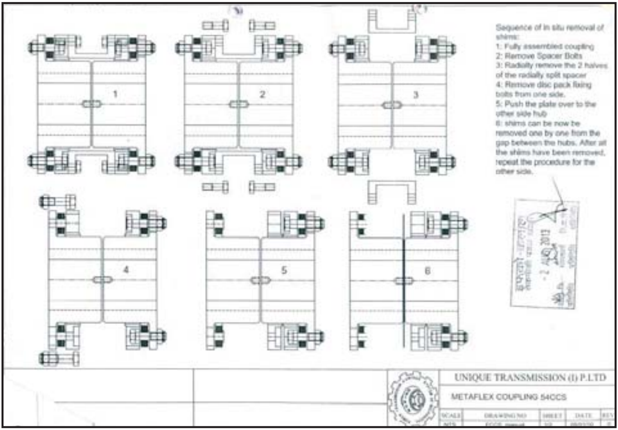
Following activities were carried out:

- Coupling between the Pump and G.B. was decoupled.
- Top half of both sides bearing housing was removed.
- Then old gland packing rings were removed.
- Old Geared coupling hub was removed from old rotor.
- For the installation of New Shim pack coupling (Metaflex Coupling Model 54 CCS/550), dimensions of pump rotor at coupling hub position was taken and accordingly bore and key in new coupling hub was prepared.
- Both the Journal Bearings were checked and coupling side journal bearing was replaced due to excessive clearance.
- Condition of the Thrust ball bearing was checked and found OK
- Bearing clearances of the pump was checked and recorded as

Sr. No.	Description	Recommend. Value (MM)	Value after PM (MM)
1	Total Float	0.8	--
2	Coupling End Journal Bearing Top Clearance	0.2 - 0.3	0.25 - 0.28
3	Coupling End Journal Bearing Side Clearance	0.10 - 0.15	0.10
4	Coupling End Journal Bearing Interference	0.02 - 0.05	0.05
5	Free End Journal Bearing Top Clearance	0.2 - 0.3	0.22 - 0.24
6	Free End Journal Bearing Side Clearance	0.10 - 0.15	0.1
6	Free end Journal Bearing Interference	0.02 - 0.05	0.05

- During assembly correct positioning of oil splash ring in the bearing housing was ensured.
- Gland cooling water lines were opened, cleaned and boxed up.
- Other half of new shimpack coupling was fitted on gear box shaft. Cross sectional drawing of the coupling and its assembly and dis-assembly procedure is shown below:





- After preventive maint new shim pack was coupled and alignment was checked with laser alignment tool and alignment report is attached below

IFFCO KALOL UNIT

MECHANICAL (OFFSITES)

LASER ALIGNMENT REPORT

Machine Used: Easylink 2.3 P11 **Program Used:** Easyturn

File Name: 4411/A **Temperature:** 31.9C / 32.2C

Equipment Name: CWP, P-4401/A Pump to Gear Box

Date: 14.04.10 (YY.MM.DD)

Time: 10:30

Units: mm (mm/m)

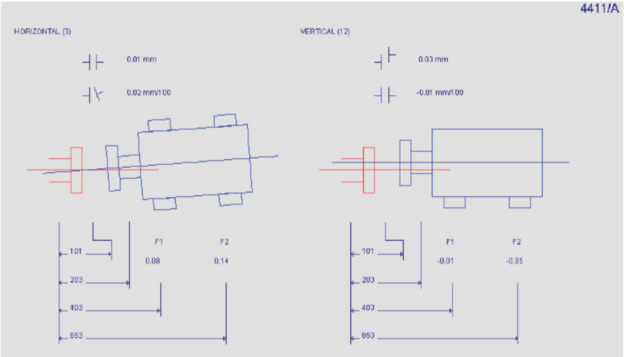
Foot Distances	
Stationary to Movable (S-M)	203
S-M Centre	101
Stationary to Foot-1	403
Stationary to Foot-2	653

Thermal Compensation		
	Offset	Angular
Horizontal (H)	0.00	0.00
Vertical (V)	0.00	0.00

Alignment Readings				
Vertical/Horixontal	Parallel Offset	Angular offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	0.01	0.02	0.08	0.14
Vertical (V)	0.03	-0.01	-0.01	-0.05

Note: All Readings are in MM

Graphical View of Alignment Readings



- After alignment gland was repacked with new 25mm. Sq PTFE gland packings.
- Finally new oil was filled in both bearing housings.
- Free rotation of the pump after coupling was ensured.

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

Following activities were carried out during PM

- Coupling between the Turbine and G.B. was decoupled.
- Turbine Bearings were opened, cleaned, checked found OK and boxed up.
- Turbine Bearing Clearances of were checked and recorded.
- Thrust float of the Turbine was measured and recorded as 0.40 mm.
- Governor was cleaned, checked and fresh oil is filled in it.
- Governor linkages were also made free.
- Oil console was drained; cleaned and fresh oil charged (SERVO PRESS T-32)
- Main oil pump & Auxiliary oil pump suction strainers were cleaned & boxed up.
- The surface condenser was opened. Hydro jetting was carried out & then boxed up.
- Final clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value after Prev.Maint
1	Thrust Float	0.25-0.30	0.25
2	Free Float	-	-
3	Coupling end Journal Bearing Clearance	0.127-0.18	0.18-0.20
4	Front End Journal Bearing Clearance	0.127-0.18	0.17-0.20

- Gland steam leak off port and line cleaned.
- All oil lines cleaned and flushed.
- Oil sump cleaned.
- Oil cooler tubes cleaned by hydrojetting.
- Oil filter replaced.
- Fresh oil servo Press T-32 filled in oil sump.
- One coupling bolt of the coupling between turbine to Gear box was found damaged which was replaced from the spare coupling.
- Final Alignment readings from Turbine to Gear Box was checked with laser alignment tool and alignment report is attached below:

IFFCO KALOL UNIT

MECHANICAL (OFFSITES)

LASER ALIGNMENT REPORT

Machine Used: Easylink 2.3 P11 **Program Used:** Easyturn
File Name: 4411 A T TO G **Temperature:** 29.8C / 30.0C
Equipment Name: CWP, P-4401/A Turbineto Gear Box

Date: 14.04.07 (YY.MM.DD)
Time: 07:35
Units: mm (mm/m)

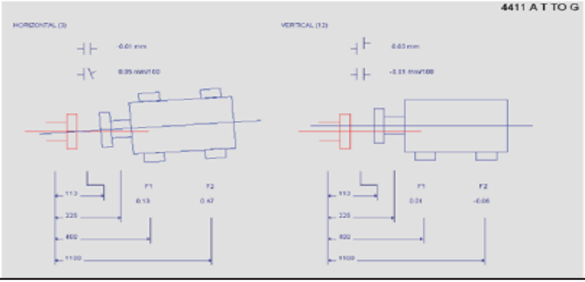
Foot Distances	
Stationary to Movable (S-M)	225
S-M Centre	113
Stationary to Foot-1	400
Stationary to Foot-2	1100

Thermal Compensation		
	Offset	Angular
Horizontal (H)	0.00	0.00
Vertical (V)	0.00	0.00

Alignment Readings				
Vertical/Horizontal	Parallel Offset	Angular offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.01	0.05	0.13	0.47
Vertical (V)	0.03	-0.01	0.01	-0.06

Note: All Readings are in MM

Graphical View of Alignment Readings



GEAR BOX (GB-4411) FOR CW Pump, P-4401/A

During Preventive maintenance following activities were carried out:

- Gear box top cover removed.
- All the bearing top halves were removed.
- Cleaning of journal on both gear wheel & pinion wheels.
- Cleaning of bearing is carried out.
- Cleaning of bearing covers is carried out.
- Gear wheel of the gear box was removed out for the easy removal of its geared coupling half.
- Old geared coupling half was removed by heating and pulling.

- Dimension of gear shaft at coupling hub portion was measured and accordingly, bore and key way was prepared in new shimpack coupling half.
- Gear wheel was again placed in the gear box housing.
- Bearing clearances are measured using lead wire.
- Bearings are assembled back and checked the bearing clearance which were given table.

Sr. No.	Description	Design/Recomm. Value (MM)	Value after PM (MM)
1	Pinion Wheel Turbine End Journal Bearing Clearance	0.15 - 0.20	0.21
2	Pinion Wheel Pump End Journal Bearing Clearance	0.15 - 0.20	0.21
3	Gear Wheel Turbine End Journal Bearing Clearance	0.20 - 0.30	0.30
4	Gear Wheel Pump End Journal Bearing Clearance	0.20 - 0.30	0.31
6	Gear Wheel Axial thrust	0.50 - 0.60	0.24
7	Gear Backlash	0.40 - 0.45	0.20

- Top covers are assembled back.
- After preventive maint new shim pack was coupled and alignment was checked with laser alignment tool and alignment report is as under.

IFFCO KALOL UNIT

MECHANICAL (OFFSITES)

LASER ALIGNMENT REPORT

Machine Used: Easylink 2.3 P11 **Program Used:** Easyturn

File Name: 4411/A **Temperature:** 31.9C / 32.2C

Equipment Name: CWP, P-4401/A Pump to Gear Box

Date: 14.04.10 (YY.MM.DD)

Time: 10:30

Units: mm (mm/m)

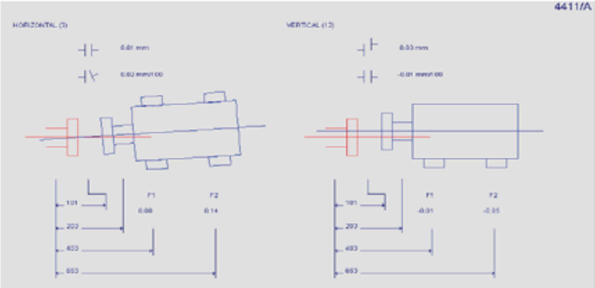
Foot Distances	
Stationary to Movable (S-M)	203
S-M Centre	101
Stationary to Foot-1	403
Stationary to Foot-2	653

Thermal Compensation		
	Offset	Angular
Horizontal (H)	0.00	0.00
Vertical (V)	0.00	0.00

Alignment Readings				
Vertical/Horixontal	Parallel Offset	Angular offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	0.01	0.02	0.08	0.14
Vertical (V)	0.03	-0.01	-0.01	-0.05

Note: All Readings are in MM

Graphical View of Alignment Readings



- Main Oil Pump drive coupling checked and found OK
- All oil lines were cleaned and flushed.
- Oil sump was cleaned.
- Oil cooler tubes were cleaning by hydrojetting.
- Duplex Oil Filters were cleaned.
- New Oil filled in oil sump

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

Following activities were carried out during PM

- Coupling between the Turbine and G.B. was decoupled.
- Both sides of the turbine bearings were opened, cleaned, checked, found OK and boxed up.
- Turbine Bearing Clearances were checked.
- Thrust float of the Turbine was measured as **0.28 mm**
- Complete governor removed from position and then again fixed after complete overhauling.
- Fresh oil was filled in the governor.
- Oil console was properly cleaned and charged with fresh oil.
- All connected oil pipe lines were also cleaned.
- Oil cooler was opened, cleaned and boxed up.
- Oil strainer was cleaned & replaced the oil filter.
- Oil filter cleaned.
- Gland Steam leak off port and lines cleaned.
- Final Clearance chart is as under:

Sr. No.	Description	Design / Recomm. Value (mm)	Value after Prev. Maint. (mm)
1	Thrust Float	0.25 - 0.30	0.28
2	Free Float	-	-
3	Coupling end Journal Bearing Clearance	0.2 - 0.3	0.27 - 0.28
4	Front End Journal Bearing Clearance	0.2 - 0.3	0.25 - 0.27

- Final Alignment Readings were checked with laser alignment tool and alignment report is attached below:

IFFCO KALOL UNIT

MECHANICAL (OFFSITES)

LASER ALIGNMENT REPORT

Machine Used: Easylink 2.3 P11 **Program Used:** Easyturn
File Name: P4401/B T TO G **Temperature:** 36.2C / 36.3C
Equipment Name: CWP, P-4401/B Turbine to Gear Box

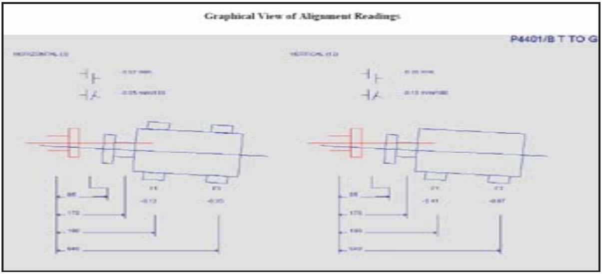
Date: 14.03.31 (YY.MM.DD)
Time: 16:04
Units: mm (mm/m)

Foot Distances	
Stationary to Movable (S-M)	170
S-M Centre	85
Stationary to Foot-1	190
Stationary to Foot-2	640

Thermal Compensation	Offset	Angular
Horizontal (H)	0.00	0.00
Vertical (V)	0.00	0.00

Alignment Readings				
Vertical/Horizontal	Parallel Offset	Angular offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.07	-0.05	-0.12	-0.35
Vertical (V)	-0.30	-0.10	-0.41	-0.87

Note: All Readings are in MM



<u>GEAR BOX (GB-4401/B) FOR CW Pump, P-4401/B</u>

Following activities were carried out during PM

- Gear top cover was opened. GB internals were checked and found OK.
- Bearings of gear box was opened, cleaned, checked and found ok.
- Bearing clearances of Gear Box was checked.
- Gear wheel thrust float was measured.
- Pinion wheel float was also measured.
- All oil lines checked and cleaned.
- Duplex oil filter cleaned.
- Final clearance chart is as under:

Sr. No.	Description	Recomm. Value (mm)	Value after Prev.Maint (mm)
1	Gear Wheel Thrust Float	0.25 - 0.30	0.30
2	Pinion Wheel Thrust Float	0.25 - 0.30	0.30
3	Gear wheel pump end Journal Bearing Clearance	0.2 - 0.3	0.25
4	Gear wheel free end Journal Bearing Clearance	0.2 - 0.3	0.25
5	Pinion wheel free end Journal bearing clearance	0.2 - 0.3	0.20
6	Pinion wheel turbine end Journal bearing clearance	0.2 - 0.3	0.20
7	Gear Backlash	-	0.20

<u>COOLING WATER PUMP (P-4401/B)</u>

Following activities were carried out during PM

- Coupling between the pump and motor was decoupled.

- Both the journal bearings were opened, checked & found OK.
- Bearing clearances were checked & and recorded.
- Coupling Float was measured as 0.21 mm.
- Final Clearance chart is as under:

Sr. No.	Description	Design/Recommend. Value (MM)	Value after PM (MM)
1	Total Float		--
2	Coupling End Journal Bearing Top Clearance	0.2-0.3	0.20-0.22
3	Coupling End Journal Bearing Side Clearance	0.10-0.15	0.10
4	Coupling End Journal Bearing Interference	0.02-0.05	0.05
5	Free End Journal Bearing Top Clearance	0.2-0.3	0.22-0.23
6	Free End Journal Bearing Side Clearance	0.10-.015	0.10
7	Free end Journal Bearing Interference	0.02-0.05	0.05

- During assembly correct positioning of oil splash ring in the bearing housing was ensured.
- Gland cooling water lines were opened, cleaned and boxed up.
- After alignment gland was repacked with new 25mm. Sq PTFE gland packings.
- Finally new oil was filled in both bearing housings.
- Free rotation of the pump after coupling was ensured.

Turbine for Cooling Water Pump, P-4403 (Q-4403):

Following activities were carried out during PM

- Coupling between the Turbine and G.B. was decoupled.
- Both sides of the turbine bearings were opened, cleaned, checked, found OK and boxed up.
- Turbine Bearing Clearances were checked.
- Thrust float of the Turbine was measured as **0.30 mm**
- Complete governor removed from position and then again fixed after complete overhauling.
- Fresh oil was filled in the governor.
- Oil console was properly cleaned and charged with fresh oil.
- All connected oil pipe lines were also cleaned.
- Oil cooler was opened, cleaned and boxed up.
- Oil strainer was cleaned & replaced the oil filter.
- Oil filter cleaned.
- Gland Steam leak off port and lines cleaned.
- Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value after Prev.Maint (mm)
1	Thrust Float	0.25-0.30	0.30
2	Free Float	-	-
3	Coupling end Journal Bearing Clearance	0.2-0.3	0.27-0.28
4	Front End Journal Bearing Clearance	0.2-0.3	0.25-0.27

- Final Alignment Readings were checked with laser alignment tool.

GEAR BOX FOR COOLING WATER PUMP P- 4403:

Following activities were carried out during PM

- Gear top cover was opened. GB internals were checked and found OK.
- Bearings of gear box was opened, cleaned, checked and found ok.
- Bearing clearances of Gear Box was checked.
- Gear wheel thrust float was measured.
- Pinion wheel float was also measured.
- All oil lines checked and cleaned.
- Duplex oil filter cleaned.
- Final clearance chart is as under:

Sr. No.	Description	Recomm. Value (mm)	Value after Prev.Maint (mm)
1	Gear Wheel Thrust Float	0.25-0.30	0.20
2	Pinion Wheel Thrust Float	0.25-0.30	0.32
3	Gear wheel pump end Journal Bearing Clearance	0.2-0.3	0.20-0.22
4	Gear wheel free end Journal Bearing Clearance	0.2-0.3	0.23-0.25
5	Pinion wheel free end Journal bearing clearance	0.2-0.3	0.16-0.18
6	Pinion wheel turbine end Journal bearing clearance	0.2-0.3	0.16-0.18
7	Gear Backlash	-	0.35

COOLING WATER PUMP, P-4403:

Following activities were carried out during PM

- Coupling between the pump and motor was decoupled.
- Both the journal bearings were opened, checked & found OK.
- Bearing clearances were checked & and recorded.
- Final Clearance chart is as under:

Sr. No.	Description	Design / Recommend Value (MM)	Value after PM (MM)
1	Total Float		--
2	Coupling End Journal Bearing Top Clearance	0.2-0.3	0.20-0.24
3	Coupling End Journal Bearing Side Clearance	0.10-0.15	0.07
4	Coupling End Journal Bearing Interference	0.02-0.05	0.05
5	Free End Journal Bearing Top Clearance	0.2-0.3	0.22-0.24
6	Free End Journal Bearing Side Clearance	0.10-0.15	0.07
7	Free end Journal Bearing Interference	0.02-0.05	0.05

- 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.

Cooling water pump P-4402

Following activities were carried out during PM

- Coupling between the pump and motor was decoupled.
- Both the journal bearings were opened, checked & found OK.
- Bearing clearances were checked & and recorded.
- Final Clearance chart is as under:

Sr. No.	Description	Design / Recommend Value (MM)	Value after PM (MM)
1	Total Float		--
2	Coupling End Journal Bearing Top Clearance	0.2 - 0.3	0.24 - 0.25
3	Coupling End Journal Bearing Side Clearance	0.10 - 0.15	0.07
4	Coupling End Journal Bearing Interference	0.02 - 0.05	0.05
5	Free End Journal Bearing Top Clearance	0.2 - 0.3	0.24 - 0.26
6	Free End Journal Bearing Side Clearance	0.010 - 0.15	0.07
7	Free end Journal Bearing Interference	0.02 - 0.05	0.05

- During assembly correct positioning of oil splash ring in the bearing housing was ensured.
- Gland cooling water lines was opened, cleaned and boxed up.
- During alignment spare reconditioned motor was provided by electrical section. But its shaft centre height was short to about 5 mm as compared to previous motor.

- So to align the motor with pump, base plates of motor was cut down and new base plates was prepared and welded on motor base frame.
- But during the alignment, water was entered in the motor, so this motor was again replaced with previous motor.
- Alignment was done with laser alignment tool and alignment report is attached below:

IFFCO KALOL UNIT

MECHANICAL (OFFSITES)

LASER ALIGNMENT REPORT

Machine Used: Easylink 2.3 P11 **Program Used:** Easyturn
File Name: P/4402 CT PUMP **Temperature:** 40.3C / 34.9C
Equipment Name: Urea Cooling Water Pump, P-4402

Date: 14.04.15 (YY.MM.DD)
Time: 13:58
Units: mm (mm/m)

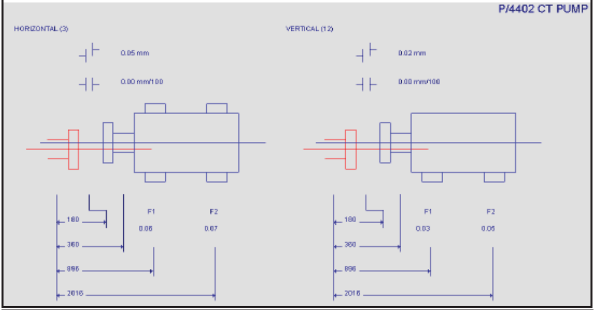
Foot Distances	
Stationary to Movable (S-M)	360
S-M Centre	180
Stationary to Foot-1	896
Stationary to Foot-2	2016

Thermal Compensation		
	Offset	Angular
Horizontal (H)	0.00	0.00
Vertical (V)	0.00	0.00

Alignment Readings				
Vertical/Horizontal	Parallel Offset	Angular offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	0.05	0.00	0.06	0.07
Vertical (V)	0.02	0.00	0.03	0.05

Note: All Readings are in MM

Graphical View of Alignment Readings



- 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.

COOLING WATER PUMP, P-4401/D

Following activities were carried out during PM

- Coupling between the pump and motor was decoupled.
- Both the journal bearings were opened, checked & found OK.
- Bearing clearances were checked & and recorded.
- Final Clearance chart is as under:

Sr. No.	Description	Design/ Recommend Value (MM)	Value after PM (MM)
1	Total Float		--
2	Coupling End Journal Bearing Top Clearance	0.20 - 0.30	0.22 - 0.24
3	Coupling End Journal Bearing Side Clearance	0.10 - 0.15	0.10
4	Coupling End Journal Bearing Interference	0.02 - 0.05	0.05
5	Free End Journal Bearing Top Clearance	0.2 - 0.3	0.20 - 0.22
6	Free End Journal Bearing Side Clearance	0.10 - 0.15	0.10
7	Free end Journal Bearing Interference	0.02 - 0.05	0.05

- 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.

PREVENTIVE MAINTENANCE OF BFW PUMP TURBINE (Q–5111):

Following activities were carried out during PM:

- Shimpack Coupling between Turbine to pump is decoupled.
- Before Preventive maintenance of the Q5111 Turbine to pump Alignment was checked.
- Turbine both ends bearings were opened cleaned properly and clearances were measured using lead wire.
- Turbine Thrust float is measured as **0.22 mm**
- Clearances of Turbine Bearings were checked and recorded.
- Final Clearance chart/float are as under:

Sr. No.	Description	Design/Recomm. Value (MM)	Value after PM (MM)
1	Front End Journal Bearing Clearance	**0.12-0.17**	0.13
2	Rear End Journal Bearing Clearance	**0.12-0.17**	0.15
3	Axial Thrust	**0.2-0.4**	0.22
4	Front End bearing oil labyrinth clearance	0.2-0.4	0.2
5	Rear End bearing oil labyrinth clearance	0.2-0.4	0.2

- Gland Steam leak off port cleaned.

- Residual Magnetism (Gauss) checked at bearing journals and bearings checked.
- Governor cleaned and its oil flushed.
- Governor Drive Gear Backlash checked and recorded.
- Governor Drive Gear Backlash was 0.30 MM
- Main Oil Pump Gear Backlash Checked and recorded. Main Oil Pump gear backlash was 0.30 MM
- All oil lines cleaned and flushed.
- Oil sump cleaned.
- Oil cooler tubes hydro jetting done.
- Duplex Oil Filters cleaned.
- New Oil filled in oil sump.
- Final alignment checked with laser alignment tool and laser alignment report is attached below:
- During start up, main oil pump was not developing the sufficient oil pressure, hence MOP was replaced with spare MOP.

IFFCO KALOL UNIT

MECHANICAL (OFFSITES)

LASER ALIGNMENT REPORT

Machine Used: Easylink 2.3 P11
File Name: P/5111 AFTER
Equipment Name: BFW Pump, P-5111

Program Used: Easyturn
Temperature: 33.4C / 35.0C

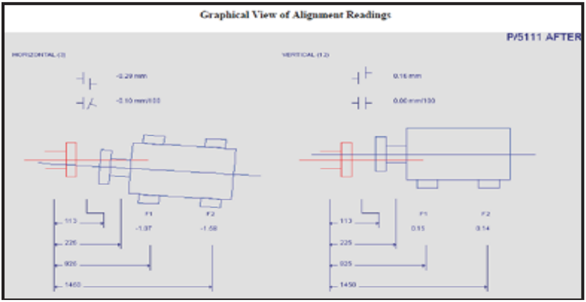
Date: 14.04.03 (YY.MM.DD)
Time: 09:14
Units: mm (mm/m)

Foot Distances	
Stationary to Movable (S-M)	225
S-M Centre	113
Stationary to Foot-1	925
Stationary to Foot-2	1450

Thermal Compensation		
	Offset	Angular
Horizontal (H)	0.00	0.00
Vertical (V)	0.00	0.00

Alignment Readings				
Vertical/Horizontal	Parallel Offset	Angular offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.29	-0.10	-1.07	-1.58
Vertical (V)	0.16	0.00	0.15	0.14

Note: All Readings are in MM



BFW PUMP, P-5111

Following activities were carried out during PM:

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

Sr. No.	Description	Design / Recommend Value (MM)	Value after PM (MM)
1	Thrust bearing axial clearance	0.28-0.33	0.18
2	Coupling End Journal Bearing Top Clearance	0.13-0.18	0.13
3	Coupling End Journal Bearing Interference	0.02-0.05	0.05
4	Free End Journal Bearing Top Clearance	0.13-0.18	0.15
5	Free end Journal Bearing Interference	0.02-0.05	0.05
6	Total float	--	

- Thickness of thrust pads were also checked and recorded as

Thrust Pads thickness

S.No	Active	In Active
1	22.20	22.21
2	22.19	22.19
3	22.22	22.22
4	22.20	22.18
5	22.21	22.18
6	22.19	22.22

- Residual Magnetism (Gauss) at bearing journals and bearing were checked.
- All oil lines cleaned and flushed.
- Oil sump cleaned.
- Oil cooler tubes cleaning done.
- Oil Filters Cleaned.
- Fresh Oil filled in oil sump.
- Alignment readings after preventive maintenance were checked with laser alignment tool and laser alignment report is attached below:

IFFCO KALOL UNIT

MECHANICAL (OFFSITES)

LASER ALIGNMENT REPORT

Machine Used: Easylink 2.3 P11
File Name: P/5111 AFTER
Equipment Name: BFW Pump, P-5111

Program Used: Easyturn
Temperature: 33.4C / 35.0C

Date: 14.04.03 (YY.MM.DD)
Time: 09:14
Units: mm (mm/in)

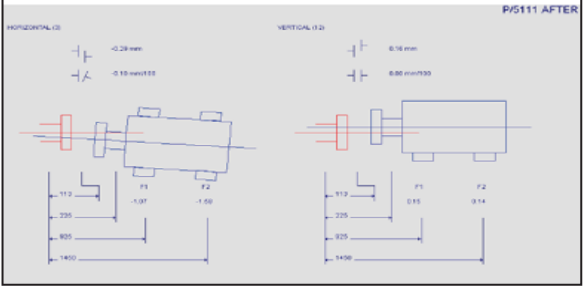
Foot Distances	
Stationary to Movable (S-M)	225
S-M Centre	113
Stationary to Foot-1	925
Stationary to Foot-2	1450

Thermal Compensation		
	Offset	Angular
Horizontal (H)	0.00	0.00
Vertical (V)	0.00	0.00

Alignment Readings				
Vertical/Horizontal	Parallel Offset	Angular offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	-0.29	-0.10	-1.07	-1.58
Vertical (V)	0.16	0.00	0.15	0.14

Note: All Readings are in MM

Graphical View of Alignment Readings



BFW PUMP, P-5112

Following activities were carried out during PM:

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

Sr. No.	Description	Design / Recommend Value (MM)	Value after PM (MM)
1	Thrust bearing axial clearance	0.28-0.33	0.28
2	Coupling End Journal Bearing Top Clearance	0.13-0.18	0.16
3	Coupling End Journal Bearing Interference	0.02-0.05	0.05
4	Free End Journal Bearing Top Clearance	0.13-0.18	0.13
5	Free end Journal Bearing Interference	0.02-0.05	0.05
6	Total float	--	--

- Thickness of thrust pads were also checked and recorded as

Thrust Pads thickness

S.No	Active	In Active
1	22.20	22.19
2	22.20	22.19
3	22.21	22.18
4	22.21	22.19
5	22.19	22.19
6	22.28	22.19

- Residual Magnetism (Gauss) at bearing journals and bearing were checked.
- All oil lines cleaned and flushed.
- Oil sump cleaned.
- Oil cooler tubes cleaning done.
- Oil Filters Cleaned.

- Fresh Oil filled in oil sump.
- Alignment readings between Gear Box to Pump after preventive maintenance were checked with laser alignment tool and laser alignment report is attached below:

IFFCO KALOL UNIT

MECHANICAL (OFFSITES)

LASER ALIGNMENT REPORT

Machine Used: Easylink 2.3 P11 **Program Used:** Easyturn
File Name: P/5112 G TO P AFTER **Temperature:** 39.9C / 36.8C
Equipment Name: BFW Pump, P-5111

Date: 14.04.03 (YY.MM.DD)
Time: 10:09
Units: mm (mm/m)

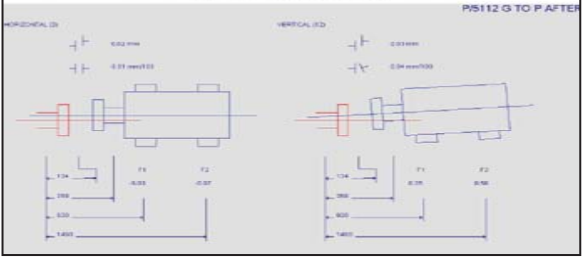
Foot Distances	
Stationary to Movable (S-M)	268
S-M Centre	134
Stationary to Foot-1	920
Stationary to Foot-2	1460

Thermal Compensation		
	Offset	Angular
Horizontal (H)	0.00	0.00
Vertical (V)	0.00	0.00

Alignment Readings				
Vertical/Horizontal	Parallel Offset	Angular offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	0.02	-0.01	-0.03	-0.07
Vertical (V)	0.03	0.04	0.35	0.56

Note: All Readings are in MM

Graphical View of Alignment Readings



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.
- Checked the bearing clearance and found ok.

Sr. No.	Description	Recommend (As per S/D-2013) (MM)	Value after PM (MM)
1	Pinion Wheel Motor End Journal Bearing Clearance	0.15 – 0.20	0.16
2	Pinion Wheel Pump End Journal Bearing Clearance	0.15 – 0.20	0.16
3	Gear Wheel Motor End Journal Bearing Clearance	0.15 – 0.20	0.17
4	Gear Wheel Pump End Journal Bearing Clearance	0.15 – 0.20	0.16
6	Gear Wheel Axial thrust	0.30	0.45
7	Gear Backlash	0.20	0.20

- Residual Magnetism (Gauss) checked and recorded.
- Main Oil Pump cleaned, checked and boxed up.
- All oil lines cleaned and flushed.
- Oil sump cleaned.
- Oil cooler tubes cleaning done.
- Duplex Oil Filters cleaned/Replaced.
- New Oil filled in oil sump.
- Final alignment between Motor to Gear Box and Gear Box to Pump was checked with laser alignment tool and laser alignment report is attached below:

IFFCO KALOL UNIT

MECHANICAL (OFFSITES)

LASER ALIGNMENT REPORT

Machine Used: Easylink 2.3 P11 **Program Used:** Easyturn
File Name: P/5112 G TO P AFTER **Temperature:** 39.9C / 36.8C
Equipment Name: BFW Pump, P-5112, Pump to Gearbox

Date: 14.04.03 (YY.MM.DD)
Time: 10:09
Units: mm (mm/m)

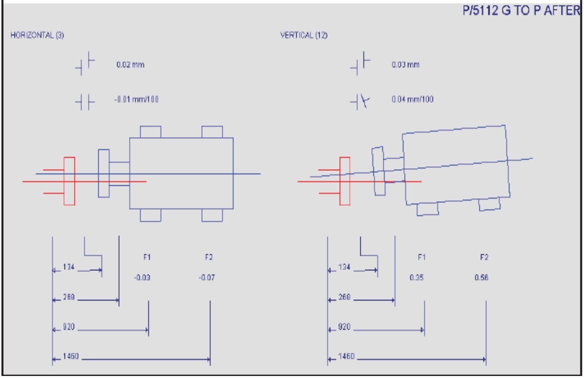
Foot Distances	
Stationary to Movable (S-M)	268
S-M Centre	134
Stationary to Foot-1	920
Stationary to Foot-2	1460

Thermal Compensation		
	Offset	Angular
Horizontal (H)	0.00	0.00
Vertical (V)	0.00	0.00

Alignment Readings				
Vertical/Horizontal	Parallel Offset	Angular offset	Correction Required	
			Foot-1	Foot-2
Horizontal (H)	0.02	-0.01	-0.03	-0.07
Vertical (V)	0.03	0.04	0.35	0.56

Note: All Readings are in MM

Graphical View of Alignment Readings



F.D FAN TURBINE WITH GEAR BOX (Q-5113)

During Shutdown-2014, it was planned to install the new plate type Air Preheater in place of old Regenerative Type Air preheater. After installation of New APH it is assumed that the load on the FD Fan will be reduced due to increased efficiency of APH (Considering zero air losses). So due to reduction of load on fan, the operating speed of fan will drop down to approx 900 RPM. However during start up it will further come down to 700-800 RPM also. So after the APH, FD fan will run in the speed range of 600-1100 RPM.

So before stopping the FD Fan, online trial of the governor has been taken on 26/03/2014, to check whether governor can perform in the new operating range of 600 -1100 RPM or not.

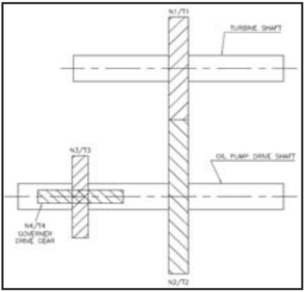
Various parameters as shown in the tabulated sheet has been recorded.

It is evident from the sheet that existing governor can satisfactorily work in the speed range of 600-1100 RPM, provided that sufficient control oil pressure of 9-10 kg/Cm2 is maintained in the governor, Because in the low speed range of below 900 Fan RPM, AOP will start automatically to maintain the control oil and lube oil pressure.

FD Fan Turbine Governor Online Testing

Date: 26/03/2014

HIC O/P (%)	Fan Rpm	Turbine RPM	Control Oil Pressure (Kg/CM2)	L.O Pressure (Kg/Cm2)	Air Flow (T/Hr)	Nozzle Box Pressure (kg/Cm2)	Steam Flow to FD (T/Hr)	AOP ON/OFF	AOP on AUTO	Remark
13	1109		9.11	0.9	81.3	36	3.26	Off	Auto	
12	1099		8.94	0.9	80.5	35	3.1	Off	Auto	
11	1089		8.82	0.9	79.4	35	3.1	Off	Auto	
10	1077		8.75	0.9	78.7	35	3.04	Off	Auto	
9	1067		8.63	0.9	77.6	35	2.99	Off	Auto	
8	1057		8.53	0.9	76.5	35	2.95	Off	Auto	
7	1047		8.43	0.9	76.2	34	2.88	Off	Auto	
6	1036		8.32	0.9	75.5	33	2.82	Off	Auto	
5	1024		8.18	0.9	74.5	33	2.79	Off	Auto	
4	1012		8.1	0.9	73.4	33	2.75	Off	Auto	
3	1002		7.99	0.9	72.9	32	2.7	Off	Auto	
2	991		7.92	0.9	72.3	32	2.67	Off	Auto	
1	980		7.84	0.9	71.5	31	2.62	Off	Auto	
0	970		7.67	0.9	70.8	31	2.6	ON	Auto	AOP Auto Starts
0	990	840	8.86	1	70.8	26		ON	Auto	With Air Tubing on Gov.
0	990	790	8.81	1.1	70.8	26		ON	Auto	W/o Air Tubing on Gov.
0	990	650	9	1.1						W/O Governor Cap
0	990	610	9	1.1						By turning 1/4 turn speed adjusting screw
0	990	585	9	1.1						By turning 1/2 turn speed adjusting screw
0	990	520	9	1.1						By turning 3/4 turn speed adjusting screw
0	990	300	9	1.1						By turning 1-1/2 turn speed adjusting screw
0	990	600	9	1.1						With cap and air tubing
1	990	800	9	1.1						..
2	990	800	9	1.1						..
3	990	804	9	1.1						..
4	990	820	9	1.1						..
5	990	830	9	1.1						..
6	990	840	9	1.1						..
10	990	850	9	1.1						..
15	990	880	9	1.1						..
20	992	992	9	1.1						..
21	1000	1000	9	1.1						..



In existing system we are getting the oil pressure of 9.3 Kg/Cm2 at 1150 Fan RPM. So if we reduce the speed of the fan upto 600 RPM, the oil pressure will also drop below 8.0 kg/Cm2 and AOP will start automatically.

Also at low RPM operation governor operating characteristics will also deteriorated and governor will not work satisfactorily in speed range of 600-900 RPM. So it would be very difficult to operate the turbine in 600-900 speed range.

To overcome this problem, internal drive system to oil pump and governor is studied and found that drive is transmitted to oil pump and governor through the gear sets as shown in the attached fig.

As per the attached fig, drive is transmitted to oil pump and governor from the turbine shaft through gears G1, G2, G3 and N4.

No. of Teeths on gears are

T1: 39

T2: 136

T3: 22

T4: 27

Existing gear ration of G1/G2 is 39/136 = 0.286 and G3/G4 is 22/27= 0.815, the calculated speeds of turbine, oil pump and governor is shown in below table:

Fan RPM	Turbine RPM (N1)	Gear oil Pump RPM (N2 = N3)	Governor RPM (N4)
1200	7200	2060	1679
1150	**6900**	**1973**	**1608**
1100	6600	1887	1537
1050	6300	1801	1467
1000	6000	1716	1398
950	5700	1630	1328
900	5400	1544	1258
850	5100	1458	1188
800	**4800**	**1372**	**1118**
750	4500	1287	1048
700	4200	1201	978
650	3900	1154	940
600	3600	1029	838

Considering the normal fan speed range of 1150 RPM before APH installation and 800 RPM after APH installation, the oil pump speed and governor speed should match with 1150 fan speed with new gear set at 800 RPM

i.e At 800 RPM, oil pump and governor speed should be approximately 1973 and 1608 RPM respectively.

So the new gear ratio required for gears G1/G2 is 0.40 for maintain the same oil pressure and governor speed range.

So new gear set G1 and G2 has been calculated with gear teeths of 51 and 124. So the new gear ratio will be 51/124= 0.41 which is as per our requirement.

At modified gear ratio of G1/G2 is 51/124 = 0.41 and G3/G4 is 22/27= 0.815, the calculated speeds of turbine, oil pump and governor is shown in below table:

Fan RPM	Turbine RPM (N1)	Gear oil Pump RPM (N2 = N3)	Governor RPM (N4)
1200	7200	2952	2405
1150	6900	2879	2346
1100	6600	2706	2205
1050	6300	2583	2105
1000	6000	2460	2004
950	5700	2337	1904
900	5400	2214	1804
850	5100	2091	1704
800	**4800**	**1968**	**1603**
750	4500	1845	1503
700	4200	1722	1403
650	3900	1599	1303
600	3600	1476	1203

It is clear from above tables that after modification we will get the same performance (RPM) of oil pump and governor at 800 RPM which we are getting at 1150 RPM before modification.

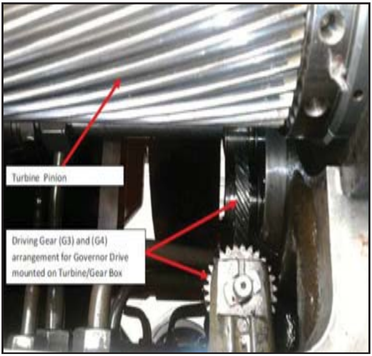
So during the preventive maint of Turbine, it was above mentioned gear set was changed to get get the desired performance of Governor and MOP.

During Preventive Maint following activities were carried out:

- De coupled the Turbine gearbox with Fan and Clutch to Motor.
- Removed all associated oil lines.
- Removed the governor and trip valve.
- Open and removed the gear box top cover.
- Opened the bearings of gear box, lift the top half of bearings.
- Cleaned and checked the condition of bearings top halfs.
- Removed and checked the bottom bearings one by one.
- Checked the bearing clearances which are tabulated in the clearance chart.

Sr. No.	Description	Design / Recomm. Value (MM)	Value after PM (MM)
1	Pinion Wheel Turbine End Journal Bearing Clearance	0.10-0.15	0.12-0.16
2	Pinion Wheel Fan End Journal Bearing Clearance	0.08-0.13	0.12-0.16
3	Gear Wheel Turbine End Journal Bearing Clearance	0.08-0.136	0.18
4	Gear Wheel Fan End Journal Bearing Clearance	0.08-0.136	0.12
5	Pinion wheel Axial Thrust	0.18-0.25	0.20
6	Gear Wheel Axial thrust	0.18-0.25	0.20

- Removed the main oil pump to access the internal gear drive arrangement to drive Main oil pump and governor as shown in the attached photographs.



- Old gear (G1-39 and G2-136 teeths) were removed and New Gear set (G1-51 and G2-124) were manufactured at M/s Ingeco Gears, Changodar, Ahmedabad and installed.
- Gear pump cleaned assembled back.
- Gear box housing cleaned properly.
- After cleaning assembled the journal bearings.
- Gear box top cover boxed up.
- Fixed the trip valve and governor.
- Rubber toothed pads of coupling between Gear Box and Fan replaced and coupled.
- Residual Magnetism (Gauss) checked and recorded
- Backlash between gear and pinion was 0.32 MM
- Main Oil Pump drive coupling bushes were checked and found OK.
- Regulating valve was replaced with new One as oil seal was leaking in old regulating valve.
- Trip valve checked and found OK.
- Coupling Rubber Toothed bushes were replaced.
- All oil lines were cleaned and flushed.
- Oil sump was cleaned.
- Oil cooler tubes hydro jetting done.
- Duplex Oil Filters were replaced.
- New fresh Oil was filled in oil sump.

After preventive maintenance, FD Fan was started and performance of turbine, oil pump and governor is measured which is as shown in given table.

FD FAN TURBINE START UP DATA WITH MOTOR ON - 14/04/2014

HIC-3	Local Gov pr	Main LO Pr Dig/G	Relay oil pr	LO Pr	Brg Oil Pr Turb side	Bg Oil Pr motor side	Turbine rpm	Nozzle box pr	AOP ON/OFF	Air flow	Suct damper opening	FD Fan motor ON/Amp
0	0	9.23/8.9	3.4	1.22	0.3	0.4			ON	70	17	ON/146
0	0	8.85/8.0	3.4	1.2	0.32	0.43			OFF	70	17	ON/146
1	0.2	11.1/10.6	3.4	1.32	0.4	0.45	4050/675	6	OFF	70	17	ON/146
2	0.2	11.17/10.7	3.4	1.33	0.4	0.45	4100/675	7	OFF	70	17	ON/146
3	0.21	10.6/10.5	3.4	1.3	0.38	0.43	4075/675	7.5	OFF	70	17	ON/146
4	0.22	10.74/10.5	3.4	1.3	0.39	0.44	4100/675	7.5	OFF	70	17	ON/146
5	0.22	10.71/10.5	3.4	1.3	0.39	0.44	4100/675	7.5	OFF	70	17	ON/146
7	0.24	10.77/10.5	3.4	1.3	0.39	0.44	4230/693	7.5	OFF	70	17	ON/146
10	0.26	10.75/10.5	3.4	1.3	0.39	0.44	4327/710	7.5	OFF	70	17	ON/146
12	0.28	108/10.5	3.4	1.3	0.39	0.44	4400/722	7.5	OFF	70	17	ON/146
15	0.3	10.83/10.52	3.4	1.3	0.39	0.44	4500/750	7.5	OFF	70	17	ON/146
18	0.32	10.89/10.55	3.4	1.3	0.395	0.45	4600/760	7.5	OFF	70	17	ON/146
20	0.34	10.89/10.55	3.4	1.3	0.395	0.45	4650/790	7.5	OFF	70	17	ON/146
25	0.38	10.97/10.6	3.4	1.3	0.395	0.45	4815/802	7.5	OFF	70	17	ON/146
30	0.42	11.17/10.7	3.4	1.3	0.4	0.45	4970/830	7.5	OFF	70	17	ON/146
35	0.46	11.19/10.7	3.4	1.3	0.4	0.45	5108/840	7.5	OFF	70	17	ON/146
40	0.5	11.19/10.8	3.4	1.3	0.4	0.45	5242/875	7.5	OFF	70	17	ON/146
45	0.54	11.51/11.1	3.4	1.26	0.4	0.45	5400/900	7.5	OFF	70	17	ON/146
50	0.58	11.48/11.1	3.4	1.2	0.41	0.45	5500/916	7.5	OFF	70	17	ON/146
55	0.62	11.60/11.2	3.4	1.2	0.41	0.45	5650/940	7.5	OFF	70	17	ON/146
60	0.66	11.72/11.3	3.4	122	0.42	0.46	5785/965	7.5	OFF	70	17	ON/146
65	0.7	11.83/11.2	3.4	1.2	0.42	0.46	5900/980	7.5	OFF	70	17	ON/146
67	0.72	11.72/11.2	3.4	1.18	0.42	0.46	5950/990	7.5	OFF	70	17	ON/146
70	0.745	11.72/11.2	3.4	1.16	0.42	0.46	6000/998	8.5	OFF	70	17	ON/136
72	0.76	11.75/11.2	3.4	1.15	0.42	0.46	1003	13	OFF	70	17	ON/70
71.5	0.76	11.77/11.3	3.4	1.1	0.41	0.45	1003	15	OFF	85	70	ON/70

FD FAN TURBINE START UP DATA WITH MOTOR OFF - 14/04/2014

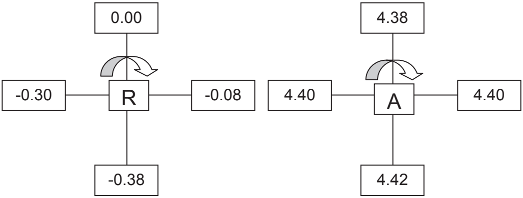
HIC-3	Local Gov pr	Main LO Pr Dig/G	Relay oil pr	LO Pr	Brg Oil Pr Turb side	Bg Oil Pr motor side	Turbine rpm	Nozzle box pr	AOP ON/OFF	Air flow	Suct damper opening	FD Fan motor OFF
71.5	0.76	11.77/11.3	3.4	1.1	0.41	0.45	990	15	OFF	85	70	OFF
71.5	0.76	11.69/11.2	3.4	0.98	0.41	0.5	990	16	OFF	87.5	100	OFF
70	0.75	11.63/11.1	3.4	0.98	0.41	0.5	990	16	OFF	87	100	OFF
67	0.73	11.43/11.0	3.4	0.98	0.4	0.48	980	15.5	OFF	85.6	100	OFF
65	0.71	11.28/10.8	3.4	0.97	0.4	0.48	970	15	OFF	84.5	100	OFF
63	0.7	11.14/10.6	3.4	0.97	0.4	0.48	960	14.5	OFF	83.8	100	OFF
60	0.68	10.89/10.4	3.4	0.95	0.39	0.46	938	14	OFF	82.2	100	OFF
57	0.65	10.7/10.3	3.4	0.93	0.37	0.44	927	13.5	OFF	81	100	OFF
55	0.63	10.54/10.1	3.4	0.9	0.35	0.42	917	13	OFF	80.3	100	OFF
53	0.61	10.43/10.0	3.4	0.9	0.34	0.4	906	13	OFF	79	100	OFF
50	0.59	10.21/9.6	3.4	0.9	0.34	0.4	895	12.5	OFF	78	100	OFF
48	0.58	10.21/9.5	3.4	0.9	0.34	0.4	885	12.3	OFF	76.7	100	OFF
45	0.56	9.98/9.5	3.4	0.9	0.34	0.4	875	12.3	OFF	75.7	100	OFF
40	0.51	9.76/9.4	3.4	0.9	0.34	0.4	841	12	OFF	73.2	100	OFF
35	0.47	9.56/9.2	3.3	0.9	0.34	0.4	831	11	OFF	71	100	OFF
30	0.44	9.78/9.3	3.2	0.9	0.34	0.4	798	10	OFF	69	100	OFF
25	0.39	9.73/9.3	3.1	0.9	0.34	0.4	775	9.5	OFF	67	100	OFF
20	0.35	9.49/9.2	3.1	0.9	0.34	0.4	743	9	OFF	65	100	OFF
18		9.38/9.0		0.9	0.34	0.4	732	8	OFF	62	100	OFF
15				0.9	0.34	0.4	720		OFF	60	100	OFF

It is evident from the data that all the parameters are as per our requirement.

FD FAN (K-5113)

During preventive maintenance following activities were carried out:

- Top bearing covers of both ends pedestal bearing removed for roller bearing inspection.
- Roller bearings cleaned, checked and found OK.
- Oil lines cleaned and flushed.
- Fan casing inspection cover opened to check the internals for inspection and no abnormality observed.
- Condition of overriding clutch checked and found OK.
- New clutch oil filled in motor side overriding clutch.
- After overhauling alignment between motor to clutch was carried out and final alignment readings are as under:



Note: Radial readings are taken by dial and axial readings are taken by feeler gauge.

BHEL BOILER JOBS (F-5111)

RLA STUDY

RLA Study of all pressure parts of boiler was carried out by M/s NTPC Alstom. As Per scope of work or IBR 391 A Table-1 all components like Steam Drum, Critical Piping, Low & High Temperature header and Tubes Include this study.

Following tests have been conducted for this study-Visual Inspection, Dimensional Inspection / Ultrasonic thickness measurement, Dye Test Penetrant, Ultrasonic Test, Magnetic Particle inspection, Fiber inspection, Replica /Hardness ,Deposit and Tube sample for lab testing. Preliminary observation report of the RLA Study is attached below:

Based on site study and Preliminary observation report all above component fit for further operation after repair /replacement .

Preliminary observation report RLA study of GT-2068 – BHEL Boiler						
Sr. No.	**Components**	**Activity**	**Area of Inspection**	**Observations**	**Status**	**Remarks**
01	**Steam Drum** Design data- ID: 1371mm Thickness: Shell: 97mm Dish End: 72mm	Visual	Surface(External & Internal)	Pitting, corrosion, minor scaling & dent marks were observed in the outer surface. Minor pitting was observed in the inner surface. Blackish deposits were in the inside drum.	completed	**Based on site study Visual, DPT, MPI, UT& HM – No abnormality found. Component fit for further operation.**

	Material: SA299	LPT	All non-pressure part weld from inside & Out side All nozzle welds from both side	No surface indication observed		Detailed report will be furnished in final report.
		MPT	All accessible inside & outside longitudinal & circumferential butt welds	No surface/sub surface indication observed		
		UT	All accessible longitudinal & circumferential butt welds	No recordable indication observed		
		ODTM		ID- Min:1372mm, Max: 1375.93mm Thickness- Dish end- Min: 79.58mm, Max: 81.03mm Shell- Min: 100.84, Max: 102.60		
		REP	On parent metal & weld joints	Replica has been taken at 4 locations		
		HT	On parent metal & weld joints	Refer Annexure-1		
		DA	From drum internal surface	Deposit has been collected		
	Water Drum Design data- ID: 914mm Thickness- Shell: 78mm Dish end: 54mm Material: SA299	Visual	Surface(External & Internal)	No abnormality observed except minor pitting observed inside drum.		
		LPT	All non-pressure part weld from inside & Out side All nozzle welds from both side	No surface indication observed		
		MPT	All accessible inside & outside longitudinal & circumferential butt welds	No surface/sub surface indication observed		
		UT	All accessible longitudinal & circumferential butt welds	No recordable indication observed		
		ODTM		ID- Min:914.40mm, Max: 919.06mm Thickness- Dish End - Min:56.56mm, Max: 57.80mm Shell - Min:82.68mm, Max: 82.88mm		
		REP	On parent metal & weld joints	Replica has been taken at 3 locations		
		HT	On parent metal & weld joints	Refer Annexure-1		
		DA	From drum internal surface	Deposit has been collected		
02	**Low temperature Headers** Design data- OD: 219mm Thickness: 25mm	VI	Surface, supports and other structural components	No major abnormalities observed	Completed	**Based on site study Visual, DPT, MPI, UT& HM – No abnormality found. Component fit for further operation.**
		LPT	All nozzle joints with header, Tube butt welds, stubs & Cap joints.	No surface indication observed		

	Material: SA106 Gr.B	ODTM	OD & Thickness Measurement	OD- Min: 220mm Thickness- Min: 22.79mm, Max: 25.88mm		Detailed report will be furnished in final report.
		FOI	Internal surface of headers	Deposits & Minor scaling observed		
		HM	Parent metal & welds	Refer Annexure - 1		
03	**Attemperator Header (De-Super heater header)** Design data- OD: 273mm Thickness: 32mm Material: SA335 P22	VI	Surface, supports and other structural components	No abnormalities observed	Completed	**Based on site study Visual, DPT, MPI, UT, ODTM, FOI, SM & HM – No abnormality found. Component fit for further operation.** Detailed report will be furnished in final report.
		UT	All circumferential butt welds	No recordable indication observed		
		LPT	All circumferential butt welds, nozzle joints etc..	No surface indication observed		
		MPT	All circumferential butt welds	No surface/sub surface indication observed		
		REP	Insitu-Metallography (Replica) on Parent metal and weld joints.	Replica has been taken at 2 locations		
		ODTM	OD & Thickness Measurement	OD- Min: 272mm, Max: 273mm Thickness- Min: 29.16mm, Max: 30.35mm		
		FOI	Internal surface of headers	Corrosion, Minor pitting and whitish deposit were observed inside the header		
		HM	Parent metal & welds	Refer Annexure-1		
		SM	Swell Measurement	Swell measurement taken, no swelling found.		
04	**Primary & Final (Secondary) Super heater coils** Design data- Primary-OD: 51mm Thickness: 7.1mm Material: SA213 T22 Secondary- OD: 51mm Thickness: 5.6mm Material: SA213 T22	VI	All accessible surface area	Minor scaling and rusting were observed in all PSH & SSH coils.	Completed	**Based on site study Visual, DPT, MPI, UT, UT-T & HM – No abnormality found. Component fit for further operation.** Detailed report will be furnished in final report.
		SAM	Tube sampling	Tube samples collected for analysis		
		ODTM	OD & Thickness Measurement at straight portion and bends	**PSH Coils** – OD- Min:51.1mm, Max: 51.3mm Thickness-Straight- Min:7.11mm,Max: 7.80mm Bend –Min:5.97mm, Max: 7.02mm **SSH Coils**-OD- Min: 51.0mm, Max: 51.2mm Thickness-Straight- Min:5.90mm,Max: 6.57mm Bend –Min: 5.29mm, Max: 6.09mm Return Bend- Min: 4.71mm, Max: 5.37mm		
		HM	Parent metal & welds	Refer Annexure - 1		
		OTI	Non-Destructive oxide thickness inspection	Oxide scale thickness found under limit		
05	**Primary & Final (Secondary) Superheater Headers**	VI	Surface, supports and other structural components	No abnormality observed	Completed	**Based on site study Visual, DPT, MPI, UT, UT-T & HM – No abnormality**
		UT	All circumferential butt welds	No recordable indication observed		

	Design Data- ***PSH Inlet-*** OD- 273mm THK- 25mm ***PSH Outlet-*** OD- 273mm THK- 32mm ***SSH Inlet-*** OD- 273mm THK- 25mm ***SSH Inlet-*** OD- 273mm THK- 25mm					**found.** **Component fit for further operation.** Detailed report will be furnished in final report.
		LPT	All circumferential butt welds, nozzle joints etc..	No surface indication observed		
		REP	Insitu-Metallography (Replica) on Parent metal and weld joints.	Replica has been taken at 2 locations		
		ODTM	OD & Thickness Measurement	**PSH Inlet** - OD- Min: 272mm, Max: 273mm Thickness- Min: 28.80mm, Max: 29.98mm **PSH Outlet** - OD- Min: 272mm, Max: 273mm Thickness- Min: 29.77mm, Max: 30.51mm **SSH Inlet** - OD- Min: 272mm, Max: 273mm Thickness- Min: 28.15mm, Max: 29.30mm **SSH Outlet** - OD- Min: 272mm, Max: 273mm Thickness- Min: 28.15mm, Max: 29.64mm		
		FOI	Internal surface of headers	IN PSH Inlet – The surface found free from scales and pitting, no abnormalities observed.		
		HM	Parent metal & welds	Refer Annexure-1		
		SM	Swell Measurement	Swell measurement taken, no swelling found.		
06	**Main Steam Piping (Main steam pipe line up to Main steam stop valve, Boiler Feed Water Pipe line after isolation valve)** **Design Data:** MS Line- OD: 273mm THK: 25mm Feed Water Line- OD: 159mm THK: 10mm	VI	Surface, supports and other structural components	No abnormalities observed	Completed	**Based on site study Visual, DPT, MPI, UT, UT-T & HM –** **No abnormality found.** **Component fit for further operation.** Detailed report will be furnished in final report.
		REP	Insitu-metallography (Replication)	Replica has been taken at 4 locations		
		ODTM	OD & Thickness measurement	MS Line-OD- Min: 273mm, Max: 274mm Thickness- Min: 23.06mm, Max: 29.50mm Feed Water Line-OD- Min: 158mm, Max: 158mm Thickness- Min: 8.72mm, Max: 10.64mm		
		HM	Parent metal & welds	Refer Annexure -1		
		MPT	Magnetic particle Testing	No surface/sub surface indication observed		
07	**Boiler Bank Tubes** Design Data: OD:51mm & THK:4mm	VI	Surface	Minor scaling and rusting observed	Completed	**Based on site study Visual, UT-T –** **No abnormality found.** **Component fit for**
		ODTM	OD & Thickness measurement	OD- Min: 63.5mm, Max: 63.8mm Thickness- Min: 3.39mm, Max: 4.56mm		

08	**Water Walls Design Data: Boiler Side Wall Tubes,** Design Data: OD:76.1mm & THK:4.5m **Boiler Shield Wall Tubes** Design Data: OD:76.1mm & THK:3.2mm **Other Furnace Tubes** Design Data: OD:76.1mm & THK:4.5mm	VI	Surface	Minor rusting/scaling found in all the water wall tubes. No major abnormalities found.		**further operation.** Detailed report will be furnished in final report.
		ODTM	OD & Thickness measurement	Boiler Front Wall Tubes- Thickness- Min: 4.24mm, Max: 5.36mm Boiler Rear Wall Tubes- Thickness- Min: 4.60mm, Max: 5.20mm Boiler Shield Wall Tubes- Thickness- Min: 4.71mm, Max: 5.42mm		
09	**Furnace Water Walls (Furnace 'D' Tubes, Furnace Corner Tubes & Baffle Wall Tubes)** **Design Data: Furnace D tubes-** OD: 76.1mm THK: 4.5mm **Furnace Corner Tubes-** OD: 76.1mm THK: 4.5 mm **Baffle Wall Tubes-** OD: 76.1mm THK: 4.5mm	VI	Surface	Minor rusting/scaling found in all the Furnace water wall tubes. No major abnormalities found.	Completed	**Based on site study Visual, DPT, UT-T– No abnormality found. Component fit for further operation.** Detailed report will be furnished in final report.
		SAM	Tube sampling	Tube samples collected for analysis		
		ODTM	OD & Thickness measurement	**Boiler Furnace Wall D Tubes**- Thickness- Min: 4.74mm, Max: 5.57mm **Boiler Furnace Corner Tubes-** Thickness- Min: 4.74mm, Max: 5.31mm **Boiler Baffle Wall Tubes-** Thickness- Min: 4.51mm, Max: 5.31mm		

During RLA

During RLA Study of boiler, samples of following tubes were taken for the destructive testing.

Sr. No.	Tube Description	Tube Size & Material	No. of Tube Samples	No. of joints.
1	Front Wall, Cut Corner, Rear Wall & Baffle Wall Tubes	76.1mm OD X 4.5 mm Thick MOC: SA – 192	04	08
2	Primary Superheater Coil	51.0 MM OD X 7.1 MM Thick MOC: T-22	01	02
3	Secondary Superheater Coil	51.0 MM OD X 5.6 MM Thick MOC: T-22	01	02

BHEL BOILER INSPECTION/HYDROTEST:

Boiler was inspected by Boiler Inspector in open condition on 03/04/2013 & IBR Hydrotest was carried out at 90.0 kg/cm2 pressure on 12.04.2013 and witnessed by Boiler Inspector.

INSTALLATION OF PLATE TYPE AIRPREHEATER WITH BFW COIL

New Plate Type Air Preheater (APH) of M/s Gea make was installed in place of old Regenerative Type Air Preheater (RAH) with additional BFW coil in Flue gas path to APH.

FIXING OF CAP ON BOTTOM BURNER TIP

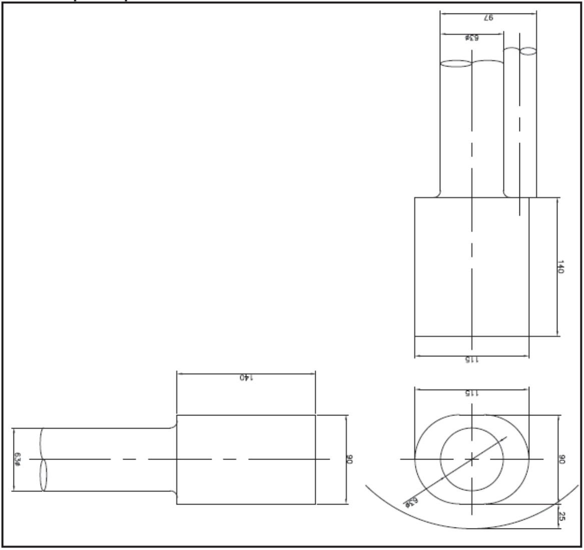
There is a problem of ignition of boiler burners since last one year. During start up of boiler, the igniters could not come into line. OEM of burner, M/s Thermax was also consulted on this problem but no concrete solution was obtained. During the study of the problem it was observed that burners could not ignited due to excess air supplied by the FD fan during start up as this leans the mixture of air and gas.

After that it was decided to cap the tip of bottom burner with some clamp type of arrangement, so that air cannot directly impinge on the burner tip.

So a Cap clamp in two pieces of SS-304 material was manufactured in our workshop and fixed on bottom burner tip on trial basis.

The photographs of cap clamp are attached below:

Sketch of cap clamp is also attached below:



WELDING OF FLANGE IN SPARE SUPERHEATER RV

Spare welded connection type Superheater safety valve was available with us, to make it one to one replacement, companion RTJ Flange was welded with the safety valve.

Details of Boiler Super Heater safety valve Nozzle and Flange is given below:

Nozzle OD: 79.4 MM

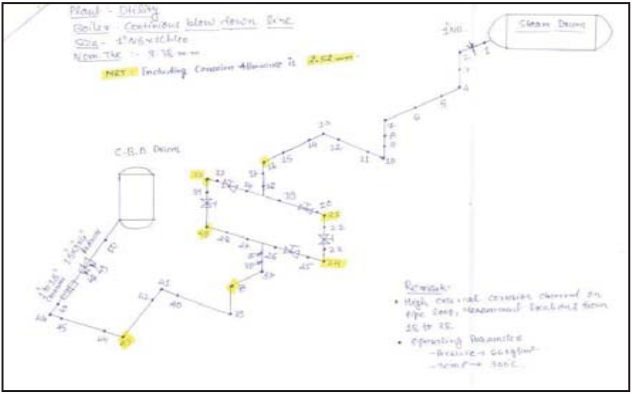
Nozzle Thickness: 20.65 MM

Flange Details: As per attached Drawing No. P3-DS-13404 Sheet 1/1, Rev.0

MOC of Flange: ASTM A 105

REPLACEMENT OF CBD DRAIN LINE

Based on the thickness survey report of inspection section, CBD drain line from drum to second isolation valves i.e upto point No. 31 and 33 was replaced with newly fabricated line.



REPLACEMENT OF FD FAN TURBINE ISOLATION VALVE

First isolation valve of FD Fan Turbine was also replaced with new one.

TESTING OF BOILER RV'S

Critical boiler RV's were removed, overhauled and then tested during
Bench test of following Safety valves of GT -2068 was done on 11/04/2014 and the readings are as under.

RV Rear		RV Front	
Pop.Pressure	Reset Pressure	Pop. Pressure	Pop. Pressure
72.0 Kg/ cm^2	70.0 Kg/ cm^2	69.0 Kg/ cm^2	67.0 Kg/ cm^2

Steam test of Superheater Safety Relief Valves of Boiler NO.GT-2068 was carried out on 14-04-2014 and the readings is as under:

RV (Super Heater)	
Popping Pressure	64.72 Kg/ cm^2
Reset Pressure	62.35 Kg/ cm^2

Other Boiler Jobs

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

Deaerator Inspection

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

COOLING TOWER AREA JOBS

Welding of SS 304 Patch plate on CW Header riser pipes.

CW header riser pipes of all cooling towers were patched with SS-304 plate where it comes out of ground level.

Details of CW Header Sizes:

(A) 36" NB Sch. STD, MOC: CS

(B) 30" NB Sch. STD, MOC: CS

(C) 24" NB Sch. STD, MOC: CS

Patch Plate: SS 304, 3 mm Thick X 1500 MM Apprx.

This job involves:

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

Replacement of Fan Deck and Staircase of Cooling Tower (H-4401/7 & 8)

Complete Fan Deck and Stair case of Ammonia Cooling Tower (H-4401/7 & 8) was replaced by new timber components by M/s Paharpur Ltd.

Installation of Sintex Make Partition Panel in Ammonia Cooling Tower

- Old Wooden damaged partition panels of Ammonia Cooling tower Cells A1-A2, A2-A3 and A3-A4 was replaced by new Sintex make PVC section partition panels by Ms Abhay Fabricators, Kalol.
- Before installation sample of sintex make PVc section was dipped in the basin for about one month and this sample was sent to Sintex Kalol for testing to confirm that this material is suitable for our cooling water application.

  Test report of Sintex make PVC section is attached below:

SINTEX INDUSTRIES LIMITED. PLASTICS DIVISION

COMPARISON SUMMARY REPORT FOR PVC PROFILE SECTION D-302 D-10 (Fresh sample) & D-302 D-10 (Exposed sample given by Mr. R.K. Sharma tried out on IFFCO cooling tower)

UNIT:	SIL – Kalol		
Date :	19/09/13	Product Code / Type	D-302 D-10

Sr. No.	PARAMETER/ CHARACTERISTIC TO BE INSPECTED	RELEVENT SPECIFICATION OR PRODUCT STD	TEST METHOD / TEST EQUIPMENTS	Actual Observation on Sample 1: D-302 D-10 (Fresh sample)	Actual Observation on Sample 2: D-302 D-10 (Exposed sample given by Mr. R.K. Sharma)	Remarks
B. TYPE TEST:						
B1	Degree of Fusion (Acetone Immersion Test)	BIS Draft Std. CED 11 (7847)P Annex- D	BIS Draft Std. Annex- D	OK (Only minor wrinkle in printed surface)	OK (Only wrinkle in printed surface)	Accepted
B2	Tensile Strength (BIS Dr Std : Cl :4.1.2)	IS:13360 P-5 / S-2 / ASTM-D-638	ASTM-D-638	< 30 N/mm2	< 32 N/mm2	Accepted

Note: 1) Pls. Note Plastic section D-302 Meant for only indoor application , protect from direct sunlight expose

TESTED BY : Mr. Jay Bhatia — **PREPARED BY** : Mr. Amit Joshi

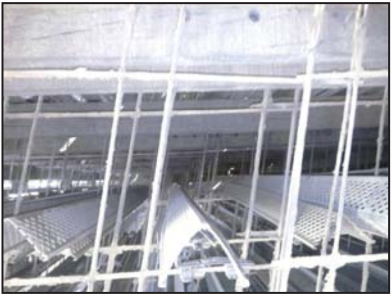
VERIFIED BY : Mr. S.venkat Ram

- Photographs of New sintex PVC partition panel are attached below:



INSPECTION AND REPAIRING OF COOLING TOWERS

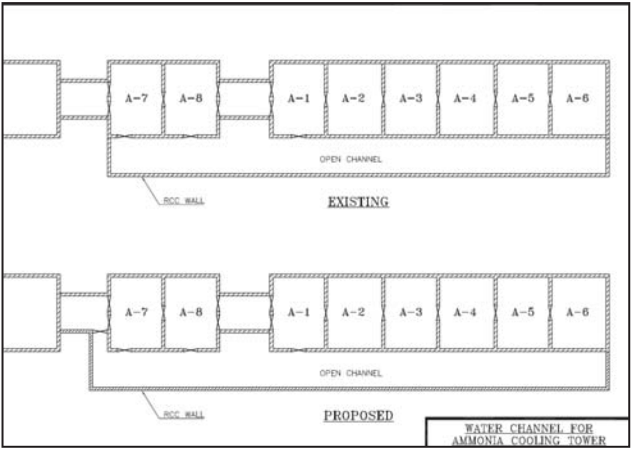
- Committee comprising members from Mech Maint, Inspection, Civil and Utility Production inspected all the cooling towers and recommended the necessary repairs.
- Based on the committee recommendations, Structural members of the cooling towers were checked and replaced the defective members.
- Corroded fasteners were replaced with new SS304 bolts with SS 304 Square washers.
- Leakages attended from end wall & louvers.
- Repaired of stair case
- Replaced on cracked Base casting (Towards admin side) of Old Urea Cooling Tower.
- Fill area of all coolinh towers were also inspected for any damage on sampling bases by providing out side scaffolding and removing louver sheet to enter in the fill area. All fill area components and structural members found in good condition, however some PVC V-bars are found dislocated and the same was rectified. Photographs of Fill area inspection are attached below:



- Job carried out through M/s Paharpur cooling tower vide No 201004131237, Dt 08/02/2013 for the repairing of cooling towers**.**

CONSTRUCTION OF BY-PASS CHANNEL

By-pass channel for the flow of cooling water through the basin was also constructed from Ammonia-1 basin to Ammonia-7 sump to facilitate the isolation of individual cooling towers (A-7 and A-8) during proposed revamping of Ammonia (H-4401/7 & 8) cooling towers. (Fig Attached)



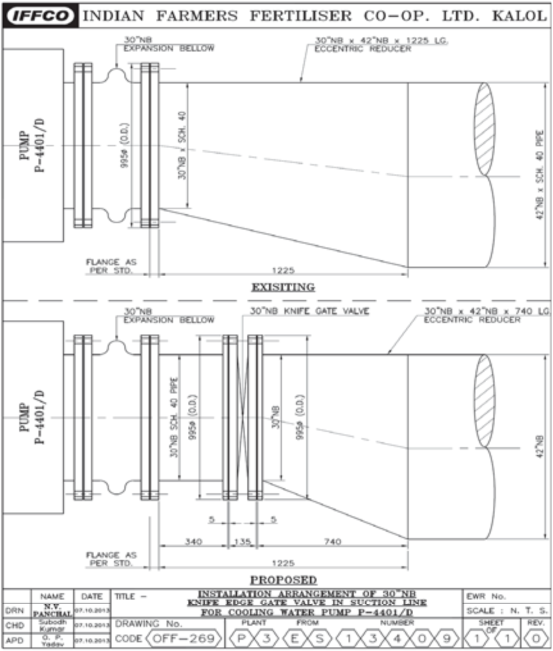
SAND BLASTING AND SPRAY GLAVANISING ON CW PIPES AND STRUCTIRES

For the long term protection of Cooling Water Header pipes, structures and tanks from out side corrosion, Sand blasting and spray galvanizing was carried out through M/s Astra Enerprises, Mumbai on following components/area:

- West Side 36" NB CW header of Old Ammonia Cooling Tower behind Cooling Tower control room.
- Cooling tower header and riser pipes in between cooling tower cells A-1 and A-8.
- Structural members in between cooling tower cells A-1 and A-8.
- VAG-A and B Tanks (Outside)

INSTALLATION OF KINFE EDGE GATE VALVE IN SUCTION LINE OF P-4401/D PUMP

New Jash make Knife Edge Gate Valve of 30" NB was installed in the suction line of CW Pump, P-4401/D to facilitate the isolation of this pump during normal running of plant. (Modified system is shown in attached sketch)



Details of CW line & Knife Edge Gate Valve is :

Type of Valve: Knife Edge Gate Valve

Size & rating: 30" (750 MM) NB X 150#

Qty: 01 No.

Material : CS

Following activities were involved in this job:

- Cutting of Existing 42" NB Sch. Std (9.5 MM Thk) Line.
- Removals of 30" NB rubber expansion bellow from the suction of the pump.
- Welding of Prefabricated reducer of Size (42" X 30") in 42" CWP Suction Line.
- Fabrication of 30" NB spool piece of approx 300 MM length with 30" NB class 150# flanges
- Installation of Knife Edge Gate valve and Rubber Expansion with gaskets.

OTHER COOLING TOWER JOBS

- All cooling tower distribution valves were attended for smooth operation.
- Internal inspection of 52” CW interconnection line was carried out and M-seal was applied at the cavities of the welding joint.
- Bell mouths of the cooling water pump suction lines were also inspected and painting carried out.
- Gland repacking of valves were carried out.

DM PLANT JOB

- Various lines of Cation and Anion were lifted with CPVC and SS-304 material.
- Some photographs of line after lifting with the use of CPVC and SS-304 material are attached below:






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

STEAM LEAK & FABRICATION JOBS

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

B & MH PLANT
(MECHANICAL)

PLANT TRANSFER CONVEYOR-M-2110

Following jobs were carried out.

- Replaced the damaged 19 Meter length of conveyor belt with new oil & heat resistance Conveyor belt (800 mm width) NN 630 / 4 (Make : MRF,OHR grade) and also removed fasteners and provided hot vulcanized joints.
- Head pulley, Tail Pulley, Bend pulley, Gravity pulley and Snub pulley were inspected and greasing done.
- Provided new rubber lagging on Gravity pulley, Tail pulley and Snub pulley.
- Two Nos of new Tega make Tru- Trac- Trough rollers were installed 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 was serviced.
- All damaged and noisy carrying rollers, Return rollers, Self alignment carrying roller frames, Self alignment return roller frames and Tracking rollers were replaced.
- New Kaveri make skirt rubber were provided.
- Replacement of tail end side SS Chute instead of MS Chute.

TWO WAY FEED HOPPER CHUTE – M-2111

Following jobs was carried out.

- Modified the discharge chute of M-2110 Conveyor (M-2111) by increasing its neck width size to avoid frequent chocking at neck.

FRESH UREA SHUTTLE CONVEYOR-M-2112

Following jobs was carried out.

- Replaced the Complete length (450 M) of conveyor belt with new oil & heat resistance Conveyor belt NN 630/3 600 mm width (M/s Dynamics rubbers) received in replacement of worn out conveyor belt.
- Rubber lagging done in Head pulley, Tail end pulley, bend pulley, snub pulley, Gravity pulley and tripper Head & Tail pulley.
- Preventive maintenance of Gear Box carried out & Coupling done after proper alignment with new rubber bushes.
- Gear box oil was replaced.(Servo system-460)
- All noisy and damaged carrier, guide and return rollers replaced with new rollers.

- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.
- Tripper Gear box over hauled and realigned with motor.
- New Kaveri make skirt rubber were provided.
- New Three Nos Tega make tru Track Trough rollers provided on carrying side for arresting sway of conveyor belt

RECLAIM CONVEYOR-M-2117 A

Following jobs were carried out

- Preventive maintenance Gear Box and Coupling done after proper alignment with new rubber bushes.
- Gear box oil was replaced.(Servo Mesh SP-320)
- All noisy and damaged carrying, guide and return rollers were replaced with new rollers.
- Greasing done in all bearings of head pulley, tail pulley, snub pulley and gravity pulley.

BAGGING BUILDING FEED CONVEYOR-M-2121

Following jobs were carried out

- Preventive maintenance of Gear Box carried out and Coupling done after proper alignment with new rubber bushes.
- Conveyor belt was repaired by cutting of damaged top ply at many places.
- Complete skirt board sealing system skirt blocks were replaced with new one.
- Replaced all damaged and noisy Carrying, Return, Impact and guide rollers with new rollers.
- Complete greasing of all pedestal bearings done.
- New rubber lagging provided on Bend pulley, Tail pulley, Snub pulley and Gravity pulley.

BAGGING BUILDING HOPPER CONVEYOR-M-2122

Following jobs were carried out

- Replaced the Complete length (60 M) of conveyor belt with new M-24 Grade Conveyor belt 800 mm width, 4 Ply, heavy duty (M/s MRF Make)
- Replaced all damaged and noisy Carrying, return and guide rollers with new rollers.
- New Kaveri make skirt rubber were provided.
- Complete greasing in all pedestal bearings done.
- Take up studs were serviced.
- Replaced complete Gearbox with another overhauled Gearbox and Coupling done after proper alignment with new rubber bushes.

BAGGING BUILDING HOPPER CONVEYOR-M-2122A1

Following jobs were carried out

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

BAGGING BUILDING HOPPER CONVEYOR-M-2122 A2

Following jobs were carried out

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

FLAT CONVEYOR BELT-M-2142

Following jobs were carried out

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

DUST & UREA LUMPS BELT CONVEYOR-M-2137

Following jobs were carried out

- Replaced all damaged and noisy Carrying and return rollers with reconditioned rollers.
- Complete greasing of all bearings done.
- Replaced Tail end pedestal bearing 75 mm dia.
- Coupling done after proper alignment with new rubber bushes.

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 oil was replaced.(Servo system-460)

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

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

AIR BLOWER-K-2161

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

AIR BLOWER-K-2704

- All lines were removed, cleaned and boxed up.

CYCLONE SEPARATOR-V-2704

- Separator was opened, cleaned and boxed up.

UREA SOLUTION TANK-T-2704

- Tank was opened, cleaned and boxed up.

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

- All screens were removed, cleaned and boxed up.

RECLAIM MACHINE-M-2116 A

Following jobs were done

- Preventive maintenance of Scrapper and Bucket elevator mechanism.
- Checking of complete slewing ring mechanism.
- Checking of upper and lower kingpost.
- Inspection of Tie Rod, Tie Rope and Pivot assembly.
- Checking of complete central Greasing mechanism.
- Complete Greasing of reclaim machine
- Replacement of lubricating oil of all Gearboxes (Servo mesh SP-320)
- Checking of Thruster and break shoes

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 4.**
- 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- 5.**
- Thickness measurement of various equipment and HT/LT Convection coils of primary reformer were carried out .Details are given at **Annexure-6.**
- Thickness measurement of various pipelines was carried out. Details are given at **Annexure-7.**
- Measurement of residual magnetism at various parts of rotating equipment and de - magnetization of the same wherever required. Details are given at **Annexure-8.**
- In-situ Metallography of selected equipment and pipelines were carried out. Detailed summary of observations and microstructure analysis is given at **Annexure-9.**
- Inspection of newly fabricated pipelines and fabrication jobs carried out departmentally by Maintenance and Technical department.
- NDT's viz. UFD & RT was carried out in the converter loop to assess the condition of weld joints & Elbow parent metal for any deterioration. The details are attached at **Annexure-10.**
- Qualification tests of welders employed by contractors.
- The detailed observations and recommendations for corrective actions required on individual equipment are given below. All the observations were recorded during inspection and were handed over to concerned Maintenance and Operation group for necessary corrective action.

PRIMARY REFORMER 101-B

RADIANT ZONE

VISUAL INSPECTION

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

OTHER NDT ACTIVITIES

- 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. of tubes and between 0.17 to 0.70 % in 01 nos. of tubes. Creep measurement of the riser tubes at tunnel slab level was also carried out using digital micrometer. Creep was found of Riser tube in the range 0.33 – 1.17 % in all 08 nos. of Riser tube. The report is attached at **Annexure 2.**
- In-situ Metallography 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-9.**
- Radiography of all 08 nos. weldolet to riser weld joints was carried out. No significant defect was observed.

CONVECTION ZONE

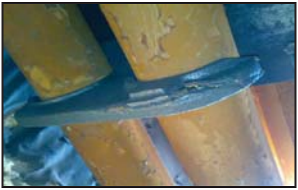
Visual inspection of HT convection zone from top and bottom manhole and Auxiliary boiler furnace was carried out. The observations made are as under:

H.T. CONVECTION SECTION

From Bottom Manhole

- Hard scaling was observed on all the tubes of Mixed Feed Coil.
- Bottom most part of Insulation covering plate was found burnt off at most of the locations. This was observed in previous inspection also.
- Refractory at the ceiling found damaged/fallen/ cracked at few locations and its holding clits were found burnt off at such locations. Refer attached photograph.

- Out of four anchor support of mixed feed coil 03 nos. were found to have crack/peeling off of top layer of casting was observed for East side support. Rests of the support were found satisfactory. Refer attached photographs.



- Tunnel thermo well pipes were found slightly bent, scaled and eroded except thermo well no. 8 counting from west. 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.
- Insulation of East, West and South wall was found satisfactory.

VESSELS & OTHER EQUIPMENT

103-D, SECONDARY REFORMER

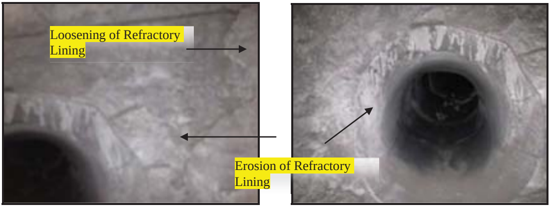
TOP AIR AND GAS ENTRY:

- Zig-Zag scattered cracks were observed on the refractory lining all over the cone region and shell.
- At few scattered locations cracks having width approx 3mm or more was observed on refractory.
- One segment of shoulder refractory on top of the cone to top-shell junction was found damaged.
- Thermo wells were found intact.
- Gap was observed between shift liners of top shell to transfer line.
- 1st Layer of refractory peeled off/detached at junction of Shell & Cone region.Crack observed on the weld joint of patch liner to transfer line liner approx. 4” length.

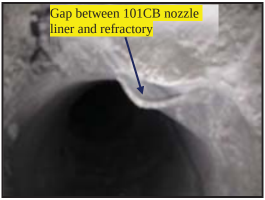
- Jacket cooling water over flow pot at the outside of the shell found cracked at both extreme ends.

<u>BOTTOM DOME :</u>

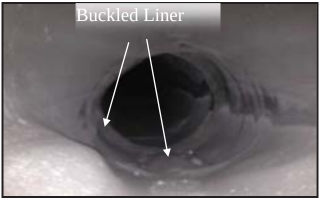
- The refractory around the 101-CA/CB gas inlet nozzles (approx half of the circumference) was found eroded and loosened.



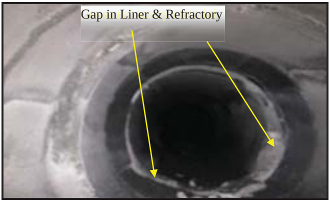
- Gap was observed between the 101-CA/CB gas inlet nozzle liner and the shell refractory joint. Gap of approx 2” was observed towards the 101-CB nozzle. The same was observed in previous inspection also.



- The liners inside the 101-CA/CB gas inlet nozzle were slightly buckled /distorted. Condition of the thermo-wells was satisfactory. The same was observed in previous inspection also.



- Loose refractory was found lying in the nozzle of 101-CA. Gap was observed between the liner and refractory.



- Loose refractory dust and refractory pieces were lying on the bottom dome.

<u>AIR MIXTRURE of 103-D:</u>

- Scattered cracks were observed at refractory around nozzle holes.
- Straightening vanes and its support ring found slightly distorted.
- Some Partition plate of nozzle holes found partially burnt and some found with crack at its centre & end welds.

- Insulation cover weld with top cover liner found eroded.

- Circumferential crack was observed at the top cover liner welding.

<u>102-EB, CO_2 STRIPPER</u>

<u>FROM TOP MANHOLE</u>

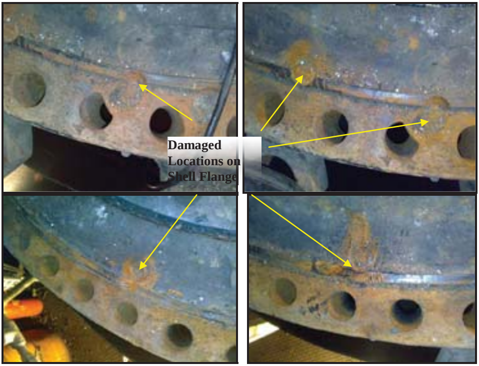
- Demister pads were found slightly shifted in middle portion.
- Demister pad supporting strips and rods were found distorted in middle portion.
- All the bolts of liquid inlet nozzle flange were found in position & intact.
- West side distributor header was found rubbing with the shell plate in S-W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

PRIMARY WASTE HEAT BOILER (101-CA) SHELL

Visual inspection of Primary Waste Heat Boiler shell liner was carried out after removal of its tube bundle. Following observations were made:

Top Flange

- Gasket sealing face was found damaged at several locations.

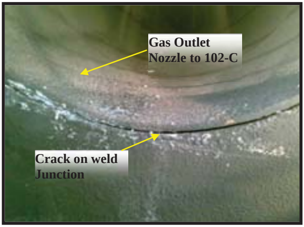


- One segment of top refractory cover liner segments was found damaged.

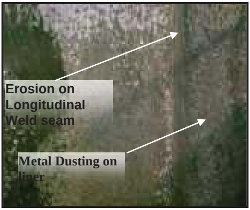
1st Liner Piece from top

- 1st course was found satisfactory except metal dusting was observed at scattered locations which have resulted in pitting of 1-1.5 mm depth at few locations. This was also observed during previous inspection.
- Superficial abrasion marks were observed on liner segments.

- Gas outlet nozzle liner was found in satisfactory condition, however a fine crack of approx. 400 mm was observed at its weld junction with shell liner. Same was observed during previous inspection also but in a length of approx. 200 mm. Refractory behind it was found intact as seen through gap.



- 2^{nd} course was found to have metal dusting attack resulted in approx. 1-3 mm deep pitting in approx. 40 % surface area of liner segment and erosion of its longitudinal weld seam by approx. 2-3 mm in its complete length below the liner surface. Its circumferential weld was found slightly eroded in approx. 80% of its length. This was also observed during previous inspection.

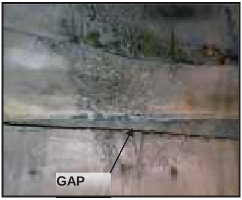


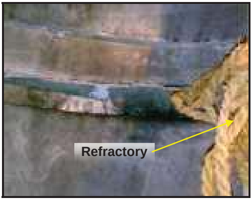
<u>2^{nd} Liner Piece from top</u>

- Surface Abrasion marks were observed approx in 500mm circumferential length in South-East side due to rubbing of the tube bundle.

- Minor metal dusting attack observed on shell liner resulted in pitting of approx.1.0 mm depth at few locations in approx. 5 % of the liner surface area. This was also observed during previous inspection.

- Inward bulging of approx. 5-10 mm was observed at South-West side. This was also observed during previous inspection.
- A gap of approx. 10mm to 60mm observed east side between loose liner and 3rd shell liner piece in approx. 70% of its circumference, causing exposure of refractory. However, condition of the refractory exposed in between seems to-be intact and observed to same as during previous inspection.





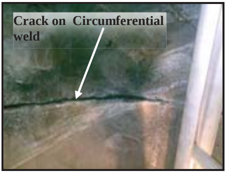
3rd Liner Piece from top

- Uneven gap observed on expansion joint. East half has 2-4 mm gap between liner segments where as 15-20 mm gap was observed in remaining half. The same was also observed in previous inspection.

4th Liner Piece from top

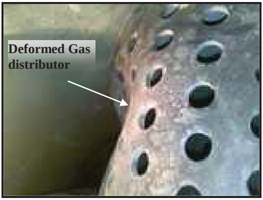
- Circumferential liner weld joint just above the gas distributor found bulged and cracked in approx. 60% of its length. Area above this length was found to have scattered cracks on liner piece. The same was also observed in previous.

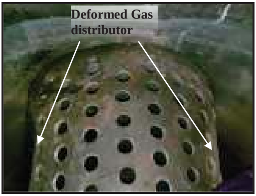
- Circumferential weld joint just at the level of the gas distributor bulged and cracked in approx. 60% of its length.



Gas Distributor

- Gas distributor was found deformed inwards from both the sides.





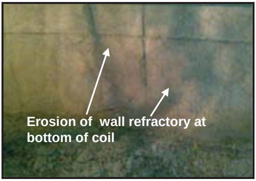
- Lot of debris was found accumulated at bottom half of gas distributor. The same was also observed in previous inspection.
- Lot of debris and mud found accumulated at the bottom of shell.

START – UP HEATER (102-B):

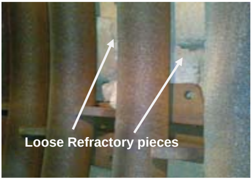
- Condition of weld joints was found satisfactory.
- Coils were observed with thin scaling/rusting on the surface.
- Minor pitting observed on the coil surface.

- Bottom floor refractory was found damaged around the burner.

- Some of the burner block bricks were found broken.
- Erosion of shell wall refractory was observed.



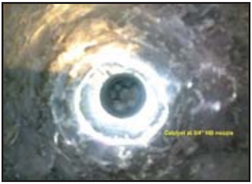
- Supports were found intact in its position.
- Loose refractory material was found entrapped between the coils in North direction.



- Thickness measurement was carried out & found satisfactory.

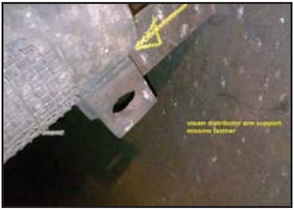
104-D1, HTS SHIFT CONVERTER:

- Coloration of vessel inside was observed to be blackish. .
- Thin scales were observed at entire internal surface.
- Magnetic particle test was carried out on all the weld joints from inside of vessel, no service defect observed.
- All the T-welds were inspected by Ultrasonic flaw Detection. Found satisfactory.
- Catalyst found lying at ¾"NB transmitter nozzle and side manhole nozzle. Refer attached photographs.

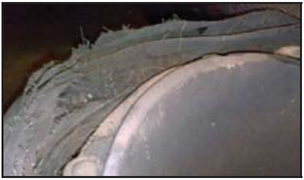


- Lot of debris found lying around the elephant stool. Refer attached photographs.

- Condition of elephant stool was found satisfactory.
- Support welding of steam inlet header and its distributor branches were found broken at many places. Also its fasteners provided with support found missing at few location. Refer attached photographs.



- Wire mesh provided around dump out nozzle found damaged. Refer photograph.



<u>106-D, METHANATOR:</u>

- Brownish black coloration was observed inside the vessel.
- All welding joints found satisfactory.
- Condition of all internals was found satisfactory.
- UFD of bottom circumferential weld joint and shell parent metal up to 300mm height from bottom cir seam was carried out from outside and all "T" joints were checked from inside and found satisfactory.
- MPI of all Circumferential weld seams, all long seams and all nozzle weld joints was carried out from inside and found satisfactory.
- Metallography was carried out at parent metal of bottom dish end & shell and at selected weld joints and found satisfactory.
- Hardness measurement was carried out on bottom circumferential weld joint from outside and observations are as under:

  Weld: 110-150 BHN

  Haz : 100-140 BHN

  Parent metal: 105-135 BHN
- Overall condition was found satisfactory.

<u>SR-1 (AMMONIA RECEIVER):</u>

- Dust accumulated in 4" nozzle of PC 2A/2B suction.
- Water accumulated in 1.5" nozzle of level glass.
- Thin scaling & minor pitting of approx. 0.5 mm depth was observed at scattered locations.
- All welding joints found satisfactory.

103-E1, HP FLASH VESSEL

FROM TOP MANHOLE

- 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.
- Scale and dust deposit found adhered on the outer surface of distributor header, pipes, gas riser and supports.
- Liquid collectors and distributor trays segment were found intact in its position.
- Weld joints found in satisfactory condition without any sign of corrosion.

101-F, STEAM DRUM

- Grayish black coloration was observed inside the drum.
- All Cyclone Separators were found intact in position.
- Demister pads were found intact in position.
- Minor pitting of approx. 0.5 to 0.75mm depth was observed at scattered locations.
- One of the hole at South end of phosphate dozing line (1” NB) was found enlarged.
- Few bolts and clamps of Demister Pad holding cover plate were found loose/missing. (Same were marked with yellow chalk.)
- Grill covering the Down Comers were found bent at few locations.
- 02 nos. bolts found loose in flange joint of 6” BFW header.

102-F , RAW GAS SEPARATOR

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

103-F, REFLUX DRUM

- Blisters observed on Dish-end Epoxy Coating, these are required to be scrapped /cleaned.
- Minor blistering was also observed on man-way coating.
- Demister pads were found intact in its position. Scales of epoxy coating were found sticking with Mesh of Demister pads.
- Epoxy paint was found peeled off from the few small scattered locations at the bottom half of the vessel. However epoxy primer was found intact at such location.

104-F, SYNTHESIS GAS COMPRESSOR SUCTION DRUM:

- Grayish black coloration was observed on bottom area, whereas brownish Coloration was observed on remaining surface.
- Condition of weld joints was found satisfactory.
- Thin scales were observed at bottom dish end.
- Condition of demister pad was found satisfactory.
- Blackish coloration was observed inside the inlet hood baffle.
- Condition of the inlet hood baffle was found satisfactory.
- Condition of the nozzle weld joints was satisfactory.
- Bottom vortex breaker was clear and its welds were found intact.

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.
- 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.
- Thickness measurement carried out and found satisfactory.

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 portion. 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. Overall condition of the vessel was found to be satisfactory.

<u>111-F, SECOND STAGE REFRIGERANT FLASH DRUM:</u>

- Blackish gray coloration was observed inside the shell surface.
- Entire internal surface was found oily.
- The demister pads were found intact in position, where as one bolt was found missing from middle support of the demister pad (marked with Yellow Chalk).
- Dish ends were found covered with scattered scales.
- Condition of all shell weld joints was found satisfactory.

<u>112-F, THIRD STAGE REFRIGERANT FLASH DRUM:</u>

- The demister pads were found intact in position.
- The coloration of the inside surface of shell was brownish black.
- Entire internal surface was found oily.
- Hard scales were observed on the shell. These were more prominent on the dished ends.
- 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.

<u>101-U, Desecrator:</u>

- Brownish coloration was found inside the vessel.
- Scattered thin scales were observed on the shell and dished end.
- Water accumulated on the bottom of the shell.
- The condition of all the weld joints of the shell, dished ends and nozzles was found satisfactory.
- Thermo well found intact in position.
- Ultrasonic thickness measurement carried out and found satisfactory.

<u>MISCELLANEOUS JOBS</u>

<u>WELDER QUALIFICATION TESTS</u>

- Performance qualification test of 17 Nos. welders offered by M/s General Engineering (Gen Engg /J&J Engineers) was carried out. 9 nos. of welders were qualified during the test. These welders were allowed to perform various PGR Piping / HTS Vent Control Valve Replacement/Aux. Boiler West Wall welding jobs in the Ammonia plant.

- Performance qualification test of 17 Nos. welders offered by M/s Shree Ganesh Engineering was carried out. 12 nos. of welders were qualified during the test. These welders were allowed to perform welding in V-1201 Offgas Line Replacement/Liner Weld joint repairing in Urea plant and Ammonia/Urea IBR Jobs, APH Structure job in Utility Plant.
- Performance qualification test of 20 Nos. welders offered by M/s General Engineering (Ram Bahadur/TMK co.) was carried out. 9 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical & Technical Departments' welding jobs.

D.P. TEST

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

RADIOGRAPHY

In order to ensure immediate radiography work and urgent processing of films, teams were hired on round the clock basis during entire shutdown period. Radiography was performed on the weld joints of the pipe lines fabricated / repaired by all contractors as well as departmentally as per the requirement.

ULTRASONIC FLAW DETECTION OF WELDS

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

The detailed list of pipeline inspected is mentioned at **Annexure-5.**

ULTRASONIC THICKNESS MEASUREMENT

During the shutdown, ultrasonic thickness measurement was carried out on various pipelines and equipment in the plant. The detailed results of inspection are attached herewith at **Annexure-6** (for equipment) and **Annexure- 7** (for pipelines).

GAUSS MEASUREMENT & D.P TEST OF BEARINGS & COUPLING BOLTS OF HIGH SPEED TURBO MACHINARIES

During this shutdown, measurements of residual magnetism (gauss) on rotary and stationary parts of various 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-8.** 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-9.**

PMI OF CRITICAL PIPE LINES

PMI of Converter loop lines and HS Lines was carried out. Material of all lines was found satisfactory, except material of drain line of HS-4-12". Material of drain line was observed as C.S., against requirement of P-11. This was informed to Mech. Maint for necessary corrective action.

INSTALLATION OF NEW PIPELINES

During this shutdown, 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.

SPARE 101-CA/CB TUBE BUNDLE

07 no. of tubes were replaced in spare 101-CA/CB tube bundle. Following inspection activities were carried out and found satisfactory.

- Visual inspection
- DP Test
- Hardness measurement
- Video imaging of internal surface of outer tube

OVER SPEED TRIP TEST

OST of following Machines was carried out/witnessed:

101-BJT : 4254 RPM

103-JLJA : 3512 RPM

103-JLJC : 3371 RPM

ANNEXURE-1

VISUAL INSPECTION REPORT :

PRIMARY REFORMER RADIANT ZONE:

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

BURNER BLOCKS : Following burner blocks were found damaged:

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

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. 2,4,5,6,7,14,15,21,22,27,35
2	Near tube no. 14,28
3	Near tube no. 14,28,29,41
4	Near tube no. 15,16,22,28
5	Near tube no. 8,26,27,28,29
6	Near tube no. 15,17,18,27,28,29,40
7	Near tube no. 1,2,3,27,32,35,36
8	Near tube no. 10,15

ROOF INSULATION:

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

Row No.	Location
Burner Row	1st Between burner no.3-4
Tube Row 1st	Near Tube No.33-34
Burner Row 2nd	Near Burner No.13
Tube Row 2nd	Near Tube No.1-3
Tube Row 3rd	Near Tube No.19, 20,28,29,30,31,32
Burner Row 4th	Between burner no.4,5,7,8, Around Burner No. 14
Tube Row 4th	Near tube no. 5,11,12,34
Burner Row 5th	Around Burner No. 1,3-4,6,7,13,14

Tube Row 5th	Near tube no. 7,32
Burner Row 6th	Around Burner No. 1,2,3,4,10,14
Tube Row 6th	Near tube no. 22, 23,29,36,37
Burner Row 7th	Around Burner No. 2,3
Burner Row 8th	Between burner no.2,12-13
Tube Row 8th	Near tube no. 1, 27,33,38,39
Burner Row 9th	Between burner no.6,10-11

REFRACTORY / INSULATION OF WALLS:

- **East wall** : Found Satisfactory.
- **West wall** **:** Found satisfactory.
- **North wall**:
  Z-MODULES **:** Between West wall and Tube Row No.1: Gap below Peep.

  REFRACTORY WALLS UPTO TUNNEL SLAB LEVEL
  Loose refractory found up to 1 ft above tunnel slab.

- **South Wall**:
  Z-MODULES : Found satisfactory.

TUNNEL SLABS: Tunnel slab found damage/broken as mentioned below.

Burner Row 2nd	Near Rise Tube & Tube no.15 (03 Nos.)
Burner Row 4th	Near Tube no. 1 & 9 (02 Nos.)

Annexure – 2 (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 – 2 (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 – 2(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 – 2(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	00	0	Total	42	0	0

Annexure – 2(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	125.70	125.89		X	
2	125.27	125.23		X	
3	125.57	125.58		X	
4	125.58	125.43		X	
5	125.77	125.82		X	
6	125.56	125.48		X	
7	125.26	125.23		X	
8	125.31	125.25		X	

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

Annexure – 3

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

COLD LOAD READINGS IN MM:

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

TRANSFER LINE SPRING HANGER LOAD READINGS

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

BOTTOM DRAIN READINGS

ROW	1	2	3	4	5	6	7	8
READINGS	**98**	**100**	**100**	**90**	**94**	**98**	**98**	**95**

AUXILIARY BOILER SPRING READINGS

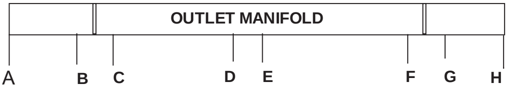
SPRING	S-E	N-E	S-W	N-W
READINGS	**65**	**65**	**63**	**63**

Annexure – 4

CLEARANCE OF OUTLET MANIFOLD FROM GROUND FLOOR IN COLD CONDITION

Header No.	Location of Measurement					
	B	C	D	E	F	G
1	*230	*200	300	300	300	*270
2	*170	*210	300	300	*190	*220
3	*200	*200	300	300	*240	300
4	300	300	*190	300	*260	300
5	*180	*200	300	300	300	300
6	*220	*180	300	*210	300	300
7	300	300	230	220	300	*270
8	300	*220	300	300	*200	*210

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



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)	12	05	06	No significant defect was observed.
2	SG-1303-09-10”	10”	120	105-D, SG-1303.08-14	108-D Inlet (Bottom)	11	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”	16	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”	10	04	-	
14	SG.1303.06-14”	14	100	121-C	124-C	19	07	-	
15	106-D	-	-	Methanator (All Weld joints & Dish End PM)		-	-	-	
16	104-D HTS	-	-	Shift Converter (All T-joints from inside)		-	-	04	

Annexure – 6

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 (Tubes)	8.89	6.40	28.01						1
2	101 - CA	Primary Waste Heat Exchanger	60.33		-	22.23	-	-	6.70	6.30 (Liner)	5.97
3	101 - CB	Primary Waste Heat Exchanger	60.33		-	22.33	-	-	6.70	6.50 (Liner)	2.99
4	108-C1A	MEA Solution Cooler	12.70	13.00	-	12.70	16.80	-	12.70	13.00	-
5	108-C2A	MEA Solution Cooler	12.70	13.00	-	12.70	16.30	-	12.70	13.00	-
6	116-C	Synthesis Gas Compressor Inter stage Cooler	11.11	11.30	-	11.11	10.90	1.89	30.72	31.50	-
7	121 - C	NH3 Converter Feed / Converter effluent Exchanger		38.30	-						
8	123 - C	NH3 Converter Feed water Exchanger	82.55	84.40	-	44.00	49.20	-			
9	124-C	Synthesis Gas Compressor After Cooler	20.00	23.40	-	16.00	20.00	-	88.90		-
10	128-C	Refrigerant Compressor Inter Cooler	12.00	12.00	-				12.00	12.80	-
11	129-JC	Air Compressor Interstate Cooler		12.40	-						
12	101 - JCA	Surface Condenser	NA	13.70	-					9.70	-
13	101 - JLC1 (Top)	Lube & Seal Oil Cooler for 101-J & 105-J	8.00	7.50	6.25	6.00	10.50	-	8.00	7.90	1.25
14	101 - JLC2 (Bottom)	Lube & Seal Oil Cooler for 101-J & 105-J	8.00	7.60	5.0	6.00	10.60	-	8.00	7.30	8.75
15	101/105	101 / 105 Lube Oil Console	NA	4.9	-						
16	101 - D	Desulphuriser No. 1	60.30	63.40	-	60.30	65.30	-			
17	102 - D	Desulphuriser No. 2	60.33	64.40	-	60.33	63.40	-			

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.
18	103 - D	Secondary Reformer	-	-	-	34.93		-	6.35 (Jot)	6.40(Jot)	-
19	105- D	Synthesis Converter	NA	88.0	-	NA	88.20 (T) 91.40(B)	-			
20	106 - D	Methanator	44.50	46.40	-	48.40		-			
21	107 - D	Transfer Line	3.2 (Liner)	3.0 (Liner)	6.25						
22	102 - EB	CO_2 Stripper (Shell)	9.53 15.90	10.80 16.40	-	11.9(T) 15.9(B)		-			
23	103-E2LP	L.P. Flash Vessel		26.20 (top MH)	-						
24	104 - E	Condensate Stripper	12.50	12.00	4.0	11.10	14.00	-			
25	102 - F	Raw Gas Separator	34.93	36.30	-	33.33	36.50	-			
26	105 - F	Synthesis Gas Compressor 1st Stage Separator	47.63	51.00	-	46.03		-			
27	107 - F	Primary Ammonia Separator	14.29	14.20	0.63	14.29	18.20	-			
28	109-F	Refrigerant Receiver	21.40	22.00	-	18.20	19.30	-			
29	110 - F	1st Stage Refrigerant	9.52	9.90	-	9.52	12.20	-			
30	112 - F	3rd Stage Refrigerant Flash Drum	9.52	10.00	-	19.05(E) 9.52(W)	22.70(E) 12.30(w)	-			
31	142-F	New Instrument Air Receiver	NA	14.00	-	NA	12.50	-			
32	2005 - F	New Instrument Air Receiver	8.00	12.30	-	8.00	12.50	-			
33	101 - U	Deaerator	9.53	9.20	3.46	NA	12.30	-			
34	2005-U	Condensate Polisher	NA	14.70	-	NA	21.60	-			
35	2007-U	Resin Trap	NA	7.60	-	NA	7.90	-			
36	B-201	Knockout Drum of Flair Stack	10.00	9.10	9.0	12.00		-			
37	E-3	Gas Exchanger	5.00	4.90	2.0	5.00	3.9	22.0			
38	K-1	Washing Tower	18.00	19.00	-		19.40	-			

NOTE: (1) All readings are in MM

THICKNESS MEASUREMENT SUMMARY OF HT/LT COILS.

SR NO	DESCRIPTION	DESIGN THICKNESS	MEASURED THICKNESS	% REDUCTION
1	HT Convection Zone : HT Steam Super Heater Coil (3rd from bottom)	8.0	7.8	2.5
2	HT Convection Zone : Air-Preheater Coil (2nd from bottom)	6.55	5.4 21.3	17.56 -
3	HT Convection Zone : Mixed Feed Coil (Bottom most)	8.0	11.4	-
4	LT Convection Zone : BFW Heater Coil (Bottom most)	5.54	4.9	11.55
5	LT Convection Zone : BFW Heater Coil (2nd from Bottom)	5.54	4.5	18.77
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	5.0	9.75
8	LT Convection Zone : LT Steam Super Heater Coil (5th from Bottom)	7.01	6.5	7.28
9	LT Convection Zone : Additional BFW Heater Coil		7.3	-
10	Auxiliary Boiler Tubes	6.13	6.8 (North) 6.9 (East) 6.8 (West)	-
11	102- B Start up Heater Internal Coils	8.89	9.4	-

NOTE: All readings are in MM

ANNEXURE- 7 (1/2)

THICKNESS MEASUREMENT OF TWO PHASE FLOW PIPELINES

SR. NO.	LINE NO.	NB (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Min. Thickness Observed (mm)	% RED.
						FROM	TO		
1	BF-1304-01	3	160	11.13	CS	142-CA/CB	107-C	**10.5**	**5.66**
2	BO-01	1.5	80	5.1	CS	BO-01-1.5"	BO-17-1.5"	**4.8**	**5.88**
3	BO-01H	1.5	80	5.1	CS	101-F	BO-01-1.5"	**9.3**	**-**
4	BO-2H	1.5	XXS	10.2	CS	101-F	BO-21-1.5"	**7.9**	**22.54**
5	BO-3H	1	160	6.35	CS	102-C	BO-13-1" (SP-7)	**4.3**	**32.28**
6	BO-4	1/1.5	80	4.5/5.1	CS	BO-6H-1" (SP-7)	BO-14-3"	**4.5 / 5.0**	**-**
7	BO-06	1	80	4.5	CS	BO-12H	BO-11-1.5"	**4.5**	**0**
8	BO-6H	1	160	6.35	CS	103-C	BO-4-1" (SP-7)	**6.2**	**2.36**
9	BO-07	1	80	4.5	CS	BO-11-1.5"	BO-14-2"	**4.5**	**0**
10	BO-9	1	80	4.5	CS	BO-11H	BO-11	**4.4**	**2.22**
11	BO-10	1	80	4.5	CS	BO-10H	BO-11	**4.5**	**0**
12	BO-10H	2	XXS	11.07	CS	AUX.BOILER COIL-E	BLOW DOWN BO-10	**9.9**	**10.56**
13	BO-11H	2	XXS	11.07	CS	AUX.BOILER COIL-D	BLOW DOWN BO-9	**10.1**	**8.76**
14	BO-12H	2	XXS	11.07	CS	AUX.BOILER COIL-C	BLOW DOWN BO-6	**8.2**	**25.92**
15	BO-13	1/1.5	80	4.5/5.1	CS	BO-21-1.5"	BO-3H-1"	**4.5 /4.8**	**-**
16	BO-13AH	2	160	9.53	CS	AUX.BOILER COIL-B	BLOW DOWN BO-8	**9.9**	**-**
17	BO-13BH	2	XXS	11.07	CS	AUX.BOILER COIL-B	BLOW DOWN BO-25	**10.00**	**9.66**
18	BO-1304.04	2	40	3.91	CS	107- C	156- F	**3.5**	**10.48**
19	BO-14AH	2	XXS	11.07	CS	AUX.BOILER COIL-A	BLOW DOWN BO-26	**9.6**	**13.27**
20	BO-14BH	2	160	8.71	CS	AUX.BOILER COIL-A	BLOW DOWN BO-7	**9.9**	**-**
21	BO-17	1	160	6.35	CS	BO-14-3"	101-CA Header	**3.4**	**46.45**
22	BO-20	1	160	6.35	CS	BO-17-1"	BW-21H (101-CB Header)	**6.1**	**3.93**
23	BO-20H	1	160	6.35	CS	BO-20-1"	101-CB Header	**6.1**	**3.93**
24	BO-21	1.5	80	5.1	CS	BO-2H-1.5"	BO-14-3"	**4.9**	**3.92**

SR. NO.	LINE NO.	NB (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Min. Thickness Observed (mm)	% RED.
						FROM	TO		
25	aMDEA-06A	10	40S	9.27	SS	109-C1A	aMDEA-61-12"	**8.6**	**7.22**
26	aMDEA-06A	8	40S	8.18	SS	109-C1A	aMDEA-61-12"	**7.9**	**3.42**
27	aMDEA-06B	10	40S	9.27	SS	109-C1B	aMDEA-61-12"	**8.7**	**6.14**
28	aMDEA-06B	8	40S	8.18	SS	109C1B / C2B	MDEA- 7-12"	**7.4**	**9.53**
29	aMDEA-07	0/12	40S	9.27	SS	aMDEA-61-12"	102-EB (aMDEA-9B-10")	**9.5**	**-**
30	aMDEA-16B	12	20	6.35	CS	108C2B	aMDEA-62-16"	**6.2**	**2.36**
31	aMDEA-17	16	20	7.92	CS	aMDEA-62-16"	aMDEA-41-16"	**7.1**	**10.35**
32	aMDEA-24A	3	40	5.5	CS	108-J	aMDEA-25-3"	**5.2**	**5.45**
33	aMDEA-24B	3	40	5.5	CS	108-JA	aMDEA-25-3"	**5.3**	**3.63**
34	aMDEA-25	3	40	5.5	CS	aMDEA-24A,B-3"	aMDEA-26B-2.5"	**4.6**	**16.36**
35	aMDEA-62	16	20	7.92	CS	HEADER	aMDEA-17-16"	**7.9**	**0.25**
36	MDEA-1202.01	18	XS	12.7	CS	101- EA	MDEA-1202.02-18" (USV-470)	**11.7**	**7.87**
37	MDEA-1202.02	18	XS	12.7	CS	MDEA-1202.01-18"	115- HT	**11.1**	**12.59**
38	MDEA-1202.02	18	XS	12.7	SS	115- HT	103-E1	**11.1**	**12.59**
39	MDEA-1202.02	18	40S	12.7	SS	115- HT	103-E1	**11.1**	**12.59**
40	MDEA-1203.02	18	10S	4.78	SS	HV-435 (MDEA-1202.03-14")	103-E1/ E2	**5.8**	**-**
41	MDEA-1204.01	24	10S	6.35	SS	103- E2 HP	LV-416	**5.6**	**11.81**
42	MDEA-1209.02	24	40	17.48	CS	103-E2LP (MDEA-1209-01-24")	115- JA	**18.1**	**-**
43	MDEA-1209.02	24	STD	9.53	CS	103-E2LP (MDEA-1209-01-24")	115- JA	**9.7**	**-**
44	MDEA-1209.03	24	40	17.48	CS	103-E2LP (MDEA-1209-01-24")	115- JB	**17.3**	**1.02**
45	MDEA-1209.03	24	STD	9.53	CS	103-E2LP (MDEA-1209-01-24")	115- JB	**9.7**	**-**
46	MDEA-1209.06	12	20	6.35	CS	103-E2LP (MDEA-1209-01-24")	MDEA-1209.07/08 (116 JA/ JB)	**6.00**	**5.51**

SR. NO.	LINE NO.	NB (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Min. Thickness Observed (mm)	% RED.
						FROM	TO		
47	MDEA-1209.07	12	10 S	4.57	SS	103-E2LP (MDEA-1209-01-24")	116- JA	**5.00**	**-**
48	MDEA-1209.08	12	10 S	4.57	SS	103-E2LP (MDEA-1209-01-24")	116- JB	**5.7**	**-**
49	MDEA-1212. 01	16	XS	12.7	CS	115- JA	101-EA (MDEA-1212-03) USV-933	**9.6**	**24.40**
50	MDEA-1212. 02	16	XS	12.7	CS	115- JB	101-EA (MDEA-1212-03) USV-935	**9.5**	**25.19**
51	MDEA-1212. 03	16	XS	12.7	CS	115JA / 115-JB(MDEA-1212-01/02)	101-EA	**12.4**	**2.36**
52	PG-10	18	40 / STD	12.7 / 9.53	CS	104-D	PG-11-20"	**8.4**	**11.85**
53	PG-11A	16	40	12.7	CS	PG-11-20"	105-CA	**11.8**	**7.08**
54	PG-11B	16	40	12.7	CS	PG-11-20"	105-CB	**12.3**	**3.14**
55	PG-12A	14	30	9.525	SS-304	105-CA	PG-26 18"	9.4	**0.26**
56	PG-12B	14	30	9.525	SS-304	105-CB	PG-26 18"	10.8	**-**
57	PG-13	16	30	9.525	SS-304	106-C	PG-26 (Header)	**9.4**	**1.31**
58	PG-26	18	30	11.13	SS-304	HEADER		**11.1**	**0.26**
59	PG-1212. 01	14	10	6.35	CS	101- EA	136- C	**6.3**	**0.78**
60	PW-17	4	120	11.13	CS	PW-1-6"	170-C	**10.5**	**5.66**
61	PW-17	4	40	6.02	SS304	PW-1-6"	170-C	**4.8**	**20.26**
62	PW-19	4	10S	3.05	SS	LC-3A	104-E	**2.6**	**14.75**
63	PW-19	4	120	11.13	CS	LC-3A	104-E	**9.2**	**17.34**
64	PW-19	2	10S	2.77	SS	LC-3A	104-E	**2.7**	**2.52**
65	PW-20	6	80	10.97	CS	104-E	170-J	**10.2**	**7.01**
66	PW-20A	6	80	10.97	CS	PW-20-6"	170 JA	**6.83**	**37.73**
67	PW-24	4	120	11.13	CS	173-C	CONTROL VALVE	**10**	**10.15**
68	PW-27	6	80	10.97	CS	PW-20-6"	PW-28-4"	**10.1**	**7.93**
69	PW-29	10	60	12.7	CS	171-C	PW-30-14"	**12.1**	**4.72**
70	PW-30	10	60	12.7	CS	171-C (PW-29-10")	PW-31-12" (HEADER)	**11.00**	**13.38**
71	PW-31	12	40	10.31	CS	PW-30-14"	104-E	**7.50**	**27.25**
72	SC-17	3	80	7.62	CS	156-F	SEWER	**5.9**	**22.57**
73	SC-44	2	80	5.5	CS	171-C	STS/45	**5.7**	-
74	MS-1304-03	1" & 2"	80 / 40	4.55 / 3.91	CS	107-C Middle Course	107-C Top (Header)	**3.9**	**0.25**
75	SG-13	12	100	21.41	CS	120-C	LETDOWN VALVE(Yellow line)	**17.4**	**18.72**

ANNEXURE- 7 (2/2)

THICKNESS MEASUREMENT OF OTHER PIPELINES

SR. NO.	LINE NO.	NB (in)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
1	BF-18	3	80	7.62	CS	BF-22	114-C	**5.1**	**33.07**
2	FIC - 7	6	40	7.11	CS	103-JLP DISCH.	103-JLP SUCT.	**6.9**	**2.95**
		4	40	6.02				**5.5**	**8.64**
3	FIC -8	4	80	8.56	CS	103-JHP DISCH.	103-JHP SUCT.	**7.4**	**13.55**
4	FICV -14	8	40	8.18	SS	aMDEA-9B	102-EB	**10.4**	**-**
		4	40	6.02				**4.8**	**20.27**
5	HS-02	12	100	21.41	CS	HS-2H	101-B	**20.2**	**5.65**
6	HS-2H	12	100	21.41	CS	101-F	HS-2	**21.3**	**0.51**
7	**HS-04**	**12**	**100**	**21.41**	**P-11**	**HS-3H**	**HS-7**	**16.3**	**23.87**
8	HS-05	10	100	18.3	P-11	HS-4	HS-9	**17.3**	**5.46**
9	HS-20-50	2	160	8.71		TRCV-142 STEAM D/S LINE		**5.8**	**33.41**
10	aMDEA-10B	12	20	6.35	CS	102-EB	aMDEA-11	**4.3**	**32.28**
11	MS-11	14	30	9.53	CS	103-J	MS-3	**20.3**	**-**
12	MS-17	2	80	5.5	CS	MS-2	2004-JA	**5.3**	**3.64**
	MS-17	2			CS	CONTROL VALVE			**-**
13	MS-19	6	40	7.11	CS	MS-1	107-JAT	**6.6**	**7.17**
	MS-19	4	40	6.02	CS	CONTROL VALVE		**5.6**	**6.98**
14	MS-21	6	40	7.11	CS	MS-40	105-J	**6.7**	**5.77**
15	MS-23	8	30	7	CS	MS-60	104-J	**6.00**	**14.29**
		6	40	7.11				**6.80**	**4.36**
		1.5	80	5.08				**4.40**	**13.39**
16	MS-24	8	30	7.04	CS	MS-60	104-JA	**6.1**	**13.35**
		6	40	7.11				**6.7**	**5.77**
17	MS-25	6	40	7.11	CS	MS-40	101-JT	**6.3**	**11.39**
18	MS-46	2	80	5.54	CS	103J-EJT	ATM	**5.5**	**0.72**
19	MS-53	4	40	6.02		MS-01-8"	PICV-25	**5.9**	**1.99**
20	NG-01	6	40	7.11	CS	BATT.LIMIT	NG-2	**7.4**	**-**
21	NG-07	8	20	6.4	CS	SPEC.BRK	101-B convection zone	**6.5**	**-**
22	NG-09	12	100	21.4	P-11	101-B	NG-11 A TO H	**19.8**	**7.48**

SR. NO.	LINE NO.	NB (in)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
23	NG-14	3	40	5.5	CS	NG-6	NG-15	**5.3**	**3.64**
24	NG-15	4	40	6.02	CS	NG-7	S-11	**3.9**	**35.22**
25	NG-23	6	40	7.11	CS	NG-30	NG-26	**6.7**	**5.77**
	NG-23	8	40	8.18	CS	NG-30	NG-26	**7.6**	**7.09**
		4	40	6.02				**5.3**	**11.96**
26	NG-26	8	40	8.18	CS	NG-23	BURNER	**7.00**	**14.43**
		6	40	7.11		NG-23-8"	BURNER	**6.9**	**2.95**
27	NG-27	2.5	40	5.2	CS	NG-63	NG-28	**5**	**3.85**
28	NG-28	2.5	40	5.2	CS	NG-27	102-B	**5.3**	**-**
29	NG-30	24	20	9.53	CS	NG-23	NG-23	**9.1**	**4.51**
30	NG-32	2	40	3.9	CS	NG-23	NG-33	**5.4**	**-**
31	NH-20	18	20	7.92	CS	105-J	NH-106 A&B	**7.6**	**4.04**
32	NH-89	6	40	7.11	CS	121-J	CONTROL VALVE	**5.00**	**29.68**
	NH-89	3		5.49		121-J	CONTROL VALVE	**5.00**	**8.93**
33	NH-89A	3		5.49		121-JA	NH-89	**5.2**	**5.28**
	NH-89A	6	40	7.11	CS	121-JA	NH-89	**6.3**	**11.39**
34	NH-106A	14	20	7.9	CS	NH-20	128-C	**7.9**	**0.00**
35	NH-106B	14	20	7.9	CS	NH-20	128-C	**7.9**	**0.00**
36	PG-18	12	30	8.4	P-11	104-C	106-D	**7.8**	**7.14**
37	PRC - 1	6	40	7.11	CS	101/102-D INLET	VENT (SP-73)	**5.3**	**25.46**
		3	40	5.5				**6**	**-**
		2	80	5.54				**9.6**	**-**
38	PRC-6 U/S (V-29-10")	10	20	6.35	CS	V-27	V-29 (SP-75)	**6.2**	**2.36**
	PRC-6 D/S (V-27-6")	6	80	10.97	CS	V-27	V-29 (SP-75)	**5.2 (MRT-3.85)**	**52.60**
39	PW-04	2.5	160	5.16	CS	PW-1	106-J	**5.6**	**-**
				3.05	SS			**2.7**	**11.48**
40	PW-13	4	10S	3.05	CS	PW-12	SEWER	**2.6**	**14.75**
41	SC-07	2.5	80	7.01	CS	SC-42	101-JC	**5.1**	**27.25**
		1	80	4.55	CS	SC-42	101-JCA	**4.3**	**5.49**
42	SC-20	2	80	5.5	CS	SC-42	SC-71	**4.9**	**10.91**
43	SC-45	2	80	5.5	CS	STS-45	SC-72	**2.8**	**49.09**
		3	40	5.49	CS	STS-45	SC-72	**3.1**	**43.53**
44	SC-47	10	40	9.27	CS	101-JC	112-J	**6.1**	**34.20**

SR. NO.	LINE NO.	NB (in)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
45	SC-47A	10	40	9.27	CS	101-JC	112-JA	**6.0**	**35.28**
46	SG-01	12	30	8.4	P-11	106-D	114-C	**8.3**	**1.19**
47	SG-02	14	20	7.92	CS	114-C	115-C	**8.4**	**-**
48	SG-05	14	20	7.92	CS	115-C	104-F	**7.6**	**4.04**
49	SG-07	10	60	12.7	CS	103-J	136-C	**11.8**	**7.09**
50	SG-08	10	40	9.27	CS	136-C	116-C	**9.2**	**0.76**
51	SG-13	12	100	21.41	CS	124-C	SG-14	**17.4**	**18.73**
52	SG-14	10	80	15.06	CS	SG-13	117-C	**16.4**	**-**
53	SG-22	12	120	25.4	CS	SG-21	105-D	**26**	**-**
54	SG-25	8	120	18.24	CS	SG-23	CONT. VALVE	**18.3**	**-**
55	SG-26	6	120	14.27	CS	SG-23	105-D	**13.7**	**3.99**
56	SG-27	6	120	14.27	CS	SG-23	105-D	**14**	**1.89**
57	SG-28	4	120	11.13	CS	SG-23	105-D	**9.5**	**14.65**
58	SG-33	14	120	31.75	P-22	122-C	123-C	**32**	**-**
59	SG-34	14	100	23.8	P-11	123-C	121-C	**25.5**	**-**
60	SG-35	12	100	21.41	CS	121-C	103-J	**19.9**	**7.05**
61	SG-42	3	80	7.62	CS	CONTR. VALVE		**7.1**	**6.82**
	SG-42	4	80	8.56	CS	SG-51	SG-11	**10.9**	**-27.34**
62	SG-47	1	80	4.5	CS	104F	LC-8DRAIN	**3.4**	**24.44**
63	SG-51	8	100	15.06	CS	CONTR. VALVE	FICA-15	**12.9**	**14.34**
64	SG-53	3	160	11.13	CS	SG-22	EVPT. DISC	**9.7**	**12.85**
65	SG-78	8	20	6.35	CS	PIC-A	V-36	**6.2**	**2.36**

- **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	B0-17	1	160	BO-14-3”	101-CA HEADER	Elbow replaced
2	BF-18	3	80	BF-22	114-C	Elbow replaced
3	HS-20-50	2	160	TRCV 142 Steam D/S Line		Elbow replaced
4	NG-15	4	40	NG-07	S-11	Pipe pieces & Elbows replaced
5	NH-89	6	40	121-J	CONTROL VALVE	Elbow replaced
6	PW-20A	6	80	PW-20-6”	170-JA	Elbow replaced
7	SC-45	2” 3”	80 40	STS-45	SC-72	02 Nos. Elbow replaced

Annexure-8

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
101-BJ (ID FAN)			
Front side Journal Bearing (GB side)	Top	0.5	
	Bottom	0.4	
Front side Thrust Collar (GB side)	Active	0.5	
	In Active	0.7	
Front Journal Shaft (GB side)		1.6	
Rear side Journal Bearing (End side)	Top	0.6	
	Bottom	0.5	
Rear Journal Shaft (End side)		1.6	
101-JT			
Journal Bearing Pad	Thrust End	T-0.9 B-0.8	
	Non Thrust End	T-0.7 B-1.0	
Journal Bearing Base ring	Thrust End	0.8	
	Non Thrust End	0.9	
Thrust Bearing Pads	Active	1.9	
	Inactive	1.4	
Thrust Bearing Base ring	Active	1.4	
	Inactive	0.8	
Shaft Journal	Thrust End	1.8	
	Non Thrust End	1.1	
Thrust Collar	Active	1.2	
	Inactive	1.7	
101-JLP			
Journal Bearing Pads	Thrust End	1.0	
	Non Thrust End	1.9	
Journal Bearing Base ring	Thrust End	0.5	
	Non Thrust End	0.7	
Thrust Bearing Pads	Active	1.0	
	Inactive	1.9	
Thrust Bearing Base ring	Active	1.6	
	Inactive	1.7	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
Shaft Journal	Thrust End	2.7	
	Non Thrust End	2.5	
Thrust Collar	Active	2.0	
	Inactive	0.9	
101-JR			
Gear Journal Bearing (Low Speed)	North side	T-0.9 B-0.5	
	South Side	T-0.6 B-0.8	
Pinion Journal Bearing (High Speed)	North side	T-0.7 B-0.6	
	South Side	T-0.5 B-0.5	
Thrust Bearing	Active	0.7	
	Inactive	0.5	
Oil Guard for Above	South	0.9	
	North	0.8	
Shaft Journal	Thrust End	1.3	
	Non Thrust End	1.8	
101-JHP			
Journal Bearing Pads	Thrust End	1.3	
	Non Thrust End	2.1	
Journal Bearing Base ring	Thrust End	1.0	
	Non Thrust End	2.1	
Thrust Bearing Pads	Active	0.8	
	Inactive	0.8	
Thrust Bearing Base ring	Active	0.9	
	Inactive	1.6	
Oil Guard for Above	South	0.9	
	North	1.0	
Shaft Journal	Thrust End	4.0	
	Non Thrust End	1.2	
104-JA			
Journal Bearing Pad	North side	T-1.1 B-0.5	“
	South Side	T-0.5 B-0.7	“
Thrust Bearing Pads	Active	0.9	“
	Inactive	1.0	“
Pump Thrust Collar	Active	0.9	
	Inactive	1.1	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
Shaft Journal	NDE	0.6	"
	Coupling End	2.2	"
104-JAT			
Journal Bearing Pad	North side	T-0.6 B-0.9	"
	South Side	T-0.4 B-0.5	"
Thrust Bearing Pads	Active	0.9	"
	Inactive	1.0	"
Turbine Thrust Collar (North Side)	Active	0.9	
	In Active	1.5	
Shaft Journal	NDE	0.9	"
	Coupling End	2.2	"
107-JT (MURRY TURBINE)			
Journal Bearing Governor End	Top Half	0.6	"
	Bottom Half	0.8	"
	Shaft	1.4	"
Journal Bearing Coupling End	Top Half	0.4	"
	Bottom Half	0.5	"
	Shaft	2.5	"
Thrust Bearing Pads	Active	1.4	
	Inactive	0.5	
Thrust Bearing Collar	Active	1.0	
	In Active	1.5	
115-JAR (Gear Box)			
HS Pinion Gear Journal Bearing (Turbine side)	Top	0.7	"
	Bottom	0.7	"
HS Pinion Gear Journal Bearing (Pump side)	Top	0.9	
	Bottom	0.7	
HS Shaft Journal	DE (Turbine Side)	2.7	
	NDE (Pump Side)	2.6	
LS Turbine side Journal Bearing	Top	0.7	
	Bottom	0.8	
LS Pump side Journal Bearing	Top	0.5	
	Bottom	0.8	
LS Shaft Journal	DE (Turbine Side)	0.9	
	NDE (Pump Side)	2.9	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
115-JA (Pump)			
Pump DE Journal Bearing (GB side)	Top	1.1	“
	Bottom	1.3	“
Shaft Journal (GB side)		2.5	
Pump NDE Journal Bearing (Clutch side)	Top	0.9	“
	Bottom	0.7	“
Pump NDE Thrust Pads (Clutch side)	Active	1.5	“
	In Active	1.0	“
Pump NDE Thrust Collar (Clutch side)	Active	2.5	
	In Active	2.2	“
Shaft Journal (Clutch side)		1.6	“
115-JAT (Turbine)			
Journal Thrust Bearing	Top	0.8	“
	Bottom	0.7	“
Thrust Bearing Pads	Active	0.7	“
	In Active	0.9	“
Thrust Collar	Active	2.0	“
	In Active	1.7	“
Fr. Shaft Journal (Gov. side)		2.6	
Rr. Journal Bearing (GB side)	Top	0.9	
	Bottom	1.3	“
Rr. Shaft Journal (Beside)		1.3	“
115-JBR (Gear Box)			
HS Pinion Gear Journal Bearing (Turbine side)	Top	1.0	“
	Bottom	0.4	“
HS Pinion Gear Journal Bearing (Pump side)	Top	0.6	
	Bottom	1.2	
HS Shaft Journal	DE (Turbine Side)	1.2	
	NDE (Pump Side)	1.7	
LS Turbine side Journal Bearing	Top	0.2	
	Bottom	0.7	
LS Pump side Journal Bearing	Top	0.2	
	Bottom	1.0	
LS Shaft Journal	DE (Turbine Side)	1.8	
	NDE (Pump Side)	2.0	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
115-JB (Pump)			
Pump DE Journal Bearing (GB side)	Top	0.5	
	Bottom	0.8	
Pump NDE Journal Bearing (Clutch side)	Top	0.6	
	Bottom	0.9	
Pump NDE Thrust Pads (Clutch side)	Active	1.3	
	In Active	1.5	“
Pump NDE Thrust Collar (Clutch side)	Active	1.8	
	In Active	1.6	
Shaft Journal	DE (GB side)	1.5	
	NDE (Clutch side)	1.5	
115-JBT (Turbine)			
Journal Thrust Bearing	Top	1.8	
	Bottom	1.7	
Thrust Bearing Pads	Active	1.3	
	In Active	2.4	
Thrust Collar	Active	1.6	
	In Active	1.2	
Fr. Shaft Journal (Gov. side)		2.5	
Journal Bearing (GB side)	Top	0.2	
	Bottom	0.4	
Rr. Shaft Journal (GB side)		2.4	
103-JAT			
Journal Bearing Sleeve	Thrust End	0.3	
	Non Thrust End	0.3	
Thrust Bearing Pads	Active	0.6	
	Inactive	1.4	
Thrust Bearing Base ring	Active	0.5	
	Inactive	1.4	
Shaft Journal	Thrust End	0.5	
	Non Thrust End	1.8	
Thrust Bearing Collar	Active	1.0	
	Inactive	0.5	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
103-JBT			
Journal Bearing Sleeve	Non Thrust End	T-0.5 B-0.5	
Thrust Bearing Pads	Active	1.3	
	Inactive	0.9	
Thrust Bearing Base ring	Active	1.6	
	Inactive	0.7	
Shaft Journal	Thrust End	1.2	
	Non Thrust End	2.4	
103-JLP			
Journal Bearing Sleeve	Thrust End	T-1.7 B-2.3	
	Non Thrust End	T-1.0 B-1.0	
Shaft Journal	Thrust End	1.2	
	Non Thrust End	2.5	
103-JHP			
Journal Bearing Sleeve	Thrust End	T-1.6 B-0.6	
	Non Thrust End	T-1.0 B-1.8	
Thrust Bearing Pads	Active	-	
	Inactive	1.0	
Thrust Bearing Base ring	Active	-	
	Inactive	1.7	
Shaft Journal	Thrust End	1.6	
	Non Thrust End	1.6	
105-JT			
Journal Bearing Pad	Thrust End	0.5	
	Non Thrust End	0.6	
Journal Bearing Base ring	Thrust End	0.5	
	Non Thrust End	1.4	
Thrust Bearing Pads	Active	1.8	
	Inactive	0.5	
Thrust Bearing Base ring	Active	1.4	
	Inactive	0.4	
Shaft Journal	Thrust End	0.6	
	Non Thrust End	1.4	
Thrust Collar	Active	0.8	
	Inactive	1.7	

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
105-JLP			
Journal Bearing Base ring	Thrust End	1.4	“
	Non Thrust End	1.6	“
Thrust Bearing Pads	Active	0.6	“
	Inactive	0.9	“
Thrust Bearing Base ring	Active	0.8	“
	Inactive	0.9	“
Shaft Journal	Thrust End	1.4	“
	Non Thrust End	1.2	“
105-JR			
Gear Journal Bearing	North side	T-1.6 B-0.5	
	South Side	T-1.3 B-0.5	
Pinion Journal Bearing	North side	T-0.8 B-0.6	
	South Side	T-0.8 B-0.6	
Thrust Bearing	Thrust End	1.6	
	Non Thrust End	1.3	
Shaft Journal	Thrust End	2.0	
	Non Thrust End	1.2	
105-JHP			
Journal Bearing Base ring	Thrust End	1.5	
	Non Thrust End	1.0	
Thrust Bearing Pads	Active	0.5	
	Inactive	0.7	
Thrust Bearing Base ring	Active	2.1	
	Inactive	1.4	
Shaft Journal	Thrust End	2.1	
	Non Thrust End	1.8	
Thrust Collar	Thrust End	1.3	
	Non Thrust End	1.4	

ANNEXURE-9

DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

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

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
4	Location: 4 (Weld/HAZ) Riser No.-4, 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 austenitic grains. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
5	Location: 5 (Weld/HAZ) Riser No.-5, 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 austenitic grains. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
6	Location: 6 (Weld/HAZ) Riser No.-6, 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 austenitic grains. Microstructure at parent metal shows 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.**
7	Location: 7 (Parent Metal) Riser Tube No.-7	Tube-G-4852M	Microstructure shows dendrite structure of primary carbides along with secondary precipitation including carbides in the austenite matrix. The primary and secondary fine precipitate seems to have coarsened within the matrix. Presence of inter-granular cracks observed.	Inter-granular cracks are observed. **Needs attention.**

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
8	Location: 8 (Weld/HAZ) Riser No.-7, 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 austenitic grains. Microstructure at parent metal shows 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.**
9	Location: 9 (Weld/HAZ) Riser No.-8, 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 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 2 years of service.
10	Location: 10 (Weld/HAZ) Row No.-1, Tube NO.35, Tube to Weldolet Weld Joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse austenitic grain with twins. Second phase carbide precipitation is observed along the grain boundaries. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**
11	Location: 11 (Weld/HAZ) Row No.-3, Tube NO.40, 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 inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. **Needs attention.**

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
12	Location: 12 (Weld/HAZ) Row No.-6, Tube No.18 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 2 years of service.
13	Location: 13 (Weld/HAZ) Row No.-7, Tube NO.37, Tube to Weldolet Weld Joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows 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.**
14	Location: 14 (Parent Metal) 106D Bottom dished Parent Metal	CS	Microstructure shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
15	Location: 15 (Parent Metal) 106D Shell Parent Metal	CS	Microstructure shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
16	Location: 16 (Weld/HAZ) 106D Bottom C Weld & HAZ of dish end	CS	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
17	Location: 17 (Weld/HAZ) 106D Bottom C Weld & HAZ of Shell	CS	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
18	Location: 18 (Weld/HAZ) 106D Long seam Weld & HAZ	CS	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
19	Location: 19 (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 structure. Degradation of pearlite observed in terms of spheroidization. Possibilities of isolated creep cavities are observed.	SEM interpretation is mentioned at 19.1
19.1			Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries.	Creep cavities are present. IInd stage of creep. Monitor after 2 year of service.
20	Location: 20 (Weld/HAZ) On weld bent. Pipe & Elbow (elbow side) of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure at weld shows ferrite and kainite in dendritic form Whereas at HAZ shows fine-grained kainite and ferrite structure. Microstructure at parent metal shows fine-grained ferrite and pearlite structure. Degradation of pearlite observed in terms of spheroidization. Possibilities of isolated creep cavities are observed.	SEM interpretation is mentioned at 20.1
20.1			Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries.	Creep cavities are present. IInd stage of creep. Monitor after 2 year of service.
21	Location: 21 **(Weld / HAZ)** On dissimilar weld bent. pipe piece & nozzle of header towards HAZ of P-11, NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11 to SS 304	Microstructure at weld shows ferrite and kainite in dendritic form Whereas at HAZ shows fine-grained kainite and ferrite structure. Microstructure at parent metal shows fine-grained ferrite and pearlite structure. Degradation of pearlite observed in terms of spheroidization.	No significant degradation observed. Monitor after 2 years of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
22	Location: 22 (Weld/HAZ) On dissimilar Weld Between pipe piece & Nozzle of Header towards HAZ of SS304, NG-9-12" (101B-mixed feed coil outlet to NG-11)	P-11 to SS 304	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix, Whereas at HAZ shows fusion is normal. No significant defect is observed at the HAZ region. Microstructure at parent metal shows fine-grained ferrite and pearlite structure.	Monitor after 2 years of service.
23	Location: 23 **(Weld / HAZ)** NG-11-H-12 On dissimilar weld & HAZ of P11 primary reformer inlet manifold NG-9-6**"**	P11 to SS304H	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix, Whereas at HAZ shows fusion is normal. No significant defect is observed at the HAZ region. Microstructure at parent metal shows fine-grained ferrite and pearlite structure.	Monitor after 2 years of service.
23.1			Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries.	SEM interpretation shows creep cavities are present. IInd stage of creep. Monitor after 2 year of service.
24	Location: 24 **(Weld / HAZ)** NG-11-F-12 On dissimilar weld & HAZ of P11 primary reformer inlet manifold NG-9-6**"**	P11 to SS304H	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix, Whereas at HAZ shows fusion is normal. No significant defect is observed at the HAZ region. Microstructure at parent metal shows fine-grained ferrite and pearlite structure. Possibilities of isolated creep cavities are observed.	SEM interpretation shows creep cavities are present. IInd stage of creep. Monitor after 2 year of service.
25	Location: 25 **(Weld / HAZ)** NG-11-D-12 On dissimilar weld & HAZ of P11 primary reformer inlet manifold NG-9-6**"**	P11 to SS304H	Microstructure at weld shows dendritic structure of ferrite pools in austenite matrix, Whereas at HAZ shows fusion is normal. No significant defect is observed at the HAZ region. Microstructure at parent metal shows fine-grained ferrite and pearlite structure. Possibilities of isolated creep cavities are observed.	SEM interpretation is mentioned at 25.1

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
25.1			Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries.	SEM interpretation shows creep cavities are present. IInd stage of creep. Monitor after 2 year of service.
26	Location: 26 (Weld/HAZ) 104D 2nd coarse shell LS weld + HAZ	SA516 Gr.70	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained ferrite pearlite structure. In-situ spheroidization of pearlite is observed. Possibilities of isolated creep cavities are observed.	SEM interpretation is mentioned at 26.1
26.1			Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries.	SEM interpretation shows Creep cavities are present. IInd stage of creep. Monitor after 2 year of service.
27	Location: 27 (Weld/HAZ) 104D T-joint weld+HAZ of bottom dish end	SA516 Gr.70	Microstructure at weld shows fine dendritic structure of ferrite and carbides. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained ferrite pearlite structure. In-situ spheroidization of pearlite is observed. Possibilities of isolated creep cavities are observed.	SEM interpretation is mentioned at 27.1
27.1			Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries.	SEM interpretation shows creep cavities are present. IInd stage of creep. Monitor after 2 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
28.	Location: 28 (Weld/HAZ) On weld bet^n. flange & Bend of gas inlet nozzle. PG-6 –18 towards east side of 103-C	P 11	Microstructure at weld metal shows ferrite and carbides in dendritic form. Coarsening of ferrite is observed in the weld region, Whereas at HAZ microstructure shows essentially fine-grained ferrite with few pearlite structure. Parent metal shows essentially fine-grained ferrite with few pearlite structure. Pearlite is observed at the grain boundaries. Possibilities of isolated creep cavities are observed.	SEM interpretation is mentioned at 28.1
28.1			Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries.	SEM interpretation shows creep cavities are present. IInd stage of creep. Monitor after 2 year of service
29.	Location: 29 (Weld/HAZ) On Weld Between BFW outlet Nozzle (East) of 103C to elbow weld+HAZ towards elbow (BW-11H-8)	CS	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal shows fine-grained ferrite and pearlite structure. Initial stage of in-situ spheroidization of pearlite is observed at grain boundaries.	IInd stage of creep degradations. Monitor after 1 year of service.
30.	Location: 30 (Weld/HAZ/PM) 106-D 1st Elbow of Gas outlet to 114-C	CS	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
31.	Location: 31 (Parent Metal) 106-D 2nd Elbow of Gas outlet to 114-C	CS	Microstructure shows fine-grained banded ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
32	Location: 32 (Weld/HAZ/PM) SG-1303, 09-10 (H-36) On 108D converter inlet nozzle, HAZ of nozzle.	P-22	Weld microstructure shows ferrite and carbides in dendrite form, Whereas at HAZ microstructure shows fine-grained ferrite & bainite structure. Parent metal microstructure shows fine-grained ferrite and bainite structure. In-situ spheroidization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
33.	Location: 33 (Weld/HAZ/PM) SG-1303, 09-10 (H-36) On 108D converter Inlet nozzle of bend at bottom	P-22	Weld microstructure shows ferrite and carbides in dendrite form, Whereas at HAZ microstructure shows fine-grained ferrite & bainite structure. Parent metal microstructure shows fine-grained ferrite and bainite structure. In-situ spheroidization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
34	Location: 34 (Weld/HAZ/PM) SG-1303, 10-14 (H-36) On 108D converter Outlet nozzle, HAZ of nozzle	P-22	Weld microstructure shows ferrite and carbides in dendrite form, Whereas at HAZ microstructure shows fine-grained ferrite & bainite structure. Parent metal microstructure shows fine-grained ferrite and bainite structure. In-situ spheroidization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
35.	Location: 35 (Weld/HAZ/PM) SG-1303, 10-14 (H-36) On 108D converter Outlet nozzle of bend at top	P-22	Weld microstructure shows ferrite and carbides in dendrite form, Whereas at HAZ microstructure shows fine tempered bainite structure. 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.
36.	Location: 36 (Weld/HAZ/PM) SG-1303 11-14 (H-34) On 107C Gas outlet nozzle & HAZ of bend	P-11	Microstructure at weld shows dendritic structure ferrite and carbides and bainite structure. Microstructure at HAZ shows fine & coarse-grained pearlite/bainite and ferrite structure. Parent metal microstructure shows fine-grained ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
37.	Location: 37 (Weld/HAZ/PM) SG-1303 11-14 (H-34) On 107C Gas outlet nozzle & HAZ of nozzle	P-11	Weld microstructure shows ferrite and carbides in dendrite form. Microstructure at HAZ shows fine-grained bainite and ferrite structure. Parent metal microstructure shows fine-grained ferrite and 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
38.	Location: 38 (Weld/HAZ/PM) SG-26-6” MICA-16 Upstream Flange weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure. Presences of widmanstatten ferrite are observed.	IInd stage of creep degradations. Monitor after 1 year of service.
39.	Location: 39 (Weld/HAZ/PM) SG-27-6” MICA-14 Upstream Flange weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure. Presences of widmanstatten ferrite are observed.	IInd stage of creep degradations. Monitor after 1 year of service.
40.	Location: 40 (Weld/HAZ/PM) SG-28-6” MICA 13 Upstream Flange weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure. Presences of widmanstatten ferrite are observed.	IInd stage of creep degradations. Monitor after 1 year of service.
41.	Location: 41 (Weld/HAZ/PM) SG-32-6” MICA-15 Upstream weld	Carbon steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine-grained ferrite and pearlite structure. Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure. Presences of widmanstatten ferrite are observed.	IInd stage of creep degradations. Monitor after 1 year of service.
42.	Location: 42 (Weld/HAZ/PM) On dissimilar weld between pipe & flange of PG-12A-14”, 105 CA to PG-26-18 (106-C)	SS 304 to CS	Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix. Whereas at HAZ microstructure shows fine-grained ferrite & bainite structure. Microstructure shows fine-grained ferrite and bainite structure	Microstructure is free from any micro cracks. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
43.	Location: 43 (Weld/HAZ/PM) On dissimilar weld between pipe & flange of PG-12B-14”, 105 CB to PG-26-18 (106-C)	SS 304 to CS	Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix. Whereas at HAZ microstructure shows fine-ferrite & pearlite structure. Parent metal microstructure shows fine-grained non-uniformly distributed ferrite and pearlite structure. Presences of widmanstatten ferrite are observed.	Microstructure is free from any micro cracks. Monitor after 1 year of service.
44.	Location: 44 (Weld/HAZ) 102B SG-62A-4” line	P5	Weld microstructure shows dendritic structure of tempered bainite/martensite structure, Whereas at HAZ shows fine-grained ferrite and bainite structure. Parent metal microstructure shows fine & coarse-grained ferrite & bainite structure. In-situ spherodization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
45.	Location: 45 (Weld/HAZ) 102B SG-62B-4” line	P5	Weld microstructure shows dendritic structure of tempered bainite/martensite structure, Whereas at HAZ shows fine-grained ferrite and bainite structure. Parent metal microstructure shows fine & coarse-grained ferrite & bainite structure. In-situ spherodization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.

Note: Location no. 1,2,3,4,5,6,7,8,10,11,13,29,32,33,34,35,37,38,39,40,41,42,43,44 and 45 shall be monitored during next turnaround in detail as recommended by M/S TCR

Annexure - 10

UFD & RT STATUS OF CONVERTER LOOP

JOINT NO.	2011		2012		2013		2014	
	UFD	RT	UFD	RT	UFD	RT	UFD	RT
FROM 108D TO 107C, **LINE NO: SG-1303-10-14**", SCH-120 (27.79MM NOM THICK.)								
Elbows 1 to 5	NSD	--	NSD	--	NSD	--	NSD	--
J-1	NSD	NSD	NSD	--	NSD	--	NSD	--
J-2	NSD	NSD	NSD	--	NSD	--	NSD	--
J-3	NSD	NSD	NSD	--	NSD	--	NSD	--
J-4	NSD	NSD	NSD	--	NSD	--	NSD	--
J-5	NSD	NSD	NSD	--	NSD	--	NSD	--
J-6	NSD	--	NSD	--	NSD	NSD	NSD	--
J-7	NSD	--	NSD	--	NSD	NSD	NSD	--
J-8	NSD	NSD	NSD	--	NSD	--	NSD	--
J-9	NSD	NSD	NSD	--	NSD	--	NSD	--
J-10	NSD	NSD	NSD		NSD	--	NSD	--
J-11	NSD	NSD	NSD	New Joint NSD, After SR	NSD	--	NSD	--
J-12	NSD	--	NSD	New Joint NSD, After SR	NSD	--	NSD	--
FROM 105D TO 108D, **LINE NO: SG-1303-8-10"** SCH-120 (21.44MM NOM THICK.), **SG-1303-8-14"** SCH 120 (27.79MM NOM THICK.), **SG-1303-9-10"** SCH-120 (21.44MM NOM THICK.) & **SG-1303-12-10**" SCH-120 (21.44 MM NOM THICK.)								
Elbows 1 to 15	NSD	--	NSD	--	E-2 & E-5 Rest of All NSD	--	NSD	--
J-1	NSD	--	NSD	--	NSD	--	NSD	--
J-2	NSD	--	NSD	--	NSD	--	NSD	--
J-3	NSD	--	NSD	--	--	--	NSD	--
J-4	NSD	--	NSD	--	--	--	NSD	--
J-5	NSD	--	NSD	--	NSD	--	NSD	--
J-6	NSD	--	NSD	--	NSD	--	NSD	--
J-7	NSD	--	NSD	--	NSD	--	NSD	--
J-8	NSD	--	NSD	--	NSD	--	NSD	--
J-9	NSD	--	NSD	NSD	--	NSD	NSD	--
J-9A	NSD	NSD	NSD	NSD	--	NSD	NSD	--
J-9B	NSD	--	NSD	--	--	NSD	NSD	--
J-10	NSD	--	NSD	NSD	--	--	NSD	--
J-11	NSD	--	NSD	NSD	NSD	--	NSD	--
J-12	NSD	--	NSD	NSD	NSD	--	NSD	--
J-13	NSD	--	NSD	NSD	NSD	--	NSD	--
J-14	NSD	--	NSD	NSD	NSD	--	NSD	--
J-15	NSD	--	NSD	NSD	NSD	--	NSD	--

JOINT NO.	2011		2012		2013		2014	
	UFD	**RT**	**UFD**	**RT**	**UFD**	**RT**	**UFD**	**RT**
J-16	NSD	--	NSD	NSD	NSD	--	NSD	--
J-17	NSD	--	NSD	NSD	NSD	--	NSD	--
J-18	NSD	--	NSD	NSD	NSD	--	NSD	--
J-19	NSD	NSD	NSD	NSD	NSD	--	NSD	--
J-20	NSD	--	NSD	NSD	NSD	--	NSD	--
J-21	NSD	--	NSD	NSD	NSD	--	NSD	--
J-22	NSD	--	NSD	NSD	NSD	--	NSD	--
J-23	NSD	--	NSD	NSD	NSD	--	NSD	--
J-24	NSD	--	NSD	NSD	NSD	--	NSD	--
J-25	NSD	--	NSD	NSD	NSD	--	NSD	--
J-26	NSD	--	NSD	NSD	NSD	--	NSD	--
J-27	NSD	--	NSD	NSD	NSD	--	NSD	--
J-28	NSD	--	NSD	NSD	NSD	--	NSD	--
J-29	NSD	--	NSD	NSD	NSD	--	NSD	--
J-30	NSD	--	NSD	NSD	NSD	--	NSD	--
J-T1	NSD	--	NSD	--	NSD	NSD	NSD	--
J-T2	NSD	--	NSD	--	NSD	NSD	NSD	--
J-T3	NSD	--	NSD	--	NSD	NSD	NSD	--
J-T4	NSD	--	NSD	--	NSD	NSD	NSD	--
J-T5	NSD	--	NSD	--	NSD	NSD	NSD	--
J-T6	NSD	--	NSD	--	NSD	NSD	NSD	--
FROM 107D TO 123C, **LINE NO: SG-1303-11-14**", SCH-140 (31.75MM NOM THICK.)								
Elbows 1 to 6	NSD	--	NSD	--	E-2 & E-3 Rest of All NSD	--	NSD	--
J-1	NSD	--	NSD	--	NSD	--	NSD	--
J-2	NSD	--	NSD	--	NSD	--	NSD	--
J-3	NSD	--	NSD	--	--	--	NSD	--
J-4	NSD	--	NSD	--	--	--	NSD	--
J-5	NSD	--	NSD	--	--	--	NSD	--
J-6	NSD	--	NSD	--	--	--	NSD	--
J-7	NSD	--	NSD	--	NSD	--	NSD	--
J-8	NSD	--	NSD	--	NSD	--	NSD	--
J-9	NSD	--	NSD	--	NSD	NSD	NSD	--
J-10	NSD	--	NSD	--	NSD	NSD	NSD	--
J-11	NSD	--	NSD	--	NSD	NSD	NSD	--
J-12	NSD	--	NSD	--	NSD	NSD	NSD	--

NSD: No Significant Defect

UREA PLANT
(INSPECTION)

During Shutdown 2014, the following major Inspection activities were performed in the Urea plant.

- Internal inspection of High-pressure vessels viz. Autoclave (V-1201), H.P Stripper (H-1201), H.P Condenser (H-1202).
- Eddy Current Testing of H.P. Stripper (H-1201) tubes by M/s TesTex NDT India Pvt. Limited.
- Eddy Current Testing of H.P. Carbamate Condenser (H-1202) tubes by M/s TesTex NDT India Pvt. Limited.
- Internal inspection of other vessels.
- Ultrasonic thickness measurement of **HP Lines.** Detailed report is attached at **Annexure-1.**
- Ultrasonic thickness measurement of **SC, ST and Other Lines.** Detailed report is attached at **Annexure-2.**
- Ultrasonic thickness measurement of various **Equipment**. Detailed report is attached at **Annexure-3.**
- Qualification tests of welders employed by contractors.
- Residual magnetism measurement and demagnetization, wherever required of Hitachi Compressor (K-1801) Train. Detail report is attached at **Annexure-4**.
- Insitu-Metallography was carried out at selected locations on equipment. Summary of observations and microstructure analysis is given at **Annexure-5**.
- Inspection of H.P. Line tapping. List is attached at **Annexure-6**.
- Dye Penetrant examination and radiography of weld joints of lines fabricated, erected and offered by Mech. Maint./Technical Department as per the requirement including HP line PR-1208-4”-X1. **Annexure-9**
- 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.
- Inspection of corrosion under support carried out in Hitachi high pressure CO_2 line. The details are attached at **Annexure-10.**

HIGH PRESSURE VESSELS

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

AUTOCLAVE (V-1201)

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

Compartment No.1 (Top Compartment)

- Roughening / corrosion of dome liner was observed. Grayish oxide layer was observed on dome and man way surface.
- 1-1.5'' area just above man way liner's top circumferential seam observed having high corrosion attack.
- Liner plate piece just below dome liner was found silver bright in colour all along the circumference.
- Overall Tray corrosion is high in all four segments.
- Few fasteners of tray segments were found loose and 4 nos. of tray segment bolts and 1 nos. of "J" bolt found missing just near to the down comer funnel at north side.

Compartment No.2

- Roughening of tray holding clits and grayish brown oxide layer was observed on bottom side of trays, same was observed during previous inspection.
- Condition of Weld joints was found satisfactory.
- 01 no. of tray holding clit was found to be blackish in colouration and having severe corrosion attack including its welds, same was observed during previous inspection.
- Due to corrosion / erosion of trays, gap increased between tray and shell liner plate.
- Overall Tray corrosion is high in first compartment.
- Down comer found dark brown in colour and rough in surface.
- In South side shell liner, 2'' above C-seam near tray clit, Pits/Localized erosion of 2 to 3 mm depth, 10-12 mm long observed, marked as **2A** with yellow chalk.

Compartment No.3

- Bulging of approx. 8mm depth and 2.5" width was observed behind tray skirt in SW to South direction, same was observed during previous inspection.
- 04 nos. of tray holding clits were found to be blackish in coloration and having severe corrosion attack including its welding, same was observed in previous inspection.
- Due to corrosion / erosion of trays, gap increased between tray and shell liner plate.
- High corrosion observed in West side tray segment.
- Manway liner having Pits/Localized erosion of 1.5mm depth, 4-5 mm width, 20 -25 mm long observed, marked as **3A** with yellow chalk.
- Overall Circumferential and long seam welding found satisfactory.

Compartment No.4

- Approx. 30 mm below circumferential weld a depression of approx. 100 mm dia. and 3 mm depth was observed in West side of the liner. Same was observed during previous inspection.
- Convex bulging of liner plate observed just above circumferential weld by approx. 4 mm all along the circumference. Same was observed during previous 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 previous inspection.
- Grayish and brownish oxide layer was observed on the bottom side of trays.
- 03 nos. of tray holding clits were found black and found to have severe corrosion attack including its welding, same observed in previous inspection.
- Due to corrosion / erosion of trays, gap increased between tray and shell liner plate.

Compartment No.5

- Convex bulging of liner plate was observed just above the circumferential weld joint by approx. 3 to 9 mm all along the periphery. The same was observed during previous inspection.
- Concave depression of approx 2-6 mm was observed at approx. 500 mm below the C-weld seam all along the periphery. The same was observed during previous inspection.
- Grayish and brownish oxide layer was observed on the bottom side of trays.

Compartment No.6

- Convex bulging of approx. 3 to 10 mm was observed on the liner above the circumferential weld from N-W to S-E direction in approx. length of 4500 mm. The same was observed during previous inspection.
- Concave depression of approx. 5 mm depth was observed at approx. One meter below C-weld seam from East to West side through North side of the shell. The same was observed during previous inspection.
- High corrosion observed on N-W corner of the tray segment.

Compartment No.7

- Convex bulging of approx. 2-6 mm was observed above the circumferential weld joint at few locations. The same was observed during previous inspection.
- Concave bulging approx. 5 mm. depth observed 1200mm below C-seam and approx. in 60% periphery, more prominent in liquid box.
- 04 nos. of tray holding clits were found to be blackish in coloration and having severe corrosion attack including it's welding, same observed in previous inspection.
- Erosion of the tray segments was observed.
- Manway liner having Pits/Localized erosion of 1.5- 2.0 mm depth, 3-4 mm width, 30-35 mm long observed, marked as **7A** with yellow chalk.
- New welding was carried out after grinding the existing circumferential & long weld seams followed by DPT. After the weld overlay it was again rechecked by DPT and found satisfactory. Welding Job was carried out by M/s. Shree Ganesh Engg. in **S/D 2014.**

Compartment No.8

- Concave bulging of approx. 3 to 6mm. depth at the elevation of approx. 300 mm above tray was observed all along the circumference. The same was observed during previous inspection.
- 05 nos. of tray holding clits were found to be blackish in coloration and having corrosion attack including its welding, same observed in previous inspection.
- Manway liner having Pits/Localized erosion of 1.5- 2.0 mm depth,4-5 mm width,20 - 25 mm long observed, marked as **8A** with yellow chalk.
- Insert liner found silver shiny in colour and its welding found intact.
- New welding was carried out after grinding the existing circumferential & long weld seams followed by DPT. After the weld overlay it was again rechecked by DPT and found satisfactory. Welding Job was carried out by M/s. Shree Ganesh Engg. in **S/D 2014.**

Compartment No.9

- 02 no. of tray holding clit was found to be blackish in coloration near man way and having severe corrosion attack including its welding, same observed during previous inspection.
- Weld roughening was observed in both East and West side long seams.

Compartment No.10

- Concave depression of approx 7mm depth at approx 70mm below the C-weld seam in South side of shell in approx. 100 mm dia. was observed. Same was observed during previous inspection.
- Concave depression of approx. 9 mm depth just above the C-weld seam towards the South side of man way and adjacent to L-seam in approx. 100 mm dia. was observed. Same was observed during previous inspection.
- Bulging of approx. 2-3 mm in 25mm width was observed from the C-weld seam to the bottom of the compartment in North side of the shell. Same was observed during previous inspection.
- Concave depression of about 5mm depth at approx 70mm below C-seam in West side just adjacent to L- seam was observed in 100mm area. The same was observed during previous inspection.
- 02 nos. of tray holding clits near man way were found blackish in coloration and having severe corrosion attack including its welding, same was observed during previous inspection.
- Weld roughening was observed in both East and West side long seams.

Compartment No.11

- Just below circumferential weld concave depression of approx. 5 to 6 mm depth in approx. 100mm dia. in North-West direction was observed. The same was observed during previous inspection.

- Concave depression of approx. 5mm and 9mm depth in approx. 100mm dia. was observed just above the C-weld seam in North and West side of the shell respectively. The same was observed during previous inspection.

- Convex bulging of max. 3 mm & width of approx. 10 mm observed just above the top circumferential weld of the insert liner approx. 125 mm in length. Same was observed during previous inspection.

- Concave depression of approx. 5-6 mm was observed just above of the top and below of bottom C-weld seam of insert liner. The same was observed during previous inspection.

- Weld roughening was observed in both East and West side long seams.

Compartment No.12 (Bottom Compartment)

- South side tray skirt is touching the shell liner may cause rubbing with the liner. Same was observed during previous inspection.

- Weld joint edges of Down comer nozzle with dish end were observed exposed. The same was observed during previous inspection.

- Dark brown coloration was observed on dish end. The same was observed during previous inspection.

- Concave depression of approx. 2-3 mm depth and approx. 5mm depth 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 previous inspection.

- Roughening / corrosion /erosion observed on bottom of the tray.

- All tray holding clits were found blackish in color and having corrosion attack including its welding.

- D.P. test of all the nozzle welds carried out and found satisfactory.

NOTE:

- Compartment wise, total 04 nos. defects marked for repair i.e. 1A-1st Compartment first defect, 2A-2nd Compartment first defect, Compartment nos. counting from top to bottom.

- Severe etching observed on Down comer in almost all the compartment.

- Ferrite was also measured on liner & welds, found Nil.

- NE-North East, SW-South West, NW-North West, SE- South East

- L-Long seam, C-Circumferential seam.

- In general, few tray holding bolts and tray segment fasteners were found loose/ missing in all the compartments and may be checked.

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	6.68	6.72	6.86	6.60	750mm Section Replaced in Yr. 2002 by BC-05.
	Shell Liner Old (Top)	5.00	4.18	4.62	4.41	3.84	
	Shell Liner (Middle)	5.00	4.15	4.63	4.54	4.10	
	Shell Liner (Bottom)	5.00	4.17	4.64	4.61	4.30	
	Top-Dome	6.50	6.60	6.82	6.55	6.70	Replaced in Yr. 2002 by BC-05.
	Tray Segment -1	8.00	3.3	3.29	3.42	3.62	
	Tray Segment -2	8.00	3.48	3.74	3.49	3.74	
	Tray Segment -3	8.00	3.37	2.96	3.62	3.70	**Overall Min. tray thickness**
	Tray Segment -4	4.42	4.55	3.44	3.29	3.52	
	Manway Liner	6.88	7.05	6.96	7.00	6.90	Replaced in Yr. 2002 by BC-05.
02	Shell Liner (Top)	5.00	3.83	4.29	4.37	3.56	**Overall Min. liner thick.**
	Shell Liner (Middle)	5.00	4.03	4.26	4.51	4.05	
	Shell Liner (Bottom)	5.00	4.09	4.33	4.56	3.99	
	Tray Segment-1	8.00	4.50	3.87	3.15	5.36	
	Tray Segment-2	8.00	3.73	3.98	3.82	3.22	
	Tray Segment-3	8.00	3.47	3.72	3.69	3.34	
	Tray Segment-4	8.00	3.31	3.87	3.79	3.59	
	Down-Comer	10.00	5.96	5.81	5.97	5.74	
03	Shell Liner (Top)	5.00	3.81	4.18	4.13	4.44	
	Shell Liner (Middle)	5.00	4.16	4.39	4.25	4.16	
	Shell Liner (Bottom)	5.00	4.32	4.17	4.23	4.24	
	Tray Segment-1	8.00	3.68	3.66	4.08	3.89	
	Tray Segment-2	8.00	3.97	3.96	4.23	3.78	
	Tray Segment-3	8.00	3.60	3.85	3.82	3.28	
	Tray Segment-4	8.00	3.95	3.78	3.87	3.93	
	Insert Liner	6.50	6.63	6.62	6.83	6.89	Replaced in Yr. 1997
	Down-Comer (Shiny)	10.00	9.22	8.80	8.92	9.01	
	Down-Comer	10.00	5.16	5.74	5.69	5.78	Overall Minimum Down-

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)	
							Comer thickness
04	Shell Liner (Top)	5.00	4.06	3.85	3.88	4.32	
	Shell Liner (Middle)	5.00	4.39	4.17	4.08	4.34	
	Shell Liner (Bottom)	5.00	4.53	4.28	4.20	4.37	
	Tray Segment-1	8.00	4.02	4.32	3.80	3.88	
	Tray Segment-2	8.00	3.99	4.11	4.42	4.32	
	Tray Segment-3	8.00	4.06	4.18	4.31	3.94	
	Tray Segment-4	8.00	4.09	4.25	4.10	3.82	
	Insert Liner	6.50	6.13	6.30	6.31	6.32	Replaced in Yr.1999
	Down-Comer	10.00	6.17	6.13	6.66	6.27	
05	Shell Liner (Top)	5.00	4.41	4.65	4.39	4.75	
	Shell Liner (Middle)	5.00	4.83	4.79	4.54	4.86	
	Shell Liner (Bottom)	5.00	4.75	4.92	4.72	4.92	
	Tray Segment-1	8.00	4.35	4.31	4.58	4.42	
	Tray Segment-2	8.00	4.41	4.00	4.43	4.57	
	Tray Segment-3	8.00	4.18	3.97	4.34	4.25	
	Tray Segment-4	8.00	3.96	4.05	4.48	4.62	
	Down-Comer	10.00	5.99	6.32	6.37	6.19	
	Down-Comer (Shiny)	10.00	8.97	9.15	8.94	9.23	
06	Shell Liner (Top)	5.00	4.38	4.69	4.39	4.42	
	Shell Liner (Middle)	5.00	4.29	4.92	4.47	4.62	
	Shell Liner (Bottom)	5.00	4.48	4.50	4.38	4.53	
	Tray Segment-1	8.00	4.50	4.57	4.44	4.59	
	Tray Segment-2	8.00	5.08	4.79	5.10	5.04	
	Tray Segment-3	8.00	4.82	4.38	4.70	5.69	
	Tray Segment-4	8.00	5.02	5.10	5.22	5.32	
	Down-Comer	10.00	6.34	6.25	6.36	6.42	
07	Shell Liner (Top)	5.00	4.41	4.68	4.52	4.69	
	Shell Liner (Middle)	5.00	4.47	4.77	4.49	4.64	
	Shell Liner (Bottom)	5.00	4.30	4.76	4.56	4.73	
	Tray Segment-1	8.00	4.90	5.16	5.12	4.97	
	Tray Segment-2	8.00	4.92	4.96	5.14	5.16	
	Tray Segment-3	8.00	4.60	4.83	4.98	4.80	
	Tray Segment-4	8.00	4.98	4.96	5.16	5.22	
	Down-Comer	10.00	6.45	6.38	6.42	6.38	
08	Shell Liner (Top)	5.00	4.56	4.38	4.70	4.62	
	Shell Liner (Middle)	5.00	4.64	4.48	4.54	4.60	
	Shell Liner (Bottom)	5.00	4.69	4.65	4.82	4.73	
	Tray Segment-1	8.00	5.52	4.91	5.22	5.07	

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-2	8.00	5.33	5.55	5.77	5.60	
	Tray Segment-3	8.00	5.96	5.82	5.61	5.88	
	Tray Segment-4	8.00	6.22	5.98	6.18	5.98	
	Insert Liner	6.50	6.46	6.86	6.55	6.62	Replaced in Yr. 2000
	Down-Comer	10.00	6.71	6.65	6.66	6.60	
09	Shell Liner (Top)	5.00	4.47	4.61	4.70	4.63	
	Shell Liner (Middle)	5.00	4.71	4.55	4.61	4.54	
	Shell Liner (Bottom)	5.00	4.89	4.56	4.64	4.70	
	Tray Segment-1	8.00	6.72	6.52	6.78	6.65	
	Tray Segment-2	8.00	6.74	6.60	6.63	6.58	
	Tray Segment-3	8.00	5.94	6.75	6.76	6.03	
	Tray Segment-4	8.00	6.46	6.56	6.72	6.76	
	Insert Liner	6.50	6.45	6.64	6.69	6.84	Replaced in Yr. 2001
	Down-Comer	10.00	6.95	7.07	7.05	7.17	
10	Shell Liner (Top)	5.00	4.77	5.24	5.16	4.70	
	Shell Liner (Middle)	5.00	4.97	5.53	5.25	4.94	
	Shell Liner (Bottom)	5.00	4.90	5.51	5.22	4.98	
	Tray Segment-1	8.00	6.44	6.68	6.72	6.57	
	Tray Segment-2	8.00	6.85	7.03	7.20	6.41	
	Tray Segment-3	8.00	6.74	7.14	6.92	6.98	
	Tray Segment-4	8.00	7.02	6.87	7.27	7.15	
	Insert Liner	6.50	6.55	6.62	6.44	6.69	Replaced in Yr. 2002
	Down-Comer	10.00	7.39	7.19	7.23	8.24	
11	Shell Liner (Top)	5.00	4.45	4.53	4.37	4.53	
	Shell Liner (Middle)	5.00	4.61	4.80	4.42	4.64	
	Shell Liner (Bottom)	5.00	4.63	4.60	4.43	4.68	
	Tray Segment-1	8.00	6.96	7.04	7.50	7.09	
	Tray Segment-2	8.00	6.94	7.50	6.89	7.02	
	Tray Segment-3	8.00	7.79	7.52	7.33	7.37	
	Tray Segment-4	8.00	7.50	7.59	7.39	7.67	
	INSERT LINER	6.50	6.52	6.70	6.50	6.66	Replaced in Yr. 2002
	DOWN-COMER	10.00	7.78	7.86	7.79	7.74	
12-(BOTTOM COMPARTMENT)	SHELL LINER	5.00	4.51	4.54	4.58	4.73	
	PETAL PLATE	7.00	6.37	6.26	6.36	6.28	
	BOTTOM DOME	7.00	6.49	6.66	6.42	6.16	Replaced in Yr. 1993
	REDUCER- 10" X 8"	10.00	9.67	9.74	9.71	9.75	Replaced in Yr. 1997

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)**	
	10" - PIPE	10.00	8.06	8.36	8.05	8.32	
	8" - PIPE (DISTANCE PIECE)	6.00	4.65	5.85	4.80	4.47	Replaced in Yr. 2000
	NOZZLE-8"	6.00	4.53	3.58	4.42	4.44	

Note :-

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

HP STRIPPER (H-1201)

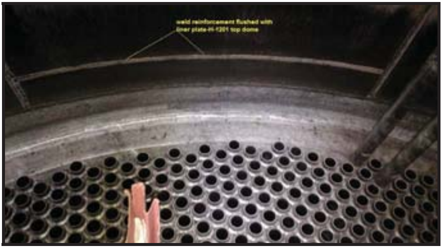
VISUAL INSPECTION

TOP CHANNEL

- The condition of sealing face was satisfactory.
- A thin blue grey oxide layer covered the overlay welding and liner in the gas phase (man way, dome and part of cylinder), except for the areas between the strip beads. The liner and liquid inlet box in the liquid phase were grey and slightly etched. No corrosion has been observed.

- The overlay welding on the tube sheet was grey and slightly etched.
- The tube welds were bright and smooth. Thick & hard oxide deposition was observed, more prominent in East - West direction between the tubes on tube sheet area.
- The tubes were found smooth from inside.

- At the central tube sheet area some of the tube ends were found having minor damage. This was observed in previous inspection also.
- In Shell south-west side insert liner “C “seam welding crowning reduced to liner level, weld deposition may be carried out. Refer attached photograph.



BOTTOM CHANNEL

- The condition of sealing face was found satisfactory.
- The overlay welds in the man way were 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 found more etched than the surrounding areas.
- 01 no. of cavity was observed on longitudinal weld seam of cylindrical liner just above CO_2 inlet line (this was observed in previous inspection also) & 01 more crevice cavity was observed adjacent to it on liner.
- The tube sheet was covered with a thin grey oxide layer. This layer seems to be more hard & bonded on tube-sheet to shell weld joint.
- The tubes from inside were smooth.
- The liquid outlet pipe and the gas inlet pipe were bright, shiny and showed no defects. Their nozzles and welds were in satisfactory condition.
- 02 nos. fasteners for Urea Solution outlet line flanges (both flanges) were turned black & corroded and few fasteners of flanges found loose.
- 02 no. fasteners for CO_2 inlet line flange (South side) turned black & corroded.

BOTTOM COVER

- The overlay welding was very 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.

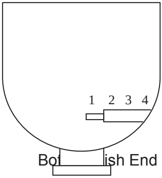
Bottom Dome

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness, mm (Minimum)
Man way (Overlay)	19.05	22.88	8.0
Dome area (Overlay)	12.12	14.58	8.0
Cylindrical area (Liner)	8.22	8.57	8.0
Tube sheet-Overlay weld	13.0 (Machined)	15.65 (Machined)	8.0
Bottom Cover (Overlay)	16.77	17.70	8.0

Top Dome

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness, mm (Minimum)
Man way (Overlay)	18.15	23.93	8.00
Dome area (Overlay)	11.57	16.12	8.00
Cylindrical area (Liner)-Gas phase	8.35	8.74	8.00
Cylindrical area (Liner)-Liquid phase	8.05	8.15	8.00
Tube sheet-Overlay weld	12.57 (Machined)	14.44 (Machined)	8.00

RADIOACTIVE SOURCE WELL



POINT NO.	DESIGN THK.	MEASURED THICKNESS (Minimum in mm)
1	7.5	8.65
2	19.0	18.71
3	19.0	18.81
4	19.0	18.68

FERRITE MEASUREMENT

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

EDDY CURRENT TESTING OF TUBES

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

- Wall loss : 0.510 to 0.600 mm observed in 43 tubes
- Wall loss : 0.641 to 0.689 mm observed in 247 tubes
- Wall loss : 0.690 to 0.750 mm observed in 1197 tubes
- Wall loss : 0.760 to 0.800 mm observed in 1014 tubes
- Wall loss : 0.810 to 0.850 mm observed in 22 tubes
- Wall loss : 0.860 to 0.900 mm observed in 57 tubes
- Wall loss : 0.910 to 0.950 mm observed in 19 tubes

Result and Conclusion: Majority of the wall thinning was observed between 2nd to 5th baffle from top tube-sheet. (Tube sheet layout attached at **Annexure-7**).

H.P. CONDENSER (H-1202)

VISUAL INSPECTION

TOP CHANNEL HEAD

- The gasket sealing face was found satisfactory.
- The liner and welds in the man way were shiny and smooth However top 1'' area circumferential area found rough.
- The liner and welds in the channel were shiny and slightly rough.
- Circumferential Weld seam, patch plate in South direction and long seam welding of shell liner found rough.
- The liners above to the gas inlet have scattered bluish grey oxide scale.
- Minor roughening was observed on the tube sheet overlay near tube sheet to channel circumferential weld joint in complete periphery. It was observed more predominant in West & South direction.
- The tray support clips were shiny and slightly etched.
- The tube-to-tube sheet welds were found satisfactory however in north direction tube sheet found bluish in color.
- The few tube ends were found slightly damaged.
- Many tube showed burn-through at ID of tube, these were also observed in earlier inspections. Tube no 31 x 19 was found susceptible from ID & was plugged.

BOTTOM CHANNEL HEAD

- The sealing face was found satisfactory.
- The man way liner was dark brownish in coloration at many locations in circumference.

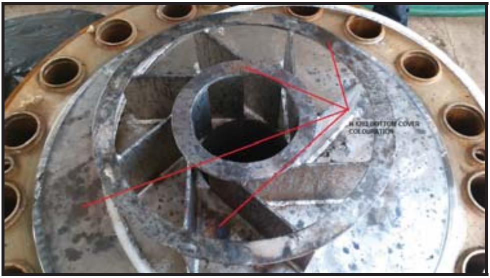
- Shell liner was silvery, shiny and dish end liner is in dark grayish in color.

  Please refer attached Photograph.
- All liner welds and repairs were bright and smooth.
- The tube to tube sheet welds were bright shiny and smooth.
- Many tubes showed burn-through defects, these were also observed in earlier inspections.
- Roughening of Gas outlet nozzle long seam welding observed.

<u>BOTTOM COVER</u>

- The sealing face was found satisfactory.
- The liner was shiny and slightly etched.
- The vortex breaker and welds found dark grayish at several locations.

  Please refer attached Photograph.



THICKNESS MEASUREMENT

Weld Overlay and Liner thickness measurement

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

BOTTOM DOME

Location of Measurement	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness (mm)
Man way (Liner)	**4.38***	6.96	6.0
Dome area (Liner)	6.60	6.95	6.0
Cylindrical area (Liner)	6.63	7.02	6.0
Tube sheet-Overlay weld	9.50	10.9	8.0 (Min)
Bottom Cover (Liner)	19.09	19.32	18.0

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

TOP DOME

Location of Measurement	Minimum Thickness mm	Maximum Thickness mm	Design Thickness mm (Minimum)
Man way (Liner)	6.5	7.1	6.0
Dome area (Liner)	6.5	6.7	6.0
Cylindrical area (Liner)	6.3	7.0	6.0
Tube sheet-Overlay weld	7.45	8.83	8.0 (min)

EDDY CURRENT TESTING OF TUBES

Eddy current inspection was carried out by M/s TesTex NDT India Pvt. Ltd. Total tubes in H.P. condenser are 1970 out of which 220 tubes were tested for 12000mm tube length and 1728 tubes tested for 3000mm length. 10 tubes could not be tested due to tray support pads obstructing the probe. 13 tubes were plugged before inspection. The observations are as under:

- No reduction in wall thickness or any abnormality was detected in other inspected tubes as compared to Calibration tube.
- Tube No. 10 x 22 was found having ovality in ID however no thinning was observed in this area. This tube was plugged as a precautionary measure.
- Tube no 31 x 19 having Burn thru and visible cavity from ID, this tube was plugged as a precautionary measure. Hence total 02 tubes were plugged in this turnaround. (Tube sheet layout attached at **Annexure-8**)

AIR-BUBBLE TEST FOR LEAK DETECTION

Air Bubble test was carried out to detect any leakage from the tube or tube to tube-sheet weld joints. The shell side was pressurized at 5.0 Kg/cm^2. No leakage was observed from any tube or tube to tube-sheet welds. The H.P. Condenser was hydro-tested and found satisfactory.

FERRITE MEASUREMENT

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

INSPECTION OF OTHER VESSELS / EQUIPMENT

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

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

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

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

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

- Thin creamy scales were observed inside few the tubes.02 nos. tubes were having white scale inside the tubes.

H-1104 ($C0_2$ SPRAY COOLER)

- Demister pad condition was found satisfactory.
- Risers holding clamps with Liquid distributor tray were found satisfactory.
- Weld joint condition was found satisfactory. However, one pin hole was observed in the fillet weld of Demister pad support ring with shell and brownish coloration was observed around it on the shell. Marked with yellow chalk.

H-1204 (RECIRCULATION HEATER)

- Hard blackish scaling prominent at bottom side observed inside the tubes may be Hydro jetting carried out.
- Brownish scaling was observed on both top and bottom tube sheet.
- Foreign particles, Glass wool wastage found lying on top tube sheet, may be.

H-1205 (L.P. CARBAMATE CONDENSER)

- Replaced by New one manufactured by M/s Ganson, Nagpur.

H-1207 (CIRCULATION SYSTEM -II COOLER)

- Pitting and scaling was observed on the tube sheet area.
- Channel cover was found pitted / corroded from inside.
- Scaling was observed on the inside surface of all tubes may be re hydro jetting Carried out.

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)

- West side end flange sealing face ID was found corroded.
- Thin creamy scales were observed inside almost all the tubes.
- Condition of tube to tube sheet weld was found satisfactory.

H-1352 (REFLUX CONDENSER)

TOP TUBE SHEET

- Tube to tube sheet welding was found satisfactory.
- Scaling was observed on the ID of all the tubes and also on tube-sheet area.

BOTTOM TUBE SHEET

- Tube to tube sheet welding was found satisfactory on CW inlet side.
- Few tubes holes were found chocked with Cooling water debris.
- Thick scaling was found on the CW outlet side tube sheet.
- On cooling water outlet side, scaling was observed inside the tubes anoutletline Elbow.
- Paint inside the channel area was observed peeled off at several locations.
- Thermowells were found intact in position, however CW outlet side thermowell was found covered with thick scaling.

H-1419 (PRE-EVAPORATOR CONDENSER)

TOP TUBESHEET:

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

H-1420 - TOP (FINAL CONDENSER)

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

H-1421, FLASH TANK CONDENSER

- Tube to tube sheet welding was found satisfactory.
- Minor scales observed inside most of the tubes.
- Most of the tubes were found filled with water.

H-1422 (1st Stage Evaporator):

- The shell and Dish ends have grayish black in coloration.
- Colour of tube sheet was brownish.
- Tubes to tube sheet weld joints were found satisfactory.
- Condition of impingement cone was found satisfactory.
- Impingement cone to support bolts were bent but tack welded and found satisfactory.
- Top distributor outlet vanes found clear and intact.
- Condensate flushing spargers (08 nos.) were found in satisfactory condition.

H-1423 (FIRST STAGE EVAPORATOR CONDENSER)

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

H-1424 (2nd Stage Evaporator):

- Shiny surface was observed inside the vessel.
- Impingement cone corner was found bent in downward direction at two locations, one is in North-west direction and the other is in south-west direction. This was also observed in earlier inspection.
- Tube to tube sheet welding found satisfactory and tubes found clear from I.D.
- Circumferential sparger and its supports found intact.
- Outlet line found clear and intact from inside of vessel till visible limit.

H-1425 (SECOND EVAPORATOR FIRST CONDENSER)

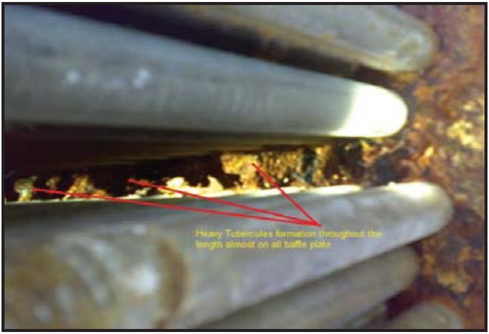
- Tube to tube sheet welding was found satisfactory.
- Whitish scale was observed inside the tubes.
- Overall condition of heat exchanger was found satisfactory.

H-1426 (SECOND EVAPORATOR SECOND CONDENSER)

- Tube to tube sheet welding was found satisfactory.
- Minor brownish/Whitish scales were observed inside of tubes.
- Minor scales were observed inside few tubes.
- Tubes were found filled with water.

H-1811 (FIRST STAGE INTER COOLER)

- Condition of tubes and tube sheet was found satisfactory.
- Tube sheet found silver shiny in color at gas inlet side and brownish in color at outlet side.
- C.S tube baffles found rusted at several locations.
- Tube sheet found silver shiny in color at gas inlet side and brownish in color at outlet side.
- Major Tubercules formation observed in baffle plates between inlet and outlet tubes at several locations. Needs to be cleaned. Photograph is attached.
- Shell I.D found rusted and paint found peeled off at many locations.



H-1814-A & 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 coating was found peeled off at several locations in the dome covers,
- Tubercles formation observed in portion plate and shell I.D at several locations.

H-1815

SOUTH SIDE HALF (EAST SIDE CHANNEL)

TOP HALF

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found peeled off at few locations.
- Thermowell was found intact..
- Minor scaling was observed at ID of few tubes.
- Tubercules formation observed at shell ID and near gasket sealing face.

BOTTOM HALF

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

SOUTH SIDE HALF (WEST SIDE CHANNEL)

TOP HALF

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

BOTTOM HALF

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found peeled off at few locations.
- Thermo well was found intact.

NORTH SIDE HALF (EAST SIDE CHANNEL)

TOP HALF

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found peeled off at few locations.
- Thermo well was found intact..
- Scaling was observed at ID of few tubes.

BOTTOM HALF

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found peeled off from the channel cover.
- Minor scaling was observed at ID of few tubes.
- Tubercules formation observed in portion plate and shell I.D at several locations

NORTH SIDE HALF (WEST SIDE CHANNEL)

TOP HALF

- Tube sheet was found in satisfactory condition.
- Minor scaling was observed inside the tubes.
- Epoxy coating was found peeled off at many locations on baffle plate, channel & cover.

BOTTOM HALF

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

V-1101 (CO_2 KNOCK OUT DRUM)

- Epoxy paint was found peeled off from several locations in bottom dished end & shell.
- Two segments of Demister pads were found shifted upwards from its position.

V-1103 (NH_3 SUCTION VESSEL)

- Vessel from inside was found blackish.
- The condition of longitudinal and circumferential weld joints was satisfactory.
- Oily layer was found on the bottom dish end, shell and man way.
- Level troll nozzles found intact.

V-1202 (RECTIFYING COLUMN)

FROM TOP MANHOLE

- Manhole, dome and shell portion observed grayish in colour
- Grey hard scales were observed on the top dish end and also on the shell portion.
- Ranching rings were found lying on the tray.
- Cleats for holding the trays have fastener holes, these holes were observed elongated downwards. This was also observed in earlier inspection.
- Tray support / Mesh Grid support strips found satisfactory and they were covered with grayish hard scales.

V-1203 (L.P. ABSORBER)

FROM BOTTOM MANHOLE

- Shell observed silver shiny in colour.
- Rasching ring holding tray bolts and support welding found satisfactory.

FROM TOP END

- Shell observed brownish in colour.
- Perforated support grid just below top hand hole was found intact in position.

V-1206 (ATMOSPHERIC VENT SCRUBBER)

- Demister pads were found intact and satisfactory in position.
- Shell observed brownish red in colour from inside.
- All bolts of liquid inlet flange found satisfactory.
- Overall condition was found satisfactory.

V-1207 (L.P. SCRUBBER)

- Shell portion observed brownish black from inside.
- Grating condition on top was satisfactory. Condition of the top cover was found satisfactory.
- Irregular and insufficient welding was observed in ID of 4” nozzle at bottom end of the vessel in west direction. This was also observed in earlier inspections.
- From top side grating found satisfactory.

V-1301 (SECOND DESORBER)

BOTTOM COMPARTMENT

- Shell observed brownish in colour from inside.
- One clamp of the tray was found tied with the adjacent one with wire.
- Nozzle condition was found satisfactory.
- Thermowell was found intact.

V-1351 (HYDROLYSER)

TOP COMPARTMENT

- Top dish end and shell has brownish black in colour.
- Trays also observed brownish black in colour.
- Fasteners of top sieve tray were found intact in position.
- Top sieve tray holes found clogged with brownish debris / sludge.
- Ammonia vapors inside the vessel sensed.

BOTTOM COMPARTMENT

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

V-1352 (FIRST DESORBER)

FROM BOTTOM MANHOLE

- Brownish coloration was observed inside the vessel.
- Thin scaling was observed on the shell surface.
- Vortex breaker was found intact.
- Condition of the perforated trays found satisfactory.
- Weld joint condition was found satisfactory.
- Oil was found coming out of the LT bottom nozzle.
- Inlet baffle condition was found satisfactory.

FROM TOP MANHOLE

- Brownish coloration was observed inside the vessel.
- All fasteners were found intact
- Weld joint condition was found satisfactory.

V-1418 (PRE EVAPORATOR SEPARATOR)

- Top half observed silver and bottom half observed brownish in colour.
- New manhole made at bottom side of vessel.
- Condition of the cone and weld joints was found satisfactory.
- Entire surface of the tube sheet was covered with grayish scales/rust.
- Tube to tube sheet weld appeared to be in satisfactory condition.
- Tubes found satisfactory.
- Impingement cone was found in intact condition.
- Little water was found accumulated on the bottom of the dish end.

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.
- Solidified urea solution particles were found adhered on demister pads at few locations.
- Support channels and outer ring of demister pads were found lifted in East direction, tied by metallic wires which are broken.
- Few numbers J- bolt/ fasteners were found loose/missing.

V-1502 (23 ATA STEAM DRUM)

- Brownish black coloration was observed inside the vessel.
- Scaling was observed at both dished ends.
- Condition of distributor pipe, all welds, all nozzles and thermo-well found satisfactory.

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 in East direction at center portion of the shell was found having pitting/cavities up to 1.5mm depth. This was observed in previous inspections also.
- Overall condition of the vessel was found satisfactory.

T-1301 (AMMONICAL 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
- Weld joints and nozzle condition was found satisfactory.
- Thermowell condition was found satisfactory.
- Internal surface of the shell was found oily.
- Condition of the roof was found satisfactory.

T-1301-A (NEW AMMONICAL WATER TANK)

- Bottom plate and bottom half of shell observed brownish in colour
- All the weld joints and nozzle condition was found satisfactory.
- Thermo-well was found intact.
- Overall condition was satisfactory

T-1401, UREA SOLUTION TANK

- Brownish coloration observed inside of the shell..
- Thermo-well condition found satisfactory.
- Nozzles and weld joints condition found satisfactory.
- Bottom plate having bulging upwards at centre and downward at entire circumference as observed in the past also.
- Stiffener provided on top roof plate was found intact in position.

T-1401-A , NEW UREA SOLUTION TANK

- Brownish gray coloration observed inside of the shell.
- Thermo-well condition found satisfactory.
- Nozzles and weld joint condition satisfactory.
- Thermo-well condition found satisfactory.
- Overall condition found satisfactory

T-1501 (CONDENSATE TANK)

- Condition of weld joints was found satisfactory.
- Reddish brown coloration was observed inside the tank.
- Supports of condensate inlet were found intact.
- Overall condition of the tank 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.
- Demister drain pipe was found intact in position.
- All Nozzles found clear from inside.
- 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 inside was found grayish in colour.
- Thickness measurement was carried out and found satisfactory.

MISCELLANEOUS JOBS

D.P. TEST

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

D.P. test of all the coupling bolts of Hitachi compressor train 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.

CORROSION UNDER INSULATION/SUPPORTS

Inspection of corrosion under support carried out in Hitachi high pressure CO_2 line. The details are attached at **Annexure-10.**

VARIOUS MODIFICATION / REPLACEMENT JOBS

During this shutdown, various modifications/replacement carried out by Technical Group. Inspection activities viz. DP Test, Radiography review and repairs etc. were carried out on the weld joints as per the fabrication procedures.

ANNEXURE-1 (1/4)

PIPELINE THICKNESS MEASUREMENT SUMMARY OF HP LINES

Sr. No	Line no.	NB (inch)	Sch.	Nom. Thk. (mm)	Line Description		Min. Thk. Observed	%Age red.
					From	To		
1	CO-F10-2119-PP25	8	160	23.01	K-1801,III	H-1813	22.05	4.17
1A		1.5	160	7.14	K-1801,III	H-1813	7.06	1.12
1B		0.75	160	5.54	K-1801,III	H-1813	5.20	6.13
2	CO-F10-2124	8	160	23.01	K-1801,DIS.	GA-1112	22.46	2.39
2A		0.75	160	5.54	K-1801,DIS.	GA-1112	5.04	9.00
3	CO-E10-2139-PP25	4	80	8.56	CO-F10-2140-4” (TV-1808)	CO-E10-2122-6”	6.95	18.8
4	CO-F10-2140	4	160	13.49	K-1801,III	V-1813	12.19	9.63
4A		0.75	160	5.56	CO-F10-2140-PP25	DRAIN	5.24	5.75
5	CO-E10-2122	6	80	10.97	H-1813	V-1813	9.79	10.75
6**	GA-1112	6	F2	14.27	K-1101-2	GA-1201	8.00	43.93
6A	GA-1112	1.5	X1	5.08	GA-1112	BYPASS	3.80	25.19
7	GA-1201	6	X4	13.33	GA-1112	H-1201	13.43	---
7A	GA-1201 TI-1207	1.5	X4	5.08	GA-1112	H-1201	4.98	1.96
8	GA-1202	1	F2	6.35	GA-1112-6"	Check Valve (GA-1203)	4.12	35.11
9	GA-1203	1	X1	4.51	GA-1202	H-1203	3.56	21.06
9A	GA-1203 Drain	0.5	X1	3.73	GA-1202	H-1203	3.56	---
10	GA-1204	1	X1	4.51	H-1203	PR-1231	3.96	12.19
10A	Drain	0.5	X1	3.73	H-1203	PR-1231	2.97	20.37
11	GA-1602	8	F2	22.83	K-1801	GA-1112	21.40	6.26
11A		0.5	3.73	3.73	K-1801	GA-1112	3.68	1.34
12	GA-1603	4	F2	11.13	GA-1602	GA-1604	10.48	5.84
13	GA-1606	1	B3	3.38	GA-1607-0.75’’	GA-1350-1”	2.89	14.49
14	GA-1607	0.75	B3	2.87	K-1801	GA-1606-1”	2.08	27.52
15**	MA-1106B	4	E2	8.56	MA-1605-6"	H-1202/MA-1203-4"	6.68	21.96
15A		1	E2	4.55	MA-1605-6"	MA-1203-4"	5.02	---
15B	MA-1106-B	0.75	E2	3.91	MA-1605-6"	MA-1203-4"	4.39	---
15C	MA-1106-B	1.5	E2	3.68	MA-1605-6"	MA-1203-4"	3.98	---

16	MA-1106-A	4	E2	8.56	P-1102-A	MA-1605-6”	7.39	13.6
16A		1	E2	4.55	P-1102-A	MA-1605-6”	4.18	8.13
16B		0.5	E2	3.73	P-1102-A	MA-1605-6”	4.06	---
17	MA-1123	4	E2	8.56	P-1102/B	MA-1605	7.30	14.7
17A		0.75	E2	3.91	P-1102/B	MA-1605	3.85	1.53
18	MA-1201	3	E2	7.62	MA-1605-6"	MA-1202-3"	5.81	23.7
18A	MA-1201	1.5	E2	5.08	MA-1605-6"	MA-1202-3"	3.44	32.0
19	MA-1202	3	X4	7.62	MA-1201	V-1201	6.40	16.01
19A	MA-1202	2	X4	5.54	MA-1201	V-1201	5.42	2.16
20	MA-1203	4	X4	9.14	MA-1106-6"	PR-1230	9.10	0.5
21	MA-1603	6	C2	7.11	MA-1122-6"	P-1102 /C	6.00	15.6
21A	MA-1603	1	C2	4.55	MA-1122-6"	P-1102 /C	4.49	1.31
21B	MA-1603	0.75	C2	3.91	MA-1122-6"	P-1102 /C	2.91	25.57
22	MA-1603	4	C2	6.02	MA-1122-6"	P-1102 /C	5.33	11.46
23	MA-1604	3	E2	7.62	P-1102 /C Dis	MA-1604-4"	5.63	26.11
23A	MA-1604	1.5	E2	5.08	P-1102 /C Dis	RV	4.44	12.59
24	MA-1604	4	E2	8.56	MA-1604-3"	MA-1605-6"	7.07	17.40
24A	MA-1604	1.5	E2	5.08	MA-1604-3"	MA-1605-6"	5.14	---
24B	MA-1604	0.75	E2	3.91	MA-1604-3"	MA-1605-6"	3.20	18.15
25	MA-1605	6	E2	14.27	MA-1106	MA-1203	12.82	10.16
25A	MA-1605	0.75	E2	3.91	MA-1106	MA-1203	3.27	16.36
26	MA-1605	4	E2	8.56	MA-1106	MA-1203	8.07	5.72
27	MA-1607	4	C2	6.02	MA-1605	MA-1116	5.40	10.29
27A	MA-1607 DRAIN	0.75	C2	3.91	MA-1605	MA-1116	3.11	20.46
28	MA-1609	4	C2	6.02	MA-1603-6”	MA-1604-3”	4.80	20.26
29	PR-1201	8	X1	19.58	V-1201	H-1201	15.39	21.39
30	PR-1202	10	X1	24.33	H-1201	H-1202	20.07	17.50
31	PR-1203	8	X1	19.58	HP-Cond. H-1202	V-1201 (Vapor Line)	17.41	11.08
32	PR-1204	8	X1	19.58	HP-Condenser	V-1201 (Liquid Line)	17.14	12.46

32A	PR-1204 TR-1202	1.5	X1	5.08	HP-Condenser	V-1201 (Liquid line)	4.04	20.47
33	PR-1205	6	X1	15.24	PR-1205-8"	V-1202	10.65	30.11
33A	PR-1205	1.5	X1	5.08	PR-1205-8"	V-1202	4.38	13.77
33B	PR-1205	0.75	X1	3.91	PR-1205-8"	Rectifying Column	3.48	10.99
34	PR-1205	8	X1	19.58	Stripper Bottom	V-1202	16.62	15.11
34A	PR-1205	6	X1	15.24	Stripper Bottom	V-1202	11.91	21.85
34B	PR-1205 TR-1210	1.5	X1	5.08	Stripper Bottom	V-1202	4.94	2.75
35	PR-1206	4	X1	10.40	PR-1210-10"	H-1203	12.31	---
36	PR-1208	4	X1	10.40	Autoclave Top	PR-1206-4"	11.17	---
36A	PR-1208 TR-1206	1.5	X1	5.08	Autoclave Top	PR-1206-4"	6.54	---
37	PR-1211	1.5	X1	5.08	PR-1208-4"	PR-1212-4"	4.20	17.32
38	PR-1212	4	X1	10.40	Scrubber	V-1201	9.09	12.59
38A	PR-1212	2	X1	5.54	Scrubber	V-1201	4.83	12.81
39	PR-1213	2	X4	5.54	PR-1201	PR-1205-6"	4.10	25.99
40	PR-1224	3	X4	7.62	P-1201B	PR-1638-4"	6.35	16.66
41	PR-1225	3	X4	7.62	P-1201A/B, PR1638-4"	H-1203	6.78	11.02
42	PR-1226	2	X4	5.54	PR-1224	H-1205	4.29	22.56
43	PR-1230	6	X1	15.24	MA-1203-4"	H-1202	13.02	14.56
43A	PR-1230 TR-1205	1.5	X1	5.08	MA-1203-4"	H-1203	4.36	14.17
44	PR-1231	3	X1	8.12	H-1203	PRCV-1201	6.93	14.65
45	PR-1232 (JACKET)	6	-	-	PRCV-1201 (RV-1209)	ATMOS	3.12	---
46	PR-1234	4	X4	10.41	PRC-1201	V-1203	10.40	---
47	PR-1234	3	X4	7.62	P-1201A	PR-1638-4"	6.01	21.12
48	PR-1637	3	X4	7.62	P-1201C	PR-1638-4"	6.80	10.76
49	PR-1638	4	X4A	9.14	P-1201A/B/C	PR-1230-6"	12.10	---
49A	PR-1638	1.5	X4A	5.08	P-1201A/B/C	PR-1230-6"	5.76	---
50	PR-1666	2	X4A	5.54	PR-1637	PR-1226	4.20	24.18

Note: **Pipeline Replacement in this Turn-Around**

- MA-1106-B-E2-4''(Sr No - 15)

  One no reducer replaced due to thickness reduction.
- GA-1112-6''-F10 two straight length replaced.(Sr.No-06) , **Annexure-10**
- PR-1208-4"-X1 (Autoclave Off-gas line) (Sr.No -36) **Annexure-09**
  Straight Pipe segment along with 03 no. RV flange's replaced.

ANNEXURE-2 (1/3)

PIPELINE THICKNESS MEASUREMENT SUMMARY

(SC, ST & OTHER LINES)

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION FROM	TO	Min. Thk. Observed	%Age red.
SC-LINES								
1	SC-1102	12’’	B1	9.53	P-1202 A/B	H-1102	7.2	24.2
2	SC-1216	4	B4	6.02	V-1204	SC-1407	5.4	10.3
3	SC-1216	2	B4	3.91	V-1204	SC-1216-4"	4	--
4	SC-1233 I FROM N	12	B4	9.53	V-1501	H-1202	8.6	9.71
5	SC-1234 II FROM N	12	B4	9.53	V-1501	H-1202	9.3	2.36
6	SC-1235 III FROM N	12	B4	9.53	V-1501	H-1202	9.2	3.41
7	SC-1236 IV FROM N	12	B4	9.53	V-1501	H-1202	8.5	10.8
8	SC-1237 I FROM NE	16	B4	9.53	H-1202	V-1501	8.9	6.56
9	SC-1238 II FROM NE	16	B4	9.53	H-1202	V-1501	12	--
10	SC-1239 III FROM NE	16	B4	9.53	H-1202	V-1501	8	16.1
11	SC-1240 IV FROM NE	16	B4	9.53	H-1202	V-1501	9.4	1.31
12	SC-1241 I FROM NW	16	B4	9.53	H-1202	V-1501	10	--
13	SC-1244 IV FROM NW	16	B4	9.53	H-1202	V-1501	9.4	1.31
14**	SC-1407	3	B4	5.49	H-1422	T-1501 Condensate Tank	1.9	65.4
15	SC-1407	8	B4	8.18	H-1422	T-1501 Condensate Tank	6.8	16.9
16	SC-1408	2	B4	3.91	H-1422	SC-1530	3.6	7.93
17	SC-1409	4	B4	6.02	H-1424	T-1501	5.1	15.3
18	SC-1409	1.5	B4	3.68	H-1424	T-1501	3.5	4.89
19	SC-1501	4	B4	6.02	T-1501	P-1501/6	5.3	12

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION FROM	TO	Min. Thk. Observed	%Age red.
20	SC-1502	3	B4	5.45	P-1501/6	V-1501	4.3	21.1
21	SC-1502	2	B4	3.91	P-1501/6	V-1501	2.98	23.785
22	SC-1504	4	B4	6.02	V-1503	V-1501	4.9	18.6
23	SC-1504	6	B4	7.11	V-1503	V-1501	5.8	18.4
24	SC-1505	6	B4	7.11	SC-1504	T-1501	6.8	4.36
25	SC-1506	2	B4	5.49	T-1501	P-1505	4.9	10.7
26	SC-1506	4	B4	6.02	T-1501	P-1505	4.5	25.2
27	SC-1510	2	F1	5.50	P-1502	PCV-1501	4.4	20
28	SC-1512	4	C1	6.02	SC-1213	LCV-1501	5.9	1.99
29	SC-1523	3	B4	5.49	HEADER	SC-1409	4.7	14.4
30	SC-1602	2	10S	2.77	SC-1603	PR-1616	2.5	9.75
31	SC-1210	8"	B4	8.18	P-1204/AB	H-1207	8.2	---
32	SC-1210	10"	B4	9.27	P-1204/AB	H-1207	8	13.7
33	COND TO MELT LINE	2''	B4	3.91	COND.HEADER	UREA MELT LINE	3.0	23.3
34	COND. TO H-1424 FLUSH	2''	B4	3.91	SC-1507	H-1424	2.8	28.0
ST-LINES								
1	ST-1124	6"	B4	10.97	ST-1104	PICV-1128	10	7.2
2	ST-1202	12"	B4	9.53	V-1502	H-1201	8.5	10.8
3	ST-1402	3	B4	5.49	ST-1415	P-1421	5.1	7.1
4	ST-1407	12	B4	9.53	4ATA HDR/ ST-1506	H-1422	9.7	---
5	ST-1412	6	B4	7.11	ST-1415	P-1424	5.6	21.2
6	ST-1415	10	B4	9.27	ST-1506	HEADER	8	13.7
7	ST-1502	4	B4	6.02	ST-1116	V-1503	5.1	15.3
8	ST-1502	2	B4	5.54	PICV-1502	V-1503	4.4	20.6
9	ST-1502	8	C1	8.20	ST-1116	PICV-1502A	7.1	13.4
10	ST-1506(GT1664 msp line	18	B4	9.53	V-1501	ST-1106 Main steam header	10	-7.09
11	ST-1508	2	B4	3.90	ST-1506 (II nd floor)	PCV-1502	3.6	7.69

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION FROM	TO	Min. Thk. Observed	%Age red.
12	ST-1508	4	B4	6.02	ST-1506 (II nd floor)	PCV-1502	6.20	---
13	ST-1603	8	B4	8.18	ST-1506	H1418/A	7.1	13.2
14	ST-1411	8	B4	8.18	ST-1415	P-1423	7.2	12
15	ST-1409	4"	B4	6.02	9 ATA STEAM	H-1424	4.9	18.6
16	ST-1409	8"	B4	8.18	9 ATA STEAM	H-1424	7	14.4
17	ST-1410	2''	B4	3.91	ST-1506	H-1424	3.7	5.4
18	ST-1206	8"	B4	8.18	4 ATA STEAM	H-1204	7.7	5.87
19	ST-1504	2"	B4	3.91	9 ATA STEAM	H-1202	2.9	25.8
20	ST-1302	6'	B4	7.11	4 ATA STEAM	V-1352	5.8	18.4
21	ST-1129	10"	B4	9.27	PICV-1128	ST-1116	8.4	9.39
OTHER LINES								
1	NH-89-6"-3"	6	B4	7.11	121/JA/JB	H-1102 Urea Plant	6.8	4.4
		3	B4	5.49	121/JA JB	H-1102 Urea Plant	5.0	8.9
2	MA-3122-6"	6"		7.11	Ammonia B/L	V-1102	6.4	10
3	MA -1103-6"	6"	7.11	7.11	V - 1102	V - 1103	7.1	---
4**	COLD NH3 TO UREA MA 1101-6",	6"	7.11	7.11	Cold Ammonia\ MA-3132-6''	H-1102 In UREA Plant	5.9	17
6	MA-1116	4''	6.02	6.02	NH3 Recycle	V-1103	6.6	22
7	PR-1656	24	10S	6.35	V-1418	H-1419	7.1	---
8	PR-1404	4''	10S	3.05	P-1401/AB	V-1409	2.3	24.6

Note(**):

- SC-1407-3''-B4 (Sr.No-14) one no elbow replaced due to thickness reduction.
- MA-1101-6'' (Sr.No-04) High External corrosion/Pitting on 45 deg and 90 deg elbows observed, replaced with SS 304.

ANNEXURE-3

UREA PLANT VESSEL THICKNESS MEASUREMENT SUMMARY

Sl. No	Equip. No.	Equip. Description	Shell			Dish End			Channel		
			Nom./ Design	Min./ Meas.	% Red.	Nom./ Design	Min./ Meas.	% Red	Nom./ Design	Min./ Meas.	% Red.
1	H-1207	Condensate circulation system-II water cooler	10.0	9.2	6.0	13(N) 10(S)	10.9/ 8.0	26.2/ 20	8.0	7.8	-
2	H-1207 A	CCS-II surface condensate heat exchanger	10.0	9.1	9.0		8.8		8.0	9.7	-
3	H-1418/ V-1418	Pre-evapor. separator	12	11.9	--	(T) 10.2 (B) 9.4		--	--	--	--
4	H-1420	Final Condenser	8.0	7.6	---	10.0	9.4		10.0	9.4	6
5	H-1421	Flash tank condenser	8.0	7.1	11.3	11(T) 7(B)	11.9 (T) 8.5 (B)	---	--	--	--
6	H-1422	1st stage Evap. Sep.		13			8.4		--	--	--
7	H-1424	2nd stage Evaparator /Seperator	10.0	10.3	--	12.0	9.0	25	--	--	--
8	T-1814	Main LO tank for Hitachi compressor	6	5.6				--	--	--	--
9	T-1501	Steam Cond. tank	10.0	10.1	--	10.0	12.0	--	--	--	--
10	V-1204	Steam Cond. pot for H-1204	6.0	8.40	--	8.0	8.3	--	--	--	--
11	V-1502	23 Ata Steam drum	30.0	30.1	--	34.0	35.7		--	--	--
12	V-1406	Flash Tank (third floor)	8 .0	8.4	--	10 .0	10.2	--	--	--	--
13	H-1209	L.P. Absorber cooler	10	10.3	0.9	7.5/1 1.5	8.2/1 1.5	--	--	--	--
14	H-1419	Pre-Evap. Condenser	10.0	10.0		12.0	11.4	5.0	12.0	12.5	--

ANNEXURE-4

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT OF K-1801 (HITACHI COMPRESSOR)

DESCRIPTION	POSITION	BEFORE (Gauss-max.)	AFTER (Gauss max.)
TURBINE (FREE ENDSIDE)			
Journal Bearing Pads	Governor side	0.4	Within limits
Journal Bearing Base Ring	Governor side	Top–0.5 Bottom–0.8	“
Shaft Journal	Governor side	0.9	“
Thrust Collar	Governor side	1.3	“
Thrust Bearing	Governor side	0.8	“
Thrust Base Ring	Governor side	1.2	“
Thrust Bearing Pads	Governor side	0.5	“
TURBINE (NORTH END)			
Journal Bearing Pads	Top Half	0.3	“
	Bottom half	0.7	“
Shaft Journal		0.9	“
Journal Bearing Base Ring	Top Half	1.2	“
	Bottom half	1.8	“
Collar	Active	0.6	“
	Inactive	0.7	“
L.P. CASE (TURBINE END)			
Shaft Journal		0.8	“
Journal Bearing Pads		Top– 1.0 Bottom–1.2	“
Journal Bearing Base Ring	Top	0.4	“
	Bottom	0.5.	
L.P. CASE (G.B. END)			
Shaft Journal		0.9	“
Journal Bearing Pads		0.9 Max	“
Journal Bearing Base Ring	Top	1.4	“
	Bottom	1.2	
Thrust Base Ring	Active	1.5	“
	Non active	0.7	“
Thrust Bearing Pads	Active	0.7	
	Non active	0.6	“
Thrust Collar		1.0	“
GEAR BOX			
L.S. Shaft Journal Bearing L.P. Side	Top half	0.4	“

DESCRIPTION	POSITION	BEFORE (Gauss-max.)	AFTER (Gauss max.)
	Bottom half	0.6	
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	0.9	“
	Bottom half	1.0	
H.S. Shaft Journal Bearing H.P. Side	Top half	1.1	“
	Bottom half	0.6	
H.S. Shaft Journal Bearing L.P. Side	Top half	0.9	
	Bottom half	0.8	
Journal Bearing Pads		Top–0.6 Bottom–0.8	“
Journal Bearing Base Ring	Top	0.6	“
	Bottom	0.8	“
Thrust Base Ring	Inboard side	Top–3.2 Bottom–3.6	0.8 Max
	Outboard side	Top– 1.4 Bottom–1.6	
Thrust Pads	Inboard side	0.4	“
	Outboard side	0.3	
Thrust Collar		0.3	“
Thrust Collar Journal		1.2	“
H.P. CASE (FREE END SIDE)			
Shaft Journal		0.3	“
Journal Bearing Pads		Top– 0.3 Bottom–0.3	New Pads
Journal Bearing Base Ring	Top	1.2	“
	Bottom	0.9	“
Oil Rings (2 Nos.)	Top	0.8	“
	Bottom	0.6	
Thrust Base Ring	Inboard side	Top-0.3 Bottom-0.4	
	Outboard side	Top-0.4 Bottom-0.6	
Thrust Pads	Inboard	0.7	
	Outboard	0.6	
Thrust Collar		0.4	“
Thrust Collar Journal		0.7	“

ANNEXURE-5

METALLOGRAPHIC EXAMINATION LIST UREA PLANT-S/D-2014

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1	H1202, H.P.Condenser Stub end Gas outlet bottom side	CS	Microstructure at weld metal shows ferrite and carbides in dendritic form. Whereas at HAZ microstructure shows fine and coarse grained ferrite/pearlite structure. Parent metal shows fine-grained ferrite and pearlite structure. Initial stage of in-situ spheroidization of pearlite is observed at the grain boundaries.	IInd stage of creep degradations. Monitor after 1 year of service.
2	LP Carbamate Separator, V-1205 Parent metal Shell	SS 304L	Microstructure shows fine-grained worked austenitic structure with twins.	Microstructure is free from any micro cracks.
3	LP Carbamate Separator, V-1205 Shell to Bottom Dish “C’’ Weld HAZ	SS 304L	Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix. Whereas at HAZ microstructure shows coarse-grained austenite structure with twins. Microstructure shows fine-grained worked austenitic structure with twins.	Microstructure is free from any micro cracks.
4	LP Carbamate Separator, V-1205 ‘’C’’ Weld to Bottom Dish HAZ	SS 304L	Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix. Few carbide precipitations are observed at inter-dendritic region, Whereas at HAZ microstructure shows fine-grained austenite structure with no carbide precipitations. Microstructure shows fine-grained worked austenitic structure with twins. Presences of strain-induce martensite is observed. No carbide precipitation is observed along the grain boundaries.	Microstructure is free from any micro cracks.
5	LP Carbamate Separator, V-1205 ‘Bottom Dish End Parent Metal	SS 304L	Microstructure shows fine-grained worked austenitic structure with twins. Presences of strain-induce martensite is observed..	Microstructure is free from any micro cracks.

ANNEXURE- 6

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-1202	H-1202 Liquid to V-1201	3rd	---	1.5" Sch. 80	5.08	Satisfactory
3	TR-1203	Amm+ Carb to H-1202	3.5th	Near H-1202	1.0" Sch.80	4.55	Satisfactory
4	TR-1205	P-1102 A/B/C Disch	3rd	Flanged Tapping	1.0" Sch.80	4.55	Satisfactory
5	TR-1206	V-1201 Offgas line	5th	Above V-1201	1.5” Sch.80	5.08	Satisfactory
6	TR-1207	CO2 to H-1201	GF	Near Stripper Bottom	1.5” Sch.80	5.08	Satisfactory
7	TI-1209	Carb Pump Disch line to HPCC	3.5th	Near HPCC	1.5” Sch.80	5.08	Satisfactory
8	**TR-1210**	H-1201 O/L Line	GF	Near Stripper Bottom	1.5” Sch.80	5.08	Satisfactory **(Replaced in S/D 2014)**
9	TI-1214	H-1203 to V-1201 Carb line	4th	Above V-1501 on P.T. Structure	1.5” Sch.80	5.08	Satisfactory
10	HPF to Seal-Iso. Valve	Liquid Outlet from V-1201	GF	Near P-1102-C N-E side	2” Sch.80	5.54	Satisfactory
11	**HPF to FICV-1204**	Carb. Pump Discharge to H-1203	3.5th	South/West corner of floor	1” Sch.80	4.55	Satisfactory **(Replaced in S/D 2014)**
12	HPF for Carb. Line	Carb. Pump Disch to HPCC	3.5th	S-W side near HPCC	1.5” Weld	-	Satisfactory

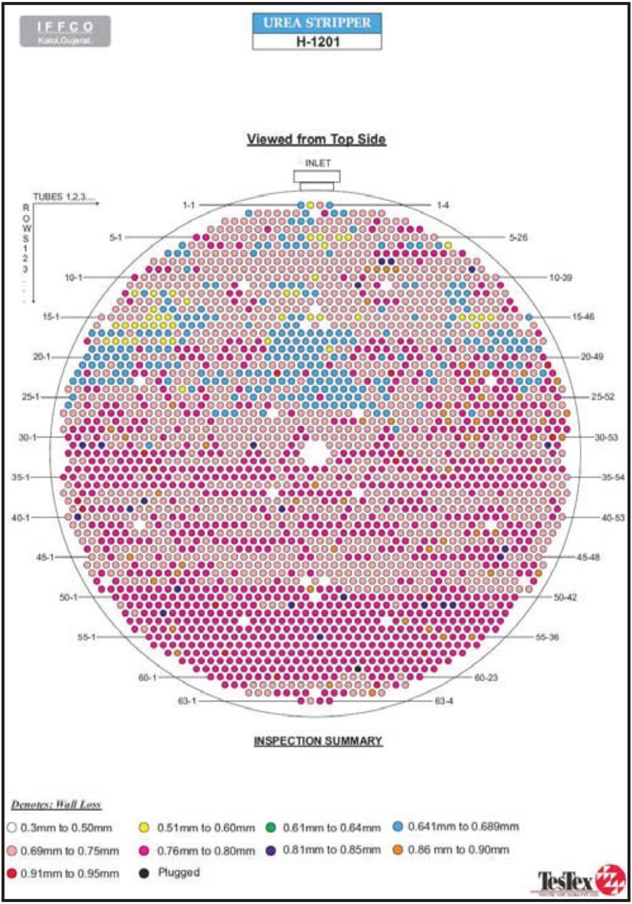
Sr No.	Fitting Identif- No.	Line where Installed	Location		Size (OD)	Nom. Thick. (mm)	RT Result
	to HPCC						
13	HPF for Amm. Line to HPCC	Ammonia Pump Disch to HPCC	3.5th	N-W`side near HPCC	1.5” Weld	-	Satisfactory
14	HPF to PRCV-1201	H-1203 Offgas to V-1203	6th	East side from PRCV-1201	1” Sch.80	4.55	Satisfactory
15	HPF to HICV-1202	V-1201 Offgas to H-1203	6th	North side from HICV 1202	1” Sch.80	4.55	Satisfactory
16	HPF V-1201 Liquid O/L	V-1201 Unloading Line	GF	---	1” Sch.80	4.55	Satisfactory
17	HPF Amm. to V-1201	---	3rd	---	1” Sch.80	4.55	Satisfactory
18	HPF H-1203 bottom	---	5th	---	1” Sch.80	4.55	Satisfactory
19	HPF for CO2 to H-1203	---	6th	---	1” Sch.80	4.55	Satisfactory
20	P1102-C Drain	Between both Disch I/Vs	GF	---	**1” Sch.80**	**4.55**	Satisfactory
21	Amm. line Tapping	U/s of FRCV 1201	3.5th	---	1.5” Sch.80	5.08	Satisfactory
22	Amm. line Tapping	U/s of FRCV 1201	3.5th	Blind Tapping	0.5” Sch.80	3.73	Satisfactory
23	Amm. line Tapping	Between MOV & FRCV 1201	3.5th	---	0.75” Sch.80	3.91	Satisfactory

- Radiography carried out on total 6 no’s Weld joints (randomly selected) of Ammonia Pumps P-1102 A/B/C discharge line to ensure joints service condition.

  No significant defects observed.

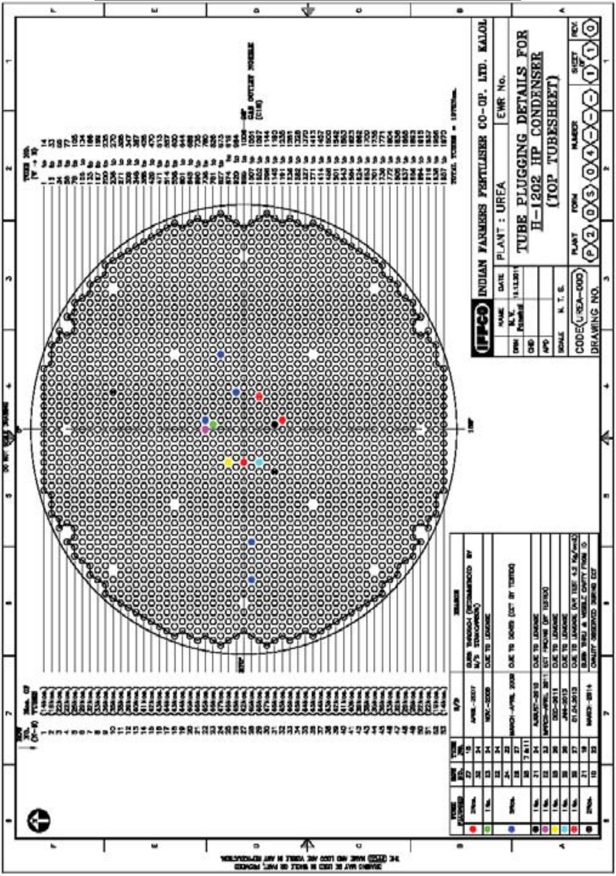
ANNEXURE- 7

TUBE SHEET LAY OUT OF H-1201 (VIEWED FROM TOP)



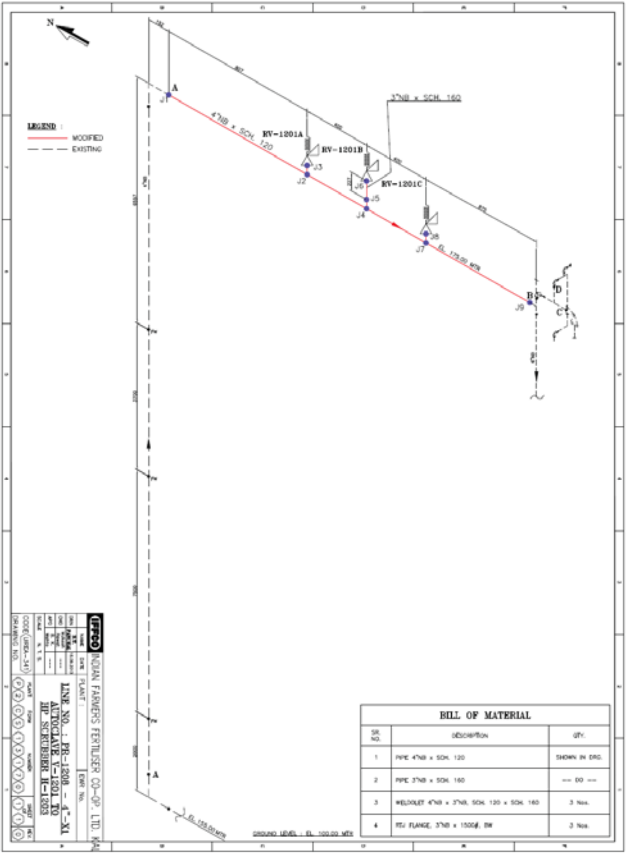
ANNEXURE- 8

TUBE SHEET LAY OUT OF H-1202 (VIEWED FROM TOP)



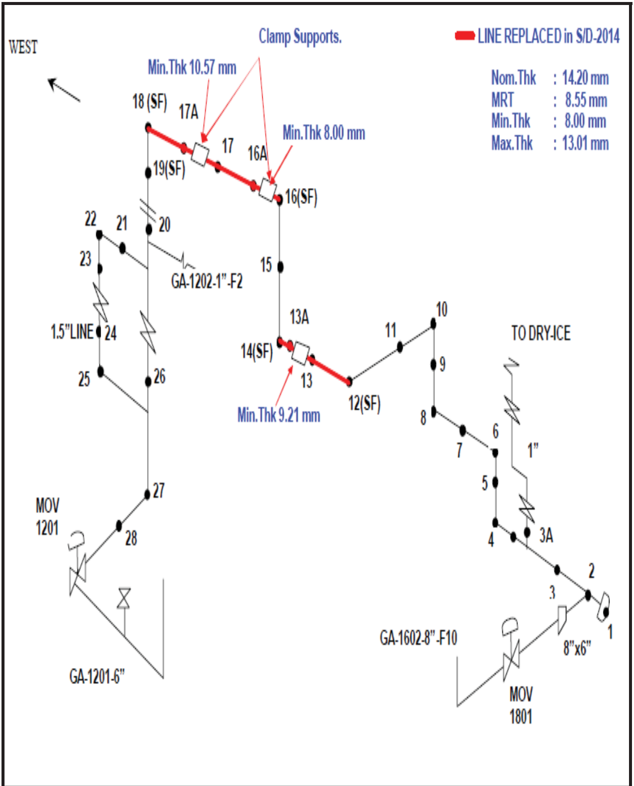
ANNEXURE- 9

(Isometric Dwg. of PR-1208-4''-X1 Autoclave to HP Scrubber Off-gas Line)



ANNEXURE- 10

(Isometric Drawing of GA- 1112-6''-F2)



LINE NO : **GA-1112-6"- F2**

FROM : **GA-1602-8"-F10** TO: **GA-1201-6"-X4**

UTILITY PLANT
(INSPECTION)

The following major inspection activities were performed in Utility Plant during Annual Shut-down 2014.

- Inspection of Deaerator.
- Inspection of 52" NB CW Inter connection line of P-4405 and P-4401 C/D sump.
- Thickness measurement of CBD line.

DEAERATOR

- Inspection of the Deaerator Head and the Storage Shell carried out and observations are as under.

Deaerator Head

- Brownish coloration was observed inside the shell and dish end.
- All tray segments and angle supports were found intact in position however some of its holding bolts were found missing though it is tack welded.

Deaerator Storage Shell

- Brownish coloration was observed inside the shell and dish end.
- Condition of the weld joint was found satisfactory.
- Minor scaling was observed at both dish ends.

52"NB CW INTER CONNECTION LINE OF P-4405 TO P4401-C/D

- Out of 33 Nos. of Circumferential weld joints,10 Nos. are Marked for Repair as previously applied putty got peeled off at scattered locations.
- Epoxy paint was found peeled off at many locations resulting in thick oxide lumps formation.
- Blisters of Epoxy paint also observed at many locations.
- Removal of oxide layers, blisters and application of epoxy paint at such locations is recommended to prevent corrosion.
- One Longitudinal weld seam(joint) between Circumferential weld seam(joint) number 14th and 15th counting from south side found eroded/corroded

MISCELLANEOUS JOBS:

D.P. TEST

Dye penetrant examination of weld joints of all the pipelines fabricated by contractors/departmentally, new pipeline fabrication / modifications job done by technical and maintenance groups etc. was carried out after root run welding and after final welding, as per requirement.

D.P test of all the coupling bolts of both the BFW pumps carried out and found satisfactory.

<u>RADIOGRAPHIC EXAMINATION</u>:

Radiographic examination of weld joints of all the pipelines fabricated by contractors/departmentally, new pipeline fabrication / modifications job done by technical and maintenance groups etc. was carried out after root run / final welding, as per requirement.

Following Lines Installed/modified in this Annual turnaround:

- 61.5 Ata vents line with silencer.
- Inlet-Outlet piping for new BFW coil in BHEL boiler.

Defects observed during the test were rectified & rechecked again for acceptance.

<u>GAUSS MEASUREMENT</u>:

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.

<u>61.5 Ata vent line with silencer modification pipeline joints De-Gaussing</u>

- It is a main steam piping from BHEL boiler to Urea plant.
- 02 no's of 10''NB butt weld joint bevel face in fit up condition of 10''x6'' reducing 'Tee' found heavily magnetized leading to difficulty in welding.
- PMI of new welded and connected pipeline carried out and found CS (SA 234 WPB) in new as well as existing pipe lines.\
- Gauss measurement was carried out on both bevel edges of reducing tee and was found around 300 gauss.
- De gaussing was carried out with cable coil wrap method and magnetism reduced to around 50 gauss.
- As further de gaussing could not be achieved root and hot pass was done with E 70 S2 filler wire by keeping cable coil in wrapped condition to avoid magnetizing during root and hot pass welding. After root and hot pass welding de gauss machine and its cables removed.
- DPT and RT of root welding joints were carried out.
- Final fill up was carried out with E 7018 and DPT and RT of final welding joints were carried out.

GAUSS MEASUREMENT OF EQUIPMENT

Q-5111		
Journal Bearing Coupling Side	Top	0.7
	Bottom	0.5
Journal Bearing Governor Side	Top	0.5
	Bottom	0.6
Shaft Journal	Thrust End	1.5
	Non Thrust End	1.3
P-5111		
Journal Bearing Motor side	Top	0.8
	Bottom	0.7
Journal Bearing Governor side	Top	0.8
	Bottom	0.9
Thrust Bearing Pads	Active	0.5
	Inactive	0.8
Thrust Bearing Base ring	Active	0.8
	Inactive	0.6
Thrust Collar		0.9
Shaft Journal	Thrust End	1.1
	Non Thrust End	1.2
P-5112 GEAR BOX		
Input shaft Coupling side	Top	0.5
	Bottom	0.5
Input shaft Turbine side	Top	0.6
	Bottom	0.3
Output shaft Coupling side	Top	1.3
	Bottom	0.8
Output shaft Pump side NDE	Top	0.5
	Bottom	0.8
H.S Shaft Journal portion Motor side DE		1.6
H.S Shaft journal portion pump side NDE		0.5
L.S Shaft Journal Portion Motor side DE		0.8
L.S Shaft Journal Portion Motor side DE		0.9
K-5113 GEAR BOX		
Input shaft pinion Coupling side	Top	0.8
	Bottom	0.2
Input shaft pinion Turbine side	Top	0.6
	Bottom	0.4
Output shaft pinion Coupling side	Top	0.2
	Bottom	0.2
Output shaft pinion Turbine side	Top	0.5
	Bottom	0.6
Shaft Journal	Thrust End	1.5
	Non Thrust End	1.3

COOLING TOWER JOINT INSPECTION REPORT BY COMMITTEE

Urea cell No 3 (H-4402/3)

- Load support spice joint found corroded, same to be replaced.
- Main diagonal 5th support‘s missing bolts to be provided.

Ammonia cell No 1 (H-4401/1)

- One support found damaged, to be replaced.
- Load support spice joint found corroded, same to be replaced.
- Wooden drift eliminators are damaged, to be attended.

Ammonia cell No 2 (H-4401/2)

- Load support spice joint found corroded, same to be replaced.
- Wooden drift eliminators are damaged, to be attended.

Ammonia cell No 3 (H-4401/3)

- Few Plywood sheets between cell No. 3 & 4 found damaged.
- Door between Cell No .3 & 4 found missing.

Ammonia cell No 4 (H-4401/4)

- Door between Cell No .4 & 5 found missing.
- Load support spice joint found corroded, same to be replaced.
- One concrete pillar is to be removed.

Ammonia cell No 5 (H-4401/5)

- Few Plywood sheets between cell No. 5 & 6 found damaged.
- Door between Cell No .5 & 6 found missing.

Ammonia cell No 6 (H-4401/6)

- Diagonal Load support spice joint found corroded, same to be replaced.

Ammonia cell No 7 (H-4401/7)- Major overhauling

- Wooden drift eliminators are damaged, to be attended.
- Load support spice joint found corroded, same to be replaced.
- All fastens & bolts to be replaced.

Ammonia cell No 8 (H-4401/8) Major overhauling.

- Wooden drift eliminators are damaged, to be attended.
- Load support spice joint found corroded, same to be replaced.
- All fastens & bolts to be replaced.

General points which is applicable to all cooling tower cells.

- Damaged plywood sheet between I cells to be replaced.
- Basin side wall in all Cooling Towers are eroded & support required plastering.
- Insides doors are to be repaired.
- Many support bolts and washer are to be placed as they are corroded.
- Distribution decks covering damaged Plywood sheets are to be replaced.
- All six side wall (End Walls) having leaks from its bolts , same to be attended.
- 'V' bars are to be re-fixed properly.

C.B.D (Continues blow down) Line from Boiler steam drum to C.B.D Vessel:

Ultrasonic thickness measurement was carried out and heavy external corrosion, pitting observed on bypass loop and minimum thickness of 1.8 mm was observed against nominal thickness of 3.38 mm (1" NB x Sch 40) , MRT as per design calculation is 2.52 mm. Line pressure is 66 kg/cm^2 and Temperature is 300^o C. Corrective action was taken by mech. maint. Section for replacement of pipeline.

INSTRUCTIONS

AMMONIA PLANT
(INSTRUMENTATION)

Control valve Maintenance jobs

FRCV-1

Actuator diaphragm was checked, found ok. General cleaning of air filter regulator was carried out. Gland packings were replaced. Finally control valve stroke was checked & found ok.

FRCV-2

The Control valve removed from bonnet for complete overhauling. Actuator diaphragm was checked, found ok. Air regulator was replaced with new one. General cleaning of positioner, air filter regulator was carried out. Gland packings were replaced. Related tubing had been replaced with new one. The control valve was re-assembled with repaired plug & stem as removed plug was found slightly damaged because of erosion. Finally stroke was checked & found ok.

FRCV-3

The Control valve removed from bonnet and trim parts were checked. All parts were cleaned and overhauled. Actuator diaphragm was inspected & found ok. General cleaning of valve positioner was carried out. Gland packings were replaced. Finally the stroke was checked & found ok.

PICV-1A

Actuator assembly with hand-jack was replaced with new one. I/P & tubing had been replaced. Feedback lever was adjusted. Finally stroke checked & found ok.

PICV-13A

The Control Valve was removed from Bonnet for leakage problem. Bonnet gasket was replaced. Plug & seat were inspected & found ok. Fine cut had been made on plug. All parts were cleaned & overhauled. New gland packing was provided. Finally stroke was checked & found ok.

FRCV- 5

Old control valve Mascot make had been replaced with New Mascot make Control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

V-7

Control valve (Double seated) was removed from bonnet for leakage problem, lapping was carried out for tight shutoff. Actuator diaphragm was opened and checked, found ok. I/P had been calibrated & found ok. Complete Overhauling was carried out & also provided new gland packings. Finally Stroke was checked & found ok.

LCV-16

Control valve actuator & hand jack assembly had been replaced as old one found damage. All parts were cleaned, overhauled, gland packing was replaced & old tubing replaced with new one, finally assembled & taken in line and stroke was checked.

TRCV- 142A

Old control valve Copes Vulcan make had been replaced with New Dresser Valves Make leakage class-V Control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

LCV-2A

Existing Masoneilan make Control valve had been replaced with IL make old control valve removed from N.G.Booster Compressor. Related tubing work had been carried out. Finally stroke was checked & found ok.

MICV-003

Old Fisher make control valve had been replaced with New higher capacity Dresser make Control valve as per EWR & approval , related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

PICV-14

Old Fisher make control valve had been replaced with New Dresser make Control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

PICV- 4

Control valve open from bonnet for trim & port inspection. Cleaning of trim parts was carried out. Control valve checked for tight shutoff. Actuator diaphragm was inspected & found ok. Complete Overhauling was carried out & also provided new gland packings & bottom gasket. Finally Stroke was checked & found ok.

FCV-1

Control valve open from bonnet for complete overhauling. Plug & seat were inspected & found plug broken. So plug had been replaced with new one. General cleaning had been done. New gland packing had been provided. Finally control valve stroke had been checked & found ok.

PICV-11A

Control valve was opened from bonnet for passing problem. Plug & seat were inspected & found ok. Seat ring & seal ring had been replaced with new one. General cleaning had been done. New gland packing had been provided. Finally control valve stroke had been checked & found ok.

FRCV-485

Control Valve Open from bonnet for Plug & seat inspection & found plug damage. Plug had been replaced with spare one. Complete Overhauling was carried out & also provided new gland packing. Finally Stroke was checked & found ok.

LCV-490

Control valve removed from bonnet and trim parts were checked. All parts were cleaned and overhauled. General cleaning of valve Positioner was carried out. Gland packing had been replaced. Finally the stroke was checked & found ok.

LCV-26

Existing Masoneilan make control valve had been replaced with new KOSO make control. Signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

PICV-178

Old Mascot make control valve had been replaced with New Dresser make Control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

TRC-10, TRC-11 & TRC-12

Actuator diaphragm was checked, found ok. General cleaning of air filter regulator was carried out. Gland packing had been replaced. Finally control valve stroke was checked & found ok.

LCV-18

I/P & Positioner had been calibrated. General cleaning & greasing was carried out. Finally C/V stroke was checked & found ok.

FICV-7,8,9 FICV-10, FICV-11 & V-18

Gland packing were replaced. Actuator diaphragm was checked, found ok & also provided new diaphragm for FICV-10 & 11. The valve stroke was checked and found ok.

V-3 & PICV-20

Actuator diaphragm was checked, found ok. General cleaning of air filter regulator was carried out. Gland packing had been replaced. Finally control valve stroke was checked & found ok.

MICV-3 & PICV-3

Control valve had been removed from line for line modification & catalyst replacement job. General cleaning of air filter regulator & Positioner was carried out. Finally control valve stroke was checked & found ok.

KV-120-1,2,3,4,5,6,7,8,9,10,and11

Control valves were removed from line for line modification job. General cleaning had been done. New flange type gasket had been provided. Finally valves were taken in line & found

VS-203

Control valve Piston actuator had been removed for complete overhauling. Provided new O-ring in cylinder. Complete overhauling had been done in cylinder/piston assembly. Finally taken in line with new pneumatic tubing of solenoid valve.

General Maintenance & stroke checking of control valves

Following important control valves general /cleaning/ greasing were carried out. Provided new gland packing wherever required. Also valve positioner was cleaned and air header & regulators also flushed & stroke checking were carried out

1	V-4	7	MICV-17
2	PRCV-1	8	MICV-16
3	MICV 1 to 9	9	PICV-002
4	PIC-44	10	MICV 1A to 9A
5	LICV-27	11	LCV-15
6	FICV-100B	12	LCV-16

COMPRESSOR HOUSE JOBS:

Air Compressor (101J)

Removed all Radial, Axial and key-phasor probes along with relevant junction Boxes, speed pick-ups, bearing pad temp T/C & RTD, pressure gauges and local THI to facilitate M/M jobs. All proximitor JBs were cleaned. EA axial probe was replaced with new one as old one found broken. After completion of M/M jobs the instruments and probes/pick-ups were fixed back after cleaning/functional checking. Gap voltage adjustments for radial and axial probes were carried out.

HIC-101J

General cleaning and overhauling of governor positioner was carried out. New lip seal of piston/Cylinder was provided. Air lock out relay was replaced with new one. Calibration of I/P Converter was carried out. New pressure gauge was provided for I/P converter, air supply Regulator. Finally governor actuator was fixed and stroke checking was performed.

TRIP-101J

Mechanical trip alarm feedback Limit switch was overhauled; coils & its insulation were inspected & found ok. Finally checked its operation & found ok.

VS-101J

The Trip Solenoid valve was overhauled. Trip solenoid valve operation was checked.

PSL-77 & PSLL-78

AOP & trip switches general cleaning was carried out and setting was checked, found ok.

101J/105J MOP

Electronic governor actuator output signal cable & two nos. of MPUs were removed to facilitate mech. maintenance Jobs and also speed probe location modified as per M/M. After completion of jobs the same were fixed back.

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.

Ammonia Refrigeration Compressor (105J)

Removed all Radial, Axial and key phasor probes along with relevant junction boxes, speed pick-ups, T/C, pressure gauges and THIs to facilitate mechanical jobs. All Proximitor JBs were cleaned. After completion of Mech. jobs the instruments and probes/pick-ups were fixed back after cleaning/functional checking. Gap voltage adjustments for radial and axial probes were carried out.

PRC-9

General cleaning and overhauling of governor positioner carried out. Air lock out relay was repaired & new lip seal of Piston/Cylinder was provided. New pressure gauges were provided for I/P Converter, air supply Regulator & Positioner. Calibration of I/P converter was carried out. Finally governor actuator was fixed and stroke checking was performed.

TRIP-105J

Mechanical trip feedback Limit switch was overhauled and its operation was checked.

VS-105J

The Trip Solenoid valve was overhauled and inspected coil and its insulation found ok. Finally Trip solenoid valve operation was checked.

105J (Trip logic)

Checked the setting for alarm and trip logic.

Synthesis Gas Compressor (103J)

Removed all Radial, Axial and key-phasor probes along with relevant junction boxes, speed pick-ups, T/C, pressure gauges and THIs to facilitate mechanical jobs. All Proximitor JBs were cleaned. TR-14-16 RTD, TR-103-8 thermocouple were replaced as old found broken. Radial probe 4V, 4H & 8H also replaced with new one. After completion of Mech. jobs the instruments and probes/pick-ups were fixed back after cleaning/functional checking. All the Temp points were sealed. Gap voltage adjustments for radial and axial probes were carried out.

PRCV-12 (103JAT)

Positioner assembly had been replaced with spare ones & lip-seal of Piston/Cylinder were replaced with new one. Air lock out relay was replaced with new one. Calibration of I/P converter was carried out. New pressure gauges were provided for I/P converter, air supply regulator & Positioner. Finally re-fixed and stroke checking was performed.

MIC-23 (103JBT)

General cleaning and overhauling of governor positioner carried out. New lip seal of Piston/Cylinder was provided. Air lock relay had been repaired. New pressure gauges were provided for I/P converter, air supply regulator & Positioner. Calibration of I/P converter was carried out. Governor actuator was re-fixed and stroke checking was performed.

VS-103J & VS-103

Trip solenoid valves VS-103J & VS-103 inspected coil and overhauled. Finally operation was checked & found ok.

103J (Trip logic)

Checked the setting for alarm and trip logic.

Field Instrument jobs:

ID Fan Turbine replacement Job

Following are the details of work carried out for ID Fan turbine replacement job:

- New junction box JBT-14 was installed for RTD points of ID fan bearing temperature. Two multi-pair RTD cables had been laid from Temperature Marshalling cabinet C212 to junction box JBT-14, related cable laying, dressing, ferruling & termination work had been carried out. Single pair RTD cables from inbuilt junction box on turbine to JBT-14 was terminated. All inputs were checked and found ok.
- New junction box JBC-58 was installed for analog inputs of ID fan. Multi-pair signal cable had been laid from Marshalling cabinet C-102 to JBC-58; related cable laying, dressing, ferruling & termination work had been carried out. Single pair cables had been laid from field tag to junction box. All inputs were checked and found ok.
- SOV's power connections were terminated in JBP-03. Alarm tags were terminated in JBA-02.PLC tags were terminated in junction box JBS-25. AOP ID Fan Auto Start indication was terminated in JB-D inside MCC-5. Branch cable from field to respective junction box had been laid, dressed, ferruled & terminated.
- Cable had been laid from ID fan to junction box WGCR-2 for trip signal from governor, related cable glanding, dressing, ferruling & termination work had been carried out.
- Transmitter's panel was installed & tubing work had been done.

- Five magnetic probes for speed measurement are installed on ID Fan turbine. Three probes are used for over speed trip with PROTECH GII and two probes are used for 505 Woodward Governor.
- Old 505 Woodward Governor was removed and relocated. Wiring & termination was done.
- New Over-speed trip device PROTECH GII make had been installed behind control room & programming was done. Wiring connection had been done as per manual.
- Trip amplifiers were installed in PLC marshalling cabinet C-271, wiring connection was done. Trip amplifiers were programmed & trip valve had been provided.
- New graphic page was made for ID Fan.
- Trip Logic was made for new ID fan trip logic & checked, found ok.
- Finally OST was performed & found ok.

<u>103-J LO/SO Console Project</u>

Following are the details of work carried out for 103-J LO/SO Console job:

- New junction box JBC-59 was installed for analog tags termination. Cable had been laid from marshalling cabinet to JBC-59. Branch cable was laid. Cable dressing, ferruling & termination had been done.
- Transmitter's panel was mounted near 103-J LO/SO Console & tubing work was done.
- PLC tags were terminated in PLC junction box JBS-22, temperature tags were terminated in JBT-26, motor indication tags were terminated in MCC5-JB-D & JBE-102, Alarm tags were terminated in JBA-22 & SOV's power connection had been terminated in JBP-22. Related branch cable laying, dressing, ferruling & termination had been done.
- LCV-41, LCV-42 & PICV-302 control valves were installed, related tubing & cable glanding, termination in field & cabinet end was done. Finally stroke were checked & found ok.
- Two number of Woodward Governor PEAK-150 were mounted behind control room & cable was laid from junction box WGCR-4 to local junction box in field for governor tags. Wiring connection & termination work was done in both Woodward Governor PEAK-150. Governors were programmed according to the data sheet.
- Trip amplifiers were installed in PLC marshalling cabinet C-274, wiring connection was done. Trip amplifiers were programmed & trip valve had been provided.

- Signal multipliers were installed in DCS marshalling cabinet C-102 & related wiring had been done. Cable was laid from DCS marshalling cabinet C-102 to PLC marshalling cabinet C-274 for connection of output of signal multiplier to trip amplifier.
- New graphic page was made for 103-J LO/SO.
- Trip Logic was made for new ID fan trip logic & checked, found ok.
- Finally OST was performed & found ok.

115-JAT & 115-JB

Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 115-JAT to facilitate Mechanical Maintenance jobs. Checked both MPUs of Electronic Governor for 115-JAT.

101-U Overflow Logic

In Dearator, M/s Fisher make pneumatic on/off controller has been installed at elevation of 8' 11" since 1974 plant commissioning for controlling extra high level of vessel and same is being reset in differential of 6" (approx.). As pneumatic On/Off switch now become obsolete so M/S Magnetrol make high level alarm switch which was already installed at elevation of 8' 10" (1" early than earlier overflow condition**)** and alarm contact has been given in DCS is now used with new solenoid valve on overflow valve and utilize parallel contact of switch to operate the solenoid valve and same will open overflow control valve and will close with reset of extra high level switch.

TI-0085 & TI-0089

Thermocouple, Thermowell & Guide pipe had been replaced with new one. DP test had been performed for new Thermowell & found ok.

TSHH-650

C.G Circulator temperature switch setting had been changed from 94◦c to 110 ◦c as per requirement of P/P.

104-J

Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 101-BJT to facilitate Mechanical Maintenance jobs. Checked both MPUs of Electronic Governor for 104-J.

AR-5

M/s YIL make old in-situ detector of oxygen analyzer had been upgraded with high temperature cell & ejector type detector assembly of same Yokogawa make oxygen analyzer. Existing signal convertor & display unit had been retained. Finally calibration had been done & taken in line, found ok.

TI-515

Thermowell had been attended for leakage problem.

Provided low range Pressure Gauges at different locations in plant as per requirement of production dept. for purging & maintenance purpose.

TRCV-12, MIC-46 & PRC-18

I/P Convertor had been shifted to new location & related tubing work was done.

Level-State (101-F)

All Electrodes were cleaned by flushing the chamber & connections had been tighten.

FIC-8

Pitot tube was removed from line for maintenance purpose. Pitot tube had been repaired by welding job. Provided new isolation valves & re-fixed back in line, found ok.

Boiler Inspection (101F, 112C & 107C)

Provided standard 10" dial size Pressure gauges on steam drum, 112C and 107C. Pressure transmitter flushing and zero checking and other jobs related with Boiler inspection were carried out. After completion of inspection Pressure gauges were reverted to original.

JBC-32 & JBA-23

Old multi-pair cable had been replaced with new one. Ferruling & termination work done, finally related tags were checked & found ok.

105-D AT & BT

- Synthesis Convertor Bed temperature Multi-pair thermocouple AT & BT had been replaced with new one.

AT

- New Air dryer heater had been replaced with new one.
- All instruments related to old ID Fan turbine & old 103-J LO/SO Console had been removed.
- Draft point Manometer tubing had been removed & re-fixed to facilitate Mech. Maintenance jobs.
- **FT-20:** New Transmitters were taken in line for new loop. Related tubing, cable lying, ferrule work had been done. Finally defined in IOM & taken in Line.
- **TI-0098:** Thermowell had been found broken, replaced with new one.
- **PSLL-107J:** Trip switch had been checked & found ok.
- **115-JA, 115-JB & 116-JB:** Pressure Switches had been calibrated & taken in line, found ok.
- **TI-0035:** Thermocouple had been replaced with new one.
- **TICV-507:** Air regulator had been replaced with new one.
- **LAH-140:** Switch had been checked & found ok.
- **PRC-23:** Cylinder & damper mechanism had been over-hauled. Damper Positioner had been checked & found ok.
- **FT-63:** Manifold had been replaced with new one.
- **TDIX:** TDIX for 105-J SMPS assembly had been replaced with spare one.
- **Push Button:** SP-1 & SP-154 push button of console had been replaced with new one, as old one found damage.
- PGR R1 & R2 old process line modification work had been done by mechanical. Maintenance person and to facilitate their job local PI, TI & thermowell's had been removed & re-fixed again.
- Old fuse had been replaced with new one for PLC marshalling cabinet & tightness of connection for all system cabinets & marshalling cabinet had been done.
- Contactor box old main incoming MCB had been replaced with new high rating MCB.
- **New 316 SS Air header :** Provided new 316 Stainless Steel tubing of following Instruments (control valve and I/P convertor) :

1	MIC-17	**7**	V-7	**13**	LCV-43	**19**	HIC-70	**25**	PIC-006A
2	LCV-27	**8**	FIC-14	**14**	LCV-44	**20**	103-J TTV	**26**	PIC-006B
3	TRC-11	**9**	LIC-8	**15**	FIC-7	**21**	PT-47		
4	TRC-12	**10**	PIC-10	**16**	FIC-8	**22**	PICV-002		
5	FIC-13	**11**	PDIC-51	**17**	PRC-4	**23**	PICV-20		
6	FRC-18	**12**	PDIC-52	**18**	LCV-3B	**24**	PRC-18		

- **Steam Drum (101F):** Following instruments of steam drum were checked.
  1. Level monitoring system- Level State.
  2. Level transmitters.
  3. Pressure Transmitters.
  4. Level switches.
- General cleaning & Calibration were carried out of ISO & CDM related instruments.
- PLC Marshalling cabinet door painting work had been done.

- **LICV-20 & PICV-44:** I/P Convertor were replaced with new one.
- **FUJI UPSS & AMCO Battery Bank:** Servicing of UPSS was carried out. Air filters of all the cabinets were cleaned and the exhaust/cooling fans were checked. Both UPSS Power supply had been switched off & total load was taken on battery bank for one hour & found before load transfer, voltage is 229 V at 50 A & after load transfer, voltage is 209 V at 50 A. Also load had been transferred on AVR & found ok. After one hour power for both UPSS had been switched on & found ok.

  Battery terminal and connecting links were cleaned, cell voltage measurement & electrolyte level checking were done. Electrolyte was poured into the cells wherever required.
- **Following Transmitters Zero checking had been done:-**

  1. PT-100 **2.** LI-1

  3. PT-82 **4.** PRC-18
- **Following ISO related Quality/Safety affecting instruments were calibrated:**

1	PT-7	**7**	TRC-12	**13**	PT-1027	**19**	PT-36	**25**	PT-80
2	PT-150	**8**	PT-501	**14**	TI -0117	**20**	FT-100	**26**	FT-1
3	PT-62	**9**	PT-8	**15**	TI-0039	**21**	FT-1006	**27**	TI-104E
4	FT-2	**10**	PT-5	**16**	PT-503	**22**	TRC-10	**28**	FT-1005
5	AR-1	**11**	PT-9	**17**	PT-10	**23**	TI-0036	**29**	TI-0011
6	PIC-1A	**12**	FT-3	**18**	PT-4	**24**	PT-28	**30**	TIC-1025

- **Following CDM related instruments were calibrated:**

1.	PI-82	**4.**	FQI-181	**7.**	TI-0043
2.	FR-6	**5.**	PI-676	**8.**	TI-0023
3	FI-65	**6**	AR-5	**9.**	TI-0065

Annual Maintenance Jobs for DCS & ESD

YIL DCS

DCS shutdown maintenance activities were carried out as per the AMC procedure.

The following activities were carried out in Ammonia plant.

- Before starting preventive maintenance activities / AMC jobs, tuning parameters of all control stations were saved on Engineering station. Project back up was taken.
- Checking of System healthiness was carried out from System details display and found Normal.
- AC and DC voltages and Battery voltages were measured wherever applicable for all
- Stations and were found within limit.
- The system was dismantled as per plant clearance and operating conditions like dust, moisture and temperature were checked. All parameters were checked and found within limit. Interior of system cabinets, ENGS and HIS consoles were cleaned thoroughly. PCBs were inspected and inspection of data bus and connectors were done. No abnormality was observed.

- Printers were cleaned/overhauled, wherever applicable. CPU back-up battery voltage and grounding were checked and the same were found within specified limit in all stations.
- Function of each component of the DCS was checked. YOKOGAWA diagnostic software was run on FCS, the results of the test Program indicated the healthiness of the system.
- Redundancy checks were performed on V net / IP Bus, CPU, PS and AAB841 cards wherever applicable. As per redundancy feature, control transfer took place to the stand by one properly.
- HIS to HIS communication was checked by pinging and found normal. After cleaning functionality of all HIS were checked and found working ok.
- Data was collected for all HIS & FCS in Project backup for reference.
- All Operator stations & engineering station Anti-virus had been updated.
- Control room dust level & temperature had been observed & found within limit.
- Compressor efficiency calculation logic was created in FCS0102 drawing number 42, 43 & 44 for three numbers of compressors as per sheet. Graphics related to the new logic was also created in graphic page GR0062, GR0065 & GR0078.
- Ammonia plant BUS fail-recovers alarm was came frequently. So checked & found problem with media convertor. New media convertor was installed & RJ45 connector was replaced with new one. BUS fail-recovers alarm kept under observation & found that no such alarm appears again.
- New graphic pages GR0079, GR0080 & GR0089 for 103-J LO/SO Console project & ID fan new turbine related had been created. Related trend group had been assigned.
- Carbon Balance & Nitrogen balance sheet had been made in DCS.
- Graphic pages had been made for Stripper low level 2003 logic, Dearator low level 2003 logic & 107-J over speed 2003 logic.

Prosafe-RS ESDS

Prosafe-RS ESD shutdown/ preventive maintenance activities were carried out as per the AMC procedure.

- Cleaning of filters, fans, cabinets etc. was carried out for all the three SCS.
- Redundancy of all the CPU, PS, V net / IP Bus and IO cards was checked and found ok.
- Latest Back up was taken on DVD media.
- New logic page had been made for 103-J LO/SO Project & ID fan turbine project. Logic modification had been done for the list provided. Following logic page had been added / modified:

1.	I-39	**4.**	I-303
2.	I-103C	**5.**	I-101BJT
3	I-103A	**6**	I-307A

- Logic pages had been made for Stripper low level 2003 logic, Dearator low level 2003 logic & 107-J over speed 2003 logic.

CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND

CONTROL VALVES

FRCV- 5

Old control valve Mascot make had been replaced with New Mascot make Control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

PICV-14

Old control valve had been replaced with New Control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

PICV-178

Old control valve had been replaced with New Control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

TRCV- 142A

Old control valve Copes Vulcan make had been replaced with New Dresser Valves Make leakage class-V Control valve. Related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

MICV-003

Old Fisher make control valve had been replaced with New higher capacity Dresser make Control valve as per EWR & approval , related signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

LCV-26

Existing Masoneilan make control valve had been replaced with new KOSO make control. Signal cable & air supply tubing work was carried out. Finally control valve stroke was checked and found ok.

EWR / SUGGESTION SCHEME / RECOMMENDATION COMMITTEE AND TECHNICAL DEPT. RELATED JOBS

107-J Over-Speed 2003 logic

- A new small Junction box had been installed near 107-J base for speed probes signal inter-connection to PLC junction box JBS-22A. Branch cable termination had been done to related junction box.
- Three numbers of speed proximity probes were fixed & cable laying, dressing & termination was carried out.
- Three nos. of F/I Convertors were installed in ESD Cabinet C-274 & related wirings inside cabinet had been done.
- Programming for F/I Convertor was carried out with trip setting.
- Logic for 107-J over-speed 2003 trip logic, I-303 block was modified to incorporate the 2003 high speed. Logic was checked & found ok.
- Finally OST had been performed & found ok.

Dearator low level trip 2003 logic

- Transmitters had been mounted on relevant position & tubing work was carried out. Calibration of transmitter & programming had been done.
- Single pair signal pair had been laid from transmitter to PLC junction box JBS-26, related cable glanding, ferruling, dressing & termination has been done in transmitter & junction box end.
- Trip Amplifiers had been installed in PLC cabinet C-274; related wiring, ferruling & termination work was done. Trip amplifier had been programmed with trip valve.
- Logic for Dearator low level 2003 trip logic, I-39 block was modified to incorporate the 2003 high speed. Logic was checked & found ok.
- Finally logic was checked & fond ok.

Stripper low level trip 2003 logic

- Transmitters had been mounted on relevant position & tubing work was carried out. Calibration of transmitter & programming had been done.
- Single pair signal pair had been laid from transmitter to PLC junction box JBS-23, related cable glanding, ferruling, dressing & termination has been done in transmitter & junction box end.
- Trip Amplifiers had been installed in PLC cabinet C-274; related wiring, ferruling & termination work was done. Trip amplifier had been programmed with trip valve.
- Logic for Dearator low level 2003 trip logic, I-303 block was modified to incorporate the 2003 high speed. Logic was checked & found ok.
- Finally logic was checked & fond ok.

CONTINUAL IMPROVEMENT

2003 Logic

To enhance the reliability of plant 2OO3 logic was incorporated in Dearator low level 2003 trip logic, Stripper low level 2OO3 trip logic & 107-J Over-speed trip logic.

UREA PLANT
(INSTRUMENTATION)

CONTROL VALVES MAINTENANCE JOBS

HICV-1801

Valve was opened from the bonnet . After Blue test of Plug and seat , seat was replaced by new one developed indigenously . All parts were cleaned & overhauled. Valve was assembled and its operation and stroke was checked.

PICV-1101

Valve was dropped from the line. Replaced its Teflon seat and flange gaskets by new one. Finally the valve was overhauled, assembled and its operation and stroke was checked.

HICV-1421

Valve was opened from the line and replaced by spare valve. Also replaced its SOV with a new one and checked the valve operation.

LICV-1502A

Valve was opened from the bonnet. Replaced the guide bushing, seat and bonnet gaskets and gland packing. All parts were cleaned & overhauled. Valve was assembled and its operation and stroke was checked.

HICV-1201

Valve was dropped from the line. Replaced its plug and seat of MOC: Ferralium 255 due to erosion with that of MOC: Safurex and provided new seal rings, bonnet gaskets and gland packing. All parts were cleaned & overhauled. Finally the valve was installed back in line and its operation and stroke was checked. Continuous flushing arrangement was provided.

LRCV-1201 Old Plug

HICV-1201 Old & New Plug

LRCV-1201

Valve was dropped from the line for checking of trim part. Replaced its plug and seat with new set as there was denting mark observed on old one. After overhauling valve was box up with new seat and bonnet sealing rings and also with new gland packing set. The valve was installed back in line and its operation and stroke was checked.

HICV-1206

Valve was opened from the bonnet. Replaced its bonnet gasket and cleaned its trim parts. Finally the valve was assembled and its operation and stroke was checked.

LICV-1351

Valve was dropped from the bonnet. Replaced the actuator 'O' Ring and overhauled the actuator. Provided new gland packing. Valve was assembled and its operation and stroke was checked.

PICV-1129

Valve was dropped from the bonnet. Machining and lapping was done for plug. Replaced the bonnet and seat gaskets , seal rings and provided new gland packing. After general cleaning and overhauling valve was assembled. Checked the signal failure and air failure action. Provided volume booster, modified the tubings and checked the operation and stroke.

PICV-1181

Valve was dropped from the bonnet. Lapping was done for the trim parts. Provided new body and plug seal rings, gaskets, plug spacer ring and gland packing. After general cleaning and overhauling , valve was assembled and operation and stroke was checked.

PICV-1502A

Valve was dropped from the line. All the trim parts were cleaned and overhauled. Provided new seat and bonnet gaskets and gland packing. Provided new actuator ' O' rings and overhauled the actuator. Valve was assembled and its operation and stroke was checked.

LICV-1203

Valve was dropped from the line. All the trim parts were cleaned and overhauled. Provided new bonnet and flange gaskets and gland packing. Valve was assembled and its operation and stroke was checked.

FICV-1302

Valve was dropped from the line. Replaced the teflon seat and provided new flange gaskets and gland packing. Assembled the valve and its operation and stroke was checked.

TRCV-1421

Valve was dropped from the line. Replaced the baffle connecting link and provided new flange gaskets and gland packing. Assembled the valve and checked the stroke.

LICV-1501

Valve was dropped from the bonnet. Replaced the plug and seat by modified one to adjust valve Cv and provided new bonnet gaskets and land packing. Valve was assembled and checked the stroke.

LRCV-1501

Valve was dropped from the bonnet. Replaced the plug and cage cum seat , seal ring, bonnet and seat gaskets and gland packing. Finally the valve was assembled and stroke checking was carried out.

FICV-1204

Valve was dropped from the line. All the trim parts were cleaned and overhauled . Actuator was completely overhauled and replaced the actuator diaphragm and provided new 'O' Ring. Provided new gland packing and assembled the contol valve and checked the operation and stroke.

PICV-1979A/B

Valves were dropped from the line. Actuators were completely overhauled, replaced the actuator diaphragms and provided new actuators' 'O'Rings. Overhauled the valve positioners. All the parts were cleaned and overhauled . Valves were assembled, checked their operation and stroke.

HICV-1222B

Valve actuator was dropped and complete overhauling was carried out. Replaced the piston 'O' Ring and overhauled the actuator internals. Actuator was assembled and installed back, checked the operation and stroke.

PRCV-1481

Overhauled the valve positioner, provided new booster relay , air
pressure regulator and gland packing , modified its SS tubings and checked its operation and stroke.

HICV-1207 & FICV-1202

Control valves were removed from the line. Lapping was carried out for plug and seat. Provided new flange gaskets & gland packing. All parts were cleaned & overhauled. Actuator diaphragm was checked and found ok. The valves were installed back in line and their operation and stroke was checked.

PICV-1201 & FRCV-1201

Control valves were dropped from the bonnet. Replaced the plug and seat, seat and bonnet gaskets and provided new gland packing. Finally the valves were assembled and their operation and stroke was checked.

FICV-1381, HICV-1211 & LICV-1203

Replaced the old Parcol make valve positioner by Eckardt make positioner.

Eckardt makes valve positioner on HICV-1211 & LICV-1203

- Replaced the gland packings for the control valves LICV-1352 & MICV-1101.
- Replaced the current to pneumatic converters for the following control valves & stroke was checked.

  LICV-1425 , HICV-1222A/B, PICV-1424, HICV-1581, LICV-1504B, PCV-1501, LICV-1201 & PICV-1131.
- Replaced the old and damaged air pressure regulators for the following control valve positioners and current to pneumatic converters.

  HICV-1385, LICV-1281, FICV-1381, LICV-1201, PICV-1502A/B, LICV-1425, LICV, 1203, HICV-1211, FICV-1302, TICV-1481, HICV-1422A/B, HICV-1405, HICV-1422, FICV-1204, PICV-1128.
- General cleaning & stroke checking of following control valves were carried out:

  PICV-1128, FICV-1102, FICV-1284, PRCV-1202, FRCV-1102, PICV-1221A, FICV-1435, PICV-1351, FICV-1351, FICV-1352

COMPRESSOR HOUSE JOBS

- All bearing RTDs in turbine, HP case, LP case & Gear Box were removed to facilitate mechanical jobs. All were checked and re-fixed after the completion of the jobs.
- All vibration probe for Radial, Axial and key-phasor points in turbine, HP case, LP case and Gear Box were removed to facilitate mechanical jobs. Replaced the axial probe XE-1801A and radial probe ZE-1801B by new ones. After completion of the jobs, the same were re-fixed. Gap voltage adjustments for radial and axial and key-phasor probes were carried out.
- All the limit switches for HP, LP and admission steam valves were removed to facilitate mechanical jobs. All were checked and re-fixed after the completion of the jobs.
- All the temp. and pressure gauges were removed to facilitate mechanical jobs. All were checked and fixed back after the completion of the jobs. Two no. of temperature gauges were replaced by new one for 60 ata and 23 ata steam temperatures.
- Following Trip and Alarm Switches were cleaned, checked and calibrated.

  PSLL-1801A, PSLL-1801B, PSLL-1801C,

  PSLL-1818A, PSLL-1818B, PSLL-1818C ,

  PSLL-1838A, PSLL-1838B, PSLL-1838C ,

  PSHH-1839A, PSHH-1839B, PSHH-1839C ,

  PSHH-1843A, PSHH-1843B, PSHH-1843C ,

  PSL-1816, PSL-1812, PSL-1813 and PSLL-1844.
- Following low level and high level switches of separators & surface condenser and were calibrated.

  LSHH-1804, LSHH-1806, LSHH-1808, LSL-1824, LSHH-1822 & LSL- 1823.
- Following leveltrols for separators & surface condenser were calibrated.

  LICT-1203, LICT-1805, LICT-1807 & LICT-1821
- Replaced the faulty PCB circuit board for lube oil overhead tank leveltrol LT-1811 and checked the calibration. Also checked calibration for level switch LSL-1810.
- 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 . Calibration of spare units of I to H converter were also checked.
- General cleaning & stroke checking of following control valves was carried out.

  HICV-1801, HICV-1802, HICV-1803, PICV-1810, LICV-1803, LICV-1805, LICV-1807, LICV-1821A/B.

FIELD JOBS

- HP Stripper's and Autoclave's Pressurised as well as empty count readings for LRC-1201 & LR-1201 detectors were taken and recorded.

- Radioactive source were removed and installed back to facilitate mechanical maintenance jobs for Autoclave & Stripper radio active level measurement instruments.
- Scintillation Counter (HP Stripper) was removed & installed back to facilitate mech. maintenance jobs.
- Calibration of "Radiac Relay" unit and its spare unit for LR-1201 (Autoclave level) was carried out.
- Normal pressure transmitter for PRC-1201 was replaced by new capilliary type pressure transmitter.

New PT of PRC-1201

New PT of PI-1201B

- Replaced the capillary type pressure transmitters for Carbamate pumps discharge PT-1201A & PT-1201B. Also checked the calibration of pressure transmitter PT-1201C.
- Calibration checked for Ammonia pump discharge pressure transmitters PT-1102A, PT-1102B and PT-1192.
- Calibration checked for the following pressure switches for Ammonia pump P-1201C.

  PAH-1193 & PAHH-1194.
- Calibration checked for the following lube oil pressure switches for Ammonia and Carbamate pumps.

  PLCO-1102A, PL-1104B, PLCO-1102B, PAL-1196, PALL-1195

  PL-1201A, PLCO-1201A, PL-1201B, PLCO-1201B
- All HP Thermowells were removed, hydro tested & checked by inspection department.

- Calibration of Ammonia Mass flow meter (FS-1101) was done at EQDC.
- Inspection of following magnetic flow meters was done.

  FICT-1435, FICT-1203, FICT-1352, FICT-1353 & FRCT-1421.

  Power supply cable for FICT-1352 & FICT-1353 were connected through new Power Junction Box PJB-03.
- Following extended pad type transmitters were calibrated:

  LICT-1421, LRCT-1421, LICT-1201, LICT-1202, LICT-1282, LICT-1353 and LT-1481.
- Following Quality affecting instruments declared in ISO were calibrated.

  PT-1121, PT-1145, PT-1802, SI-1401A, SI- 1401B, FR-1201, PICT-1202, PT-1421, PT-1422, PRC-1202, PT-5503, PT-4405 & PT-1105.
- Following leveltrolls were calibrated:

  LICT-1235, LICT-1501 & LICT-1203
- All Plant Junction Box terminals were checked, cleaned and tightened.
- General inspection and checking was carried out for N/C ratio meter mono block valve and pressure reducing capillary. N/C Ratio-meter local panel and JB cables and wiring were also checked.
- Manometer was connected for Differential pressure measurement of HP stripper ferrules checking and disconnected after completion of work.
- All the instruments were removed from the vessels V-1205 and H-1205 and connected back after installation of new vessels.
- Cleaned the I/P panel at prill bucket room and general checked the I/P converters/associated tubing for leakage etc.
- Weep holes were checked for HP Vessels (Autoclave Source side & Scrubber Top side) and required tubing was modified for the same. Also modified and replaced the PVC tubing with SS for HP Condenser and Autoclave.
- Painting and earthing on all Prill Tower top control valves were done.
- Flushed the instrument air header for any foreign particles accumulation.
- Replaced the cable and proper termination provided for oil centrifuge M- 1803 Lube oil SOV.
- Replaced the thermocouple for TIC-1353 by new one.
- Removed the thermo wells TI-1422 & TI-1433 for draining .
- Instrument electrical interface cables and wiring identified for Instrument JB in MCC-14, MCC-6 & MCC-15.
- Calibration checked for the following steam and CO2 transmitters.

  PIC-1128, PIC-1129, PIC-1130, PIC-1131, PIC-1181, FI-1811, FI-1812,

  FI-1813, FI-1814, FI-1124, FR-1801, FR-1803, PR-1807, PR-1808,

  FR-1504, PR-1501, PR-1502, PIC-1502, FR-1502, PI-1841.

- Replaced the manifold valve for Flow transmitter FR-1803.
- Extended the orifice tapping nipple for FI-1208 (Off gases vent).
- Provided ball valve in place of needle valve for LIC-1206 (Off gas).

DCS RELATED CONTROL/ MARSHALLING ROOM JOBS

- DCS System & Panel earth resistance was measured.

  The measured resistance values were:

  System earth resistance: 7.4 Ohms , Panel earth resistance: 2.1 Ohms.
- Following jobs were carried out in vibration monitoring system:
- Checking of the Danger voting logic for compressor's axial and radial monitors.
- Cleaning of Vibration display modules and the Vibration Monitoring Cabinet was carried out.
- Provided parallel connection for key phasor KE-1803 from TDX Rack 1 to TDX Rack 2.
- Measured the gap voltages for all the vibration probes from Vibration cabinet.
- In the DCS System, complete system was "powered down" and dismantled. All the hardware of FCS0201, FCS0501 and HIS0260 to HIS0263 and Engineering station were cleaned and installed back. All the System, marshalling and vibration cabinets were cleaned. The system was "powered on" and taken online. After power ON, system functioning was found ok.
- Measured control room temperature and dust level, both were found within limits.
- AC/ DC and battery voltages were measured, wherever applicable, for all the stations and found within limits.
- Checked System healthiness. Checked CPU, PSU and communication cards redundancy and found working fine. Checked overall system functionality and found working normal.
- All operator stations and Engg. Stations were up graded with anti-virus McAfee AV updates.
- Application Project backup was taken for DCS in DVDs (two set). One Set of the backup retained with us and one set of the backup is kept by M/S YIL for their future reference.
- MCBs were replaced for ACDB Cabinet, PDB<121>, System Cab. <501>, Analogue Marshalling Cab. <101> & <102>, Digital Marshalling Cab. <111>, <112>, <113> and Vibration Monitoring Cab.
- Fuses for terminals in Digital Marshalling cabinet <201> for Compressors' Trip logic were replaced.
- Painting work done for DCS system cab. <501>, Analogue Marshalling Cab. <101> & <102>, Digital Marshalling Cab. <111>, <112>, <113> and Vibration Monitoring Cab. PDB<121>.

- Removed PJB-02, PJB-03 and 24 V power supply from the Marshalling room. Provided new MCB connections for PJB-03 (Hydrolyser) and LR-1201, LRC-1201 level display units (LB-440 M/S & LB-441) in ACDB Cabinet.
- Provided new cable between PDB<121> and control room for Control room horn system. Also, Auxiliary Console power (MOV push button indication) supply was lined up from PDB Cab<121>.

CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND

- Following HP Thermowells and Ring joint gasket of SS316L were replaced with new one of material 2RE69.

  TR-1202, TR-1203, TR-1205 and TR-1209

- Following existing control valves were replaced with the new valves.
  PICV-1130 and PRCV-1504

New C/V PICV-1130

New C/V PRCV-1504

EWR JOBS

- P-1102A and P-1102B Discharge pressure High Trip (EWR U-259)

  Generated high discharge pressure trip signal PAHH-1102A from PI-1102A and PAHH-1102B from PI-1102B. Both signals were incorporated in existing trip logic I-3A and I-3B for pump P-1102A and P-1102B respectively. Also updated all related DCS graphics for same logic.

- P-1201A and P-1201B Discharge pressure High Trip (EWR U-259)

  Generated high discharge pressure trip signal PAHH-1201A from PI-1201A and PAHH-1201B from PI-1201B. Both signals were incorporated in existing trip logic I-4A and I-4B for pump P-1201A and P-1201B respectively. Also updated all related DCS graphics for same logic.

- Motor Current/Ampere Indication for Pump P-1102A/B and P-1201A/B (EWR U-257)

  Current / Ampere indications for motors of pumps P-1201A/B & P-1102A/B were configured in DCS.

- MOV-1801 Start permissive logic (EWR U-260)

  Start permissive logic was implemented in DCS, with necessary Logic Graphics and wiring from MOV JB to DCS marshalling cabinet, for opening of MOV-1801 only if anticorrosion air blower is running.

- MOV-1842 Operation from DCS and Closing of MOV with Tripping of Hitachi compressor (EWR U-260)

  MOV-1842 Operation Push button and Indications were shifted from LCP of Hitachi compressor to DCS with necessary wiring shifting from LCP to DCS marshalling cabinet and implementing necessory logic. Also interate same logic with compressor common trip for closing of MOV-1842 with tripping of Hitachi compressor.

CONTINUAL IMPROVEMENT

- Old and obsolute control valve PICV-1130 was replaced with new control valve manufactured and supplied by M/s Severn Glocon.
- Old and obsolute control valve PRCV-1504 was replaced with new control valve manufactured and supplied by M/s Dresser Masoneilan.

OFFSITE & UTILITY PLANT
(INSTRUMENTATION)

BOILER PLANT

CONTROL VALVES

- Following control valves were replaced with new one.

  TCV-1, MICV-4401-B,

- Following control valves were opened from Bonnet for partial maintenance.

  Inspection of Seat/Plug, valve positioner, Actuator diaphragm, Gland packing, control valve stroke checking etc.:

  FCV- 01 (100% BFW c/v)

- Following control valve's preventive maintenance was carried out. General cleaning and control valve stroke checking:

  HICV-5151, pHCV-4401, pHCV-4402

  (HICV-5151,Carried out SS tubing for new Electro-pneumatic valve positioner.)

FIELD JOBS BOILER

- F.D. Fan & BFW pump turbine related field inst. were removed for mech. maintenance job and installed back.
- FD fan suction damper I/P was calibrated. Also overhauled positioner.
- Cleaning of 8 nos. of Furnace draft points, PSH-11and PSH-12.
- Pressure Gauges PI-2, PI-3, PI-4 and PI-5 were calibrated w.r.t. Boiler inspection.
- RAH outlet damper related SOV & limit switches, pneumatic motor air supply line

  SOV & filter lubricator etc. were removed due to APH modification.
- Flushed air header of Boiler and DM Plant area and also checked joints for leakages. Mech. Isolation valve on inlet air line to Boiler Air receiver was provided by Mech. Maint.
- TR-13 & TR-13-A Furnace Temp. T/C were replaced with a new 'K' type T/C.
- APH inlet air damper related SOV, Air regulator etc. were replaced with new one. Carried out SS tubing and signal cable wiring for SOV of damper. Limit switch signal cable laying & wiring was also done.
- Checked and calibrated ISO instruments as per schedule.
- Following field switch set value were checked: Furnace pressure high alarm switch PSH-11 setting was checked (set at 300mmwc) and Furnace pressure high trip switch PSH-12 (set at 350mmwc) LSLL-1 of steam drum level.
- Following Pressure switche's set value were checked:

P-5112 (BFW pump - motor driven): PAL-5115, PLCI-5114, PLCO- 5113, PLCI-5115 and PAL-5113,P-5111 (BFW - turbine driven) : PAL-5114, PLCI-5113, PLCO- 5112,PLCI-5111, PLCI-5112 and PAL 5111.

- High tech" make steam drum level indicator electrodes were checked and tighten all terminals.
- Filed Instrument , Cables , junction boxes related with new APH modification were re-located. New Instruments TI-14A (Flue gas Temp at BFW Coil Outlet), PI-14A (Flue Gas Pr at BFW Coil Outlet) , TI-3A (BFW COIL I/L Temp.), PI-1A (BFW Coil I/L Pr.) (Pressure Diff. across APH) were installed for DCS indication.
- Flue Gas O2 analyser was removed from location and re-installed at new location after BFW Coil due to New APH Modification.
- Deaerator middle & low level switch LAH-5111& LAL-5111 were replaced with new one and checked their operation.
- Igniters: Cleaning & checking of both the burner's igniter and scanner was carried out.
- Limit switch for 'open' / 'close' indication of BNR#2 Fuel air damper was adjusted.

FIELD JOBS COOLING TOWER

- Q- 4401 (Elliott Turbine.) All radial vibration probes, speed pick-up probe, local ThI and local THI and PI were removed & reinstalled to facilitate mechanical maintenance.
- All the three level switches (LSAL-01, LSAH-01 & LSHH-01) of H-4411 (Surface Condenser) were cleaned & checked.
- Tachometer of Q-4402 & Q-4403 were cleaned, checked and fixed back.
- Disconnected tachometer, PI / TI from P-4402 for mech. maintenance. jobs and reinstalled after mechanical Maintenance.
- Cleaning of control panel & tightening of all terminals inside panel was carried out.
- Cleaned and Checked calibration of Surface condenser level transmitter LT-01.
- New Smart DP transmitter provided for FI-1090 (Steam Flow to Q-4411) & FI-1091 (Condensate flow from CEP) .Old transmitter were of analog type and giving frequent problem/unreliable reading.
- Speed indication for Q-4401B & Q-4403 are provided with Proximity sensor. Necessary Notch made on low speed shaft . New Proximity Speed sensor and Frequency to Current Convertor installed . Cable wiring /termination done for DCS indication.

FIELD JOBS I.G. PLANT

- Overhauling 4-way valve of New I.G. dryer (Gaso make) was carried out as it was inoperative.
- Siren of new I.G. plant was replaced with new one as it was not working.(Coil was found short)
- Attended all running jobs.

FIELD JOBS NH3 STORAGE

- Following V-Automat make level transmitters were checked for calibration. LIC-3058A, LIC-3053A, LIC-3055A, LIC-3051A.
- Following press. Switches were cleaned and checked for their set value.PSH-3063A, PSH-3057A, PSH-3060A, PSL-3071A & PSLL-3072A.
- Following Leveltrol were replaced with new V-Automat make, a) LT-3102 (Separator) and b) LT-3101 (Flash cooler)

FIELD JOBS E.T. PLANT

- Cleaning of sampling system and calibration of Ammonia analyzer were carried out
- Attended routine running jobs.

DCS RELATED JOBS BOILER

- Carried out AMC jobs for DCS / Stardom PLC. Checked the DCS/PLC redundancy.
- Updated Antivirus Patch in HIS PCs. Taken up the application project back up in DVD.
- Replaced total 12 nos of panel fans.(3 nos in boiler DCS Panels, 3 Nos. in DM DCS Panels and 5 nos. in WTP DCS Panels)
- DCS graphics modified as per new APH Modification. Old Tags of LSHS Oil related removed from Graphics.
- Replaced all Fuse Terminal strips (with Fuse) of DCS & PLC Marshalling cabinets as old were spring loaded type which were problematic &not reliable.

DCS RELATED JOBS D.M.W.T. PLANT

- Carried out AMC jobs for DM DCS . Checked the DCS redundancy. Updated Antivirus Patch in HIS PCs. Taken up the application project back up in DVD
- One faulty FFTDU is changed in DM Marshalling Panel with spare one.

DCS / PLC RELATED JOBS NARMADA WTP

- Carried out AMC jobs for DM DCS . Checked the DCS redundancy. Updated Antivirus Patch in HIS PCs. Taken up the application project back up in DVD

UPSS SYSTEM

EMERSON make 2 X 60 KVA

- Carried out AMC jobs for 'EMERSON' make 2 x 60 KVA UPSS and AMCO battery bank by Service Engineer.k Power System Ltd. and M/s Syntech Power System (AMCO).
- Replaced the UPS logic board of UPS-2 as sometimes UPS display screen was getting blank and All UPS alarms were appearing in DCS through serial communication link.
- Performance of UPS was checked with draining of battery for about One Hrs. Redundancy Functionality of UPS checked. Load Taken on AVR for 15 minutes.

- Replaced 4 nos. of AMCO battery cells with new one as these cells were bypassed & not generating Voltage .
- Checked the Battery voltage/performance during charging & discharging . Found OK.

DB MAKE 2 X 5 KVA UPS (JASPUR)

- AMC Jobs for 2 X 5 KVA DB Make UPS carried out . Redundancy/functionality test carried out . Found O.K.

  DB MAKE 2 X 10 KVA UPS (NARMADA WTP)

- AMC Jobs for 2 X 10 KVA DB Make UPS carried out .Redundancy/functionality test carried out. Found O.K.

EMERSON make 2 X 10 KVA (AMMONIA STORAGE & HANDLING)

- AMC jobs for 'EMERSON' make 2 x 10 KVA UPS and AMCO battery bank was carried out by Service Engineer..
- UPS-2 Rectfier Logic Module PCB is replaced with new . Found that UPS -2 Rectifier voltage is varying from low to high limit when Battery isolated and Battery cable disconnected from Battery terminal.

CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND

- TCV-1 and MICV-4401-B control valve were replaced with new Dresser & Kent-introl make control valve resply.

B&MH. PLANT
(INSTRUMENTATION)

“ASHBEE” MAKE WEIGH BRIDGE

- Ashbee make Weigh bridge maintenance was carried out by service engineer from M/S Ashbee Systems. Calibration of Weigh Bridge was carried out with standard weights. Stamping of the weigh bridge got done. Painting of platform and weighbridge pit was also carried out.

“POWER BUILD” MAKE AUTOMATIC BAGGING M/C

- Following activities were carried out for the below mentioned Power Build” make automatic bagging m/c and Mettler-Toledo make weighing scales:

  P/S No. : 1, 2, 3, 4, 7, 8, 9A, 9B, 10 A and 10B & Weighing scales.

- Cleaning and tightening of terminals in local, load cell junction box and proximity Switch junction box of all the p/s was carried out. Provided lugs in solenoid box where required.
- P/S No. 9 & 10: Hopper level s/w was cleaned and checked it’s operation.
- Diverter 1 & 2: Cleaned solenoids, relay, limit switch etc. and checked it’s function.
- Checked wiring terminals in the main panel, local panel, Solenoid boxes, and Load cell boxes.
- Cleaned and checked CSC-25, relay board, fuses, and all sensors.
- Checked functioning and calibration of all Packer Scales.
- All the solenoid valves were overhauled.
- Maintenance of new reclaim M/C Belt weigher was done.
- Cleaned the Dust Extraction plant panel.
- Cleaned all field instruments (C/V, Flow Tx ,Level Tx etc.) related to DES
- Cleaning & Painting of all the Mettler-Toledo make weigh scale’s platform got done.
- Removed old JSRL make Bagging Conveyor Panel &PLC . New PLC Panel with simplified wiring is prepared , installed & commissioned vide EWR-B-90. New cables laid & terminated from Panel to JB and JB to Instruments. New JB provided for Instrument & Electrical Interface. Provided new Solenoid Valves with 24 VDC Coil for Divertor-1 & Divertor-2. Prepared complete documentation. Checked the belt conveyor logic with new PLC panel . Found OK.

  P/S No.-10B Control Panel was aligned with P/S No.-9A/9B,10A Panels .

ELECTRICAL

AMMONIA PLANT
(ELECTRICAL)

Modification and New Installations

1. **PGR Heater replacement**: Process gas was leaking out from the flange and punctured heater element coil. Defective heater assembly replaced with new.
2. **Installation & commissioning of Metallic Shaft Grounding brush of** compressor **101J & 105 J:** To discharge induced voltage of shaft of compressor ntrain 'Sohre" make shaft grounding brush were installed & commissioned. Existing carbon brushes were not effective for this prurpose.
3. **Installation & commissioning of new 103JLO/SO pumps motors**: Before this both the pumps was driven by a double shaft motor. Now separate motor is provided to both the pumps.
4. **Installation & commissioning of new 101BJT AOP motors**

Scheduled Preventive Maintenance

Preventive maintenance of transformer:

- Transformer taken under preventive maintenance are as under :

  TR-6 and TR-21, Tr- 22 & Tr-24

  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 earthling 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.

- **Specific Activity carried out on transformer Tr-6:**

  - Replacement of conservator tank: Conservator tank was in corroded condition and also oil was leaking out from drain valve. So conservator tank with its accessories replaced.
  - Leakage of oil from HV bus bar chamber to terminal box: LV bushing gaskets and oil seal changed.
  - Low IR valve of HV to earth: Detailed inspection was carried out.: Moisture was observed in HV bus bar chamber oil. Oil in bus bar chamber and bushing gasket & bus bar chamber cover gasket changed.

- **<u>Specific Job of TR-24 and Tr-22:</u>**
  - Oil was leaking from flange of valve between bushels and conservator. Gasket of valve replaced.
  - CT terminal box gasket was worn out. So replaced with new.
  - Replacement of breather of Tr-22.

Preventive maintenance of MCC:

Preventive maintenance carried out on all the feeder compartments in MCC-5, MCC-5A, MCC-5B & MCC-16 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>Specific Job of MCC-5, 5A & 5B:</u>**
  - Bus bar of two feeders was found damaged at the place where lyra contact makes contact. Bus bar replaced with new.
  - Some of lira contact found overheated. So damaged lyra contact replaced with new.
  - Location of connector strip in DG incomer found unsafe for maintenance point of view. Shifted the connector strip at safe location.

- **<u>Specific Job of MCC-16:</u>**
  - Replacement of under voltage relay of feeder FDR-8F3.
  - Replacement of overheated fuse base in some of feeder.

Overhauling of critical motors:

- Overhauling of following motors was carried out in Ammonia plant.

172-JA	Aquous Ammo. Pump
118 - J	Ammonia Transfer Pump
118 JA	Ammonia Transfer Pump
108 JA	Ammonia Reflax Pump
104-JA	AOP of
104-J	AOP of

104-JT	AOP of
104-JAT	AOP of
170-JA	Stripped condensate Pump
2004-J	DM Water Pump
170-J	Stripped condensate Pump
112-J	Condensate Extraction Pump
115-JMB	Aux. Lube oil pump
175-JA	Condensate pump
112-JB	Condensate Extraction Pump
116-JB	Split steam pump
117-J	Recycle gas compressor
118-JB	Cold ammonia pump
PC-2 A	Liquid Ammonia pump

- **Specific Job:**
  - Replacement of fan cover of 104 JT motor.
  - Repairing of DE side end shield of 112 JB motor because a crack was observed in end shield.
  - Reglanding and reluging of cable of motor 170 JA.
  - In the motor terminal box of 117J, cable was found overheated. Self adhesive sleeve was fixed on end terminals and relugging was carried out.

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.

<u>Specific Jobs carried out are as under</u>:

- Replacement of oil seals in SP3 because oil was leaking out from main shaft.
- Replacement of oil seal & O-ring of hand wheel in SP 4 & SP 5.
- Circuit was modified for continuous operation from DCS PB for SP 158, 159, 70 & 151 valve Actuators.

Testing & calibration of power analyzer installed in MCC-16 for 117 J compressors has been carried out.

Testing and Servicing of L&T Air Circuit breakers were done in respective MCCs

Interlock for low process gas trip through DCS was incorporated in start up heater control panel.

UREA PLANT
(ELECTRICAL)

Scheduled Preventive Maintenance

- **Preventive maintenance of transformer:**

  a. Transformer taken under preventive maintenance are as TR-7A, TR-7B, TR-17, Tr-18 & Tr-20

  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.

  b. Specific Job carried out on different transformer during maintenance:

  - Conservator tank of Tr-7A was in corroded condition. So tank replaced.
  - Some stud of inspection window of Tr-17 was broken. Due to this oil was leaking out. New studs have been welded and gasket of inspection window replaced.
  - Replacement of gasket of radiator.
  - Filtration of transformer oil of Tr-17.

- **Preventive maintenance of MCC**:

  Preventive maintenance of the all feeder compartment in MCC 6, MCC 14, and MCC 15 were carried out and the job details are as under:

  c. 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.

d. Specific job carried out:

- Outgoing lead of P-1302/A motor found overheated. Reluging and connection has been done.
- Replacement of elemax connector in different feeders of MCC-6 wherever found damaged.
- Replacement of power contactor of capacitor feeder in MCC-6.
- Replacement of lyra contact wherever found damaged.
- Replacement of fuse base wherever found burnt.
- Replacement of DC indication lamp of incomer breaker of section B.
- Cable of some of the equipment found faulty. New cable laid and terminate at both ends.
- Repairing of overheated lead wherever found.
- Replacement of lugs wherever found damaged.

➢ **Overhauling of critical motors:**

Overhauling of following motor was carried out in urea plant.

P-1202/A	CCS-1
P-1701/B	Urea Solution Pump
MP-1201 C	Carbamate Pump
K- 1102 C	Anti corrosion Blower
P-1408	Urea melt Pump
K-1401-2	Prill Tower Fan
K-1401-1	Prill Tower Fan
K-1401-3	Prill Tower Fan
K-1401-4	Prill Tower Fan
M-1401 A	Prill bucket
MP-1815 A	Condensate Extraction Pump
MP-1815 B	Condensate Extraction Pump
P-1505 B	Condensate Extraction Pump
P-1505 A	Condensate Extraction Pump
P-1501	Boiler feed water pump
P-1506	Boiler feed water pump
K-1702	I D fan PCS
M-1402/1	Urea Scrapper
M-1402/2	Urea Scrapper
P-1131 B	LOP of P-1102 B
P-1131 A	LOP of P-1102 A
P-1231 A	LOP of P-1201 A
P-1231 B	LOP of P-1201 B
P-1202 A	Condensate Pump
M-1421	Conveyor
M-1403/3	Conveyor

M-1403/2	Conveyor
M-1419	Conveyor
K-1102 A	Anti corrosion Blower
M-1802	Barring gear of Comp.
M-1401 spare	P.T. Fan spare motor
M-1401 B	Prill Bucket
M-1403/1	Conveyor
P-1302 C	

Specific job carried out:

- Replacement of broken fan of MP-1815 A, M-1403/2 motors.
- Replacement of damaged oil seal of MP-1815 B motor.
- Replacement of fan cover net of K-1702 motor.
- For M-1403/1 equipment new motor on new foundation was provided for fluid coupling, for replacement of chain coupling.
- Repair and maintenance of K-1401 (Spare) motor terminal box.

Preventive maintenance of actuator of following MOV's was carried out:

MOV 1101, 1102, 1201, 1202, 1203, 1501 & 1801

Specific job carried out:

Leakage of oil was observed from hand wheel. Oil seal and O-ring replaced.

Testing and Servicing of L&T and Siemens Air Circuit breakers were carried out in respective MCCs.

OFFSITE & UTILITY PLANT
(ELECTRICAL)

OFFSITE PLANT

Preventive maintenance of transformer:

- **Preventive maintenance on following transformers was carried**

  Tr-1A, 1B, 15, 4A and TR-4B

  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.

- **Specific Job carried out on different transformer during maintenance:**
  - Replacement of valve between conservator and buchholz & buchholz and main tank of Tr-1A.
  - Replacement of broken studs of OLTC inspection window of Tr-1A.
  - Replacement of mercury switch of trip assembly of buchholz relay of Tr-1A.
  - Filtration of transformer main tank oil.
  - Complete overhauling of Tr-1B.
  - Cleaning of OLTC of Tr-1B.
  - Replacement of broken connectors at main tank from OLTC to HV winding of Tr-1B.
  - Replacement of gasket of HV bus bar chamber of Tr-15.

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.

➢ **Specific Jobs carried out:**

- Retapping of cable wherever insulation found damaged.
- Tightening of loose connection wherever found.
- Replacement of single pole MCB of spring charge circuit of I/C from MCC-4 of breaker in MCC-10.
- Replacement of SFU MP-6002 motor feeder in Jaspur MCC.

➢ **Overhauling of critical motors**: Following motors were overhauled in offsite plant.

MP-6132/A	Chlorine booster pump(Pre)-A
MP-6135/A	Chlorine booster pump(Post)-A
P-6135/B	Chroline Pump
P-6132/B	Chroline Pump
K-6125/B	Air Compressor
E-6126/B	Agitator
P-6132 A	Chlorine booster Pump
P-6135 A	Chlorine booster Pump
MP-6125 A	Air Compressor
OLTC-TR-1A	OLTC-TR-1A
P-6126 A	Alum agitator
TR-1 OLTC	OLTC Motor
P-4101	Raw water pump

Specific job carried out:

- Winding of OLTC motor of Tr-1A found overheated. Rewinding of motor was carried out.

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. As per detail given below:

- **<u>Common activity carried out during maintenance:</u>**
  - Visual inspection of breakers for any abnormality.
  - Thorough cleaning of breakers was carried out
  - Checked power & control circuit connections in the breaker for tightness.
  - Vacuum of vacuum interrupters was checked
  - Gear box operation, tripping mechanism, spring charging limit switch Operation , Circlips ,Mechanical interlocks were checked
  - Mechanism was tested and lubricated.
  - Insulation resistance of each breaker was measured
  - Closing & Tripping time of all the Breakers was measured.
  - Closing coil & Tripping coil resistance was measured.

<u>UTILITY PLANT</u>

<u>New installation:</u>

- **Revamping of MCC-2F sec B, with new Siemens panel:**
  - Removed and shifted old panel from existing location and all power and control cables disconnected from old MCC panel.
  - Testing, installation and commissioning of new panel Section B was done. Re-termination of all power and control cables was carried out in new panel.
  - Old MCC 2F sec B was removed.
  - Connection on new MCC 2F Section B with existing section A was carried out by doing bus bar modification.

<u>Scheduled Preventive Maintenance</u>

<u>Preventive maintenance of transformer</u>:

- Preventive maintenance of following transformer TR-2A, 2B, 3A, 3B, 8, 11, 12, 13, 14, 16 and 23 were carried out. Detail is given as below**:**

  <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.

- **Specific Job carried out on different transformer during maintenance:**
  - Replacement of gasket & oil in HV & LV bus bar chamber of TR-2A, 3A and oil of bus bar chamber in Tr-2B & TR-3B.
  - Trip signal was not coming in appropriate way. Trip assembly of buchholz relay of transformer TR-2A interchanged with new.
  - Leakage of oil observed from the operation head of tap changer. Tap switch O-Ring of Tr-2A & Tr-14 & TR-11 replaced.
  - Replacement of LV bushing gasket and oil seal of Tr-2A 7 TR-8.
  - Replacement of buchholz relay and valve between relay and conservator in TR-8.
  - Repairing of overheated lead in LV terminal box in Tr-8.
  - Replacement of oil level indicator frame in Tr-11.
  - Complete overhauling of Tr-12.
  - Replacement of CT terminal bushing and breather in Tr-16.
  - Filtration of main tank oil of Tr-16.
  - Replacement of gasket wherever found damaged.
  - Replacement of gasket of inspection window located at top cover and HT terminal box.

Preventive maintenance of MCC:

- **Preventive maintenance of following MCC were carried out.**

  MCC 1, MCC 2B & 2E, MCC-11 and MCC 13

  <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>Specific Jobs carried out:</u>**
  - PT fuse of bus coupler in MCC-1 found blown off. Fuse has been replaced**.**
  - P-4206/A motor feeder sliding contact was out of order and fixing nut was missing. Feeder has been repaired.
  - Hollow pin of feeder draw out mechanism was missing in MCC-2B/2E. Installed new pin.
  - Installation of power contactor in feeder 3R4 in MCC-2B/2E.

- P-4418/A feeder B phase CT replaced in MCC-13.
- Replacement of contact of 180-Jm motor feeder breaker.
- Incomer breaker of MCC-13 replaced due to fault in closing coil and closing mechanism of breaker.

➢ **Overhauling of critical motors:**

Overhauling of following motors was carried out in utility plant.

P-4412	LOP of Q-4401 A
P-4405	LOP of Q-4401 B
P-4403	LOP of Q-4403
P-5119	Ammonia Dosing Pump
P-5111A	A O P FOR PUMP P-5111
P-5112 A	AOP for PUMP 5112
P-5112 B	AOP for Motor 5112
P-5117	Hydrayzne dosing pump
P-5118 A	Phosphate dosing pump
P-5118 B	Phosphate dosing pump
P-5111 B	A O P FOR PUMP Q -5111
P-4203 C	DM Water Pump (IG Plant)
P-5120	condensate Pump
P-5113	AOP of E-5113
P-4203 C	DM Water Pump (IG Plant)
K-4201 A	De gasser blower D M plant
P-4206 A	De gasser Pump D M plant
P-4411 A	Condensate pump C.T area
P-4203 A	D M Water feed pump
P-4206 B	De-gasser Pump
K-4201 B	De-gasser Blower

➢ **Specific job carried out:**

- Replacement of terminal block of AOP for Motor 5112
- Replacement of DE side bearing cover bolts of AOP of E-5113.
- Replacement of DE side oil seal in P-4203 C.
- Reglanding and reluging of cable of K-4201 A

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

Specific job carried out :

- Replacement of oil seal & o-ring of hand wheel of main steam stop valve.

- Main shaft oil seal replacement of main steam bypass valve, SH header drain valve isolating type, SH header drain valve from regulating type, feed water shut off valve, P-4401/B, P-4402 and P-4403(700).

Testing and servicing of Air circuit breaker were carried out in respective MCCs.

B.&MH. PLANT
(ELECTRICAL)

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.
- **Specific Job carried out on different transformer during maintenance:**
  - Replacement of HV & LV bushing gasket of Tr-5A & 5B.
  - Replacement of HV & LV bus bar chamber oil 5A & 5B.
  - Replacement of breather of Tr-5B.

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.

- **Specific Jobs carried out:**
  - Repairing of outgoing contact block of M-2111motor feeder of MCC-4.
  - Some holes were observed in incomer and bus coupler panel of MCC-4. Holes covered with hylem sheet and m-seal.
  - Relay 7SJ6001 terminal strip found overheated, of the outgoing panel of Narmada MCC breaker of MCC-4. Spare terminal strip installed.

- **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

- **Specific job carried out:**
  - Replacement of fan cover net of M-2121 motor.
  - Replacement of broken bolt on NDE side end shield of M-2137 motor.
  - Motor feeder for K-2161 was modified in MCC-4. SFU with fuse (250A) and contactor were replaced in feeder.

Testing and servicing of Air circuit breakers was carried out.

NON PLANT

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.

➢ **Specific job carried out:**

- Replacement of mercury switch of trip assembly of buchholz relay of Tr-10A.
- Replacement of oil level indicator glass of buchholz relay of Tr-10A.
- Replacement of breather of Tr-10B.
- Replacement of top cover gasket of Tr-10B.

Preventive maintenance of MCC:

Preventive maintenance of all the feeder compartment MCC-7 and fire MCC was carried out.

➢ <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.

➢ **Specific Job Carried Out:**

- Replacement of contactor coil and contactor wherever found burnt.
- Testing and servicing of Air circuit breakers was carried out.

CIVIL

AMMONIA PLANT

(CIVIL)

Construction of foundation for synthesis gas compressor new lube oil console system in ammonia plant

The lube oil system of synthesis gas compressor in ammonia plant is replaced by new system supplied by M/s KEPL. To accommodate new lube oil system, construction of consol foundation had been carried out as per drawing supplied by M/S KEPL. It was required to extend the existing foundation & drilling of new pockets. Suitable foundation construction was carried out and required pockets were drilled using Hilti make core cutter. With the use of Hilti make core cutter, quality cores were drilled in fast way.



Photographs showing new foundation and cores.

Foundation jobs for I D Fan turbine assembly (101-BJT)

Primary reformer ID Fan turbine assembly is replaced with new. The turbine is installed on existing foundation by minor modification jobs like required chipping of concrete, construction of new footings, grouting of pockets etc. were carried out.

Refractory repairing jobs in primary reformer , Secondary reformer & Primary <u>waste heat exchanger</u>

The refractory repairing in primary reformer, secondary reformer & primary heat exchanger were carried out. The 12 no. of hollow blocks in primary reformer were replaced. The casting of auxiliary boiler side panels was carried out by M/s Ace Calderys using the refractory material ''Whytheat''.

<u>Removal of refractory from Syn gas convertor</u>

For modification in synthesis gas convertor, it was required to remove the existing refractory from fourth bed & bottom. The refractory was too hard to break and working space and approach was limited. However, the job could be completed within time.

<u>Construction of foundation for Phosphate dosing pump (2002-LJ)</u>

The modification was carried out in Phosphate dosing pumps in ammonia plant. The subsequent changes in the foundation had been carried out to accommodate the new system.

UREA PLANT

(CIVIL)

Repairing of scrapper floor by providing elastomeric lining & replacing acid/ alkali proof bricks

There was continuous seepage of urea melt from scrapper floor, which creates nuisance in the MCC & mechanical store below scrapper floor. Various attempts had been taken previously to arrest the seepage but problem was not resolved. It was decided to rehabilitate the scrapper floor completely & to provide elastomeric lining of M/s Greensboro product Polydee-ADG after removal of existing brick lining. The procedure involves the removal of existing acid/ alkali proof brick lining, cleaning of the surface, primer application, application of Polydee- ADG, laying of bricks, Pointing of bricks & top layer application. The said job is executed by M/S Greensboro Poly chem. Pvt. Ltd.

Repairing of prill tower top floor by providing elastomeric lining & replacing acid/ alkali proof bricks

There was bit mastic lining over the prill tower top floor, which was badly damaged & non- uniform. The water accumulation over the surface was taking place and seepage in prill bucket room was faced. After successful renovation of scrapper by M/s Greensboro, it was decided to provide elastomeric lining & layer of acid/alkali proof bricks on the prill tower top also. The procedure involves the removal of existing acid/ alkali proof brick lining, cleaning of the surface, primer application, application of Polydee- ADG, laying of bricks, pointing of bricks & top layer application. The said job is successfully executed by M/S Greensboro Poly chem. Pvt. Ltd.

Rehabilitation of bucket room (outside) at prill tower top by providing elastomeric lining.

The bucket room at the prill tower top was badly damaged. The plaster was broken & urea was penetrated in the wall. It was required to rehabilitate the bucket room. The procedure provided by M/S Greensboro polychem Pvt. Ltd for B&MH plant structure in packer scale was repeated for bucket rooms. The procedure involves removal of existing plaster, cleaning of the surface, application of Polydee-RC (Rust convertor), application of bond coat, providing polymer modified mortar (PMM), proper curing of the PMM & application of 1 mm thick elastomeric layer.

Prill Bucket room walls with Greensboro treatment

Replacement of hand rail at the prill tower top & stair case

The existing mild steel hand rails of the prill tower was corroded badly with the time & was in unsafe conditions. To replace it with SS railing, Hilti make Anchor rod HAS-E-RM 10 X 90/21 with INJECTABLE MORTAR HIT-RE-500/330/1 were provided to support the new railing. The SS anchors of size M-10 was inserted in the concrete & fixed by using Hilti chemical.

To create space for crane movement for replacement of LPCC

To replace LPCC in urea plant, it was required to demolish flooring behind urea plant for crane approach. Accordingly, flooring of one meter height and 50 m^2 area was demolished. After completion of job same was reconstructed and IPS was carried out.

Construction of Bye- pass channel in Ammonia cooling tower

The bye pass channel was constructed in ammonia cooling tower to isolate the cell No. 7 & 8 for maintenance purpose during running plant. The channel constructed by using Reinforced cement concrete. The approximate depth of the channel is 1.5 m & width is 2.5 meters. The partition brick walls inside the cooling tower as per requirement were constructed & MS gates were provided for isolation between cell no. 7 & 8.

Replacement of marine plywood sheet in cooling tower deck (KEP-97, ammonia & urea cooling tower)

Damaged plywood sheets of the cooling tower deck were replaced with new marine plywood sheets.

Excavation of cooling tower header for wrapping & coating of the pipe lines & backfilling including PCC of the header

The surrounding area of cooling water return headers was excavated for the preventive maintenance including wrapping & coating of the headers. Excavation for total 6 no. of headers for the depth of 1.5 meters was carried out. Same were back filled after completion of mechanical maintenance job. The top PCC layer was provided around the headers to restrict the ingress of water & to reduce the possibility of corrosion of MS header.

Fixing of anchor fasteners on the circumference of clarriflocculator to replace the rail

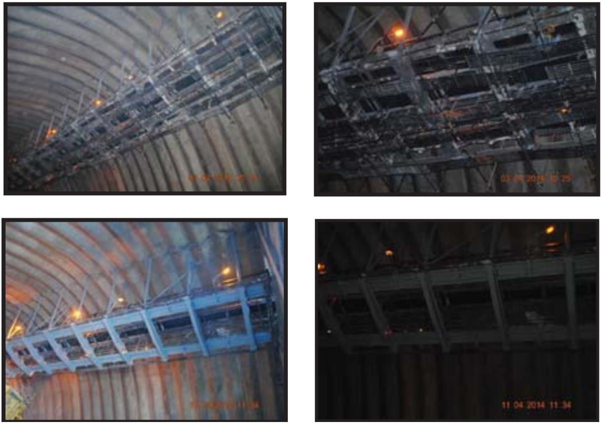
The existing circumferential rail of clarriflocculator was eroded & damaged. It was decided to replace the it with new & solid rail. The civil jobs involving removal of base plate, leveling of surface, fixing of ''Hilti'' make anchor fasteners of diameter 16 mm with chemical & grouting of the plate over the circumferential wall were carried out. Total 140 anchor fasteners were grouted.

B & MH PLANT

(CIVIL)

Providing IP Net coating in Silo, conveyor gallery & transfer tower

IP Net coating was provided as a rehabilitation measures in Silo, transfer tower sieving floor & conveyor gallery (M-2112). The process included the cleaning of the surface & application of putty on the eroded surface to make the surface uniform & application of three coat system of I P Net. The scaffolding arrangement for conveyor belt M-2112 was crucial as the height of the conveyor belt was approximately 18 meter & length of belt is approximately 217 Meters. The job was executed successfully and within specified time by M/s Krishna Conchem Pvt Ltd.



The gallery before and after application of IP Net.

Rehabilitation of stitching floor (beams & columns) of B & MH plant by providing elastomeric lining

Every year epoxy is applied on concrete structure in packer scale area. To have long life solution and to get quality jobs, It was decided to rehabilate rthe structure by products of M/S Greensboro polychem Pvt. Ltd. Accordingly the job was carried out which included removal of existing plaster, cleaning of the surface, application of Polydee-RC (Rust convertor), application of bond coat, providing polymer modified mortar (PMM), proper curing of the PMM & application of 1 mm thick elastomeric layer. The supply of material and job execution was carried out by m/s Greensboro.

Stitching floor before & after application PMM & elastomeric coating

Fixing of Kota stone in transfer tower floors in B& MH

The existing bitumastic lining was on all floors of transfer tower were damaged & non uniform. The bitumen lining was completely removed & machine cut kota stone are fixed in the transfer tower. To restrict the further penetration of urea dust, gap on Kota stone surface is filled with the layer of araldite.

Bagging silo screen and transfer tower area after application of Kota Stones.

TECHNICAL

AMMONIA PLANT
(TECHNICAL)

Replacement of ID Fan turbine (101BJT)

P.O. No. 201004140744 of value Rs. 303.6 Lakhs, Dated22/11/2013 was placed on "M/s Kirlosker Ebara Pumps Ltd." for manufacturing and supply of new ID fan turbine, gear box, LS & HS couplings and related accessories.

Turbine skid/ frame along with gear box received on 26/04/2014 at site and job of removal of existing turbine, gear box, inlet/ outlet piping, lube oil cooler and auxiliary piping etc. started by "M/s BBL system" crew under IFFCO supervision.

Existing foundation chipping work and pad grouting work completed by 31/03/2014. Turbine skid/ frame installed at position and level was checked. Skid was levelled 0.0mm in both the direction and gear box mounted on skid on 02/04/2014.

Simultaneously, lubrication skid levelling work was under progress. Skid was kept at position on 04/04/2014 with gear box and checked the alignment with respect to fan and maintained DBSE 13mm.

Turbine was received at site on 05/04/2014 at 11 am and the same was mounted on skid and checked the alignment with respect to gear box. Rough alignment was completed and started lubrication pipe lines mounting work as per photos received from M/s KEPL while assembly at KEPL.

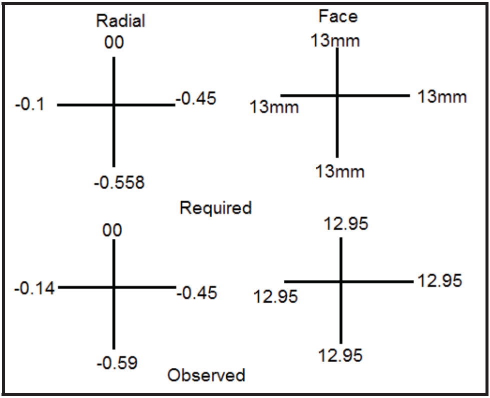
By 06/04/2014 lubrication piping connection and acid pickling/ passivation was completed and lubrication system's skid grouted had been completed.

Turbine top bearing liner was removed on 07/04/2014 for oil flushing and flushing oil (46-T) filled in tank. Lube oil flushing work started using 120 micron mesh. Coupling hub of old gear box removal started and instrumentation team from KEPL started job of instrumentation.

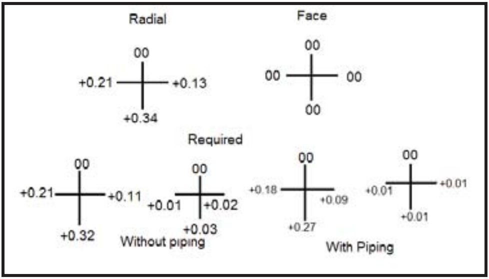
Steam inlet and outlet lines fabrication, target blowing and lube oil flushing completed by 14/04/4014 . All interlock checked and Pro-tech GII powered and configured. OST rpm setting done at 4250 in protech GII and 4560rpm in woodward governor. OST successfully conducted on 16/04/2014 at 2.00am and turbine is successfully commissioned on 16/04/2014.

The final alignment readings (in mm) are as under :-

A) Gear box to fan (Dial rotated on ID fan coupling hub)



(B)Turbine to gear box (Dial gauge rotating on gear pinion hob



Advantage : With new turbine there is saving of approximately 1.36 ton/hr MP steam saving , Which is approximately Rs. 1.0 Crore per year.

Replacement of ammonia converter interchanger (122-C)

P.O. No. 201004140177Dt.24/05/2013 was placed on M/s ISGEC heavy Engg. Ltd. Yamunanagar for manufacturing and supply of 122-C.

All the drawings were developed in house based on existing interchanger and Phulpur exchanger design. The MOC of new 122-C has been upgraded to SS 321 from SS304.



Insulation on outer shell of above exchanger was done at site by M/s Balaji Insulation.

The above exchanger was received at site on 01/04/2014 before 20 days of its scheduled delivery.

<u>CONNECTION FROM 123-C OUTLET LINE TO UTILITY BFW COIL OUTLET LINE FOR MORE FLOW THROUGH 123-C. (EWR NO. A-274, Dt.15/01/2013)</u>

EWR No. A-274 was raised by Ammonia Plant to provide suitable size permanent connection with flow measurement and controls for providing more BFW through 123-C.

For the implementation of above EWR, following modifications have been carried out:-

- One 3" line tapping taken from 123-C shell side outlet 8" line (u/s of check valve in horizontal position) and connected to offsite BFW coil outlet 6" line.
- One 2" flow control valve provided with upstream and downstream isolation valve.
- 1" bypass line with isolation valve provided for flow control valve.
- A check valve (3''NB) provided at downstream of control valve before joining to utility header in new line to restrict reversal flow.
- One flow orifice provided for flow indication to DCS.


This modification have resulted in better heat recovery in 123-C, helps to reduce 105-D inlet temperature.

Installation of Instrument air receiver of 35m^3 capacity :-

Ammonia Plant is self sufficient for its instrument air (IA) requirement during normal plant operation. However, when the process air compressor(101-J) is not in operation, Utility Plant supplies IA to Ammonia. Presently, about 2000-2500 NM^3/hr of HP air is being sent to Utility plant for meeting the IA requirement of Urea, Utility, offsite, Bagging & other plants.

Two existing IA storage vessels (141-F,142-F) are installed in Ammonia plant for meeting the emergency requirement of IA, having total storage capacity of about 10 m^3 at 6.5-7.0 kg/cm^{2}g pressure and ambient temperature. IA consumption in Ammonia Plant during normal plant operation is about 500 NM^3/hr. With 2 kg/cm^2 pressure differential, IA was available for 2 minutes for safe plant operation in case of IA emergency.

In view of above, one 35 m^3 storage IA vessel in Ammonia Plant (adjacent to 142-F) near aMDEA storage tank was installed to meet the IA emergency requirement.

One instrument air receiver was installed in Urea plant south side of CO_2 compressor.

With new vessels in line, total IA storage capacity will be 40 m^3, which can meet the IA requirement upto 9 minutes in case of IA emergency.

REPLACEMENT OF PICV-14

The existing control valve was having problems due to aging and obsolution.Therefore We intend to replace existing angle control valve being use for steam vent service. The new control valve installed with IBR piping modification to suit the site.

Modification in Bottom Grid of Metanator (EWR No. A-283Dated 04/06/2013):

The above EWR was received for modifying the bottom outlet gas collector of methanator (106-D) for reducing pressure drop. The design pressure drop of Kalol methanator is 0.30 Kg/ Cm^2, which is expected to reduce to 0.21 Kg/ Cm^2.

It was planned to replace methanator catalyst in ATA-2014 after 22 years of service. Presently the pressure drop is above 0.5 Kg/ Cm^2 with $18m^3$ catalyst volume .

Therefore modification in the catalyst bed supports of methanator similar to HTS and LTS can be done to reduce drop in it and thereby increase operating margin in air compressor.

Provision of direct supply line of DM water for BFW pump 9123-J) bearing jacket cooling(EWR A-291Dated 03/03/2014):-

In existing system DM water is supplied to 123-J for its bearing jacket cooling from BFW pump (104-JA) supply line.

In above EWR it was suggested to provide direct supply line of DM water for BFW pump (123-J) bearing jacket cooling. Accordingly direct DM water supply line of size 1-1/2 inch with isolation valve for BFW pump (123-J) bearing jacket cooling provided.The job was carried out by M/s AM Erectors.

This has resulted in improved operation flexibility during plant start up.

Electric Heater for steam deriming Heater (E-5) at PGR Unit (EWR A-270, Dt.18/09/12)

In existing system, Deriming of Cold Box is being carried out with inert gas at temperature of about 80 deg C through deriming heater (E-5).

LP steam in Ammonia Plant is generally available with steam lines charging during Ammonia Plant start-up from Utility Boiler. About 30-36 hours is available before the Ammonia Plant production lined up for deriming of Cold box with LP steam.

However, due to inert gas non-availability during start-up and Ammonia Plant start-up activities, it is envisage to carry out the deriming operation during plant turnaround period with electric heater with inert gas before the start-up activities of Ammonia Plant.

EWR A-270 was issued to make provision for an Electrical Heater, as an alternate for the existing Steam Heater E-5 for operational flexibility and to avoid production loss.

Accordingly, provision was made to make electric regeneration heater (E-4) for deriming operation during shut down .

For this proposal, to use the Regeneration heater (E-4) for deriming purpose in place of E-5 during shut down, following jobs will be involved :

- Two isolation valve (4" 150# CS) provided on inlet and exit gas line of E-4.
- One 4" bypass line with isolation valve (4"x 150# CS) for E-4 provided for maintenance jobs of electric heater during normal plant operation.
- One 2" tapping with isolation valve (2"x 150# CS) with figure "8" blind provision provided to supply inert gas (N2) from E-5 inlet header to inlet line of E-4 at upstream of HCV-168.
- 2" tapping with isolation valve (2" x 150# CS) with figure "8" blind provided for return of hot inert gas (N2) from E-4 inlet header to exit line of E-5.
- Existing temperature control system (TSH-147, TSL-147) of E-4 will be used for deriming operation to control the inert gas (N2) temperature.

With above modification existing Regeneration Heater (E-4) can be utilised for deriming operation during shut down period in place of LP steam heated heater (E-5).

Replacement of LC-2A (101JCA Level Control)

Existing LC2A (1'' Masoneilan make valve with Cv 12) was installed in surface condensate pump (112-J/JA/JB) minimum flow line to surface condenser. This valve was in service since commissioning of plant and its spares are not available.

A spare control valve of M/s IL make of size 1.5 inch (Cv 17) was available and the same was installed with u/s and d/s isolation valve.

The above job was carried out by M/s AM Erectors.

Up gradation of CS Instrument Air header and Branch Line with SS material in Ammonia plant.

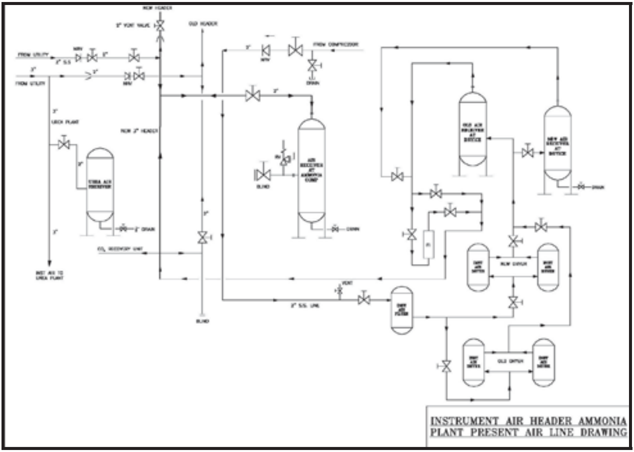
Following instrument air lines have been replaced to increase the reliability of the instrument air system in ammonia plant..

- Main instrument air header in Ammonia plant replaced by 3” SS Pipe.
- Instrument air supply line from air header to instrument is replaced by 1” and ½“ S.S. line.
- Air supply line from ammonia air compressor to instrument air dryer with 2” SS line. Old CS line has been removed.
- Air supply line from IG plant to Ammonia air header with 2” SS line.
- 2” CS line removed from old Air receiver to IG plant and arrangement made for isolation of air receiver near ammonia air compressor.

Now old and new Instrument air headers are parallel and both are in line.

We used 1200 Meters pipe line, 70 No. ½”SS ball valves, 30 No 1” SS ball valves and 8 Nos. 2” SS ball valves. The job was carried out by M/s Aneesh engineers.

Present Instrument air line system is as per following drawing



Provision of additional manhole of 500 mm size in Pre-evaporator (V-1418) in Urea plant.(EWR No. U-249 dated 24/05/2013.)

Above EWR was received from Urea Plant for provision of additional manhole of 500 mm size in Pre-evaporator (V-1418) to make easy access for hydro-jetting during shutdown and for better purging of vessel to remove ammonia vapour.

Accordingly one additional 500mm size manhole is provided at bottom of pre-evaporator separator (V-1418) towards south west side to make easy access for hydro-jetting/ inspection during shutdown and for better purging of vessel to remove ammonia vapour.

Details of additional manhole are as under :-

Manhole Flange	: Size 20Inchx150#
Nozzle neck	: Pipe thk 12mm-SA 240TP 304L
Flange/ Blind flange material	: SA182F30L
C/L above the T.L.	: 550mm
Orientation	: South west (at 180 Degrees to existing manhole nozzle N6)

Increase of melt lute drain size between Ist stage evaporator and 2nd stage evaporator (EWR No. U-252 Dated 17/07/2013)

In above EWR it was requested to increase the melt lute drain size from ¾'' to 1-1/2'' provided between Ist & 2nd stage evaporators to increase the condensate draining rate and reduce the prilling shutdown time.

Accordingly melt drain size was increased from ¾ inch to 1-1/2 inch. Including 02nos of isolation valves. The job was carried out by M/s AM Erectors.

<u>Re-route of neem oil supply line to spray nozzles provided on product conveyor (M-1421) and link conveyor (M-1419). EWR No. U-248 dated 23/05/2013.</u>

In existing system, neem oil is directly supplied from Neem oil transfer pump (P-1901 A/B) at a pressure of 1.8 to 2.2 kg/cm2g and temperature of 60 - 70 deg C to neem oil spray nozzles of Product conveyor (M-1421) and Link Conveyor (M-1419).

Originally the neem oil day tank is provided on first floor of PCS system to ensure constant oil pressure of 0.7 kg/cm2g at spray nozzles.Since the commissioning of system, neem oil spray nozzles are operated in the range of 1.5 to 2.0 kg/cm2g pressure and the neem oil day tank is bypassed.

According to EWR, the neem oil day tank is not in use and the same is to be removed to reduce the pressure drop and temperature drop of neem oil.

Therefore re routing of neem oil lines carried out by removing inlet and out pipes of day tank. With the above modification, reduction in pressure drop and temperature drop of neem oil is achieved and extra open space will be available on 1st floor of PCS.

UTILITY PLANT
(TECHNICAL)

Installation of Air pre heater and BFW coil in flue gas duct of BHEL boiler

P.O. No. 201004140764,Dated 03/12/2013 was placed on M/s GEA Ecoflex India Pvt. Ltd. For design manufacturing and supply of APH and BFW coil.

W.O. No. 201004140765,Dated 03/12/2013 was also placed on M/s GEA Ecoflex for removal of existing RAH and installation of APH + BFW coil in flue gas duct of BHEL boiler.

The removal of dismantling of existing structure and supporting structure for APH started on 28/03/2014 and 4Nos of ISMB 400 were created adjacent to RAH foundation with bracing of 3inch pipes. Fabrication of supports for APH and removing of structure above existing RAH was done before stoppage of plant .Supporting column for BFW coil fabricated coil Erection on temporary supporting structure.

RAH and all Associated ducts were removed upto B/ L and APH received on 31.03.2014 and erected on the same day. Insulation job on cold/ hot hood and flue gas ducts started before Erection which resulted in time saving of insulation job.APH Casing and Hot and Cold Hoods erected on 02/04/2014.

Vendor involved in above jobs were as follows :-

- APH and flue gas/ air ducts were manufactured by M/s GEA Ecoflex India Pvt. Ltd.
- Coil was manufactured at M/s ME Energy works, Pune.
- Finning job on coil was carried out at M/s Akshar Precision works, Vadodara.
- Erection of APH+BFW coil was carried out by M/s Shree Ganesh Engg.
- Insulation job was carried out by M/s Khandelwal Insulation.


Welding of duct connections except Flue Gas Inlet and bellow was completed by 09.04.2014. BFW Coil despatched on 07.04.2014 from M/s ME energy works Pune and reached at side on 09/04/2014. The erection of BFW coil was done on the same day i.e. 09/04/2014.


The BFW piping with 100% radiography and downstream side of duct welding completed by 11.04.2014 and coil hydro testing was done on 11.04.14 at 110Kg/ Cm^2 in presence of boiler inspector.

<u>Advantage</u>

Stack temperature has reduced from 170^0C to 130^0C approximately which has resulted saving of Rs.1.2 Crore per year and there is reduction in steam consumption in FD fan turbine of about $265 sm^3/Hr$ which have also resulted in saving of about Rs.80 Lakhs/ year.

The total energy saving is equivalent to ~ 0.02Gcal/ ton of Urea.

Provision of additional steam venting from 60 ata steam header in BHEL boiler during urea plant start-up and shutdown (EWR no: SG-63)

It is requested in EWR, to provide additional venting of about 40 t/h by providing control valve to adjust with steam drawl style of urea plant during plant start up and shutdown.

Accordingly to have independent system for steam venting in BHEL boiler, 150mm tapping with isolation valve taken on 60 ata steam header to Urea plant in boiler battery limit to install following facilities :-

- Control valve of about 40 t/h.
- new silencer for venting 60 ata steam to atmosphere.
- Logic : The valve will work as PICV to control preset header pressure of 60 ata steam to Urea palnt

Installation of VAG (Valve less automatic gravity) filter for new CT

To maintain the turbidity in circulating CW within 10 NTU level, four sand filters, two conventional pressurised sand filters and two VAG filters are installed in existing system. An additional VAG filter is installed in New CT area, as turbidity level in all the three basins has gone beyond 10 NTU .

P.O. No. 201004140641,Dated 19/09/2013 was placed on M/s Varenium Engg. Enterprise of Rs 13.6 Lakhs manufacturing and supply of VAG filter.

The vessel was designed in house and nozzles were supplied to manufacturer fabricated from usable scrap to reduce the cost.The MOC of base shell and base plate of vessel was chosen SS304 to avoid corrosion. The Erection of vessel was done departmentally and piping fabrication was done by M/s General Engg. Works.