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REPORT NO. 32 / 2012

IFFCO

KALOL UNIT

PLAN TURNAROUND REPORT

(MARCH – APRIL – 2012)

INDIAN FARMERS FERTILISER CO – OPERATIVE LIMITED

INDEX

PREFACE

The Annual Plant Turnaround for the year 2012 was taken from 28th of March, 2012 for carrying out Preventive maintenance of Static & Rotary equipments, Statutory IBR inspection, Preventive maintenance of Electrical & Instrument systems, Civil related jobs and for attending jobs which were pending for Shut down.

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 28th March 2012. This shutdown report contains Plant wise and section wise details of the jobs carried out. Ammonia plant was restarted and regular production was lined up at 22.00 Hrs. on 13th April, 2012. Similarly Urea plant also restarted and production was resumed at 19.45 Hrs. on 12th April, 2012.

Critical jobs like, Catalyst of the 1st bed of the Ammonia Converter was replaced by new one. Catalyst of LTS was replaced by new one. For the first time mobile steam generation unit was installed for reduction of new LTS catalyst. In Urea plant all tubes of 1st inter stage cooler (H-1811) and 3rd Inter stage cooler (H-1813) of Hitachi compressor train were replaced with duplex tubes (SAF 2205). In LP Carbamate condenser (H-1205) IRIS inspection was carried out. 66 nos. of tubes were plugged. In Offsite/Utility plants, IBR inspection of BHEL Boiler (GT-2068) was done after replacement of leaking secondary superheater top coil of BHEL Boiler. Old Analog and Digital Marshalling cabinets of Yokogawa DCS were replaced with the new Marshalling Cabinets, AMC services of DCS / PLC, Analyzers and UPSS were carried out of DCS software of Boiler, DM Plant & WT plant was upgraded to version R5.01.10 for compatibility to Windows 7 OS.

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 in the scheduled period of 16 days 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.

MECHANICAL

❖ AMMONIA

- Major overhauling of Syn. Gas Compressor drive Condensing Turbine 103-JBT, was carried out.
- Major overhauling of 101/105-J Lube Oil Pump Drive Turbine 101/105-JLJT was carried out. The TTV was upgraded to new vertically installed TTV.
- Major overhauling of 103-J Lube Oil Pump Drive Turbine 103-JLJT was carried out.
- Major overhauling of Re-cycle gas compressor, 117-J was carried.

- The gear type coupling of BFW Pump Drive Turbine 104-JT was replaced by upgraded Disc Type Coupling.
- 29 No of damaged Burner Blocks of Primary Reformer were replaced by new upgraded burner blocks.
- Replacement of the leaking PI & Drain tapping's Sockolet on the outlet piping of new Ammonia Converter, 108-D was carried out.
- New radar type Level Troll was installed for 101-F
- New steam inlet isolation valves were installed for 101-JT and 105-JT
- The 2 ½" 300 # control valves on the fuel header lines of Primary Reformer were replaced by New 3" X 300# control valves.
- The 10" NB inlet line of 102-EB was replaced by higher size i.e. 12" NB.
- The catalyst of LTS was replaced by new one. For the first time mobile steam generation unit was installed for reduction of new LTS catalyst.
- The catalyst of the 1st bed of the Ammonia Converter was replaced by new one. This was a unique attempt and 1st time in the history of IFFCO.
- Boiler 101-F was inspected by the Boiler Inspector and got approval of CIB Gujarat.

❖ **UREA**

- Minor overhauling of CO2 compressor drive turbine (Q-1801) Siemens make, LP Case (K-1801-1), HP case (K-1801-2) and Gear box of Hitachi CO2 compressor was carried out.
- Routine inspection of Autoclave (V-1201) & Eddy current testing of tubes of H-1201 was carried out.
- In LP Carbamate condenser (H-1205) IRIS inspection was carried out. 66 nos. of tubes were plugged
- All tubes of 1st inter stage cooler (H-1811) and 3rd Inter stage cooler (H-1813) of Hitachi compressor train were replaced with duplex tubes (SAF 2205) .
- Tube bundle of HP Scrubber (H-1203) was lowered for inspection.
- Partial replacement of off gas line (PR-1208-4"-X1 & P-1206-4"-X1) of V-1201 was carried out due to the thickness reduction.
- LP Vessels inspection was carried out and necessary repairs were undertaken as per inspection findings.
- Conveyor belt of M-1419 & M-1421 was replaced with OHR (Oil & Heat Resistant) grade belt.

❖ **OFFSITE & UTILITY**

Major jobs carried out during Annual turnaround:

- Replacement of leaking secondary superheater top coils, Replacement of Existing welded drum & superheater safety valves with flanged end safety valves, Re-Examination of Boiler Bank Tubes and Replacement of Burnout components of BHEL boiler Burner.

- IBR inspection of BHEL Boiler (GT-2068)
- Overhauling of FD fan drive turbine, Q-5113
- Replacement of rubber expansion bellows of all cooling water pump's suction.
- Complete overhauling of Elliott Turbine, Q-4411
- Installation of Pump Rotor having SS impeller in P-4401/A.
- Replacement of Cooling water pump sump sluice gates of P-4401/C & D with Jash make sluice gates.
- Repairing of deck and other structural members of cooling tower H-4401/7 & 8
- Preventive Maintenance/Overhauling of Cooling Water Pumps, RAH, BFW Pumps and Turbines.
- Maintenance of Air Compressors , Cooling water pumps & Preventive Maintenance of Cooling Tower Fans was carried out during Pre-shutdown activities:

❖ **B&MH**

- All conveyor and drive gear boxes were taken for preventive maintenance.
- Preventive maintenance of all packer scales and stitching machines.

INSTRUMENTATION

❖ **AMMONIA**

Old Analog and Digital Marshalling cabinets of Yokogawa DCS were replaced with the new Marshalling Cabinets. Required pre-fab cables and signal cables for these cabinets were replaced with new ones. New earthing for DCS, in place of old earthing, was connected.

New Terminal Server PC was commissioned. The data from all plant areas of IFFCO Kalol are available on this terminal server. DCS software was upgraded to version R5.01.10 for compatibility to Windows 7 OS.

Replaced old control valves MICV-1 to MICV-9 and TICV-60. Three nos. of new RADAR type level transmitters were installed in place of old leveltrols.

AMC services of DCS/PLC, Analyzers and UPSS were carried out with the help of supplier's service engineers. Preventive maintenance of control valves was done. Calibration of all quality affecting instruments was carried out.

❖ **UREA**

One spare node in system cabinet was installed and one new marshalling cabinet was installed for analog field inputs. Two new L3 switches were installed in system cabinet for Urea & boiler plants' data transmission to terminal server installed in Ammonia plant.

AMC services of DCS were carried out with the help of supplier's service engineers. DCS software was upgraded to version R5.01.10 for compatibility to Windows 7 OS.

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. Calibration of all quality affecting instruments was carried out.

- **OFFSITE & UTILITY**

  AMC services of DCS / PLC, Analyzers and UPSS were carried out with the help of supplier's service engineers. DCS software of Boiler, DM Plant & WT plant was upgraded to version R5.01.10 for compatibility to Windows 7 OS.

  Preventive maintenance of control valves was done. Calibration of all quality affecting instruments was carried out.

- **B & MH**

  Road Weigh Bridges and weighing machines were overhauled and calibrated.

ELECTRICAL

Annual plant turn around-2012 was carried out during March-April 2012. During this period various preventive maintenance jobs and modification jobs were carried out which are illustrated as below.

All the feeders of MCC panels were thoroughly cleaned. Burnt out/ damaged components of feeder were replaced. Tightness of connections was checked.

Replacement of MCC-2 sec B was carried out.

Replacement of 52F breaker by 52L breaker was carried out in 66KV switchyard. Also painting of entire switchyard structure was carried out during shutdown period.

Testing calibration and checking of all protective relays installed in various electrical panels were carried out.

Preventive maintenance of all the transformers was carried out. Marshaling boxes were checked. Insulation resistance between HV to earth, LV to earth and Between HV and LV windings were checked and recorded. Oil having low BDV values in transformers was filtered.

Painting of Transformers which were in poor condition due to corrosion was carried out.

Servicing of CTR make on load tap changer of Transformer 1B was carried out by lifting the tap changer from its position and replaced the insulating oil.

Servicing of Siemens make HT VCBs installed in 11KV panel and L&T make LT ACBs in various MCCs were carried out. Closing and tripping time of all the circuit breaker were checked and recorded.

All critical LT motors installed at various locations in plants were overhauled.

Servicing of All MOVs installed in Ammonia, Urea and Utility Plant were carried out .

Preventive maintenance carried out on all rope switches installed on conveyors.

Replacement of old, damaged, corroded power plug sockets of old reclaim machine with new power socket were carried out.

TECHNICAL

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

Various modification Scheme jobs were carried out by Technical Department in Ammonia, Urea, Utility and offsite Plants in Annual Turnaround – 2012. This includes

major jobs of “tappings for hook of New 1000 MT Ammonia tank”, “ installation of bypass valve of FV-14 & its piping support rectification” and “support modification job of HP Ammonia & Carbamate pump suction/ discharge piping after pulsation study by M/s Systech, Mumbai to solve vibration problem”.

Above jobs have been completed within stipulated time because of meticulous planning, procurement of material at right time and also completion of major prefabrication work well before start of the shut down.

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

- More than 85% LTCS pipes received from Aonla Unit.
- Most of the jobs have been executed by SOR contractor at regular rates.
- More and more Piping materials and valves etc were used out of our existing stocks.
- Pipings were so designed, so as to use material out of our stocks in most cases thereby minimizing Procurements, by meeting the requirements with in-house availability.

As lots of rigging work was involved during execution of above jobs, safety was given top most priority in and thus jobs were completed with no unsafe act occurrence.

PLANT TURNAROUND MARCH - APRIL - 2012

GENERAL - DETAILS

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

(II) HIRED - CONTRACT MANPOWER :

Sr. No.	Category	Man days
1	General Fitter	1351
3	Rigger	1640
4	S.S. Rigger	4498
5	Fabricator	228
6	Grinder	566
7	Gas Cutter	160
8	IBR Welder	102
9	Non-IBR Welder	130
10	Carpenter	115
11	Mason	136
12	Machinist	113

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

SHUT DOWN RELATED CONTRACTS

SR. NO.	PLANT	WO NO. & DATE	DESCRIPTION OF JOB	VENDOR'S NAME
1	MECH (AMMONIA)	201004120196 21/01/2012	Major overhauling and preventive maintenance of various rotating equipment in Ammonia	BVL Power Systems, Hyderabad
2	MECH (AMMONIA)	201004120195 21/01/2012	Major overhauling and preventive maintenance of various rotating equipment in Urea and Utility plants	TURBO ENGG SERVICES, Hyderabad
3	MECH (AMMONIA)	20110852 26/11/2011	Services of Scaffolding & Blinding / De-blinding jobs during Annual Shutdown	RAM BAHADUR & CO., Allahabad
4	MECH (AMMONIA)	20110785 26/11/2011	Overhauling of Re-cycle gas compressor 117-J	MALHAN ENTERPRISES PVT. LTD., Ahmedabad.
5	MECH (AMMONIA)	20101145 02/02/11	Services for Critical Fabrication Jobs in Ammonia Plant during Annual Shut-Down	DOWEL ERECTORS PVT. LTD., Ahmedabad.
6	MECH (AMMONIA)	20110850 26/11/11	In Situ Repairing of Valves.	AMRUTHA ENGINEERING, New Panvel.
7	MECH (AMMONIA)	20101302 17/03/11	Modification of Over speed Trip system.	FORBES AND COMPANY LTD., MUMBAI
8	MECH (UREA)	201004120601 28/05/12	Lowering & Lifting back of HP Scrubber H-1203 Tube Bundle	M/S Skywin Erectors, Vadodara
9	MECH (UREA)	201004120531 05/03/12	Repairing of Liner Weld Joints of Autoclave (V-1201)	DOWEL ERECTORS PVT LTD
10	MECH (UREA)	20110858 27/11/2011	Insitu Retubing of Inter stage Intercoolers (H-1811, H-1812 & H-1813)	M/s Nigasu Engineering Works , Mumbai 919820525525
11	MECH (OFFSITE)	201004130105 11/01/12	IBR Fabrication Jobs	M/S Skywin Erectors, Vadodara
12	MECH (OFFSITE)	0019 21/12/11	Replacement of Rubber Expansion Bellows of suction line of CW Pumps	M/S General Engg. Works, Bharuch
13	MECH (OFFSITE)	20110735 14/11/11	Gland Repacking of Valves	M/S Amrutha Engg, Mumbai
14	MECH (OFFSITE)	20110784 21/11/11	Installation of Sluice Gates	M/S Jash Engg, Indore
15	MECH (OFFSITE)	0255 09/02/12	Repairing of BDK Make butterfly Valve of P-4404 Disch	M/S BDK Valves, Vadodara
16	MECH (OFFSITE)	201004120540 06/03/12	Service of M/S BHEL for Boiler Tube Leak identification & Repairing	M/S BHEL, Vadodara
17	MECH (OFFSITE)	201004120506 10/03/2012	Re-examination of Boiler Bank Tubes	M/S Thermax, Pune
18	MECH (OFFSITE)	201004120574 15/03/2012	Services of M/s Thermax for Repairing of BHEL Boiler Burners	M/S Thermax, Pune
19	MECH (OFFSITE)	--	Services for Hydrotest and Re-expansion of Boiler Tubes	M/S A.M Erectors, Ahmedabad

20	MECH (OFFSITE)	201004120579 16/03/2012	Services for the refractory work in BHEL Boiler Burners	M/S Ace Calderys, Ahmedabad
21	MECH (OFFSITE)	20110478 05/10/2011	Repairing of Cooling Towers	M/S Paharpur, Vadodara
22	B&MH	2010041220019 27/12/11	Overhauling of Reclaim machine	M/s Emtici engg,VV Nagar
23	B&MH	20100517 14/08/10	Overhauling of tracking rollers	M/s Hosch Equipments, Ahmedabad [Office]
24	B&MH	20100561 09/09/10	Servicing of stitching machines	M/s Gabbar Engg Ahmedabad
25	B&MH	20091187 02/02/10	Hot vulcanizing of conveyor belts	M/s J.K.Rubber works Ahmedabad
26	B&MH	20110834 26/11/11	Rubber lining of pulleys	M/s J.K.Rubber works Ahmedabad
27	INSPECTION	20091032 01/01/10	NDT TEAMS FOR CARRYING OUT RADIOGRAPHY WORK	NDT SERVICES, AHMEDABAD
28	INSPECTION	20104120068 02/02/11	IRIS INSPECTION OF LP CARBAMATE CONDENSER	TESTEX NDT, MUMBAI
29	INSPECTION	20110550 27/09/11	NDT TEAMS FOR CARRYING OUT DYE PENETRANT TESTING	ENGG. INSPECTION SERVICES, MUMBAI
30	INSPECTION	20110604 08/10/11	NDT TEAMS FOR ULTRASONIC THICKNESS MEASUREMENT WORK	ENGG. INSPECTION SERVICES, MUMBAI
31	INSPECTION	20110554 23/09/11	NDT TEAMS FOR CARRYING OUT ULTRASONIC FLAW DETECTION	ENGG. INSPECTION SERVICES, MUMBAI
32	INSPECTION	20110542 16/09/11	NDT TEAMS FOR CARRYING OUT MPI	ENGG. INSPECTION SERVICES, MUMBAI
33	INSPECTION	20091025 30/12/09	IN-SITU METALLOGRAPHY WORK	TCR ADVANCED ENGG. VADODARA
34	INSPECTION	20110605 20/10/11	EDDY CURRENT TESTING OF HP STRIPPER AND HP CONDENSER TUBES	TESTEX NDT, MUMBAI
35	INSTRUMENT	201004120239 01/02/12	Preventive maint./ checking of Ammonia Plant FUJI make UPSS	M/s Instrumentation Ltd., Kota
36	INSTRUMENT	201004120263 25/01/12	AMC for servicing of ABB make Analyzers	M/s ABB Ltd , Ahmedabad
37	INSTRUMENT	201004120266 25/01/12	Maintenance of Control Valves	M/s Amrutha Engineering, New Panvel (Maharastra)
38	INSTRUMENT	20110592 30/09/11	Petty maintenance Jobs	M/s Bajrang & Co., Kalol
39	INSTRUMENT	20110421 26/08/11	Metso Ball valve maintenance	M/s Metso Automation Pvt. Ltd., Vadodara
40	INSTRUMENT	201001120366 16/02/12	AMC for preventive maintenance of plants DCS	M/s Yokogawa India Ltd., Vadodara
41	INSTRUMENT	201001120261 24/01/12	Replacement of Marshalling cabinets for DCS	M/s Yokogawa India Ltd., Vadodara
42	INSTRUMENT	20081307 20/02/09	Inspection & Repair of gland leakage of HICV-1201	Key Tech Engineering , Mumbai

43	INSTRUMENT	201001120213 23/01/12	Skilled Man power for Inst. Jobs	MPR under progress
44	ELECTRICAL	201004120013	Servicing of Siemens make 11 KV Vacuum circuit breakers	M/S SIEMENS
45	ELECTRICAL	201004120428	Servicing of Siemens make LT air circuit breakers	M/S PRADIP POWERTECH
46	ELECTRICAL	201004120203	Servicing of L&T make LT air circuit breakers	M/S L&T
47	ELECTRICAL	201004120256 13/12/11	Maintenance and Painting of transformers	M/S UNIQUE
48	ELECTRICAL	201004120214	Servicing of MOVs installed at various locations in plant	M/S ROTORK
49	ELECTRICAL	20101401 30/03/11	Replacement of MCC 2 sec B	SIEMENS LTD.
50	ELECTRICAL	201004120192 11/01/12	Servicing of CTR make OLTC of transformer-1B	M/S CTR
51	ELECTRICAL	20110801 24/11/11	Supply & Installation of GI cable tray in Silo new reclaim machine	M/S A.N. ELECTRICALS
52	ELECTRICAL	201004120287	Testing of protective relays	M/S ELCON ENGINEERS PVT.LTD.
53	ELECTRICAL	201004120082 07/01/12	Servicing of Battery & Battery charger in MPSS	M/S CHABHI
54			Replacement of MOCB	M/S BHEL
55	PLANNING	20090531 29/09/09	Annual Rate Contract for supplying & application of Anti-corrosive paints in Urea & B&MH plant	M/s.Vaidehi & Co, Baroda
56	PLANNING	20100493 21/08/10	Annual Rate Contractor for supplying & application of Anti-corrosive paints in Ammonia & Offsite plant	M/s B.Chauhan & Co, Kalol
57	PLANNING	20101164 08/03/11	Annual Rate contract for Fabrication & Erection of piping & steel structure.	M/s.J & J Engineers – Kalol
58	PLANNING	20101165 08/03/11	Annual Rate contract for Fabrication & Erection of piping & steel structure.	M/s.Smitha Engineers– Kalol
59	PLANNING	201004120197 13/1/12	Opening & Box-up of Heat Exchangers in Ammonia, Urea and Offsite plants.	M/s. General Engg. Bharuch
60	PLANNING	201004120098 12/01/12	Assisting IFFCO during Breakdown/Plant Turnaround jobs.	M/s. General Engg. Bharuch
61	PLANNING	201004120097 12/01/12	Assisting IFFCO during Breakdown/Plant Turnaround jobs.	M/s. Ram Bahadur and Co, Pali Babuganj
62	PLANNING	201004120246 24/01/12	Annual Rate Contract for Hydro jet cleaning of Heat Exchangers.	M/s.Deluxe Hydroblasting Services,Mumbai
63	PLANNING	20110867 18/11/11	Rate contract for carrying out various insulation jobs.	M/s. Balaji Insulation
64	PLANNING	20110867 18/11/11	Rate contract for carrying out various insulation jobs.	M/s. Khandelwal Insulation
65	PLANNING	20100107 18/06/10	Rate contract for carrying out various Petty Maint. jobs.	M/s. J & J Engineers – Shertha

66	PLANNING	20110745 17/11/11	Over hauling of Relief valves (Critical)	M/s Flotec Eng.Services, Surat
67	PLANNING	20110831 26/11/11	Over hauling of Relief valves (Non-Critical)	M/s Flotec Eng.Services, Surat
68	CIVIL	20110778 26/11/11	Providing and applying epoxy monolithic plaster at B & MH building and Conveyor gallery at silo.	Jenney Corrosion Controllers
69	CIVIL	20110822 26/11/11	Repair and maintenance of Bitumastic Lining, Acid and Alkalis proof brick lining in Strong / Week effluent pit, Water Treatment Plant, Prill Tower-top floor, Bagging Plant and other Plant areas.	ANANT BUILDERS
70	CIVIL	20110782 18/11/11	Providing and applying Epoxy painting & White wash to RCC structure of Bagging Plant and Urea Plant.	VAIDEHI & COMPANY
71	CIVIL	20110781 18/11/11	Repairing of plaster in Bagging plant and other areas in plant.	I.M.NAIK
72	CIVIL	201004120057 25/01/12	Providing and applying IP net protective coating on RCC structures of Silo, B & MH plant area, Conveyor Gallery, Prill- Tower etc.	KRISHNA CONCHEM PRODUCTS PVT LTD
73	CIVIL	20110780 26/11/2011	Miscellaneous civil work in various area of plant during annual turnaround 2012-2013	I.M.NAIK
74	CIVIL	20101160 12/12/2011	Maintenance of damaged cooling tower deck covering by water proof plywood sheet.	SUDAMA FURNITURE PRODUCTS PVT LTD
75	CIVIL	201004120227 18/01/12	Repairing of Refractory lining work for Primary Reformer , Auxiliary and BHEL boiler area.	M H DETRICK (INDIA) PVT LTD
76	CIVIL	20110779 25/11/11	Repair of side walls of B & MH plant by providing ceramic tiles.	ROSHNI CONSTRUCTION CO.
77	CIVIL	201004120156 25/01/12	Replacement of Precast R.C.C railing in silo of conveyor gallery No - M-2117 .	J & J ENGINEERS

MECHANICAL

AMMONIA PLANT
(MECHANICAL)

AIR COMPRESSOR TRAIN (101-J)

101-JT ,Air Compressor Drive Turbine

Turbine was decoupled and Thrust bearing as well as both end Journal bearings were taken for inspection. One of the active side thrust bearing pad was found with 40 % white metal removed. It was observed that the washer below the leveling semispherical ball was missing. The same was manufactured in-house and the thrust bearing was assembled with a new thrust pad. The thickness of all the pads was matched before assembly. Gauss readings of the bearing pads were measured and found within limits. Bearing clearances were taken and found within the design range. The governor drive gear assembly were also inspected and found OK.

101-JLP, Air Compressor

101-JLP was decoupled from both ends. Journal bearings and Thrust bearing 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. 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

101-JHP was decoupled at gear box end. 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	0.019	0.019
	North	0.015-0.021	0.019	0.019

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
Governor End				
Journal Bearing	Mandrel	0.007-0.009	0.0078	0.0078
	North	0.015-0.021	0.019	0.019
Oil Guard For Thrust Bearing	South	0.002-0.004	0.0038	0.0038
	North	0.002-0.004	0.0038	0.0038
Axial Thrust.	With Top Housing	0.008-0.012	0.008	0.008
Nozzle Clearance	With Top Housing	0.055-0.065	0.043	0.043
Total float	With Top Housing	0.180	0.177	0.177

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	0.9368	0.938	0.4996	0.4996
No 2	0.9368	0.938	0.50	0.50
No 3	0.9368	0.938	0.50	0.50
No 4	0.9231	0.938	0.50	0.50
No 5	0.9350 -0.9354	0.9350 -0.9354	0.50	0.50

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
Oil Guard (For Journal Bearing)	North	0.013-0.015	0.010	0.010
	South	0.013-0.015	0.012	0.012
Oil Guard (For Outer Housing)	North	0.021-0.027	0.026	0.026
	South	0.021-0.027	0.023	0.023

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
Gear Box End.				
Journal Bearing Clearance	Mandrel	0.005-0.008	0.008	0.009
Oil Guard (For Journal Bearing)	North	0.013-0.015	0.012	0.012
	South	0.013-0.015	0.010	0.010
Oil Guard (For Thrust bearing)	North	0.002-0.004	0.002	0.002
	South	0.002-0.004	0.002	0.002
Axial Thrust	With Top Housing	0.010 - 0.015	0.010	0.010

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	0.7813	0.7813	0.7822	0.7822
No 2	0.7811	0.7811	0.7818	0.7818
No 3	0.7826	0.7826	0.7818	0.7818
No 4	0.7816	0.7816	0.7822	0.7822
No 5	0.7811	0.7811	0.7818	0.7818
No 6	0.7826	0.7826	0.7818	0.7818
No 7	0.7830	0.7830	0.7818	0.7818
No 8	0.7834	0.7834	0.7818	0.7818

CLEARANCE CHART - 101-JR

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
Journal Bearing (Low Speed drive gear)	North	0.008-0.010	0.011	0.011
	South	0.008-0.010	0.010	0.010
Axial Thrust	---	0.014-0.024	0.014	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	---	---	0.015	0.015

CLEARANCE RECORDS – 101JHP

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
GB End				
Journal Bearing Clearance	Mandrel	0.004-0.007	0.007	0.007
Oil Guard (For Journal Bearing)	North	0.013-0.016	0.014	0.014
	South	0.013-0.016	0.015	0.015
Oil Guard (For Top Housing)	North	0.015-0.022	0.013	0.013
	South	0.015-0.022	0.023	0.023
Non Drive End				
Journal Bearing Clearance	Mandrel	0.004-0.007	0.0067	0.0067
Oil Guard (For Journal Bearing)	North	0.013-0.016	0.015	0.015
	South	0.013-0.016	0.015	0.015
Oil Guard (For Thrust bearing)	North	0.002-0.004	0.002	0.002
	South	0.002-0.04	0.002	0.002
	South	0.015-0.022	0.013	0.013
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	0.561	0.561
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

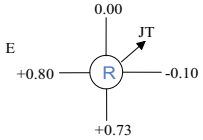
Thrust Bearing Pad Thickness - 101 – JHP

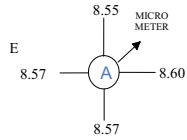
Pad	ACTIVE		INACTIVE	
	Before (inch)	After (inch)	Before (inch)	After (inch)
No 1	0.5000	0.5000	0.4990	0.4990
No 2	0.4997	0.4997	04985	04985
No 3	0.4999	0.4999	0.4990	0.4990
No 4	0.5003	0.5003	0.4990	0.4990
No 5	0.4998	0.4998	0.4990	0.4990
No 6	0.5005	0.5005	0.4986	0.4986

Magnetism Level Records : 101-J TRAIN

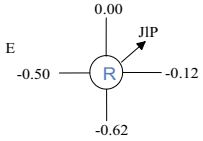
Description	Position	Before (Gauss)	After (Gauss)
101- JT			
Journal Bearing pads	Thrust End	1.3-1.7	1.3-1.7
	Non thrust end	0.6-1.3	0.6-1.3
Journal Bearing base ring	Thrust End	1.3	1.3
	Non thrust end	1.5	1.5
Thrust bearing pads	Active	2.0	2.0
	Inactive	0.7	0.7
Thrust Bearing base ring	Active	1.8	1.8
	Inactive	1.0	1.0
Shaft Journal	Thrust End	2.7	2.7
	Non thrust end	2.5	2.5
101 - JLP			
Journal Bearing pads	Thrust End	0.8-1.6	0.8-1.6
	Non thrust end	1.1-3.1	1.1-3.1
Journal Bearing base ring	Thrust End	1.9	1.9
	Non thrust end	1.7	1.7
Thrust bearing pads	Active	1.7	1.7
	Inactive	1.3	1.3
Thrust Bearing base ring	Active	1.7	1.7
	Inactive	1.3	1.3
Shaft Journal	Thrust End	2.8	2.8
	Non thrust end	3.2	3.2
101 – JR			
Gear Journal Bearing	North	0.4-0.5	0.4-0.5
	South	0.6-1.2	0.6-1.2
Pinion Journal Bearing	North	0.5-1.1	0.5-1.1
	South	0.6	0.6
Thrust bearing	Active	0.7-1.2	0.7-1.2
	Inactive	0.8-0.9	0.8-0.9
Shaft Journal	Thrust End	1.6	1.6
	Non thrust end	1.5	1.5
101 - JHP			
Journal Bearing pads	Thrust End	0.9	0.9
	Non thrust end	1.2	1.2
Journal Bearing base ring	Thrust End	1.3	1.3
	Non thrust end	1.3	1.3
Thrust bearing pads	Active	0.4	0.4
	Inactive	0.5	0.5
Thrust Bearing base ring	Active	1.8	1.8
	Inactive	1.5	1.5
Shaft Journal	Thrust End	4.2	4.2
	Non thrust end	1.8	1.8

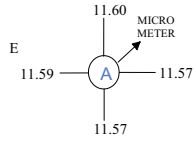
Alignment (in mm) : **101-JT to 101-JLP** After Preventive Maintenance



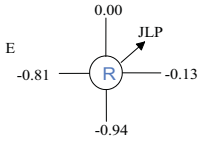


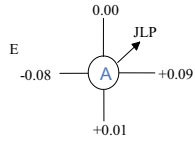
Alignment (in mm) : **101-JLP to 101-JR** After Preventive Maintenance





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





SYNTHESIS GAS COMPRESSOR TRAIN, 103-J

103-JBT, Condensing turbine, Overhauling

Turbine was decoupled and taken for major overhauling. The top casing was removed and all axial clearances were measured. The rotor was removed and taken for inspection. Very heavy silica deposits were found on the blades of the rotor as well as the diaphragms. These deposits were removed by sand blasting. Deep scorings were also observed on the parting planes of the diaphragms and on the top casing diaphragm seating area. These were repaired by welding and filing. The magnetism level measurement of the complete rotor assembly was carried out and found to be within limit. The hand valve spindles were made free and the total travel of each valve was measured and found to be in the range of 27-31 mm.

The tapping for exhaust on the top casing flange was found to be having a broken nipple. The same was replaced by a new nipple. The rotor was placed inside the casing and all axial clearances were measured and found within limit. The top casing was assembled and the bearing clearances were measured and found to be within limit. The magnetism level of the Journal bearing pad/base ring, Thrust bearing pads/leveling plates/base ring/inactive ring/ thrust collar was measured and found within limit.

The steam gland labyrinth clearances were measured and found to be within limit. The OST assembly was checked and found to be free. The governor drive gear assembly

was also found to be good conditions. The governor final travel was measured and found to be 24.5 mm (Design 1"). The pneumatic cylinder, PRC-23's travel was also checked and found to be 24.5 mm (Design 1").

103-JBT Over Speed Trip Check

The turbine coupling was kept decoupled and the coupling hub skirt flange along with the flexible elements was locked using gagging screw. On the first attempt for OST, the turbine speed was increased up to 12300 RPM and the turbine did not tripped.

The turbine was stopped & the journal bearing housing, trip levers assembly & three way valve was removed. The weight assembly was removed from the shaft and it was observed the there was metal flow around the tip of the Weight(1) and as a result of which, it was not very free inside the Nut(2) , Shaft & Shim (4). The inside diameter of the Nut (2) & Shim (4) was cleaned using a round file. The outside diameter of the weight was made parallel on lathe using a emery paper. After reassembly, the 2nd attempt was taken and the speed was increased upto 12340 RPM and again turbine did not trip.

This time the governor assembly was removed in order to completely expose the OST assembly and the trip levers. The trip lever pin was found damaged. The same was replaced. Clearance of 0.100" was kept between trip weight and the lever. The governor was assembled. The third trial was taken and the turbine tripped at 11885 RPM.

103-JBT ROTOR CLEANED BY SAND BLASTING

103-JLP, Synthesis Gas Compressor

The non thrust end journal bearing was removed and the clearance was measured and found to be within limit. The thrust end journal bearing was not accessible as it required removal of thrust collar, but the active end pads were removed for inspection. 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

Thrust bearing and both end Journal bearing which were accessible were inspected and found O.K Gauss readings of both end journal bearing pad and base ring, shaft journal area, thrust bearing and thrust collar was measured and found within limit. All removed pads were Dye Penetration tested and no surface cracks were found.

103-JAT, Backpressure turbine

Turbine was decoupled and thrust bearing as well as both ends Journal bearings were inspected and found O.K. Gauss readings of end journal bearing pad and base ring, shaft journal area, thrust bearing and thrust collar was measured and found OK. Bearing clearances were taken and found within the design range.

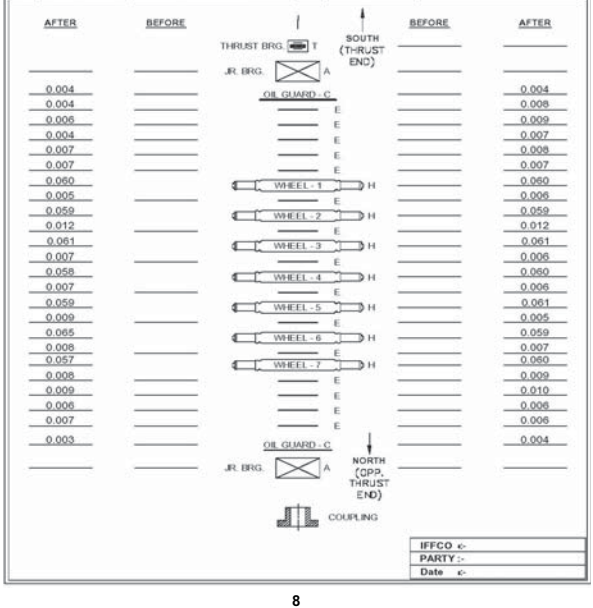
Couplings Inspection

All the couplings were visually inspected. The DBSE of all the couplings were measured and found OK. Wherever coupling hub locknuts have been provided, the coupling hub to locknut clearances were measured and found OK. Wherever lock nuts are not provided, the coupling hub overhang/ override were measured and found within limit.

IFFCO - KALOL

AXIAL / DIAMETRICAL CLEARANCES - 103-JBT

REF.	CLEARANCE - INCHES	BETWEEN	REF.	CLEARANCE - INCHES	BETWEEN
A	0.007 TO 0.009	JOURNAL BEARING TO SHAFT	H	0.055 TO 0.065	AXIAL WHEEL TO DIAPHRAGM
C	0.015 TO 0.021	OIL GUARD TO SHAFT	T	0.008 TO 0.012	ENT THRUST
E	0.012 TO 0.019	LABYRINTH RING RO SHAFT			



COUPLING RECORDS 103-J TRAIN

Distance between Coupling Hub Flange faces				
Description	**Position**	**Design (Inch)**	**Before (Inch)**	**After (Inch)**
103 JBT - JAT	---		10.823	10.823
103 JAT - JLP	---		13.484	13.484
103 JLP- JHP	---		17.689	17.689

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	0.0105	0.0105
Oil Guard (For Jr. Brg Housing)	South	C	0.008-0.014	0.11	0.11
Oil Guard (For Seal Housing)	---	D	0.039-0.071	0.11	0.11
Bearing Pinch	Jr. Brg.			0.032	0.032
Shaft Diameter	Jr. Brg.			2.999	2.999
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	0.010	0.010
Axial Thrust.	With Top Housing		0.008-0.012	0.008	0.008

PREVENTIVE MAINTENANCE RECORDS: 103 – JBT

Journal Bearing Pad thickness				
PAD	**NORTH SIDE BEARING** (mm)		**SOUTH SIDE BEARING** (mm)	
	Before	**After**	**Before**	**After**
No 1	19.02	19.02	19.00	19.00
No 2	19.01	19.01	19.00	19.00
No 3	19.01	19.01	19.01	19.01
No 4	19.01	19.01	19.01	19.01
No 5	19.01	19.01	19.00	19.00
Thrust Bearing Pad Thickness				
PAD	**ACTIVE** (mm)		**INACTIVE** (mm)	
	Before	**After**	**Before**	**After**
No 1	15.88	15.88	12.71 (TOP)	12.71 (TOP)
No 2	15.86	15.86	12.72 (BOTTOM)	12.72 (BOTTOM)
No 3	15.87	15.87	NA	NA
No 4	15.90	15.90	NA	NA
No 5	15.90	15.90	NA	NA
No 6	15.89	15.89	NA	NA

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	0.075	0.075
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	0.011	0.011
Oil Guard (For Brg. Housing	North	C	0.015-0.021	0.015	0.015
Axial Thrust.	With Top Housing	---	0.008-0.012	0.011	0.011
Oil Guard (For Thrust Bearing)	North	A	0.002-0.004	0.004	0.004
	South	A	0.002-0.004	0.004	0.004

PREVENTIVE MAINTENANCE RECORDS: 103 – JAT

Journal Bearing Pad thickness				
PAD	**NORTH SIDE BEARING (mm)**		**SOUTH SIDE BEARING (mm)**	
	Before	**After**	**Before**	**After**
No 1	19.03	19.03	20.62	20.62
No 2	19.03	19.03	20.60	20.60
No 3	19.04	19.04	20.60	20.60
No 4	19.03	19.03	20.61	20.61
No 5	19.03	19.03	20.60	20.60
Thrust Bearing Pad Thickness				
Pad	**ACTIVE (mm)**		**INACTIVE (mm)**	
	Before	**After**	**Before**	**After**
No 1	25.36	25.36	15.88 (TOP)	15.88 (TOP)
No 2	25.34	25.34	15.89(BOTTOM)	15.89(BOTTOM)
No 3	25.35	25.35	NA	NA
No 4	25.34	25.34	NA	NA
No 5	25.33	25.33	NA	NA
No 6	25.36	25.36	NA	NA

PREVENTIVE MAINTENANCE RECORDS : 103- JLP

Description	Position	Clr. Chart Ref.	Design Clearances (Inch)	Before (Inch)	After (Inch)
NON THRUST END					
Journal Brg. Clearance	Filler / lead wire	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 Brg. Clearance	Filler / lead wire	C1	0.002"-0.004"	0.005	0.005
Axial Thrust	With Top Housing		0.015" - 0.022"	0.016	0.016

PREVENTIVE MAINTENANCE RECORDS : 103 – JHP

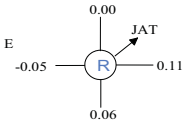
Description	Position	Clearance Chart Ref.	Design Clearances (Inch)	Before (Inch)	After (Inch)
NON THRUST END					
Journal Bearing Clearance	Filler / lead wire	A1	0.0023"-0.0033"	0.005	0.005
Oil Guard (For Journal Bearing)	North	A2	0.0085"- 0.0115"	0.011	0.011
	South	A2	0.0085"- 0.0115"	0.011	0.011
THRUST END					
Journal Bearing Clearance	Filler / lead wire	A1	0.023"-0.033"	0.006	0.006
Axial Thrust	With Top Housing		0.015"- 0.022"	0.015	0.015

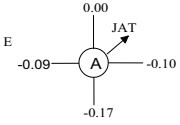
Magnetism Level Record

Description	Position	Before (Gauss)	After (Gauss)
103- JBT			
Journal Bearing Sleeve	Thrust End	1.2	1.2
	Non thrust end	2.3	2.3
Thrust bearing pads	Active	2.3	2.3
	Inactive	1.2	1.2
Thrust Bearing base ring	Active	0.9	0.9
	Inactive	1.6	1.6
Shaft Journal	Thrust End	1.3	1.3
	Non thrust end	2.5	2.5
103 - JAT			
Journal Bearing Sleeve	Thrust End	1.7	1.7
	Non thrust end	2.3	2.3
Thrust bearing pads	Active	1.7	1.7
	Inactive	1.5	1.5
Thrust Bearing base ring	Active	1.5	1.5
	Inactive	1.6	1.6
Shaft Journal	Thrust End	3.0	3.0
	Non thrust end	1.2	1.2
103 - JLP			
Journal Bearing Sleeve	Thrust End	1.4	1.4
	Non thrust end	1.1	1.1
Shaft Journal	Thrust End	2.2	2.2
	Non thrust end	1.6	1.6
103-JHP			
Journal Bearing Sleeve	Thrust End	0.8	0.8
	Non thrust end	0.9	0.9
Thrust bearing pads	Active	1.5	1.5
	Inactive	NA	NA
Shaft Journal	Thrust End	2.1	2.1
	Non thrust end	2.4	2.4

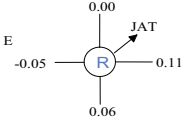
Alignment: 103-JBT to 103-JAT

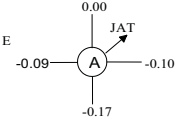
Before Preventive Maintenance (mm)





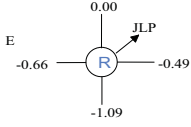
After Preventive Maintenance (mm)

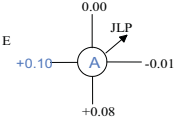




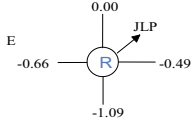
Alignment: 103-JAT to 103-JLP

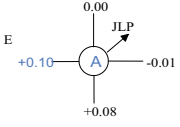
Before Preventive Maintenance (mm)





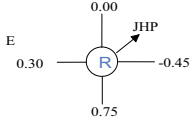
After Preventive Maintenance (mm)

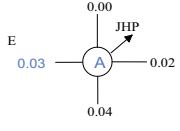




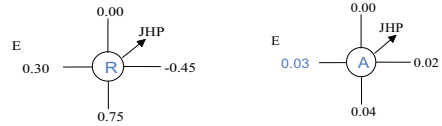
Alignment : 103-JLP to 103-JHP

Before Preventive Maintenance (mm)





After Preventive Maintenance (mm)



REFRIGERATION COMPRESSOR TRAIN 105-J

105-JT, Refrigeration Compressor Drive Turbine

Turbine was decoupled and both ends Journal bearings as well as Thrust bearing 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 were also inspected and found OK.

105-JLP Refrigeration Compressor

101-JLP, gear box end was decoupled. Journal bearings as well as Thrust bearing 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.

105-JR Gear Box

101-JR, HP end was decoupled. 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.

105-JHP Refrigeration Compressor

The Journal bearing as well as thrust bearing were inspected and dye penetration tested and found OK. The bearing clearances were within limit. Gauss readings of journal and thrust bearing pads and base ring, shaft journal, thrust collar were measured and found within limit.

Couplings Inspection

All the couplings were visually inspected. The DBSE of all the couplings were measured and found OK. Wherever coupling hub locknuts have been provided, the coupling hub to locknut clearances were measured and found OK. Wherever Lock nuts are not provided, the coupling hub overhang/ override were measured and found OK.

CLEARANCE CHART: 105-JT

Description	Position	Clr. Chart Ref	Design Clearances (Inch)	Before (Inch)	After (Inch)
JLP end					
Journal Bearing	Mandrel	B	0.007-0.009	0.0085	0.0085
Oil Guard For Jr. Brg Housing	South	C	0.015-0.021	0.019	0.019
	North	G	0.015-0.021	0.019	0.019

Description	Position	Clr. Chart Ref	Design Clearances (Inch)	Before (Inch)	After (Inch)
Governor End					
Journal Bearing	Mandrel	B	0.007-0.009	0.0085	0.0085
Oil Guard For Brg. Housing	North	C	0.015-0.021	0.019	0.019
Oil Guard For Thrust Brg.	South	A	0.002-0.04	0.002	0.002
	North	A	0.002-0.004	0.002	0.002
Axial Thrust.	With Top Housing	---	0.008-0.012	0.010	0.010
Nozzle Clearance.	---	---	0.055-0.065	0.055	0.055
Total Float	With Top Housing	---	0.180	0.188	0.188
Trip Lever - Plunger	---	---	0.120-0.130	0.122	0.122

Journal Bearing Pads thickness: 105 – JT

PAD	NORTH SIDE BEARING (mm)		SOUTH SIDE BEARING (mm)	
	Before	After	Before	After
No 1	20.61	20.61	20.36	20.36
No 2	20.61	20.61	20.36	20.36
No 3	20.61	20.61	20.36	20.36
No 4	20.61	20.61	20.36	20.36
No 5	20.61	20.61	20.36	20.36

Thrust Bearing Pad Thickness: 105-JT

Pad	ACTIVE (mm)		INACTIVE (mm)	
	Before	After	Before	After
No 1	19.56	19.56	15.92(Top)	15.92(Top)
No 2	19.56	19.56	15.92(Bottom)	15.92(Bottom)
No 3	19.56	19.56	NA	NA
No 4	19.56	19.56	NA	NA
No 5	19.56	19.56	NA	NA
No 6	19.56	19.56	NA	NA

CLEARANCE CHART : 105 – JLP

Description	Position	Clearance Chart Ref.	Design Clearances (Inch)	Before (Inch)	After (Inch)
TURBINE END					
Journal Bearing Clearance	By Dial Gauge	F	0.006-0.008	0.007	0.007
GEAR BOX END					
Journal Bearing Clearance	Mandrel	F	0.006 - 0.008	0.007	0.007
Oil Guard (For Thrust bearing)	North	C	0.002 - 0.004	0.006	0.006
	South	C	0.002 - 0.004	0.005	0.005
Oil Guard (For Outer Housing)	North	A	0.020 - 0.026	0.0275	0.0275
Axial Thrust	With Top Housing	----	0.011– 0.015	0.009	0.009

Journal Bearing Pads thickness: 105 – JLP

PAD	NORTH SIDE BEARING		SOUTH SIDE BEARING	
	Before (inch)	After (inch) (NEW PADS)	Before (inch)	After (inch)
No 1	19.05	19.05	NA	NA
No 2	19.06	19.06	NA	NA
No 3	19.05	19.05	NA	NA
No 4	19.05	19.05	NA	NA
No 5	19.05	19.05	NA	NA

Thrust Bearing Pad Thickness: 105-JLP

Pad	ACTIVE		INACTIVE	
	Before (mm)	After (mm)	Before (mm)	After (mm)
No 1	19.76	19.76	19.76	19.76
No 2	19.76	19.76	19.76	19.76
No 3	19.76	19.76	19.76	19.76
No 4	19.76	19.76	19.76	19.76
No 5	19.76	19.76	19.76	19.76

CLEARANCE CHART: 105-JR

Description	Position	Design Clearances (Inch)	Before (Inch)	After (Inch)
Journal Bearing (Low Speed drive gear)	North	0.014 – 0.016	0.014	0.014
	South	-- do --	0.014	0.014
Axial Thrust	---	0.014-0.024	0.014	0.014
Journal Bearing (High Speed driven Pinion)	North	0.013 -	0.013	0.013
	South	-- do --	0.013	0.013
Backlash	---	---	0.019	0.019

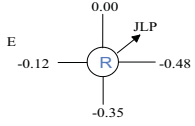
CLEARANCE CHART : 105 – JHP

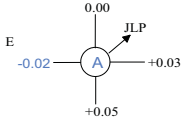
Description	Position	Clr. Chart Ref.	Design Clearances (Inch)	Before (Inch)	After (Inch)
GEAR BOX END					
Journal Bearing Clearance	By Dial Gauge	C	0.004 – 0.007	0.006	0.006
NON DRIVE END					
Journal Bearing Clearance	Mandrel	C	0.004 – 0.007	0.006	0.006
Oil Guard (For Thrust bearing)	North	P	0.002 – 0.004	0.005	0.005
	South	P	0.002 – 0.004	0.005	0.005
Oil Guard (For Top Housing)	North	P	0.002 – 0.004	0.005	0.005
Axial Thrust	With Top Housing	---	0.009 – 0.013	0.013	0.013

Thrust Bearing Pad Thickness: 105-JHP

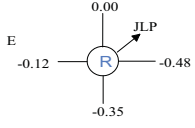
Pad	ACTIVE		INACTIVE	
	Before (mm)	After (mm)	Before (mm)	After (mm)
No 1	14.30	14.30	14.27	14.27
No 2	14.30	14.30	14.27	14.27
No 3	14.30	14.30	14.27	14.27
No 4	14.30	14.30	14.27	14.27
No 5	14.30	14.30	14.27	14.27
No 6	14.30	14.30	14.27	14.27
No 7	14.30	14.30	14.27	14.27
No 8	14.30	14.30	14.27	14.27

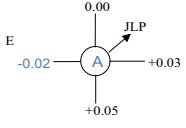
Alignment (in mm) : 105-JT to JLP (Before PM)



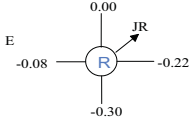


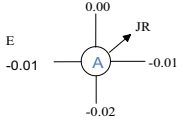
Alignment (in mm) : 105-JT to JLP (After PM)



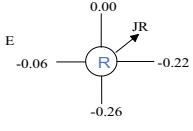


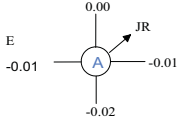
Alignment (in mm) : 105 JLP to GB (Before)



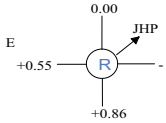


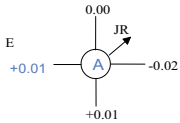
Alignment (in mm) : 105 JLP to GB (Before)



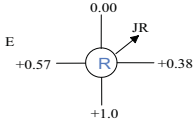


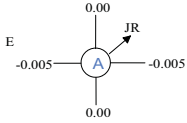
Alignment (in mm) : 105 GB to JHP (Before PM)





Alignment (in mm) : 105 GB to JHP (After PM)





INDUCED DRAFT FAN 101-BJ TRAIN

101- BJT Drive 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 PGPL actuator was replaced by new one as per schedule.

101- BJ Fan

Journal bearings and thrust bearing 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 surface cracks were found Bearing clearances were taken and found within the design range. Cooling water was circulated in lines and no leaks were observed. The final bearing clearance was measured and found within design range.

101-BJR Gear box Overhauling

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

Couplings Inspection

Both the couplings i.e. between turbine to gear box and between gearboxes to fan were inspected and found OK. The gear coupling float was measured and noted. The flexible element of the coupling between the turbine and the gear box was found in good condition

CLEARANCE CHART 101- BJT

Description	Position	Clr. Chart Ref	Design Clearances (Inch)	Before (Inch)	After (Inch)
Gear Box End					
Journal Bearing	Filler / lead wire	---	0.007-0.010	0.011	0.011
Oil Guard (For Jr. Brg Housing)	CT Side	---	0.015"-0.0195"	0.018	0.018
	SILO Side	---	0.015"-0.0195"	0.018	0.018
Governor End					
Journal Bearing	Filler / lead wire	---	0.006-0.009	0.012	0.012
Oil Guard (For Brg. Housing	CT Side	---	0.015"-0.0195"	0.014	0.014
Axial Thrust.	With Top Housing	---	0.014"	0.014	0.014

101-BJR				
Description	**Position**	**Design Clearances (Inch)**	**Before (Inch)**	**After (Inch)**
Journal Bearing (High Speed drive Pinion)	CT Side	0.005"-0.008"	0.010	0.010
	SILO Side	0.005"-0.008"	0.007	0.007
Axial Thrust	---		0.014	0.014
Journal Bearing (Low Speed driven Gear)	CT Side	0.005"-0.008"	0.009	0.009
	SILO Side	0.005"-0.008"	0.008	0.008
Backlash	---	0.013"-0.017"	0.016	0.016
Shaft Diameter (High Speed drive Pinion)	CT Side	---	4.494	4.494
	SILO Side	---	4.494	4.494

CLEARANCE CHART: 101 – BJ

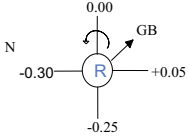
Description	Position	Clearance Chart Ref	Design Clearances (Inch)	Before (Inch)	After (Inch)
Gear Box End					
Journal Bearing	Filler / lead wire	---	0.008" - 0.012"	0.014	0.014
Shaft Diameter	Jr. Brg.	---	---	6.997	6.997
Free End					
Journal Bearing	Filler / lead wire	---	0.008" - 0.012"	0.014	0.014
Shaft Diameter	Journal bearing	---	---	6.997	6.997

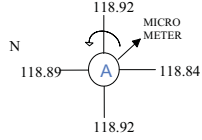
GAUSS RECORDS - 101-BJ TRAIN

Description	Position	Before (Gauss)	After (Gauss)
101- BJT			
Journal Bearing liner	CT Side	2.1	2.1
	SILO Side	1.5	1.5
Shaft Journal	CT Side	2.2	2.2
	SILO Side	2.6	2.6
101 – JR (High Speed drive Pinion)			
Journal Bearing	CT Side	0.9	0.9
	SILO Side	0.6	0.6
Shaft Journal	CT Side	1.2	1.2
	SILO Side	2.3	2.3
101 – JR (Low Speed driven Gear)			
Journal Bearing	CT Side	1.0	1.0
	SILO Side	1.6	1.6
Shaft Journal	CT Side	3.0	3.0
	SILO Side	2.2	2.2
101-BJ			
Journal Bearing	CT Side	2.3	2.3
	SILO Side	1.6	1.6
Shaft Journal	CT Side	2.0	2.0
	SILO Side	0.6	0.6

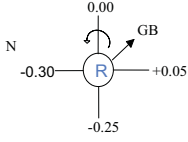
ALIGNMENT RECORDS

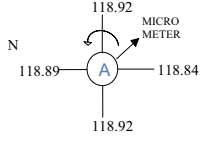
101 BJT to 101 BJR (Before PM) in mm



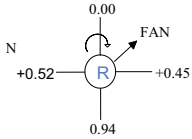


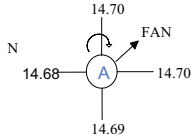
101 BJT to 101 BJR (After PM) in mm



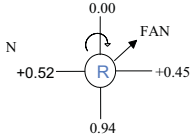


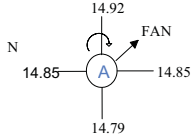
101 BJR (G/B) to 101 BJ (Before PM) in mm





101 BJR (G/B) to 101 BJ (After PM) in mm





SEMILEAN SOLUTION PUMP115-JA TRAIN

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. The mechanical seal flushing line strainer was cleaned.

115-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 oil was flushed and filter cleaned.

115-JAR Gear Box

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

Hydraulic Turbine 115-HT

The hydraulic 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 suction strainer was cleaned. The mechanical seal flushing line strainer was cleaned.

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	0.0075	0.0075
Axial Thrust	0.013 – 0.015 (0.35 - 0.40 mm)	0.011	0.011

Thrust Bearing Pad Thickness: 115-JA

Pad	ACTIVE		INACTIVE	
	Before (inch)	After (inch)	Before (inch)	After (inch)
No 1	1.25	1.25	1.25	1.25
No 2	1.25	1.25	1.25	1.25
No 3	1.25	1.25	1.25	1.25
No 4	1.25	1.25	1.25	1.25
No 5	1.25	1.25	1.25	1.25
No 6	1.25	1.25	1.25	1.25
No 7	1.25	1.25	1.25	1.25
No 8	1.25	1.25	1.25	1.25

CLEARANCE CHART: 115-HT

Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
Thrust end bearing	0.0048-0.0058	0.063	0.063
Opp. Thrust end bearing	0.0048-0.0058	0.064	0.064
Axial Thrust	0.010-0.011	0.011	0.011

Thrust Bearing Pad Thickness: 115-HT

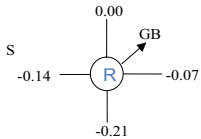
Pad	ACTIVE		INACTIVE	
	Before (inch)	After (inch)	Before (inch)	After (inch)
No 1	0.742	0.742	0.744	0.744
No 2	0.743	0.743	0.744	0.744
No 3	0.743	0.743	0.744	0.744
No 4	0.742	0.742	0.744	0.744
No 5	0.742	0.742	0.744	0.744
No 6	0.742	0.742	0.744	0.744

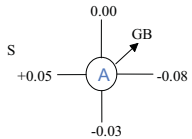
CLEARANCE CHART: 115- JAT

Description		Design Clearances (Inch)	Before (Inch)	After (Inch)
Axial Thrust		0.010 – 0.012	0.010	0.010
Coupling side bearing		0.0055-0.008	0.014	0.014
Governor side bearing		-- do --	0.010	0.010
Oil Guard Coupling side (inboard)	Radial	0.0100-0.0125	0.012	0.012
Oil Guard Coupling side (outboard)	Radial	0.0100-0.0125	0.015	0.015
Oil Guard Governor side	Radial	0.0100-0.0125	0.006	0.006

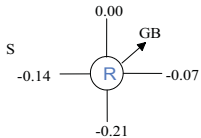
Journal Bearing Pads thickness				
LINER	THRUST END BEARING		NON THRUST END BEARING	
	Before	After	Before	After
TOP	0.117	0.117	0.117	0.117
BOTTOM	0.117	0.117	0.117	0.117
Thrust Bearing Pad Thickness				
Pad	ACTIVE		INACTIVE	
	Before	After	Before	After
No 1	0.686	0.686	0.688	0.688
No 2	0.686	0.686	0.687	0.687
No 3	0.686	0.686	0.687	0.687
No 4	0.687	0.687	0.688	0.688
No 5	0.687	0.687	0.687	0.687
No 6	0.687	0.687	0.687	0.687

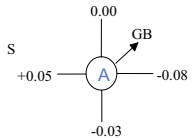
Alignment : 115-JAT to 115-GB (BEFORE) in mm



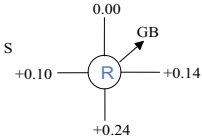


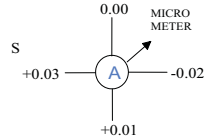
Alignment : 115-JAT to 115-GB (AFTER) in mm



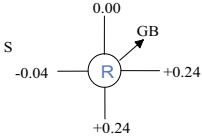


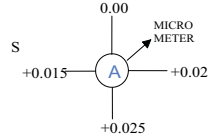
Alignment : 115-GB to 115-JA (BEFORE PM) in "mm"



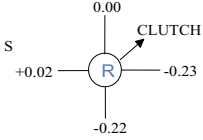


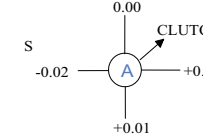
Alignment : 115-GB to 115-JA (AFTER PM) in "mm"



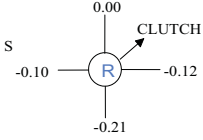


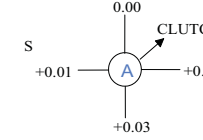
Alignment : CLUTCH to 115-HT (BEFORE PM) in "mm"





Alignment : CLUTCH to 115-HT (AFTER PM) 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. Gauss measurement of the bearings was carried out and found within desired value. The main oil console and the filters were cleaned. The seal flushing fluid cooler and strainers were cleaned.

104-JAT Drive Turbine

The turbine was decoupled and the coupling was inspected. The pump side flexible elements were found broken and was replaced by new assembly. Both end bearings was inspected and found in good condition. The suction strainers were cleaned. The lube oil coolers and console were cleaned. Gauss measurements was carried out and found below maximum limit. The actuator coupling was found to be in good condition. The TTV tappet assembly's rubber end was found broken. The same was replaced by new one. The governing valve packing was replaced by new one.

Coupling inspection

The coupling was inspected and none of the flexible element assembly was having broken shims. The DBSE and coupling hub / shaft overhang was measured and found within limit.

DIAMETRICAL CLEARANCES - 104-JAT

Description	Design Clearance (Inch)	Before PM (Inch)	After PM (Inch)
104-JAT (TERRY TURBINE)			
Journal bearing (Thrust end bearing)	0.005-0.007	0.005	0.005
Journal bearing (Opposite thrust end)	0.005-0.007	0.007	0.007
Axial Thrust	0.011-0.0016	0.014	0.012

Thrust Bearing Pad Thickness : 104-JAT				
Pad	**ACTIVE**		**INACTIVE**	
	Before (Inch)	**After (Inch)**	**Before (Inch)**	**After (Inch)**
No 1	0.624	0.624	0.626	0.626
No 2	0.624	0.624	0.626	0.626
No 3	0.624	0.624	0.625	0.625
No 4	0.625	0.625	0.645	0.645
No 5	0.622	0.622	0.627	0.627
No 6	0.622	0.622	0.625	0.625

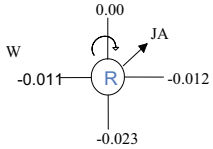
CLEARANCE CHART : 104-JA

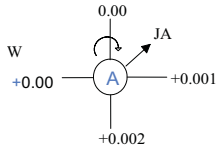
Description	Design Clearance (Inch)	Before PM (Inch)	After PM (Inch)
104 JA			
Journal bearing (Thrust end bearing)	0.006 - 0.008	0.005	0.006
Journal bearing (Opposite thrust end)	0.006 - 0.008	0.006	0.006
Axial Thrust	0.014	0.009	0.011

Thrust Bearing Pad Thickness : 104-JA				
Pad	ACTIVE		INACTIVE	
	Before (Inch)	After (Inch)	Before (Inch)	After (Inch)
No 1	0.999	0.999	0.999	0.999
No 2	0.999	0.999	0.998	0.998
No 3	0.999	0.999	0.998	0.998
No 4	0.999	0.999	0.999	0.999
No 5	1.000	1.000	0.999	0.999
No 6	0.998	0.998	0.999	0.999

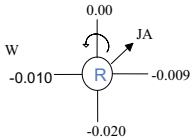
The alignment readings are as follows.

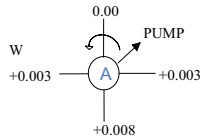
104-JAT to 104-JA (Before PM) in “mm”





104-JAT to 104-JA (After PM) in”mm”





aMDEA PUMP 107-J Train

107-JT Drive Turbine

The turbine was decoupled and the coupling was inspected. The pump side flexible elements were found broken and was replaced by new assembly. Both end bearings was inspected and found in good condition. The suction strainers were cleaned. The lube oil coolers and console were cleaned. The main oil pump was removed from installation and the drive gear assembly was cleaned. Gauss measurements was carried out and found below maximum limit.

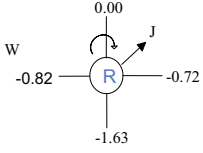
107-J aMDEA Solution Pump

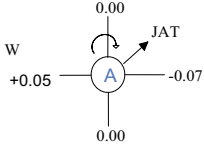
The pump suction strainers were cleaned and bearing oil flushed.

CLEARANCE CHART: 107-JT (MURRY TURBINE)

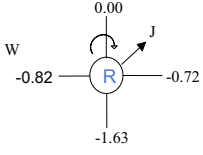
Description	Design Clearance (Inch)	Before PM (Inch)	After PM (Inch)
Journal bearing Thrust end	0.004 – 0.006	0.059	0.059
Oil Guard Thrust end - Inboard	0.011" – 0.017"	0.008	0.008
Journal bearing Opposite thrust end	0.004 – 0.006	0.0051	0.0051
Oil Guard Opposite thrust end - Inboard	0.011" – 0.017"	0.007	0.007
Axial Thrust	0.007 – 0.013	0.012	0.012

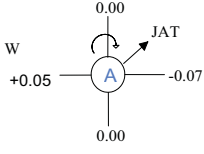
107-JT to 107-J (Before PM) in "mm"





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





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. New piston assembly of both the cylinders was installed. 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 cylinder liners were inspected and found OK. New piston assembly of both the cylinders was installed. Spare refurbished gas packings were reinstalled on both the cylinders. All the valve assemblies were

reconditioned. The Ahmedabad side distance piece was found to be having crack at the packing area. The same was repaired by welding.

Crank case assembly Overhauling

Open 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. The big end bearings were replaced by new ones as the linings were found worn out. All other clearances were measured and found within limit. All critical nuts were tightened at respective design torque. The AOP was run and oil flow inside the crank case was checked and found OK. The oil scrapper rings were replaced by new one.

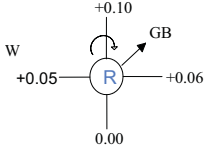
The tube bundle of the interstage cooler was pulled out and cleaned by hydro jetting. The same was hydro tested on shell side at a pressure of 8 kg/cm^2, and found satisfactory. The LP and HP flow dampener were checked and found OK. The lube oil strainer was cleaned and reinstalled.

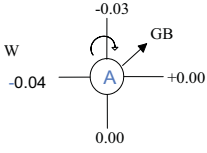
CLEARANCE CHART : 117-J TRAIN

Description	Position		Design clearance(mm)	Before (mm)	After (mm)
Piston end clr. (Front /**TDC**)	LP	Urea side	2	2.65	2.80
		Ammonia side	-- do --	2.40	2.72
	HP	Urea side	-- do --	2.50	2.49
		Ammonia side	-- do --	2.30	2.50
Piston end clr. (Intermediate /**BDC**)	LP	Urea side	1.5	1.15	1.90
		Ammonia side	-- do --	1.00	1.90
	HP	Urea side	-- do --	1.40	1.62
		Ammonia side	-- do --	1.30	1.70
Main bearing	I	Urea side to Ammonia side	0.08-0.15 (0.3 MAX)	0.16	
	II		-- do --	0.14	
	III		-- do --	0.14	
	IV		-- do --	0.15	
	V		-- do --	0.16	
Big end bearing	LP	Urea side	0.07-0.13 (0.3 MAX)	0.16	0.10
		Ammonia side	-- do --	0.17	0.10
	HP	Urea side	-- do --	0.16	0.10
		Ammonia side	-- do --	0.16	0.10
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

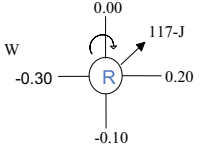
Description	Position		Design clearance(mm)	Before (mm)	After (mm)
Cross head guide	LP	Urea side	0.18-0.26 (0.6 MAX)		0.20
		Ammonia side	-- do --		0.20
	HP	Urea side	-- do --		0.20
		Ammonia side	-- do --		0.20
Side clearance (Crank shaft)	----	Crank shaft	0.45-0.60 (0.9 MAX)		0.50
Side clearance (Connecting 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

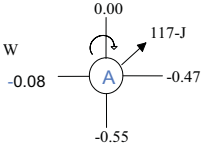
117-JM to Gear Box - (After PM) in "mm"



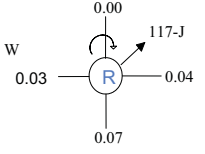


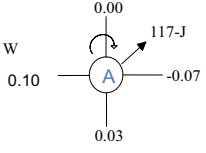
Gear Box to 117-J - (Before PM) in "mm"





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





COPPUS TURBINES

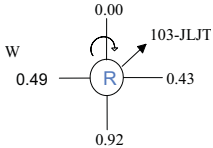
103-JLJT OVERHAULING

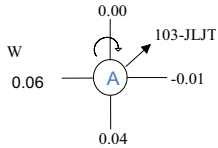
The turbine was taken for major overhauling. The seal oil pump was first removed to ease the dismantling process. Both ends bearing housing and gland housing were removed. The removable vertical half of the casing was removed. The sector was dropped to remove the rotor assembly. The bearing area diameter on the shaft was found to be reduced. Hence it was decided to replace the complete rotor assembly by new dynamically balanced rotor. The rotor assembly was installed. The carbon rings were replaced by new ones. New bearings were installed. The governor drive worm wheel (Hylem) was having number of damaged teeth. This was replaced by new one. New tested and calibrated governor was installed. The bearing housing cooler and cooling water lines were cleaned and flushed respectively.

The turbine was taken for OST. The governor was set at min speed and steam inlet valve was opened. The speed was then increased from the governor. The turbine tripped at 3240 RPM in the second attempt.

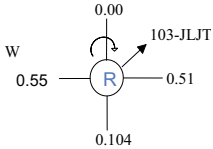
DESCRIPTION	DESIGN (Inch)	BEFORE O/H (Inch)	AFTER O/H (Inch)
END THRUST	0.003	0.006	0.003
NOZZLE CLEARANCE	0.062	0.062	0.062
TOTAL FLOAT	0.078	0.078	0.078
TRIP LEVER CLEARANCE	0.0156	0.0156	0.0156
TRIP SPEED			3240

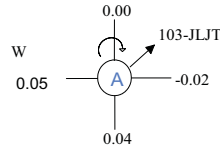
ALIGNMENT 103-JLOP to 103-JLJT





ALIGNMENT 103-JSOP to 103-JLJT





101 / 105-JLOPT

The lube oil pump drive turbines, was taken for preventive maintenance and upgradation of TTV. The existing TTV was of horizontal balanced piston type. This was replaced by new vertical valve operated by linkages. The following items were installed.

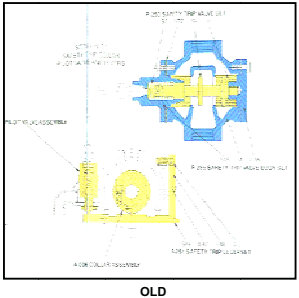
New trip collar assembly.

New governor mounting housing with the trip lever.

New vertical TTV.

New governor mounting plate.

The existing flanged end valve was removed and it was replaced by new flanged end TTV. Necessary fabrication was carried out in the inlet piping to adjust the difference in the length of the valve. The new bolt trip collar assembly was having pin/plunger type weight. To install this pin a in-situ 1/2" drill was made on the shaft as per the instruction in the manual and using a drill bushing kit (Drill Jig) which was part of the supply. The new actuator mounting housing was installed. To get the required gap between the turbine end shaft and governor shaft, the supplied governor mounting plate thickness was not sufficient. Hence a new mounting plate was manufactured at W/s. The same was installed and new actuator was installed.



OLD

NEW

During the installation of the turbine it was found that the turbine thrust bearings were completely damaged. Hence it was decided to take the complete turbine for overhauling. Both ends bearing housing and gland housing were removed. The removable vertical half of the casing was removed. The sector was dropped to remove the rotor assembly. The Rotor assembly was found to be in good condition. The same was cleaned, DP tested and reinstalled. The carbon rings were replaced by new ones. New bearings were installed. The bearing housing jacket and cooling water lines were cleaned and flushed respectively.

The turbine was taken for OST. The turbine tripped at 2070 RPM in the second attempt.

DESCRIPTION	DESIGN (Inch)	BEFORE O/H (Inch)	AFTER O/H (Inch)
END THRUST	0.000	0.003	0.001
NOZZLE CLEARANCE	0.062	0.062	0.062
TOTAL FLOAT	0.078	0.078	0.078
TRIP LEVER CLEARANCE	0.0156	0.0156	0.0156
TRIP SPEED			2070

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

The Primary Reformer Radiant Zone's

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

Row No.	Burner Nos.
1	104 , 106, 114
2	101, 105, 106, 110
3	309, 310, 311, 314
4	401, 402, 403, 406, 407, 408, 409, 410, 411
5	508, 509,
6	608, 609
8	805, 808, 809, 811, 812

The roof insulations were inspected and damaged ones were replaced by new ones. The wall insulation was found to be in good conditions.04 Nos. damaged Tunnel slabs were replaced by new ones. Damaged header insulation were replaced/ repaired. Preventive maintenance of all Tunnel Burners were carried out.

NEW BURNER BLOCKS

The Primary Reformer Convection Zone's

New ceramic Z section modules was found to be having erosion on the protective coating. New layer of coat of "Cercoat ZL"was provided on these damaged areas by the Civil Section using paint brush. The LT and HT end panel walls were opened for external cleaning of the coils. The same were boxed up after coil cleaning.

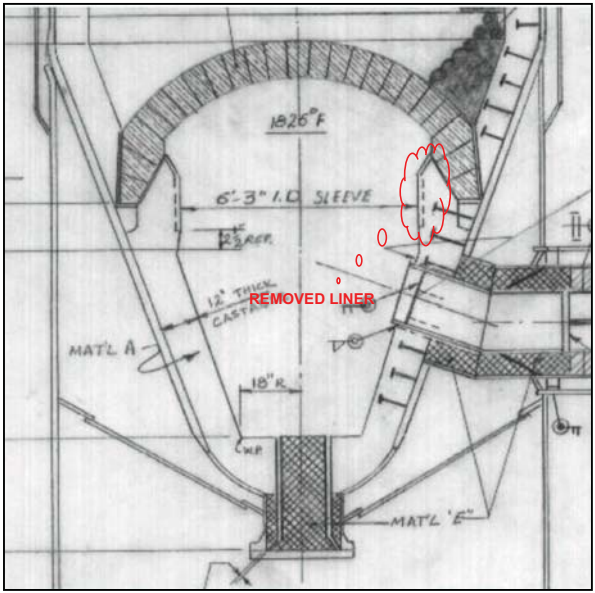
The transfer line end cover was opened for inspection and the line's cooling water jacket leak was repaired.

The Aux. Boiler

Burners were taken for preventive maintenance. The air resistors were made free. The man hole was opened for inspection/repair of the refractory.

The Secondary Reformer

Bottom cover was opened for removal of the bottom refractory liner as highlighted in the sketch. This 6 mm thick incolloy liner were cut & removed completely.



103-D BOTTOM REFRACTORY LINER

HEAT EXCHANGERS & COOLER JOBS

EQP TAG		TUBE SIDE (Hydro - jetting)	SHELL SIDE (Tube bundle pull out)	OTHER JOBS	HYDRO
101-BJT	LUBE OIL COOLER	✓	✓		x
101-BJT	ACTU.OIL COOLER	✓	✓		x
101-JCA		✓	x	CHANNEL PAINTING ON INSIDE	x
101-JCA	I/A COOLER	✓	x	CHANNEL PAINTING ON INSIDE	x
101-JCB		✓	x	CHANNEL PAINTING ON INSIDE	x
101-JCB	I/A COOLER	✓	x	CHANNEL PAINTING ON INSIDE	x
101-JT	GLAND CONDENSER	✓	x		x
101-JLC1	LUBE OIL COOLER	✓	x		x
101-JLC2	LUBE OIL COOLER	✓	x		x
101-JLC3	LUBE OIL COOLER	✓	x		x
103-JLC1	LUBE OIL COOLER	✓	x		x
103-JLC2	LUBE OIL COOLER	✓	x		x
103-JBT	GLAND CONDENSER	✓	x		Two tubes plugged
104-J	LUBE OIL COOLER	x	x		x
104-JT	LUBE OIL COOLER	x	x		x
104-JT	GOV OIL COOLER	x	x		x
104-JA	LUBE OIL COOLER	✓	✓		x
104-JAT	LUBE OIL COOLER	✓	✓		x
104-JAT	ACTU OIL COOLER	✓	x		x
105-JT	GLAND CONDENSER	✓	x		x
105-CA		✓	✓	TOP SHELL FLANGE TO TS LEAK	✓
105-CB		✓	✓	TOP SHELL FLANGE TO TS LEAK	✓
107-JT	LUBE OIL COOLER	✓	✓		x
107-JAT	LUBE OIL COOLER	x	x		x
108-C1A		✓	x		✓
108-C2A		✓	x		✓
109-C1A	SILO SIDE	x	x		x
109-C2A	SILO SIDE	x	x		x
109-C1B	REFORMER SIDE	✓	✓		x
109-C2B	REFORMER SIDE	✓	✓		x
110-CA		✓	x		x

EQP TAG		TUBE SIDE (Hydro - jetting)	SHELL SIDE (Tube bundle pull out)	OTHER JOBS	HYDRO
110-CB		✓	x		x
114-C		x	x		x
115-C		✓	✓	TUBE EXP. & SEAL WELDING	x
115- JALC1	LUBE OIL COOLER	✓	x		x
115-JALC2	LUBE OIL COOLER	✓	x		x
115-JBLC1	LUBE OIL COOLER	✓	x		x
115-JBLC2	LUBE OIL COOLER	✓	x		x
116-C		✓	✓	CHANELL COVER LEAK (TOP)	x
117-J	INTERCOOLER	✓	✓		x
117-J	1st STAGE COOLER	✓	x		x
126-C		✓	✓	PERFORMANCE NOT GOOD	x
127-CA		✓	x		x
127-CB		✓	x		x
128-C		✓	x		x
129-JC		✓	x	SHELL PAINTING	✓
130-JC		✓	x	SHELL PAINTING	✓
131-JC		✓	✓	SHELL PAINTING	✓
142-CA		x	x		x
142-CB		x	x		x
143-C		x	x		x
150-C		✓	x		x
173-C		✓	x		x

VALVE GLAND LEAK JOBS

- The following valve's gland packings were replaced by new ones.
- 101-F, Steam drum connected all first and Second isolation valve.
- All rotary equipment Inlet and Outlet First Isolation valve.
- Auxiliary Boiler Coil A 2nd isolation valve
- Auxiliary Boiler Coil IBD isolation valve
- Auxiliary Boiler Coil A & D isolation valve
- 107-C MP boiler connected all 1st and 2nd isolation valves.
- 112-C LP steam boiler connected all 1st and 2nd isolation valves
- 101-F Eye Hye top & bottom isolation valve.

- 101-F CBD sample point isolation valve.
- 107-C south side low level switch top isolation valve.
- 101-BJT Steam flow TX HP tapping isolation valve.
- Utility BFW coil R.V. isolation valve
- 107-C LSL-488(low level switch south side) top isolation
- PIC-502 Bypass valve.
- PIC-21 D/S drain valve.
- 101-F LI-1 HP tapping root isolation valve.
- 101-F LI-1 top isolation valve.
- ARU MP steam battery limits TX HP tapping root valve.

FLANGE LEAK /VALVE BONNET LEAK & VALVE PASSING JOBS

- The following flange/bonnet leaks were attended by replacement of gaskets.
- 102-C Riser Chemical dozing flange leak.
- LTS guard bypass valve upstream flange leak.
- 107-C Eye Hye top isolation 1st isolation down stream flange leak.
- CO2 Absorber sample line isolation valve upstream flange.
- 109-F local vent isolation valve upstream flange.
- 103-JAT casing drain valve down stream flange.
- 101-F South side level glass isolation valve
- 107-C north side high level switch top isolation valve bonnet.
- 107-C south side Eye-hye top isolation valve bonnet.
- 156-F drain valve upstream flange.
- PAP of 115-JBT top flange.
- PSV-919 upstream isolation valve bonnet.
- 103-J Seal oil Turbine steam inlet valve bonnet.
- 115-JBT steam inlet 1st isolation valve down stream strainer flange.
- PIC-13A upstream flange.
- LTS bottom steam line flange.
- FRC-2 Bypass line flange.
- 116-JAT steam inlet orifice flange.
- 106-F level troll top isolation valve bonnet.

RELIEF VALVES OVERHAULING

The following RVs & SRVs were overhauled and tested on test bench:

Sr. No.	RV Tag NO	Valve Size	C.D.P.S (kg/cm^2) g	Seat Tightness Test Pressure (kg/cm^2) g
		GENERAL RVs		
1	RV S-26	2 ½" X 4"	14.0	12.70
2	RV-S-007	4" X 6"	14.70	13.20
3	RV – MS 9	4" x 6"	42.2	38.0
4	RV-103-JAT - 1	1" G1 2"	46.40	41.80
5	RV-103-JAT - 2	4" P 6"	46.40	41.80
6	RV – BFW 1	1.5" x 2.5"	92.0	82.8
7	RV – 112 CA	1.5" x 3"	10.50	9.50
8	RV – 112 CB	1.5" x 3"	10.50	9.50
9	RV – 109 F	6" x 8"	19.0	17.1
10	RV-122-F	4" M 6"	6.30	5.70
11	RV 104-JAT	8" X 10"	0.35	0.25
12	PSV-919	6" X 10"	10.0	9.0
13	PSV-920	6" X 10"	10.5	9.5
14	PSV-921	6" X 10"	10.5	9.5
15	PSV-976	4" X 6"	30.6	27.5
16	PSV-977	4" P 6"	32.2	29.0
17	RV – 110 F-North	3" x 4"	7.0	6.3
18	RV – 110 F - South	3" x 4"	7.0	6.3
19	RV – 111 F	4" x 6"	6.3	5.7
20	RV – 112 F	4" x 6"	6.3	5.67
21	RV 101- J	4" x 6"	37.0	33.20
22	RV – 104 D 2	1.5" x 2"	34.10	30.70
23	RV 105-F	1" X 2"	73.80	66.4
24	RV 104-F	1" X 2"	29.2	26.3
25	RV 160-F	1 ½" X 2"	158.0	142.2
26	RV-104-D1	6" X 8"	35.0	31.50
27	123-CA	3 J 6	122.0	110.0
28	123-CB	3 J 6	122.0	110.0
29	SV-03	1 ½" X 2"	30.2	27.2
30	SV-02	1 ½" X 2"	15.8	14.2
31	SV-01	1 ½" X 2"	5.8	5.2
32	PSV-914	1" X 2"	30.2	27.2
33	RV-170-C	3" X 4"	5.7	5.2
34	RV-170-C	¾" X 1"	30.6	27.5
		PILOT OPERATED RVs		
35	RV – 102 F	6" x 8"	29.60	26.60
36	RV-105-D -A	3"x 4"	153.0	137.6
37	RV – 103- JA	3" x 4"	159.00	143.0
38	RV – 106-F	1.5' x 2"	158.00	142.2

Sr. No.	RV Tag NO	Valve Size	C.D.P.S (kg/cm^2) g	Seat Tightness Test Pressure (kg/cm^2) g
		IBR RVs		
39	RV-986	4" L 6"	45.0	40.50
40	RV-987	4" L 6"	46.30	41.40
41	RV 101-F-1	2 ½ " K 6"	118.80	107.00
42	RV 101-F-2	2 ½ " K 6"	117.00	105.00
43	RV 101-F-3	2 ½ " K 6"	115.30	104.00
44	RV-101-B	3" M 6"	111.8	101.00

VALVE REFURBISHING JOBS

In-situ refurbishing of the following valves were carried out. In-situ seat machining/lapping was done and the bonnet gaskets were replaced by new one.

- LTS outlet vent gear operated valve (10" x 300 #)
- 142-C Inlet and outlet isolation valve (6" x1500 #)
- 107-J Discharge isolation valve (12" x 300 #)

BOILER (GT-1632)

Both manhole covers of Steam drum (101 F) were opened. Internals were cleaned & checked. Some loose/Missing bolts of demister pads were tightened / replaced. Open inspection carried out on 03/04/2012 by Boiler Inspector and cleared by them for Box up & hydrotest. Both Manhole covers were boxed up with new gasket.

Hydrotest of Boiler was carried out on 07/04/2012 at 146.0 Kg/CM^2 in presence of Assistant Director, Gujarat Boiler Inspection department.

VESSEL INSPECTION / REPAIR JOBS

The manholes of the following vessels were opened for carrying out internal inspection.

- 101-EA
- HP/LP Flash drum. The HP's inlet distributer flange was found to be leaking. On removing the gasket, it was observed that the leakage was due to improper fitment of the flanges. The fitment of the flange was corrected by fabrication.
- 102- EB.,102-F, 103-F , 104-F , 106-F , 107-F , 109-F ,110-F , 111-F ,112-F ,172-F

FABRICATION JOBS (CRITICAL)

102-EB outlet line

102-EB outlet line was of carbon steel & thickness reduction was observed at various location. There was leakage in the end cap which had been arrested by providing a box, and hence the same was replaced by new SS 316 line.

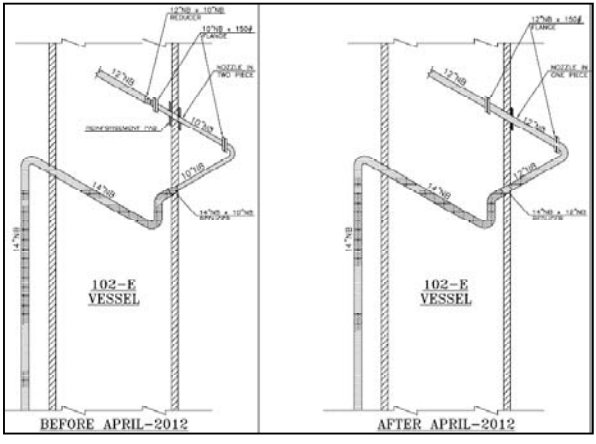
101-JT & 105-JT steam inlet

101-JT & 105-JT steam inlet valves were passing and the same were replaced by new ones. The 6 " X 600 # BW valves were replaced by new 6" X 900 # flanged end valves. Proper blowing was carried out before taking the valves in line.

102-EB inlet line

102-EB inlet line was of 14" size starting from FRC-14 at ground floor till the inlet of the vessel. At the inlet this 14" line was reduced to 10" and connected to the flanged end

nozzle of size 10". Inside the vessel the distributor was of size 12" which was reduced to 10" and connected to the 10" flanged end nozzle. Heavy vibration was being observed in the vessel due to this reduction in inlet line from 14" to 10 ". Further this nozzle was in two pieces and welded to the shell on either side leading to leakage. (Refer sketch). Hence the 10" inlet nozzle (Two piece) was replaced by new 12"(Single piece) nozzle. A larger diameter reinforcement pad was provided on the outer side of the shell. The shell had SS lining and to increase this nozzle opening diameter plasma cutting was used.



102-EB INLET NOZZLE MODIFICATION

102-EB NEW INLET NOZZLE FROM INSIDE

Control Valve (TCV-60)

Control Valve (TCV-60) & its drain valve on Boiler Feed Water line to de-superheating station was replaced by new control valve

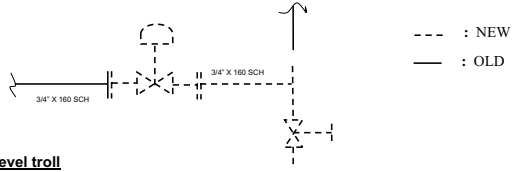
Carbon Steel Control Valve, Flanged End, ¾" X 1500 #

Carbon Steel Flange WNRF, ¾" x 1500 #

C S Pipe – ¾" x 160 Sch.

Carbon Steel TEE, 3/4" X 6000 #,

Carbon Steel Gate Valve 3/4" x 600 #, SW ends



101-F level troll

101-F level troll was replaced by new GWR Type Level Transmitter as per the sketch.

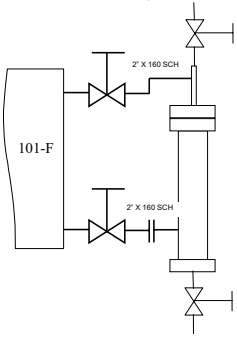
Pipe Line Size: 2" x Sch. 160, A 106, IBR

Flange Size: 2" x 1500#, WNRTJ, ASTM A 105, IBR

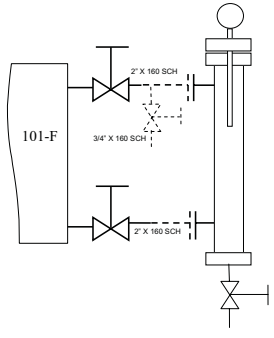
Tee: 2" x ¾" x 6000# (160 Sch.) A105, IBR

Gate valve ¾" x 1500#, SW ends

New level transmitter, Flanged end, IBR



OLD LEVEL TROLL OF 101-F



NEW LEVEL TRANSMITTER OF 101-F

: NEW

: OLD

108-D outlet line "PDI tapping 484"

Root sockolet was leaking from weld joint and reinforcement pad had been provided to arrest the leakage. This pad was removed and new imported sockolet was provided. De-hydrogenation, preheating & PWHT was carried out as follows:

Pipe Size: 14" x Sch. 120, ASTM A 240 P22

Sockolet Size: 14" x ¾" x Sch. 160, MOC – P22

DEHYDROGENATION

Soaking Temperature	:	400 degree C
Soaking time	:	24 hours
Heating Rate	:	100 degree C/hr
Cooling Rate	:	100 degree C/hr

Loading/Unloading Temperature: 200 degree C

PREHEAT (QW - 406)

Preheat Temperature : 175 - 200 ^{O} C

Inter pass Temperature max.: 250 ^{O} C

POST WELD HEAT TREATMENT (QW - 407)

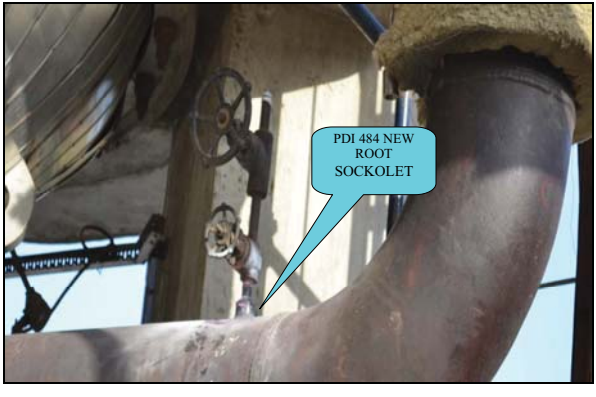
Temperature : 704 to 760^{O} C

Soaking time: 02 Hour minimum

Heating Rate : 200 ^{O} C / hr. max

Cooling Rate: 200 ^{O} C / hr. up to 300^{O}C, then natural cooling under asbestos.

Loading : 200 degree C

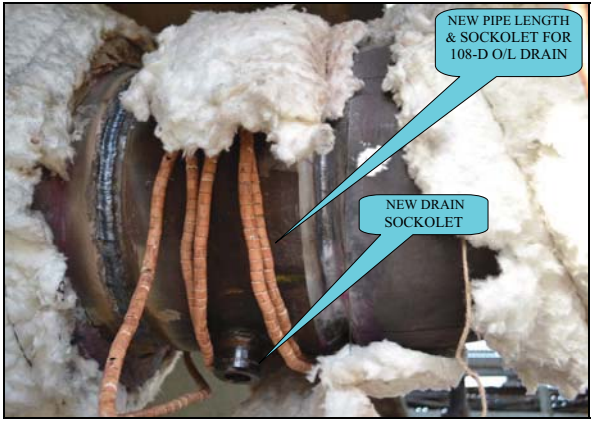


108-D outlet line "Drain Tapping" near 107-C

Root sockolets was leaking from weld joint and reinforcement pad had been provided to arrest the leakage. This pad was removed and DP was carried out wherein parent material failure was detected. Hence a 6" long pipe was replaced by new one. New imported sockolet was provided on this new pipe. De-hydrogenation, preheating & PWHT was carried out as as per the previous job.

Pipe Size: 14" x Sch. 120, ASTM A 240 P22

Sockolet Size: 14" x ¾" x Sch. 160, MOC – P22



101-BJT Exhaust isolation valve

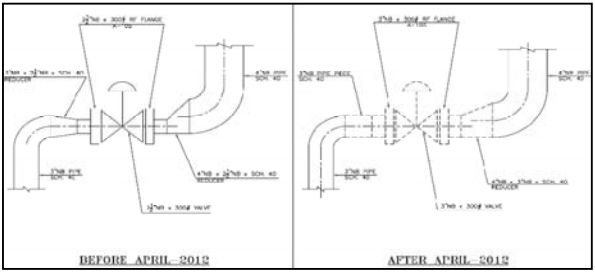
101-BJT Exhaust isolation valve was not approachable and hence this valve was repositioned onto a platform near Aux. Boiler

MIC-1 to MIC-9 Control valve

MIC-1 to MIC-9 Control valve was undersized(2½" X 300 #) and hence was replaced by new valves of saize 3"X300# as per the sketch.

Existing Control valve size: 2 ½" X 800 # , MOC : CS, Ends : Flanged

New Control valve size: 3" X 800 #, MOC : CS, Ends : Flanged



101-JCA 18" manhole

101-JCA 18" manhole was provided on the hotwell for future inspection and cleaning. The hotwell was cleaned properly and all debris removed before boxup of the manhole.

Steam line to HTS

Steam line to HTS had a pin hole leak near HTS. There was thickness reduction on this pipe. This pipeline was replaced completely.

NON CRITICAL FABRICATION JOBS

- 3.5 KG steam line for 107-JAT union box removed.
- Main isolation valve provide for 3.5kg line going to 107-JAT ejector.
- 115-JA/JB/HT mechanical seal flushing line additional 2" strainer and bypass strainer provided.
- Non performing and passing steam traps were replaced.
- 107-C EYE-HYE top 1st isolation valve replaced
- 107-C North side L.G. top isolation valve replaced.
- 115-JAT steam inlet USV upstream drain valve replaced.
- C.G.Circulator discharge to LTS inlet line drain valve replaced.
- 3.5 KG header vent Isolation valve replaced.
- FI-51 HP tapping root isolation valve replaced.
- Steam to I.D.Fan orifice HP Tapping I/V Gland leak.(MWO-1105101475)
- Cooling water line for Auxiliary Boiler Burner No-1&2 replaced.
- 103-JAT Nozzle valve (PRC-12) leak off line (C.T.side) welding to be strengthening.
- PT-12 Root Isolation valve replaced.
- C.G. Receiver tank PIC-5506 upstream and downstream isolation valve replaced.
- Stripper to LPFV CO2 line drain isolation down stream union leak attended.

- Locking arrangement done for NRV PIC 137 down stream check valve (PGR).
- Gratings fixed at PRC-23 new platform at Ahmedabad side
- Hook welding for lifting of 114-C connected line to avoid insulation damage.
- Platform extended for 103-D Hoist for easy work for electrical fitting.
- Flange leak at absorber sample line isolaton valve attended.
- Support provided for Continuous air line tapping on Desulphurisers.
- Provided proper draining arrangement for HPFV PSV (R.V.) common line.
- Ladder support welding in ARU.
- 101-D / 102-D RV exhaust lines to be fixed
- 101-C platform replacement
- 157-F Drain valve bush broken. Pipe to be replace with new valve.(MWO-1105101831)

MISCELENOUS JOBS

- PRC-23 preventive maintenance was carried out.
- All plug valves greasing done.
- 120-C shell side bypass plug valve giant button head replaced as it was passing.
- Mechanical seal glycol pot flushing and refilling done.
- Gear operated valve greasing done.
- FIC-13 C.V. upstream plug valve grease nipple replaced.
- PDIC-52 valve upstream isolation valve wheel replaced.
- Cold Ammonia receiving valve for 107-F (PLUG VALVE) grease nipple leak attended

AMMONIA CONVERTER (105-D)- CATALYST REPLACEMENT

A new pipeline of 6" size was laid down from N_2 Circuit Isolation Valve of LTS to Converter bottom for purging as a pre-shutdown activity.

Top bed catalyst was replaced through M/s Plant-tech Industrial Service against WO. No.201004120355.

The following activities were carried out.

- Side manhole cover was opened.
- Purging/cooling of convertor was done.
- All safety equipment were installed in position & checked.
- Inner manhole cover was opened.
- Three segment of protection screen were untied & rolled towards inner basket.
- Top catalyst was unloaded directly to vacuum truck brought by the party.

- Three segment of separation screen were unbolted from one side and rolled to another end.
- 1st bed catalyst was unloaded directly to vacuum truck.
- Inspections of all internals of 1st bed were carried out through video camera installed by the party. All internal were found intact and in good condition.
- 1st bed catalyst loaded.
- Separation screen fixed back in position.
- Top catalyst loaded.
- Protection screen fixed back in position.
- Inner manhole cover & side manhole cover boxed up.

LTS (104-D2)- CATALYST REPLACEMENT

Catalyst of LTS replaced. The following activities were carried out.

- Opened top Manhole cover.
- Purging / cooling of HTS was done.
- Top gratings were removed.
- Rasching Rings were unloaded.
- Top screen was removed.
- Catalyst was unloaded.
- Bottom Screen was removed.
- Alumina balls were unloaded.
- Scaffolding was erected inside the HTS for cleaning & inspection.
- Visual inspection of internals, NDT of all weld seam & thickness measurement were carried out and found satisfactory.
- Lower outlet grid supports were inspected. All support ring section, bearing bar, clamp hold down bar, clamp, wire mesh etc. were found intact in position . However, catalyst was found under the grid. 04 Nos alternate grid section were opened and fallen catalyst under the grid were removed. Grid sections were fixed back in position.
- Scaffolding was removed.
- Alumina balls were loaded.
- Bottom screen was fixed back in position.
- Screen patches were provided at all the peripheral location to cover the gap between existing screen & shell ID to avoid falling of catalyst under the grid in future.
- Catalyst was loaded.
- Top screen was fixed back in position.
- Rasching rings were loaded.
- Top gratings were fixed back in position
- Manhole cover boxed up with new gasket.

ROTATING EQUIPMENT

MINOR OVERHAULING OF CO_2 COMPRESSOR DRIVE TURBINE (Q-1801)

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

- Decoupled the Turbine from LP case.
- Alignment of Turbine and LP case was checked and found disturbed.
- Journal bearing pads on free end were opened for inspection. Found clearance values within acceptable limit. (Ref Table-1).
- Journal bearing pads on LP case were opened for inspection. Found clearance values within acceptable limit. (Ref Table-1).
- Thrust bearing was opened for inspection. Clearances value found within acceptable limits. (Ref Table-1).

  Turbine float: 0.23mm (Net float = Total float – Housing play = 0.35 - 0.12).
- Gauss measurement of Journal and thrust bearing pads, base rings, shaft journal, thrust collar were carried out. Gauss value of bottom half base ring of north side journal bearing was 4.2. It was reduced to the acceptable limit by demagnetization.
- 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	Before PM (mm)	Design Value (mm)	After PM (mm)
Journal bearing clearance on free end	0.28	0.18 to 0.31	0.28
Journal bearing clearance on LP side	0.31	0.24 to 0.35	0.31
Thrust bearing clearance	0.22	0.25 to 0.35	0.23

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

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

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

- Journal bearing pads on GB side were opened for inspection. Clearance values found above the design value. Bearing pads were replaced with new ones. (Ref Table-2)
- Journal bearing pads on Turbine side were opened for inspection. Clearance values found above the design value. Bearing pads were replaced with new ones. (Ref Table-2).
- Thrust bearing was opened for inspection. Clearances value found within acceptable limits. (Ref Table-2).
- Gauss measurement of Journal and thrust bearing pads, base rings, shaft journal, thrust collar were carried out. Gauss value of thrust bearing base ring (active side) was 12.6. It was reduced to the acceptable limit by demagnetization.
- 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

Bearing Description	Before O/H (mm)	Design value (mm)	After O/H (mm)
Journal bearing clearance on Turbine side	0.20	0.11 ~ 0.15	0.16 (new bearing)
Journal bearing clearance on Gear Box side	0.27	0.11 ~ 0.15	0.17 (new bearing)
Axial Thrus	0.38	0.28 ~ 0.38	0.38

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

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

- Decoupled the HP case from Gear box
- Alignment readings were checked and found disturbed.
- Journal bearing pads on Gear box side were opened for inspection. Clearance values found marginally above design clearance however it was not replaced. (Clearance values measured are given in Table-3)
- Journal bearing pads on free end side were opened for inspection. Clearance values found marginally above design clearance however it was not replaced. (Clearance values measured are given in Table-3)
- Thrust bearing was opened for inspection. Clearances values found within acceptable limits. (Clearance values measured are given in Table-3).

- 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	Before PM (mm)	Design Value (mm)	After PM (mm)
Journal bearing clearance on Free end	0.16	0.11 to 0.14	0.16
Journal bearing clearance on Gear Box side	0.15	0.11 to 0.14	0.15
Thrust bearing clearance	0.33	0.25 to 0.35	0.33

MAJOR OVERHAULING 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. Thrust bearing was having scoring marks; same was replaced with new one. 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 8.6. 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	0.16	0.125 to 0.185	0.16
	Journal bearing clearance on HP side	0.16	0.125 to 0.185	0.16
	Thrust bearing clearance	0.38	0.38 to 0.61	0.38 (new bearing)
High speed shaft	Journal bearing clearance on LP side	0.30	0.15 to 0.21	0.20 (new bearing)
	Journal bearing clearance on HP side	0.27	0.15 to 0.21	0.20 (new bearing)
Gear backlash		0.50	0.383 to 0.608	0.50

** All strainers of CO2 compressor line were cleaned

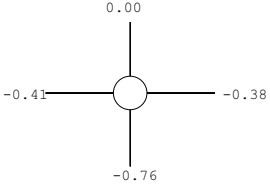
ALIGNMENT READINGS: TURBINE TO LP COMPRESSOR

Dial on LP Compressor Coupling

All values are in mm

Before PM

RADIAL



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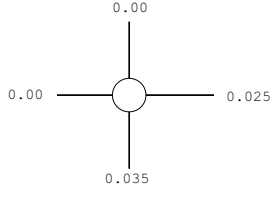

Protocol Values

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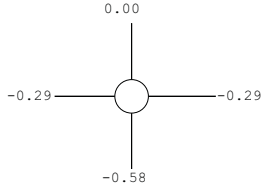

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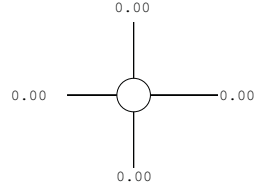

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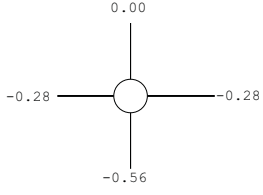

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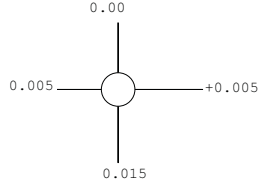

ALIGNMENT READINGS: GEAR BOX TO LP COMPRESSOR

Dial on LP Compressor Coupling
All values are in mm

Before PM:

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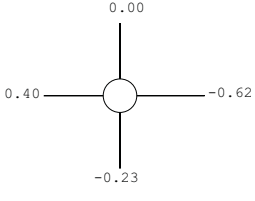

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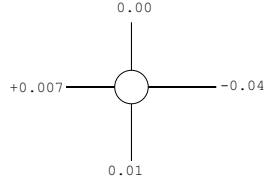

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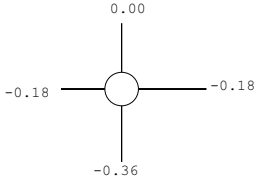

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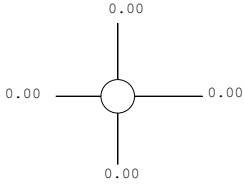

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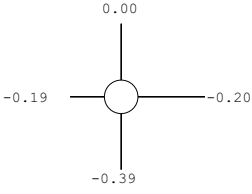

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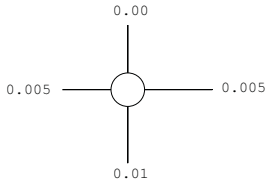

ALIGNMENT READINGS: GEAR BOX TO HP COMPRESSOR

Dial on HP Compressor Coupling
All values are in mm

Before PM

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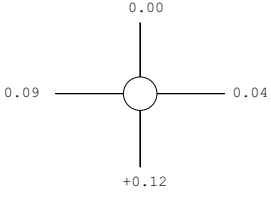

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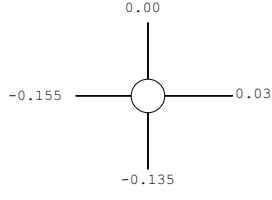

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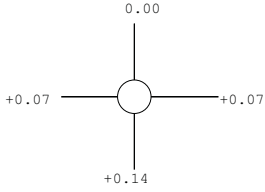

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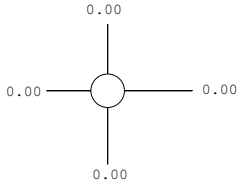

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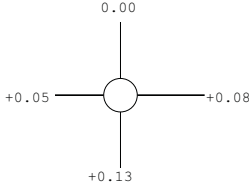

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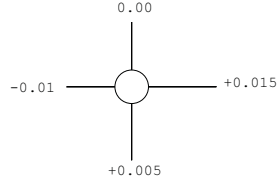


HP VESSELS

HP Stripper (H-1201)

Bottom Dome

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

Autoclave V-1201

Repair of Liner weld joints of Autoclave

Up to 6th compartment of V-1201, liner weld of each compartment were most affected by corrosion. It was decided to repair liner weld one by one during shutdown.

- During shutdown 2009 liner welds of 1st and 3rd compartment were repaired
- During shutdown 2010, liner welds of 2nd and 4th compartment were repaired
- During shutdown 2011, liner welds of 5th compartment were repaired.

During shutdown 2012, repairing of liner weld of 6th compartment was carried out. WO was placed on M/s Dowel Erectors, Vadodara (WO 201004120531 dated 15-03-2012) for executing the job.

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)

Approx 3" long crack towards west side at Manway and approx 3" long crack towards north side at top dish end petal liner were replaced. Few loose fasteners of tray segments were tightened.

Compartment No.2

7 nos. of loosed tray holding 'J' bolts were tightened.

Compartment No.3

7 nos. of loosed tray holding 'J' bolts were tightened.

Compartment No.4

Crevice/corrosion cavities in longitudinal weld near man-way (west side) were repaired. 4 nos. of loosed tray holding 'J' bolts were tightened.

Compartment No.5

6 nos. of loosed tray holding 'J' bolts were tightened.

Compartment No.6

6 nos. of loosed tray holding 'J' bolts were tightened.

Compartment No.7

Crevice/corrosion cavities of shell liner welding were repaired.

Compartment No.8

Corrosion cavities observed on liner welding were repaired. 1 no. of loosed tray segment bolt was tightened. Crevice/Cavities observed in Circumferential and longitudinal weld were repaired.

Compartment No.12 (Bottom Compartment)

Crack like indication and pinhole observed during DP test in down comer fillet weld were repaired. Porosity observed in nozzle Fillet weld was repaired. Crevice/Cavities observed in petal weld in east side same was 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

Lowering of Tube Bundle of HP Scrubber (H-1203)

Last tube bundle inspection of H-1203 was carried out during annual shutdown 2004. Hence it was decided to lower the tube bundle for inspection during forthcoming shut-down 2012. WO was Placed on M/s Skywin Erectors, Ahmedabad (WO No.: 201004120601 dtd. 30-05-2012) for executing the job.

Preparation before shutdown

Load testing of all rigging tools were carried out in the presence of inspection department. During testing of all 5 nos. of 10 ton capacity chain blocks, abnormal sound absorbed in 2 nos. of chain block,. Defective chain blocks were repaired at M/s Neelkanth Engineering, Ahmedabad.

For load testing of 4 nos. of eye bolts in horizontal loading condition, new frame structure was fabricated as shown in attached figure.

Eye bolt tightening horizontally - 1

Eye bolt tightening horizontally - 2

Lifting of load in eye bolt testing arrangement - 1

Lifting of load in eye bolt testing arrangement - 2

Loading test of all 4 nos. of eye bolts were done at weight 17 ton for ½ hr.

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

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

Removal of top dome

- Removed the insulation for top dome lifting from following portions.
  - Off gas line flange
  - Flange of top dome and shell
  - Steam tracing line
  - Carbamate Inlet flange
  - CO2 purging Inlet
- Cleaned monorail for top dome and applied grease
- Prepared the scaffolding for offgas flange /steam tracing
- Placed the wooden plank on platform for safe working
- Removed the cap of stud of top dome, cleaned by rustolene and wire brush
- Marked the all process and steam line connections and disconnected.
- Disconnected the following flange of top dome
  - Offgas flange (C3-3"x1500#) ** used safety belt
  - Carbamate solution inlet (C6 - 3"x1500#)
  - CO2 purg conn. (1"x1500,3nos.)
- Cut the steam tracing line
- Prepared the lifting arrangement for top dome (2 nos. of monorail, 2 nos. of 10 ton chain blocks, 2 nos. of 5 ton slings & 2 nos. of hook-chuk) . Mounted the these tools on 2 nos. of trunion and tied sling with hook of chain block for safety purpose
- Loosened the nut one by one using bolt tensioner at 750 kg/cm2 g and removed all nuts.
- Disconnected the drain line flange (inside shell, 1/2") after lifting top dome upto stud using chain block place sleeper in between studs for safey of flange seating area of shell
- Shifted the top dome towards K-1403-3 , placed on wooden sleeper
- Removed the diaphragm
- Departmental inspection was carried out. No repair work was done.
- Refixed the diaphragm on its position in top dome

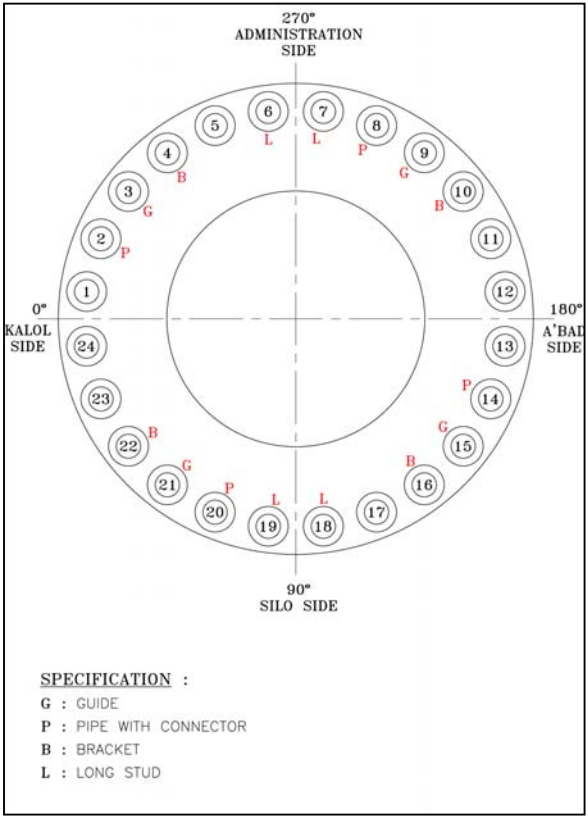
Lowering and lifting of tube bundle

- Removed the insulation for tube bundle lowering from the following portions.
  - Gas inlet flange
  - CCS-II inlet/outlet flange
  - Condensate flushing line flange
  - Steam tracing line flange
- Cleaned all flange using rustolene
- Marked the all process and steam line connections, which were to be loosened
- Placed the wooden plank on platform for keeping hydraulic jack safely
- Loosened the following connected flanges
  - Gas inlet (C1 - 4 " x 1500#, 2nos.) along with spacer and cond. flushing line 1 " x1500, 2nos.
  - CCS-II inlet/outlet (C4/C5-10 " x 150#, 2 nos.)
- Cut the steam tracing line
- Mounted the 4 nos. of 5 ton slinging (in U- shape) on I-beam after placing damaged urea bags
- Mounted the 10 ton chain block on slinging one by one with help of hook-chuck.
- Tightened the 4 nos. of eye bolt on bottom flange and connected 10 ton chain block with help of 10 ton d-shackle. Took the load on 10 ton chain block
- Loosened the all nut one by one using bolt tensioner at 750 kg/cm2 g and removed all except 4 nos of nut of long stud.
- Now loosened the 4 nos. of nut half round and lowered the tube bundle using chain block. Again loosened the 4 nos. of nut half round and lowered the tube bundle using chain block. This activity was required to free the tube bundle inside the shell
- Measured the gap between shell girth flange and bottom dome flange at all 4 position of eye bolt. After ensuring the tube bundle was free inside the shell, lowered the tube bundle 25mm with the help of chain block equally by measuring the gap.
- Inserted the 4 nos. of dowel guides on 4 nos. of stud.
- Again lowered the tube bundle with help of chain block 630mm equally by measuring the gap providing 4 nos. of tube sheet holding bracket.
- Removed the platform grill and channel
- Tightened the 4 nos. of connector with 4 nos. of stud.

- Inserted the Sleeve with washer in opposite 4 nos. holes of bottom flange.
- Inserted the pipe (8.00 mtr long) through bottom flange and welded it with connector
- Lowered tube bundle using chain block equally by measuring the gap between shell flange and bottom dome flange at position of all eye bolts
- Gasket was removed after lowering the tube bundle up to 7 mtr.
- Prepared the scaffolding for inspection
- Departmental inspection was carried out. Tacks welding of loosened spacer tubes were done with 3rd, 4th & 6th no. of baffle.
- Placed the gasket on the tube bundle and hold it at platform
- Lifted the tube bundle with help of chain block up to the 4nos. of guide dowel
- Removed the tube sheet holding bracket , pipe, connecter, washer
- Placed the all platform grill and structure
- Cleaned both flange seating area by HNO3 + Acetone + DM water, placed the gasket properly. And applied the antisieze grease on stud
- Lifted the tube bundle with the help of guide and tightened the nut
- Tightened the nut as per procedure (In 4 steps at 300 kg/cm2 g, 500 kg/cm2 g, 700 kg/cm2 g pressure and checked final round at 700 kg/cm2 g using hydraulic bolt tensioner as per sequence)
- Tightened the connected flange and welded the steam tracing flange line for bottom dome
- Removed the rigging arrangement for tube bundle lowering

Box-up of top dome

- Shifted the top dome and kept it upto the studs to tighten the inside drain flange.
- Kept the top dome on its position.
- Tightened the nut as per procedure (In 4 steps at 300 kg/cm2 g, 500 kg/cm2 g, 700 kg/cm2 g pressure and final check round at 700 kg/cm2 g using hydraulic bolt tensioner as per sequence)
- Connected the all flange and welded the steam tracing line flange and Insulation was done .



Position of guide, pipe with connector, tube sheet holding bracket and long stud in bottom dome flange

HP Scrubber – Top Dome Removal

Rigging arrangement – North side

Rigging arrangement – South side

Top dome flange

Top dome flange – after nut removal

Lifting of top dome

Lifting of top dome - 1

Lifting of top dome – up to stud

Placing of top dome

Funnel

Diaphragm from bottom

Tube bundle lowering

Rigging arrangement - 1

Rigging arrangement - 2

Bottom dome -1

Bottom dome -2

Bottom dome – after removing the nut except 4 nos. of loosened nut

Lowering of tube bundle

Tube bundle lowering after providing 4 nos. of guide

Lowering of tube bundle with help of 4 nos. of guide

Tightened the 4 nos. of tube sheet holding bracket and pipe connecter

Lowering of tube bundle with help of 4 nos. of guide pipe -1

Lowering of tube bundle with help of 4 nos. of guide pipe -2

Lowering of tube bundle with help of 4 nos. of guide pipe -3

Lowering of tube bundle with help of 4 nos. of guide pipe -4

Lowering of tube bundle with help of 4 nos. of guide pipe -5

Lowering of tube bundle with help of 4 nos. of guide pipe -6

Lowering of tube bundle with help of 4 nos. of guide pipe -7

IRIS inspection and Hydrotest of LP Carbamate Condenser (H-1205)

Condensate inlet and outlet lines were removed by Kobelco crane. Dome cover was removed by monorail. IRIS of tubes was carried out by inspection department after cleaned by hydojetting using DM water. 66 nos. of tubes were plugged as per inspection report. Total 88 nos. of tubes are plugged till date.

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

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

Pump and Pressure gauge was provided at C3 Nozzle (1.5" X 150#). Water was filled in shell side through the hose. Shell vent (C11) was used to remove air. Hydrotest test pressure was kept 11.0 kg /cm2 g for 30 minutes. No leakage was observed.

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

Retubing of 1st and 3rd inter stage cooler of Hitachi CO2 Compressor (H-1811 & H1813) with duplex tubes (SAF2205)

Frequent tube failure in H-1811, H-1812 & H-1813 were occurred since installation in 1997. Tubes were failing due to stress corrosion cracking in the presence of high CO2 gas temperature (tube side) and chloride presence in cooling water (shell side).

Brief history of tube failure in H-1811, H-1812 & H-1813 is as follows.

Sr. No.	Duration	Problems in Equipments	Remarks
1	July. 1998	Tube leaking in H-1812	Urea plant was forced to take shut down & 35 Nos. of tubes were plugged.
2	Feb. 2009	Tube leaking in H-1813	Urea plant was forced to take shut down & 10 Nos. of tubes were plugged.
3	Shutdown-09	H-1813	Retubing of complete top half of cooler was carried out.
4	Jan. 2011	Tube leaking in H-1813	Urea plant was forced to take shutdown & 3 Nos. of tubes were plugged
5	Jul. 2011	Tube leaking in H-1811	Urea plant was forced to take shutdown & 77 Nos. of tubes were plugged
6	Shutdown-11	H-1813	Retubing of complete top half of cooler was carried out.

Due to the frequent tube failure, it was decided to replace the tubes of SS 304L with the duplex tubes (SAF2205) in all inter stage coolers.

Advantages of duplex material (SAF 2205) over SS304L are as follows.

- High resistance to stress corrosion cracking in chloride-bearing environments and in environments containing hydrogen sulphide.
- High resistance to general corrosion, pitting and crevice corrosion
- High resistance to erosion corrosion and corrosion fatigue.

Work order 20110858 dated 27-11-2011 for retubing 3 nos. of inter stage coolers (H-1811, H-1812 & H-1813) was awarded to M/s Nigasu Engineering Works, Mumbai. To ensure the duplex tube to SS 304L tube sheet joint, mock test piece was fabricated. 2 nos. of duplex tubes expanded at works of M/s Patel Air Temp and 2 nos. of tubes expanded in Urea maintenance site. Hydrotest was done at 12 kg/cm2 g, no leakage observed.

Mock-up test piece for hydro testing to check tube to tube sheet expansion joint

2 nos. of tube expanded at works of M/s Patel Air Temp and 2 nos. of tubes expanded in urea maintenance site

M/s Nigasu Engineering Works was having limited resources to complete the retubing of all 3 nos. of inter stage coolers within shutdown period. Hence, it was decided to award the retubing of H-1813 to M/s Aerotherm Engineering, Ahmedabad as per WO 201004130034 dated 17-04-2012 and retubing of H-1812 was planned for next shutdown.

Retubing of H-1811

Following activities were carried out.

- Removed the equipment from its position with the help of Hitachi monorail after loosening the all flanges.
- Tube sheet was removed from the shell.
- Tubes were cleaned by hydojetting from the out side.
- Due to corrosion in outer surface, tubes were unable to pull out from the tube sheet.
- It was decided to cut the tubes with the help of cut rods.

Cutting of tubes with the help of cut rods-1

Cutting of tubes with the help of cut rods - 2

Pulling out of tube bundle of H-1813

Pulling out of tube bundle of H-1813

Hydrojetting of H-1812

- All tubes were cut with the help of cut rod. Both tube sheets were sent to central workshop to remove the expanded stub tubes from the tube sheet with the help of drilling.
- Replaced the existing CS tie rod with new SS tie rods.
- New tubes of duplex material were inserted in to the both tube sheet one by one.
- Tubes were expanded from 8% to 10% into the tube sheet. Measured Tube ID after expansion: 16.96 mm to 16.98mm

Note: Calculation for tube expansion

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

Tube sheet ID: 19.25mm

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

Required Expansion: 8% to 10%

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

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

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

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

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

Retubing of H-1813

Following activities were carried out.

- Removed the equipment from its position with the help of Hitachi monorail after loosening the all flanges.
- Tube sheet was removed from the shell after dismantling the floating head , dome and channel cover.
- Tubes were cleaned by hydojetting from the out side.
- Due to corrosion in outer surface, tubes were unable to pull out from the tube sheet. Tubes were cut with the help of grinding.
- Both tube sheets were sent to the central workshop, where expanded stub tubes in tube sheet were removed with help of drilling.

- New tubes of duplex material were inserted in to the both tube sheet one by one.
- Tubes were expanded from 8% to 10% into the tube sheet. Measured Tube ID after expansion: 16.96 mm to 16.98mm
- To check the leak from tube to tube sheet joint, Hydrotest was carried out at 12 kg/cm2 g from the shell side. After hydrotest, minor leakage was observed through tube OD. Those tubes were expanded again. Confirmation hydrotest was done. No tube leakage was found.
- Heat exchanger was kept on the foundation & boxed up.

Tube bundle of H-1812 were boxed up and placed on foundation after hydojetting from the shell side.

Hydrotest of V-1205

During operating condition, gasket of level gauge glass was leaked. To attend the leak, jacket box was fabricated and welded it with shell of V-1205 by covering the level gauge glass. During welding of jacket with shell, approx 1" linear crack horizontally observed in shell body at just below the welding. Repairing by welding was stopped. Leakage was not stopped after applying the Stanvac, Loctite and Omega compound.

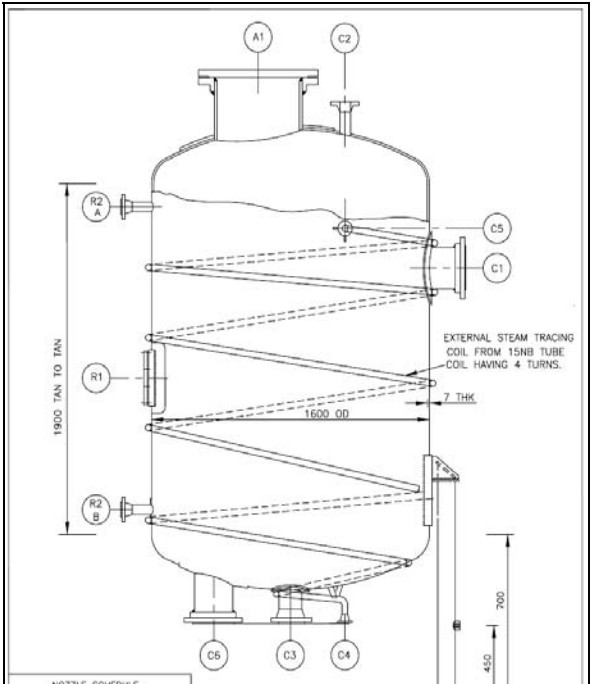
We consulted with M/s L & T representative and they suggested electrode Eutec Staintrode D, Size - 2.5 mm, Make - L & T, for low heat input. With the same electrode welding of jacket with shell was done successfully during operating condition.

During shutdown, we cut the jacket of level gauge glass. Frame of level gauge glass found in corroded condition. New frame was fabricated in workshop. To attend the crack, caulking was done on crack area and magna compound applied on the crack.

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
- R1 – rectangular blind was fabricated in work shown in attached drawing
- C2 – 3 nos. of flanges (not shown in drawing) , 3" x 150# (2 nos.) & 1" x 150# (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 pressurise the shell up to 6kg/ cm2 g. No leakage was observed from the cracked area. Deblinding was done and boxed up the vessel.



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/cm²g	6	6
DESIGN TEMPERATURE	°C	100	160
OPERATING PRESSURE	kg/cm²g	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

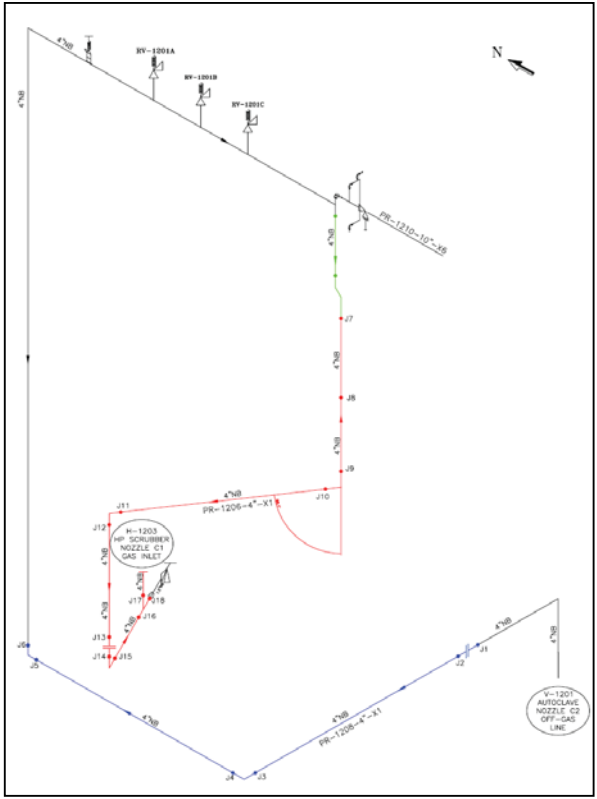
Corroded frame of level gauge glass

Rectangular blind of level gauge glass

Cut jacket of level gauge glass

Replacement of Offgas line of V-1201

On 15th December 2012, offgas line of V-1201 (line no. PR-1206 - 4" - X1) was punctured at elbow (4" X 120 Sch, 45 Deg., SS 316L Urea Grade, 1st elbow from top marked with arrow) near HP scrubber (H-1203) due thickness reduction. Forced shutdown was taken for repairing the puncture due to its position. Line (shown by green color in figure) was replaced with new one.



It was decided to check the line thickness from off gas line of autoclave to H-1203 bottom during forthcoming shutdown-2012.

Due to thickness reduction, it was decided to replace line (PR-1206-4"-X1, shown by blue color) from J1 to J6 departmentally

Following welding procedure was adopted for all joints.

- Edge preparation and DP
- Root welding : TIG , DP and RT
- Final welding : TIG , DP and RT

Filler wire used for welding: AWS/ASME SFA 5.9 (310MOL) DIN 8556-SG, R 25.22.2LMN, Size: 2.4mm x 1000mm, Sandvik make

Following activities were carried out.

- Cut the line from J6 , removed it with the help of Kobelco crane
- Welding of joints J2, J3, J4 & J5 was carried out at workshop
- Welding of joints J1 and J6 was carried out at site.
- Approx 6.6 meter long pipes, 2 nos. of elbow (4" x 160 Sch, 90 Deg. SS 316L Urea Grade) and 2 nos. of flange (4" x 1500#, RTJ, SS 316L Urea Grade) were used.

Fabrication jobs to replace the line (PR-1206-4"-X1, shown by red color in drawing) from J7 to J17 were awarded to M/s Dowel Erectors, Vadodara against WO 201004120531 dated 15-03-2012.

Following activities were carried out.

- Cut the line from joint J7, J10 & J12 and removed it with the help of Kobelco crane
- Removed the line from the bottom of H-1203 after loosening the 3 nos. of flange.
- Welding of joints J8, J10, J11, J13, J14, J15, J16, J17, and J18 carried out at workshop
- Welding of joints J7, J9 & J12 was carried out at site.
- Approx. 18.0 meter long pipe (4" x 160 Sch, SS 316L Urea Grade) , 3 nos. of elbow (4" x 160 Sch, 90 Deg. SS 316L Urea Grade), 1 no. of equal tee (4" x 160 Sch, SS 316L Urea Grade) and 2 nos. of flange (4" x 1500#, RTJ, SS 316L Urea Grade) were used.

Elbow replacement due to thickness reduction

- 4 nos. of CS elbow in condensate line from 23 ata steam drum to 9 ata steam drum (SC-1213-4"-B4) were replaced with SS Elbow (4" x 10 Sch, SS 304, 90 Deg.) due to thickness reduction
- 1st elbow (4" x 80 Sch, CS , 90 Deg.) from pump (suction line of P-1102 C) was replaced due to the thickness reduction

Base frame replacement of P-1202 B

Corroded base frame of P-1202 B was replaced with new one.

Prill Cooling System

Inlet Air Fan (K-1701)

- Visual inspection of both bearing was done. Pitting and scoring was observed in pulley side bearing. Same bearing was replaced with new one. Oil flushing of both bearing was done.
- Existing Fan pulley (875mm OD) was replaced with new pulley (960mm OD) as per energy saving scheme.
- Suction eye side casing structure was corroded. Strengthening of same was done by provided additional plate.
- New rubber gasket was provided in all inspection windows.
- Oil make up line (inlet line) and drain line of bearing (suction eye side) was replaced with new fabricated line.
- Alignment of both pulleys was done and guard was provided.

Exhaust Air Fan (K-1702)

- Visual inspection of both bearing was done. Oil flushing of both bearing was done.
- New rubber gasket was provided in all inspection windows.
- Alignment of both pulleys was done and guard was provided.

Conveyor System

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

M-1403-1 conveyor

- Existing belt was replaced with new HRT2 grade belt (630/4, Heat Resistant, 3/1.5, 800mm wide)
- All damaged carrying rollers and return rollers were replaced with reconditioned ones.
- Head pulley was replaced with new one.
- Gear box oil was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.

M-1403-2 conveyor

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

M-1403-3 conveyor

- Gear box oil was flushed. New coupling bush was provided

Link Conveyor (M-1419)

- Existing belt was replaced with new OHR grade belt (630/4, Oil & Heat Resistant, HD, 3/1.5, 800mm wide)
- All damaged carrying rollers and return rollers were replaced with reconditioned ones.
- Gear box oil was flushed. New coupling bush was provided. Greasing of chain and sprocket was done.
- Alignment was done between gear box to motor and from gearbox to pulley.

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

Dust Conveyor System (M-1702)

- 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.

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

Scraper (M-1402-1/2)

Scraper oil was flushed.

Fluid Coupling

- Existing both pulley was replaced with pembrill coupling
- Alignment of motor and coupling was done.

Gear Box of Scraper, M-1402

- Oil flushed.

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

K-1401-1

- Belts were replaced with new one. Alignment of motor and fan pulley was corrected.

K-1401-2

- Belts were replaced with new one. Alignment of motor and fan pulley was corrected.
- Inspection of both bearing was done. Pitting and scoring marks were observed in bearing. Both bearings were replaced.

K-1401-3

- Belts were replaced with new one. Alignment of motor and fan pulley was corrected.

K-1401-4

- Belts were replaced with new one. Alignment of motor and fan pulley was corrected.
- Inspection of both bearing was done. Pitting and scoring marks were observed in bearing. Both bearings were replaced.

Repairing was done in following equipments after manhole opening

H-1104 ($C0_2$ SPRAY COOLER)

Loosened rectangular risers holding clamps with Liquid distributor tray were tightened.

H-1814-A & H-1814-B (L.O. COOLER OF HITACHI COMPRESSOR)

Back flushing arrangement was fabricated for H-1814 (top)

H-1815 (SURFACE CONDENSER)

Loctite compound (chemical resistant coating) applied on north side channel cover.

T-1301 (AMMONIA WATER TANK)

Tack welding of broken tack weld of 2" line (in East) with bottom plate done. Same repaired.

T-1401(UREA SOLUTION TANK)

Deep grinding mark / groove found on inside weld with shell of 2" LT nozzle located in the North-West bottom direction filled up by weld deposition.

V-1101 (CO2 KNOCK OUT DRUM)

Inside the CO2 Knockout Drum, Painting by Epoxy paint was done. Damaged demister pads were properly fixed & tied by SS Wires.

V-1102 (NH_3 SUCTION FILTER)

Replaced filter cloth of Ammonia Suction Fillter

V-1202 (RECTIFYING COLUMN)

On the S-W side cleat, cleat weld with the shell found removed taking away shell material approx 1.5" length x 0.5" width x 5mm depth. Weld material was filled.

V-1206 (ATMOSPHERIC VENT SCRUBBER)

All bolts of Liquid inlet flange (inside vessel) which were found highly corroded and loose replaced by SS 316L.

V-1351 (HYDROLYSER)

Tightened 02 nos. of fasteners of steam inlet flange & the support clamp fasteners of the steam line in the West side which was found loose.

V-1423 (1st Stage Evaporator Scrubber)

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

V-1501 (4 ATA STEAM DRUM)

One no. new bolt provided in place of missing one of distribution sparger flange (South side). Tightened loose bolts of South-West side Riser cover plate.

V-1503(9 ATA STEAM DRUM)

New Nut in place of missing one of South side U-clamp of inlet steam header was Provided.

V-1418 (PRE EVAPORATOR SEPARATOR)

Off gas line with elbow was removed with the help of Kobelco Crane. Hydojetting of tubes were done.

RELIEF VALVE OVERHAULING AND TESTING

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

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

Sr. No.	RV No.	Description	Test Medium	Set Pressure Kg/cm2 g	Reset Pressure Kg/cm2 g	Remarks
1	RV-1201 A	V-1201 off gas line	Nitrogen	165	150	
2	RV-1201 B	V-1201 off gas line	Nitrogen	165	150	
3	RV-1201 C	V-1201 off gas line	Nitrogen	165	148	
4	RV-1205	P-1201 A discharge	Water	165	148	
5	RV-1206	P-1201 B discharge	Water	165	148	Bellow Replaced
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	Bonnet Machined, Adjusting Bolt Replaced
14	RV-1202C	V-1202 off gas line LP System	Nitrogen	6	5.5	Bonnet Machined, Adjusting Bolt Replaced
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-1108 A	Cold ammonia line from Amm storage tank to H-1102	Water	31	29	
23	RV-1108 B	Cold ammonia line from Amm storage tank to H-1102	Water	31	29	
24	RV-1106 A	Liquid amm, line from amm. Plant to amm. filter.	Water	31	29	
25	RV-1106 B	Liquid amm, line from amm. Plant to amm. filter.	Water	31	29	
26	RV-1107 A	Liquid anmmonia line(hot) before ammonia filter	Water	31	29	

27	RV-1107 B	Liquid anmmonia line(hot) before ammonia filter	Water	31	29	
28	RV-1110 A	Liquid ammonia line from atm. Amm.storage tank to H-1102	Water	31	28	
29	RV-1110 B	Liquid ammonia line from atm. Amm. storage tank to H-1102	Water	31	28	
30	RV-1901	1st stage discharge of K-1801.	Nitrogen	7	6.7	
31	RV-1902	2nd stage discharge of K-1801	Nitrogen	27	25.1	
32	RV-1503	23 ata Steam	Nitrogen	25	23.8	
33	RV-1504	9 ata Steam Drum	Nitrogen	12	11	
34	RV-1129 A	4 ata Steam Header	Nitrogen	6	5.4	
35	RV-1129 B	4 ata Steam Header	Nitrogen	6	5.4	
36	RV-1501	4 ata Steam Drum	Nitrogen	7.5	6.8	
37	RV-1502	4 ata Steam Drum	Nitrogen	7.5	6.6	
38	RV-1506	4 ata Steam Main	Nitrogen	6	5.4	
39	RV-1209	V-1203 Vessel	Nitrogen	10	9	
40	RV-1351	RV of V-1351	Nitrogen	24	23	Bonnet Machined
41	RV-1352	RV of V-1352	Water	6	5.4	Bonnet Machined, Adjusting Bolt Replaced
42	RV-1301	RV of V-1301	Nitrogen	6	5.9	Adjusting Bolt Replaced
43	RV-1184 (CCS-I)	H-1102 outlet NH3 outlet	Water	6	5.5	
44	RV-1221 (CCS-II)	P-1204 disch. To H-1203	Water	16.5	15	
45	RV-1913	Ejector system of Q-1801	Nitrogen	0.20	0.20	Disc Replaced
46	RV-1914	Ejector system of Q-1801	Nitrogen	0.20	0.20	Disc Replaced
47	RV-1916	23 ata Steam extraction	Nitrogen	28	26	
48	RV-1917	4 ata Steam exhaust	Nitrogen	4	3.6	

49	RV-1351 A	RV of P-1351 A	Water	10	9	
50	RV-1351 B	RV of P-1351 B	Water	10	9	
51	RV-1130	24 ata steam header	Nitrogen	26	22.5	
52	RV-1904	H-1811 1st stage gas cooler	Water	7	6	
53	RV-1905	H-1812 2nd stage gas cooler	Water	7	6	
54	RV-1906	H-1813 3rd stage gas cooler	Water	7	6	
55	RV-1224	C.W from utilities	Water	6	5.4	
56	RV-1201 A	V-1201 Offgas Line (Spare Valve)	Nitrogen	165	150	Nozzle & Disc Replaced
57	RV-1201 B	V-1201 Offgas Line (Spare Valve)	Nitrogen	165	150	
58	RV-1201 C	V-1201 Offgas Line (Spare Valve)	Nitrogen	165	150	Nozzle Replaced
59	RV-1205	P-1201 A Discharge	Water	165	150	Spring & Bellow Replaced

CLEANING AND HYDROJETTING OF HEAT EXCHANGERS

The Hydrojetting job was awarded to M/s. Deluxe Hydroblasting Services, Mumbai vide W.O. No. 201004120248 dated 24/01/2012. 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)
- Shell of 1st Stage Intercooler (H-1811), 2nd Stage Intercooler (H-1812) & 3rd Stage Intercooler (H-1813)

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
- 4 ata steam to V-1301
- Condensate to melt return line
- P-1201 A/B steam injection to discharge RV
- 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

Following process jobs were carried out.

Sr. No.	Job
Compressor	
1	LT-1807 , tapping i/v, g/l . New gland repacking was done.
Ground floor	
2	2nd recycle I/V of P-1102 A was passing badly. Valve was replaced with new one. (Gate valve , 4" x 900# , CS)
3	H-1301, o/l, PI gauge i/v. Valve was replaced with new one . (Gate valve , 3/4" x 800#)
4	T-1301 top water seal line was replaced from CS to SS.
5	CO2 to H-1201, MOV-1201, g/l . New gland repacking was done gland leak
6	NH3 water inlet flushing i/v wheel was broken, new was provided .
First Floor	
7	Drain i/v was passing . It was replaced with new one (Gate Valve, 2" x150#)
8	Bottom flange was found leaked, gasket was replaced.
9	P-1210 A/B , d/s , i/v , g/l. New gland repacking was done. (Gate valve , 6"x 150#, SS 304)

Second Floor	
10	ANR-1203A Carbamate density meter inlet i/v was passing . Same was replaced with new one.
11	H-1419, CW inlet I/V was hard to operate. Same was replaced with new one.
12	H-1207 CW, inlet i/v was hard to operate . Same was replaced with new one
13	P-1201 A, 2nd d/s , i/v was passing. Same was replaced with new one.
14	H-1421 gas outlet line pinhole leak near steam injection . New line was fabricated
Third Floor	
15	Pre-Evaporator ejector steam i/v was replaced after rerouting .
16	H-1424 top dome steam tracing I/V wheel free. Valve was replaced with new one.
17	V-1201, seal 2nd i/v, bonnet leak . Gasket was replaced with new one.
18	CO2 to H-1203 FT-1202, d/s , i/v was passing. Same was replaced with new one.
19	P-1201 A/B/C common suction I/V was replaced due to bonnet leak
20	HPF to NH3 condenser second I/V wheel was broken. New wheel was provided.
21	V-1206, new LT tapping was provided
Prill Tower Top	
22	CO_2 to H-1203 , drain i/v was passing heavily. Same was repLaced with new one
Hydrolyser	
23	LIC-1353 d/s i/v flange leak . Gaket was replaced.
24	2 nos. of i/v were provided in up steam of line of MICV-1351A & MICV-1351B

Following steam jobs were carried out.

Sr. No.	Job
Compressor	
1	Steam trap i/v near fire alram was passing , same was replaced with new one.
2	Bypass I/V of 60 ata steam Main I/V was passing , same replaced with new one (Globe valve , 1-1/2" x 1500#, CS)
3	60 ata header drain line 1st I/V near H-1812 was hard to operate, same was replaced with new one . (Gate valve , 3/4" x 800#)
4	3 Nos. of 60 ata drain valve (Gate valve , 3/4" x 1500#, CS) near lube oil tank were passing, same were replaced with new ones.
5	PICV-1181 u/s, I/v, g/l. New gland repacking was done.

6	60 ata to Q-1801 both trap I/V & its bypass I/V were passing (Gate valve, 1" x 1500#, CS), both were replaced with new.
7	60 ata header to Q-1801, near FI-1811 , Insulation is was provided on two bend.
8	FI-1813 H P Tapping I/V (23 ata steam) & V-1813 LG LP Tapping I/V gland leak. Both i/v were replaced with new ones.
9	PALL-1838 root i/v, g/l (4th i/v - Gate valve, 3/4" x 800#, from control room side)
10	Two supports of 60 ata to Q-1801 condensate outlet (trap) line were strengthened.
Ground floor	
11	PICV-1129 u/s, i/v, g/l , new gland repacking was done.
12	23 ata steam header steam trap i/v & it's by pass i/v were not operatable . Both were replaced. (Gate valve , 1/2"x 800#, CS)
13	PICV-1129 drain line trap d/s I/v was not operatable . Same was replaced with new one. (Gate valve , 3/4" x 800#, CS)
14	P-1501 suction i/v was replaced
15	Bonnet leak of HPF to unloading line near stripper sample point drain i/v was observed. bonnet was replaced with new one. (Bel valve, 1/2" x 1500#)
16	P-1204 B suction (pump side) flange leak. gasket was replaced.
17	PICV-1128 u/s, i/v , bonnet leak . Gasket was replaced with new one.
First Floor	
18	Condensate flushing was relocated for external heating for V-1201 sample point
19	23 ATA steam to hydrolyser i/v, g/l near urea solution filter . New gland repacking was done.
20	Steam tracing i/v , g/l of d/s, i/v between steam tracing i/v , g/l was passing, same was replaced with new one. (Gate valve , 3/4" x 800#, CS)
Second Floor	
21	PCV-1502 u/s, i/v, g/l, new gland repacking was done.
22	4 ata to pre-evaporator, flange leak , gasket was replaced.
23	Condensate flushing To carbamate density meter i/v, g/l. New gland reacking was done.
24	4 ata steam tracing main i/v , g/l. New gland repacking was done.
25	4 ata steam header to H-1418 , i/v was replaced due to flange leak.
Third Floor	
26	Near V-1201 bottom, bonnet leak of steam tracing trap was observed . The same was replaced with new one (BPT-21, 1/2" x800, CS).
27	TRCV-1421 u/s , i/v , d/s , flange leak. New gasket was provided.
28	H-1424 Top dom steam tracing I/V wheel free . New wheel was provided.

29	H-1422 dom steam tracing line pin hole leak. line (1/2" x 40 sch , CS) was replaced.
30	H-1424 dom steam tracing line pin hole leak near PICV-1424. New line was fabricated with new one.
31	LIC-1202 condensate flushing i/v , g/l . New gland repacking was done.
32	RV-1202C steam injection i/v , g/l . New gland repacking was done.
33	Jacket was provided in condensate return line near 3.5th floor during operating condition. New line was ffabricated.
Prill Tower Top	
34	Pin hole leak in steam tracing line near K-1401-3. New line was fabricated .
35	Ejector line in bucket room near wall side was relocated.
36	New steam tapping were provided for steaming of k-1401-1 to 4 from u/s of HICV-1401
Hydrolyser	
37	PICV-1351 bypass i/v , g/l . New gland repacking was done.
38	Condensate flushing I/V to H-1352 flange leaked , gasket was replaced.
39	FICV-1351 U/S I/v gland leak. New gland repacking was done.
40	23 ata Steam to LT-1351 orifice leak was observed . Jacket was provided during operating condition. Line with new flange were fabricated after removing the jacket.

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.
- Pump top casing was opened and removed from the position.
- Top half of both sides bearing housing was removed.
- Then old gland packing rings, lantern ring and gland bush was removed.
- Rotor was removed from the bottom casing.
- Geared coupling hub was removed from old rotor.
- New thrust bearing was fitted on the **new rotor having SS impeller**.
- Dimensions of new rotor at coupling hub position and old coupling hub were measured.
- Old removed coupling was fitted on new rotor by oil heating
- New rotor placed in the bottom casing.
- Both the Journal Bearings were checked and found OK.
- Bearing clearances of the pump was checked and recorded as

  JOURNAL BEARING CLEARANCE:

Front bearing	(Coupling Side)	:	0.22mm
Rear bearing	(Free End Side)	:	0.20mm

- Pump total float is measured and found **0.60 mm**
- Both side glands of pump were repacked with 25 mm PTFE packing.
- Gear teeths of coupling hub of Low speed shaft of Gear box was found in damaged condition, so it was replaced with new geared coupling hub.
- Alignment of Gear box with pump was carried out.
- Coupling float was measured and recorded = 10 mm

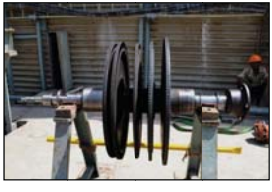
- Final Clearance Chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Total Float	-	-	0.60
2	Coupling end Journal Bearing Clearance	0.20	-	0.22
3	Front End Journal Bearing Clearance	0.20	-	0.20

ELLIOTT TURBINE (Q-4411)

Complete overhauling of the Turbine was carried out and during overhauling following activities were carried out:

- Coupling between the Turbine and G.B. was decoupled.
- Checked & recorded the turbine to Gearbox alignment readings.
- Removed Turbine Exhaust line.
- All oil lines, steam and air lines were also removed.
- Governor was removed from the position.
- Removed the carbon seal top housing and carbon seals of both sides.
- Removed all the bolts of the turbine casing and lifted the casing from the position.
- Top half of the bearing housings were also removed.
- Lifted the turbine rotor from the position.

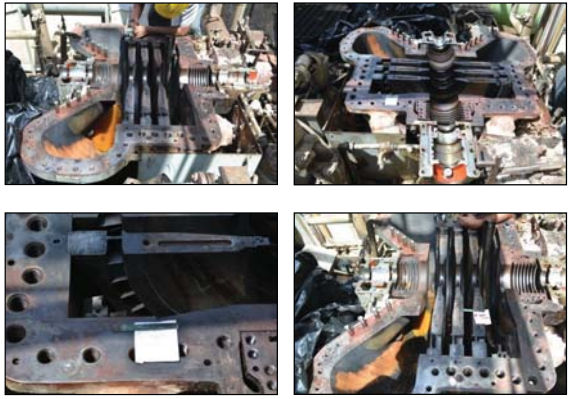


- Turbine diaphragms were checked and found ok.
- Bottom half of both the journal bearings were removed. Thrust bearing were also removed.
- Visual and dimensional checks of thrust pads and journal bearings and inspection by DP&U.T

Thrust pad thicknesses were recorded as:

S.NO	Active side pads	Non active side pads
1	17.40	17.45
2	17.43	17.44
3	17.44	17.46
4	17.40	17.45
5	17.41	17.45
6	17.45	17.45

- After through cleaning and checking rotor was placed in the bottom casing.
- All gaps and clearances were measured.
- Partition plane levels of all diaphragms were checked.



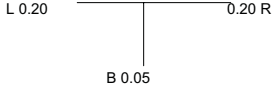
Bottom Casing & diaphragms of Elliott Turbine

- Axial float of the rotor was checked.
- Top casing was positioned and tightened.
- Fixed the carbon seals (Some seals were replaced)
- Fixed the journal bearings. Due to high clearance, coupling side journal bearing was replaced.

- Oil deflector ring was also positioned.
- Thrust float of the Turbine was measured and recorded as 0.40 mm.
- Turbine oil seal clearance were also measured and recorded as

Front (governor side):

Rear front (gear box side):



Rear Rear (gear box side):

Note: all dimensions are in 'mm'

- Governor was replaced with new tested governor and fresh oil is filled in it.
- Governor linkages were also made free.
- Oil console was drained; cleaned and fresh oil charged (SERVO-PRIME 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. During boxup some of the cover bolts were replaced.

Final clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Thrust Float	0.25-0.30	-	0.40
2	Free Float (w/o thrust bearings)	-	-	2.06
3	Coupling end Journal Bearing Clearance	0.127-0.18	-	0.25-0.26
4	Front End Journal Bearing Clearance	0.127-0.18	-	0.26 – 0.28

Turbine rotor axial clearance:

S.NO	Left(ammonia side)		Right(cooling tower side)	
	Front	rear	Front	rear
1	1.00	3.20	1.10	3.30
2	1.30	-	1.45	-
3	1.55	4.45	1.10	4.40
4	1.25	4.30	1.30	4.25
5	1.40	-	1.60	-

Turbine rotor radial clearances:

S.NO	left	right
1	3.60	3.55
2	3.70	3.70

Labyrinth seal to rotor body radial clearance:

S.NO	Left	right	bottom
1	0.20	0.30	0.35
2	0.30	0.25	0.30
3	0.45	0.25	0.40

Parting plane level:

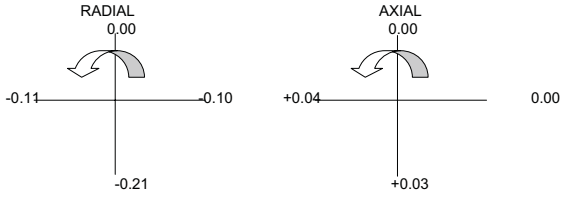
S.NO	left	right
1	+0.26	+1.38
2	+1.45	+0.27
3	+1.18	+0.29

Note: all dimensions are in ‘mm’

TURBINE TO GB FINAL ALIGNMENT READING

TURBINE TO GEAR BOX

FIXTURE ON TURBINE AND DAIL ON GEARBOX

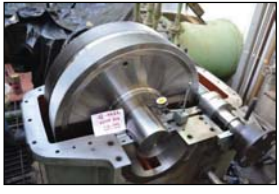


Note: fixture on turbine and dial on gear box.

LUFKIN GEAR BOX FOR COOLING WATER PUMP P-4401/A

Following activities were carried out during PM

- Gear top cover was opened. GB internals were checked and found OK.



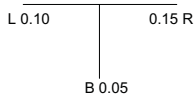
- Bearings of gear box was opened, cleaned, checked and found ok.
- During removal of MOP from the Pinion Shaft its coupling was damaged which was locally purchased and fitted.
- During the checking of GB to Pump coupling, GB side pump hub coupling teeths were found damaged. So pump side coupling was replaced (Coupling Model, Falk G-1020)

- Bearing clearances of Gear Box were checked and recorded.

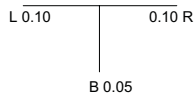
Pinion Front bearing (turbine side)	:	0.18/20mm
Pinion rear bearing (pump side)	:	0.18/20mm
Gear wheel front bearing (turbine side)	:	0.26/28mm
Gear wheel rear bearing (pump side)	:	0.26/28mm
Gear wheel float	:	0.60mm
Gear wheel backlash	:	0.44mm

- Oil Seal clearances were also checked and recorded as

Gear wheel oil seal clearance:



Pinion wheel oil seal clearance:



Final clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Gear wheel pump end Journal Bearing Clearance	-	-	0.26-0.28
2	Gear wheel free end Journal Bearing Clearance	-	-	0.26-0.28
3	Pinion wheel free end Journal bearing clearance	-	-	0.18-0.20
4	Pinion wheel turbine end Journal bearing clearance	-	-	0.18-0.20

TURBINE FOR COOLING WATER PUMP P- 4401/B (Q-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 **0.33mm**
- Complete governor removed from position and then again fixed after complete overhauling.
- Fresh oil SERVO PRIME 32 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.

Final Clearance chart is as under:

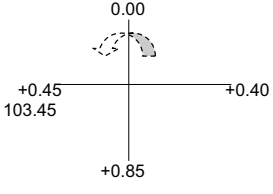
Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Thrust Float	0.25-0.30	-	0.33
2	Free Float	-	-	-
3	Coupling end Journal Bearing Clearance	-	-	0.24
4	Front End Journal Bearing Clearance	-	-	0.24

Final Alignment Readings between turbine to GB are as under:

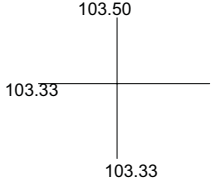
After PM Maint:

{Dial on gear box}

Radial by dial. Fixture on turbine and dial on gear box



Axial alignment by inside micro meter



Coupling float : 20mm

GEAR BOX FOR COOLING WATER PUMP P-4401/B

Following activities were carried out during PM

- Gear Box 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 as **0.38mm**
- Pinion wheel float was measured as **0.40mm**
- Backlash was also measured as **0.57mm**

Final clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Gear Wheel Thrust Float	-	-	0.30
2	Pinion Wheel Thrust Float	-	-	0.40
3	Gear wheel pump end Journal Bearing Clearance	-	-	0.22-0.25
4	Gear wheel free end Journal Bearing Clearance	-	-	0.25-0.28
5	Pinion wheel free end Journal bearing clearance	-	-	0.16-0.18
6	Pinion wheel turbine end Journal bearing clearance	-	-	0.15-01.8

COOLING WATER PUMP (P-4401/B)

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 & following are the readings:

Rear bearing (non drive end)	:	0.24 mm
Front bearing (drive end)	:	0.24 mm
Interference	:	0.05mm
Coupling float	:	21mm

Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Total Float	-	-	-
2	Coupling end Journal Bearing Clearance	0.22-0.23	-	0.19-0.20
3	Free End Journal Bearing Clearance	0.23-0.24	-	0.22-0.23

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

Following activities were carried out during PM

- Coupling between Turbine and Gear Box was decoupled.
- Before preventive maintenance Turbine to gear box alignment readings were checked.
- Turbine bearings were opened, cleaned, checked and found OK.
- Bearing clearances of turbine were checked and readings are:

  Front bearing (governor side) : 0.24mm

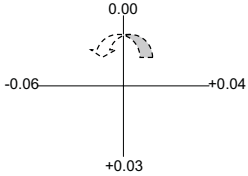
  Rear bearing (gear box side) : 0.24mm
- Thrust float of the Turbine was measured as **0.33 mm**
- After preventive maintenance alignment between Turbine to Gear box was checked.
- Governor was removed from the position, complete over hauled and again boxed up.
- Oil cooler was opened, cleaned and then boxed up. After charging the oil system 02 nos of cooler tubes were found punctured which were plugged.
- All connected oil pipe lines were also cleaned and checked.
- Oil console was cleaned and then charged with fresh oil.

Final Clearance Chart is as under:

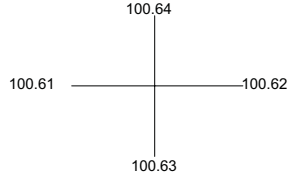
Sr. No.	Description	Design Value (mm)	Value before Prev.Maint	Value after Prev.Maint
1	Thrust Float	0.25-0.30	-	0.33
2	Coupling end Journal Bearing Clearance	-	-	0.24
3	Free End Journal Bearing Clearance	-	-	0.24

After Preventive Maint. Alignment readings are as under

Radial by dial. Fixture on turbine
And dial on gear box



Axial Alignment
by inside micro meter



Coupling float : 20mm

GEAR BOX FOR COOLING WATER PUMP P- 4403

Following activities were carried out during PM

- Bearings of gear box was opened, cleaned, checked and found ok.
- Bearing clearances of Gear Box were checked and recorded.
- Gear wheel Float was measured as **0.20mm**
- Pinion wheel float was measured as **0.20mm**
- Backlash was measured as **0.62mm**

Final clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint	Value after Prev.Maint
1	Gear Wheel Thrust Float	-	-	0.20
2	Pinion Wheel Thrust Float	-	-	0.20
3	Gear wheel pump end Journal Bearing Clearance	-	-	0.25
4	Gear wheel free end side Journal Bearing Clearance	-	-	0.23
5	Pinion wheel free end Journal bearing clearance	-	-	0.23
6	Pinion wheel turbine end Journal bearing clearance	-	-	0.25

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, cleaned, checked & found OK.
- Bearing clearances were checked & recorded.

  Front bearing (gear box side) : 0.22mm

  Rear bearing (free end side) : 0.20mm
- Total float of the pump was measured as = **0.57** mm

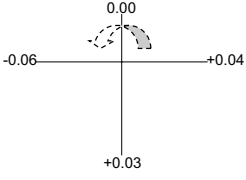
Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint	Value after Prev.Maint
1	Total Float	-	-	0.57
2	Coupling end Journal Bearing Clearance	0.20-0.21	-	0.22

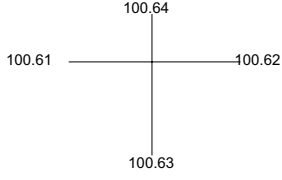
After Preventive Maint. Alignment readings are as under

Alignment reading on turbine to gear box:

Radial by dial. Fixture on turbine
And dial on gear box



Axial Alignment
by inside micro meter



Coupling float : 20mm

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, cleaned, checked & found OK.
- Bearing clearances were checked & recorded.

  Rear bearing (non drive end) : 0.22/23mm

  Interference with 0.15mm shim on bearing top : 0.02mm

  Front bearing (drive end) : 0.19/20mm

  Interference : 0.05mm

  Coupling float : 21mm

Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint	Value after Prev.Maint
1	Total Float	-	-	0.55
2	Coupling end Journal Bearing Clearance (Rear)	0.20-0.21	-	0.22/0.23
3	Front end Journal Bearing Clearance	0.20-0.21	-	0.19/0.20

After Preventive Maint. Alignment readings were checked.

BFW PUMP TURBINE (Q–5111)

Following activities were carried out during PM

- 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.
- Clearances of Turbine Bearings were checked and recorded as

  Front bearing (drive end side) : 0.26 mm
  Front side oil clearance : 0.10mm
  Front labyrinth seal clearance : 0.20mm
  Rear bearing (free end side) : 0.26 mm
  Rotor thrust float : 0.15mm

  Turbine Thrust float is measured as **0.15 mm**
- **Geared type coupling was replaced with Euroflex make Shim Pack Coupling Model 6GH-120-S**

Final Clearance chart/float are as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Thrust Float	0.2-0.4	-	0.15
2	Coupling end Journal Bearing Clearance	0.12-0.17	-	0.26
3	Free End Journal Bearing Clearance	0.12-0.17	-	0.26

- After Preventive Maint: alignment was done with laser alignment tool.
- Oil filters were cleaned and box up
- Oil cooler was opened & box up after hydro jetting.
- Oil from the oil sump was completely drained, cleaned properly and charged with the fresh oil. (Servo Prime-68)
- Governor was cleaned and flushed with fresh oil.

BFW PUMP (P- 5111)

Following activities were carried out during PM

- Alignment between turbine to pump was checked.
- Both Bearings of pump was opened, cleaned, checked and found in good condition.
- Pump Bearing clearances were checked and recorded as :

  Front side:

  Front bearing (turbine side) : 0.14/15 mm

  Front side oil clearance : 0.10mm

  Front labyrinth seal clearance : 0.20mm

  Rear side:

  Rear bearing (free end side) : 0.16/17 mm

  Front side oil clearance : 0.10mm

  Front labyrinth seal clearance : 0.20mm

  Rotor thrust float : 0.25mm

- After preventive maintenance, alignment readings between pump and turbine were again checked and recorded with laser alignment tool.
- Thrust float of the pump was recorded as **0.25** mm
- Oil filters were opened, cleaned and boxed up.
- Oil sump was cleaned and charged with fresh oil.
- All connected oil pipe lines were also cleaned and checked.

Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Thrust Float	0.28-0.33	-	0.25
2	Coupling end Journal Bearing Clearance	0.13-0.18		0.14-0.15
3	Free End Journal Bearing Clearance	0.13-0.18		0.16-0.17

After preventive Maint: Alignment done with laser Alignment Tool.

BFW PUMP MOTOR DRIVEN (P-5112)

Following activities were carried out during PM

- Coupling float of motor to gear box coupling was measured.
- Coupling float of Pump to gear box coupling was measured.
- Motor and Pump was decoupled.
- Pump bearings were opened, cleaned, checked.and found in good condition.
- Bearing clearances of Pump was measured and readings are as under:

Front side:

Front bearing (drive end side)	:	0.15/016 mm
Front side oil clearance	:	0.10mm
Front labyrinth seal clearance	:	0.10mm

Rear side:

Rear bearing (free end side)	:	0.14/15 mm
Rear side oil clearance	:	0.10mm
Rear labyrinth seal clearance	:	0.10mm
Rotor thrust float	:	0.25mm

- Motor to gearbox Alignment readings were checked.
- Pump to gear box alignment readings were also checked.
- Thrust float of the pump was measured and recorded as **0.25** mm
- Oil cooler was opened, cleaned, hydro tested and then boxed up.
- Oil sump was cleaned and charged with fresh Servo Prime-68 oil.
- **During start up worm wheel which gives drive to Auxiliary pump shaft was damaged which was replaced.**

  Worm Gear- Part No. 103 of Pump assembly Drg.No. 500-B51137

  Qty: 01 No.

Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
3	Thrust Float	0.28-0.33	-	0.35
4	Coupling end Journal Bearing Clearance	0.13-0.18	-	0.15/0.16
5	Free End Journal Bearing Clearance	0.13-0.18	-	0.14/0.15

- Motor to gearbox & Gear Box to Pump Alignment readings were checked with Shaft Laser Alignment Tool

GEAR BOX FOR MOTOR DRIVEN BFW PUMP (P-5112)

Following activities were carried out during PM

- Gear box bearings were opened, cleaned, checked and found OK.
- High speed pinion bearings were replaced with locally developed bearings by Ms Patel Brass Works.
- Bearing clearances of Gear Box were checked and recorded.

Pinion Front bearing	:	0.15/0.16mm
Pinion rear bearing	:	0.15/0.16mm
Interference	:	0.05mm
Gear wheel front bearing	:	0.15/0.16mm
Gear wheel rear bearing	:	0.15/0.16mm
Gear wheel float	:	0.70mm
Gear wheel backlash	:	0.70mm

- Gear box Bearings end covers "**O**" rings were replaced.

Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Gear wheel Motor end Journal Bearing Clearance	-	-	0.15-0.16
2	Gear wheel free end Journal Bearing Clearance	-	-	0.15-0.16
5	Pinion wheel free end Journal bearing clearance	-	-	0.15-0.16
6	Pinion wheel Pump end Journal bearing clearance	-	-	0.15-0.16
9	Backlash	-	-	0.70

F.D FAN (K-5113)

Following activities were carried out during PM

- FD fan bearing pedestal were cleaned.
- Bearings of FD fan were checked and found ok.
- Breather filter of Clutch was cleaned.
- Oil in clutch between FD Fan & Motor was replaced.

FD FAN TURBINE WITH GEARBOX (Q-5113)

Complete overhauling of turbine was carried out to replace the turbine stuffing box and reversing chambers.

Activities carried out are:-

- Turbine was completely dismantled.
- Turbine wheel was removed & found in good condition.
- Turbine casing was removed from its position.
- All the carbon rings and chamber rings were removed.
- Old cracked stuffing box was removed by turning in the workshop.
- After proper cleaning, new stuffing box fixed in the turbine housing. (see attached photographs)

Old Cracked Stuffing Box

- After that new carbon rings were fixed in the stuffing box.
- Following carbon seal clearances were maintained Carbon seal clearance:

Seal no	Clearance
5	0.10mm
4	0.10mm
3	0.10mm
2	0.10mm
1	0.10mm

- Now turbine casing was fixed on the position and pinion shaft on which turbine wheel is mounted fixed on the position.
- Pinion bearings found in good conditions, so bearing clearances were checked and recorded.
- After that Turbine wheel was fixed on the pinion shaft and then **new reversing chamber fixed on the turbine casing. (See the attached Photographs)**

Old Cracked and damaged Reversing Chambers

Old Cracked reversing Chambers

- Following clearances were maintained during fixing of reversing chambers

  Front top Reversing chamber & Wheel clearance = 0.90 mm

  Front top Reversing chamber nozzle clearance = 1.55 mm

  Front side Reversing chamber & Wheel clearance = 0.80 mm

  Front side Reversing chamber nozzle clearance = 1.80 mm

- Thrust cum journal bearing of the Gear shaft was found in minor damaged condition, so it was replaced with new journal cum thrust bearing and clearances were recorded.

Gear box bearing clearances:

Pinion Front bearing	:	0.14mm
Pinion rear bearing	:	0.17mm
Interference	:	0.03mm
Pinion thrust float	:	0.22mm
Run out	:	0.01mm
Gear wheel front bearing (new bearing)	:	0.11mm
Gear wheel rear bearing	:	0.14mm
Run out	:	0.01mm
Gear wheel float	:	0.22mm
Gear wheel backlash	:	0.27mm

- Oil console and all connected oil pipelines were removed, cleaned and then boxed up.
- Oil cooler was opened; hydrojet cleaned and then boxed up.
- Fresh oil SERVO PRIME 68 was charged in oil console.

Final Clearance chart is as under:

Sr. No.	Description	Design Value (mm)	Value before Prev.Maint (mm)	Value after Prev.Maint (mm)
1	Gear wheel Fan end Journal Bearing Clearance	-	-	0.14
2	Gear wheel free end Journal Bearing Clearance	-	-	0.11
3	Pinion wheel free end Journal bearing clearance	-	-	0.17
4	Pinion wheel Turbine end Journal bearing clearance	-	-	0.14
5	Backlash	-	-	0.27

- During checking of the trip system, it was found that its trip system is not working, so its Rapid closing Governor with relay (Trip assembly), Fig 380 was removed and dismantled for checking.
- On dismantling following parts were found in damaged condition.

Sr.No.	Part No.	Part Description	Qty
1	390 00.02	Control Bush	01
2	390 00.03	Control slide	01
3	390 00.10	Release Bolt	01
4		Lock Pin	01

- Trip assembly was again assembled with above mentioned spare parts and fixed on the position and on testing found working all right.

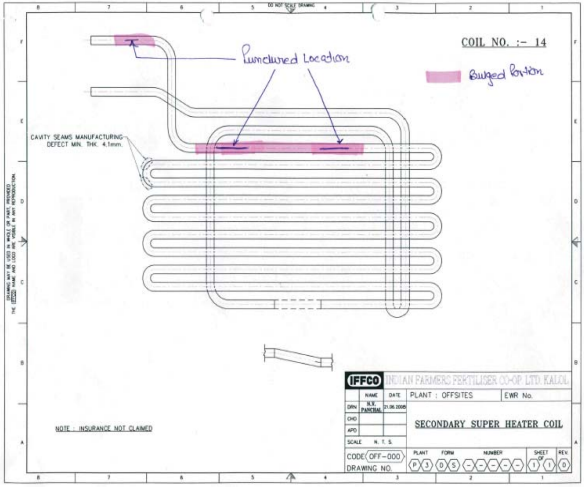
BHEL BOILER JOBS (F-5111)

BHEL BOILER INSPECTION/HYDROTEST

- Boiler was inspected by Boiler Inspector in open condition on 04/04/2012 & Hydrotest was carried out at 90.0 kg/cm2 pressure on 07.04.2011 and witnessed by Boiler Inspector.

Replacement of Secondary Super Heater Coil

- Boiler was having suspected leak from past some months prior to shutdown. On opening the boiler, top most coil of the Secondary Superheater was found bulged and punctured at several location. (See below sketch)

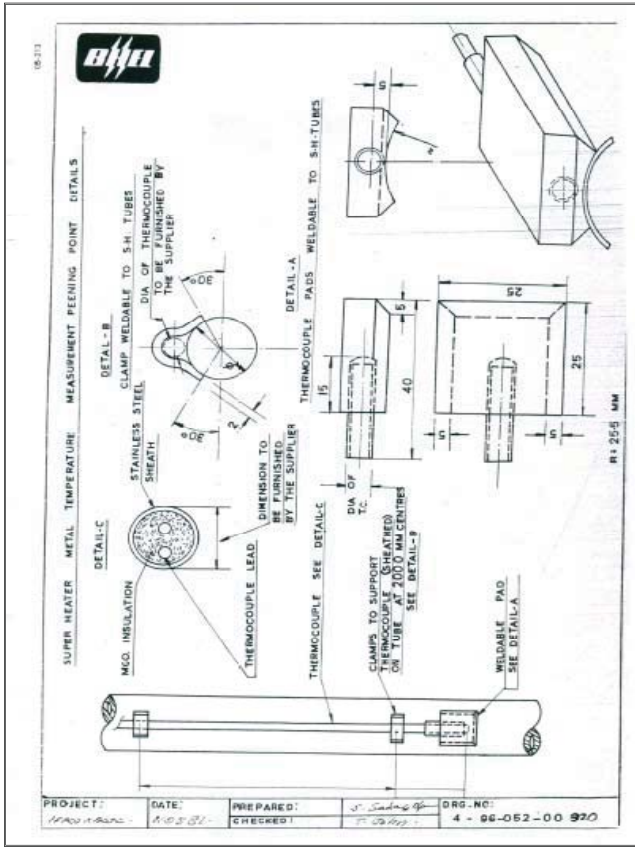


- Due to leakage of steam, refractory of boiler drum and at some other places were also found damaged.

- So, punctured SSH coil was cut from its header stub joints and removed from the position.

- New spare secondary SSH coil was inserted by cutting one cut corner wall tube and welded with its header stub joints.

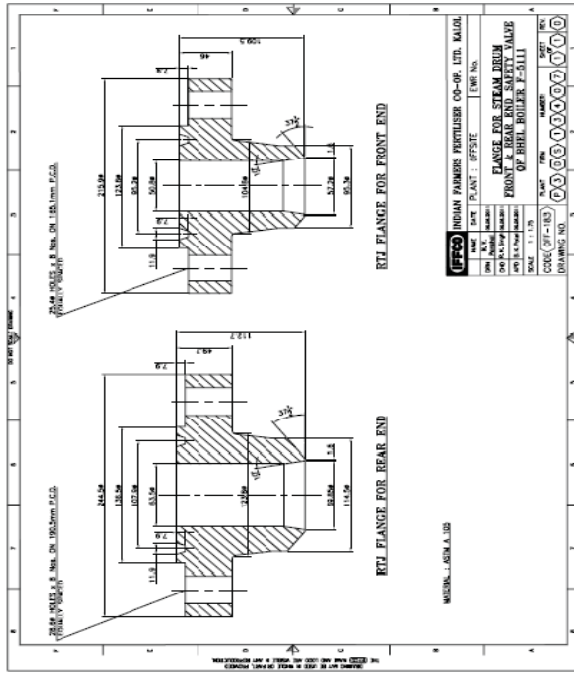
- It was indicated from the failed SSH coil that, overheating may be the reason for the failure. So one thermocouple pad was also welded on the top most SSH coil for online temperature indication. Drawing of Thermocouple pad is shown below:



- Tube sample of failed coil was also given to M/s BHEL for failure analysis.

Replacement of Existing welded type Boiler Drum and Super Heater RV with Flanged End safety Valves.

- Existing welded drum safety valves were cut from its nozzle joints and companion flanges matching with new flanged type safety valves were welded on drum front and rear nozzles. Drawing (P3-DS-13407 Sheet 1/1)of companion nozzles is shown below.



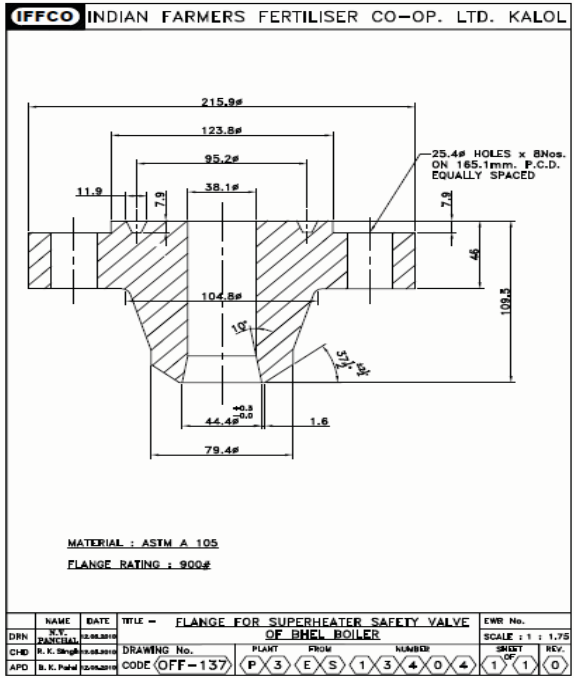
New flanged type RV's were procured from M/s Tyco valves whose data-sheet are given below:

P.O No. **20101417, Dt 24/03/2011**

DATA SHEET OF SAFETY VALVES

Sr. No.	Parameter	Description	
1.0	**General**		
1.1	Tag No.	RV –F- 5111-1 (Rear)	RV –F- 5111-2 (Front)
1.2	Valve Model	**2.5 K2 6.0 HCI-56-IBR-FN-SPL**	**2.0 J2 4.0 HCI-56-IBR-FN-SPL**
1.3	Orifice Size	**2.5 K2 6.0**	**2.0 J2 4.0**
1.4	Service	Saturated Steam	Saturated Steam
1.5	Line / Vessels No.	F-5111 (Boiler Steam Drum Rear)	F-5111 (Boiler Steam Drum Front)
2.0	**Connections**		
2.1	Size : Inlet / Outlet	2-1/2" / 6"	2" / 4"
2.2	Flange Rating & Faces	Inlet:900# (RTJ) Outlet: 150# (RF)	Inlet:900# (RTJ) Outlet: 150# (RF)
3.0	**Basis of Design**		
3.1	Relieves to	Atmosphere	Atmosphere
4.0	**Input Data**		
4.1	Set Pressure	1025 PSI	982 PSI
4.2	Operating Pressure	65.5 Kg/cm2 g	65.5 Kg/cm2 g
4.3	Temperature	Saturated steam	Saturated steam
4.4	Allowable Overpressure	5%	5%
4.5	Capacity Rated	122995 lbs / Hr	66296 lbs/Hr
4.6	Blow-down	2.5 to 5.0%	2.5 to 5.0%

- Existing superheater safety valve was cut from its nozzle and one companion flange was welded on nozzle and one companion flange was welded on spare superheater safety valve to make it flanged end. Drawing of companion flange (P3-ES-13404, SHEET 1 OF 1, REV. 0.) is given below:



- Before installation at site, both Front & Rear Flanged end safety valves were tested on valve testing machine and online floating was carried out on super heater safety valve and following valve parameters were recorded.

Description	Popping Pressure Kg/cm2g	Reset Pressure Kg/cm2g
Drum Rear R.V. (On Valve testing Machine)	72.0	--
Drum Front R.V.(On Valve testing Machine)	69.00	--
Super Heater R.V. (Online Floating)	64.40	62.30

Replacement of Burnout Components of Boiler Burners

- During the visual inspection Boiler burners in last Annual shutdown-2011, burner impeller and nozzle tips of both top and bottom syn gas burners were found in burnout condition and the same was shown in the attached photographs

- Supplier of the burners M/s Thermax was contacted and finally M/S Thermax was agreed to supply the modified syn gas burner assembly free of cost to IFFCO.
- In the modified burner syn gas burner assembly, main syn gas burner was taken 144 mm back from the main burner level to reduce the heat impingement. Modified burner as per Drawing no. : L11-WR-93361, Rev-0 M/s. Thermax Limited, Pune.
- For the replacement of burn out components of burner, contract was awarded to M/s Thermax Ltd, Pune and for the removal and then re-application of burner refractory another contract was awarded to M/s Ace Calderys.

- M/s Thermax Supplied the Burn out syn gas burner assembly along with cooling air manifold as shown in the attached photographs.




- **New Modified Syn Gas Burner assembly**

- For the easy removal of burners from its position beams and other structure was erected. With help of this both top and bottom burners was easily removed from its position by breaking the burner refractory and opening the burner front main flange bolts.


Beams erected for the easy removal and rigging of the burners


Breaking and removal of Burner Block refractory

Removal of Burners from its position

- After removing the complete burner assembly, burnout portion of the syn gas burner removed by plasma cutting and then new syn gas burner was welded keeping it back 144 mm from main gas spud plane.
- New syn gas cooling manifold along with its central pipe was also inserted in the burners.
- After completing the replacement of burnout components again both burners were inserted and erected in position in front boiler wall. See below attached photographs.

Burner wind Box

Installation of Burners after modification

- After installation of both burners, all connected lines and attachments were fixed.
- After installation burner blocks were again casted with castable refractory ACCOMON CAR.

Casting of Burner Block refractory

- Now before and after view of burners is shown in the below photographs

Before Modification

After Modification

- In nut shell following modification were carried out in BHEL boiler Burners:
  - Replaced the burnout syn gas burner assembly.
  - Syn gas burner assembly was taken back by 114 mm from main RLNG gas spuds plane to reduce heat impingement.
  - In syn gas burners no. of capped and un capped gas ports were reduced to 12 each from 13 and 14 nos respectively.
  - Burners front syn gas air cooling inlet pipe manifold was modified with 4" pipe as against the old cooling air inlet pipe of 2" size which was taken from FD fan out let duct.
  - Old Burner drawing No. L11-1RT-45042 Rev.1
  - New Modified Burner Drawing No. L11-1WR-93361

Re-Examination of Boiler Bank Tubes

- Complete RLA study of the BHEL Boiler was carried in March-April-2010.
- During the RLA Stydy-2010, tube sample was taken from boiler Bank tubes for the destructive testing. Microstructure report of Boiler Bank tube shows decarburization and grain coarsening on inner and outer surface of the tube.
- Based on above finding and Five year action plan approved by CIB Gujarat, reexamination of boiler bank tubes were carried out through M/s Thermax Ltd.
- During Re-examination of boiler bank tubes following tests were carried out:
  - Thickness measurement at accessible locations – Found Within limits
  - OD measurement at accessible locations – Found Within limits
  - Tube sampling for Destructive analysis – Normal microstructure observed in microstructure analysis except minor decarb layer on outer edge which is acceptable for further boiler operation.

Other Boiler Jobs

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

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

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

  Hot End: 1-3 mm, Cold end: 1-4 mm
- Both End Rotor Bearings (Self-aligning Spherical Roller Bearing 22330 CCK/C3 W 33 with Adapter sleeve H 2330 T) housing were opened for inspection, condition of both end bearings were found OK. So it was boxed-up after replacement of Hot End side Oil seal (125 X 95 X 12mm) and 95 mm dia speedi sleeve and fresh oil (Servo Prime C 100, 8 liters approx.) charged.
- RAH Drive unit (Electric motor with Gear Box & sprocket) was replaced by Re conditioned gearbox. (Code : 141110925101)
- Bearings Clearances were checked by feeler gauge and their readings were as follows:

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

- RAH Air Motor Clutch oil flushed.

Deaerator Inspection

- Internal inspection of Deaerator was carried out and some trays were found loose which were rectified.

COOLING TOWER AREA JOBS

Replacement of Cooling Water pumps suction rubber Expansion bellows

- Old deteriorated rubber expansion bellows installed in suction line of Cooling water pumps were replaced.
- Job carried out through M/s General Engg vide W.O No 201004120019, Dt 21/12/2011 for the replacement of these bellows.

Installation of JASH make sluice gate in CW sump of P-4401/C & D

- Gates installed in Cooling Water Sump of P-4401/C & D were locally manufactured and not giving complete isolation to these pumps. So Sluice gates were purchased from M/s Jash Engineering, Indore.
- After draining of Sump, old sump gates were removed as shown in the attached pectures.


Removal of old Gates

- After the removal of old gates, RCC blockout was made as per the drawing and new gates were installed in the presence of Service Engineer of M/s Jash engineering.
- After the installation, movement of gates were checked and found smooth.




New Jash Gates after installation

Repairing of Cooling Towers, H-4401/7 & 8

- Distribution deck of cooling towers H-4401/7 & 8 were repaired by fixing new TG planks in cooling tower distribution deck and top deck area.
- Railing of Both the towers were also repaired.
- Structural members of the cooling towers were also checked and replaced the defective members.
- Corroded fasteners were replaced with new SS304 bolts with SS 304 Square washers.

Repairing of Discharge valve of P-4404/E

- 700 MM NB BDK make butterfly valve was installed in the discharge line of P-4404/E.
- The valve was always observed to be passing.
- To attend the valve valve was removed from the position by opening the flange bolts.
- Valve was thoroughly cleaned and inspected by the service Engineer of M/s BDK.
- Seat Ring of the valve was found damaged which was replaced. (see attached Photographs)

- For the installation of valve again in position, it was required to cut pump side flange along with approx 500 long spool piece, which was again rewelded after valve positioning. The same is shown in attached fig.

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

DM PLANT JOB

- The Man hole of Degasser tower sump was opened for cleaning & inspection. Degasser sump was found OK and then boxed up with new gasket.
- Corroded casing of Degasser blower, K-4201/B was replaced with new in-house fabricated casing.

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 jobsas per request from the prod. Deptt.
- Replaced the passing 40 ata bypass valve above shift office.
- Replaced various inoperative valves.

CONVEYOR M-2110

Following jobs were carried out:

- Inspection of Head end pulley, Bend pulleys, Snub pulley, Gravity pulley and Tail end pulley and its bearings were done, found satisfactory.
- Greasing of all pedestal bearings was done.
- Bend pulley was replaced.(East side)and Rubber lagging was replaced(West side Bend pulley)
- Return tracking roller was replaced.
- All damaged and noisy Impact rollers, carrying rollers, return rollers, and guide rollers were replaced.
- Skirt rubbers were replaced.
- Inspection of flap valve was done. Lubricated the same.
- Preventive maintenance of Gear Box carried out.
- Proper alignment was done.
- Rubber bushes of Couplings were replaced.
- Complete cleaning and painting done on the conveyor structure.

CONVEYOR M-2112

Following jobs were carried out:

- Inspection of Head end pulley, Bend pulleys, Snub pulley, Gravity pulley and Tail end pulley and its bearings were done, found satisfactory.
- Greasing of all pedestal bearings was done.
- Rubbers lagging of bend pulleys [both] were replaced.
- All damaged and noisy Impact rollers, carrying rollers, return rollers, and guide rollers were replaced.
- Skirt rubbers were replaced.
- Hot vulcanizing (3nos.) joints of conveyor belt were done instead of fastener joints.
- Base slot of frames of Carrying roller were increased. [50 nos.]
- Preventive maintenance of Gear Box carried out.
- Proper alignment was done.
- Rubber bushes of Couplings were replaced.
- Preventive maintenance of Tripper system carried out.
- Complete cleaning and painting done on the conveyor structure.

CONVEYOR M-2117

Following jobs were carried out

- Inspection of Head end pulley, Bend pulleys, Snub pulley, Gravity pulley and Tail end pulley and its bearings were done, found satisfactory.
- Greasing of all pedestal bearings was done.
- All damaged and noisy Impact rollers, carrying rollers, return rollers, and guide rollers were replaced.
- A hot vulcanizing (1no.) joint of conveyor belt was done to remove the fastener joint.
- Preventive maintenance of Gear Box carried out.
- Proper alignment was done.
- Rubber bushes of Couplings were replaced.
- Complete cleaning and painting done on the conveyor structure.

CONVEYOR M-2121

Following jobs were carried out:

- Inspection of Head end pulley, Bend pulleys, Snub pulley, Gravity pulley and Tail end pulley and its bearings were done, found satisfactory.
- Greasing of all pedestal bearings was done.
- Rubbers lagging of bend pulley [East] was replaced.
- All damaged and noisy Impact rollers, carrying rollers, return rollers, and guide rollers were replaced.
- Skirt rubbers were replaced.
- Hot vulcanizing (1no.) joint of conveyor belt was done to adjust the belt length due to elongation.
- Preventive maintenance of Gear Box carried out.
- Proper alignment was done.
- Rubber bushes of Couplings were replaced.
- Complete cleaning and painting done on the conveyor structure.

CONVEYOR M-2122

Following jobs were carried out

- Inspection of Head end pulley, Snub pulley, Tail end pulley and Tripper pulleys and its bearings were done, found satisfactory.
- Greasing of all pedestal bearings was done.
- All damaged and noisy Impact rollers, carrying rollers, return rollers, and guide rollers were replaced.
- Skirt rubbers were replaced.
- Preventive maintenance of Gear Box carried out.
- Proper alignment was done.
- Rubber bushes of Couplings were replaced.
- Complete cleaning and painting done on the conveyor structure.

CONVEYOR M-2122/A1

Following jobs were carried out

- Inspection of Head end pulley, Snub pulley and Tail end pulley and its bearings were done, found satisfactory.
- Greasing of all pedestal bearings was done.
- All damaged and noisy Impact rollers, carrying rollers, return rollers, and guide rollers were replaced.
- Skirt rubbers were replaced.
- Preventive maintenance of Gear Box carried out.
- Proper alignment was done.
- Rubber bushes of Couplings were replaced.
- Complete cleaning and painting done on the conveyor structure.

CONVEYOR M-2122/A2

Following jobs were carried out

- Inspection of Head end pulley, Snub pulley and Tail end pulley and its bearings were done, found satisfactory.
- Greasing of all pedestal bearings was done.
- All damaged and noisy Impact rollers, carrying rollers, return rollers, and guide rollers were replaced.
- Skirt rubbers were replaced.
- Preventive maintenance of Gear Box carried out.
- Proper alignment was done.
- Rubber bushes of Couplings were replaced.
- Complete cleaning and painting done on the conveyor structure.

DUST CONVEYOR, M-2137

Following jobs were carried out

- Inspection of Head end pulley and Tail end pulley and its bearings were done, found satisfactory.
- Greasing of all pedestal bearings was done.
- All damaged and noisy carrying rollers, return rollers, and guide rollers were replaced.
- Rubber bushes of Couplings were replaced.
- Complete cleaning and painting done on the conveyor structure.

PAY LOADER CONVEYOR, M-2113

Following jobs were carried out

- Inspection of Head end pulley and Tail end pulley and its bearings were done, found satisfactory.
- Greasing of all pedestal bearings was done.
- All damaged and noisy carrying rollers, return rollers, and guide rollers were replaced.
- Rubber bushes of Couplings were replaced.
- Complete cleaning and painting done on the conveyor structure.

CONVEYOR M-2142/1

Following jobs were carried out

- Inspection of Head end pulley, Snub pulley and Tail end pulley and its bearings were done, found satisfactory.
- Greasing of all pedestal bearings was done.
- All damaged and noisy carrying rollers, return rollers, and guide rollers were replaced.
- Preventive maintenance of Gear Box carried out.
- Proper alignment was done.
- Rubber bushes of Couplings were replaced.
- Cleaning of complete structure done.

VIBRATING SCREEN (A, B, C & D)

Following jobs were carried out on the Vibrating Screen

- All the screens were cleaned thoroughly. Seals were checked, found ok. All the screen gaskets were replaced.
- Cleaning of structure for all the screens was carried out.

Blowers

- Preventive maintenance of K-2161 & K-2704 carried out.
- Coupling done after proper alignment.

PREVENTIVE MAINTENANCE OF PACKER SCALES

- Preventive maintenance of all the assemblies of Packer scales were carried out.
- Servicing of all Air cylinders was done. Replaced the seal kits of all the Air cylinders.
- Replacement and Alignment of stabilizer plate done.
- Calibration of all packer scales done.

SLAT CONVEYOR M-2124

Following jobs were carried out on the slat conveyors

- Preventive Maintenance of Gear boxes were done.
- Conveyor adjusting mechanism serviced.
- Cleaning of all slat conveyors was done.
- Replaced damaged Coupling bushes and bolts.
- Complete cleaning and painting done.

WAGON LOADER

Following jobs were carried out.

- Preventive maintenance of Gear Box carried out. Coupling done after proper alignment. Main drive chain adjusted.
- Replaced all damaged and noisy Carrying, Return and Guide rollers by spare reconditioned rollers
- Cleaning of complete structure done.

TRUCK LOADER

Following jobs were carried out

- Preventive maintenance of Gear Box carried out. Coupling done after proper alignment.
- Replaced all damaged and noisy Carrying and return rollers by spare reconditioned rollers.
- Cleaning of complete structure done.

INSPECTION

AMMONIA PLANT
(INSPECTION)

The following major inspection activities were performed in Ammonia Plant.

- Inspection of primary reformer, catalyst tubes and risers. Details are given at **Annexure-1 to 4.**
- Visual inspection of equipments.
- 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 equipments 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. 02 Nos. of sockolet and 01 Nos. of Spool piece were replaced in S-50 converter 108-D to MP Boiler 107-C pipeline loop. Details of inspection activities carried out are given at **Annexure-10.**
- NDT's viz. UFD & RT was carried out in the converter loop to assess the condition of weld joints & Elbow parent metal for any deterioration. The details are attached at **Annexure-11.**
- Qualification 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 12 nos. of outlet manifold field weld joints & all riser 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 331 nos. of tubes and between 0.17 to 0.70 % in 05 nos. of tubes. Creep measurement of the riser tubes at tunnel slab level was also carried out using digital micrometer. Creep was found in the range of 0 – 0.33 % for 01 no. of Riser tube 0.33 – 1.17 % in 07 no. 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 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.
- Thermo-wells were found slightly bent, scaled & eroded except thermo-well no. 8 counting from West.
- Bottom floor was found sagged at some locations.
- Bottom floor Refractory bricks were found loosened at some places.
- Tunnel Block was found lying in the central tunnel.
- Refractory condition of the tunnels was found satisfactory.
- Insulation of East, South & West wall was found satisfactory.

Auxiliary Boiler Furnace

- Burner block refractory repair work has been carried out in this turnaround. The refractory matter was found adhered on the Burner Fan holes. Need to be cleaned.
- Condition of the tubes was found satisfactory.
- Wall refractory in the N-W corner was found fallen behind the tubes.
- Top header refractory was found having cracks.

VESSELS & OTHER EQUIPMENTS

101-CA/CB GAS INLET NOZZLE

- Inward bulging and distortion of approx. 20-40mm was observed at the ID of liner segments of both 101-CA and 101-CB gas inlet paths.
- Approx 3" gap observed in entire circumference of 101-CA gas inlet paths.

- Scattered circumferential cracks were observed at second liner plate from 103D side.
- Refractory support behind the gas inlet liner of 101-CA found very poor need to repaired.
- Gas inlet liner found buckled at 101-CA.
- The refractory above the skirt liner area in entire circumference was found damaged & need to be repaired.
- 02 nos. crack found in bottom manway weld of the vessel approx 3" in length.

103-D, SECONDARY REFORMER

BOTTOM DOME

- Erosion of refractory and scattered cracks was observed at few locations and same were found more prominent around both the gas inlet nozzles.
- Upper layer of refractory was found damaged at scattered locations.
- Loose refractory material was found at Bottom floor.
- Top Dome refractory was found intact except some of the refractory brick slots were found chocked with alumina balls.
- Skirt liner removed from the shell.

104-D, HT SHIFT CONVERTER

- Magnetic Particle test was carried out on all Circumferential and Longitudinal weld joints of 104-D from inside. At the same time Ultrasonic Flaw Detection was carried out in length of 6" x 6" of all T-joints and approx. 12" area of parent metal. No significant defect was observed.
- In-situ Metallography on parent metal and longitudinal weld joint carried out. The detailed report is attached in **Annexure-9.**

107 - D, TRANSFER LINE

(FROM OUTSIDE)

- Minor damage of the refractory was observed near he end plug of the transfer line.
- Minor buckling of the liner was observed at scattered locations throughout the length of the transfer line.
- Thermo well was found intact in position

102-EB, CO_2 STRIPPER

FROM TOP MANHOLE

- Demister pads were found slightly shifted in middle portion.
- Demister pad supporting strips and rods were found distorted in middle portion.
- Only 02 nos. bolts of liquid inlet nozzle flange were in position & in loose condition. Rest of the bolts were found missing.

- West side distributor header was found rubbing with the shell plate in S-W direction causing dent in the shell plate. Same was also observed in previous inspections.
- North side U-Clamp of East side distribution header was found loose as the clamp holes got enlarged. Need to be rectified.
- Few fasteners of top tray were found missing.
- East Side Distributor's support / rest plate weld with shell was found broken in South direction approx 4" in length.
- Cracks were observed near the U-Clamp holes on the West side distributor.
- Plate provided behind the West side distributor was found cracked towards South end approx. 1.5" in length.

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.
- Liquid distributor header flange joint gasket found in damaged condition and its few bolts found loose.
- Ultrasonic thickness measurement carried out and found satisfactory.

FROM BOTTOM MANHOLE

- No abnormality observed however lumps of soft black debris found along with rasing rings.

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. This was observed in previous inspections also.
- One of the hole at South end of phosphate dozing line (1" NB) was found enlarged. This was observed in previous inspections also.

- On east side cover plate, 2 nos. of clamps were found loose.
- On west side cover plate, 1 no. of clamp was found loose.

102-F , RAW GAS SEPARATOR

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

103-F, REFLUX DRUM

- Demister pads were found intact in its position.
- Epoxy paint was found peeled off from the few small scattered locations at the bottom half of the vessel. However epoxy primer was found intact at such location.
- Dust & loose metallic pieces were found lying at the dish end of the vessel need to be cleaned.
- Water found accumulated in bottom dish end of the vessel.
- Overall condition of the vessel was found satisfactory.

104-F, SYN GAS COMPRESSOR SUCTION SEPARATOR

- 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.

105-F, SYN. GAS COMPRESSOR 1ST STAGE SEPARATOR

- The coloration of vessel was brownish black from inside.
- Demister pads were found intact in position.
- Scattered minor pittings were observed throughout the shell surface, the same was observed in past also.
- Entire internal surface was found oily.
- The Overall condition of the vessel was found satisfactory.

106-F, AMMONIA SEPARATOR

- Brownish black colouration was observed inside the vessel.
- Demister pad was found intact.

- Scattered minor scales and pitting up to a depth of 1mm were observed throughout the shell surface.
- Internal baffle demister supports and its welding were found in satisfactory condition.
- Inlet distributor welding was found in satisfactory condition.
- Oil sludge and dust particles were found adhered to entire internal surface and on demisters. Proper cleaning is recommended.
- Overall condition of the vessel was found satisfactory.
- Thickness measurement was carried out. No abnormality was observed.

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.
- Thermowell found intact in position.

109-F, REFRIGERANT RECEIVER

- The shell had assumed Grayish black 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 pittings / 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 internal surface was found oily.
- Thermowell found intact in position.
- Overall condition of the vessel was found to be satisfactory.

110-F, FIRST STAGE REFRIGERANT FLASH DRUM

- Brownish black coloration was observed inside the drum.
- Entire internal surface was found oily.
- The demister pads were found intact in position.
- Scattered scales were observed on the surface of the dish ends and shell.
- Thermowell found intact in position.
- Overall condition of the vessel was found to be satisfactory.

111-F, SECOND STAGE REFRIGERANT FLASH DRUM

- Blackish gray coloration was observed inside the shell surface.
- Entire internal surface was found oily.

- The demister pads were found intact in position, where as one bolt was found missing from middle support of the demister pad. The same was observed during last inspection also.
- Dish ends were found covered with scattered scales.
- Condition of all shell weld joints was found satisfactory.
- Seal weld (approx. 2") was missing from 10" nozzle on top of shell in the middle of the vessel. The same was observed during last inspection also.
- Thermowell found intact in position.
- Ultrasonic thickness measurement carried out and found satisfactory.

112-F, THIRD STAGE REFRIGERANT FLASH DRUM

- The demister pads were found intact in position.
- The coloration of the inside surface of shell was brownish black.
- Surface of the entire vessel was found oily.
- 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.
- Thermowell found intact in position
- Overall condition of the vessel was found satisfactory.

MISCELLANEOUS JOBS

WELDER QUALIFICATION TESTS

- Performance qualification test of 17 Nos. welders offered by M/s General Engineering was carried out. 08 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical departmental welding jobs in the plant.
- Performance qualification test of 05 Nos. welders offered by M/s Dowel Erectors was carried out. All the 05 nos. of welders were qualified during the test. These welders were allowed to perform welding in Ammmonia Converter Sockolet replacement job , Spool piece replacement of Ammonia Converter outlet line & Control valve replacement job in Primary Reformer.
- Welder qualification test of 03 Nos. welders of M/S. Skywin Erectors. was carried out. 03 welders were qualified. These welders were qualified for performing Superheater RV, Steam Drum RV & leaky SH coil replacement jobs.
- Performance qualification test of 05 Nos. welders offered by M/s General Engineering (Ram Bahadur) was carried out. 03 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical & Technical Department's 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.

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.**

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

During this shutdown measurement 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.**

INSTALLATION OF NEW PIPELINES

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

OVER SPEED TRIP TEST

- OST of following Machines was carried out/witnessed:

  103-JT : 11880 RPM

  103-JLJT : 3385 RPM

ANNEXURE-1

VISUAL INSPECTION REPORT :

PRIMARY REFORMER RADIANT ZONE:

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

BURNER BLOCKS: Following burner blocks were found damaged:

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

BOTTOM HEADER INSULATION:

Header insulation was found damaged near following tube nos.:

Header No.	Tube no(s) where insulation found damaged
1	Near tube no. 3,4,5,10,11,15,17,25,26
2	Near tube no. 1,2,3,14,15,16,20,21,riser,24,25,30,31,41,42
3	Near tube no. 3,4,8,9,10,18,21,23-25,31-37,40-41
4	Near tube no. 1,21,25-29,35
5	Near tube no. 1,4,7,18-21,22-27,28-32,38-42
6	Near tube no. 3-8,11-12,15-16,19,26-27,30-40
7	Near tube no. 4,7-9,12-13,21,27,31,36-37,42
8	Near tube no. 3,7-9,11-12,17-20,23-26,30-35,37-40

ROOF INSULATION:

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

Row No.	Location
Burner Row 1st	Between burner no. 12-13 near tube no.34,42
Burner Row 2nd	Between burner no.1-2,6-7,13-14 near tube no.32
Burner Row 3rd	Between burner no. 4-5, around burner block no. 3-4
Burner Row 4th	Near tube no.34, around burner block no.14
Burner Row 5th	Near Burner no. 9, near tube no.20
Burner Row 6th	Between burner no.1,2 &3
Burner Row 7th	Burner no.3
Tube Row 7th	Near tube no. 22
Burner Row 8th	Burner No. 2
Tube Row 8th	Near tube no. 30-32

REFRACTORY WALLS:

- **East wall**:

1. Z module insulation was found loose near manhole on south direction.
2. Gap observed between wall bricks & tunnel slab

- **South Wall**:Gap Observed between tunnel slab & Z-Module at Row no. 2 &6
- **North wall**: Found Satisfactory.
- **West wall**: Found satisfactory. However, minor bulging observed at south end below burner no.2

TUNNEL SLAB:

Row No. : 9 No of slab broken: 01

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	40	02	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	41	01	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	41	01	0

Annexure – 2(5/5)

CREEP MEASUREMENT OF PRIMARY REFORMER RISER TUBES AT SLAB LEVEL:

Riser	N- S	E- W	Creep in Percentage		
			0 - 0.33	0.33- 1.10	1.10- 1.44
1	125.48	125.53	X		
2	124.98	125.01		X	
3	125.12	125.16		X	
4	125.02	124.89		X	
5	125.46	125.45		X	
6	125.11	125.04		X	
7	124.89	124.97		X	
8	125.10	125.05		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	-10	-10	-16	-14	-20	-10	-9	-7	0	-2	-9	-7	-12	-13	-13	-10	-13	0	0	18
2	-5	-3	-2	-6	-3	-3	-10	-11	-6	-4	-2	-2	0	0	-5	-7	-8	3	-3	-1	0	0
3	-2	0	-2	-6	-7	-8	-8	-10	-2	0	0	2	3	0	-4	-7	-8	-3	-3	0	3	5
4	0	2	0	-2	-2	-3	-3	0	1	0	1	0	0	0	0	0	0	0	0	0	2	3
5	4	2	0	-2	-2	-4	-7	-4	-3	2	0	0	0	0	0	0	0	2	0	1	3	3
6	5	3	2	0	-3	-5	-2	0	-3	-11	0	-15	2	3	-2	-3	-6	-6	-3	1	0	5
7	3	3	0	-2	-6	-5	-4	-4	-4	-3	0	0	-2	-4	-3	-6	-6	-5	0	0	2	7
8	10	-1	2	0	-3	0	-9	-6	-2	-2	0	-3	-4	2	-8	-5	-2	0	0	-12	9	13

TRANSFER LINE SPRING HANGER LOAD READINGS

ROW	1	2	3	4	5	6	7
READINGS	-34	-27	-28	-32	-39	-18	-18

BOTTOM DRAIN READINGS

ROW	1	2	3	4	5	6	7	8
READINGS	**95**	**98**	**100**	**90**	**93**	**98**	**97**	**95**

AUXILIARY BOILER SPRING READINGS

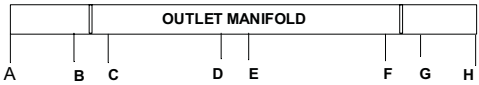
SPRING	S-E	N-E	S-W	N-W
READINGS	**67**	**67**	**65**	**64**

Annexure – 4

CLEARANCE OF OUTLET MANIFOLD FROM GROUND FLOOR IN COLD CONDITION

Header No.	Location of Meausrement					
	B	C	D	E	F	G
1	*170	*200	*180	*140	*160	*170
2	305	310	285	*215	*180	*210
3	*160	240	*200	290	*225	*230
4	*160	*180	*200	*230	310	*220
5	*185	280	280	275	280	300
6	280	270	*140	*150	*160	*145
7	295	300	305	*190	290	300
8	300	300	*170	300	300	300

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



SOUTH **NORTH**

Annexure – 5

LIST OF PIPELINES FOR ULTRASONIC FLAW DETECTION

SR NO	LINE NO	SIZE (NB)	SCH	FROM	TO	NO. OF WELD JOINTS	No. of Elbows	REMARKS
1	SG-1303-08-14”	14”	120	SG-33-14” (105-D)	108-D Inlet (Bottom)	06	03	No significant defect was observed.
2	SG-1303-09-10”	10”	120	SG-1303-08-14” (105-D)	108-D Inlet (Bottom)	18	06	
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/CB	PG-26	02	00	
8	NG-11-A TO H	6”	120	NG-9	101-B	06	03	
9	NG-09-12”	12”	100	101-B	103-D	03	01	
10	SG-1303-02-14”	14”	100	121-C	SG-12-14”	16	08	
12	SG-1303-03-08”	8”	100	SG-12-14”	137-C	08	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	16	08	

Annexure – 6

THICKNESS MEASUREMENT SUMMARY OF EQUIPMENT

Sr. No.	Equipt . No.	Equipment Description	Shell			Dish End			Channel		
			Nom./ Design	Min. Measured	% Red.	Nom./ Design	Min. Measured	% Red	Nom./ Design	Min. Measured	% Red.
1	104 - C	Methanator Feed Heater	17.46	17.66	-	19.05	23.15	-		-	
2	105 -CA	CO2 Stripper Gas Exchanger	28.58	29.28	-	26.99	28.56	-		-	
3	105 -CB	CO2 Stripper Gas Exchanger	28.58	29.72	-	26.99	30.36	-			
4	106 - C	Shift Effluent Feed	6.35	6.82	-	15.08	15.78	-			
5	109CA2	aMDEA Solution Exchanger	12.70	12.19	4.0	12.70	-	-		25.11	-
6	109CB2	aMDEA Solution Exchanger	12.70	13.08	-	12.70	-	-		23.73	-
7	110-CA	CO2 Stripper Condenser	12.70	14.78	-	12.70	-	-			
8	110-CB	CO2 Stripper Condenser	12.70	11.95	5.9	-	-	-			
9	112-C	LTS Converter Inlet Boiler	12.70	13.43	-	26.99	29.82	-			
10	114-C	Methanator Effluent FW Heater	58.00	58.36	-	NA	19.04	-			
11	115-C	Methanator Effuent Cooler	12.50	12.44	0.4	12.50	13.90	-			
12	124-C	Syn. Gas Compressor After Cooler	20.00	22.44	-	16.00	19.61	-			
13	129-JC	Air Com. Inter stage Cooler no.1	12.00	12.25	-	12.00	8.57	28.5			
14	130-JC	Air Com. Inter Stage Cooler no.2	NA	11.74		NA	9.60	-			
15	131-JC	Air Com, Inter stageCooler no.3	15.80	15.29	3.2	NA	8.53	-			
16	136-C	Syn.Gas Methanator Feed Exchanger	15.80	15.84	-	NA	30.79	-			
17	150-C	Fuel Preheat Exchanger	8.38	9.85	-	12.70	12.36	2.6			
18	151-C	Fuel Preheat Exchanger	8.38	7.79	7.4	9.52	7.94	20.7			
19	170-CA	Condensate Stripper Feed Bottom Exchanger	9.50	8.99	5.6	NA	-	-			
20	170-CB	Condensate Stripper Feed Bottom Exchanger	9.50	8.90	6.31	NA	-	-			
21	171-C	Condensate Stripper Exchanger	9.52	5.77	39.3	9.52	7.39	22.3			
22	103-E1	H P Flash Vessel		19.79			22.72				
23	104-E	Condensate Stripper	12.50	11.46	8.32	11.10	13.48	-			

Sr. No.	Equipt. No.	Equipment Description	Shell			Dish End			Channel		
			Nom./ Design	Min. Measured	% Red.	Nom./ Design	Min. Measured	% Red	Nom./ Design	Min. Measured	% Red.
24	101-F	Steam Drum	106.4	108.27	-	106.4	107.56	-			
25	106-F	Secondary Ammonia Separator	104.8	104.37	0.4	54.0	59.05	-			
26	111-F	2nd Stage Refrigerant Flash Drum	9.52	10.37	-	19.05	22.77	-			
27	156-F	Blow Down Drum	11.11	10.90	1.89	NA	12.04	-			
28	157-F	Process Gas Separator	19.84	22.58	-	17.46	25.21	-			
29	158-FA	Natural Gas Separator	24.00	24.88	-	NA	22.09	-			
30	158-FB	Natural Gas Separator	24.00	23.22	3.25	NA	23.01	-			
31	172-F	Ammonia liquor Tank	12.00	12.31	-	NA	12.09	-			
32	E-110 A	Process Feed Stock Pre heater	NA	14.31	-	NA	10.02	-			
33	E-110 B	Process Feed Stock Pre heater	NA	14.32	-	NA	9.90	-			
34	B-110	Condensate Drum for E-110	NA	8.14	-	NA	11.28	-			
35	B-111	Knock Out Drum For R-110	7.11	6.36	10.5	NA	8.91	-			
36	B-112	Knock Out Drum For H-111		6.54	-		6.53	-			
37	E-4	Regeneration Heater	5.00	6.18	-	8.00	8.09	-			
38	R-1	Drying Vessel	36.00	36.27	-	36.00	35.02	2.7			
39	R-2	Drying Vessel	36.00	36.23	-	35.00	34.48	1.4			

NOTE: (1) All readings are in MM

THICKNESS MEASUREMENT SUMMARY OF HT & LT COILS.

SR NO	DESCRIPTION	DESIGN THICKNESS	MEASURED THICKNESS	% REDUCTION
1	HT STEAM SUPER HEATER COIL (HT Convection, 3rd from bottom)	8.0	8.0	0
2	AIR-PREHEATER COIL (HT Convection, 2nd from bottom)	6.55	6.8	-
3	MIXED FEED COIL (HT Convection, bottom most)	8.0	12.10	-
4	LT CONVECTION COIL (1st coil from bottom stage 2 offsites BFW coil)	5.54	4.8	13.35
5	LT CONVECTION COIL (2nd coil from bottom stage 2 offsites BFW coil)	5.54	4.7	15.16
6	LT CONVECTION COIL (3rd coil from bottom BFW header)	5.54	4.0	27.79
7	LT CONVECTION COIL (4th coil from bottom BFW header)	5.54	5.7	-
8	LT CONVECTION COIL (5th coil from bottom LT steam header)	7.01	6.8	2.99

NOTE: All readings are in MM

ANNEXURE- 7 (1/2)

THICKNESS MEASUREMENT OF TWO PHASE FLOW PIPELINES

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Min. Thickness Observed (mm)	% RED.
						FROM	TO		
1	BF-1304-01	3	160	11.13	CS	142-CA/CB	107-C	11	1.16
2	BO-01	1.5	80	5.1	CS	BO-1H-1.5"	BO-21-1.5"	6	-
3	BO-2H	1.5	XXS	10.2	CS	101-F	BO-2-1.5"	9.1	10.78
4	BO-3H	1	160	6.35	CS	102-C	BO-3-1"	5.6	11.81
5	BO-06	1	80	4.5	CS	BO-12H	BO-11-1.5"	4.5	0
6	BO-6H	1	160	6.35	CS	103-C	BO-4-1"	5.6	11.81
7	BO-1304.04	2	40	3.91	CS	107- C	156- F	3.1	20.71
8	BO-14BH	2	160	8.71	CS	AUX.BOILER COIL-A	BLOW DOWN BO-7	7.5	13.89
9	BO-17	1	160	6.35	CS	BO-14-3"	BO-20-1"	4.1	35.43
10	BO-20	1	160	6.35	CS	BO-17-1"	BW-21H	4.5	29.13
11	BO-21	1.5	80	5.1	CS	BO-2-1.5"	BO-14-3"	5.2	-
12	aMDEA-06A	10	40S	9.27	SS	109-C1A	aMDEA-61-12"	8.8	5.07
13	aMDEA-06A	8	40S	8.18	SS	109-C1A	aMDEA-61-12"	6.8	16.87
14	aMDEA-06B	10	40S	9.27	SS	109-C1B	aMDEA-61-12"	8.5	8.30
15	aMDEA-06B	8	40S	8.18	SS	109C1B/ C2B	MDEA- 7-12"	7.2	11.98
16	aMDEA-07	10/12	40S	9.27	SS	aMDEA-61-12"	102-EB (aMDEA-9B-10")	8.5	8.30
17	aMDEA-16B	12	20	6.35	CS	108C2B	aMDEA-62-16"	6.3	0.78
18	aMDEA-17	16	20	7.92	CS	aMDEA-62-16"	aMDEA-41-16"	7.4	6.56
19	aMDEA-24A	3	40	5.5	CS	108-J	aMDEA-25-3"	5.3	3.63
20	aMDEA-24B	3	40	5.5	CS	108-JA	aMDEA-25-3"	4.9	10.90
21	aMDEA-25	3	40	5.5	CS	aMDEA-24A, B-3"	aMDEA-26B-2.5"	5.9	-
22	aMDEA-62	16	20	7.92	CS	HEADER	aMDEA-17-16"	6.8	14.14
23	MDEA-1202.01	18	XS	12.7	CS	101- EA	MDEA- 1202.02-8"	12	5.51
24	MDEA-1202.02	18	XS	12.7	CS	MDEA-1202.01-18"	115- HT	12.1	4.72
25	MDEA-1202.02	18	XS	13.38	SS	115- JT	103-E1	11.0	17.78
26	MDEA-1202.02	18	XS	13.38	SS	115- JT	103-E1	11.0	17.78
27	MDEA-1203.02	18	10S	4.78	SS	HV-435 (MDEA-1202.03-14")	103-E1/ E2	5.2	-
28	MDEA-1204.01	24	10S	6.35	SS	103- E2 HP	LV-416	4.8	24.40
29	MDEA-1209.02	24	40	17.48	CS	103-E2LP (MDEA-1209-01-24")	115- JA	17.8	-
30	MDEA-1209.02	24	STD	9.53	CS	103-E2LP (MDEA-1209-01-24")	115- JA	9.7	-
31	MDEA-1209.03	24	40	17.48	CS	103-E2LP (MDEA-1209-01-24")	115- JB	18.3	-
32	MDEA-1209.03	24	STD	9.53	CS	103-E2LP (MDEA-1209-01-24")	115- JB	10	-

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Min. Thickness Observed (mm)	% RED.
						FROM	TO		
33	MDEA-1209.06	12	20	6.35	CS	103-E2LP (MDEA-1209-01-24")	MDEA- 1209.07/08 (116 JA/ JB)	6.3	0.78
34	MDEA-1209.07	12	10 S	4.57	SS	103-E2LP (MDEA-1209-01-24")	116- JB	4.2	8.09
35	MDEA-1209.08	12	10 S	4.57	SS	103-E2LP (MDEA-1209-01-24")	116- JA	4.5	1.53
36	MDEA-1212.01	16	XS	12.7	CS	115- JA	101-EA (MDEA-1212-03)	9.8	22.83
37	MDEA-1212.02	16	XS	12.7	CS	115- JB	101-EA (MDEA-1212-03)	9.8	22.83
38	MDEA-1212.03	16	XS	12.7	CS	115JA / 115-JB(MDEA-1212-01/02)	101-EA	9.8	22.83
39	PG-10	18	40/ STD	12.7 / 9.53	CS	104-D	PG-21-20"	8.5	
40	PG-11A	16	40	12.7	CS	PG-21-20"	105-CA	11.9	6.29
41	PG-11B	16	40	12.7	CS	PG-21-20"	105-CB	14.4	-
42	PG-12A	14	30	9.525	SS -304	105-CA	PG-26 18"	8.8	7.61
43	PG-12B	14	30	9.525	SS -304	105-CB	PG-26 18"	10	-
44	PG-26	18	30	11.13	SS -304	HEADER		9.5	14.64
45	PG-1212. 01	14	10	6.35	CS	101- EA	136- C	6.8	-
46	PW-17	4	120	11.13	CS	PW-1-6"	170-C	11.0	1.16
47	PW-17	4	40	6.02	SS304	PW-1-6"	170-C	4.5	25.25
47	PW-17	4	40	6.02	SS304	PW-1-6"	170-C	4.4	26.91
48	PW-19	4	10S	3.05	SS	LC-3A	104-E		
49	PW-19	4	120	11.13	CS	LC-3A	104-E		
50	PW-19	2	10S	2.77	SS	LC-3A	104-E		
51	PW-20	6	80	10.97	CS	104-E	170-J	11.2	-
52	PW-20A	6	80	10.97	CS	PW-20-6"	170 JA	8.2	25.25
53	PW-24	4	120	11.13	CS	173-C	CONTROL VALVE		
54	PW-27	6	80	10.97	CS	PW-20-6"	PW-28-4"	10.7	2.46
55	PW-29	10	60	12.7	CS	171-C	PW-30-14"	12	5.51
56	PW-29A	10	60	12.7	CS	171-C	PW-30-14"	10.4	18.11
57	PW-31	12	40	10.31	CS	PW-30-14"	104-E	9.5	7.85
58	SC-17	3	80	7.62	CS	156-F	SEWER	6.2	18.63
59	SC-44	2	80	5.5	CS	171-C	STS/45	5.1	7.27
60	SG-41	10	100	18.24	CS	120-C	LETDOWN VALVE (Yellow line)	17.2	5.7

ANNEXURE- 7 (2/2)

THICKNESS MEASUREMENT OF OTHER PIPELINES

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
1	A-20	10	20	6.35	C.S.	101 J	101 B	6.2	2.36
2	A-21	10	60	12.7	P-11	101 B	103 D	13.8	-
3	A-32	6	40	7.11	CS	101-J LP DISCH.	CV	3.8	46.55
4	BF-01	12	20	6.35	CS	101-U	HEADER	6.4	-
5	BF-02	10	20	6.35	CS	BF-1-12"	104-J	6	5.51
6	BF-03	10	20	6.35	CS	BF-1-12"	104-JA	6.4	-
7	BF-04	6	80	10.97	CS	104-JA	BF-22-8"	10.6	3.37
8	BF-06	6	80	10.97	CS	BF-22-8"	123-C	10.8	1.54
9	BF-07	6	80	10.97	CS	104-J	BF-22-8"	11.5	-
10	BW-04H	10	100	18.24	CS	101-F	102-C	17.9	1.86
11	BW-05H	14	100	23.8	CS	101-CB	BW-43 HA,HB	23	3.36
12	BW-06H	18	100	29.36	CS	101-F	101-CB	27.3	7.01
13	BW-07H	10	100	18.26	CS	BW-8H-12"	101-F	15.3	16.21
14	BW-08H	12	100	21.44	CS	HEADER	103-C	20.2	5.78
15	BW-09H	8	100	15.06	CS	103-C	BW-8H-12"	14.1	6.37
16	BW-10H	8	100	15.06	CS	103-C	BW-8H-12"	13.8	8.36
17	BW-11H	8	100	15.06	CS	BW-14H-10"	103-C	14.6	3.05
18	BW-12H	8	100	15.06	CS	BW-14H-10"	103-C	14.8	1.72
19	BW-14H	10	100	18.24	CS	HEADER	103-C	17.9	1.86
20	BW-26H	8	100	15.06	CS	101-F	BW-14H-10"	14.4	4.38
21	HS-04	12	100	21.41	P-11	HS-3H-12"	HS-7-10"	20.4	4.71
22	HS-07	10	100	18.3	P-11	HS-4-12"	103-J	18.3	0
23	HS-10	6	100	13	P-11	HS-5-10"	PIC-13 A	12.2	6.15
24	HS-11	6	120	14.27	P-11	HS-9-8"	PIC-13 B	13.1	8.19

SR. NO.	LINE NO.	N.B. (in.)	SCH.	NOM. THK. (mm)	MAT.	LINE DESCRIPTION		Minimum Thickness Observed (mm)	% RED.
						FROM	TO		
25	HS-12	6	100	13	P-11	HS-9-8"	MICA-22	13.4	-
26	HS-20	2	160	8.71	P-11	HS-9-8"	MIC-22	7.3	16.18
27	HS-20-50	2		8.71		TRCV-142 STEAM D/S LINE		7.3	16.18
28	NG-02	6	40	7.11	CS	NG-1-6"	101-D	7.3	-
29	NG-03	6	40	7.11	CS	NG-1-6"	102-D	6.9	2.95
30	NG-04	6	40	7.11	CS	101-D	NG-6A-8"	7.3	-
31	NG-05	6	40	7.11	CS	102-D	NG-6A-8"	6.2	12.79
32	NG-06	8	20	6.4	CS	150-C	101-D	6.7	-
33	NG-06A	8	20	8.18	CS	NG-4-6"	150-C	6.2	24.20
34	NG-08	12	30	8.4	CS	NG-7-8"	101-B,MFD COIL	9.5	-
35	NG-11C	6	120	14.3	P-11	NG-9-12"	101-B	14.5	-
36	NG-11E	6	120	14.3	P-11	NG-9-12"	101-B	13.9	2.79
37	NG-11G	6	120	14.3	P-11	NG-9-12"	101-B	14.1	1.39
38		8	80S	10.97	SS304H	NG-9-12"	101-B		
39	SG-13	12	100	21.41	CS	124-C	SG-14-10"	21.9	-
40	SG-29	4	120	11.13	CS	SG-21-14"	HEADER	11.6	-
41	SG-35	12	100	21.41	CS	121-C	103-J	20.7	3.31
42	SG-1303-02	14	100	23.83	CS	121-C	SG1303-03 (121-C)	23.4	1.80
43	SG-1303-03	8	100	15.09	CS	SG-1303-02-14"(121-C)	137-C	14.6	3.24
44	SG-1303-04	8	100	15.09	CS	137-C	SG-51-8"	14.7	2.58
45	SG-1303-06	14	100	23.83	CS	121-C	124-C	21.3	10.61
46	SG-1303- 10	14	120	27.79	P 22	108- D	107- C	25.6	7.88
47	SG-1303- 11	14	140	31.75	P 11	107- C	123- C	29.1	8.34
48	BF-17	3	80	7.62	CS	114-C	BF-3H-3"	6.3	17.32
49	BF-18	3	80	7.62	CS	BF-22-8" (CV-4)	114-C	4.9	35.69

Annexure-8

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
101-BJT			
Journal Bearing Liner	East Side(CT side)	2.1	Within limits
	West Side(Silo side)	1.5	"
Shaft Journal	East Side	2.2	"
	West Side	2.6	"
101-BJR (High Speed Drive Pinion)			
Journal Bearing	East Side(CT side)	0.9	"
	West Side(Silo side)	0.6	"
Shaft Journal	East Side(CT side)	1.2	"
	West Side(Silo side)	2.3	"
101-BJR(Low Speed Driven Gear)			
Journal Bearing Liner	East Side(CT side)	1.0	"
	West Side(Silo side)	1.6	"
Shaft Journal	East Side(CT side)	3.0	"
	West Side(Silo side)	2.2	"
101-BJ			
Journal Bearing Liner	East Side(CT side)	2.3	"
	West Side(Silo side)	1.6	"
Shaft Journal	East Side(CT side)	2.0	"
	West Side(Silo side)	0.6	"
101-JT			
Journal Bearing Pad	Thrust End	T-1.7 B-1.3	"
	Non Thrust End	T-0.6 B-1.3	"
Journal Bearing Base ring	Thrust End	1.3	"
	Non Thrust End	1.5	"
Thrust Bearing Pads	Active	2.0	"
	Inactive	0.7	"
Thrust Bearing Base ring	Active	1.8	"
	Inactive	1.0	"
Shaft Journal	Thrust End	2.7	"
	Non Thrust End	2.5	"

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
101-JLP			
Journal Bearing Pads	Thrust End	T-0.8 B-1.6	Within limits
	Non Thrust End	T-1.1 B-3.1	"
Journal Bearing Base ring	Thrust End	1.9	"
	Non Thrust End	1.7	"
Thrust Bearing Pads	Active	1.7	"
	Inactive	1.3	"
Thrust Bearing Base ring	Active	1.7	"
	Inactive	1.3	"
Shaft Journal	Thrust End	2.8	"
	Non Thrust End	3.2	"
101-JR			
Gear Journal Bearing	North side	T-0.5 B-0.4	"
	South Side	T-0.6 B-1.2	"
Pinion Journal Bearing	North side	T-0.5 B-1.1	"
	South Side	T-0.6 B-0.6	"
Thrust Bearing	Active	T-0.7 B-1.2	"
	Inactive	T-0.8 B-0.9	"
Shaft Journal	Thrust End	1.6	"
	Non Thrust End	1.5	"
101-JHP			
Journal Bearing Pads	Thrust End	0.9	"
	Non Thrust End	1.2	"
Journal Bearing Base ring	Thrust End	1.3	"
	Non Thrust End	1.3	"
Thrust Bearing Pads	Active	0.4	"
	Inactive	0.5	"
Thrust Bearing Base ring	Active	1.8	"
	Inactive	1.5	"
Shaft Journal	Thrust End	4.2	"
	Non Thrust End	1.8	"
104-JT			
Journal Bearing Sleeve	Thrust End	T-1.2 B-1.6	"
	Non Thrust End	T-1.9 B-1.6	"
Shaft Journal	Thrust End	2.2	"
	Non Thrust End	1.8	"

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
104-J			
Journal Bearing Sleeve	Thrust End	T-0.8 B-0.6	Within limits
	Non Thrust End	T-0.5 B-0.6	"
Thrust Bearing Pads	Active	0.9	"
	Inactive	0.7	"
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	"
104-JA			
Journal Bearing Pad	North side	T-0.9 B-1.4	"
	South Side	T-0.5 B-0.6	"
Thrust Bearing Pads	Active	1.2	"
	Inactive	1.5	"
Shaft Journal	NDE	1.7	"
	Coupling End	2.3	"
104-JAT			
Journal Bearing Pad	North side	T-0.4 B-0.3	"
	South Side	T-0.6 B-1.1	"
Thrust Bearing Pads	Active	0.9	"
	Inactive	1.6	"
Shaft Journal	NDE	2.7	"
	Coupling End	2.4	"
107-JT (MURRY TURBINE)			
Journal Bearing Governor End	Top Half	1.6	"
	Bottom Half	1.5	"
	Shaft	2.4	"
Journal Bearing Coupling End	Top Half	1.3	"
	Bottom Half	0.8	"
	Shaft	2.3	"
Thrust Bearing	Collar	Active - 2.0 Inactive – 2.5	"
	Pads	Active – 0.8 Inactive – 1.2	"

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
115-HT (Hydraulic Turbine)			
Journal Bearing Sleeve	Thrust End	T-1.0 B-0.5	Within limits
	Non Thrust End	T-1.1 B-1.2	"
Thrust Bearing Pads	Active	0.8	"
	Inactive	0.8	"
Thrust Bearing Base ring	Active	1.5	"
	Inactive	1.6	"
Shaft Journal	Thrust End	1.2	"
	Non Thrust End	1.3	"
115-JAR (Gear Box)			
Gear Journal Bearing	North End (DE)	T-2.2 B-2.3 Sh-2.3	"
	South End (NDE)	T-2.4 B-1.6 Sh-2.4	"
Pinion Journal Bearing	North End (DE)	T-2.0 B-1.7 Sh-1.7	"
	South End (NDE)	T-1.8 B-1.0 Sh-2.3	"
115-JA (Pump)			
Journal bearing sleeve	Thrust End	T-2.3 B-1.7	"
	Non Thrust End	T-2.0 B-2.3	"
Thrust Pads	Active	2.0	"
	Inactive	2.5	"
Thrust Bearing Base ring	Active	2.4	"
	Inactive	2.2	"
Shaft Journal	Thrust End	1.3	"
	Non Thrust End	1.7	"
115-JAT			
Journal Bearing Liner	Thrust End	T-0.9 B-1.2	"
	Non Thrust End	T-1.6 B-1.3	"
Shaft Journal	Thrust End	3.5	"
	Non Thrust End	2.5	"
Thrust Bearing Base ring	Active	3.2	"
	Inactive	2.5	"
Thrust Bearing Pads	Active	0.5	"
	Inactive	1.2	"

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
103-JAT			
Journal Bearing Sleeve	Thrust End	1.3	Within limits
	Non Thrust End	0.8	"
Thrust Bearing Pads	Active	2.0	"
	Inactive	2.4	"
Thrust Bearing Base ring	Active	T-2.0 B-1.6	"
	Inactive	T-2.3 B-2.3	"
Shaft Journal	Thrust End	2.3	"
	Non Thrust End	1.6	"
103-JBT			
Journal Bearing Sleeve	Thrust End	T-2.0 B-2.0	"
	Non Thrust End	T-2.0 B-1.6	"
Thrust Bearing Pads	Active	T-2.1 B-1.3	"
	Inactive	T-1.3 B-1.1	"
Thrust Bearing Base ring	Active	T-1.8 B-2.2	"
	Inactive	T-1.2 B-1.3	"
Shaft Journal	Thrust End	1.3	"
	Non Thrust End	2.3	"
105-JT			
Journal Bearing Pad	Thrust End	1.1	"
	Non Thrust End	0.7	"
Journal Bearing Base ring	Thrust End	1.3	"
	Non Thrust End	1.9	"
Thrust Bearing Pads	Active	1.2	"
	Inactive	0.4	"
Thrust Bearing Base ring	Active	1.7	"
	Inactive	1.7	"
Shaft Journal	Thrust End	1.3	"
	Non Thrust End	0.8	"
Thrust Collar	Active	0.8	"
	Inactive	1.1	"

DESCRIPTION	POSITION	INITIAL (Gauss)	AFTER DEGAUSSING (Gauss)
105-JLP			
Journal Bearing Pads	Thrust End	0.8	Within limits
	Non Thrust End	1.0	"
Journal Bearing Base ring	Thrust End	1.1	"
	Non Thrust End	0.9	"
Thrust Bearing Pads	Active	T-0.4 B-0.5	"
	Inactive	T-0.9 B-1.1	"
Thrust Bearing Base ring	Active	0.9	"
	Inactive	0.6	"
Shaft Journal	Thrust End	0.6	"
	Non Thrust End	1.5	"
105-JR			
Gear Journal Bearing	North side	T-0.9 B-1.1	"
	South Side	T-0.8 B-1.1	"
Pinion Journal Bearing	North side	T-0.8 B-0.8	"
	South Side	T-1.2 B-1.1	"
Thrust Bearing	Thrust End	1.1	"
	Non Thrust End	1.6	"
105-JHP			
Thrust Bearing Pads	Active	1.3	"
	Inactive	0.2	"
Thrust Bearing Base ring	Active	1.3	"
	Inactive	1.4	"
Oil guard for Above	South	0.7	"
	North	1.4	"
Shaft Journal	Thrust End	1.2	"
	Non Thrust End	1.8	"

ANNEXURE-9

DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1	Location: 17 (Weld/HAZ) 102B SG-62A-4" line	P5	Weld microstructure shows dendritic structure of fine tempered bainite/martensite structure, Whereas at HAZ shows fine tempered bainite structure. Parent metal microstructure shows fine tempered bainite with few ferrites. In-situ spherodization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
2	Location: 18 (Weld/HAZ) 102B SG-62B-4" line	P5	Weld microstructure shows dendritic structure of fine tempered bainite/martensite structure, Whereas at HAZ microstructure shows fine & coarse-grained ferrite & bainite structure. Parent metal microstructure shows fine tempered bainite with few ferrites. In-situ spherodization of bainite is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
3	Location: 19 (Weld/HAZ) SG-26-6" MICA-16 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 with presences of few widmanstatten ferrites.	IInd stage of creep degradations. Monitor after 1 year of service.
4	Location: 20 (Weld/HAZ) SG-27-6" MICA-14 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 widmanstatten ferrite and pearlite structure.	IInd stage of creep degradations. Monitor after 1 year of service.
5	Location: 21 (Weld/HAZ) SG-28-6" MICA 13 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 widmanstatten ferrite and pearlite structure.	IInd stage of creep degradations. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
6	Location: 22 (Weld/HAZ) 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 widmanstatten ferrite and pearlite structure.	IInd stage of creep degradations. Monitor after 1 year of service.
7	Location: 23 (Weld/HAZ) 104D HTS On Bottom dish end from inside	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 non-uniformly distributed ferrite and pearlite structure.	No significant degradation observed. Monitor after 2 years of service.
8	Location: 24 (Weld/HAZ) 104D HTS On Longitudinal weld joint between shell	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 pearlitee is observed.	IInd stage of creep degradations. Monitor after 1 year of service.
9	Location: 25 (Weld/HAZ) SG-1303-09-10 (H-36) On 108D converter Inlet nozzle	P-22	Weld microstructure shows ferrite and carbides in dendrite form. Microstructure at HAZ shows fine-grained ferrite & bainite structure. Whereas at 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.
10	Location: 26 (Weld/HAZ) 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. Microstructure at HAZ shows fine-grained ferrite and bainite structure. Whereas at parent metal microstructure shows non-uniformly distributed fine-grained ferrite and bainite structure. In-situ spherodization of bainite is observed.	. IInd stage of creep degradations. Monitor after 1 year of service.
11	Location: 28 (Weld/HAZ) 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. Microstructure at HAZ shows fine-grained ferrite and bainite structure. Whereas at parent metal microstructure shows non-uniformly distributed fine-grained ferrite and bainite structure. In-situ spherodization of bainite is observed.	. IInd stage of creep degradations. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
12	Location: 29 (Parent metal) SG-1303-10-14 On 108-D outlet to 107C Gas inlet elbow-5	P-22	Microstructure shows fine & coarse-grained ferrite & pearlite/bainite structure.	No significant degradation observed. Monitor after 2 years of service.
13	Location: 30 (Weld/HAZ) 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 in situ spherodization of ferrite and pearlite/bainite structure. Indications of isolated creep cavities are observed.	IInd stage of creep degradations. Monitor after 1 year of service.
14	Location: 31 (Weld/HAZ) 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/bainite structure. Ferrite observed at prior austenite grain boundaries.	No significant degradation observed. Monitor after 2 years of service.
15	Location: 32 (Parent Metal) SG-1303-11-14 (H-34) On 107C Gas outlet nozzle at bend	P-11	Microstructure shows fine-grained ferrite and pearlite/bainite structure. In-situ spherodization of pearlite/bainite is observed at grain boundaries.	IInd stage of creep degradations. Monitor after 1 year of service.
16	Location: 33 (Weld/PM) SG-1303-11-14 (H-34) On 123C Gas inlet nozzle	P-11	Microstructure at weld shows dendritic structure ferrite/carbides and bainite structure. Microstructure at HAZ 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: 34 (Weld/HAZ) SG-1303-11-14 (H-34) On 123C Gas intlet nozzle HAZ of bend	P-11	Microstructure at weld shows dendritic structure tempered bainite structure. Parent metal microstructure shows tempered bainite structure. Indication of creep damage in term of aligned creep cavities are observed at grain boundaries	SEM interpretation is kept below to find out the degradations based on creep damage.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
17.1	Location: 34.1 (Weld/HAZ) SG-1303-11-14 (H-34) On 123C Gas intlet nozzle HAZ of bend	P-11	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.
18	Location: 35 (Parent Metal) On face of 1st Bend of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure shows essentially fine-grained elongated ferrite and spheroidial carbide structure. Degradation of pearlite observed in terms of spherodization. Possibilities of isolated creep cavities are observed.	SEM interpretation is kept below to find out the degradations based on creep damage
18.1	Location: 35.1 (Parent Metal) On face of 1st Bend of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure shows oriented creep cavities at the grain boundaries.	Approaching 3rd stage of creep damage. Monitor after one year of service.
19	Location: 36 (Weld/HAZ) On weld betn. Pipe & Elbow (elbow side) of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure at weld shows ferrite and bainite in dendritic form Whereas at HAZ shows fine-grained bainite and ferrite structure. Microstructure at parent metal shows essentially fine-grained elongated ferrite and spheroid carbide structure. Degradation of bainite is observed. Possibilities of isolated creep cavities are observed.	SEM interpretation is kept below to find out the degradations based on creep damage
19.1	Location: 36.1 (Weld/HAZ) On weld betn. Pipe & Elbow (elbow side) of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure shows oriented creep cavities at the grain boundaries.	Approaching 3rd stage of creep damage. Monitor after one year of service.
20	Location: 37 (Weld/HAZ) On weld betn. Pipe & Elbow (pipe side) of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure at weld shows ferrite and bainite in dendritic form Whereas at HAZ shows fine-grained bainite and ferrite structure. Microstructure at parent metal shows fine-grained ferrite and pearlite/bainite structure.	No significant degradation observed. Monitor after 2 years of service.
21	Location: 38 (Weld / HAZ) On weld betn. Pipe & Elbow (pipe side) of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure at weld shows ferrite and bainite in dendritic form Whereas at HAZ shows fine-grained bainite and ferrite structure. Microstructure at parent metal shows fine-grained ferrite and pearlite/bainite structure.	No significant degradation observed. Monitor after 2 years of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
22	Location: 39 (Weld / HAZ) On weld bet^{n}. Pipe & Elbow (pipe side) of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure at weld shows ferrite and bainite in dendritic form Whereas at HAZ shows fine-grained bainite and ferrite structure. Microstructure at parent metal shows essentially fine-grained ferrite and spheroid carbide structure. Degradation of bainite is observed. Possibilities of isolated creep cavities are observed.	SEM interpretation is kept below to find out the degradations based on creep damage
22.1	Location: 39.1 (Weld / HAZ) On weld bet^{n}. Pipe & Elbow (pipe side) of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure shows oriented creep cavities at the grain boundaries. Initial levels of coalescence of cavities are observed.	Approaching 3rd stage of creep damage. Monitor after one year of service.
23	Location: 40 (Weld/HAZ) Riser No.-1, Riser 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.	Microstructure is free from any micro cracks. Monitor after 2 years of service.
24	Location: 41 (Weld/HAZ) Riser No.-2, Riser 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.
25	Location: 42 (Weld/HAZ) Riser No.-3, Riser 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
26	Location: 43 (Weld/HAZ) Riser No.-4, Riser 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.
27	Location: 44 (Weld/HAZ) Riser No.-5, Riser 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.
28	Location: 45 (Weld/HAZ) Riser No.-6, Riser 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.
29	Location: 46 (Weld/HAZ) Riser No.-7, Riser 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.	Microstructure is free from any micro cracks. Monitor after 2 years of service.
30	Location: 47 Parent Metal Riser No.-7	Tube-G-4852M	Microstructure shows fine & coarse-grained austenitic grain with twins.	Microstructure is free from any micro cracks. Monitor after 2 years of service.
31	Location: 48 (Weld/HAZ) Riser No.-8, Riser 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.	Microstructure is free from any micro cracks. Monitor after 2 years of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
32	Location: 49 (Parent Metal) Hot spot, Raw no.-6, Tube no.6 on parent metal	Tube-G-4852M	Microstructure shows network of primary precipitates including carbides in a cast structure. The primary and secondary precipitate seems to have coarsened within the matrix.	Microstructure is free from any micro cracks. Monitor after 2 years of service.
33	Location: 50 (Weld/HAZ) Raw no.-1, Tube no.35, 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.	Microstructure is free from any micro cracks. Monitor after 2 years of service.
34	Location: 51 (Weld/HAZ) Raw 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.
35	Location: 56 (Parent Metal) SG-1303, 09-10 (H-36) On 108D converter near socklet hole after de-hydrogenation	P-22	Microstructure shows tempered Bainite structure. In-situ spherodization of bainite is observed.	IInd stage of creep degradations. Monitor after 2 year of service.
36	Location: 52 (Weld/HAZ) Raw no.-6, Tube no.18, Tube to weldolet weld joint	Tube-G-4852M Weldolet 800HT	Microstructure at weld shows ferrite pools in austenite matrix with carbides, whereas HAZ microstructure shows coarse-grained austenitic grains. Microstructure at parent metal shows fine & coarse-grained austenitic grain with twins. Presence of inter-granular cracks observed at HAZ region.	Inter-granular cracks are observed at HAZ region. Needs attention.
37	Location: 53 (Weld/HAZ) Raw no.-7, Tube no.37, 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
38	Location: 54 (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 coarse-grained essentially ferrite structure. Parent metal shows fine-grained essentially ferrite and spherodization of pearlite is observed at grain boundaries.	IInd stage of creep degradations. Monitor after 1 year of service.
39	Location: 55 (Weld/HAZ) On Weld Between BW outlet Nozzle BW-11H-8'' & 103-C Shell at bottom towards East 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 grain boundaries.	IInd stage of creep degradations. Monitor after 1 year of service.
40	Location: 56 (Parent Metal) SG-1303-10-14 (H-36) On 108D converter near socklet hole after de-hydrogenation	P-22	Microstructure shows tempered Bainite structure. In-situ spherodization of bainite is observed.	IInd stage of creep degradations. Monitor after 2 year of service.

Note: Location no. 24,25,26,27,28,34,36 and 37 shall be monitored during next turnaround in detail as recommended by M/S TCR

Annexure-10

NDT Activities carried out during replacement of Sockolets at Convertor Loop

Description	Line No. on which Sockolet was installed	D. P. test of parent metal (after removal of old sockolet)	D. P. test of Root & Final Weld	Hardness (BHN) before Stress Relieving			Hardness (BHN) after Stress Relieving			Remarks
				Wel	HA	PM	Wel	HAZ	PM	
PDI- 484 tapping Size: 3/4" N.B.	SG-1303. 10-14" (H 36) (108- D outlet line).	Fissures were observed, removed by grinding.	Found satisfactory	170	140	170	170	140	160	M.O.C. of sockolets P22
Drain Size:3/4"" N.B.	SG-1303. 10-14" (H 36) (107- C inlet line).	Cracks were observed, Spool piece replaced	Found satisfactory	130	110	110	110	120	125	
Spool Piece	SG-1303. 10-14" (H 36) (107- C inlet line).	Spool piece replaced	Found satisfactory			125	1205	1105	120	M.O.C. of Spool piece P22

- Video-Image inspection was also carried out thru the thermowell bore to ensure the penetration and fusion of the weld metal during welding of sockolets. Found satisfactory.

Annexure - 11

UFD & RT STATUS OF CONVERTER LOOP

JOINT NO.	2009		2010		2011		2012	
	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	Elbow No 5, NSD	NSD	--	NSD	--
J-1	NSD	--	NSD	--	NSD	NSD	NSD	--
J-2	NSD	--	NSD	--	NSD	NSD	NSD	--
J-3	NSD	--	NSD	--	NSD	NSD	NSD	--
J-4	NSD	--	NSD	--	NSD	NSD	NSD	--
J-5	NSD	--	NSD	--	NSD	NSD	NSD	--
J-6	Indication Observed	--	Indication Observed	NSD	NSD	--	NSD	--
J-7	NSD	--	Indication Observed	NSD	NSD	--	NSD	--
J-8	NSD	--	NSD	--	NSD	NSD	NSD	--
J-9	Indication Observed	--	NSD	--	NSD	NSD	NSD	--
J-10	NSD	--	NSD	--	NSD	NSD	NSD	
J-11	NSD	--	Indication Observed	NSD	NSD	NSD	NSD	New Joint NSD, After SR
J-12	NSD	--	NSD	--	NSD	--	NSD	New Joint NSD, After SR
FROM 105D TO 108D, **LINE NO:** SG-1303-8-10" SCH-120 (21.44MM NOM THICK.), SG-1303-8-14" SCH 120 (27.79MM NOM THICK.), SG-1303-9-10" SCH-120 (21.44MM NOM THICK.) & SG-1303-12-10" SCH-120 (21.44 MM NOM THICK.)								
Elbows 1 to 15	NSD	--	NSD	--	NSD	--	NSD	--
J-1	NSD	--	NSD	--	NSD	--	NSD	--
J-2	NSD	--	--	--	NSD	--	NSD	--
J-3	NSD	--	--	NSD	NSD	--	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	--
J-8	NSD	--	NSD	--	NSD	--	NSD	--
J-9	Indication Observed	--	NSD	NSD	NSD	--	NSD	NSD
J-9A	--	--	Crack hence Repair	Repair, NSD	NSD	NSD	NSD	NSD
J-9B	--	--	NSD	NSD	NSD	--	NSD	--
J-10	NSD	--	NSD	--	NSD	--	NSD	NSD
J-11	NSD	--	NSD	--	NSD	--	NSD	NSD
J-12	Indication Observed	--	NSD	--	NSD	--	NSD	NSD
J-13	NSD	--	Indication Observed	NSD	NSD	--	NSD	NSD
J-14	NSD	--	NSD	--	NSD	--	NSD	NSD

JOINT NO.	2009		2010		2011		2012	
	UFD	RT	UFD	RT	UFD	RT	UFD	RT
J-15	Indication Observed	--	NSD	--	NSD	--	NSD	NSD
J-16	Indication Observed	--	NSD	--	NSD	--	NSD	NSD
J-17	Indication Observed	--	NSD	--	NSD	--	NSD	NSD
J-18	Indication Observed	--	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	Indication Observed	--	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	--	Indication Observed	NSD	NSD	--	NSD	--
J-T2	NSD	--	Indication Observed	NSD	NSD	--	NSD	--
J-T3	NSD	--	NSD	--	NSD	--	NSD	--
J-T4	NSD	--	NSD	--	NSD	--	NSD	--
J-T5	NSD	--	NSD	--	NSD	--	NSD	--
J-T6	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	--	NSD	--	NSD	--
J-1	NSD	--	NSD	--	NSD	--	NSD	--
J-2	NSD	--	NSD	--	NSD	--	NSD	--
J-3	NSD	--	NSD	--	NSD	--	NSD	--
J-4	NSD	--	NSD	--	NSD	--	NSD	--
J-5	NSD	--	NSD	--	NSD	--	NSD	--
J-6	NSD	--	NSD	--	NSD	--	NSD	--
J-7	Indication Observed	--	NSD	--	NSD	--	NSD	--
J-8	NSD	--	NSD	--	NSD	--	NSD	--
J-9	NSD	--	NSD	--	NSD	--	NSD	--
J-10	NSD	--	NSD	--	NSD	--	NSD	--
J-11	NSD	--	NSD	--	NSD	--	NSD	--
J-12	NSD	--	NSD	--	NSD	--	NSD	--

NSD: No Significant Defect

UREA PLANT
(INSPECTION)

During Shutdown 2012, 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/A), H.P Scrubber (H-1203)
- Inspection of Autoclave liner weld repair job in Compartment no. 6.
- Eddy Current Testing of H.P. Stripper (H-1201/A) tubes by M/s TesTex NDT India Pvt. Limited.
- Inspection of L.P. Carbamate Condenser (H-1205) tubes by M/s TesTex NDT India Pvt. Limited by Internal Rotating Inspection System (IRIS).
- Internal inspection of other vessels.
- Ultrasonic thickness measurement of **HP lines.** Detailed report is attached at **Annexure-1.**
- Ultrasonic thickness measurement of **Steam Condensate lines.** Detailed report is attached at **Annexure-2.**
- Ultrasonic thickness measurement of various **Equipment**. Detailed report is attached at **Annexure-3.**
- Dye Penetrant examination and radiography of weld joints of lines fabricated, erected and offered by Mech. Maint./Technical Department as per the requirement.
- 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 at selected spots on some equipment was carried out. Summary of observations and microstructure analysis is given at **Annexure-5**.
- The detailed observations and recommendations for corrective actions required on individual equipment are given below. All the observations were recorded during inspection and were handed over to concerned maintenance and operation group for necessary corrective action.

HIGH PRESSURE VESSELS

Following High-pressure equipment was inspected. Main observations are listed below:

AUTOCLAVE (V-1201)

VISUAL INSPECTION

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

Compartment No.1 (Top Compartment)

- Minor Roughening /corrosion of dome liner was observed and grayish oxide layer was observed on dome and man way surface.
- Dark brown-grayish patches observed on East side of shell liner. Liner plate piece just below dome liner was found bright silver in colour.
- Crack like indication observed approx 3" in length towards West side at Manway.
- Crack like indication observed approx 3" in length towards North side at top dish end petal liner.
- Few fasteners of tray segments were found loose.

Compartment No.2

- Minor roughening of tray holding clits and grayish brown oxide layer was observed on bottom side of trays, same was observed during previous inspection.
- 07 nos. of tray holding 'J' bolts were found loose.
- Weld joints condition 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 observed in last inspection.
- Due to corrosion / erosion of trays, cavities/gaps were observed between tray and it's welding with annular plate.

Compartment No.3

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

Compartment No.4

- Approx. 30 mm below circumferential weld a depression of approx. 100 mm dia. And 3 mm depth was observed at west side liner. Same was observed during last inspection also.
- Convex bulging of liner plate observed just above circumferential weld by approx. 4 mm height in complete circumference. Same was observed during last inspection also.
- Concave depression of approx 2-5 mm depth observed at approx. 200mm below the C-weld seam in approx. 80% of the periphery. Same was observed during last inspection also.
- Grayish and brownish oxide layer was observed on the bottom side of trays.
- 03 nos. of tray holding clits were found black and found to have severe corrosion attack including its welding, same observed in last inspection.

- Concave depression of liner plate of approx 6 mm depth was observed at approx 160mm below C-seam in North West direction in approx 100 mm area. Same was observed during last inspection also.
- Due to corrosion / erosion of trays, cavities/gaps were observed between tray and it's welding with annular plate.
- Few fasteners of tray segments were found loose.
- 04 nos. of tray holding 'J' bolts were found loose.
- Crevice/corrosion cavities were observed in longitudinal weld in bottom near man-way (west side) **same was marked as D-4-1**

Compartment No.5

- Convex bulging of liner plate was observed just above the circumferential weld joint by approx. 3 to 9 mm height in almost all the periphery. The same was observed during last inspection also.
- Concave depression of approx 2-6 mm was observed at approx. 500 mm below the C-weld seam in full periphery. The same was observed during last inspection also.
- Grayish and brownish oxide layer was observed on the bottom side of trays.
- Approx. 750mm. of NW long seam was found to have corrosion leading to weld reinforcement reduction. Same was observed during last inspection also.
- 02 nos. of tray holding clits near man-way were found black in colour, however its welding was found satisfactory.
- Few fasteners of tray segments were found loose.
- 06 nos. of tray holding 'J' bolts were found loose.

Compartment No.6

- Convex bulging of liner plate was observed above the circumferential weld joint by approx. 3 to 10 mm height, which starts from north-west to south-east direction in approx. Length of 4500 mm. The same was observed during last inspection also.
- Concave depression of approx. 5 mm depth was observed at approx. One meter below C-weld seam from East to West side L-seam through North side of the shell. The same was observed during last inspection also.
- 06 nos. of tray holding 'J' bolts were found loose.
- New welding was done on circumferential weld seam and long seam by M/s. Dowel Erectors.

Compartment No.7

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

- Minor erosion of the tray was observed.
- All tray holding 'J' bolts were found satisfactory.
- Crevice/corrosion cavities were observed on shell liner welding and **marked as D-7-1 and D-7-2 for repair.**

Compartment No.8

- Concave bulging at the elevation of approx. 300 mm above tray and 3 to 6mm. deep was observed in complete circumference. The same was observed during last inspection also.
- Corrosion cavities were observed on liner welding and **Marked as D-8-3 for repair.**
- 01 no. of tray segment bolt was loose.
- 05 nos. of tray holding clits were found to be blackish in coloration and having corrosion attack including its welding, same observed in last inspection.
- Crevice/Cavities observed in Circumferential and longitudinal weld and same was **Marked as D-8-1 & D-8-2.**

Compartment No.9

- 02 no. of tray holding clit was found to be blackish in coloration and having severe corrosion attack including its welding, same observed in last inspection.
- Few fasteners of tray segments were found loose.
- All tray holding 'J' bolts were found satisfactory.

Compartment No.10

- Concave depression of approx 7mm depth at approx 70mm below the C-weld seam in south side of shell in approx. 100 mm dia was observed. Same as last Inspection.
- Concave depression of approx. 9 mm depth just above the C-weld seam towards the south side of man way and adjacent to L-seam in approx. 100 mm dia. was observed. Same as last Inspection.
- Vertical bulging of approx. 2-3 mm height 25mm wide was observed from the C-weld seam to the bottom of the compartment in north side of the shell.The same was observed during last inspection also.
- Concave depression of about 5mm depth at approx 70mm below C seam in west side just adjacent to L seam was observed in 100 mm area. The same was observed during last inspection also.
- 100mm. dia with annular plate & 4 mm concave bulging was observed in NE direction approx. 25mm above tray. The same was observed during last inspection also.
- All fasteners of tray segments was found satisfactory.
- All tray holding 'J' bolts were found satisfactory.
- 02 nos. of tray holding clits were found to be blackish in coloration and having severe corrosion attack including its welding, same observed in last inspection.

Compartment No.11

- Just below circumferential weld concave depression of approx. 4 to 6 mm depth in approx. 80mm dia in North-West direction was observed. The same was observed during last inspection also.
- Concave depression of approx. 5mm and 9mm deep in approx. 100mm dia Was observed just below the C-weld seam in north and west side of the shell respectively. The same was observed during last inspection also.
- 10 to 12 mm gap was observed between tray and shell liner from East to South side. The same was observed during last inspection also.
- On new liner segment convex bulging up to max. 3 mm height having width approx. 10 mm observed just above circumferential stitch welds (approx. 125 mm long). Same was observed during last Inspection also.
- Concave depression of about 5-6 mm was observed just above and below of C-weld seam in old and new liner. The same was observed during last inspection also.
- All tray holding 'J' bolts were found satisfactory.
- Few fasteners of tray segments were found loose.
- Weld joints condition was found satisfactory.

Compartment No.12 (Bottom Compartment)

- South side tray skirt is touching the shell liner. The same was observed during last inspection also.
- Down comer nozzle with dish end liner weld joint edges were observed exposed. The same was observed during last inspection also.
- Dark brown coloration on dish end. The same was observed during last inspection also.
- Concave depression of approx. 2-3 mm depth and approx. 5mm depth were observed at approx. 200mm above the C-weld seam in 4"dia in east and west direction of the shell respectively. The same was observed during last inspection also.
- Minor corrosion/erosion was observed at bottom of the tray.
- Crack like indication and pinhole observed during DP test in Downcomer Fillet weld **marked for repair as D-12-1 to D-12-4.**
- Porosity observed in nozzle Fillet weld and same was **marked for repaired as D-12-5.**
- Crevice/Cavities observed in Petal weld in East side same was **marked for repaired as D-12-6.**
- All tray holding clits were found blackish in color and having severe corrosion attack including its welding.

NOTE

- Total 12 Nos defects marked Compartment wise e.g. D4-1, counting from top to bottom.
- Repair / welding of Long seams and Circumferential seams in compartment no. 6.

- Severe etching observed on Downcomer in almost all the compartment.
- Ferrite was also measured on liner & welds, found Nil.
- NE-North East, SW-South West, NW-North West, SE- South East
- L-Long seam, C-Circumferential seam.
- In general, few tray holding bolts and tray segment fasteners were found loose in all the compartments hence it may be checked

REPAIR / WELDING JOB IN COMPARTMENT NO. 6

It was decided to carry out repair and re-welding of 02 nos. Longitudinal and only Circumferential weld seam in Compartment no. 6.

The job was carried out by M/s Dowel Erectors. The welder qualification test was carried out well before starting of the job to avoid any hindrance.

Following procedure was followed for repair of the liner weld joints:

- Removal of existing weld crowning by grinding up to the surface of the liner.
- D.P. testing the flushed area and removal of any defect if observed.
- Welding by using 25-22-2 LMn filler wire dia. 2.4mm.
- Ferrite measurement was carried out in between welding job and found NIL.
- Final D.P. test.
- Clean and passivate the weld by washing with 10% HNO3 and rinse with plenty of DM water.

DETAILED THICKNESS REPORT OF AUTOCLAVE (V-1201)

COMPARTMENT NO.	LOCATION OF MEASURMENT	NOM. THK. (mm.)	OBSERVED THICKNESS (in mm.)				REMARK
			EAST (1)	WEST (2)	NORTH (3)	SOUTH (4)	
01 TOP COMPARTMENT	Shell Liner (New)	6.50	6.74	6.69	6.95	6.71	750mm.section replaced in Yr. 2002 by BC-05.
	Shell Liner Old (Top)	5.00	3.38	4.17	4.03	3.96	
	Shell Liner (Middle)	5.00	4.39	4.68	4.76	4.38	
	Shell Liner (Bottom)	5.00	4.06	4.69	4.67	4.30	
	Top-Dome	6.50	6.64	6.69	6.74	6.70	Replaced in Yr. 2002 by BC-05.
	Tray Segment -1	8.00	4.55	4.23	4.26	4.26	
	Tray Segment -2	8.00	4.56	4.33	4.43	4.22	
	Tray Segment -3	8.00	3.78	4.12	3.93	**3.70**	Overall Min. tray thickness
	Tray Segment -4	8.00	4.48	4.45	6.53	6.59	
	Manway Liner	6.50	6.86	6.78	6.90	6.98	Replaced in Yr. 2002 by BC-05.

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)	
02	Shell Liner (Top)	5.00	3.18	4.08	3.47	4.03	Overall Min. liner thick.
	Shell Liner (Middle)	5.00	4.50	4.60	4.18	4.60	
	Shell Liner (Bottom)	5.00	4.09	4.43	4.32	4.84	
	Tray Segment-1	8.00	4.18	4.47	3.81	5.92	
	Tray Segment-2	8.00	4.17	4.68	4.31	4.40	
	Tray Segment-3	8.00	4.09	4.27	4.06	4.04	
	Tray Segment-4	8.00	4.00	4.39	4.37	4.17	
	Down-Comer	10.00	5.92	7.57	6.56	6.74	Overall Minimum Down- Comer thick-ness
03	Shell Liner (Top)	5.00	3.85	4.46	4.14	3.99	
	Shell Liner (Middle)	5.00	4.42	4.48	4.36	4.24	
	Shell Liner (Bottom)	5.00	3.98	4.27	4.12	4.36	
	Tray Segment-1	8.00	4.44	4.75	4.73	4.78	
	Tray Segment-2	8.00	4.68	4.82	4.84	4.27	
	Tray Segment-3	8.00	3.77	4.28	4.65	3.65	
	Tray Segment-4	8.00	4.71	4.83	4.38	4.55	
	Insert Liner	6.50	6.52	6.68	6.81	6.91	Replaced in Yr. 1997
	Down-Comer (Shiny)	10.00	9.31	9.06	9.09	9.27	
	Down-Comer	10.00	6.56	6.54	6.82	6.52	
04	Shell Liner (Top)	5.00	4.33	3.82	3.86	4.39	
	Shell Liner (Middle)	5.00	4.44	4.18	4.26	4.57	
	Shell Liner (Bottom)	5.00	4.47	4.28	4.31	4.36	
	Tray Segment-1	8.00	4.62	4.83	4.92	4.89	
	Tray Segment-2	8.00	4.78	4.84	4.78	4.63	
	Tray Segment-3	8.00	4.72	4.82	4.97	4.48	
	Tray Segment-4	8.00	4.71	4.78	4.86	4.55	
	Insert Liner	6.50	6.32	6.31	6.28	6.26	Replaced in Yr.1999
	Down-Comer	10.00	6.71	6.76	6.84	6.75	
05	Shell Liner (Top)	5.00	4.72	4.77	4.40	4.71	
	Shell Liner (Middle)	5.00	4.73	4.86	4.78	4.87	
	Shell Liner (Bottom)	5.00	4.85	4.85	4.80	4.86	
	Tray Segment-1	8.00	5.35	5.10	5.20	5.45	
	Tray Segment-2	8.00	4.60	5.15	5.18	4.70	
	Tray Segment-3	8.00	4.77	4.80	4.71	5.08	
	Tray Segment-4	8.00	4.68	5.04	4.81	4.65	
	Down-Comer	10.00	6.62	6.83	6.62	7.75	
	Down-Comer (Shiny)	10.00	9.36	9.35	9.36	9.31	

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)	
06	Shell Liner (Top)	5.00	4.44	5.00	4.72	4.48	
	Shell Liner (Middle)	5.00	4.42	4.74	4.59	4.52	
	Shell Liner (Bottom)	5.00	4.49	4.83	4.44	4.72	
	Tray Segment-1	8.00	4.92	5.33	5.22	5.70	
	Tray Segment-2	8.00	5.46	5.61	5.76	5.36	
	Tray Segment-3	8.00	5.13	5.33	5.28	5.10	
	Tray Segment-4	8.00	5.55	5.57	5.60	5.70	
	Down-Comer	10.00	7.20	6.74	6.98	7.11	
07	Shell Liner (Top)	5.00	4.49	4.70	4.55	4.57	
	Shell Liner (Middle)	5.00	4.54	4.95	4.64	4.82	
	Shell Liner (Bottom)	5.00	4.47	4.90	4.62	4.83	
	Tray Segment-1	8.00	5.36	5.45	5.51	5.33	
	Tray Segment-2	8.00	5.46	5.66	5.55	5.22	
	Tray Segment-3	8.00	5.62	5.34	5.78	5.42	
	Tray Segment-4	8.00	6.01	5.72	5.62	5.81	
	Down-Comer	10.00	7.16	7.25	7.12	7.24	
08	Shell Liner (Top)	5.00	4.64	4.55	4.59	4.57	
	Shell Liner (Middle)	5.00	4.86	4.65	4.78	4.74	
	Shell Liner (Bottom)	5.00	4.92	4.73	4.67	4.70	
	Tray Segment-1	8.00	5.86	6.08	6.09	6.95	
	Tray Segment-2	8.00	6.04	6.07	5.84	6.05	
	Tray Segment-3	8.00	6.13	6.34	6.35	6.35	
	Tray Segment-4	8.00	6.58	6.76	6.67	6.55	
	Insert Liner	6.50	6.71	6.92	6.49	6.80	Replaced in Yr. 2000
	Down-Comer	10.00	7.30	7.51	7.45	7.82	
09	Shell Liner (Top)	5.00	4.64	4.69	4.68	4.47	
	Shell Liner (Middle)	5.00	4.79	4.71	4.74	4.59	
	Shell Liner (Bottom)	5.00	4.82	4.67	4.72	4.69	
	Tray Segment-1	8.00	7.06	7.08	6.92	6.95	
	Tray Segment-2	8.00	7.04	6.97	6.84	6.96	
	Tray Segment-3	8.00	6.46	7.36	6.91	6.37	
	Tray Segment-4	8.00	6.70	7.02	6.66	6.98	
	Insert Liner	6.50	6.82	6.75	6.79	6.56	Replaced in Yr. 2001

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)	
	Down-Comer	10.00	7.68	7.76	7.71	7.83	
10	Shell Liner (Top)	5.00	4.84	5.13	5.27	4.72	
	Shell Liner (Middle)	5.00	4.96	5.27	5.35	4.98	
	Shell Liner (Bottom)	5.00	5.03	5.32	5.44	4.94	
	Tray Segment-1	8.00	6.85	6.93	6.89	6.8	
	Tray Segment-2	8.00	6.84	7.25	7.32	7.12	
	Tray Segment-3	8.00	6.98	7.31	7.42	7.34	
	Tray Segment-4	8.00	7.04	7.37	7.34	7.16	
	Insert Liner	6.50	6.63	6.65	6.58	6.53	Replaced in Yr. 2002
	Down-Comer	10.00	7.97	7.85	7.91	8.03	
11	Shell Liner (Top)	5.00	4.51	4.57	4.48	4.63	
	Shell Liner (Middle)	5.00	4.66	4.76	4.64	4.81	
	Shell Liner (Bottom)	5.00	4.71	4.77	4.65	4.75	
	Tray Segment-1	8.00	7.18	7.16	7.14	7.39	
	Tray Segment-2	8.00	7.66	7.65	7.67	7.41	
	Tray Segment-3	8.00	7.82	7.77	7.84	7.71	
	Tray Segment-4	8.00	7.67	7.69	7.72	7.73	
	INSERT LINER	6.50	6.64	6.68	6.53	6.68	Replaced in Yr. 2002
	DOWN-COMER	10.00	8.27	8.29	8.22	8.17	
12- (BOTTOM COMPARTMENT)	SHELL LINER	5.00	4.57	4.55	4.60	4.62	
	PETAL PLATE	7.00	5.81	6.26	6.53	6.25	
	BOTTOM DOME	7.00	6.53	6.43	6.57	6.32	Replaced in Yr. 1993
	REDUCER- 10" X 8"	10.00	9.93	9.53	9.87	9.79	Replaced in Yr. 1997
	10" - PIPE	10.00	8.53	8.54	8.53	8.57	
	8" - PIPE (DISTANCE PIECE)	6.00	4.98	6.04	5.04	4.97	Replaced in Yr. 2000
	NOZZLE-8"	6.00	4.72	4.22	4.52	5.27	

Note :

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

HP STRIPPER (H-1201)

VISUAL INSPECTION

TOP CHANNEL

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

BOTTOM CHANNEL

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

BOTTOM COVER

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

THICKNESS MEASUREMENT

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

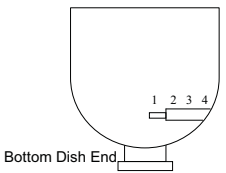
BOTTOM DOME

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness, mm (Minimum)
Man way (Overlay)	18.95	23.75	8.0
Dome area (Overlay)	12.65	14.82	8.0
Cylindrical area (Liner)	8.28	10.67	8.0
Tube sheet-Overlay weld	13.0 (Machined)	15.67 (Machined)	8.0
Bottom Cover (Overlay)	16.26	19.22	8.0

TOP DOME

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness, mm (Minimum)
Man way (Overlay)	20.20	23.67	8.00
Dome area (Overlay)	12.21	13.31	8.00
Cylindrical area (Liner)-Gas phase	8.04	8.62	8.00
Cylindrical area (Liner)-Liquid phase	8.02	8.51	8.00
Tube sheet-Overlay weld	12.38 (Machined)	14.35 (Machined)	8.00

RADIOACTIVE SOURCE WELL



POINT NO.	DESIGN THK.	MEASURED THICKNESS (Minimum)
1	7.5	8.52
2	19.0	18.67
3	19.0	18.62
4	19.0	18.93

All measurements are in mm.

FERRITE MEASUREMENT

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

EDDY CURRENT TESTING OF TUBES

Eddy current inspection of tubes was carried out by M/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 326 tubes
- Wall loss : 0.610 to 0.640 mm observed in 472 tubes
- Wall loss : 0.641 to 0.689 mm observed in 651 tubes
- Wall loss : 0.690 to 0.750 mm observed in 579 tubes
- Wall loss : 0.760 to 0.800 mm observed in 560 tubes
- Wall loss : 0.810 to 0.850 mm observed in 11 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-6**)

HP SCRUBBER (H-1203)

VISUAL INSPECTION

TOP DOME

- Shell internal surface was found Reddish-brown in coloration
- Scratch marks were found on the inside surface of shell liner. Depth of these marks was approx. 0.5mm max.
- CO_2 inlet nozzle flange (3/4"NB) located at west side was found etched & blackish in coloration.
- CO_2 inlet line in South was found intact with its supports.
- Shell liner weld joint below the diaphragm plate found satisfactory.
- Condition of liquid inlet and gas outlet pipe found satisfactory.

TUBE BUNDLE

After complete lowering of the tube bundle, visual inspection of bundle was carried out. The following observations were made.

- Coloration of tubes external surface assumed to be brownish black above 1st baffle from top and dull golden at the rest of area.
- Few nos. of tie rods spacers between baffle were found loose and tack weld also found cracked at few locations.
- Mechanical abrasion/impact mark seen on the two tubes just above the topmost baffle plate at North-East side (1st & 2nd tube towards East of baffle plate tie rod.) Abrasion mark size on one tube is approx. 50x10x (0.75-0.9mm depth) and that on other tube is having depth of approx. 0.1 to 0.2mm. The same was observed during previous inspection.

- 1st and 3rd baffle plate counting from top were found smooth and shiny whereas other baffle plates were observed rough and brownish black in coloration.
- Thickness measurement on 5 nos. of tubes was carried out above the top baffle plate, readings are as under.

Tube nos. counting from North side	East (mm)	West (mm)	Bend (mm)	Design Thk. (mm)
1	3.42	3.42	3.4	3.6
2	3.4	3.43	3.9	3.6
3	3.38	3.38	3.37	3.6
4	3.44	3.39	3.30	3.6
5	3.39	3.40	3.33	3.6

BOTTOM SHELL

- Abrasion marks due to the lowering of tube bundle were observed at scattered locations on the liner including those caused in the past.
- Top two course found to have brownish black coloration whereas bottom course was silver grey in colour.
- Liquid over flow basket weld & Carbamate inlet line nozzle weld found satisfactory.
- ¾" NB CO2 inlet line holding clit weld was found to have minor crevice, however welding of its holding pad was found satisfactory.
- All circumferential weld joints (04 nos.) and longitudinal weld joints (03) were found in satisfactory condition with minor roughening.
- Thickness measurement of shell liner was carried out, readings as under:

Course No	North	South	East	West	Design Thk. (mm)
1	5.26	5.42	5.34	5.27	5.0
2	5.40	5.3	5.42	5.32	5.0
3	5.42	5.39	5.4	5.38	5.0

Note: Course nos. are counted from top to bottom

INSPECTION OF OTHER VESSELS

H-1104 ($C0_2$ SPRAY COOLER)

- Demister pad condition was found satisfactory.
- Rectangular Risers holding clamps with Liquid distributor tray were found loose at several locations.
- Foreign material were lying on the Liquid distributor tray, need to be removed.
- Weld joint condition was found satisfactory.

H-1205 (L.P. CARBAMATE CONDENSER)

- In Annual turnaround 2011 the tubes were got inspected by M/S Escon, Chennai by Internal Rotating Ultrasonic Inspection System (IRIS). 21 nos. tubes were plugged on basis of IRIS inspection. 05 Nos. of tubes were plugged earlier due to leakage in past.

- In this turnaround the tubes were inspected by M/s TesTex NDT India Ltd., Mumbai by IRIS.

Result and Conclusion: It was observed that majority of the wall thinning was due to tube fretting under baffles. Hence total 62 nos. of tubes which had recorded thinning in the range of 48-65 % were plugged. (Tube sheet layout is attached at **Annexure-7** Total 88 nos. of tubes are plugged till date.

H-1207 (CIRCULATION SYSTEM –II COOLER)

- Heavy corrosion/ pitting and scaling was observed on the tube sheet area.
- Channel cover was found heavily pitted / corroded from inside.
- Scaling was observed on the inside surface of all tubes.
- Baffle plate was found heavily pitted/corroded.
- CW return line at the top was found having thick milky scales.

H-1209 (LP ABSORBER COOLER)

- Brownish & whitish thick scales was deposited on the inside surface of the shell which needs proper cleaning.
- Condition of the channel covers was found satisfactory.
- Thick hard scales were observed on the outer surface of the tubes.
- Condition of the tube sheet was found satisfactory.
- Condition of tube to tube sheet welding was found satisfactory.

H-1352 (REFLUX CONDENSER)

TOP TUBE SHEET

- Tube to tube sheet welding was found satisfactory.
- Hard scaling was observed on the inside surface of all the tubes and also on tube-sheet area. The same was observed during last inspection also.
- Out of four resting bracket of equipment with floor beam, one no. of bracket was found fixed.

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, hard creamy scaling was observed inside all the tubes and on the tube projections, including inside of outlet pipeline elbow. The same was observed during last inspection also.
- Paint inside the channel area was observed peeled off & thick scales were found sticking on channel and baffle plate.
- Thermowells were found intact in position, however CW outlet side thermowell was found covered with paint/scaling. The same was observed during last inspection also.

H-1419 (PRE-EVAPORATOR CONDENSER)

TOP TUBESHEET

- Tube to tube sheet weld was found satisfactory.
- Milky scaling was observed inside the tubes.
- Overall condition of heat exchanger was found satisfactory.

BOTTOM TUBESHEET

- Tube to tube sheet weld was found satisfactory.
- Thick scaling was observed inside the tubes.

H-1420 (FINAL CONDENSER)

- Top & bottom tube to tube sheet welding was found satisfactory.
- Rusting/ brownish scaling was observed on inside surface of channel covers.
- Inside surface of the tubes was found clean.

H-1421 (FLASH TANK CONDENSER)

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

H-1422 (1st Stage Evaporator)

- The shell and Dish ends have assumed grayish black in coloration with scattered brownish and whitish patches.
- Coloration of tube sheet was shiny.
- Tubes to tube sheet weld joints were found satisfactory.
- Condition of impingement cone was found satisfactory.
- Impingement cone to support welding was found satisfactory.
- Water was found accumulated at the bottom of the dish end.
- Top distributor outlet vanes found 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.
- Brownish scaling was observed on the tube to tube sheet weld joints.
- Minor scales were observed inside few tubes.
- 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.
- Tube to tube sheet weld joints were found slightly etched.
- Impingement cone was found bent in downward direction at two locations, one is in north-west direction and the other is in south-west direction. This was also observed in earlier inspection.
- Thin whitish scaling was observed inside of all the tubes from approx. 2" below the tube face.

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.
- Thick brownish scales were observed on the tube sheet.
- All the tubes were found filled with water.
- Tube ends were found having minor damage.

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, channel & baffle plates.
- Erosion / large pits were observed on Flanged weld joint of H-1814-B dome cover (West end) from Inside. The same was also observed in Past Inspection also.
- Pits approx 2-3mm deep were observed on Flanged weld joint of H -1814-B shell flange (East end) from Inside.

H-1815 (SURFACE CONDENSER)

SOUTH SIDE HALF (EAST SIDE CHANNEL)

TOP HALF

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found peeled off at few locations.
- Thermowell was found intact.
- Debris was found collected above portion plate.
- Scaling was observed at ID of few tubes.

BOTTOM HALF

- Tube sheet was found in satisfactory condition.
- Epoxy coating was found peeled off in channel area and also from the channel cover.
- Scaling was observed at ID of few tubes.

SOUTH SIDE HALF (WEST SIDE CHANNEL)

TOP HALF

- Tube sheet was found in satisfactory condition.
- Minor scaling was observed inside the tubes.
- Epoxy coating was found peeled off on baffle plate, channel & cover.
- Edges of the shell flange I.D. & Baffle plate were found to have corrosion oxides at few locations. It Needs attention.
- Debris was found collected above portion plate.

BOTTOM HALF

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

T-1301 (AMMONIA WATER TANK)

- Brownish coloration was observed on bottom plate and bottom half of shell where as shiny silver coloration observed on top half of shell.
- Bottom plate was found bulged upwards at various locations. Same was observed during previous inspection also.
- Weld joints and nozzle condition was found satisfactory.
- Tack weld of 2" line in East with bottom plate was found broken, need to be tacked.
- Thermo well condition was found satisfactory.
- Internal surface of the shell was found oily.
- Condition of the Roof was found satisfactory.

T-1301-A (NEW AMMONIA WATER TANK)

- Brownish coloration was observed on bottom plate & bottom half of shell and silver bright coloration was observed on top half of the shell.
- All the weld joints and nozzle condition was found satisfactory.
- Thermowell was found intact.
- Overall condition was satisfactory.

T-1401(UREA SOLUTION TANK)

- Brownish coloration was observed inside of the shell.
- 2" LT nozzle located in the North-West bottom direction is having a deep grinding mark / groove on inside weld with shell. Need to be filled up with weld deposition.
- Other nozzles and weld joint condition was fund satisfactory.
- Thermo-well condition was found satisfactory.
- Bottom plate was having bulging upwards as had been 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 was observed inside of the shell.
- Nozzles and weld joint condition was satisfactory.
- Thermo-well condition was found satisfactory.
- Overall condition was found satisfactory.

V-1101 (CO_2 KNOCK OUT DRUM)

- Epoxy paint was found peeled off from few locations, need to be repaired.
- 02 nos. demister pads of west half were found fallen on the bottom dished end, which need to be fixed. Other demister pads in the west half need to be tied properly as the wires used for tying seems to be loose & opened-up.
- Demister pad holding frame found bent at one location.
- The top dish end coloration was yellowish.

V-1102 (NH_3 SUCTION FILTER)

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

V-1202 (RECTIFYING COLUMN)

FROM TOP MANHOLE

- Coloration of vessel was grayish at manhole, dome and shell portion.
- Grey hard scales were observed on the top dish end and also on the shell portion.
- Metallic matter, Rasching 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.
- On the S-W side cleat, cleat weld with the shell found removed taking away shell material approx 1.5" length x 0.5" width x 5mm depth. This need to be rectified.
- Tray support / Mesh Grid support strips have tacked nuts. Some nuts are missing and 01 no. Nut has its tack broken in man way.
- Trays were covered with grayish hard scales.

FROM BOTTOM MANHOLE

- Coloration of top cone was silver with black patches where as brown coloration was found on bottom-dish end and shell portion.
- Thick scaling was observed on shell just below dome to shell circumferential weld seam. May be removed by scrapping.
- Collector for Recirculation outlet line welds with shell were found severely etched.
- Cone welds were found etched and almost leveled with the parent metal.
- Blackish scales were observed on the bottom dished end.

V-1206(ATMOSPHERIC VENT SCRUBBER)

- Demister pads were found intact in position and condition of the same was found satisfactory.
- Reddish brown coloration was observed inside the vessel.
- All bolts of Liquid inlet flange (inside vessel) highly corroded and found loose, need to be replaced with suitable material.
- Overall condition was found satisfactory.

V-1301(SECOND DESORBER)

BOTTOM COMPARTMENT

- Brownish coloration was observed inside the vessel.
- One clamp of the tray was found loose and tied with the adjacent one with wire. This was observed in previous inspection also.
- Nozzle condition was found satisfactory.
- Thermo-well was found intact.

TOP COMPARTMENT

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

V-1351 (HYDROLYSER)

BOTTOM COMPARTMENT

- Grayish black colouration was observed from inside.
- Oily surface was observed inside the vessel.
- 02 nos. of fasteners of steam inlet flange was found loose. The support clamp fasteners of the steam line in the West side were also found loose. Need to be tightened.
- Condition of the trays, clamps & steam inlet pipe was found satisfactory.

V-1352 (FIRST DESORBER)

FROM BOTTOM MANHOLE

- Brownish coloration was observed inside the vessel.
- Trays and its fasteners were found intact.
- Impingement plate was found intact.
- Weld joint condition was found satisfactory.

FROM TOP MANHOLE

- Brownish coloration was observed inside the vessel.
- All fasteners were found intact
- Weld joint condition was found satisfactory.
- All internals were found intact in position.
- Leakage marks and channeling was observed from one of the inlet flange bolts of $1^{1}/_{2}$" reflux line towards south. This was also observed in previous inspection.

V-1418 (PRE EVAPORATOR SEPARATOR)

- Grayish coloration at the top half and brownish coloration at the bottom half was observed in the vessel.
- Condition of the cone and weld joints was found satisfactory.
- Entire surface of the tube sheet was covered with grayish hard scales.
- Grayish hard scaling was observed inside the surface of all tubes.
- Tube to tube sheet weld appeared to be in satisfactory condition.
- Impingement cone was found in intact condition.
- Water was found accumulated on the bottom of the dish end.
- Hard debris of SS material found in accumulated water.

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.
- Demister pad support rod was found detached in North side just in front of hand hole.
- Few numbers J- bolt was found loose.

V-1501 (4 ATA STEAM DRUM)

- Shell and Dish ends were found Grayish with Reddish brown coloration at scattered locations.
- Distribution sparger was found intact in position though its flange towards South having one bolts missing.
- Demister pads were found intact in position and condition of the same was found satisfactory.
- South-West side Riser cover plate, few bolts found loose.
- Water was lying at bottom of the vessel.
- Condition of all the weld joints was found satisfactory.
- Minor pitting was observed on bottom of the shell.
- Hard scaling was observed on both the dished ends.

V-1502(23 ATA STEAM DRUM)

- Brownish black coloration was observed inside the vessel.
- Scaling was observed at both dished ends.
- Condition of distributor pipe, all welds, all nozzles and thermo-well found satisfactory.
- A pitting of 2-3 mm depth was observed above west manhole.
- Overall condition was found satisfactory.

V-1503 (9 ATA STEAM DRUM)

- Grayish black coloration was observed inside the vessel.
- Nut of South side U-clamp of inlet steam header was found missing. Need to be provided.
- I.D. of 1" bottom nozzle for Level controller in East direction at center portion of the shell was found having pitting/cavities up to 1.5mm depth. This was observed in previous inspections also.
- Overall condition of the vessel was found satisfactory.

V-1811 (1ST STAGE SEPARATOR)

- Demister pads were found intact in position.
- Vessel inside was found grayish in colour.
- Vortex breaker was found intact in position.
- Condition of the weld joints was found satisfactory.
- Demister drain pipe was found intact in position.
- Overall condition of the vessel was found satisfactory.
- Thickness measurement was carried out and found satisfactory.

V-1812 (2ND STAGE SEPARATOR)

- Demister pads were found intact in position.
- Vessel inside was found grayish in colour.
- Vortex breaker was found intact in position.
- Condition of the weld joints was found satisfactory.
- Demister drain pipe was found intact in position.
- Overall condition of the vessel was found satisfactory.
- Thickness measurement was carried out and 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.

RADIOGRAPHY

In order to ensure immediate radiography work and urgent processing of films, teams were hired on round the clock basis during entire shutdown period. Radiography was performed on the weld joints of the pipe lines fabricated / repaired by all contractors as well as departmentally as per the requirement.

INSTALLATION OF NEW PIPELINES

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

ANNEXURE-1 (1/3)

PIPELINE THICKNESS MEASUREMENT SUMMARY OF HP LINES

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION		MIN. THK. OBSERVED	%AGE RED.
					FROM	TO		
1	CO-F10-2119-PP25	8	160	23.01	K-1801,III	H-1813	22.26	3.5
1A	CO-F10-2119-PP25	1.5	160	7.14	K-1801,III	H-1813	7.01	2
1B	CO-F10-2119-PP25	0.75	160	5.54	K-1801,III	H-1813	5.34	3.6
2	CO-F10-2124	8	160	23.01	K-1801,DIS.	GA-1112	22.50	2.2
2A	CO-F10-2124	0.75	160	5.54	K-1801,DIS.	GA-1112	5.29	4.5
3	CO-E10-2139-PP25	4	80	8.56	CO-F10-2140-4" (TV-1808)	CO-E10-2122-6"	6.96	18.6
4	CO-F10-2140	4	160	13.49	K-1801,III	V-1813	12.53	7.11
4A	CO-F10-2140	0.75	160	5.56	CO-F10-2140-PP25	DRAIN	5.42	2.5
5	CO-E10-2122	6	80	10.97	H-1813	V-1813	9.93	9.5
6	GA-1112	6	F2	14.27	K-1101-2	GA-1201	11.86	16.88
6A	GA-1112	1.5	X1	5.08	FROM GA-1112	TO BYPASS	4.03	20
7	GA-1201	6	X4	13.33	GA-1112	H-1201	13.18	1.2
7A	GA-1201 TI-1207	1.5	X4	5.54	GA-1112	H-1201	4.98	10
8	GA-1202	1	F2	6.35	GA-1112-6"	C-VALVE (GA-1203)	4.37	31
9	GA-1203	1	X1	4.51	GA-1202	H-1203	3.67	18.5
9A	GA-1203 DRAIN	0.5	X1	3.73	GA-1202	H-1203	3.62	3
10	GA-1204	1	X1	4.51	H-1203	PR-1231	4.01	11
10A	GA-1204 DRAIN	0.5	X1	3.73	H-1203	PR-1231	3.02	19
11	GA-1602	8	F2	22.83	K-1801	GA-1112	21.82	4.4
12	GA-1603	4	F2	11.13	GA-1602	GA-1604	10.68	4
13	GA-1606	0.75	B3	2.87	K-1801	GA-1350-1"	2.27	20
14	MA-1106-B	4	E2	8.56	MA-1605-6"	MA-1203-4"	6.93	19
14A	MA-1106-B	1	E2	4.55	MA-1605-6"	MA-1203-4"	4.08	10.3
14B	MA-1106-B	0.75	E2	3.91	MA-1605-6"	MA-1203-4"	3.72	4.85
15	MA-1106-A	4	E2	8.56	P-1102-A	MA-1605-6"	7.48	12.5
15A	MA-1106-A	1	E2	4.55	P-1102-A	MA-1605-6"	4.18	8

ANNEXURE-1 (2/3)

PIPELINE THICKNESS MEASUREMENT SUMMARY OF HP LINES

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION		MIN. THK. OBSERVED	%AGE RED.
					FROM	TO		
15B	MA-1106-A	0.5	E2	3.73	P-1102-A	MA-1605-6"	4.09	-
16	MA-1123	4	E2	8.56	P-1102/B	MA-1605	7.45	13
16A	MA-1123	0.75	E2	3.91	P-1102/B	MA-1605	4.06	-
17	MA-1201	3	E2	7.62	MA-1605-6"	MA-1202-3"	6.28	17.5
17A	MA-1201	1.5	E2	5.08	MA-1605-6"	MA-1202-3"	3.41	32
18	MA-1202	3	X4	7.62	MA-1201	V-1201	6.65	12.7
18A	MA-1202	2	X4	5.54	MA-1201	V-1201	5.41	2.3
19	MA-1203	4	X4	9.14	MA-1106-6"	PR-1230	9.32	-
20	MA-1603	6	C2	7.11	MA-1122-6"	P-1102 /C	5.82	18.14
20A	MA-1603	1	C2	4.55	MA-1122-6"	P-1102 /C	4.39	3.51
20B	MA-1603	0.75	C2	3.91	MA-1122-6"	P-1102 /C	3.11	20.46
21	**MA-1603**	**4**	**C2**	**6.02**	**MA-1122-6"**	**P-1102 /C**	**4.46**	**25.91****
22	MA-1604	3	E2	7.62	P-1102 /C Dis	MA-1604-4"	5.88	22.83
22A	MA-1604	1	E2	4.55	P-1102 /C Dis	RV	4.72	-
23	MA-1604	4	E2	8.56	MA-1604-3"	MA-1605-6"	7.78	9.11
23A	MA-1604	2	E2	5.54	MA-1604-3"	MA-1605-6"	5.16	6.85
23B	MA-1604	0.75	E2	3.91	MA-1604-3"	MA-1605-6"	3.15	19.43
24	MA-1605	6	E2	14.27	MA-1106	MA-1203	13.14	7.91
25	MA-1605	4	E2	8.56	MA-1106	MA-1203	8.09	5.49
26	MA-1607	4	C2	6.02	MA-1605	MA-1116	5.47	9.13
26A	MA-1607 DRAIN	0.75	C2	3.91	MA-1605	MA-1116	3.37	13.81
27	MA-1609	4	C2	6.02	MA-1603-6"	MA-1604-3"	4.86	19.26
28	PR-1201	8	X1	19.58	V-1201	H-1201	17.40	11.13
29	PR-1202	10	X1	24.33	HP-Stripper H-1201	HP-Condenser	20.77	14.63
30	PR-1203	8	X1	19.58	HP-Cond. H-1202	V-1201 (Vapor Line)	17.96	8.27
31	PR-1204	8	X1	19.58	HP-Condenser	V-1201 (Liquid Line)	17.03	13.02

ANNEXURE-1 (3/3)

PIPELINE THICKNESS MEASUREMENT SUMMARY OF HP LINES

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION		MIN. THK. OBSERVED	%AGE RED.
					FROM	TO		
31A	PR-1204 TR-1202	1.5	X1	5.08	HP-Condenser	V-1201 (Liquid line)	4.21	17.12
32	PR-1205	6	X1	15.24	PR-1205-8"	Rectifying Columen	10.35	32.08
32A	PR-1205	1.5	X1	5.08	PR-1205-8"	Rectifying Columen	4.39	13.58
32B	PR-1205	0.75	X1	3.91	PR-1205-8"	Rectifying Columen	3.66	6.39
33	PR-1205	8	X1	19.58	Stripper Bottom	V-1202	16.68	14.81
33A	PR-1205 TR-1210	1.5	X1	5.08	Stripper Bottom	V-1202	4.77	6.10
34	**PR-1206**	**4**	**X1**	**10.40**	**PR-1210-10"**	**H-1203**	**2.46**	**76.34****
35	**PR-1208**	**4**	**X1**	**10.40**	**Autoclave Top**	**PR-1206-4"**	**7.46**	**28.26****
35A	PR-1208 TR-1206	1.5	X1	5.08	Autoclave Top	PR-1206-4"	7.71	-
36	PR-1211	1.5	X1	5.08	PR-1208-4"	PR-1212-4"	4.32	14.96
37	PR-1212	4	X1	10.40	Scrubber	Autoclave Bottom	9.21	11.44
37A	PR-1212	2	X1	5.54	Scrubber	Autoclave Bottom	4.83	12.81
38	PR-1213	2	X4	5.54	PR-1201	PR-1205-6"	4.17	24.72
39	PR-1224	3	X4	7.62	P-1201B	PR-1638-4"	7.22	5.24
40	PR-1225	3	X4	7.62	P-1201A/B, PR1638-4"	H-1203	6.85	10.10
41	PR-1226	2	X4	5.54	PR-1224	H-1205	4.26	23.10
42	PR-1230	6	X1	15.24	MA-1203-4"	H-1202	14.73	3.34
42A	PR-1230 TR-1205	1.5	X1	5.08	MA-1203-4"	H-1203	3.92	22.84
43	PR-1231	3	X1	8.12	H-1203	PRCV-1201	7.92	2.46
44	PR-1232 (JAKET)	6	-	-	PRCV-1201 (RV-1209)	ATMOS	3.17	-
45	PR-1234	4	X4	10.41	PRC-1201 (H-1203)	V-1203	10.47	-
46	PR-1234	3	X4	7.62	P-1201A	PR-1638-4"	6.13	19.55
47	PR-1637	3	X4	7.62	P-1201C	PR-1638-4"	6.79	10.89
48	PR-1638	4	X4A	9.14	P-1201A/B/C	PR-1230-6"	12.46	-
49	PR-1666	2	X4A	5.54	PR-1637	PR-1226	4.31	22.20

Note(**): **Replacement due to thickness reduction**

- PR-1206-4"-X1
  - 03 nos. elbows were replaced with available 4"-Sch-160 elbows.
  - 01 nos. Tee was replaced. &
  - Total 03 nos. straight pipe lengths were replaced.
- PR-1208-4"-X1
  - 02 nos. elbows were replaced with available 4"-Sch-160 elbows.
  - 02 nos. flanges were replaced.
  - Total 02 nos. straight pipe lengths were replaced.
- MA-1603-4"-C2
  - 1st elbow from Ammonia pump, P-1102/C Suction line was replaced.

ANNEXURE-2 (1/2)

PIPELINE THICKNESS MEASUREMENT SUMMARY (STEAM CONDENSATE LINE)

Sr. No	LINE NO.	NB (inch)	SCH.	NOM. THK. (MM)	LINE DESCRIPTION		MIN. THK. OBSERVED	%AGE RED.
					FROM	TO		
1	SC-1213	6	C1	7.11	H-1201	V-1502	5.7	19.83
1A	**SC-1213**	**4**	**B4**	**6.02**	**LCV-1501**	**V-1503**	**2.2**	**63.4****
2	SC-1216	4	B4	6.02	V-1204	SC-1407-6"	4.7	21.92
2A	SC-1216	2	B4	3.91	V-1204	SC-1216-4"	4.3	-
3	SC-1233 1st From North	12	B4	9.53	V-1501	H-1202	9.60	-
4	SC-1234 2nd From North	12	B4	9.53	V-1501	H-1202	10.00	-
5	SC-1235 3rd From North	12	B4	9.53	V-1501	H-1202	10.10	-
6	SC-1236 4th From North	12	B4	9.53	V-1501	H-1202	9.50	0.31
7	SC-1237 1st From N-E	16	B4	9.53	H-1202	V-1501	8.80	7.66
8	SC-1238 2nd From N-E	16	B4	9.53	H-1202	V-1501	10.30	-
9	SC-1239 3rdFrom N-E	16	B4	9.53	H-1202	V-1501	8.60	9.75
10	SC-1240 4th From N-E	16	B4	9.53	H-1202	V-1501	10.60	-
11	SC-1241 1st From N-W	16	B4	9.53	H-1202	V-1501	10.10	-
12	SC-1242 2nd From N-W	16	B4	9.53	H-1202	V-1501	9.20	3.46
13	SC-1243 3rd From N-W	16	B4	9.53	H-1202	V-1501	10.20	-
14	SC-1244 4th From N-W	16	B4	9.53	H-1202	V-1501	10.90	-
15	SC-1245	10	B4	9.27	H-1202	BD-1201	4.10	55.77
16	SC-1407	3	B4	5.49	H-1422	T-1501	5.20	5.28
16A	SC-1407	8	B4	8.18	H-1422	T-1501	6.30	22.98
17	SC-1408	2	B4	3.91	H-1422	SC-1530	3.30	15.60
18	SC-1409	4	B4	6.02	H-1424	T-1501	5.80	3.65
18A	SC-1409	1.5	B4	5.08	H-1424	T-1501	3.00	40.94
19	SC-1501	4	B4	6.02	T-1501	P-1501/6	4.50	25.24
20	SC-1502	3	B4	5.45	P-1501/6	V-1501	5.00	8.25
20A	SC-1502	2	B4	3.91	P-1501/6	V-1501	4.00	-
21	SC-1504	4	B4	6.02	V-1503	V-1501	4.80	20.26
21A	SC-1504	6	B4	7.11	V-1503	V-1501	6.00	15.61
22	SC-1505	6	B4	7.11	SC-1504	T-1501	5.30	25.45
22A	SC-1506	4	B4	6.02	T-1501	P-1505-A/B	5.00	16.94
23	SC-1507	3	B4	5.48	P-1505-A/B	T-1501 / DEARATOR	4.80	12.40
24	SC-1510	2	F1	5.54	P-1502	PCV-1501	5.10	7.94
25	SC-1514	4	B4	6.02	T-1501	SEAL POT	5.70	5.31
26	SC-1515	2	C1	3.91	V-1502	DRAIN	3.50	10.48
27	SC-1522	4	B4	6.02	SC-1529	SC-1409	5.60	6.97
28	SC-1523	3	B4	5.49	HEADER	SC-1409	5.00	8.92
29	SC-1530	3	B4	5.49	HEADER	SC-1407	4.60	16.21

Note(**): **Replacement due to thickness reduction.**

1. SC-1213-4"-B4, 4 nos. elbows were replaced with SS elbows.

ANNEXURE-3 (1/2)

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-1102	LP NH3 PREHEATER	8.0	9.8	-	8.0 / 10.0	12.0	-	-	-	-
2	H-1204	RECIRCULATION HEATER	11.0	10.8	2	7.0 / 9.0	9.7	-	-	-	-
3	H-1209	LP ABSORBER COOLER	10.0	10.3	-	7.5 / 11.5	8.2 / 11.0	- /4.5	6.0	6.9	-
4	H-1303	DESORBER SURFACE COND. HEAT EXCHANGER	10.0	9.9	1.0	10.0 / 12.0	10.6	- /11.0	12.0	12.3	-
5	H-1419	PRE-EVAPORATOR CONDENSER	9.5	9.8	-	12.7	11.9	6.0	-	-	-
7	H-1423	1^{SI} STAGE EVAPORATOR CONDENSER	10/7	11.0 / 7.8	-	12 / 15 7 / 10	12.3 - 10.7	-	13.0	10.8	15
8	H-1425	2ND STAGE EVAPORATOR 1ST CONDENSER	14.0	12.7	10.0	--	18.0	--	15.0	15.2	-
9	H-1426	2ND STAGE EVAPORATOR 2ND CONDENSER	7.0 / 10.0	7.9 / 10.3	-	9.0(B) / 13.0(T)	12.7 / 9.1	3.0/-	10.0	9.6	5.0
10	H-1502	VENT CONDENSER DM WATER HEATER	10.0	10.0	-	10.0 / 13.0	9.7	3	10.0	9.7	3
11	H-1811	1ST STAGE INTER COOLER FOR K-1801	12.0	12.7	-	12.0	11.9	1.0	12.0	13.3	-
12	H-1812	2^{NU} STAGE INTER COOLER FOR K-1801	10.0	11.2	-	10.0	11.4	-	12.0	12.7	-
13	H-1813	3rd STAGE INTER COOLER FOR K-1801	10.0	10.3	-	10.0 / 20.0	9.3 / 20.2	7.0	10.0 / 30.0	9.7 / 31.8	3.0
14	H-1814A	MAIN LUBE OIL COOLER FOR K-1801	12.0	11.3	5.8	-	-	-	12.0	11.6	4.1
15	H-1814B	MAIN LUBE OIL COOLER FOR K-1801	12.0	11.3	5.8	-	-	-	12.0	11.5	4.

ANNEXURE-3 (2/2)

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.
15	H-1815	SURFACE CONDENSER FOR Q-1801	NA	15.0	-	-	-	-	-	-	-
16	T-1814	MAIN LO TANK	6.00	5.8	3.4	-	-	-	-	-	-
17	V-1101	CO2 K.O DRUM	10.0	10.0	-	13.0	12.8	4.5	-	-	-
18	V-1301	SECOND DESORBER	6.0	6.2	-	6.0	8.3	-	-	-	-
19	V-1202	RECTIFYING COLUMN	9.0	9.7	-	11.0	11.4	-	-	-	-
20	V-1352	FIRST DESORBER	8.0	7.9	1.25	10.0	9.8	2.0	-	-	-
21	V-1353	LEVEL TANK FOR REFLUX CONDENSER	6.0	6.2	-	4.5 / 6.0	5.6	-	-	-	-
22	V-1401	FIRST STAGE EVAPORATOR CONDENSER POT	NA	8.3	-	NA	8.2	-	-	-	-
23	V-1406	FLASH TANK SEPARATOR	8.0	8.8	-	10.0	10.4	-	-	-	-
24	V-1409/A	UREA SOLUTION FILTER	6.0	6.6	-	-	-	-	-	-	-
25	V-1409/B	UREA SOLUTION FILTER	6.0	6.6	-	-	-	-	-	-	-
26	V-1418	PRE EVAPORATOR SEPARATOR	12.0	12.3	-	10.0 / 12.0	10.6	-	-	-	-
27	V-1811	1^{SI} STAGE EVAPORATOR	6.0	5.3	11.66	6.0	5.8	3.33	-	-	-
28	V-1812	2^{ND} STAGE EVAPORATOR	10.0	10.9	-	10.0	12.3	-	-	-	-
29	V-1813	3^{RD} STAGE EVAPORATOR	30.00	30.2	-	30.00	29.4	2.0	-	-	-

ANNEXURE-4 (1/2)

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	0.9	Within limits
Journal Bearing Base Ring	Governor side	Top–1.3 Bottom–1.6	"
Shaft Journal	Governor side	1.4	"
Thrust Collar	Governor side	1.5	"
Thrust Bearing	Governor side	0.8	"
Thrust Base Ring	Governor side	1.7	"
Thrust Bearing Pads	Governor side	0.6	"
TURBINE (NORTH END)			
Journal Bearing Pads	Top Half	1.4	"
	Bottom half	0.6	"
Shaft Journal		0.8	"
Journal Bearing Base Ring	Top Half	1.3	"
	Bottom half	4.2	0.5
Collar	Active		"
	Inactive		"
L.P. CASE (TURBINE END)			
Shaft Journal		1.4	"
Journal Bearing Pads		Top– 1.2 Bottom–1.4	"
Journal Bearing Base Ring	Top	2.0	"
	Bottom	2.3	
			"
L.P. CASE (G.B. END)			
Shaft Journal		1.2	"
Journal Bearing Pads		New Pads	"
Journal Bearing Base Ring	Top		"
	Bottom		
Thrust Base Ring	Active	12.6	1.9
	Non active	1.8	
Thrust Bearing Pads	Active	1.3	"
	Non active	1.3	
Thrust Collar		1.2	"

DESCRIPTION	POSITION	BEFORE (Gauss-max.)	AFTER (Gauss max.)
GEAR BOX			
L.S. Shaft Journal Bearing L.P. Side	Top half	0.6	withinlimits
	Bottom half	0.4	
L.S. Shaft Journal Bearing H.P. Side	Top half	1.2	"
	Bottom half	1.3	
H.S. Shaft Journal Bearing L.P. Side	Top half	0.2	"
	Bottom half	0.5	
H.S. Shaft Journal Bearing H.P. Side	Top half	0.5	"
	Bottom half	0.6	
L.S. Shaft	Teeth	1.1	"
	Journal portion	0.9	
H.S. Shaft	Teeth	1.2	"
	Journal portion	0.6	
Thrust pads		1.3	"
Thrust Base Ring	Inboard side	8.6	1.8
	Outboard side	1.3	
Thrust Collar		1.2	"
H.P. CASE (FREE END SIDE)			
Shaft Journal		0.5	"
Journal Bearing Pads		Top–1.3 Bottom–1.4	"
Journal Bearing Base Ring	Top	0.4	"
	Bottom	0.7	"
Thrust Base Ring	Inboard side	Top–1.2 Bottom–1.4	"
	Outboard side	Top– 1.4 Bottom–1.6	
Thrust Pads	Inboard side	1.2	"
	Outboard side	0.9	
Thrust Collar		1.2	"
Thrust Collar Journal		0.9	"
H.P. CASE (G.B. SIDE)			
Shaft Journal		1.8	"
Journal Bearing Pads		Top– 1.2 Bottom–1.0	"
Journal Bearing Base Ring	Top	1.6	"
	Bottom	1.3	"
Oil Rings (2 Nos.)	Top	0.6	"
	Bottom	0.5	

ANNEXURE- 5

DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1	Location: 57 (Parent Metal) HP CONDENSER H-1202 Stub end Gas outlet bottom side	SS 316L	Microstructure shows fine-grained worked austenitic structure with twins. Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix. Presence of weld spot is observed at PM region.	Presence of weld spot is observed at PM region. No significant degradation observed. Monitor after 1 year of service.
2	Location: 58 (Weld/HAZ) LP CARBAMATE SEPRATOR V-1205 PM & Nozzle weld outside	SS 304L	Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix. Whereas at HAZ microstructure shows fine-grained austenite structure with twins. Microstructure shows fine-grained worked austenitic structure with twins.	Microstructure is free from any micro cracks. Monitor after 1 year of service.
3	Location: 59 (Parent Metal) LP CARBAMATE SEPRATOR V-1205 - outside	SS 304L	Microstructure shows fine-grained worked austenitic structure with twins. Presences of ferrite stringers are observed.	Microstructure is free from any micro cracks. Monitor after 1 year of service.
4	Location: 60 (Weld/HAZ) V-1205 Nozzle Weld inside	SS 304L	Presence of weld spot is observed at PM region. Weld metal microstructure shows dendritic structure of ferrite pools in austenite matrix. Whereas at HAZ microstructure shows fine-grained austenite structure with twins. Microstructure shows fine-grained worked austenitic structure with twins. Presence of inter-dendritic crack is observed in weld spot region.	Presence of weld spot is observed at PM region. Inter-dendritic cracks are observed in weld spot region. Needs attention.

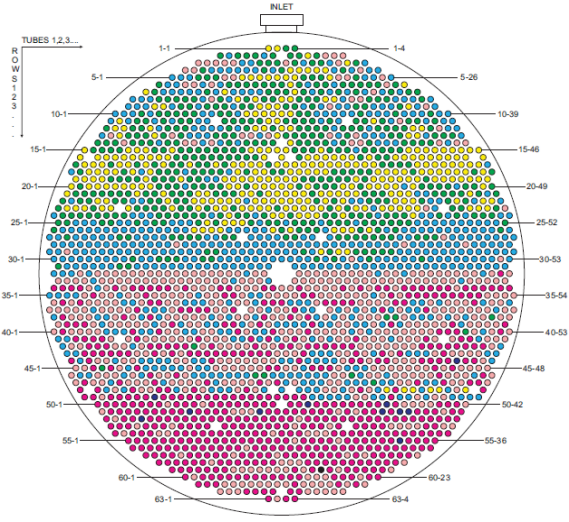
ANNEXURE- 6

TUBE SHEET LAY OUT OF H-1201/A (VIEWED FROM TOP)

I.F.F.C.O
Kalol,Gujarat.

UREA STRIPPER
H-1201/A

Viewed from Top Side



INSPECTION SUMMARY

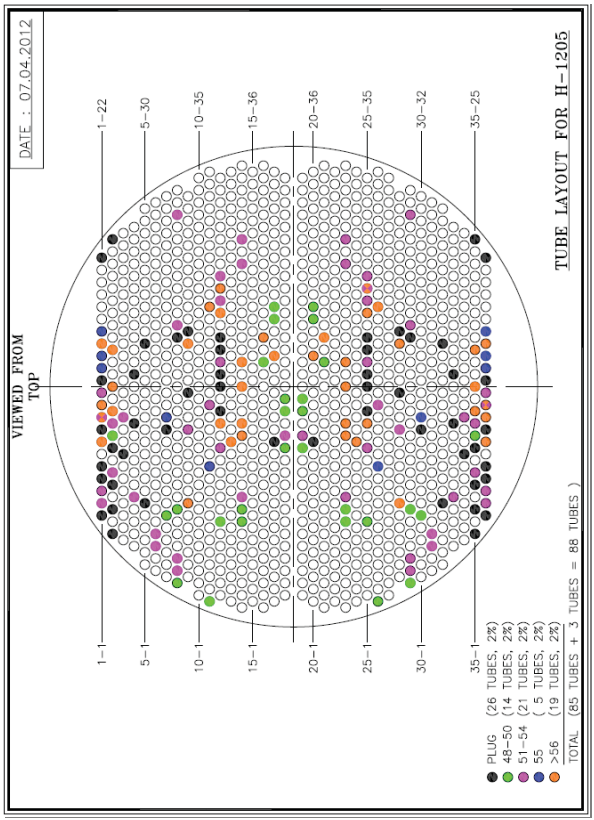
Denotes: Wall Loss

○ 0.3mm to 0.50mm ○ 0.51mm to 0.60mm ○ 0.61mm to 0.64mm ○ 0.641 mm to 0.689mm
○ 0.69mm to 0.75mm ○ 0.76mm to 0.80mm ○ 0.81mm to 0.85mm ● Plugged

TesTex

ANNEXURE- 7

TUBE SHEET LAY OUT OF H-1205 (VIEWED FROM TOP)



UTILITY PLANT
(INSPECTION)

The following major inspection activities were performed in Utility Plant.

- Inspection of BHEL boiler drums and furnace tubes.
- Inspection of Deaerator.
- Inspection of 52" NB CW Inter connection line of P-4405 and P-4401 C/D sump.
- Insitu Metallographic Examination of failed as well as spare steam super heater coil, FD fan turbine casing and wheel.

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

BHEL BOILER (GT-2068):

Visual inspection of Steam Drum, Mud Drum, Furnace tubes and Super heater tubes was carried out during this shutdown. Also, Ultrasonic thickness measurement of secondary super heater tubes was carried out. Minimum thickness of 4.6 mm was observed near the failed location against the nominal thickness of 5.6 mm.

No abnormality was observed on visual inspection except crack was observed on the top tube of secondary super heater coil.

DEAERATOR:

Deaerator Head:

- Bottom two ray segments were found to have displaced trays.
- Brownish coloration was observed inside the shell and dish end.

Deaerator Storage Shell:

- Brownish coloration was observed inside the shell and dish end.
- Condition of the weld joint was found satisfactory.
- Scaling was observed at both dished end.

52"NB CW INTER CONNECTION LINE OF P-4405 TO P4401-C/D:

- Circumferential & Longitudinal weld joints were found to have poor welding from inside and same was marked with yellow chalk.
- Epoxy paint was found peeled off at many locations resulting in oxide layer formation.
- Blisters of Epoxy paint also observed at many locations.
- Removal of oxide layers, blisters and application of epoxy paint at such locations is recommended to prevent corrosion.
- P-4405 suction line portion inside the sump severely corroded. Necessary action recommended.

MISCELLANEOUS JOBS:

D.P. TEST:

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

RADIOGRAPHIC EXAMINATION:

Radiographic examination of butt weld joints of furnace bank tube which was cut for RLA sampling, steam drum front safety valve, rear safety valve, 40 ata bypass line and super heater safety valve weld neck flange etc was carried out and found satisfactory.

GAUSS MEASUREMENT:

During this shutdown measurement of residual magnetism (gauss) on rotary and stationary parts of BFW pump (P-5111) bearings was carried out. Wherever residual magnetism was higher than acceptable limits, same was demagnetized and brought down within acceptable limits.

WELDER QUALIFICATION TESTS:

Performance qualification test of 17 Nos. welders offered by M/s General Engineering was carried out. 08 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical departmental welding jobs in the plant.

Welder qualification test of 03 Nos. welders of M/S. Skywin Erectors. was carried out. 03 welders were qualified. These welders were qualified for performing Superheater RV, Steam Drum RV & leaky SH coil replacement jobs.

METALLOGRAPHIC EXAMINATION:

Insitu Metallographic examination of steam super heater failed coil, spare new coil ,FD fan turbine casing and wheel was carried out and observations are mentioned below.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1.	Location: 1 (Parent Metal) Inlet Header **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows ferrite and bainite structure. Degradation of bainite in terms of carbide formation is observed.	Monitor after 2 years of service.
2.	Location: 2 (Parent Metal) Inlet coil Tube No. 1 Outside Furnace **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows ferrite and bainite structure.	No significant degradation is observed. Monitor after 2 years of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
3	Location: 3 (Parent Metal) Outlet Header **SECONDARY SUPERHEATER COIL (FAILED)**	P22	Microstructure shows ferrite and bainite structure. Effect of banding observed.	No significant degradation is observed. Monitor after 2 years of service.
4.	Location: 4 (Parent Metal) Outlet coil Tube No. 1 Outside Furnace **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows ferrite and bainite structure.	No significant degradation is observed. Monitor after 2 years of service.
5.	Location: 5 (Parent Metal) Tube no. 1 near bulged area Top side (Near header) **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows ferrite and bainite structure. Bainite is observed degrading into fine rounded carbides. Presence of creep damage in terms of creep cavities and initial level of micro cracks at the grain boundaries is observed.	**Needs attention.**
6.	Location: 6 (Parent Metal) Tube no. 1 near Top side (Long crack) **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows ferrite and bainite structure. Bainite is observed degrading in to fine rounded carbides. Presence of creep damage in terms of creep cavities and initial level of micro cracks at the grain boundaries is observed.	**Needs attention.**
7.	Location: 7 (Parent Metal) Tube no. 1 on sound area Under scale Top side (Near header) **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure fine grained ferrite and carbide structure. Presence of creep damage in terms of creep cavities and initial level of micro cracks at the grain boundaries is observed.	**Needs attention.**
8.	Location: 8 (Parent Metal) Tube no. 2 Top side **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows ferrite and bainite structure. Bainite is observed degraded in the microstructure. Indication of creep damage in terms of aligned creep cavities are observed at grain boundaries	SEM interpretation is kept below to find out the degradations based on creep damage.
8.1	Location: 8.1 (Parent Metal) Tube no. 2 Top side **SECONDARY SUPERHEATER COIL(FAILED)**	P22	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.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
9	Location: 9 (Parent Metal) Tube no. 3 Top side **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows ferrite and carbides. Bainite is observed degraded in terms of ferrite and carbides, however at some locations prior bainite structure is maintained. Indication of creep damage in term of aligned creep cavities are observed at grain boundaries	SEM interpretation is kept below to find out the degradations based on creep damage. .
9.1	Location: 9.1 (Parent Metal) Tube no. 3 Top side **SECONDARY SUPERHEATER COIL(FAILED)**	P22	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.
10.	Location: 10 (Parent Metal) Tube no. 4 Top side **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows ferrite and bainite structure. Initial level of degradation of bainite is observed. Indication of creep cavities are also observed in the microstructure.	SEM interpretation is kept below to find out the degradations based on creep damage.
10.1	Location: 10.1 (Parent Metal) Tube no. 4 Top side **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows oriented creep cavities at the grain boundaries.	Approaching 3rd stage of creep damage. Monitor after one year of service.
11.	Location: 11 (Parent Metal) Tube no. 5 Top side **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows ferrite and carbides. Bainite is observed degraded in terms of ferrite and carbides however some locations prior bainite structure is maintained. Indication of creep damage in term of aligned creep cavities are observed at grain boundaries.	SEM interpretation is kept below to find out the degradations based on creep damage.
11.1	Location: 11.1 (Parent Metal) Tube no. 5 Top side **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows alloy carbides with isolated creep cavities are observed.	Creep cavities are present. IInd stage of creep monitor after 2 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
12	Location: 12 (Parent Metal) Tube no. 6 Top side **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows ferrite and carbides. Bainite is observed degraded in terms of ferrite and carbides however some locations prior bainite structure is maintained. Indication of creep damage in term of aligned creep cavities are observed at grain boundaries	SEM interpretation is kept below to find out the degradations based on creep damage.
12.1	Location: 12 (Parent Metal) Tube no. 6 Top side **SECONDARY SUPERHEATER COIL(FAILED)**	P22	Microstructure shows alloy carbides with isolated creep cavities are observed.	Creep cavities are present. IInd stage of creep monitor after 2 year of service.
13	Location: 13 (Parent Metal) Steam Drum Bottom just above failed secondary super heater coil from where refractory was peeled off	CS	Microstructure shows very fine grained ferrite and bainite structure. Bainite is observed degrading in to fine rounded carbides.	SEM interpretation is kept below to find out the degradations based on creep damage.
13.1	Location: 13.1 (Parent Metal) Steam Drum Bottom just above failed secondary super heater coil from where refractory was peeled off	CS	Microstructure shows alloy carbides with isolated creep cavities at the grain boundaries.	Creep cavities are present. IInd stage of creep monitor after 2 year of service.
14	Location: 14 (Parent Metal) Spare New Secondary Super Heater Coil segment outlet tube	P22	Microstructure shows fine-grained ferrite and pearlite/bainite structure.	No significant degradation observed. Monitor after 2 years of service.
15	Location: 15 (Parent Metal) FD Fan Turbine Wheel	Cr Steel	Microstructure shows tempered bainite structure.	No significant degradation observed. Monitor after 2 years of service.
16	Location: 16 (Parent Metal) FD Fan Turbine Casing	Cr Steel	Microstructure shows fine-grained ferrite and pearlite/bainite structure.	No significant degradation observed. Monitor after 2 years of service.

Note: Location no. 5 to 12 are on top coil of failed secondary super heater coil counting from FD fan side to BFW pump side.

INSTRUMENTATION

Control valve Maintenance jobs

FRCV- 1: New positioner was provided due to block leakage in old positioner. Actuator diaphragm was checked, found ok. General cleaning of air filter regulator was carried out. Gland packings were replaced. Finally control valve stroke was checked.

FRCV-2: Removed from bonnet & found that plug was damaged, so it was replaced with repaired one. Actuator diaphragm was checked, found ok. General cleaning of positioner, air filter regulator was carried out. Gland packings were replaced. The control valve was assembled, reinstalled and stroke was checked.

FRCV-3: The Control valve removed from bonnet, seat & plug were checked. All parts were cleaned and overhauled. Also Actuator diaphragm was opened and checked, found ok. General cleaning of valve positioner was carried out. Gland packings were replaced. Finally the stroke was checked.

PICV-14: The Control Valve Body Gasket was replaced to solve passing problem & also new gland packings were provided. Actuator diaphragm was checked and found ok. Control Valve stroke was checked.

FICV-485: The Control Valve Trim Part Lapping was carried out and control valve tight shut-off was made by lowering down the stem. New air regulator was provided. General cleaning was carried out and the valve stroke was checked.

LCV-490: The Control Valve Trim Part Lapping was carried out and control valve tight shut-off was made by lowering down the stem. New air regulator was provided. General cleaning was carried out and the valve stroke was checked.

PICV-21: The Control Valve was removed from bonnet. Checked and found that the stem was broken from plug end. The Plug was assembled with new stem. Lapping of the plug and seat was carried out. Actuator diaphragm was checked and found ok. All parts were cleaned & overhauled. New air regulator was provided. The stroke of C/V was checked.

FRCV- 5: The control valve was opened from bonnet for inspection of trim parts which were found o.k. Actuator diaphragm was opened and checked, found ok, also provided new gland packings. Stroke was checked.

FRCV- 5A (V-7): Control valve removed from bonnet, machining was carried out in plug for tight shutoff. Actuator diaphragm was opened and checked, found ok. Complete Overhauling was carried out & also provided new gland packings. Stroke was checked.

TRCV- 10, 11: Actuator diaphragm was opened and checked, found ok. New gland packings were provided. Stroke was checked.

PICV-003: Control valve removed from bonnet, Machining was carried out in plug for tight shutoff. Actuator diaphragm was opened and checked, found ok. Complete Overhauling was carried out & also provided new gland packings. Stroke was checked.

MICV-003: Control valve removed from bonnet, cleaning of trim parts was carried out. The control valve was checked for tight shutoff. New carbon seal rings were provided. Actuator diaphragm was opened and checked, found ok. Complete Overhauling was carried out & also provided new gland packings. Stroke was checked.

PRCV- 25: Control Valve diaphragm was checked and found ok. New gland packings were provided Stroke was checked.

PICV-6A/6B & PICV-2: C/V diaphragm was checked and found ok. New gland packings were provided. Stroke was checked.

PICV-13A: Gland packings were replaced. General cleaning & greasing was carried out. Finally C/V stroke was checked.

PICV-13B: Gland packings were replaced. General cleaning & greasing was carried out. Finally C/V stroke was checked.

LC-25: Gland packings were replaced & also provided new Diaphragm. General cleaning & greasing was carried out. Finally C/V stroke was checked.

MICV-22: New seat and carbon ring on the plug were provided as old carbon rings were broken**.** Gland packings were replaced. General cleaning & greasing was carried out. Finally control valve was checked for tight shutoff and operation which was found satisfactory.

LICV-44: Gland packings were replaced. General cleaning & greasing was carried out. Finally C/V stroke was checked.

FICV-11: Positioner & Gland packing were replaced. The valve stroke was checked and the stroke was found ok.

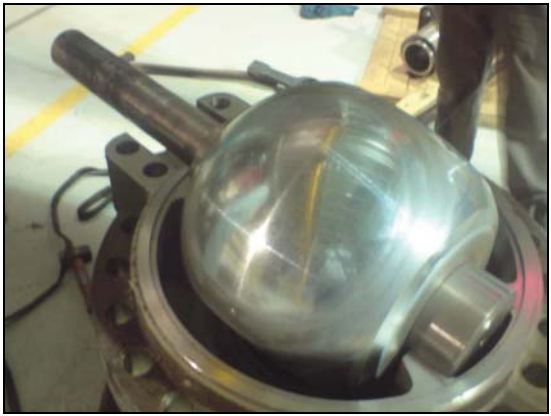
FRCV-8: Gland packing were replaced & also provided new diaphragm and air filter regulator. The valve stroke was checked and found ok.

PICV-6: General cleaning/greasing, replacement of gland packing, overhauling job of hand-jack assembly were carried out. C/V stroke was checked.

KV 120-1: Left side dome was replaced with new locally fabricated S.S dome. Checked and found ok.

USV-933: Problem of passing was there; the valve was dropped from line and was send to M/S METSO Workshop, Baroda. Passing problem was solved by replacing internal gasket of seat ring. Also, lapping of plug and seat was done. Valve was tested by Air and Hydro-test was carried out. Finally Control Valve was Boxed up & found ok.

USV – 933 Control valve under dismantling



USV – 933 Control valve Plug and seat after dismantling

FICV-14: C/V was opened from bonnet. Plug & seat were taken out for inspection. All parts were cleaned, overhauled, gland packing was replaced & old tubing replaced with new one, finally assembled & reinstalled and checked stroke.

TICV-60: Replaced old Masoneilan make control valve with new KOSO Make control valve. Related fabrication job and necessary signal & air supply tubing work was carried out. C/V stroke was checked and found ok.

MICV-1 TO MICV-9 : All the Nine control valves in fuel service at primary reformer were replaced with new dresser Masoneilan make control valves. Related fabrication job and necessary signal & air supply tubing work was carried out. Control Valves stroke were checked and found ok.

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	9	MICV-16
2	V-5	10	PICV-002
3	PICV-20	11	MICV 1A to 9A
4	PRCV-11	12	MICV 24 to 32
5	MICV-13	13	LCV-15,16, 18
6	MICV-14	14	LCV-16
7	MICV-15	15	LCV-18
8	PICV-16	16	VS-18

COMPRESSOR HOUSE JOBS

Air Compressor (101J):-

Removed all Radial, Axial and key-phasor probes along with relevant junction Boxes, speed pick-ups, T/C, pressure gauges and local THI to facilitate M/M jobs. All proximitor JBs were cleaned. After completion of M/M jobs the instruments and probes/pick-ups were fixed back after cleaning/functional checking. Gap voltage adjustments for radial and axial probes were carried out.

HIC-101J : General cleaning and overhauling of governor positioner was carried out. New lip seal of piston/Cylinder & Actuator Loading Pressure Regulator were provided. Air lock out relay was checked. Checked calibration of I/P Converter. New pressure gauge was provided for I/P converter, air supply Regulator & Positioner. Finally Positioner was fixed and stroke checking was performed.

TRIP-101J : Mechanical trip feedback Limit switch was overhauled and checked its operation.

VS-101J : The Trip Solenoid valve was overhauled & new coil was provided. Trip solenoid valve operation was checked.

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.

Following probes were replaced with new one: 1V/1H, 7H, 8V & 10A/10B

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 checked. New lip seal of Piston/Cylinder was provided. New pressure gauges were provided for I/P Converter, air supply Regulator & Positioner. Checked calibration of I/P converter. Finally Positioner 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 & new coil was provided. Finally Trip solenoid valve operation was checked.

105J (Trip logic): Checked the setting for alarm and trip logic.

SI-105J: Beacon speed indicator was not working properly so replaced with repaired one.

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. After completion of Mech. jobs the instruments and probes/pick-ups were fixed back after cleaning/functional checking. All the Temp points were sealed. Gap voltage adjustments for radial and axial probes were carried out. Replaced probe of point 1 V.

PRCV-12 (103JAT): Replaced the lip-seal of Piston/Cylinder & positioner assembly with spare ones. Air lock relay was checked & found ok. Checked calibration of I/P converter. 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. Checked lock out relay, cylinder leakage. New pressure gauges were provided for I/P converter, air supply Regulator & Positioner. Checked calibration of I/P Converter. Positioner was re-fixed and stroke checking was performed.

VS-103J & VS-103: Trip solenoid valves VS-103J & VS-103 were overhauled. The coils of 103JAT Trip Solenoid Valve were replaced with new one. Finally Trip solenoid valve operation was checked.

103J (Trip logic): Checked the setting for alarm and trip logic.

Extension Cable & Conduits were provided for Key phasor & 2V/2H Probes.

TI-103-9B: New K Type Thermocouple was replaced with new one for 103-9B.

TR-14-16: 103JBT Bearing Temperature RTD Replaced with new one.

Field Instrument jobs :

- Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 115-JAT to facilitate Mech. Maintenance jobs. Checked both MPUs of Electronic Governor for 115-JAT.
- Alarm, AOP Start & Trip pressure switches of 115-JAT & 115-JBT were checked, & calibrated.
- Thermocouples from 108-C, 109-C & 114-C were removed to facilitate Mech. Maint. Jobs and re-fixed the same after completion of Mech. Maint. Jobs.
- 115-JA: one bearing RTD at Turbine side was found damaged, after repairing it was fixed back.
- Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 104-JT to facilitate Mech. Maint. jobs. Checked both MPUs of Electronic Governor for 104-JT.
- Removed & reinstalled different instruments (RTD, MPU, SV etc.) at 101-BJT to facilitate Mech. Maint. jobs. Checked both MPUs of Electronic Governor for 101-BJT.
- Various instruments (PI, TI, SV, RTD, MPU etc.) were removed at 107-JAT to facilitate Mech. Maintenance jobs. After completion of Mech. jobs the instruments were reinstalled.
- Provided low range Pressure Gauges at different locations in plant as per requirement of production dept. for purging & maintenance purpose.
- PT-104: Tapping Removed for I.G. purging and reconnected after completion of purging.
- Instrument air headers flushing were carried out at different locations.
- Boiler Inspection: Provided standard 10" dial size Pressure gauges on HP pump, 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.
- FT-5: Transmitter manifold was checked & found ok.
- FT-33 and PT-18: Replaced old transmitters with new ones for better readability . Calibration of the transmitters was carried out.
- PRCV-23: Damper Cylinder Checked & Found ok.
- Following Thermocouples were Checked & Found ok.
- TI-0084, TIC-28, TI-651, TI-28.
- Following Thermocouples were Replaced with New one:-

- TI-077 to TI-084 North side Reformer tube of Primary Reformer.
- TI-109 to TI-116 South side Reformer tube of Primary Reformer.
- TI-0031, TI-0043, TI-8500, TI-0075 & TI-0117

- FRCV-1: Orifice physical condition was Inspected & found in good condition, re-fixed by Mechanical Maintenance.
- JBT-3: Internal Wiring was inspected.
- ZLL-SP3: Single pair cable for the switch was replaced from SP-3 to JBS-221, as the old existing cable was not giving proper connectivity.
- Pressure Switches for 115-JA Trip & AOP Start were replaced with new ones.
- Steam Drum (101F): Following instruments of steam drum were checked.
  - Level monitoring system- Level State.
  - Level transmitters.
  - Pressure Transmitters.
  - Level switches.
- General cleaning & Calibration were carried out of ISO & CDM related instruments.
- 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, UPSS & Gas Analyzers

YIL DCS

DCS shutdown maintenance activities were carried out as per the AMC procedure.

The following activities were carried out in Ammonia plant.

- Before starting preventive maintenance activities / AMC jobs, tuning parameters of all control stations were saved on Engineering station. Project back up was taken.
- Checking of System healthiness was carried out from System details display and found Normal.
- AC and DC voltages and Battery voltages were measured wherever applicable for all Stations and were found within limit.
- The system was dismantled as per plant clearance and operating conditions like dust, moisture and temperature were checked. All parameter were checked and found

within limits. Interior of system cabinets, ENGS and HIS consoles were cleaned thoroughly. PCBs were inspected and inspection of data bus and connectors were done. No abnormality was observed.

- Printers were cleaned/overhauled, wherever applicable. CPU back-up battery voltages and grounding were checked and the same were found within specified limits in all stations.
- Function of each component of the DCS was checked. YOKOGAWA diagnostic software was run on FCS, the results of the test Program indicated the healthiness of the system.
- Calibration of I/O cards of selected 2 cards in each nest was checked and found OK.
- 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.
- Total 24 nos. of TETC boards were replaced with new TETC boards. After replacement of boards, the functionality of TETC boards was found Ok.
- Centum VP software was upgraded to R5.01.10 in all HIS and Engineering Station after that the project was downloaded off-line to all FCS one by one.
- Latest project backup was taken on DVD media.

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.
- Prosafe-RS software version was upgraded to R2.03.00 in ESD Engineering Station.
- Logic for High Speed Trip of 107-JAT was developed and downloaded to CPU.
- Project backup was downloaded off-line to all SCS one by one.
- Latest Back up was taken on DVD media.

Fuji UPSS:

- Servicing of UPSS was carried out by IL service engineers. Air filters of all the cabinets were cleaned and the exhaust/cooling fans were checked. Voltage on all the test points was measured. Software data was checked by UPS loader & found ok.
- Full Load testing for the battery bank was carried out. Duration for that was 30 minutes.
- Electrolyte was poured into the cells wherever required. Finally voltage readings of battery bank as well as each batteries were taken (Total no of cells: 175).
- Load was transferred from UPS to AVR & vice versa. Operation was found ok.
- Fuse of AVR was failed. It was replaced with new one.

On line Gas Analyzer: ABB make CH_4 and CO_2 (AR-1 & AR-2) :

- Preventive maintenance of ABB make CO_2 and CH_4 analyzers were carried out. CO_2 and CH_4 analyzers were checked. Conditions of sample cells were good. Sensor CPU board, detector and cells were checked. Paper filters in sample system were replaced with spare ones. Sensors were cleaned.
- Manual Calibration of CO_2 and CH_4 analyzers were performed & found ok.

On line Gas Analyzer: O_2 and H_2 (AR-4 & ARC-3)

- Preventive maintenance of Oxygen analyzer AR-4 and Hydrogen analyzer ARC-3 was carried out. Cleaned sample path of AR-4 by flushing it with air jet. Cleaned sample conditioning system of ARC-3.
- Manual Calibration of O_2 and H_2 analyzers were performed & found ok.

CONTROL ROOM JOBS :

- Widening of Cable trench inside DCS Marshalling Room was carried out.

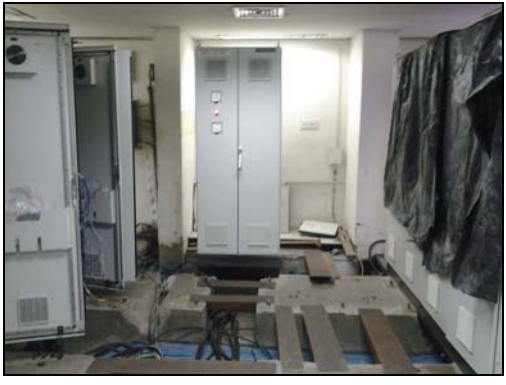
Widening and preparation of Cable trench inside DCS Marshalling Room

- Four nos. of new Earth pits were prepared. Two nos. of these earth pits were connected in parallel connection mode for the DCS/ESD system earthing and rest of the two were connected in parallel connection mode for the DCS/ESD cabinet earthing. Resistance of these Earth Pits arrangement were measured and the same were found within acceptable limits. The DCS and ESD systems were connected to the new Earth pits.
- Power cables for new Analog / Digital Marshalling cabinets were laid from C-210 and PDB cabinets.
- Fuses inside ESD Marshalling cabinet terminals were replaced with larger size fuses.
- TBs inside System Cabinets, Marshalling cabinets and Aux. consoles were tightened.
- 24V DC power supply to DCS/ESD Marshalling cabinets and Aux. Consoles were measured and found ok.

CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND

DCS MARSHALLING CABINET REPLACEMENT:

- Three nos. of Old Analog Marshalling Cabinets & three nos. of Old Digital Marshalling cabinets of Yokogawa DCS were replaced with New Marshalling Cabinets. Three nos. of Analog Marshalling Cabinets, one no of Digital Marshalling Cabinet & one Analog cum Digital Marshalling Cabinet were installed inside DCS Marshalling Room.



Replacement of DCS Marshalling Cabinets

- Old field cables were removed from TBs inside the marshalling cabinets. Then the cables were removed from cable glands. All old existing Pre-fab cables were also removed from Signal conditioning/Digital Boards as well as from related IO cards
- inside System cabinets C-210 & C-211.
- Old Marshalling Cabinets were removed from DCS Marshalling room one by one.
- New DCS Marshalling Cabinets were placed and erected inside the Marshalling room one by one. After that the cabinets were interconnected as per requirement. Three nos. of Analog Marshalling Cabinets, one no. of Digital Marshalling Cabinet and one no. of Analog cum Digital Marshalling Cabinet were installed. All three analog cabinets C101, C102 and C103 were interconnected in group. Two digital cabinets C111 and C112 also interconnected in group.
- New Relay boards, YRI32ADV and YRO32ADV, in digital Marshalling cabinet in C111 and C112 were provided. Digital input Card ADV159 and Digital Output card ADV559 were changed with new card ADV151 (Digital input) and ADV551 (Digital output) respectively for compatibility with the new relay boards.

Prefab Cable connections in DCS System

- Spare Analog Close loop cards (AAB841), mounted in FCS0102 at Node7 (Slot 3, 4) and in FCS0103 at Node 5 (Slot 3, 4), were lined up by connecting prefab cable for close loop Analog input ELCO board R1 and R2 in C111. Also, spare open loop analog input card AAV141 was lined up by connecting prefab cable to open loop analog input ELCO board R3 in C111.

- Pre-fab cable laying path was prepared, for protection of the cables, using aluminum cable tray and the new Pre-fab cables were laid from C-210 & C-211 to different Marshalling cabinets. Pre-fab cables were passed through plastic conduit between cabinets for entry in the cabinets. All new Pre-fab cables were connected at both ends.

- 09 nos. of old 12-pair signal cables from JB to Analog Marshalling cabinets were replaced with new 12-pair signal cables. The cables from JBC-22, 23,24,26,27,28,29,33 & 37 were replaced. Cable Laying, dressing, Cable glanding, related ferruling and termination jobs were carried out at both ends.

- Old damaged JB, JBC-37 was replaced with new one.

- All Field Cables were re-glanded in different Analog & Digital Marshalling Cabinets. Related ferruling work was carried out. All the Cables were terminated as per IOM details. Continuity checking of all new 12 pair signal cables were carried out.

- All Field Cables Glanding were done in different Analog & Digital Marshalling Cabinets and related ferruling work was carried out. All the Cables were terminated

as per IOM details. Continuity checking of all new 12 pair cable were carried out and their shield cable were connected with earth point..

- Power cables for new Analog/Digital Marshalling cabinets were laid from C-210 and PDB cabinets. The power cables were terminated inside Analog/Digital Marshalling Cabinets. Analog/Digital Marshalling Cabinets were powered on after checking voltage.

- Loop checking for all Analog/Digital loops was carried out.

- DCS-ESD inter connecting cable was replaced with a new cable. The cable was glanded at both ends. Related ferruling and termination job was carried out.

Terminal Server

A new Server PC called Terminal Server was installed and commissioned in Ammonia Control Room. Basically, the Terminal Server is a HIS installed in Ammonia Plant. It is connected on optical fiber network of integrated control system. Two nos. of L3 switches are connected in Urea Marshalling cabinet to connect it with all the three plants - Ammonia, Urea and Utility. The data from all plant areas (Ammonia, Urea, Boiler, and DM / WTP) of IFFCO Kalol are available on it. The graphics can be displayed in a remote PC connected through IFFCO LAN / WAN. A "Cisco" Firewall is installed in Ammonia control room to provide connection between Terminal Server and IFFCO LAN. Further it is connected to IFFCO WAN to provide the said data at HO.

CONTROL VALVES

MICV-1 TO MICV-9: All nine control valves were replaced with new Masoneilan make control valves with valve positioner. C/V Operation was checked and found ok.

TICV-60: Replaced old Masoneilan make control valve with new KOSO Make control valve. C/V Operation of was checked and found ok.

Guided Wave Radar (GWR) Level Transmitters

- LI-1: New GWR (Model: 705-510A) of M/s Magnetrol was installed for Steam Drum level measurement. The installation was completed by using necessary IBR certified mating flanges for this new instrument.

- LI-103JLT: New GWR, of M/s "Krohne" make, was installed for 103J Lube Oil Tank level measurement.

- LIC-23 (101U) New GWR of M/s "Krohne" make was installed for Deaerator level measurement.

EWR / SUGGESTION SCHEME / RECOMMENDATION COMMITTEE AND TECHNICAL DEPT. RELATED JOBS

- **EWR A-260**: Two no of 12 pair K-type Thermo couple cables were laid from JBT-26 to C-212 inside DCS marshalling room.

- **107 – JAT BREAK DOWN: Recommendation of committee**
  - **Relocation of FT-14 & FSL-14**:

    The new Orifice Plate was installed by General Eng. Section in new location at discharge of 116-JA / JB at upstream of 109 C and both the Transmitters were re-located near the new orifice plate. Transmitter mounting stands were installed, related wiring & impulse tubing jobs were carried out.
  - **Provision for high speed tripping of 107- JAT:**

    For two out of three logic for high speed tripping of 107-JAT, mounted two proximity type speed probe B and C along with the existing probe A. To line up both the new probes necessary cabling and frequency transducers were provided and its logic was generated in PLC.
  - **"Auto" start of 107- JA:**

    As per committee recommendation, logic of suction pressure permissive was implemented for "Auto" start of 107-JA on low discharge flow of 107-J.

CONTINUAL IMPROVEMENT:

New GWR (Model: 705-510A) of M/s Magnetrol was installed for Steam Drum level measurement in place of existing electronic type leveltrol.

Control valve Maintenance jobs

FRCV-1421: Valve was opened from the bonnet. Machining and lapping was carried out on the plug and seat. New gland packings and bonnet gasket provided. Finally control valve was assembled, reinstalled and stroke was checked.

LICV-1420: Valve was opened from the bonnet. Lapping was done on plug. Bonnet gasket was changed. All parts were cleaned & overhauled .Finally the stroke was checked.

LICV-1502B: Valve was removed from the line. Gland packings and bonnet gasket were changed. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

LICV-1807: Valve was removed from the line. Machining & lapping on the plug was done. Finally the stroke of C/V was checked.

HICV-1201: Valve was opened from the bonnet. Old gland assembly and bottom sleeve were replaced with new ones. Provided new plug with stem & bonnet gasket. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

HICV-1201 Old Removed Plug

HICV-1201 Old (Removed) & New Plug

HICV-1201 Plug and Bonnet Assembly

LRCV-1201: Valve was removed from the line. Its complete body, gland assembly & diaphragm were checked. Its plug and seat were repaired. Provided steam tracing. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

PICV-1129: Valve was opened from the bonnet. Machining was done on the guide. New gland packing was provided. Bonnet and seat gaskets were changed. Its action reversed from valve positioner. Finally the stroke of C/V was checked.

LIC-1501: Valve was removed from the line. The actuator was replaced with new one and gland packing was changed. Finally the stroke of C/V was checked.

LICV-1235: Valve was opened from the bonnet. Lapping was done. Provided new bonnet gasket & gland packing. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

PICV-1202: Valve was removed from the line. Lapping was done. Provided new bonnet gasket & gland packing. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

FICV-1282: Valve was removed from the bonnet. Lapping was done. Provided new bonnet gasket & gland packing. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

HICV-1206: Valve was removed from the line. Lapping was done. Provided new bonnet gasket & gland packing. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

PRCV-1201: Valve was removed from the line. Lapping was done. Provided new bonnet gasket, gland packing & diaphragm. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

PICV-1207: Valve was removed from the line. Lapping was done. Provided new bonnet gasket & gland packing. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

HICV-1102: New diaphragm was provided. General cleaning & stroke checking was done.

LRCV-1421: Valve was removed from the line. Provided new bonnet gasket, gland packing & diaphragm. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

HICV-1421: The three way valve was opened from the line, checked its condition, the valve body was replaced with spare one as its eflon sleeve needed replacement. The valve was reassembled, checked and fixed back.

LICV-1502A: Valve was opened from the bonnet. Its original actuator was replaced, in previous short shutdown, with a spare one. The original actuator was refixed in the valve as it was repaired and ready for service. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

LICV-1206: Valve was opened from the bonnet. Lapping was done. Provided new bonnet gasket. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

FICV-1351: Valve was opened from the bonnet. Provided new gland & bonnet gasket. All parts were cleaned & overhauled. Finally the stroke of C/V was checked.

PRCV-1504: The control valve operation and leakage from the actuator diaphragm was checked for proper operation and found o.k. General cleaning & stroke checking of the valve done.

PICV-1131: The control valve operation and leakage from the actuator diaphragm was checked for proper operation and found o.k. General stroke checking of the valve done.

LICV-1352: Valve was opened from the bonnet. New gland, diaphragm and seal ring were provided. General cleaning and stroke checking of the valve was carried out.

General cleaning & stroke checking of following control valves was carried out:

PICV-1128, FICV-1102, FRCV-1102, LCV-1101, PIC-1181, MICV-1101, HICV-1581, FICV-1284, HICV-1222A/B, PRCV-1202, LICV-1201, HICV-1425, PICV-1422, HICV-1481, FICV-1204, FRCV-1201 ,FICV-1303, FICV-1302, LICV-1352, FICV-1352, LICV-1353, PICV-1353, LICV-1351, TICV-1351, PICV-1351, FICV-1381, FICV-1382, LICV-1301, TRCV-1201, PICV-1201, HICV-1422, HICV-1202, HICV-1801, HICV-1802, HICV-1803, PICV-1810, LICV-1803, LICV-1805.

COMPRESSOR HOUSE JOBS

CO2 COMPRESSOR

- All bearing RTDs fixed in turbine, HP case, LP case & Gear Box were removed to facilitate mechanical jobs. They were checked and re-fixed after the completion of the jobs.
- Removed all Radial, Axial and key-phasor probes in turbine, HP case and LP case & Gear Box to facilitate mechanical jobs. After completion of the jobs, the same were re-fixed. Gap voltage adjustments for radial and axial and key-phasor probes were carried out.
- Following Trip and Alarm Switches were cleaned, checked and calibrated.

  PSLL-1801A, PSLL-1801B, PSLL-1801C,

  PSLL-1818A, PSLL-1818B, PSLL-1818C,

  PSLL-1838A, PSLL-1838B, PSLL-1838C,

  PSHH-1839A, PSHH-1839B, PSHH-1839C,

  PSHH-1843A, PSHH-1843B, PSHH-1843C,

  PSL-1816, PSL-1812, PSL-1813, PSLL-1844.
- Following low level and high level switches of separators & surface condenser were calibrated.

  LSHH-1804, LSHH-1806, LSHH-1808, LSL-1824, LSHH-1822 & LSL- 1823.
- Following level trolls were calibrated.

  LICT-1803, LICT-1805, LICT-1807 & LICT-1821
- FT-1811 flow transmitter was replaced with new one for achieving better performance.
- Mock up test from Woodward governor 505 E for HP and LP valves was done.

- Ferrule replaced for the compressor JB's & wire continuity testing done. All junction boxes were cleaned; terminals tightened and changed PVC cover for all Instruments.
- Provision of 24V DC through fuse TB was done in Local Control Panel & necessary ferrules were provided. Local Control Panel and turbine local control box were cleaned, all wiring connections were tightened.
- Valve LICV-1807 was removed from the line. Machining & lapping on the plug was done. Finally the stroke of C/V was checked.
- General cleaning & stroke checking of following control valves was carried out.

  HICV-1801, HICV-1802, HICV-1803, PICV-1810, LICV-1803, and LICV-1805.

FIELD JOBS

- Pressurized as well as empty count readings of LRC-1201 & LH-1201 detectors were taken.
- Autoclave & Stripper source were removed and installed back to facilitate mech. maintenance jobs.
- Batteries were replaced for N/C ratio meter signal converter unit , LRC- 1201, LH-1201 (HP Stripper indicators) & LR-1201 Master & Slave (Autoclave level indicators).
- Programming for N/C ratio meter signal converter unit, LH-1201 & its spare unit (HP Stripper) was checked.
- All HP Thermo wells were removed, hydro tested & checked by inspection department. Two new 2RE69 thermo wells were replaced for TR-1201 & TR-1206.
- Calibration of Mass flow meter at EQDC was done.
- New I/P converters were provided for the following control valves.

  LICV-1502B, LICV-1501, PICV-1201, LRCV-1201, TRCV-1201, TRCV-1202, HICV- 1422B, TRCV-1421.Stroke of the control valves were checked. Found ok.
- Installed a new orifice & flow transmitter for FI-1208 in place of existing vortex type flow meter. Installed new level transmitter LT-1206 and LICT-1352.
- Inspection of following magnetic flow meters was done:

  FRCT-1421, FICT-1203, FICT-1351, FICT-1352.
- Following extended pad type transmitters were calibrated.

  LIC-1421, LRCT-1421, LT-1421, LI-1282, LT-1202, LIC-1353 & LT-1481.
- Gasket replaced from Asbestos to Spiral one for the following.
  - All the thermo wells for 1st Desorber & Hydrolyser.
  - Transmitter PIC-1353 flange nozzle gasket.
  - Transmitter PIC-1351 isolation valve upstream & downstream gasket.
- All the thermo wells for 1st Desorber, Hydrolyser & TI-1701, and TI-1702 & TI-1423 were checked for erosion. All were cleaned & installed back.
- Following ISO Quality affecting instruments were calibrated.

  PT-1121, PT-1145, PT-1201, PT-1802, SI-1401A, SI- 1401B, FT-1201, PICT-1202, PT-1421 & PT-1105.

- Following level trolls were calibrated.

  LIC-1235, LIC-1501 and LIC-1203
- Calibration of following level transmitters was done.

  LICT-1501 (4 ata), LT-1501 (4 ata), and LICT-1502 (9 ata).
- Calibration of following Ammonia & Carbamate pumps pressure transmitters was done.

  PT-1102 A, PT-1192, PT-1102 C, PT-1201 A, PT-1201 B, and PT-1201 C.
- New thermo well was installed on vessel H-1815 (EWR Job).
- Provided new thermocouple for TR-1206 & a new SOV (HCO-1421) for HICV-1421.
- Calibration of radiac relay unit and its spare for LR-1201 (Autoclave level) were done.
- N/C Ratio meter monoblock valve was replaced by a spare one after hydro testingand inspection.
- Modification of scrubber weep holes tubing & Autoclave source and receiving side weep holes tubing were done.
- General checking, inspection and tightening for all the plant junction boxes were carried out.
- Painting & earthing on all Prill Tower top control valves were done.
- Painting on all other important control valves was done.

DCS RELATED CONTROL /MARSHALLING ROOM JOBS

- Replaced common radial & axial alarms wiring in vibration monitoring cabinet.
- Power cabinet ACDB of offsite plant was removed from marshalling cabinet room. Installed two new L3 switches in system cabinet <200> for Urea & boiler plants data transmission to Ammonia plant terminal server. Power supplies were provided to these switches from PDC121.
- Installed 01 spare node in system cabinet (cabinet no. <200>). Inter panel Wiring for 05 signal distributor (distributor model no.03 YBNM*10B and 02 YBNC*10B) were done.
- A new marshalling cabinet (cabinet no. <202>) installed for analog field inputs. Signal distributors wiring of cabinet 200 were diverted to this new cabinet <202>. All analog I/O & temp. Inputs wiring of cabinet <200> were terminated in marshalling cabinet <202>.
- Replaced 110V AC phase non fused TBs to fused TBs in cabinets <113> and <114>. Terminals tightening in DCS cabinets <200>& <201> was carried out.
- DCS System & Panel earth resistance were measured and the same were found within acceptable limits.
- The complete system was powered down and dismantled. All the hardware of FCS020I, FCS0501 HIS0260 to HIS0263 & Engineering station was cleaned and installed back. All the System, marshalling and vibration cabinets were cleaned. The system was powered up and taken online. After powering up, the 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 stations and it is found within limit.
- Checked overall System healthiness. Checked CPU, PSU, communication cards and bus redundancy and found working fine. Checked overall system functionality and found working normal.
- DCS software up gradation from R4 to R5 was carried out in all operator stations and Engineering station. All operator stations were loaded with anti-virus McAfee AV updates.
- Application Project backup was taken for DCS in DVD (two set). One set of backup handed over to M/s IFFCO and one set of backup kept by M/S YIL for their future reference.

OFFSITE & UTILITY PLANT
(INSTRUMENTATION)

BOILER PLANT

CONTROL VALVES:

- Following control valves were removed from line for complete overhauling.
- (Inspection/Maint of Seat/Plug, valve positioner, I/P Converter, Actuator diaphragm, land packing, cleaning of Air supply regulator, replacement of Gasket as required, C/V stroke checking etc.) LCV-5111, LCV-2905 (Replaced it's seat ring with new one)FICV- 4502 A (C/V was replaced with Fisher make c/v, earlier used in Naphtha Storage plant for temp. control), GHTV -'VIRGO' make ball valve was replaced with EL-O-MATIC make Trunion, type 6", ON-OFF ball valve.
- 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.) TCV- 4, LCV-01, LCV-02, HICV-5151 (I/P converter of TCV-4, HICV-151 and LCV-02 was replaced with new one.)
- Following control valve's preventive maintenance was carried out. (General cleaning and control valve stroke checking.) FCV-42, PCV-42, HICV-4401-B, PCV-3, LCV-3, PICV-25, FRCV-22, LRCV-4, TCV-25 and FCV-1 (100% BFW), FCV-2 (30%).

FIELD JOBS

- F.D. Fan & BFW pump turbine related field inst. were removed for mech. maintenance job and same were installed back.
- FD fan turbine, SV-Q-5113 trip solenoid valve was replaced with new one.
- New O2 Analyzer sensor was removed from line and re fixed after shortening pipe length.
- Cleaning of 8 nos. of Furnace draft points, PSH-11and PSH-12.
- Pressure Gauges PI-2, PI-3, PI-4 and PI-5 were calibrated w.r.t. Boiler inspection.
- RAH pneumatic motor air supply line filter lubricator was cleaned and refilled lubricator with oil.
- Flushed air header of Boiler and DM Plant area and also checked joints for leakages.
- TR-13 Furnace Temp. T/C was replaced with a new one. Installed new K-type T/C. TR-13A at the bottom side of existing TR-13 as standby.
- Following Damper's limit switches, solenoid valves, air regulators etc. were overhauled and checked their operation.
- FD. fan inlet damper and F.D. fan outlet damper. Air heater inlet damper and air heater outlet damper.
- Checked and calibrated ISO instruments as per schedule.
- Following field switch set value were checked:

- Furnace Pressure, PSH-11 (alarm - 300 mm wc) & PSH -12 (trip - 350 mm wc)
- Installed new redundant switch PSH-12A near existing PSH-12.
- LSLL-1 of steam drum level.
- Following Pressure switches set value were checked:

  P-5112 (BFW pump - motor driven): PAL-5115, PLCI-5114, PLCO- 5113, PLCI-5115 and PAL-5113

  P-5111 (BFW (turbine driven): PAL-5114, PLCI-5113, PLCO- 5112, PLCOI-5111, PLCI-5112 and PAL 5112

STEAM DRUM :

- "High tech" make steam drum level indicator electrodes were checked and all the terminals were tightened.
- Field junction boxes (BM-13, BM-15, BM-10-1,BM-12,BM-11,BM-5,JBC-9A ,JBC-9, TJB-1, JB, BM16-2 and BM-14 were cleaned and tighten terminals.
- Deaerator high level switch LAHH-5111 was repaired and fixed back. It was taken in service (Switch logic from LRC-4 transmitter was de linked).
- New T/C for secondary super heater coil No. 36 were installed. Trend of secondary super heater coil thermocouple TI-30-17 and TI-30-36 were defined in DCS.
- Burner-1: Replaced the solenoid valve of BTV -1- 4B to solve its passing problem.
- PT-5151 was relocated at suitable place and carried out it's impulse line tubing.
- New Oxygen Analyzer electrode (Length-500mm) was installed.

IGNITORS:

- Cleaning & checking of both the burner's igniter and scanner was carried out. (BNR#1, Ignitor cable was replaced with new one as it was not working)

CONROL ROOM JOBS:

- Filter cleaning of all the DCS cabinets were carried out. Replaced 2 nos. of Exhaust Fans.
- Carried out AMC jobs for DCS / PLC.
- Upgraded the CENTUM VP software version from R4.02 to R 5.01.10 which is compatible with Windows 7 OS and installed Antivirus software in HIS PC.
- HIS0361 OS restored from "DELL" restore backup available in Hard disk. Reloaded the Centum VP software and downloaded the Application Program. (This is done to solve the HIS0361 had problem of frequent hanging).
- Selector switch in Graphic provided to select the transmitter input to controller in Air Flow, Steam Flow and BFW Flow transmitters.
- Deaerator flow valve operation normalized with High Level switch after the switch was rectified. (Earlier Valve operation logic was through HH alarm level of LRC-4)
- Established the Boiler DCS connectivity with Terminal Server located at Ammonia plant to transfer boiler Graphic pages at H.O.

- New Tags TI-30-36 (Sec. Super Heater Coil No. 36 Temp.), TI-13A (Furnace Thermocouple-K-T/C) configured in DCS.
- New Report Page “DAILY-5” generated as per operation requirement.
- Checked the DCS redundancy. Found OK
- Taken up the application project back up in DVD.

D. M. WATER TREATMENT PLANT:

- FT-2003, Narmada / Raw water inlet to DM plant flow impulse lines were replaced with new one.
- Orifice installation for measurement of individual flow to ACF-1, 2, and 3 was done by general Engineering Section.

UPSS: EMERSON make 2 x 60 KVA:

- Installed new ACDB panel in DM plant Marshalling room for distribution of power from UPSS to Boiler and D M plant DCS system. Connected UPSS output with the ACDB panel. Power cable was laid from ACDB panel to Boiler D.C.S PDB and D.M. DCS PDB cabinet. Disconnected UPSS power coming from Urea plant MCB to Boiler DCS PDB and connected power from ACDB panel.

  AMC related work for ‘EMERSON’ make 2 x 60 KVA UPSS was carried out by Service Engineer from EMERSON Network Power System Ltd. Performance of UPSS was checked successfully with draining of battery for about two Hrs.

D.M. WATER TREATMENT PLANT DCS RELATED AMC JOB:

- Filter cleaning of all the DCS cabinets was carried out.
- Upgraded the CENTUM VP software version from R4.02 TO R 5.01.10 which is compatible with Windows 7 OS.
- Antivirus soft ware installed in HIS PC.
- HIS0360, HIS0359 OS restored from “DELL” restore backup available in Hard disk. Reloaded the Centum VP software and downloaded the Application Program. (This is done to solve the HIS0359, HIS 0360 had problem of frequent hanging).
- Printer driver re-installed and lined up the printer.
- Checked the DCS redundancy. Found OK
- Taken up the application project back up in DVD.

AMMONIA / NAPHTHA STORAGE AND HANDLING AREA:

- General cleaning/ stroke checking of LCV-3058B, LCV-3051B, LCV-3055B, PCV-3065B, PCV-3064B, PCV-3009 valve was carried out.
- V-Automat make level transmitters LIC-3058A, LIC-3053A, LIC-3055A, LIC-3051A were calibrated.
- SH-3063A, PSH-3057A, PSH-3060A, PSL-3071A & PSLL-3072A Press Switches were cleaned and checked for their set value.

COOLING TOWER:

- Q- 4411 (Elliott Turbine.) All radial vibration probes, speed pick-up probe, local THI & PI were removed & reinstalled to facilitate mech. maint.
- Q- 4411 (Elliott Turbine.) lube oil press. Switches PS-01, PS-02 & PS-03 were
- relocated at suitable place. Cleaned & checked all the switches for its set value.
- 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.
- Carried out general cleaning and stroke checking of LCV-01, LCV-02, MICV-4401B, FCV-01, HICV-5153 and HICV-5154.
- Disconnected tachometer, PI/TI from P-4402 for mech. maintenance. jobs and reinstalled after mech. maintenance.
- Cleaning of control panel & tightening of all terminals inside panel was carried out.
- Checked operation of PSH-01 (Q-4411-Elliott turbine exhaust. Press. high trip switch)
- Checked LT-01, CT basin level electronic Transmitter.

I.G. PLANT:

Servicing and calibration of ABB make H2 analyzer of new I. G. Plant was carried out by Service engineer from M/s ABB in our presence.

- P4203A & P4203B related logic was changed over to P4203B & P4203C. i.e. pressure switch of P4203 A is shifted to discharge of P-4203-C. Now P-4203 C will start at low pressure of P-4203 B. P-4203 A can be started / stopped manually.
- Attended all running jobs.

WEIGH BRIDGE (40 MT):

- Ashbee make Weigh bridge maintenance was carried out by service engineer from M/S Ashbee Systems. Calibration of Weigh Bridge was carried out with standard weights. Stamping of the weigh bridge got done. Painting of platform was also carried out.

B & MH PLANT
(INSTRUMENTATION)

PBL make Bag filling m/c: P/S No. : 1, 2 , 3, 4 , 7, 8 , 9A , 9B ,10 A & 10B

- Cleaning and tightening of terminals in local , load cell junction box and proximity Switch junction box of all the p/s was carried out. Provided lugs in solenoid box where required.
- P/S No. 9 & 10: Hopper level s/w was cleaned and checked its operation.
- Diverter 1 & 2: Cleaned solenoids, relay, limit switch etc. and checked its function.
- Checked wiring terminals in the main panel, local panel, Solenoid boxes, and Load cell boxes.
- Cleaned and checked CSC-25, relay board, fuses, solenoid valves and all sensors.
- Checked functioning and calibration of all Packer Scales.

"Mettler - Toledo" Make Weigh Scales:

- Carried out cleaning & calibration of Mettler weigh scales located at railway platform and empty bag storage area. Cleaning & painting of all Mettler weighing scale's platform was done.

DUST EXTRACTION SYSTEM:

- Cleaned the Dust Extraction plant panel and all field instruments (C/V, Flow Tx, Level Transmitter,etc.)

EFFLUENT TREATMENT PLANT:

- Cleaning of sampling system and calibration of Ammonia analyzer were carried out.
- Attended routine running jobs.

NARMADA WATER TREATMENT PLANT DCS / PLC RELATED AMC JOB

- Filter cleaning of all the DCS cabinets were carried out.
- Upgraded the CENTUM VP software version from R4.02 TO R 5.01.10 which is compatible with Windows 7 OS and installed Antivirus software in HIS PC.
- HIS0458 OS restored from DELL restore backup available in Hard disk. Reloaded the Centum VP software and downloaded the Application Program. (This is done to solve the VF702 network detection problem after version up gradation). Still, V-Net Card failure was occurring. Hence, provided new HIS PC after loading DCS software. Also replaced VF702 Card with new one.
- Linux Software configured to transfer the DCS tags indication between Boiler/DM and Narmada DCS
- Printer driver re-installed and lined up the printer..
- Checked the DCS redundancy. Found OK
- Taken up the application project back up in DVD.

ELECTRICAL

AMMONIAPLANT
(ELECTRICAL)

PREVENTIVE MAINTENANCE OF TRANSFORMERS

Preventive maintenance of transformers TR-21, TR-6, TR-22 and TR-Start-up heater was carried out and the job details are as under:

- Inspection of primary and secondary cable boxes, end termination, checking and tightening of connections.
- Recommended Testing & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
- Alarm & tripping contacts of Buchholz relay and MOG were checked.
- Condition of silica gel was checked. Accordingly discharged silica gel was recharged.
- Oil leakages from the transformers were attended and damaged gaskets were replaced.
- Painting of transformers TR-21 & TR-22 to protect it from corrosion for lengthening its life.

REPLACEMENT OF EMERGENCY PUSH BUTTON OF TRANSFORME

- Preventive maintenance carried out on all the feeder compartments in MCC-5, MCC-5A, MCC-5 B & MCC-16 and the job details are as under:
  - Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders.
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts etc.
- Overhauling of following motors was carried out:

  104J,104JA,104JT,104JAT,107JT, 101BJT 115JA, 115JB, 117J, 117J LOP, 118J, 118JA, 118JB, 121J, 121JA, 170J, 170JA, 2001LJ, 2001LJA, 2002 LJ, 2002 LJA, 2004 LJP, P-172 J, P-172 JA, P-1, P-2, PC-2A, PC-2B
- Preventive maintenance of actuators carried out for the following MOVs and tested with their interlocks (If any):

  SP1, SP3, SP4, SP5, SP70, SP71, SP151, SP152, SP 154, SP 156 and SP 158 & SP 159.
- Testing and calibration of power analyzer installed in MCC-16 for 117J compressor have been carried out.
- Testing and Servicing of L&T Air Circuit breakers were done in respective MCCs.
- Testing and calibration of protective relays installed in MCCs and substations were carried out
- Modification in AC power circuit of ammonia control room.

UREA PLANT
(ELECTRICAL)

Modification and New Installations

Modification in AC power circuit of urea control room

Scheduled Preventive Maintenance

- Preventive maintenance of transformers TR-17, TR-18, TR-20, and TR-7B & TR-7A.was carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connections.
  - Recommended Testing & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked.
  - Condition of silica gel was checked. Discharged silica gel was recharged.
  - Oil leakages from the transformers were attended and damaged gaskets were replaced.
  - Painting of transformers TR-20 & TR-18 to protect it from Urea solution & corrosion for lengthening its life.
- Preventive maintenance of the all feeder compartment in MCC 6, MCC 14, and MCC 15 were carried out and the job details are as under:
  - Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders.
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts, etc.
- Complete overhauling of following LT motors—

  K1401/1, K1401/2, k1401/3, k1401/4, K1701, K1702, M1402/1&2, M-1403/1, M1403/2, M1403/3, M1419, M1421, P-1401/A, P-1401/B, P-1402, P-1408, P-1501, P-1506
- Preventive maintenance of actuators of following MOVs was carried out: MOV 1101, 1102, 1201, 1202, 1203, 1501 & 1801
- Preventive maintenance of LT Air circuit Breakers of Siemens & L & T make, installed in MCC 14 & 15 was carried out.
- Testing and calibration of protective relays installed in MCCs were carried out.

Modification and New Installations

- Revamping of MCC-2 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.
  - Performed Testing, commissioning and installation of new panel and relocated all power and control cables connected from old MCC panel to new panel.
  - Old MCC sec B was removed.

Scheduled Preventive Maintenance

- Preventive maintenance of transformers TR-2A, TR-2B, TR-3A, TR-3B, TR-8, TR-11, TR-12, TR-13 TR-14, TR-16 and TR-23 was carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
  - Recommended Testing & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked.
  - Condition of silica gel was checked. Discharged silica gel was accordingly recharged.
  - Oil leakages from the transformers were attended and damaged gaskets were replaced.
  - Painting of transformers TR-2A & TR-3B to protect it from corrosion for lengthening its life.
  - Modification in control circuit of MCC 13 HT breaker
- Preventive maintenance of the all feeder compartment in MCC-1, MCC-2B/2E, MCC-11 and MCC-13 was carried out and the job details are as under:
  - Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts, etc.

- Overhauling of the following LT motors was carried out:

  P-5113, P-4406, P-4405/B, P-4412, P-4411/B, P-5118B, P-5118A, P-5119, P- 5117, P-5111/A, P-5111/B, P-5112/B, P5112/A, P-5116, P-5120, FD Fan

- Servicing of all FL2(MAIN), FL2(BYPASS), S2 (MAIN), S2 (BYPASS), S5, S6, 4403(700), 4403(900), 4401/A, 4401/B, 4401/C, 4401/D, 4402 Rotork make actuators installed in utility plant were carried out.

- Preventive maintenance of LT Air circuit Breakers of Siemens & L & T make installed in MCC 1, 2, 2F & 13 was carried out.

- Testing and calibration of protective relays installed in MCCs and offsite were carried out.

OFFSITE

SCHEDULED PREVENTIVE MAINTENANCE

- Preventive maintenance of transformers TR-1A, TR-1B, TR-15 and TR-4A, TR-4B, TR-DG set was carried out and the job details are as under:

  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.

  - Recommended Testing & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.

  - Alarm & tripping contacts of Buchholz relay and MOG were checked.

  - Condition of silica gel was checked. Discharged silica gel was recharged.

  - Oil leakages from on the transformers were attended and damaged gaskets was replaced.

- Servicing of CTR make On Load Tap Changer of transformer 1 B.

- Preventive maintenance jobs were carried out in 66 KV switchyard:

  - Cleaning of insulators of all the CT & PT units, bus bar support, lightning arrester, breakers, etc.

  - Insulation Resistance was measured of all the CTs & PTs.

  - All the moving parts of isolators were cleaned and lubricated.

  - 11 KV VCB panels were cleaned and outgoing cable terminals were checked for its tightness or hot spot.

  - Maintenance of SABARMATI isolator was carried out.

- Preventive maintenance jobs were carried out in 11 KV MPSS Jyoti & Siemens Panel.
  - Checked the tightness of outgoing terminals.
  - Thoroughly Cleaned the feeder compartment of both Jyoti and Siemens panel
  - Replaced damaged /worn out contacts, etc.
  - Checked power & control circuit connections in the feeders.
- Preventive maintenance of the all feeder compartment in DG MCC, MCC-3, MCC-10, MCC-10 A and Jaspur MCC was carried out and the job details are as under:
  - Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders.
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts, etc.
- Servicing of Chabhi make Battery & Battery charger in 11 KV MPSS.
- Servicing of 6101, 6102, 6201, 6202, 6203, 6204, 6207, 6208, 6209 Rotork make actuators installed in utility plant were carried out.
- Preventive maintenance and servicing of HT Siemens make Breakers installed in 11KV MPSS Siemens panel were carried out.
- Testing and calibration of protective relays installed in MPSS, 66 KV Switchyard and DG set panel were carried out.

B & MH PLANT
(ELECTRICAL)

Modification/New Installation

Installation of GI cable tray in Silo new reclaim machine

Scheduled Preventive Maintenance

- Preventive maintenance of transformers TR-5A, TR-5B was carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
  - Recommended Testing & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.
  - Alarm & tripping contacts of Buchholz relay and MOG were checked. Servicing of Buchholz Relay of transformers was carried out.
  - Condition of silica gel was checked. Discharged silica gel was recharged.
  - Oil leakages from on the transformers were attended and damaged gaskets was replaced.
- Preventive maintenance of the all feeder compartment in MCC-4 and MCC 4A (New &Old) was carried out and the job details are as under:
  - Checked the tightness of cable, wiring terminals and power & control circuit connections in the feeders.
  - Thoroughly cleaned the feeder compartments.
  - Replaced damaged/ worn out contacts, etc.
- Overhauling of following LT motors was carried out

  M210, M2112, M-2117, M2121, M2122, M2122-A1, M2122-A2, M2161
- Testing and calibration of protective relays installed in MCCs were carried out.
- Maintenance of all Rope switches of all conveyors.

Non plant

Scheduled Preventive Maintenance

- Preventive maintenance of transformers TR-10A and TR-10B was carried out and the job details are as under:
  - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
  - Recommended Testing & Measurement of parameters like Insulation resistance, BDV of transformer oil was carried out on each transformer.

- Alarm & tripping contacts of Buchholz relay and MOG were checked. Servicing of Buchholz Relay of transformers was carried out.
- Condition of silica gel was checked. Discharged silica gel was recharged.
- Oil leakages from on the transformers were attended and damaged gaskets was replaced.

- Preventive maintenance of LT Air circuit Breakers of L & T make installed in MCC and township MCC was carried out.
- Testing and calibration of protective relays installed in Township substation were carried out.
- Replacement of old, damaged, corroded power socket boxes of old reclaim machine with new sockets

CIVIL

AMMONIA PLANT
(CIVIL)

- Repairing of Refractory lining for Primary Reformer and Auxiliary boiler.
- Repairing of Refractory lining for Secondary Reformer.
- Dismantling and Excavation for cooling water pipe line repair.
- Dismantling Brick work and PCC for laying Electrical Panel in MCC-2E.

UREA PLANT
(CIVIL)

- Fixing of new SS door at scraper floor of Prill Tower in urea plant.
- Repairing of Damaged Foundations in urea plant (Epoxy coating provided)
- APP Water proofing on 7A & 7B Transformer top floor in urea plant
- Epoxy Nozzles grouting in scrapper floor at bottom of prill tower
- Epoxy paint in Bucket room of Prilling Tower.
- Bitumastic lining on flooring of Prill Cooling System.
- I.P.Net coating of M-2110 conveyor gallery in Urea plant.
- Application of Epoxy paint & Epoxy plaster in Urea solution tank.

OFFSITE & UTILITY PLANT
(CIVIL)

OFFSITE PLANT

- Required bitumastic lining in strong & weak effluent storage tanks.
- Acid proof brick lining for Effluent Storage tank in ETP.

UTILITY PLANT

- Bitumastic lining on flooring of D. M. Plant area.
- Provision of Drain chamber and fixing of valve for basin draining in new CT.
- Fixing of new sluice gate for Cooling water pumps P-4401-C and P-4401-D suction sump.
- Repairing of wall plasters of Ammonia and Urea Cooling Tower basin.
- Cooling Tower basin wall crack filling carried out by chemical grouting.
- Replacement of water proofing plywood sheets on deck slab of Urea, Ammonia & New Cooling Tower.
- Repairing of Refractory lining in BHEL boiler.

B & MH PLANT
(CIVIL)

- Tiles fixing on wall and room at 2nd floor of bagging plant.
- Epoxy painting on wall and slab bottom at bagging 1st and 2nd floor.
- S.S. Railing provided in silo conveyor gallery (M-2117).
- Provision of Monolithic Plaster on Hoper floor and columns at bagging 1st & 2nd floor.
- I.P.Net coating on conveyor gallery, column and slab bottom at bagging plant.
- Plaster repairing carried out at various locations in bagging plant.
- White wash and Snowcem painting work inside and outside of for bagging 1st floor.

OTHER MISCELANIOUS JOB IN PLANT

- Dismantling brick wall for AC duck fitting in MPSS room near Ammonia Control room.
- Removal of debris from various locations of plant.

TECHNICAL

INSTALLATION OF 8" SIZE BYPASS LINE TO FICV-14 WITH ISOLATION VALVE :

(Ref. Process Scheme TM/02/1200,Dt.18/08/2011)

Following problems were being faced in CO_2 removal systems due to two phase flow :

- Vibration in liquid inlet line and flow control valve FICV – 14,
- Damage to CO_2 stripper liquid inlet nozzle,
- Damage to liquid distributor and its support clamps in CO_2 stripper.

During normal plant operation, with 100% opening of FICV – 14, pressure drop across FICV – 14 is about 1.3 kg/cm^2 against the design pressure drop of 0.4 kg/cm^2. So to reduce pressure drop across FICV – 14, which in-turn will reduce the vibration problem inlet pipeline to CO_2 stripper and FICV – 14, an 8" size bypass line across FICV -14 with isolation valve (Globe valve) is installed.

Following material have been procured for above job :-

- Pipe , 8"xSch40,SS304 vide P.O. No. 201004120008Dt.29/12/2011 from M/s Calico
- Elbows (8" NB) from M/s Paras fittings vide P.O. No. 201004120051Dt.02/01/2012
- Unequal tee (10"x8" NB) has been procured from M/s Tubeline fabricator Mumbai vide P.O. No. 201004120443Dt.16/02/2012
- Uneqaul tee (14"x8"NB) has been procured from M/s Swastik Llyods vide P.O. No. 201004120054Dt.02/01/2012
- Globe Valve (8"x300#) from M/s Star Engineers vide P.O. No. 201004120034Dt.31/12/2011.
- Flanges have been used from the stock available from Kalol Unit's store.

8" size bypass line to FICV – 14 with isolation valve

The above job have been carried out by M/s J&J vide W.O. No. 201004120118Dt.12/01/2012.

Advantage of above scheme :

Installation of 8" bypass valve to FICV-14 will reduce pressure drop across the FICV-14 and will reduce Vibration problem in aMDEA line and FICV-14.

With reduced pressure drop with bypass across FICV-14, pump head to be generated will reduce and will lead to operation of 116-JA at a lower speed of about 1300 rpm compared to present operation at 1400 rpm.

In addition to reduction in vibration problem, installation of 8" bypass valve to FICV-14 will reduce the energy requirement in 116-JAT and save MP steam.

FICV-14 D/S LINE SUPPORT REACTIFICATION AND SUPPORTING STRUCTURE STRENGTHING :

With reference to PDIL's drawing no. 4132-1012-6324-MEA-7, Support No. S-11, S-28, S-29, S-30, S-31 have been restored as per drawing with respect to rest, guide or fix. All flimsy structures have been fixed properly for carrying the supports.

FICV-14 d/s Line support rectification

Advantage:

With rectifications of supports in downstream line of FV-14, vibration problem in this line has been reduced within acceptable limits.

INSTALLATION OF FI-14 IN PUMP DISCHARGE LINE :

Semi lean aMDEA solution is pumped by 116-JA/JB through 109-Cs and FV-14 to CO_2 stripper (102-EB). Presently FI-14 orifice installed in the system is that of originally installed for MEA system and the design details for FI-14 is also that given in MWK data-sheet.

FI - 14 is installed at downstream of 109-C at upstream of FV-14. Flow indicated by FI-14 is much higher compared to lean aMDEA flow by FRC-5 and higher due to CO2 dissolved in it and two phase flow thru FI-14.

To reduce the effect of two phase flow on FI-14, new orifice designed as per the properties of aMDEA installed at the upstream of 109-C with lesser pressure drop across the orifice.

Advantage :

A new flow orifice FI-14 is installed on MDEA – 1210.03-8" (discharge line of 116-JA/JB at upstream of 101-L filter) for improving the accuracy of flow measurement.

Installation of FI-14 in 116-JA/JB pump discharge line

The above job have been carried out by M/s J&J vide W.O. No. 201004120118Dt.12/01/2012.

Specifications of orifice plate assembly :

The orifice plate assembly have been procured from M/s Micro Precision Products vide P.O. No. 20110510Dt.12/09/2011.

ORIFICE PLATE TYPE

1.1	Type	Concentric, Square edge
1.2	Inst. Tag No.	FI-14
1.3	Tag Plate	shall be welded to orifice plate by employing TIG welding and shall be of same material.

DATA SHEET FOR ORIFICE PLATE

2.1	Orifice Design	As per ISO-5167-1 Standard
2.2	Fluid /service	aMDEA Solution to CO2 stripper
2.3	Maximum Flow	540 m3/h
2.4	Up-stream pressure	4.9 Kg/cm2g (max)
2.5	Density	1054 Kg/m3 at operating Pressure
2.6	Viscocity	1.5 cp
2.7	Differential Pressure	5000 mm WC at Maximum flow
2.8	Fluid Temperature	85 Deg. C
2.9	Pipe size and Sch.	8 ", Sch.10S
2.10	Material of Plate	SS316
2.11	d/D Ratio	0.7 (approx)

DATA SHEET FOR ORIFICE FLANGES

3.1	Type	Weld-Neck RF
3.2	Size	8"
3.3	Rating	300 #
3.4	Dimensions	As per ANSI B16.5
3.5	Drilling	As per ANSI B16.36
3.6	Material	ASTM- A182 F304
3.7	Pressure Tapings	Two tapings, 180 Deg. Apart, ½" NPT (F) with Plug on each Flange
3.8	Gaskets	Spiral wound, SS304, CAF
3.9	Pipe Schedule	10S

6"NB TAPPING WITH ISOLATION VALVES FOR WATER RING VACUUM PUMP.

Since commissioning of Ammonia Plant, problem of low vacuum in surface condenser (101 JCA/JCB) is faced. In summer months with Cooling Water temperature of more than 32 deg C, vacuum achieved in surface condenser (101-JC) is in range of 635 to 645 mm Hg (Design : 671 mm Hg). So, to improve the vacuum in surface condensers it is decided to install water ring vacuum pump for which two 6" tappings, with isolation valve are taken in both surface condensers (101 JCA/JCB).

The above job have been carried out by M/s Smitha Engg. vide W.O. No. 201004120125. All the material for the above tappings have been arranged from the available stock from Kalol Unit's store.

50 mm NB DRAIN WITH ISOLATION VALVE AT SHELL SIDE OF 131-JC

Presently, there were two 1" condensate drains lines with traps on shell of 131-JC. During monsoon, condensate draining limitation has been faced with existing two 1" drain lines.

Therefore, one 50 NB drain with isolation valve from shell side of 131-JC for condensate draining has been provided in case of limitation of existing trap / drain lines similar to other two inter stage coolers (129-JC & 130-JC).

The above job have been carried out by M/s J&J and material have been taken from the available stock at store.

PROVISION OF COOLING WATER INLET LINE TO 137-C FROM 101-JCA OUTLET.

(Ref. : Suggestion No. SS/AMM/11/24,Dt.13/11/2011)

Kick back cooler (137-C) was installed at downstream of FICV-15 during ESP with syn gas repiping to cool the syn gas compressor discharge gas to 103-J suction. Presently CW inlet tapping for 137-C was from 127-C outlet (i.e. 101-JCA inlet header) and its outlet tapping is to 101-JCA outlet header.

As during normal plant operation, there is no load on 137-C and CW flow through it remains unused, so to improve vacuum of 101-JCA during summer months, re-routing of the CW lines for 137-C was undertaken, in which CW inlet tapping was taken from 101-JCA CW outlet header.

Cooling water Inlet line to 137-C from 101-JCA outlet

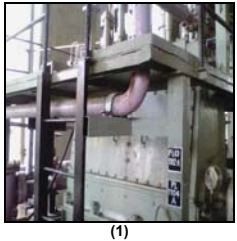
The above job have been carried out by M/s Smitha Engg. vide W.O. No. 201004120125. All the material for the above tappings have been arranged from the available stock from Kalol Unit's store.

SUPPORT REACTIFICATION IN COMMON DISCHARGE LINES OF HP AMMONIA AND CARBAMATE PUMPS

HP Ammonia Pump Discharge line support rectification

In Urea Plant, there are three reciprocating HP Ammonia Pumps. Out of these three reciprocating pumps installed for Ammonia service, two pumps remain in operation and one pump is kept standby. High vibrations were being observed in piping of HP Ammonia pumps when one Triplex Single Acting Plunger Pump (P-1102-C, F. Peroni Model), along with any one Quintuplex Single Acting Plunger Pumps (P-1102-A/B, Deutsche Worthington Model) remain in operation and other Quintuplex is kept standby.

So, to control the high vibrations in the piping system of HP Ammonia Pumps, major pipe support rectification job was carried out, in which heavy duty structural steel (ISMC 150, box section) is used for strengthening the existing supports & U-bolt pipe supports (which were insufficient to arrest the vibrations in piping system) were replaced with pipe clamps, and additional heavy duty structural steel supports (ISMC 150, box section) with pipe clamps were also provided in the piping system as per the recommendations given by consultant (M/s Systec).



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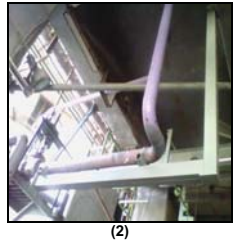

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HP Ammonia Pump Discharge line support rectification

HP Carbamate Pump Discharge line support rectification

In Urea plant, there are three reciprocating HP Carbamate pumps. Out of these three reciprocating pumps installed for Carbamate service, two pumps remain in operation and one pump is kept standby. High vibrations were being observed in piping system of HP Carbamate pumps when two Triplex Single acting Plunger pumps (P-1201 A/B, Deutsche Worthington Model) remain in operation and one Quintuplex Single Acting plunger pump (P-1201 C, F. Peroni Model) is kept standby.

So, to control the high vibrations in the piping system of HP Carbamate Pumps, major pipe support rectification was carried out, in which heavy duty structural steel (ISMC 150 box section) is used for strengthening the existing supports, U-bolt pipe supports (which were insufficient to arrest the vibrations in piping system) were replaced with pipe clamps and additional heavy duty structural steel supports (ISMC 150 box section) with pipe clamps were also provided in the piping system as per the recommendations given by the consultant (M/s Systec) in their report.

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1,2,3,4,5 & 6 : HP Carbamate Pump Discharge line support rectification

INSTALLATION OF ORIFICE FLOW PLATES IN THE INLET OF ALL THE THREE OLD ACTIVATED CARBON FILTERS (REF. EWR No. : WT-92)

In present system turbine type flow meters were provided in inlet of all the three ACFs which were not working properly. Therefore flow meters in inlet lines of all the three ACFs have been provided with piping modification to take care of u/s and d/s dimensions of flow orifice.

Advantage :

It will help to maintain proper flow in all the units during service cycle as well as regeneration. It will also indicate reduction in flow if any of ACF laterals are broken and outlet conical filter is choked.

Installation of Orifice Flow Plates

Provision of individual drain at new CT cell no. 3. (Ref. EWR CW-102)

In new cooling tower basin drains are provided with isolation valves for CT cell no. 1 & 2 . There is no drain for CT No. 3

Therefore to facilitate draining of all CT cell of new tower to open channel, 4''NB drain has been provided in third compartment with isolation valve.

The job of laying 8'' NB pipe line upto open channel will be carried out in running plant.

Above modification will facilitate total emptying of basin during annual turnaround and basin drain from any CT cell as and when required without spoiling CT area.

Drain at New CT cell no. 3.

OFFSITE PLANT

TAPPINGS FOR HOOK UP OF NEW AMMONIA TANK (T-3501) :

During Annual Turnaround 2012, four nos. of new tapping connections (Out of total 11 nos. of tapping connections) were taken from the existing piping network in Ammonia storage area for hooking up the New Ammonia Storage Tank (T 3501) with the existing Ammonia Storage System.

The various P.O.s and details of above four tapping connections are as under :-

Details of P.O.:

Sr. No.	Item	P.O. No.	P.O. Date	Vendor
1	LTCS Pipe	201004120003	29/12/2011	M/s National tubes
2	LTCS Fittings	201004120048 201004120050 201004120051	02/01/2012	M/s Dee Development M/s Mechwell fittings M/s Paras fittings
3	LTCS Flanges	201004120078 201004120209 201004120081	03/01/2012 13/01/2012 03/01/2012	M/s Techno forge M/s Techno Forge M/s Sanghvi Forging
4	LTCS Gate and check valves	201004120083	29/12/2011	M/s BDK

Details of tappings :

8" Tapping connection (TP- 3506) on Liquid Ammonia Line from Plant to Tank (MA-3102-150-B7)

8" NB tapping connection **(TP 3506)** with isolation valve (Gate Valve) of size 8" x 300# taken in line no. **MA-3102-150-B7 (Liquid Ammonia line from Plant to existing Ammonia tanks).** This tapping was taken after installing an expander of size 6" x 8" in line no. **MA-3102-150-B7** and an additional isolation valve (Gate valve) of size 8" x 300# is also provided in the existing line.

8" Tapping connection (TP 3512) on Ammonia Vapour Line to Ammonia Plant (MA-3151-300-B7)

8"NB tapping connection **(TP 3512)** with isolation valve (Gate Valve) of size 8" x 300# taken in line no. **MA-31521-300-B7 (Ammonia vapour line to Ammonia Plant).**

8" Tapping connection (TP 3512)

6" Tapping connection (TP-3511) on Pump discharge line to Urea (MA-3121-150-C4)

6"NB tapping connection **(TP 3511)** with isolation valve (Gate Valve) of size 6" x 300# taken in line no. **MA-3121-150-C4 (Ammonia vapour line to Ammonia Plant).**

6" Tapping connection -TP 3511

12" Tapping connection (TP-3509) on Pump suction (Tank outlet) line (MA-117-300-1C)

12" tapping connection **(TP 3509)** with isolation valve (Gate Valve) of size 12" x 300# taken in line no. **MA-117-300-1C (Pump suction Header).** An additional isolation valve (Gate valve) of size 12" x 300# has been provided before the tapping point in line no. **MA-117-300-1C.**

12" Tapping connection -TP 3509