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K A L O L U N I T

PLANT TURNAROUND REPORT

(APRIL - MAY - 2007)

INDIAN FARMERS FERTILISER CO - OPERATIVE LIMITED

INDEX

PREFACE

The Annual Plant Turnaround for the year 2007 was taken from 14th April 2007, 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 shut down jobs, it was decided to stop Ammonia Plant and Urea Plants on 14th April 2007. This shutdown report contains Plant wise and section wise details of the jobs carried out. Ammonia plant was started on 3rd May 2007 and regular production resumed on 7th May 2007. Similarly, Urea plant shutdown was completed on 5th May 2007.

During start-up of Ammonia plant, coupling failure of Refrigeration Gas Compressor (105-J) occurred on 9th May 2007 and hence, Ammonia Plant could be put back into operation on 13th May'2007 and accordingly, Urea plant came into operation on 14th May 2007.

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 29 days for Ammonia Plant and 21 days for 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

- Synthesis Gas Compressor Drive Turbines 103-JAT & 103-JBT were taken for retrofitting and major overhauling. In the post ESP scenario, with LNG as feed stock, the power requirement of Syn. Gas Compressor reduced. To achieve this power, the steam requirement was calculated at 182 Ton/hrs. for 103-JAT and 20 Ton/hrs. for 103-JBT. To achieve the required steam balance, the following modifications were carried out in these Turbines.

  - 103-JAT Turbine capacity was de-rated by installing old Nozzle Ring of 256 Tons/Hr in place of existing Nozzle Ring of 275 Ton/hrs.
  - Higher capacity Nozzle Ring (28 Ton/day) was provided in 103-JBT Turbine to replace the old Nozzle Ring (18 Ton/day).
  - To take care of higher HP requirements in view of the above modification, a new "Euroflex" make Shim Pack Coupling of 7500 HP was provided in place of Gear Coupling (5200 HP).
  - Over speed trip checking of 103-JBT was carried out at 12100 RPM.

- Routine preventive maintenance of Refrigeration Compressor train (105-J) was carried out. However, during start-up, coupling hub of H.P.case rotor (coupling between H.P. case & Gear box) got slipped from its position and there by causing extensive damage to both coupling hub & Rotor shaft end. The machine was assembled by replacing the spare rotor & gear coupling and put back in to operation within 3 days.

- The existing TG 10 Governor of 101/105 -J Lube oil pump drive COPPUS Turbine was replaced with electronic governing system consisting of TG 13E actuator having PEAK 150 controller.

- Boiler Feed Water Pump 104-JA was overhauled.

- New Tushaco make screw pump was provided in place of existing imported gear pump of motor driven 103-J seal oil pump.

- 115-JA pump rotor had seized during Shutdown & the same was overhauled by replacing the pump rotor.

- Secondary Waste Heat Exchanger (102-C) was hydrotested at 40 kg/cm2g and 7 Nos. tubes (45 Nos. already plugged earlier) and 74 Nos. Tube to Tubesheet seal welding leakages were attended after necessary de-hydrogenation and PWHT.

- New Synthesis Gas Converter (108-D) outlet to MP boiler inlet Elbow (14" x Sch 120) had developed a crack in the parent metal and the same was attended during running plant. In addition old Synthesis Converter (105-D) elbow (8" x Sch 120) was having lamination defect. Both the elbows were replaced during shutdown by purging the Synthesis loop, proper de-hydrogenation and PWHT.

- Routine preventive maintenance jobs of other rotary and static equipments were carried out.

- Waste Heat Boilers 101-F, 112-C and 107-C were offered for IBR inspection.

UREA

- HP case compressor and Gear Box of Hitachi compressor Train were taken for major overhauling. Drive Turbine and LP case was taken for preventive maintenance. Lube oil console tank was thoroughly cleaned & fresh charge of Servoprime 46-T Lube oil was loaded.

- M/s Stamicarbon carried out inspection of HP Vessel, viz. Autoclave, HP Stripper and HP Condenser.

- 20" NB CS Vent Stack pipe was replaced with SS304 material, adopting special ringing procedure.
- Chemical cleaning of Plate type heat exchanger, (H-1206) was carried out to verify effectiveness of cleaning as per procedure given by M/s Alfa Laval.

- LP Vessels inspection was carried out and necessary repairs were undertaken as per inspection findings.

- Prill Tower ID fans, Prill Cooling system (PCS) fans and Urea scraper were taken for Preventive maintenance.

- Conveyor belts of Urea Product Conveyor (M-1403) & dust conveyor (M-1703) were replaced.

OFFSITES

- All cooling water pumps, BFW pumps and turbines were taken for preventive maintenance.

- Base plate of Cooling Water Pump P-4403 & Raw Water Pump P-4101-B were replaced with new one fabricated departmentally.

- All 12 Nos. of Cold end baskets of Regenerative Air Preheater were replaced.

- IBR Inspection of BHEL Boiler, (GT-2068) was carried out.

- Re-Examination of Primary & Secondary Superheater coils along with associated Header was carried out by M/s THARMEX LTD, Pune.

- The wooden structure of all cooling tower cells was inspected by M/s.Paharpur Cooling Tower Pvt.Ltd, Vadodara, for Condition Assessment and also through a committee of IFFCO Officials nominated by the competent authority. Necessary corrective actions were taken.

- Rubber Expansion Bellows of Cooling Water Pump P-4401-C/D/E were replaced with new bellows.

- Inside surface of 52" dia underground pipe line inter connecting old & new cooling tower basin was painted with Epoxy paint after metal shot blasting & spray painting.

- All 28 Nos.of distributor valves of CW return headers were overhauled.

B & MH

- Existing worm Gear box of M-2112 & M-2117 conveyors were replaced with helical Gear box.

- Overhauling of Reclaim machine was carried out.

- All Conveyors and drive Gearbox were taken for preventive maintenance.

- All packer scales and stitching machine were overhauled.

ELECTRICAL

- MCC-1 Section-A panel was replaced with new latest Siemens pannel.
- Preventive maintenance of all the transformers were carried out.
- Complete Overhauling of transformers having low IR values i.e. TR-2B & TR-7B was carried out.
- Overhauling of all the MOCBs, Jyoti VCBs and TMG ACBs were carried out. Retrofitting with Siemens 3WL breakers in feeders of K-1701 & K-1702 by removing old 3WE outdated breakers.
- All critical motors installed at various locations in plants were overhauled.
- All the MOVs were thoroughly checked in various plants. Actuators of MOVs of SP-152, SP-158, SP-159, SP-4, S-5, 4401/C, 4401/D were replaced with ROTORK make actuators.
- Electrification of renovated Boiler control room was carried out.
- Preventive maintenance was carried out of all the rope switches installed in conveyors.

INSTRUMENTATION

AMMONIA

- Related instrument jobs in control room and field was carried out for the New Peak-150 woodward governor of 101J/105J lube oil console.
- Replacement old & obsolete pneumatic level transmitters with new SMART electronic transmitters of M/s Masoneilan ,France make for better reliability & performance. Tag no.LIC-1, LIC-13, LIC-3, LIC-101 in was done in phased manner. This is phase **III.**
- AMC services of DCS/PLC systems/Analysers/UPSS,Belt weighers were carried out with the help of supplier's service engineers.
- Preventive maintenance of control valves was done .

UREA

- In Urea plant 2 nos. of old pneumatic transmitters of extended diaphragm type (LICT-1353 & LICT-1282) were replaced with electronic transmitters for better performance and reliability.
- Servicing of DCS/Omron PLC system for Hitachi compressor was carried out by suppliers' engineers.

- Servicing and overhauling of the control valves was done . Body of LRCV-1201 and HICV-1201 were replaced with repaired ones.

OFFSITE & UTILITY

- Installation & Commissioning of DCS in DM Plant was carried out. The connectivity of DM Plant DCS and Boiler DCS through OFC cable was established. All these jobs were carried out under supervision of supplier M/s Yokogawa India Limited commissioning engineer.

- Maintenance of control valves was done.

- Three new control valves for LSHS temperature control were commissioned.

- Old pneumatic controllers were replaced with electronic controllers in ammonia storage area.

- Removal and re–installation of various instruments to facilitate Mechanical Maintenance /Production deptt./Technical deptt. activities were carried out in entire plant areas as and when required during shutdown and start up.

B & MH

- Obsolete JSRL make bagging machine (10A & 10B) were replaced by new Power build make machines.

- 40 MT Ashbee road weigh Bridge and weighing machines were overhauled and calibrated.

CIVIL

- Damaged top cover plywood sheets of cooling towers were repaired.

- Repairs & Maintenance of Bitumastic lining, acid alkalis proof brick lining in strong / weak effluent pit and HCl storage tank in water treatment plant and other plant area.

- Application of epoxy monolithic plaster on RCC Suspenders, walkways for conveyors, beams, columns and staircase of transfer tower of silo building and other areas in B & MH building.

- Application of IP Net protective coating on RCC wall of Conveyor gallery and other structures (Silo, B & MH, Urea plant etc.)

- Application of Bitumastic lining for SB assembly unit & Anion Tanks in water treatment plant.

- Application of epoxy painting in RCC Structure of bagging plant transfer tower, prill cooling systems and hydrolyser urea plant area.

- Repairs of refractory lining work inside Primary, & Secondary Reformers and Auxiliary & BHEL boilers.

- Repair of damaged flooring of Urea plant Prill cooling system.
- Repair of damaged AC sheet of cooling tower, reformer & other area in plant.

TECHNICAL

AMMONIA

- As a Energy Saving measure, LNG pre heater was installed for pre heating of LNG to Aux. Boiler by using redundant Lube Oil Cooler of GHH Compressor.
- For improving the vacuum of 101JCA, a bigger size inter – after condenser was installed by using a redundant inter-after condenser removed from NG Booster Compressor.
- Carbon Steel Flanges (6 nos.) were replaced by SS Flanges in New Absorber piping as a measure of reliability improvement.
- Isolation valves were provided in 9 nos. of critical relief valves to attend the relief valves during running of the plant.
- Additional conventional relief valves (with isolation valves) were provided parallel to the pilot operated relief valve in the discharge and recycle line of syn. gas compressor (103-J). This will reduce the down time in case of mal functioning of pilot operated valves which was being faced.
- For easy approach to the top of S-50 Converter, Old converter and 123-C, a massive platform structure from ground floor was fabricated and erected .
- Modification in pre reformer piping area was carried out for heating of LNG feed to reformer.

UREA

- As a pollution control measure to reduce ammonia vent to atmosphere a two bed atmospheric scrubber (V-1206) was erected, commissioned and taken in line. Associated heat exchangers and pumps were also installed, commissioned and taken into operation.
- Desorber heat exchanger (H-1301) was replaced with a new plate type exchanger of higher capacity.
- Redundant CO_2 centrifugal compressor and PB CO_2 reciprocating compressor were disconnected from plant piping system.
- 11 nos. of control valves / FI / TI / PI were provided against different EWRs and schemes.

OFFSITE

- A Control valve in the steam line to gas pre heater was provided.

PLANT TURNAROUND APRIL - MAY - 2007

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	Mill Wright Fitter	83
2	General Fitter	777
3	Rigger	972
4	S.S. Rigger	2657
5	Fabricator	134
6	Grinder	148
7	Gas Cutter	71
8	IBR Welder	34
9	Non-IBR Welder	66
10	Carpenter	57
11	Mason	55
12	Machinist	00
13	Draftman	00
14	Master Rigger	00

THE PLANT TURNAROUNDS AT A GLANCE

SR. NO.	YEAR	AMMONIA PLANT				UREA PLANT				REASON IF ANY
		PERIOD FROM PRODUCTION TO PRODUCTION								
		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

SHUT DOWN RELATED CONTRACT

Sr. No.	Plant	Wo No. & Date	Description Of Job	Vendor's Name
1	Ammonia (Mech)	9920043 9920011 19/01/2007	Retrofit of TG-10 Wood word make Governor for 101J/ 105J Lub oil drive turbine	M/s Goodwill Governer service, Mumbai
2	Ammonia (Mech)	9920125 14/02/2007	Scaffolding, Blinding, Deblinding.	M/s Anu Engineers, Baroda
3	Ammonia (Mech)	9920350 15/03/2007	Repair of 102-C & replacement of isolation gate valves for PIC-13A, PIC-13B, MIC-22	M/s Skywin Erectors, Ahmedabad
4	Ammonia (Mech)	9920391 23/03/2007	Overhauling & testing of various Relief valves in Ammonia, Urea & Offsites Plant	M/s Flotec Eng. Services, Surat
5	Ammonia (Mech)	9920319 02/03/2007	Overhauling & testing of RV & Pilot operated valves in Ammonia plant	M/s Flotec Eng. Services , Surat
6	Ammonia (Mech	9920434 23/03/2007	Replacement of elbows in 105-D &108-D	M/s Ganesh Engg, Ahmedabad
7	Ammonia (Mech	9920384 24/03/2007	101 CA/ CB BFW Flange joint on line sealing	M/s Nicco Engg, Baroda
8	Ammonia (Mech)	9920272 03/03/2007	Insitu repair of critical valves applied in process gas & steam in Ammonia plant	M/s Efco, Hyderabad
9	Ammonia (Mech)	9920147 20/01/2007	Supply, Installation & commissioning or gearbox for motor operated valve SP-1	M/s Rotork Controls india Pvt. Ltd
10	Ammonia (Mech)	9920453 02/04/2007	Major overhauling & preventive maint.of various Rotary equipment of Ammonia, Urea & Offsites plant	M/s Spic SMO, Mumbai
11	Ammonia (Mech)	9920451 02/04/2007	Major overhauling & preventive. Maint..of various Rotary equipment of Ammonia, Urea & Offsites plant	M/s Rotodyne, Hyderabad
12	Urea (Mech)	9920122 19/02/2007	Services of M/s Stami carbon Inspectors	M/s Stamicarbon
13	Urea (Mech)	9920152 23/01/2007	Supervisory services of M/s Alfa laval Engineer for H-1206	M/s Alfa laval (India) Ltd, Baroda
14	Urea (Mech)	9920369 30/03/2007	Contract for : (1)Removal & Erection of CO2 spray cooler. (2)20" size vent stack line replacement from CS to SS	M/s Ganesh Engineers
15	Urea (Mech)	9919807 27/11/2006	Damper for K-1701/ k-1702	M/s C.Doctor & Company, Ahmedabad
16	Urea (Mech)	9920526 10/04/2007	Expansion Bellow for K-1702	M/S Urja, Ahmedabad

17	Mech (Offsites)	9920340 16/03/2007	Re RLA study of pressure parts of boiler	M/s TBW, Pune
18	Mech (Offsites)	9920219 07/02/2007	Tube sampling fabrication for Re-RLA study of boiler	M/s Shree Ganesh Engg.Co,Ahmedabaad
19	Mech (Offsites)	9920242 09/02/2007	Insitu Machining, Overhauling & on line testing of safety valves of Boiler	M/s Flotec Engg. Co, Surat
20	Mech (Offsites)	9920053 18/01/2007	Insitu repairing of Gland packing of valves.	M/s Amrutha Engg, New Panvel
21	B&MH (Mech)	15/00566/ 9920259 01/03/2007	Overhauling of Reclaim Machine	M/s EMTICI Engineering Ltd, V.V.Nagar
22	B&MH (Mech)	9920457 9920458 04/04/2007	Overhauling of Tracking Rollers	M/s Hosch Equipments, Kolkata
23	B&MH (Mech)	9919119 01/07/2007	Pennwalt Make Vibrating Screen	M/s Pennwalt, Mumbai
24	Planning	9916832 06/01/2007	Hydro jetting of Heat Exchangers tubes	M/s Delux Hydro Services , Mumbai
25	Planning	9920379 21/03/2007	Opening & Boxed up of Heat Exchangers.	M/s General Engineering works ,Bharuch
26	Planning	9920307 13/03/2007	Assisting IFFCO during shut down /plant turnaround jobs	M/s General Engineering works, Bharuch
27	Planning	9920313 13/03/2007	Assisting IFFCO during shut down /plant turnaround jobs	M/s Saiyed & co, Saij
28	Inspection	9920097 29/01/2007	RFET of 102-C Tubes	M/s Testex NDT, Mumbai
29	Inspection	9919708 11/01/2007	RFET of 142-C Tubes	M/s Testex NDT, Mumbai
30	Inspection	9919946 11/01/2007	REFT & ECT of 108-C tubes	M/s Testex NDT, Mumbai
31	Inspection		Radiography team, on round the clock basis	M/s NDT Services, Ahmedabad
32	Inspection	9920206 12/02/2007	In-Situ metalography	M/s.TCR Advance,Vadodara
33	Inspection	9920128 19/02/2007	Thickness Survey	M/s NDT Services, Ahmedabad
34	Inspection	9920127 09/02/2007	Dye Penetrant Teams	M/s.NDT Services,Ahmedabad
35	Inspection	9920130 20/01/2007	MPI Teams	M/s.NDT Services,Ahmedabad
36	Inspection	9920131 20/01/2007	UFD Teams	M/s.NDT Services, Ahmedabad
37	Inspection	9920132 22/01/2007	Automatic Ultrasonic Scanning of Reformer tubes.	M/s PDIL, Sindri
38	Electrical	9920218 20/02/2007	Servicing of TMG make LT Air circuit breakers	M/s. Heatex Industries

39	Electrical	9920342 29/03/2007	Maint.of transformers at plant site	M/s.VOLTAMP transformers Ltd, Vadodara
40	Electrical	9919793 21/11/2006 9919795 21/11/2006 9920139 20/01/2007	Replacement of MOVs in plant	M/s Rorork controls India Ltd,Mumbai
41	Electrical	9920368 26/03/2007	Overhauling of MOCB in 66KV switch yard	M/s Sun Gentech Pvt. Ltd
42	Electrical	9920098 23/01/2007	Replacement of MCC Panel.	M/s Siemence Ltd, Vadodara
43	Electrical	9920326 02/04/2007	Overhauling of CTR makeOLTC	M/s CTR Manufacturing
44	Electrical	9920467 30/03/2007	Servicing of Jyoti make HT Breakers	M/s Gayatri sales& service
45	Instrument	9920145 05/03/2007	Contract forMaint.of Control Valves	M/s.Hi-tech Controls,Vadodara
46	Instrument	9919902 10/01/2007	Preventive Maint. Of Ammonia, Urea & Utility plants DCS	M/s Yokogawa India Ltd, Baroda
47	Instrument	9918774 22/02/2006	Skilled Man power supply for Shut down	M/s A-Z Instrument services, Baroda
48	Instrument	9918861 03/04/2006	Preventive Maintenance of Ammonia plant PLC	M/s L&T, Navi Mumbai
49	Instrument	9916234 27/11/2004	Preventive Maintenance /Checking of Ammonia Plant UPSS	M/s Instrumentation Ltd, Kota
50	Instrument	9916725 18/02/2005	AMC for UPS Batteries	M/s AMCO Power Systems Ltd, Banglore
51	Instrument	9919529 22/11/2006	AMC for servicing of Analyzers	M/s ABB Analitical, Banglore
52	Instrument	9918899 24/03/2006	Retrofitting job of Pneumatic level trolls	M/s Dresser Valves, Mumbai
53	Instrument	9917069 23/03/2005	Attending Level state level monitoring system of steam drum 101-F	M/s Hi-Tech Systems & Services
54	Instrument	9916240 25/11/2004	Calibration & speed measurement system of compressors	M/s Beacon Industrial Electronics Pvt.Ltd,
55	Instrument	9920198 05/02/2007	AMC for servicing of belt weigher system	M/s EMTICI Engg Ltd, V.V, Nagaar
56	Instrument	9919984 29/12/2006	Instrument erection contract for D.M. Plant	M/s A-Z Instrument services, Baroda
57	Instrument	9919645 12/10/2006	Erection & Commissioning of Bagging Machine	M/s Power Build Ltd, V.V Nagar
58	Instrument	9915881 12/08/2006	AMC for Allen Bradly PLC	M/s Pima Controls Pvt. Ltd, Ahmedabad

59	Instrument	9920346 16/03/2007	AMC for OMRON PLC of pf Hitachi compressor	M/s Masibus Process Ists., GandhiNagar
60	Instrument	9918045 22/10/2005	Servicing & Maint. Of 40 T Weigh bridge	Ashbee Systems Pvt. Ltd
61	Instrument	9918894 22/03/2006	Erection & Commissioning of level state monitoring system of steam drum level in boiler	M/s Hi-Tech Systems & Services
62	Civil	9920085 12/02/2007	Providing & applying epoxy monolithic plaster on RCC Suspenders,walkway for conveyor,beams,columns and staircase of transfer tower of silo building & misc. work in B&MH building and Urea plant.	M/s.Indochem Engineering Comany
63	Civil	9920444 02/04/2007	Providing and applying IP net protective coating on RCC wall of conveyor gallery and other structures (Silo, B&MH , Urea plant etc.)	M/s.Krishna Chem, Mumbai
64	Civil	9920150 01/02/2007	Repairs of Refractory lining work Inside Primary, Auxilary Reformer and BHEL Boiler.	M/s.Detrick
65	Civil	9920295 26/03/2007	To carry out repair of damaged Top cover Plywood sheets of cooling Towers	M/s Akruti, Ahmedabad
66	Civil	9920056 17/01/07	Repair & Maintenance of Bitumastic lining, acid alkalis proof brick lining in strong/ weak effluent pit and HCL storage tank in water treatment plant and other plant areas	M/s Indocom, Ahmedabad
67	Civil	9919940 20/12/2006	Shifting of debries /malvas etc. From various location at plant site.	M/s Jalaram Construction
68	Civil	9919924 18/12/2007	Providing and applying epoxy painting in RCC structure of bagging plant transfer tower, prill cooling systems and hydrolizer of urea plant area,RCC coloumns, Pedestals & other structures	M/s P. M.Patel
69	Civil	9919939 18/12/2007	Repair of damaged AC sheet of cooling tower, Reformer and other area in plant.	M/s Roshni Construction

AMMONIA PLANT

AIR COMPRESSOR TRAIN (101-J)

101-JT Air Compressor Drive Turbine Preventive Maintenance.

Turbine was decoupled and both ends Journal bearings as well as Thrust bearings were inspected and found in good condition and the same was fitted back. Gauss measurement of shaft journal, thrust collar, journal and thrust bearing pads / base rings bearings was carried out and found within limit. Bearing clearances were taken and found within the design range. The governor drive GB at front end of the turbine was also overhauled

101-JLP Air Compressor Preventive Maintenance.

101-JLP, gear box end was decoupled. Journal bearings and Thrust bearings were inspected and found in good condition and the same was fitted back. Gauss reading of thrust end journal bearing pads, thrust bearing pads, thrust bearing base ring and non thrust end journal bearing pads were found to be high and hence were reduced to below acceptable limit of 3 Gauss. Bearing clearances were taken and found within the design range. The entire bag filters as well as Roll-O-Matic filters were replaced.

101-JR Gear Box Preventive Maintenance.

101-JR, HP end was decoupled. All the bearings were inspected and found in good condition and the same was fitted back. Both the gear as well as Pinion were inspected and found in good condition and fitted back the same. 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 Preventive Maintenance.

Drive end Journal bearing as well as thrust bearings were inspected and found good condition and fitted back the same where as the non drive end journal bearing clearance was measured and found above design range and hence the bearing pads were replaced. Gauss readings of non thrust end journal bearing pads, thrust collar & non thrust end journal shaft were found above limits and hence were reduced to below acceptable limit of 3 Gauss.

Couplings Inspection

All the couplings were inspected and found to be O.K. All the DBSE and coupling overhang/override were measured and found to be acceptable.

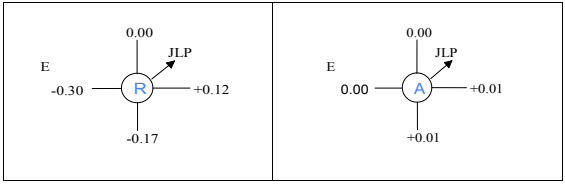
The readings taken during the preventive maintenance of 101J train are recorded as under.

Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
101 JT			
Thrust end bearing	0.007 - 0.009	0.011	0.011
Opp Thrust end bearing	0.007 - 0.009	0.0082	0.0082
Axial Thrust	0.008 - 0.012	0.007	0.009
Thrust end Labyrinth	N.A.	0.0078	0.0078
Opp. Thrust end Labyrinth	N.A.	0.0086	0.0086
101 JLP			
Thrust end bearing	0.006 - 0.008	0.009	0.009
Opp Thrust end bearing	0.006 - 0.008	0.007	0.007
Axial Thrust	0.011 - 0.015	0.0078	0.007
101 JR			
Drive gear North bearing	0.010 - 0.011	0.0094	0.0094
Drive gear South bearing	0.010 - 0.011	0.0094	0.0094
Axial Thrust	0.014 "	0.0118	0.011
Pinion North bearing	0.010 - 0.012	0.011	0.011
Pinion South bearing	0.010 - 0.012	0.010	0.010
Free float	N.A.	0.031	0.0385
Backlash	N.A.	0.0157	0.0157

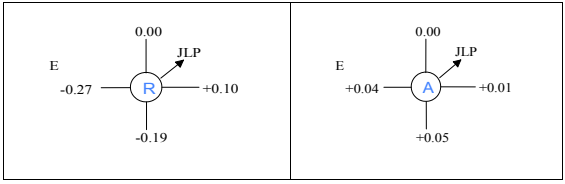
Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
101 JHP			
Thrust end bearing	0.004 - 0.007	0.0094	0.0051
Opp Thrust end bearing	0.004 - 0.007	0.0067	0.0067
Axial Thrust	0.008 - 0.012	0.0094	0.0095
Thrust end Labyrinth		0.0067	0.0067
Opp. Thrust end Labyrinth		0.0067	0.0067
DBSE (With Rotor at extreme ends)			
101 JT-JLP	N.A.	10.511	10.511
101 JLP-JR	N.A.	8.30	8.30
101 JR-JHP	N.A.	8.294	8.294
Coupling Hub Overhang (+) / Override (-)			
101 JAT	N.A.	-1.51 mm	-1.51 mm
101 JLP (JAT End)	N.A.	0.00 mm	0.00 mm
101 JLP (JR End)	N.A.	-0.10 mm	-0.10 mm
101 JR (LP End)	N.A.	+0.15 mm	+0.15 mm
101 JR (HP End)	N.A.	+0.60 mm	+0.60 mm
101 JHP	N.A.	-0.13 mm	-0.13 mm

Final alignment reading of the train is as under:

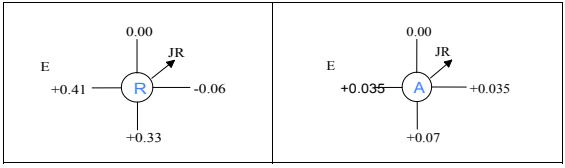
101-JT to 101-JLP (Before)



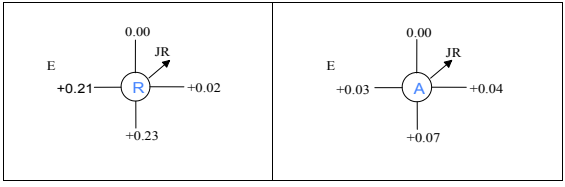
101-JT to 101-JLP (After)



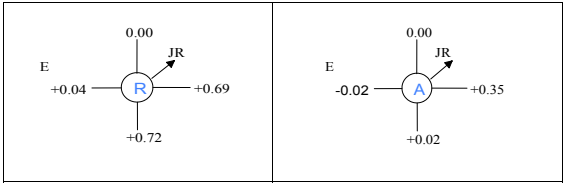
101-JLP to 101-JR (Before)



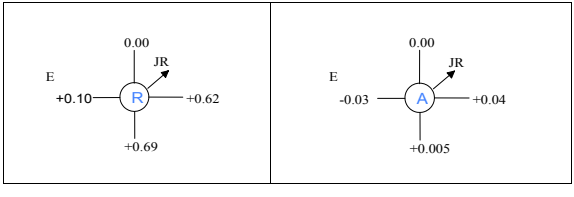
101-JLP to 101-JR (After PM)



101-JR to 101-JHP (Before PM)



101-JR to 101-JHP (After PM)



SYNTHESIS GAS COMPRESSOR TRAIN (103-J)

103-JBT Retrofit & 103-JAT Revert back to original

After the execution of ESP-Phase – II the power requirement of synthesis gas compressor reduced to 11601 KW at 9700 RPM for 1100 MTPD Ammonia plant (as per LNG Case PFD) from 12396 KW for 987 MTPD Ammonia plant (Base case study by HTAS). To achieve this power, the steam requirement was calculated at 182 ton / hr for 103-JAT and 20 ton / hr for 103-JBT.

Upon start up, to achieve the power, the steam consumption in 103-JBT was raised up to rated capacity of about 20 ton / day, but still the power could not be achieved. Since no scope was left with 103-JBT, the required power was achieved by increasing the steam consumption in 103-JAT to 210 ton / day. This resulted in surplus MP steam production of 18 ton per day in Ammonia plant.

For closing the steam balance of Ammonia Plant, it was proposed to retrofit 103-JBT with a redesigned higher capacity Nozzle so as to increase the flexibility to consume 38 Kg steam. At the same time it was proposed to revert back the capacity of 103-JAT by using the lower capacity (Original) Nozzle so as to increase the overall efficiency and achieve the required operating parameters.

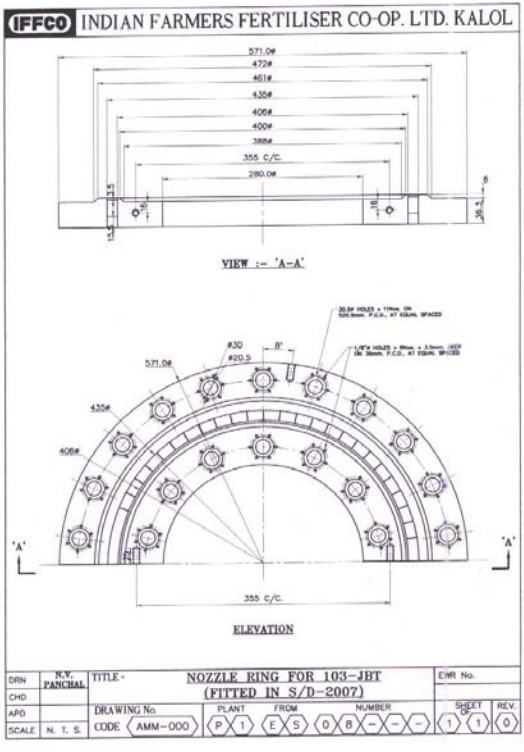
It was proposed to upgrade the 5200 HP coupling to 7500 HP coupling to accommodate the increase in power of 103 JBT and torque transmitted between the two turbines.

Syn. Gas Compressor Drive Condensing Turbine 103-JBT Retrofitting:
Turbine was decoupled. Governor and connected oil pipe lines were removed. Exhaust pipe line and elbow was removed. Top half of the casing was removed. Rotor assembly was lifted after taking measurement of labyrinth clearances. The old nozzle ring was removed without damaging the dowel pins. The new nozzle ring was checked for blue match. Blue match in excess of 90 percent was obtained. Since the nozzle ring comes in one half (Bottom half), it was made sure that the end faces of the same does not fouls with the turbine's top casing. The new cap screws for nozzle were slightly shorter in length and hence it was not possible to lock the head by punching. So it was tightened with the cap screws along with a washer of size 29 x 19.5 x 5 mm. The washer was manufactured at our workshop and material used was, 22-Cr-Mo-V martensitic stainless steel having ASTM Designation: A-565 Gr 616 & UNS Designation S42200 Condition T.

The parting plane of the top and bottom casing was inspected and scoring marks found at four points. These were repaired by fusion welding & grinding followed by lapping. The parting plane was repaired by metal spray technology. The build up surface ground finish after the spray. Repair carried out as given below:

- Surface Preparation at worn out area with grinding
- Preheating of the parting plane.
- Spraying and fusing of EWAC 1005 EC, L&T powder
- Grinding and lapping to make the surface plane

Sketch of the New Nozzle Ring of 103-JBT:



Details of the Original Nozzle Ring and Modified Nozzle Ring

Sr. No.	Parameters		Modified Nozzle Ring	Original 1974-2007
1	Capacity	Normal	26000 kg/hr	10977 kg/hr
		Rated	28000 kg/hr	20866 kg/hr
2	Steam Condition	Normal	Inlet : 545 psig at 610 F Exhaust : 4" Hga	Inlet: 545 psig at 610 F Exhaust: 4" Hga
		Rated	Inlet: 545 psig at 610 F Exhaust: 4" Hga	Inlet: 545 psig at 610 F Exhaust: 4" Hga
3	Power	Normal	5880 HP (4384 KW) at 10850 rpm	2618 HP (1953 KW) at 10348 rpm
		Rated	6385 HP (4760 KW) at 10850 rpm	5200 HP (3879 KW) at 10850 rpm
4	Water Rate	Normal	9.75 lb/hp-hr (5.88 kg/kw-hr)	5.62 kg/kw-hr
		Rated	9.67 lb/hp-hr (5.88 kg/kw-hr)	5.38 kg/kw-hr
5	Ring pressure	Normal	255.7 psia (17.98 kg/cm^2)	111 psia (7.80 kg/cm^2) at 10977 Kg/Hr Throttle Flow
		Rated	275.2 psia (19.35 kg/cm^2)	218 psia (15.32 kg/cm^2) at 20866 Kg/Hr Throttle Flow
6	Total No. of nozzle in the ring		25 Nos.	20 Nos.

103-JBT Rotor assembly was removed from bottom casing and was put on the stand. The old gear coupling was removed from the Rotor. The new Euroflex coupling was installed and the final overhang measured. As per the final overhang the coupling locknut was designed and manufactured in our workshop. As there was an addition was this new lock nut on rotor assembly, the Rotor was taken for balancing. The Euroflex coupling hub was then removed and the coupling locknut installed for balancing the same along with the rotor at 500 RPM at our workshop. After balancing the Euroflex coupling hub was reinstalled and the locknut tightened.

Details of Euroflex Made Coupling Hub Installation On 103-JBT

Sr. No.	Description	UOM	Reading	Remarks
Coupling Make : EUROFLEX (103-JBT)				
1.0	Coupling Hub Blue match	%	85	
2.0	Dry fit Stand off '**A**' (With 'O'-Ring)	mm	13.7	
3.0	Wet fit Stand off '**B**' (Without 'O'-Ring)	mm	13.7	'B'='A' made by hand push of hub.
4.0	Push Required '**C**'	mm	10.8	**Design**
5.0	Calculated hub over hang '**D**' = **C** - **B**	mm	2.9	
6.0	Actual Over Hang '**E**'	mm	2.85	**Final**
7.0	Hub Lock Nut step '**F**'	mm	3.15	
8.0	Calculated Gap between Hub & Locknut **F** - **D**	mm	0.25	
9.0	Actual Gap between Hub face & Lock nut face **F** - **E**	mm	0.30	**Final**
10.0	Maximum expander pressure	PSI	23000	
11.0	Maximum pusher pressure	Kg /cm^2	106	
12.0	Pusher pressure hold up time at final pressure	Min	30	

Gauss measurements were done and the readings are as below:

Sr. No.	Component Description	Max. gauss reading	
		Before	After
1	Base Ring	1.3	1.3
2	Pads	2.4	2.4
3	Thrust Collar	3.2	3.2
4	Journal Bearing Shaft	1.4	1.4
5	Thrust Side Journal Area	3.0	3.0
6	Thrust Side Shaft End	2.5	2.5

The rotor was installed inside the casing. All the clearances were measured and found within design range. Due to decrease in thickness of nozzle ring by 0.2 mm, nozzle clearance increased to 0.065" which was on the higher side of the design range. Hence it was decided to increase the thickness of the nozzle clearance adjusting shim (Inboard shim) to reduce the clearance.

Details of 103-JBT nozzle clearance adjustment has been tabulated below

Sr. No	Description	Reading	Remarks
1.	Original Nozzle Ring Clearance	0.055"	Decrease in nozzle ring thickness by 0.010" increases nozzle clearance by 0.010".
2.	Modified Nozzle ring thickness	1.683"	
3.	New nozzle ring thickness	1.673"	
4.	Changed nozzle clearance	0.065"	
5.	Shim thickness Before retrofitting	0.430" (10.90mm)	Increasing shim thickness by 0.010" to result in decreasing nozzle clearance by 0.010"
6.	New Shim thickness	0.440" (11.20mm)	
7.	New nozzle clearance	0.055"	
8.	Final nozzle clearance obtained	0.059"	Design : 0.055" – 0.065"

Since the thickness of nozzle clearance adjusting shim (Inboard shim) was increased by 0.010", the axial float decreased by 0.010" to 0.002" which was well below the design range of 0.008" - 0.012". Hence the thickness of axial thrust adjusting shims (Outboard shim) was reduced by 0.007" to get the desired thrust.

Details of axial thrust adjustment have been tabulated below.

Sr. No	Description	Readings	Remarks
1.	Axial Float Before retrofitting	0.012"	Increase in thickness of nozzle clearance adjusting shim (Inboard) by 0.010" reduced axial float by 0.010" to 0.002"
2.	Axial Float after increase in nozzle adjusting shim thickness.	0.002"	
3.	Thrust adjusting shim thickness	0.187" (4.75mm)	Decrease in shim thickness by 0.007" to result in increase in thrust by 0.007" to 0.009"
4.	New shim thickness	0.180" (4.55mm)	
5.	Axial float	0.009"	
6.	**Final axial float obtained**	0.008"	**Design : 0.008" – 0.012"**

The oil deflector (governor side), part No 17, Delaval No HJ – 588 – AZ, was replaced by new one and the turbine was boxed up. The final bearing clearances were noted and found within design range. The governor was taken for preventive maintenance. The servomotor assembly was dismantled, cleaned and reassembled.

Syn. Gas Compressor Drive Turbine 103-JAT

The turbine was taken for derating with original, lower capacity Nozzle ring. The existing Nozzle ring was removed to install the original, lower capacity older ring. A detail comparison of the Nozzle rings has been tabulated below:

Details of Original and Existing Nozzle Rings:

Sr. No.	Parameters		Existed Higher Capacity Nozzle. (1997-2007)	Original Lower Capacity Nozzle. (1974-1997) (2007 Onwards)
1	Capacity (kg/hr)	Normal	221019	221019
		Rated	275,000	256284
2	Steam Condition (PSIG)	Normal	Inlet : 1450 PSIG at 824 ^{0}CF Exhaust : 555^{0}F	Inlet : 1450 PSIG at 824 ^{0}CF Exhaust : 555^{0}F
		Rated	Inlet : 1450 at 824 ^{0}F Exhaust : 555 F	Inlet : 1450 at 824 ^{0}F Exhaust : 555 F
3	Power (hp)	Normal	14800	14800
		Rated	18500	17900
4	Water Rate (Kg /kw-Hr)	Normal	20.01	20.01
		Rated		19.19
5	Total No. of nozzle in the New nozzle block		48	48

The 8 Nos cap screws of the nozzle ring & gland ring were replaced by new one. The rotor was installed in the casing and all clearances were noted. The turbine was boxed up.

The original nozzle ring was lapped at our Mechanical Ammonia Workshop and was taken to main work shop for blue match. Only 50 % blue match was found on table. The nozzle ring was sent to M/S Mehul, Ahmedabad for surface finishing. After surface grinding, blue match was checked on table and more than 90 % was observed. This original nozzle ring was installed.
The gear coupling hub on 103-JAT rotor towards JBT side was removed and new Euroflex make coupling hub was installed and the over hang was measured. As per the overhang obtained, new coupling hub locknut was designed and made in workshop.

Both ends coupling hubs of 103-JAT rotor were removed and the rotor along with the new coupling hub locknuts was balanced in workshop at 500 RPM. Euroflex make coupling hub was installed on 103-JBT side of 103-JAT rotor and Johncrane make coupling hub was installed on 103-JLP side of 103-JAT rotor.

Details of Euroflex Made Coupling Hub Installation on 103-JAT (103-JBT side)

Sr. No	Description	UOM	Reading	Remarks
Coupling Make : EUROFLEX (On 103-JAT towards 103-JBT side))				
1.0	Coupling Hub Blue match	%	85	
2.0	Dry fit Stand off '**A**' (With 'O'-Ring)	mm	12.27	
3.0	Wet fit Stand off '**B**' (Without 'O'-Ring)	mm	12.27	'B'='A' made by hand push of hub.
4.0	Push Required '**C**'	mm	11.00	**Design**
5.0	Calculated hub over hang '**D**' = **C** - **B**	mm	1.27	
6.0	Actual Over Hang '**E**'	mm	1.23	**Final**
7.0	Hub Lock Nut step '**F**'	mm	1.45	
8.0	Calculated Gap between Hub & Locknut **F** - **D**	mm	0.18	
9.0	Actual Gap between Hub face & Lock nut face **F** - **E**	mm	0.22	**Final**
10.0	Maximum expander pressure	PSI	23000	
11.0	Maximum pusher pressure	Kg /cm^2	130	
12.0	Pusher pressure hold up time at final pressure	Min	30	

Details of Johncrane Make Coupling Hub Installation On 103-JAT (103-JLP side):

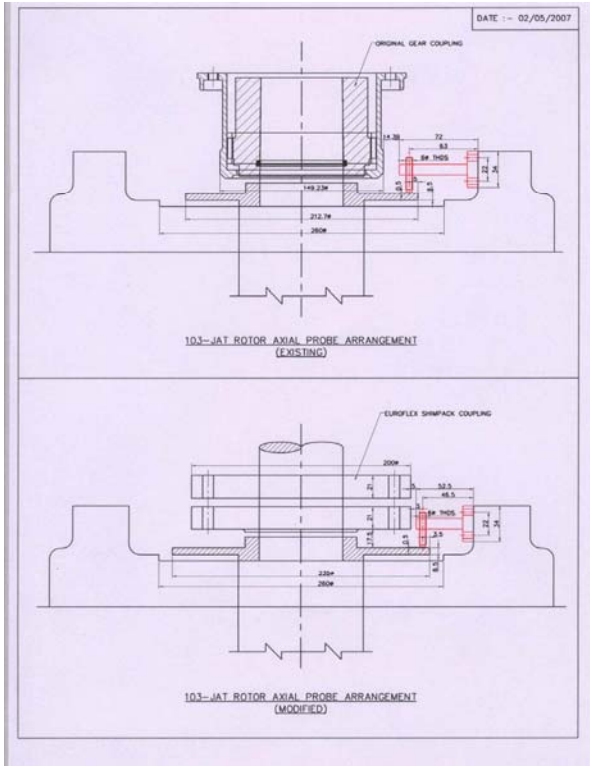
Sr. No	Description	UOM	Reading	Remarks
Coupling Make : EUROFLEX (On 103-JAT towards 103-JLP side)				
1.0	Coupling Hub Blue match	%	85	
2.0	Dry fit Stand off '**A**' (With 'O'-Ring)	mm	11.66	
3.0	Wet fit Stand off '**B**' (Without 'O'-Ring)	mm	11.66	'B'='A' made by hand push of hub.
4.0	Push Required '**C**'	mm	10.23	**Design**
5.0	Calculated hub over hang '**D**' = **C** - **B**	mm	1.43	
6.0	Actual Over Hang '**E**'	mm	1.40	**Final**
7.0	Hub Lock Nut step '**F**'	mm	1.68	
8.0	Calculated Gap between Hub & Locknut **F** - **D**	mm	0.25	
9.0	Actual Gap between Hub face & Lock nut face **F** - **E**	mm	0.28	**Final**
10.0	Maximum expander pressure	PSI	23000	
11.0	Maximum pusher pressure	Kg/cm^2	140	
12.0	Pusher pressure hold up time at final pressure	Min	30	

Axial Probe Installation on 103-JAT Rotor:

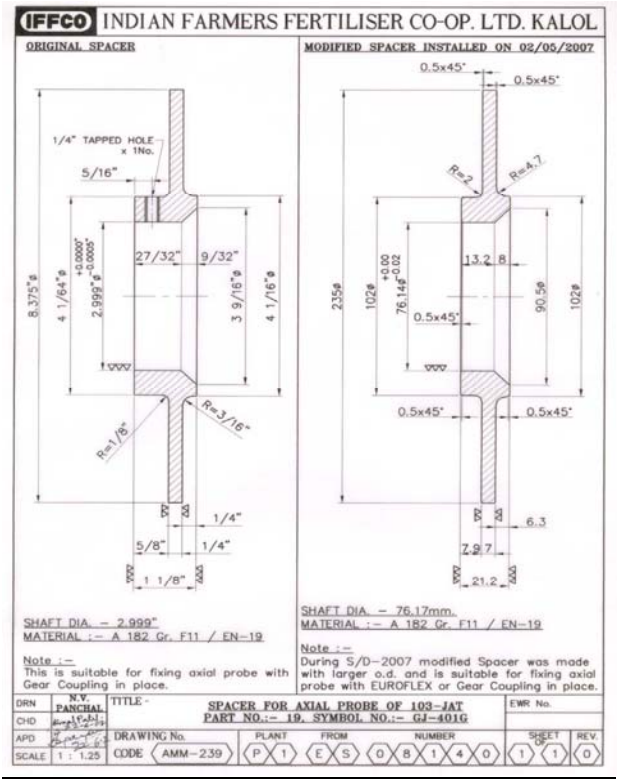
While installing axial probe on the 103-JAT rotor, it was found that, the space for axial probe between the coupling hub rear end and a spacer provided for probe on the rotor, had reduced. This happened because, the new Euroflex coupling hub had flanges at the rear end. After studying it was decided to make a new spacer having OD of around 20-30 mm larger than that of original spacer. Since the spacer is not subjected to steam pressure and temperature material of grade F11 was found to be suitable.

New spacer was made from grade F-11, 6" x 600 # blind flange. The spacer was balanced at 500 RPM. The original Spacer was removed and the new Spacer was installed by heating to around 100^0C using a gas cutter. Finally it was possible to install axial probe at site.

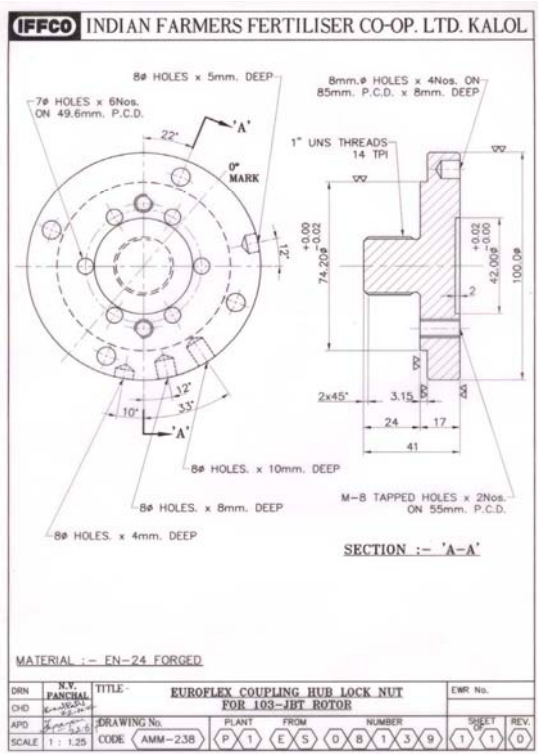
Arrangement for installing Axial probe for 103-JAT:



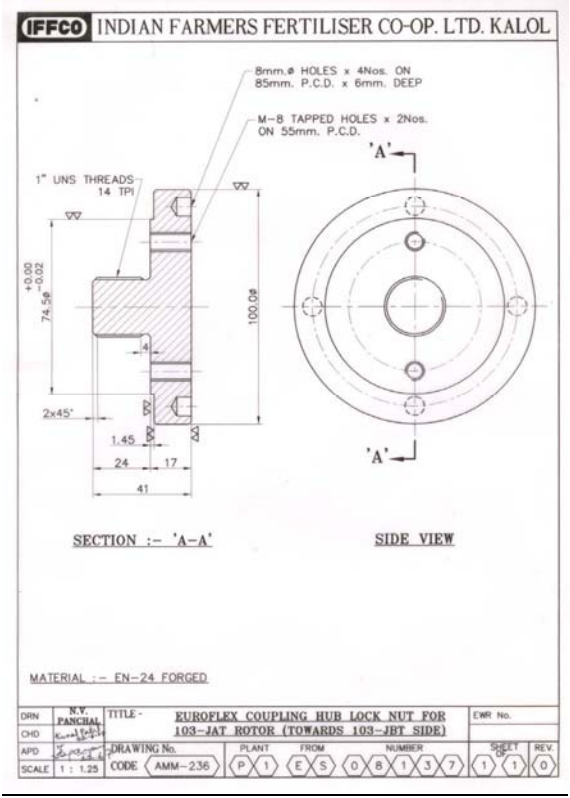
The Details of the Existed and New Spacer for Axial Probe for 103-JAT:



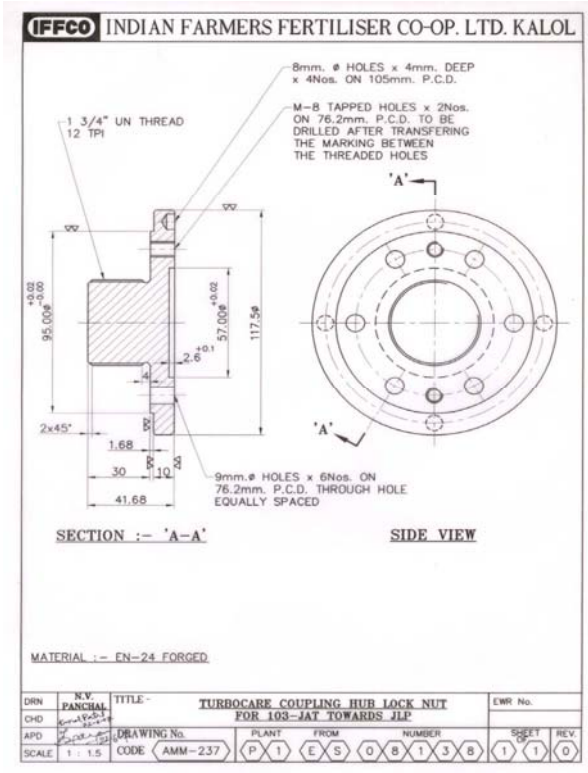
Lock Nut for Euroflex Coupling Hub for 103- JBT:



The details of 103-JAT (JBT Side) locking nuts:



The details of 103-JAT (JLP Side) locking nuts:



103-JAT TTV Overhauling:

The TTV was taken for preventive maintenance. The complete assembly was dismantled and cleaned. Ball bearing, oil seal and other locking pins were replaced.

Installation of New Euroflex Coupling between 103-JAT and 103-JBT
As part of revamping the 5200 HP Gear coupling was upgraded to 7500 HP Euroflex Shim Packed Flexible coupling. The coupling hub with lock nut was already installed on their respective shafts. For design DBSE and Coupling Hub travel, the design Nos of Shims required was calculated at '9' to get a design Pre-Stretch of 6 mm. But due to variations in DBSE & coupling hub travel during installation, a practical method to calculate the Nos of Shims was followed as follows:

Euroflex coupling between 103-JAT & 103-JBT, prestretch calculation:

Description	Value	Remarks
Step – I : Design calculation of No of shims required		
DBSE (With shafts at extreme ends)	333.43 mm	Measured for Record only
Hub Face to face (With shafts at extreme ends)	329.53 mm	Measured for Record only
Hub Flange to Hub Flange (With shafts at extreme ends)	275.95 mm	Measured
Spacer flange to flange length	266.20 mm	Design
Maximum Pre stretch possible	9.75 mm	275.95 – 266.20
Pre stretch required	6.00 mm	Design
Total shim thickness required	3.75 mm	9.75 – 6.00
No of shims calculated	9	3.75 / 0.381

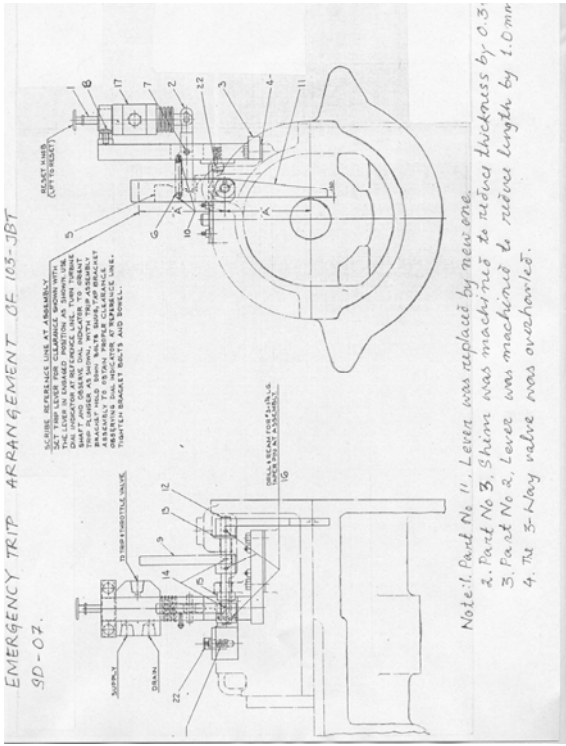
Description	Value	Remarks
Step – II : Pre stretch obtained		
Flexible element thickness	12.1 mm	Design
Gap between Hub Rear end flanges	14.6	Measured
Pre stretch obtained	5.0 mm	2 x (14.6 – 12.1)
Pre stretch required	6.00 mm	Design
Difference	1.0 mm	6 - 5
Allowable difference	0.5 mm (Design)	Required Adjustment was done
Step – III : Adding shims to decrease pre stretch / Removing shims to increase pre stretch		
Pre stretch required	6.00 mm	Design
Shims to be removed	2 Nos	(6-5) / 0.381
Gap between Hub end flanges	14.9 mm	Measured
Pre stretch obtained	5.6 mm	2 x (14.9 – 12.1)
Shims under compression	0.4 mm	6 – 5.6
Step – IV: Final pre stretch was measured at 5.6 mm with 7 Nos shims in place. Three Shims on JBT side and four on JAT side.		

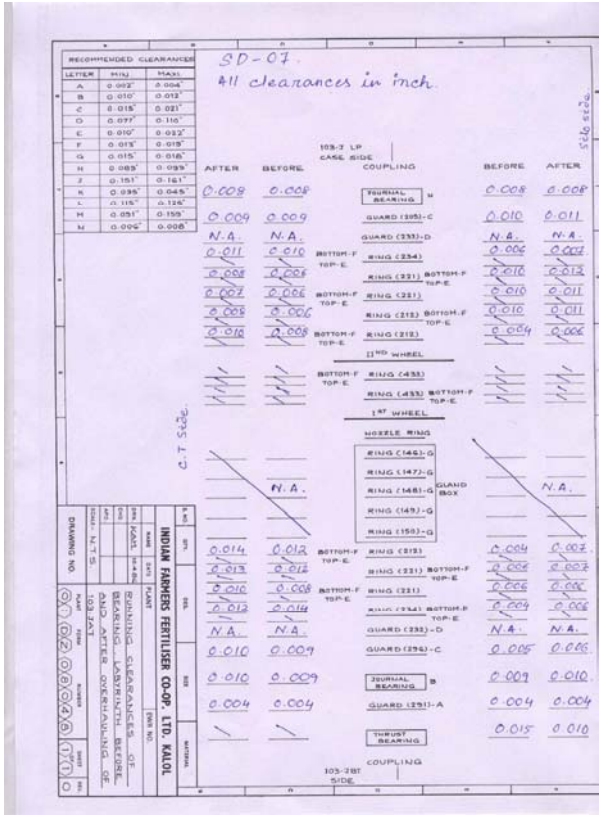
Over Speed Trip adjustment of 103-JBT

Over Speed Trip of the condensing turbine 103-JBT was achieved as follows:

- Turbine was tripped after 5 Trials.
- The coupling was locked with a solo plate provided by Euroflex. In the **1st** attempt, speed as increased upto 12100 RPM but the turbine did not trip.
- The complete governor assembly was removed to check the clearance between the trip lever and the OST pin. The gap between pin and lever was found 120 mills. The lever was removed and on close inspection it was found that deep depressions had developed due to hitting of the weight / pin. These depressions were filled by weld deposits.
- **2nd** trial was attempted and the turbine tripped at 11090 RPM. The **3rd** trial was attempted but the turbine did not trip. On dismantling the whole assembly was again dismantled and inspected. It was observed that the weld deposit worn out and new depressions had developed due to hitting of the weight (pin) on the lever. The depressions were refilled using Incolloy electrode.
- **4th** trial was made but the turbine did not trip.
- Finally part no 11, lever was replaced by new lever. The trip lever assembly was installed and clearance measured. The gap was set to120 mills.
- As per the OEM's instruction the clearance can be increased by increasing the thickness of Part No 4, shim. Expecting the reverse to happen thickness was reduced by 0.3 mm. But the clearance increased instead.
- Finally it was decided to reduce the clearance by reducing the length of lever, Part No 2. by 1.0 mm. Final clearance was measured at 100 mills and the complete assembly was assembled.
- The three way valve was overhauled. All its 'O'- Rings were replaced.
- In the **5th** attempt, the turbine tripped at 11800 RPM.

Emergency Trip Assembly of 103-JBT

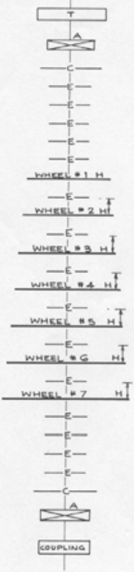



SD-07.
All clearances in inch.
RECOMMENDED CLEARANCES
LETTER MIN MAX
A 0.002" 0.004"
B 0.010" 0.012"
C 0.015" 0.021"
D 0.077" 0.116"
E 0.010" 0.012"
F 0.013" 0.015"
G 0.015" 0.016"
H 0.089" 0.095"
J 0.151" 0.161"
K 0.035" 0.045"
L 0.115" 0.126"
M 0.051" 0.055"
N 0.006" 0.008"
103-2 LP CASE SIDE
AFTER
BEFORE
COUPLING
BEFORE
AFTER
0.008 0.008 TOURNAL BEARING N 0.008 0.008
0.009 0.009 GUARD (305)-C 0.010 0.011
N.A. N.A. GUARD (333)-D N.A. N.A.
0.011 0.010 BOTTOM-F TOP-E RING (334) 0.006 0.007
0.008 0.008 RING (331) BOTTOM-F TOP-E 0.010 0.012
0.007 0.006 BOTTOM-F TOP-E RING (321) 0.010 0.011
0.008 0.006 RING (213) BOTTOM-F TOP-E 0.010 0.011
0.010 0.008 BOTTOM-F TOP-E RING (212) 0.004 0.006
II ND WHEEL
BOTTOM-F TOP-E RING (433)
RING (433) BOTTOM-F TOP-E
I ST WHEEL
NOZZLE RING
RING (146)-G
RING (147)-G
N.A. RING (148)-G GLAND BOX N.A.
RING (149)-G
RING (150)-G
0.014 0.012 BOTTOM-F TOP-E RING (213) 0.004 0.007
0.013 0.012 RING (321) BOTTOM-F TOP-E 0.006 0.007
0.010 0.008 BOTTOM-F TOP-E RING (331) 0.006 0.006
0.012 0.014 RING (334) BOTTOM-F TOP-E 0.004 0.006
N.A. N.A. GUARD (332)-D N.A. N.A.
0.010 0.009 GUARD (296)-C 0.005 0.006
0.010 0.009 JOURNAL BEARING B 0.009 0.010
0.004 0.004 GUARD (291)-A 0.004 0.004
THRUST BEARING 0.015 0.010
COUPLING
103-2BT SIDE
C.T Side.
Side side.
INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL
DRAWING NO.
RUNNING CLEARANCES OF BEARING, LABYRINTH BEFORE AND AFTER OVERHAULING OF 103 2AT

SD-07.

RECOMMENDED CLEARANCES (INCHES)

LETTER	MIN.	MAX.
A	0.010	0.012
C	0.008	0.014
E	0.013	0.019
H	0.055	0.065
T	0.008	0.012



Location	REFORMER SIDE AFTER	REFORMER SIDE BEFORE	SILO SIDE BEFORE	SILO SIDE AFTER
T			0.012	0.008
A			0.010	0.010
C	0.012	0.012.	0.012	0.012.
E	0.008	0.006	0.006	0.010
E	0.007.	0.005	0.010	0.010
E	0.006	0.005	0.010	0.011
E	0.007	0.007.	0.012	0.013
E	0.007	0.007.	0.012	0.012.
WHEEL #1 H	0.059	0.065	0.055	0.055
E	0.008	0.007.	0.007	0.008
WHEEL #2 H	0.060	0.062	0.062	0.060
E	0.008	0.007	0.007	0.008
WHEEL #3 H	0.063	0.069	0.069	0.063
E	0.008	0.008	0.008	0.008
WHEEL #4 H	0.059	0.056	0.056	0.059
E	0.008	0.006	0.006	0.008
WHEEL #5 H	0.061	0.062	0.062	0.061
E	0.010	0.008	0.008	0.010
WHEEL #6 H	0.060	0.061	0.061	0.060
E	0.008	0.006	0.006	0.008
WHEEL #7 H	0.055	0.066	0.066	0.065.
E	0.012.	0.012	0.006	0.006.
E	0.012	0.012	0.006	0.007
E	0.011	0.010	0.007	0.007
E	0.012	0.012	0.007	0.008
C	0.008	0.008	0.018	0.018
A			0.010	0.010
COUPLING				

Note: All clearances in inch.

INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL

103-JBT BEARING, LABYRINTH, NOZZLE CLEARANCES BEFORE AND AFTER OVERHAULING

DRAWING NO. 01 D2 08 03 SHEET 1 OF 1 REV. 0

103-JHP Synthesis Gas Compressor Preventive Maintenance.

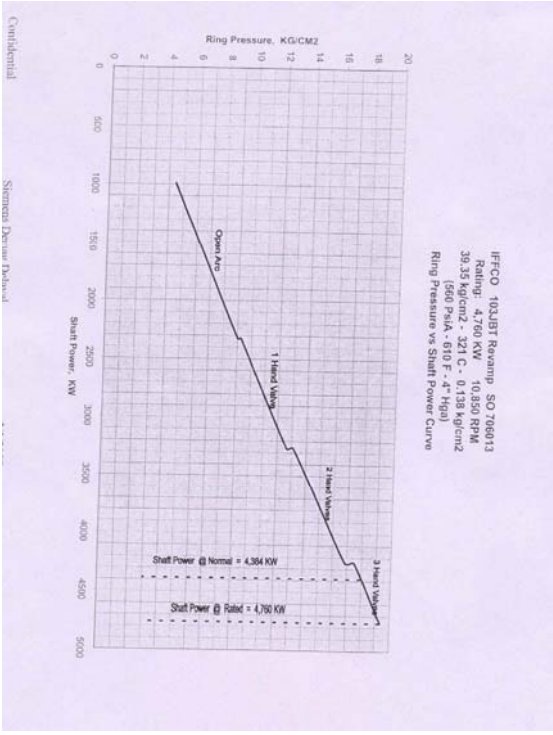
The compressor was decoupled and thrust bearing and both end Journal bearing were inspected and found O.K. Gauss readings of thrust end journal bearing's base ring (8.8) was found to be above limit and hence demagnetized to below 3 gauss. All pads were Dye Penetration tested and no surface cracks were found. The final journal bearing clearance was measured and found within limit. To get the required axial thrust ***2 Nos, 0.07 mm gaskets*** were used

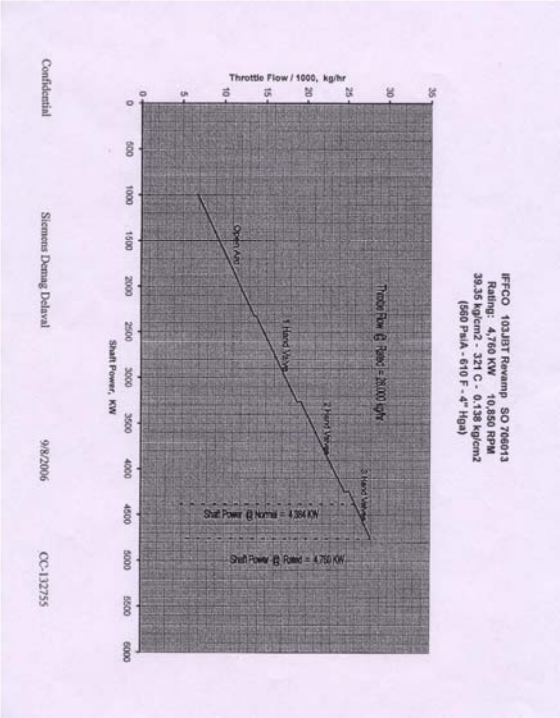
103-JLP Synthesis Gas Compressor Preventive Maintenance.
Journal bearings and thrust bearings were inspected and found O.K. Gauss readings of thrust and both end journal bearing were measured and found within limit. Dye penetration test was performed on all the pads and no surface cracks were found.

The bearing clearances measured before and after overhauling:

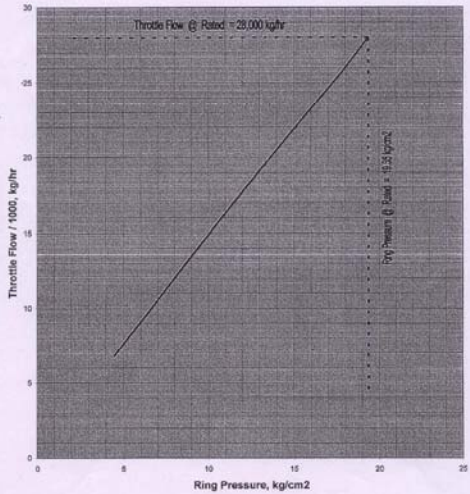
Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
103 -JBT			
Thrust end bearing	0.010 - 0.012	0.010	0.010
Opp Thrust end bearing	0.010 - 0.012	0.010	0.010
Axial Thrust	0.008 - 0.012	0.012	0.008
103 - JAT			
Thrust end bearing	0.010 - 0.012	0.009	0.010
Opp Thrust end bearing	0.006 - 0.008	0.008	0.008
Axial Thrust	0.011 - 0.015	0.015	0.010
103- JHP			
Thrust end bearing	0.0023 – 0.0033	0.004	0.004
Opp Thrust end bearing	0.0023 – 0.0033	0.004	0.004
Axial Thrust	0.015" – 0.022"	0.0157	0.0157
Description	**Design Clearances (Inch)**	**Before (Inch)**	**After (Inch)**
103-JLP			
Thrust end bearing	0.002 – 0.004	0.007	0.007
Opp Thrust end bearing	0.002 – 0.004	0.004	0.004
Axial Thrust	0.015 – 0.022	0.015	0.0173
Coupling Hub Overhang (+) / Override (-)			
103 JBT	N.A.	+ 2.85 mm	+ 2.85 mm
103 JAT (JBT End)	N.A.	+ 1.23 mm	+ 1.23 mm
103 JAT (LP End)	N.A.	+ 1.40 mm	+ 1.40 mm

Performance Curve for New Nozzle Ring:




IFFCO 103JBT Revamp SO 706013
Rating: 4,760 KW 10,850 RPM
39.35 kg/cm2 - 321 C - 0.138 kg/cm2
(560 PsiA - 610 F - 4" Hga)
Throttle Flow / 1000, kg/hr
Shaft Power, KW
Open Arc
1 Hand Valve
2 Hand Valves
3 Hand Valves
Shaft Power @ Normal = 4,384 KW
Shaft Power @ Rated = 4,760 KW
Confidential
Siemens Demag Delaval
9/8/2006
CC-132755

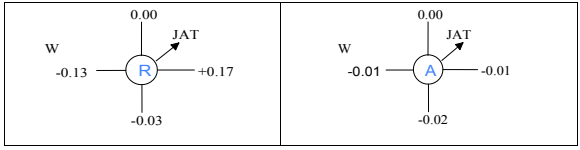
IFFCO 103JBT Revamp SO 706013
Rating: 4,760 KW 10,850 RPM
39.35 kg/cm2 - 321 C - 0.138 kg/cm2
(560 PsiA - 610 F - 4" Hga)
Ring Pressure Curve



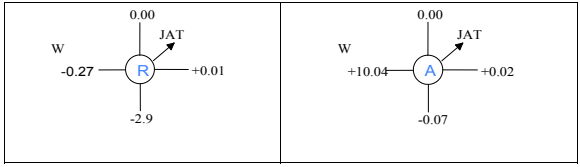
Confidential Siemens Demag Delaval 9/8/2006 CC-132756

Final alignment reading of the train is as under:

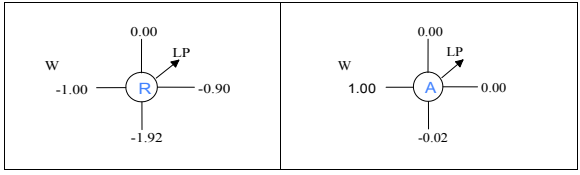
103-JBT to 103-JAT (Before PM)



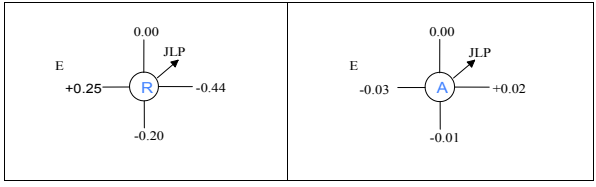
103-JBT to 103-JAT (After PM)



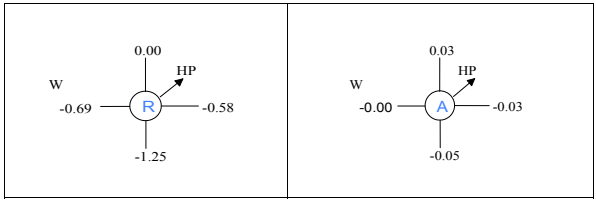
103-JAT to 103-JLP (Before PM)



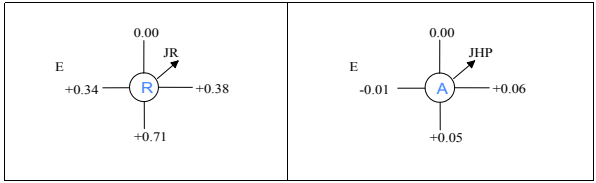
103-JAT to 103-JLP (After PM)



103-JLP to 103-JHP (Before PM)



103-JLP to 103-JHP (After PM)



REFRIGERATION COMPRESSOR TRAIN:

Refrigeration Compressor Drive Turbine, 105-JT Preventive Maintenance

Turbine was decoupled and both ends Journal bearings & Thrust bearings were inspected and found O.K. Gauss measurement of thrust end journal bearing pads (6.0) was found to be above limit and hence demagnetized to below 3.0 gauss. Gauss reading of all other bearing and shaft journal was measured and found within limit. Bearing clearances were taken and found within the design range. Greasing of governor valve linkages was carried out. The governor drive GB at front end of the turbine was also overhauled

Low Pressure Refrigeration Compressor, 105-JLP Preventive Maintenance.

105-JLP, gear box end was decoupled. Journal bearings and thrust bearings were inspected and found O.K. Gauss reading of thrust bearing base ring (5.2) was found to be high and hence were reduced below 3 Gauss. Gauss reading of all other bearings and shaft journal was found to be within limit. All bearing clearances were taken and found within the design range.

Gear Box Preventive Maintenance (105-JR).

101-JR, HP end was decoupled. 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 readings of low speed shaft south side bearing (3.7), High Speed south side bearing (12.0), High speed shaft, North side bearing (4.2) were found to be above limit and hence were reduced below acceptable limit of 3 gauss. Bearings clearance were measured and found within limit.

The readings taken during the maintenance of 105-J train are recorded as under:

Description	Design Clearances (Inch)	Before	After
105 JT			
Thrust end bearing	0.007 - 0.009	0.010	0.010
Opp Thrust end bearing	0.007 - 0.009	0.010	0.010
Axial Thrust	0.008 - 0.012	0.0138	0.0138
105 JLP			
Thrust end bearing	0.006 - 0.008	0.0118	0.011
Opp Thrust end bearing	0.006 - 0.008	0.011	0.011
Axial Thrust	0.011 - 0.015	0.014	0.013
105 JR			
Drive gear North bearing	0.010 - 0.011	0.016	0.016
Drive gear South bearing	0.010 - 0.011	0.016	0.016
Axial Thrust	0.014	0.0196	0.0196
Pinion North bearing	0.010 - 0.012	0.0126	0.0.126
Pinion South bearing	0.010 - 0.012	0.0126	0.0.126
Free float	N.A.	0.011	0.011

Refrigeration Compressor (105-JHP):

Rotor Replacement of 105-JHP Case:

After plant annual turnaround, the Ammonia plant was started on 03-05-2007 and production resumed on 07-05-2007. The plant was running smoothly till 09-05-2007. However, the machine tripped at around 23:50 Hrs on 09-05-2007. After restarting the machine, abnormal vibrations were noticed in Gear Box and HP case of the machine, at around 01:30 Hrs on 10-05-2007. The machine was immediately stopped for inspection. On thorough inspection of the train, it was found that the HP case rotor coupling had slipped from its position and thereby causing extensive damage to both coupling hub &

rotor shaft end. As an immediate measure, HP case rotor & coupling were replaced with available spare ones and the machine train was put back into operation and regular Production was lined up on 14-05-2007 onwards.

System was isolated, clearance for opening of the machine obtained. After removal of top casing, general condition of internals was found good. No oil additives deposit was found. Both the mechanical seals were in good condition. Labyrinth clearances were found in limit. Lining marks were observed on the journal bearing pads; hence the pads were replaced with new one.

Following jobs were carried out in HP Case during the Rotor replacement:

The activity list for the breakdown maintenance of 105-JHP Case in chronicle order is as follows:

Date	Sr No	Time	Activity
05-05-2007	1	21:00 Hrs	Machine put on slow run
07-05-2007	1	19:15 Hrs	Speed up to minimum gov. speed
09-05-2007	1	23:50 Hrs	Machine tripped due to.
10-05-2007	1	01:30 Hrs	Machine restarted again. Heavy vibrations noticed and machine was stopped for inspection.
	2	09:30 Hrs	Coupling between Gear Box and HP case was opened. Noticed coupling hub of HP case had slipped.
	3		Ammonia depressurization from HP case started.
	4		Coupling between Turbine to LP case and LP case to Gear Box opened.
	5		Gear Box bearing probe wiring removed. Gear Box cover, Gears and bearings removed. Inspection of Gears and Bearings carried out.
	6		Spare HP Compressor Rotor, Coupling, Bearings, Labyrinths and other parts issued and cleaning started.
	7		Alternate bolts of the HP case opening started.
	8		Gear Box assembled and boxed up.
11-05-2007	1	11:00 Hrs	Clearance for opening the HP case received and balance bolt opening started.
	2	09:00 Hrs	Gear Box opened again as vibration probes were overlooked during box up.
	3	14:00 Hrs	Top casing removed.
	4	15:30 Hrs	Top half casing cleaning started.
	5	17:00 Hrs	Rotor removed from position after checking all bearing and Labyrinth clearances.
	6	18:00 Hrs	Bottom half casing cleaning.
	7	18:00 Hrs	Assembly of Mechanical seals, new Gear Coupling Hub and other parts on the spare Rotor started. This activity was completed at 04:00Hrs on 12-05-2007.
	8	16:30 Hrs	Lock nut drawings made and given to Workshop.

12-05-2007	1	07:00 Hrs	Rotor placed in position. Clearances of Labyrinths checked.
	2	17:00 Hrs	Top Casing put into position.
	3	14:30 Hrs	One ring was left out and could not be installed on the HP case rotor due to lower Dia. than the coupling hub. Therefore, Gear Box cover and output Gear pinion removed again after probe removal.
	4	17:00 Hrs	HP case Coupling Hub removed in position for installation of left out ring. Completed by 18:00 Hrs.
	5	17:30 Hrs	Lock Nut preparation for installation.
	6		Both end bearings boxed up.
			Casing bolt tightening.
			Final tightening of casing bolts.
			Alignment checking between HP case and Gear Box.
			All three coupling box up.
			Oil piping box up with new flexitallic gaskets.
			Vibration probe fixing and wiring.
13-05-2007	1	07:00 Hrs	Machine completed in all respect and handed over to Production for operation.
	2	09:00 Hrs	Machine taken on slow roll. Minor oil leakage noticed in one flange was tightened.

The following items were replaced issued from store:

Sr. No.	Description	Qty.	Store Code
1	Rotor (Detail embossed the Rotor shaft End: I-171, ST18, 0355, BFS – 20 52 Fx2)	1 No	101050320000
2	Gear Coupling between G/B & HP Case , (Part No.: 1624 A)	1 No	112050615000
3	Journal Bearings Pads (Symbol : BF395A)	2 Sets (1set=5 Nos.)	112050233500

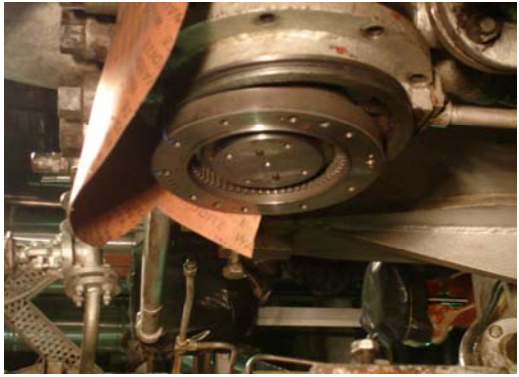
New Hydraulic gear coupling on 105-JHP was installed and the installation detail is as follows:

Sr. No.	Description	UOM	Reading	Remarks
1.0	Coupling Hub Blue match	%	100	
2.0	Dry fit Stand off '**A**' (With 'O'-Ring)	mm	9.15	
3.0	Wet fit Stand off '**B**' (Without 'O'-Ring)	mm	9.15	'B'='A' made by hand push of hub.
4.0	Push Required '**C**'	mm	7.641	**Design**
5.0	Calculated hub over hang '**D**' = **C** - **B**	mm	1.5	
6.0	Actual Over Hang '**E**'	mm	1.8	**Final**
7.0	Maximum expander pressure	PSI	20000	
8.0	Maximum pusher pressure	Kg /cm^2	40	
9.0	Pusher pressure hold up time at final pressure	Min	30	

105-JT – JLP – JHP COUPLING / SHAFT DBSE Detail was recoded and it is as follows:

Sr. No.	Description	105-JT TO 105-JLP		105-JLP TO Gear Box		Gear Box TO 105-JHP	
1	DBSE	271.27mm.		265.68mm.		209.29mm.	
2	Hub to Hub	271.27mm.		267.38mm.		207.05mm.	
3	Hub Lock Nut to Lock Nut	236.96mm.		250.30mm.		197.29mm.	
4	Shaft Overhang	2.0mm.	--------	1.5mm.	--------	------	--------
5	Hub Overhang	--------	2.5mm.	--------	--------	------	1.5mm.
6	Lock Nut Gap	0.010"	0.009"	0.012"	--------	------	0.008" (0.2mm.)
7	Spool Piece Length	231.65mm.		228.55mm.		176.10mm.	

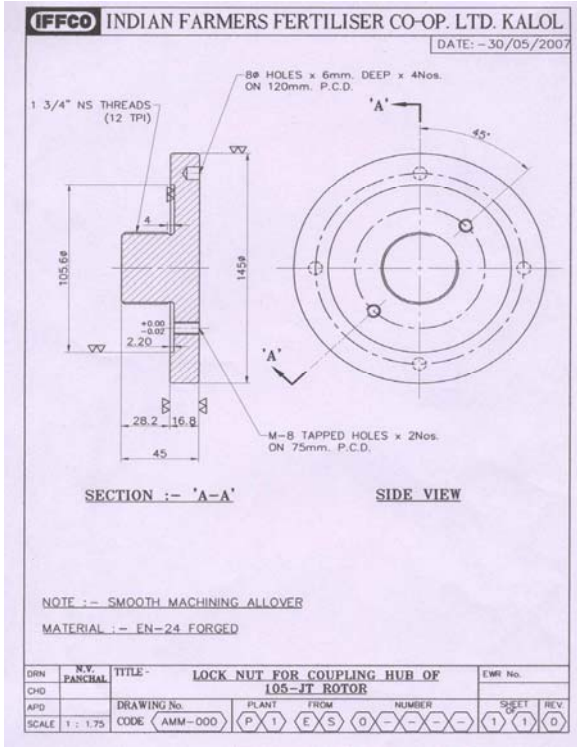
General view of Rotor Removal from bottom casing



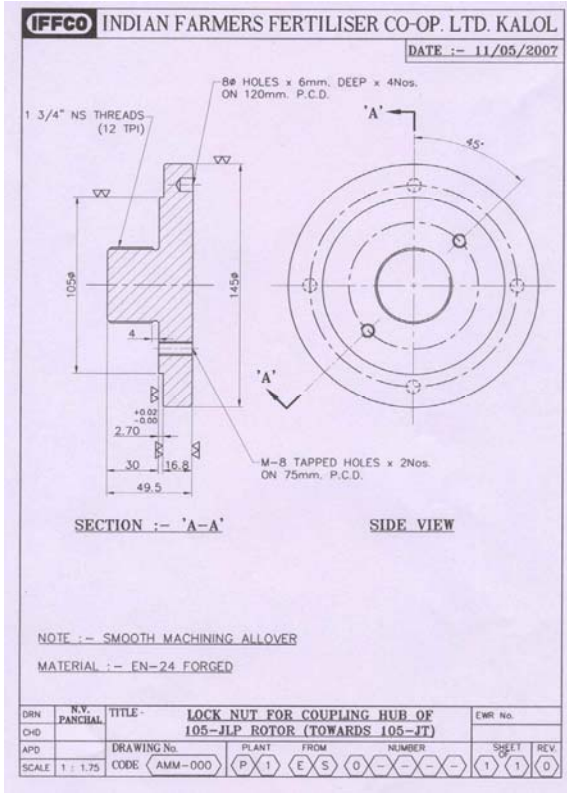
Photograph showing Locknut installed on the 105-JHP Rotor Shaft

Locknuts on shaft for all the hydraulically fitted coupling hubs were installed. The locknut sketch is given below:

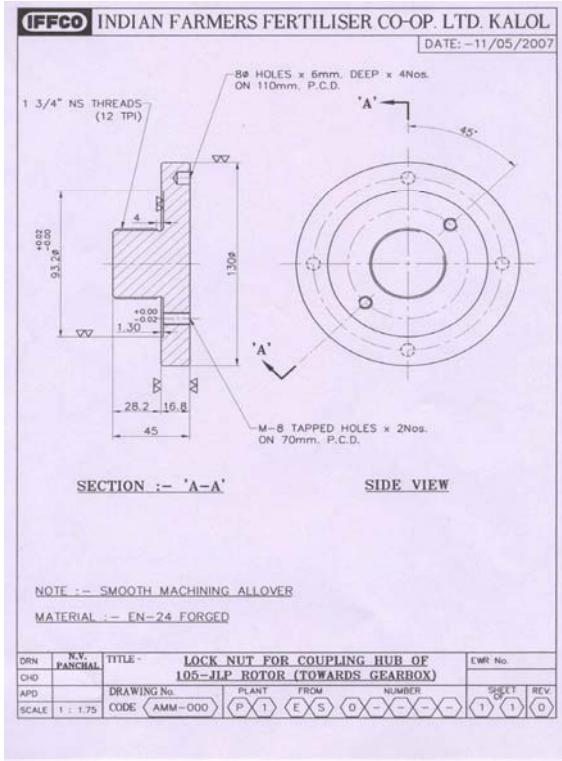
LOCK NUT ON 105-JT:



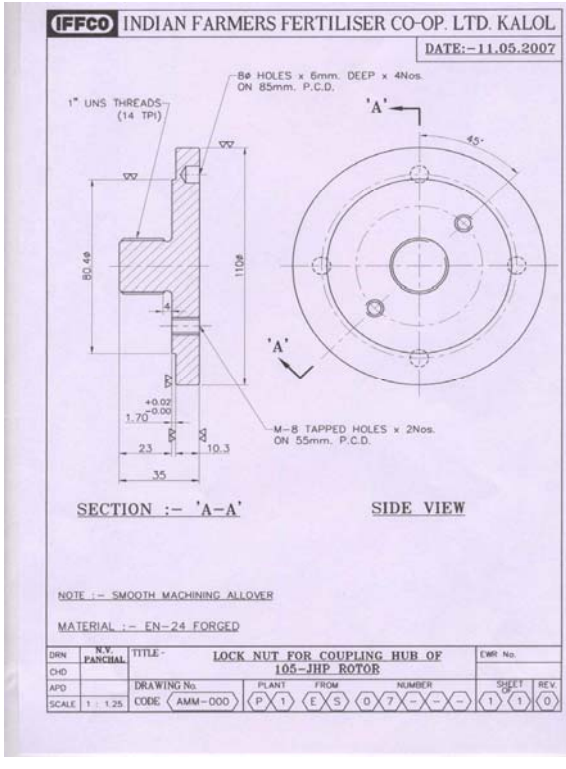
LOCK NUT 105-JLP (TOWARD 105-JT):



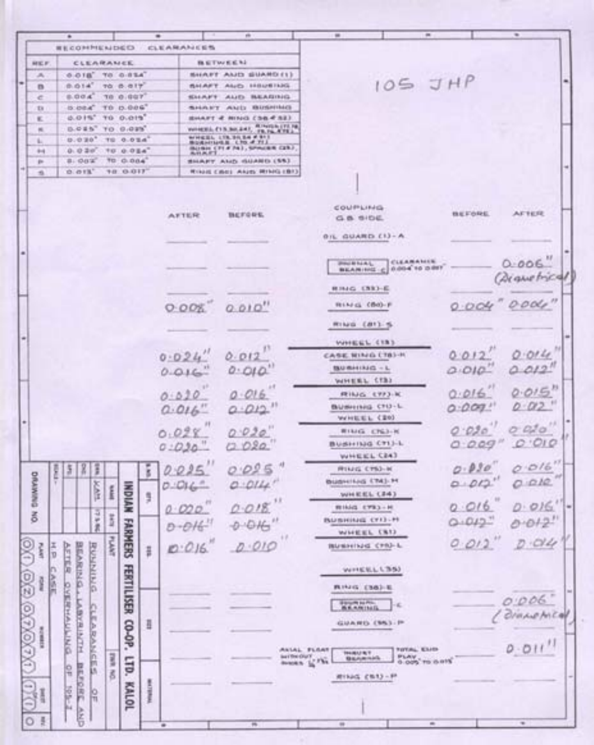
LOCK NUT 105-JLP (TOWARD GB):



LOCKNUT 105-JHP:



Labyrinth Clearances recorded with old Rotor and with New Rotor. The readings are as follows:



RECOMMENDED CLEARANCES

REF	CLEARANCE	BETWEEN
A	0.018" TO 0.024"	SHAFT AND GUARD (1)
B	0.014" TO 0.017"	SHAFT AND HOUSING
C	0.004" TO 0.007"	SHAFT AND BEARING
D	0.004" TO 0.006"	SHAFT AND BUSHING
E	0.015" TO 0.019"	SHAFT & RING (38 & 33)
K	0.025" TO 0.035"	WHEEL (15,30,24), RINGS [illegible]
L	0.020" TO 0.024"	WHEEL [illegible], BUSHINGS [illegible]
M	0.020" TO 0.024"	BUSH (71 & 74), SPACER (23), SHAFT
P	0.002" TO 0.004"	SHAFT AND GUARD (55)
S	0.013" TO 0.017"	RING (80) AND RING (81)

105 JHP

AFTER	BEFORE	COUPLING G.B. SIDE	BEFORE	AFTER
		OIL GUARD (1)-A		
		JOURNAL BEARING -C CLEARANCE 0.004" TO 0.007"		0.006" (Diametrical)
		RING (33)-E		
0.008"	0.010"	RING (80)-F	0.004"	0.006"
		RING (81)-S		
		WHEEL (15)		
0.024"	0.012"	CASE RING (78)-K	0.012"	0.014"
0.016"	0.010"	BUSHING -L	0.010"	0.012"
		WHEEL (13)		
0.020"	0.016"	RING (77)-K	0.016"	0.015"
0.016"	0.012"	BUSHING (71)-L	0.007"	0.012"
		WHEEL (20)		
0.028"	0.020"	RING (76)-K	0.020"	0.020"
0.020"	0.020"	BUSHING (71)-L	0.009"	0.010"
		WHEEL (24)		
0.025"	0.025"	RING (75)-K	0.020"	0.016"
0.016"	0.014"	BUSHING (74)-M	0.012"	0.010"
		WHEEL (24)		
0.020"	0.018"	RING (73)-K	0.016"	0.016"
0.016"	0.016"	BUSHING (71)-M	0.012"	0.012"
		WHEEL (31)		
0.016"	0.010"	BUSHING (70)-L	0.012"	0.014"
		WHEEL (35)		
		RING (38)-E		
		JOURNAL BEARING -C		0.006" (Diametrical)
		GUARD (55)-P		
		AXIAL FLOAT WITHOUT SHOES; THRUST BEARING; TOTAL END PLAY 0.005" TO 0.015"		0.011"
		RING (51)-P		

INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL

RUNNING CLEARANCES OF BEARING, LABYRINTH BEFORE AND AFTER OVERHAULING OF 105-J H.P. CASE

Free Axial Float and other readings are as follows:

105 JHP			
	Design	**Old Rotor**	**New Rotor**
Thrust end bearing	0.004 - 0.007	0.006”	0.006”
Opp Thrust end bearing	0.004 - 0.007	0.006”	0.006”
Axial Thrust	0.008 - 0.012		0.011”
Axial Float (Top casing removed, Thrust Brg. Boxed up)		0.65 mm	0.30 mm
Axial Float (Top casing removed, Thrust Brg. Removed)		4.3 mm	4.5 mm
Thrust Collar Run Out			0.0015”

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

Sr. No.	**Component Description**	**Max. gauss reading**	
		Before	**After**
105-J, REF. GAS COMPRESSOR:			
1	**Turbine Free End Journal Bearing**		
1.1	Base Ring	1.1	
1.2	Pads	1.3	
1.3	Shaft Journal	2.6	
2	**Turbine Coupling End Journal Bearing**		
2.1	Shaft Journal Portion	2.6	
2.2	Thrust Collar	2.8	
2.3	Base Ring	4.0	
2.4	Pads	6.0	0.2
2.5	Thrust Bearing	1.4	
3	**HP Case Coupling End Journal Bearing**		
3.1	Shaft Journal Portion	3.9	2.3
3.2	Pads	3	
3.3	Bearing Base Ring	1.4	
4	**HP Case Free End Thrust Bearing**		
4.1	Thrust Bearing Shaft	12	3.1
4.2	Thrust Bearing Pads	2.0	
4.3	Thrust Collar	5	0.9
5	**LP Case Free End Thrust Bearing**		
5.1	Thrust Bearing Shaft	0.6	
5.2	Thrust Bearing Pads	1.2	
5.3	Thrust Bearing Base Ring	5.2	2.0
5.4	Thrust Collar	0.9	
6	**Gear Box**		
6.1	LS Shaft South side	1.4	
6.2	LS Shaft South side Bearing	3.7	1.4
6.3	LS Shaft North side	2.0	
6.4	LS Shaft North side Bearing	2.1	
6.5	HS Shaft South side	0.9	
6.6	HS Shaft South side Bearing	12.0	3.2
6.7	HS Shaft North side	1.3	
6.8	HS Shaft North side Bearing	4.2	1.6

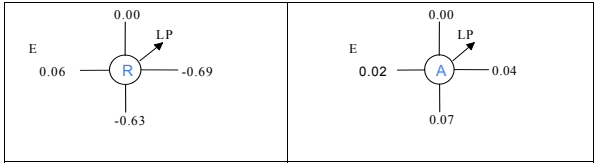
Locknuts were provided in all the hydraulic gear coupling of 105-J Train to avoid slippage of the coupling hub. Rotor was not dynamically balanced after this modification. However after this modification, the machine vibration reading noted from the Bentley panel was normal and compared with the reading of the same before tripping of the machine was also normal. Some sample vibration readings are as given below:

Comparative Statement of Bently Readings of 105-J Train:

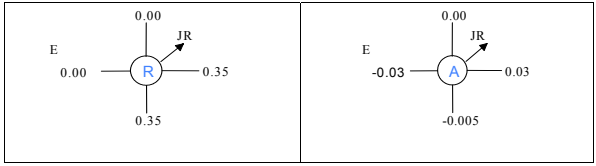
BEFORE TURNAROUNE-2007			AFTER TURNAROUNE-2007
Location	**Description**	**Amplitude in Mil**	**Amplitude in Mil**
1H	Turbine FJB (x)	0.60	0.59
1V	Turbine FJB (y)	0.76	0.66
2H	Turbine RJB (x)	0.65	0.41
2V	Turbine RJB (x)	0.71	0.45
3H	LP Compressor FJB (x)	0.40	0.86
3V	LP Compressor FJB (y)	0.48	0.75
4H	LP Compressor RJB (x)	0.25	0.37
4V	LP Compressor RJB (y)	0.27	0.37
7H	HP Compressor FJB (x)	0.77	0.63
7V	HP Compressor FJB (y)	0.97	0.56
8H	HP Compressor RJB (y)	0.96	1.09
8V	HP Compressor RJB (y)	1.16	1.84
Operating Parameters	**Date :11-04-2007 Turbine Speed : 5850 RPM Plant Load : 89 % Time : 16:00 Hrs**		**Date :14-05-2007 Turbine Speed :6018 RPM Plant Load : 89 % Time : 16:30 Hrs**
Legend	H-Horozontal, V-Vertical, FJB – Front journal Bearing, RJB-Rear journal Bearing,		
Remark	Lock nut provided at coupling of Turbine shaft, LP compressor shaft both end & HP compressor shaft		

Train Alignment Reading (All readings are in mm) are as below:

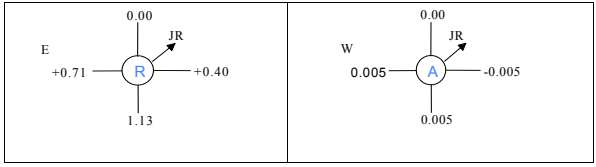
105-JT to 105-JLP (FINAL)



105-JLP to 105-JR (FINAL)



105-JR to 105-JHP (FINAL)



INDUCED DRAFT FAN 101-BJT TRAIN

ID Fan Drive Turbine, 101- BJT, Preventive Maintenance.
Turbine was decoupled and both ends bearings as well as thrust bearings were inspected and found O.K. Gauss measurement of rotor both end shaft journal, journal and thrust bearing pads / base rings and thrust collar, was measured and found within 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. The PGPL governor was replaced. The governor oil cooler channel cover was replaced by new channel cover fabricated at our workshop.

ID Fan, 101- BJ, Preventive Maintenance.

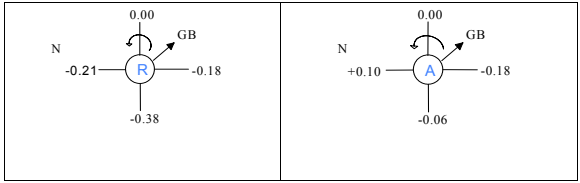
Journal bearings and thrust bearings were inspected and found O.K. Gauss reading was taken and found below maximum allowable limit. All the bearing pads were Dye Penetration tested and no surface cracks were found Bearing clearances were taken and found within the design range. The bearing dust seals were replaced. Cooling water was circulated in lines and no leaks were observed. The final bearing clearance was measured and found within design range.

Gear Box, 101-BJR, Preventive Maintenance.
The gear and pinion were inspected and found O.K. All the bearings were inspected and found O.K. Gauss measurement of gear shaft and bearings carried out and found within limit. The oil was flushed with new oil. The final bearing clearance was measured and found within design range.
Final clearances reading of the train is as under:

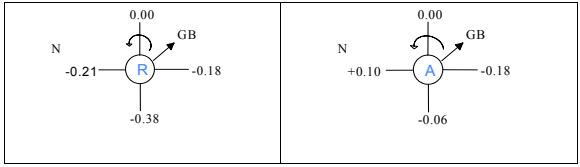
Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
101 BJT			
Thrust end bearing	0.006 - 0.009	0.005 - 0.010	0.005 – 0.010
Opp Thrust end bearing	0.006 - 0.009	0.004 – 0.011	0.004 – 0.011
Axial Thrust	0.014 "	0.0157	0.0157
101 BJR			
Pinion bearing (Turbine side)	0.005 - 0.0108	0.009	0.009
Pinion bearing (Fan side)	0.005 - 0.0108	0.0078	0.0078
pinion float	N.A.	0.025	0.025
Gear bearing (Turbine side)	0.005 - 0.0108	0.006	0.006
Gear bearing (Fan side)	0.005 - 0.0108	0.0078	0.0078
Gear Thrust	N.A.	0.027	0.027
Back lash	N.A.	0.0149	0.0188
101 BJ			
Thrust end bearing (coupling side)	0.008 - 0.012	0.011 – 0.014	0.011 – 0.014
Opp Thrust end bearing	0.008 - 0.012	0.011 – 0.013	0.011 – 0.013
Axial Thrust	N.A.	0.054	0.054

Final alignment reading of the train is as under:

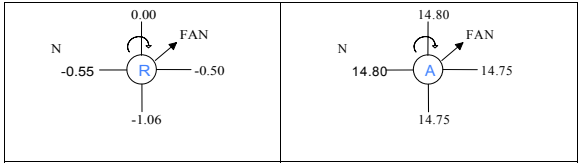
101 BJT to 101 BJR (Before PM)



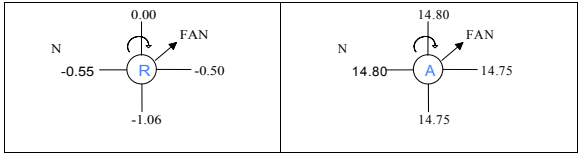
101 BJT to 101 BJR (After PM)



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



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



RETROFITTING OF 101/105-J LUBE OIL PUMP DRIVE COPPUS TURBINE:

The turbine speed was governed by TG10 type governor. In this retrofit the existing governing system was replaced with electronic governor TG13E actuator having PEAK 150 controller.

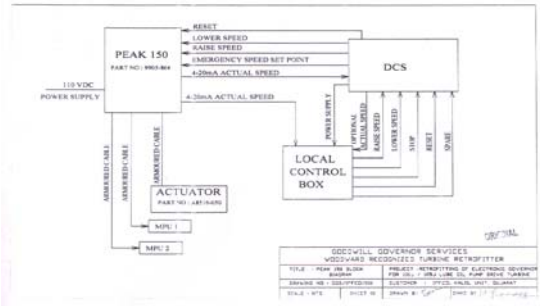
To enhance the speed control of the turbine, the mechanical governor was replaced by new Woodward electronic governor. The following were used for the retrofit:

- TG13E Actuator : 1 No.
- Magnetic Pick Up Unit (MPU) : 2 Nos.
- PEAK-150 Controller : 1 No.
- Tooth wheel : 1 No.
- MPU Cable : 200 Meters.

Turbine Detail is as follows:

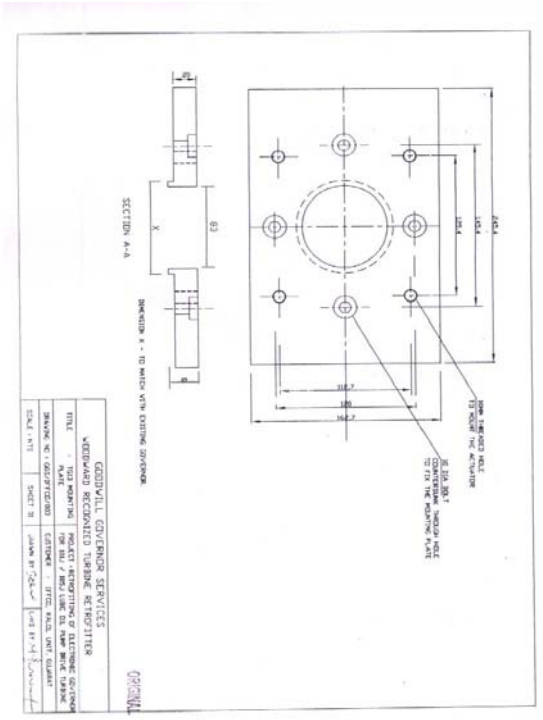
- Make : COPPUS ENGINEERING, USA
- Sr. No : 71 T 9030
- Turbine type & size : TFV – 16L
- Rated Speed : 1750 RPM
- Normal Speed : 1450 RPM
- Power Rated : 50 HP
- Inlet steam Pressure : 525 PSIG
- Exhaust steam pressure : 50 PSIG
- Steam temperature : 610 F
- Trip Speed : 2200 RPM
- Rotation : Counter clockwise from coupling side
- Installation : Vertical

Peak 150 block diagram for the retrofitted TG 13 Governor is below:



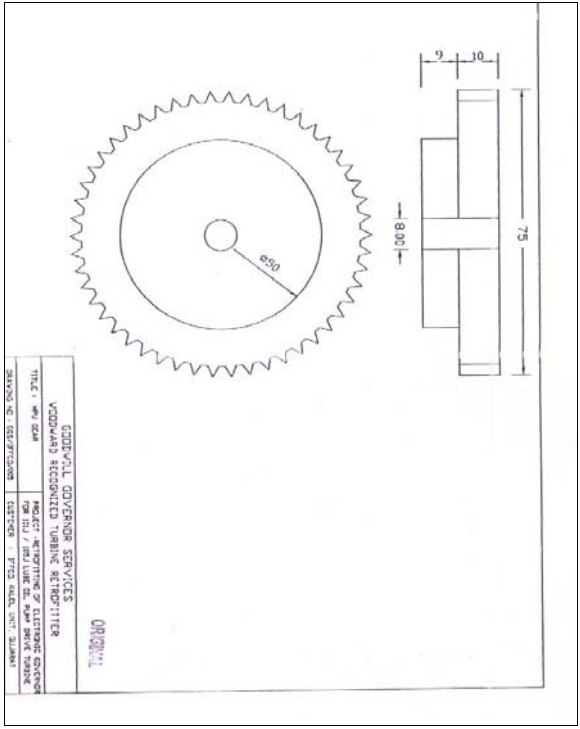
Peak 150 block diagram

Details of TG 13 mounting plate on turbine is as below:



TG 13 mounting plate

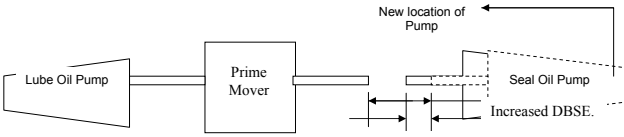
MPU Gear for new Governor:



103-J SEAL OIL PUMP RELOCATION

The 103-J Seal oil pump was so positioned that, the after decoupling, the DBSE was not sufficient for remove the mechnical seal of the pump at site. Hence whenever there was a mechanical seal failure the pump had to be completely removed to attend the failure. Hence both the seal oil pumps were shifted by about 4" away from their prime mover to facilitate the removal of mechanical seal at site.

The Original & Final Position of 103-J Seal Oil Pump



4". The increased DBSE will facilitate the removal of Mech. Seal at site.

BOILER FEED WATER PUMP, 104-JA OVERHAULING AND DRIVE TURBINE 104-JAT PREVENTIVE MAINTENANCE

BOILER FEED WATER PUMP, 104-JA OVERHAULING:

The Boiler Feed Water Pump 104-JA showed high vibrations. Before Shutdown, even after realignment the vibrations did not stop. Further the shims of the coupling flexible element were found broken. Hence it was decided to replace the complete rotor assembly of pump. The turbine was taken for preventive maintenance.

104-J Rotor Assembly Replacement and Overhauling

The pump was decoupled and the alignment readings were noted. The flexible elements and fasteners were inspected and found in good conditions. The coupling hub was removed. Both end radial bearing sleeves was removed and inspected and found in good condition. The bearing clearance was noted.

A systematic step by step procedure followed for complete dismantling, replacement of rotor and reassembling, has been elaborated below:

- The NDE lube and cooling water lines were removed. The main oil reservoir and the pumps were removed. Both end mechanical seals were locked and removed.
- The ***Discharge Diffuser – Head assembly*** constituting of Head, Discharge Diffuser, Inner Head Gasket & Pressure Reducing Bushing, was removed with the help of screw jack. A ***1-1/4" x 12" long x UNF thread***. stud was used as the jack.

- The ***Unitized internal assembly*** was pulled out with the help of a Hydra. Wooden sleepers were kept below the assembly to guide the same. The assembly was taken to main workshop and placed horizontally on floor for dismantling.

- The Shaft Sleeve Compression Nut, Shaft Sleeve, Seal Ring & Inlet Spacer respectively came out with ease.

- The 1st Impeller Spacer Sleeve / Lock Nut got struck on the shaft and could not be removed. The same was removed by cutting on lathe.

- The 1st stage Impeller also got struck on the shaft. The impeller was heated and attempt was made to remove it by pulling with a special jack, but the same did not come out. The rotor was cut and drilled on lathe to remove the impeller.

- Then the 1st set of Intermediate Cover with, Bushing, Wearing ring & Diffuser was removed.

- Then the 2nd Impeller Spacer Sleeve / Lock Nut was removed & the 2nd stage impeller was pulled out.

- Steps No 8.0 & 9.0 was repeated to dismantle the remaining stages i.e. from .3rd to 7th.

- Before removing each impeller, the following were measured and tabulated to calculate the clearances :

    - Impeller ***Wear Ring*** O.D.
    - Impeller ***Spacer Sleeve*** O.D.
    - Removed Suction Spacer /Intermediate Cover/ Discharge Spacer ***Wear Ring*** I.D.
    - Removed Suction Spacer / Intermediate Cover/ Discharge Spacer. ***Bushing*** I.D.

- The run out of the new rotor assembly of Shaft, Impellers & Impeller Spacer Sleeve was checked on 'V' Block and found within limit. The assembly was later dismantled leaving behind the shaft assembled with Pressure Reducing Sleeve, Pressure Reducing Sleeve Lock Nut, Shaft Sleeve & Shaft Sleeve Compression Nut.

- The above assembly was placed vertically with the Pressure reducing Sleeve seated in between two I-Beams and coupling end open towards top.

- Vertically installation was started with 7th Impeller with Wear Ring and the same was locked with Spacer Sleeve.

- Then assembly of Discharge Spacer, Wearing ring, Bushing & Diffuser was installed.

- Steps No 13 & 14 was repeated until the 1st Impeller and the 1st Impeller Lock Nut was installed.

- After installing each impeller, the following were measured and tabulated to calculate the clearances. :

  - Impeller ***Wear Ring*** O.D & ***Spacer Sleeve*** O.D.
  - Next Suction Spacer/Intermediate Cover/Discharge Spacer ***Wear Ring*** I.D.
  - Next Suction Spacer / Intermediate Cover/ Discharge Spacer. ***Bushing*** I.D.

- Finally the Suction Spacer with Wear Ring was installed. This was followed by installation of seal Ring, Shaft Sleeve & Shaft Sleeve Compression Nut. The ***Unitized internal assembly*** was ready to be installed in the casing.

- The Unitized internal assembly was placed inside the casing and the ***Discharge Diffuser – Head assembly*** bolted to the casing.

- Both ends mechanical seals were installed. The stationary and rotating rings of both the mechanical seals were lapped and reassembled. All the 'O'-Rings were replaced by new ones.

- The centering of the complete rotor assembly was checked with a dial gauge. The assembly was found to be having eccentricity of 0.2 mm towards the coupling end. The coupling end bearing housing was lowered by 0.2 mm to nullify the eccentricity.

Preventive maintenance of Boiler Feed Water Pump Drive Turbine 104-JAT

The turbine float was measured and found to 0.0275" well above the design range of 0.011" – 0.016". The coupling end journal bearings were dismantled and inspected and found in good conditions. The bearing sleeve was cleaned and reassembled. The diametrical clearance was measured and found within limit. The Non Drive End Kingsbury thrust cum journal bearing was removed and dismantled. The seating area of thrust pads were found damaged. The complete assembly was replaced by new one. Gauss measurement of rotor as well as bearing was done and degaussing was done wherever required. Both ends bearings were boxed up and final Axial Thrust was measured at 0.010".

The governing valve was dismantled for replacing the carbon rings and washers. 10 No of carbon rings and washers were replaced by new ones. The rings and the washers were placed alternatively.

The ***governing valve*** adjustment was done as follows:

- Total design valve opening / travel : 9/16"
- Half opening /travel : 9/32"
- Lever was set horizontal with valve 9/32" open.
- Servomotor piston was held at 7/32" from top stop and connecting rod was adjusted so as to keep the valve just closed.

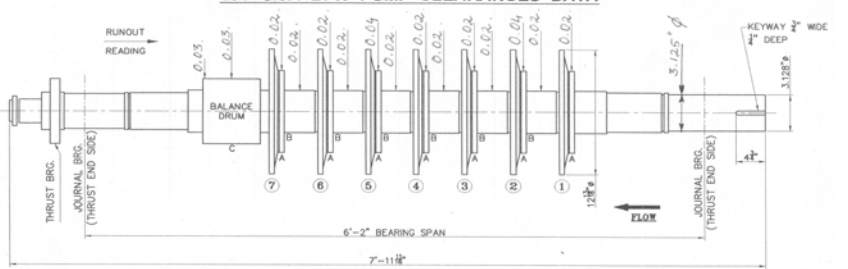
An overview of 104-JA, BFW PUMP during dismantling:

The readings of various clearances taken are as follows:

Description	Design Clearance (Inch)	Before PM (Inch)	After PM (Inch)
104-JAT (TERRY TURBINE)			
Thrust end bearing	0.005-0.007	0.009	0.008
Opp thrust end bearing	0.005-0.007	0.006	0.006
Axial Thrust	0.011-0.0016	0.027	0.010
104 JA			
Thrust end bearing	0.006 - 0.008	0.0068	0.006
Opp Thrust end bearing	0.006 - 0.008	0.008	0.006
Axial Thrust	0.014	0.010	0.012
DBSE	127 mm	129.5	129.5

SD APRIL - MAY - 2007

104 - 8/JA BFW PUMP CLEARANCES DATA



IMPELLER NECK RING CLEARANCE (A)

IMPELLER NO.	WEAR RING I.D. SUC. : 8.500" INT. : 7.375"	NECK RING O.D. SUC. : 8.485" INT. : 7.362"	CLEARANCE SUC. : 0.015" INT. : 0.013"
1	8.485	8.467	0.018
2	7.368	7.346	0.022
3	7.366	7.345	0.021
4	7.364	7.345	0.019
5	7.365	7.345	0.020
6	7.365	7.345	0.020
7	7.364	7.346	0.018

INTERSTAGE BUSHING CLEARANCE (B)

BETWEEN IMPELLER NO.	BUSH I.D. 4.000"	SLEEVE O.D. 3.988"	CLEARANCE 0.012"
1–2	3.999	3.979	0.020
2–3	3.996	3.979	0.017
3–4	3.995	3.980	0.015
4–5	3.995	3.980	0.015
5–6	3.997	3.979	0.018
6–7	3.997	3.979	0.018

SR NO.	DESCRIPTION	DESIGN	ACTUAL
1	JOURNAL BRG. CLEARANCE (COUPLING SIDE)	0.006"–0.008"	0.006"
2	JOURNAL BRG. CLEARANCE (THRUST END SIDE)	0.006"–0.008"	0.006"
3	AXIAL THRUST	0.014"	0.012"
4	TOTAL FLOAT		

BALANCE DRUM CLEARANCE (C)

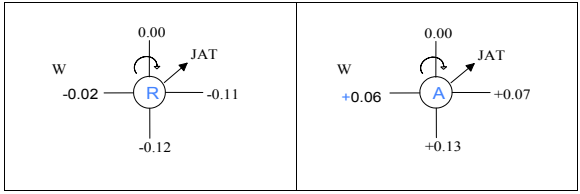
BUSH I.D. 6.875"	BALANCE DRUM O.D. 6.868"	CLEARANCE 0.007"
6.863	6.851	0.012

NOTE :-
R.P.M. :– 3500
ROTOR WEIGHT :– 223 Kg.
SIZE :– 6" LL BFIC

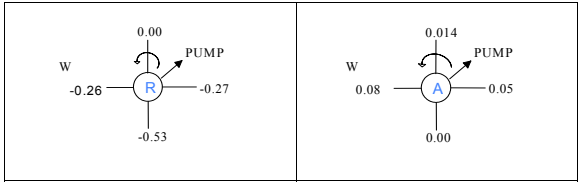
Clearance chart

The alignment readings are as follows.

104-JAT to 104-JA (Before PM)



104-JAT to 104-JA (After PM)

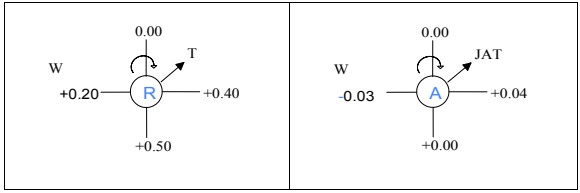


AMDEA PUMP DRIVE TURBINE (MURRY), 107-JT, PREVENTIVE MAINTENANCE

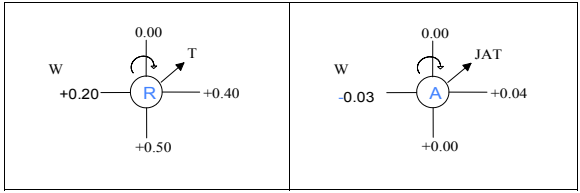
The turbine was decoupled and the coupling was inspected. The pump side flexible elements we found broken. Bearings were inspected and found in good condition. The final journal bearing clearances were measure and found within the design range. The suction strainers were cleaned. Gauss measurements was taken and found below maximum limit. Oil console was cleaned.

The alignment readings are as follows.

107-JT to 107-J (Before PM)



107-JT to 107-J (After PM)



The clearances readings are as follows:

Description	Design Clearance (Inch)	Before PM (Inch)	After PM (Inch)
107-JT (MURRY TURBINE)			
Thrust end bearing	0.004 – 0.006	0.0058 – 0.0068	0.0059 – 0.0068
Opp thrust end bearing	0.004 – 0.006	0.0058 – 0.0062	0.0062 – 0.007
Axial Thrust	0.007 – 0.013	0.0101	0.010

LEAN aMDEA SOLUTION PUMP TRAIN

115-JA Pump Rotor Replacement Job:

During shut down, Preventive Maintenance was done and general condition of Bearings, Couplings, and Gear Box was okay. After opening of bearing, clearance noted and found to be within limit. Gauss measurement was also taken and found to be within the limits.

After preventive maintenance of 115-JA Train, the equipment was taken in line in startup of Ammonia Plant. 115-JA and Gear Box Coupling, Coupling bolts of the Gear Box Coupling Hub was reported broken from production side. Upon inspection, coupling bolts of the Gear Box Coupling Hub towards Gear Box Side was found sheared and 115-JA pump was found jam. There was no movement of Rotor in any direction.

Bearings were opened and found Okay. Casing bolts were opened. Top Casing was found heavily jam and was not coming up with the help of jack bolts. There was provision of only 2 jack bolts at 180 degree apart. After removal of Top casing with difficulty, additional provision for 2 jack bolts at 180 degree apart was done in workshop. Top casing weighing was done and it was 1370 Kgs.

After removal of Top casing, the following items were found seized with Rotor (Refer KEPL Drawing No. KSO 010140 001 0100, Rev. 1):

- Stage Piece (Balancing Drum ring) - 2nd stage, Part No. 74-2.
- Impeller wear Ring – Ist stage, Part No. 25-1 (both sides).
- Impeller wear Ring – 2nd stage, Part No. 25-2.

Mechanical seals of both ends (Part No. 111-1 & 111-2) were found damaged.

Rotor assembly was removed from Bottom Casing. The Rotor was found heavily jam and was not coming up with the help of 5 Ton EOT. The same was removed with the help of RT Crane.

After thorough cleaning of casings and internals, the assembly was started with new Dynamically Balanced Rotor assembly available at store. The Rotor assembly was issued from store against Store code: 113150146300. Dimensions of Rotor were recorded for making Drawing.

While assembly, stage Piece (Balancing Drum ring) - 2nd stage, Part No. 74-2 was not properly fitted in the bottom casing groove. The OD of the ring was measured larger than the corresponding ID.

ID of stage Piece (Balancing Drum ring) - 2nd stage, Part No. 74-2 in the bottom casing was 389.62 mm & OD was 390.00 mm.

High spots were removed from casing grooves and a cut of 0.15 mm on the stage piece ring OD was taken in the workshop. Match the ring with top and bottom casings. Clearance with bottom casing was measured 0.02mm.
The rotor assembly was placed the in the bottom casing. Free float of the Rotor was measure 15.8 mm against design of 6 mm minimum.

The rotor was fixed in position by tightening the journal bearing of both sides. Clearances from Gear Box to Clutch side were measured and these are as follows:

Sr. No.	Item Description	Design Clearance Total (mm)	Clearance between Rotor shaft (Top position) (mm)	Clearance between Rotor shaft (Bottom position) (mm)
1	Throat Bush, Gear Box side	00		
2	stage Piece (Balancing Drum ring) - 2nd stage, Part No. 74-2.	0.510 – 0.569	0.30	0.30
3	Impeller wear Ring – 2nd stage, Part No. 25-2. Clutch end side	0.580 – 0.656	0.30	0.25
4	stage Piece (Center ring) – Ist stage, Part No. 74-1.	0.510 – 0.569	0.35	0.30
5	Impeller wear Ring – Ist stage, Part No. 25-1. Gear Box side	0.580 – 0.656	0.40	0.25
6	Impeller wear Ring – Ist stage, Part No. 25-1. Clutch end side	0.580 – 0.656	0.30	0.25
7	Throat Bush, Clutch end	00		

After taking all the measurement, the top casing half was boxed up. New mechanical seals were installed (Store code: 113155136900). All the gaskets were replaced with new one. Bearings were assembled.

Bearing clearances are as follows:

Description	Design (mm)	Actual (mm)
Journal Brg. Cl. (Thrust end side)	0.217 to 0.249	0.20
Journal Brg. Cl. (Opp. Thrust end side)	0.217 to 0.249	0.24
Axial Thrust	0.35 to 0.40	0.35

115-JAT Turbine Preventive Maintenance:

Both ends bearings were opened and general condition of the bearings were found ok. Clearances were measured and found within limit. Gauss readings were also taken and found within limit.

115-JHT Hydraulic Turbine Preventive Maintenance:

Both ends bearings were opened and general condition of the bearings were found ok. Clearances were measured and found within limit. Gauss reading was taken and found within limit.

115-JA GEAR BOX:

Gear box top cover was opened. General condition of the gear teeth was found ok. Gear box boxed up. Clearances of the bearing were measured.

- High speed pinion shaft Brg. (Turbine side): 0.15 – 0.20 mm
- High speed pinion shaft Brg. (Pump side): 0.18 – 0.22 mm
- Low speed Gear shaft Brg. (MOP side): 0.18 – 0.24 mm
- Low speed Gear shaft Brg. (Pump side): 0.18 – 0.24 mm

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT:

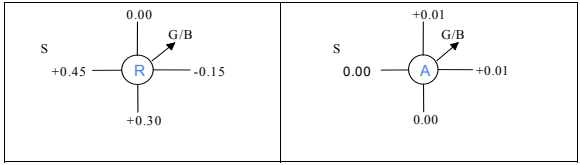
Sr. No.	Component Description	Max. gauss reading	
		Before	After
115-JAT			
1	**Turbine Thrust End**		
1.1	Thrust Pads	1.8	
1.2	Thrust collar	1.2	
1.3	Shaft Journal	0.8	
1.4	Journal Bearing	2.2	

2	**Turbine coupling end**		
2.1	Shaft Journal	2.9	
2.2	Journal Bearings	2.6	
3 115-JA			
3.1	Thrust Bearing Pads	7.0	1.6
3.2	Thrust Collar	2.9	
3.3	Journal bearing	3.4	
3.4	Shaft Journal	0.5	

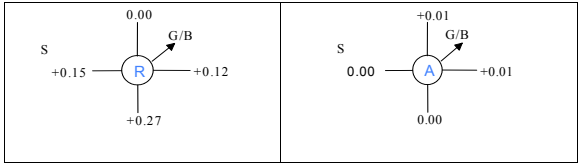
Alignment readings of the train is as follows:

Turbine to Gear Box

Before:

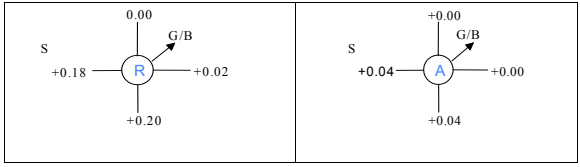


Final:

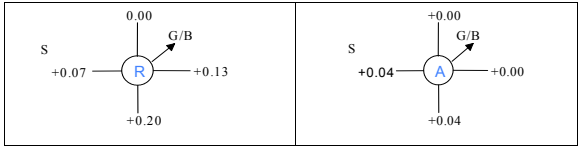


Gear Box to Pump

Before:

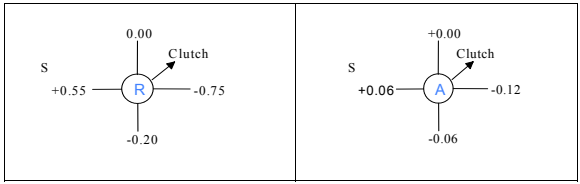


Final:

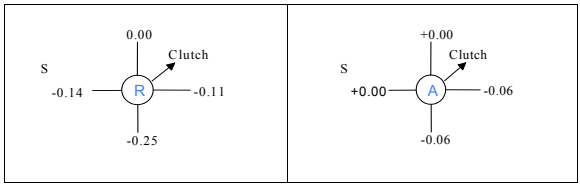


Pump to Clutch

Before:



Final:



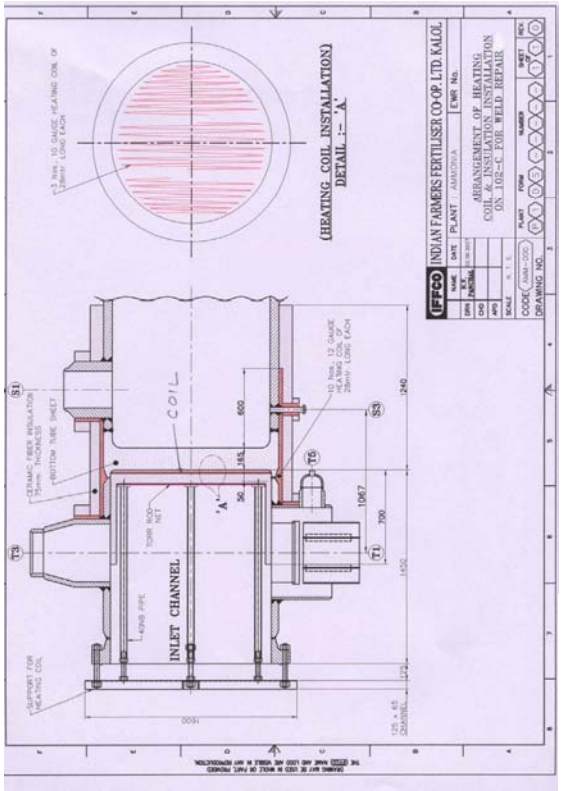
115-JB Pump Preventive Maintenance

Pump bearings opened and checked the clearances and found to be within the limit.

SECONDARY WASTE HEAT EXCHANGER 102-C

This exchanger was repaired for leakages during anuual turn around of 2005 and 2006 by plugging and 45 tubes were plugged. It was decided to do hydrotest of Secondary waste heat exchanger (102-C) immediately after taking shut down of Ammonia Plant. Top & Bottom coves were opened. Hydrotest was carried out at 40 Kg/cm2g by motor driven BFW Pump 123-J. Seven (07) Nos. tubes and 74 Nos. tube to tube sheet seal welding leak were noticed.

102-C was taken for Plugging of leaky tubes and welding of leaky tube to tube sheet welding. Contract for the above job was awarded to M/S Skywin Erectors, Ahmedabad. 102-C is being used in Hydrogen service. Dehydrogenation of the tube sheet was required for proper welding of plug and tube to tube sheet seal weld leak. Bottom support fabrication for heating coils was done and installed in the bottom tube sheet with the help of bottom channel cover flange. Schematic / Photograph arrangement of heating coils and insulation showing the arrangement is as below:



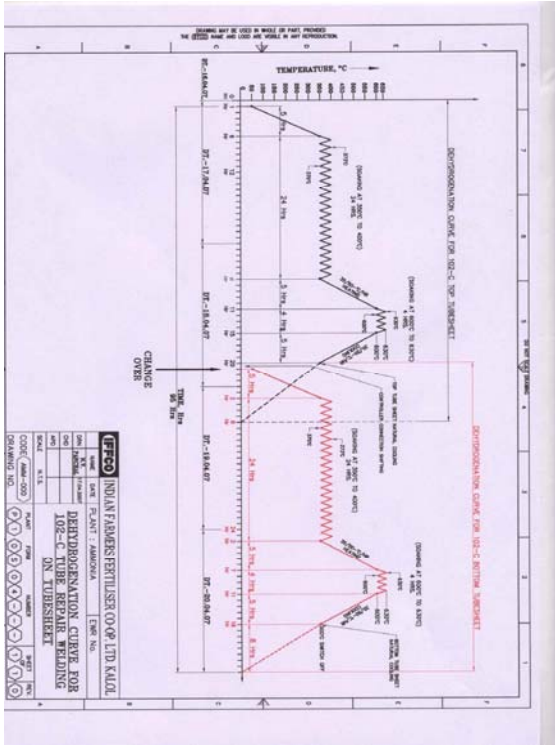
Sketch for arrangement of heating coil and insulation

Following materials were used for Dehydrogenation and PWHT for each Tube Sheet:

- Thermocouples: 10 Meter long wire of 17 Gauge thickness – 1 No.
- Heating Coils: 25 Meter long wire of 10 Gauge thickness – 3 Nos.
- Heating Coils: 25 Meter long wire of 12 Gauge thickness – 10 Nos.
- Recorder: 3 Nos.
- Control Panel: 2 Nos.
- M10 X 1 ½ " long CS Bolt with nut: 50 Nos.
- Ceramic Blanket (Cera Felt): 10 Bundles.

Photograph for arrangement of heating coil in bottom channel cover

Dehydrogenation of the Top & Bottom tube sheet was carried out as per the attached procedure as given below:



Time – Temperature curve for Dehydrogenation of 102-C

Dehydrogenation of the Top & Bottom tube sheet was carried out one by one to prevent both the tube sheets reaching elevated temperature of more than 400 degree C at same time. Total 15 Nos. thermocouples each were installed for recording temperature of Top & Bottom tube sheets. Positions of these thermocouples and application of insulation are shown as below:

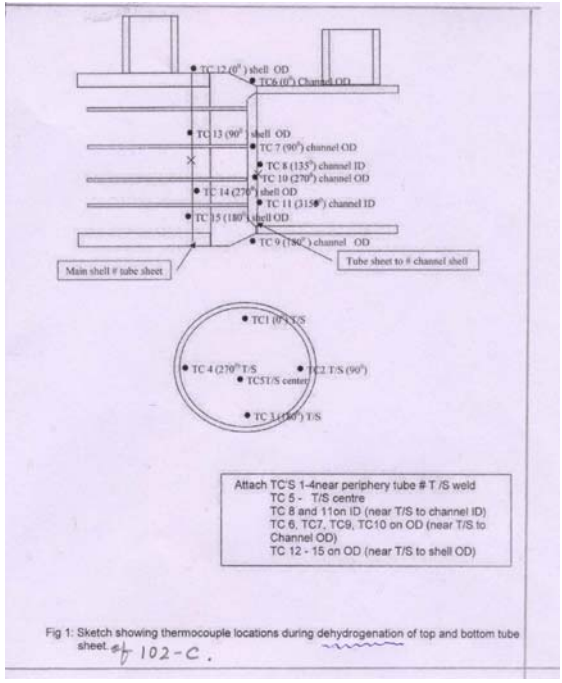


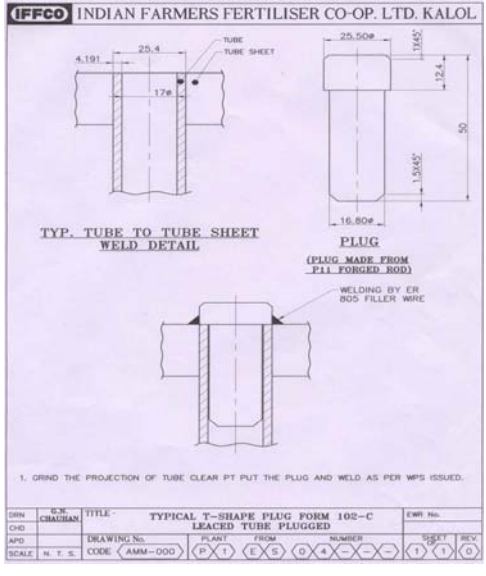
Fig 1: Sketch showing thermocouple locations during dehydrogenation of top and bottom tube sheet of 102-C.

Position of Thermocouples arrangement in 102-C

Dehydrogenation process took around 40 Hrs. for both the tube sheets. After completion of Dehydrogenation, 'hydrojet cleaning' of all the remaining 705 tubes (Upto 2006 shut down, 45 tubes were already plugged from total of 750 tubes) were carried out to facilitate RFET.

Then Remote Field Electromagnetic Test (RFET) of tubes was carried out by TesTex NDT India Pvt. Ltd., Mumbai. During this test, Six (06) tubes were detected for wall loss of 35% or more due to Baffle fretting. These 6 Nos. tubes were decided to be plugged.

Accordingly 13 Nos. tubes were plugged with T-Shaped plugs (see attached drg.) and 74 Nos. tube to tube sheet seal welding was done. To avoid dissimilar weld for tube and tube sheet weld, plug was made from same material (F-11) as that of tube sheet. For welding of plugs, filler wire ER 80SG, 2.4 MM was used. Sketch of 'T-Shape' plug is shown below:



T-Shape' plugs

After completion of above welding on both the tube sheets, the equipment was rehydrotested at 125kg/cm2g. In this hydrotest, 18 Nos. old plug weld leak were noticed in Top tube sheet and 22 Nos. tube to tube sheet seal weld & old plug weld leak were noticed in Bottom tube sheet. The same was attended. DP Test was carried out in both the tube sheets completely.

Dehydrogenation, Welding and PWHT for Repair of 102-C was done as per attached procedure (Welding and PWHT was done as per QW -201.1 Section IX, ASME BPVC which is attached below):

Welding Process : GTAW
Type : Manual

- BASE METALS (QW - 403):

  P.No. 4 to P. No. 4
  Specification : SA 182 Gr.- F11 to SA 213 Gr.-T11
  Thickness Range: Tube Sheet 165mm (6½"), Tube :- 4.191 mm (8BWG)
  Tube projection 4.76-6.35mm, Fillet of 4.76 mm.

- FILLER METALS (QW - 404):

  Weld metal analysis : A No. 3
  Filler Metal F No. : 6
  AWS No. (Class) : Filler: SFA 5.28 (ER 80SG)
  Size of Filler wire : 2.4 mm

- POSITION (QW - 405**):**

  Position of Groove Welding Progression : ALL

- PREHEAT (QW - 406**):**
  Preheat Temperature min. : 125 to 150 degree C
  Interpass Temperature max. : 300 degree C
  Preheat Maintenance : 150 degree C

- DEHYDROGENATION:
  Soaking Temperature: 350 degree C
  Soaking time : 24 hours
  Soaking Temperature: 620 degree C
  Soaking time : 4 hours
  Heating Rate : 50 degree C/hr
  Cooling Rate : 50 degree C/hr
  Loading/Unloading Temperature: 300 degree C

- **GAS (QW - 408)**

  Shielding gas : Argon
  Gas consumption : 99.995 %
  Flow rate : 10 to 12 litters / min

- **ELECTRICAL CHARACTERISTICS (QW - 409)**

Current	:	DC
Polarity	:	EP for GTAW
Ampere (Range)	:	80 to 130

- **TECHNIQUE (QW - 410)**

String or weave bead	:	String and weave
Initial & Interpass cleaning	:	Grinding & brushing
Single or multiple pass	:	Multiple
Travel Speed (Range)	:	4 to 6 cm/min for GTAW

- **WELD INSPECTION**

Root weld	:	DP Test
Final weld	:	DP Test

- **STRESS RELIEVING PROCEDURE**

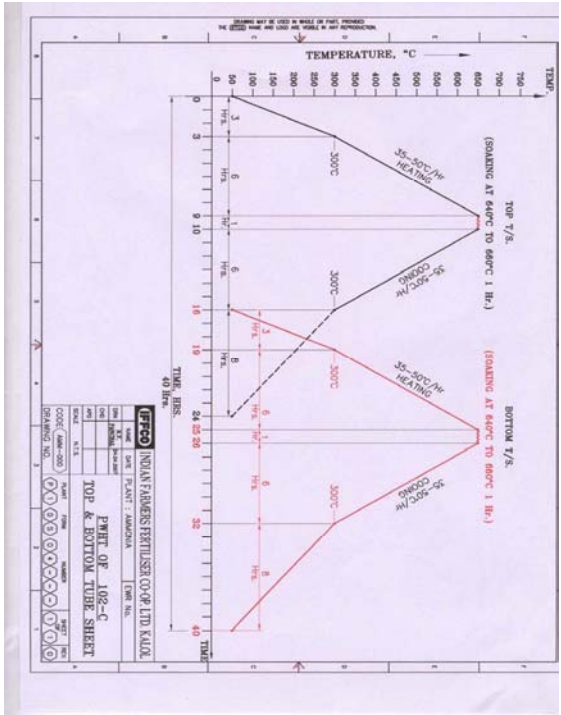
Soaking Temperature	:	650 degree C
Soaking time	:	1 hour
Heating Rate	:	50 degree C/hr (Max.)
Cooling Rate	:	50 degree C/hr (Max.)
Loading Temperature	:	300 degree C
Unloading Temperature	:	300 degree C

After completion of above welding, Post Weld Heat Treatment (PWHT) of the Top & Bottom tube sheet was carried out one by one to prevent both the tube sheets at elevated temperature of more than 400 degree C at same time.

PWHT of the Top & Bottom tube sheet was carried out as per the attached procedure depicted as below:

Total 15 Nos. thermocouples each were installed for recording temperature of Top & Bottom tube sheets. Positions of these thermocouples & application of insulation for the purpose of PWHT was similar to the application in Dehydrogenation.

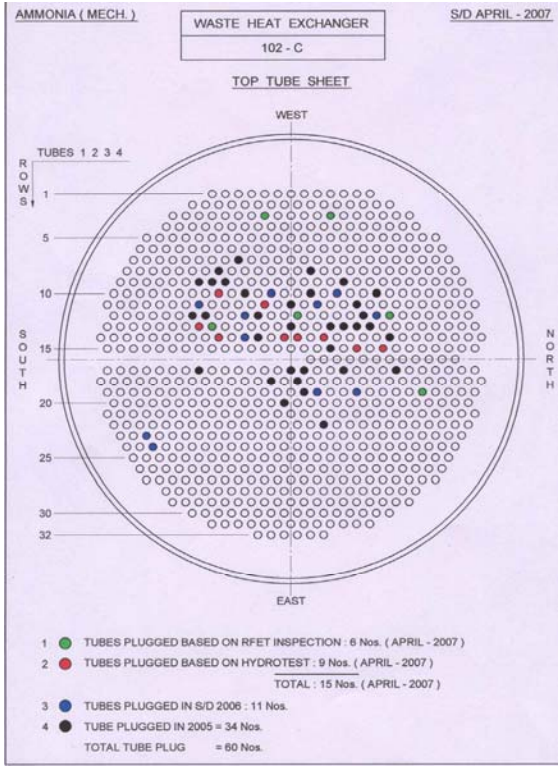
After completion of PWHT, the equipment was again hydrotested at 125kg/cm2g. In this hydrotest, Two (02) Nos. plugs were noticed leaking. The same was attended.



Time – Temperature curve for PWHT of 102-C

DP Test was carried out and found OK. The equipment was boxed up with new gaskets and handed over to production.

At present a total of 60 Nos. tubes are plugged out of 750. The final layout of tube plugged is as below:



Layout of tube sheet

Annual Inspection of Boilers GT-1631(112-C), GT-1632(101-F), and GT- 5217(107-C):

OPEN INSPECTION :

The IBR open inspection of all the above Boilers was carried out on 23/04/2007.

HYDROTEST:

Hydrotest of the following Boilers was carried out as under.

- GT-1631 at 15.0 Kg / cm ^{2}g Test Pressure on 27/04/2007.
- GT-5217 at 67.5 Kg / cm ^{2}g Test Pressure on 27/04/2007
- GT-1632 at 145.0 Kg / cm ^{2}g Test Pressure on 30/04/2007

The Boilers were inspected by IBR Inspector and found satisfactory.

Bench Test of RVs of Boiler No. GT- No.GT-5217 RVs:

Bench test of following Safety valves **1631 & Boiler** was done on 23/04/2007 and the readings are as under.

GT-1631, RV No.1 (Front)		**RV No.2 (Rear)**	
Pop. Pressure	Reset Pressure	Pop. Pressure	Reset Pressure
10.5 Kg/cm^{2}g	9.5 Kg/cm^{2}g	10.0 Kg/cm^{2}g	9.5 Kg/cm^{2}g
GT-5217, RV No.1		**RV No.2**	
Pop. Pressure	Reset Pressure	Pop. Pressure	Reset Pressure
45.0 Kg/cm^{2}g	43.65 Kg/cm^{2}g	46.3 Kg/cm^{2}g	44.9 Kg/cm^{2}g

RV FLOATING:

Boiler No. GT-1632:

Steam test of Safety valves of GT-1632 was carried out on 04/05/2007 and the readings are as under.

	RV (North)	**RV (Middle)**	**RV (South)**	**RV (Super Heater)**
Popping Press.	117.70 Kg/cm^{2}g	119.90 Kg/cm^{2}g	115.00 Kg/cm^{2}g	112.35 Kg/cm^{2}g
Reset Press.	112.20 Kg/cm^{2}g	112.70 Kg/cm^{2}g	108.00 Kg/cm^{2}g	105.15 Kg/cm^{2}g

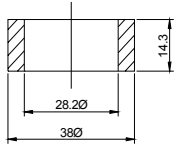
PLUGGING OF TUBES IN SECONDARY WASTE HEAT EXCHANGER (102- C) OF BOILER REG. NO. GT-1632 :

During hydrotest, total **15 no. tubes** were found leaking in Secondary waste heat exchanger (102-C). These tubes were plugged through M/s sky win erectors Ahmedabad.

ENGRAVING THE BOILER NO. 5217:

With reference to CIB letter No.SBSN / Tech / V-4/14415 Dated 27 July 2006 New registration no.GT-5217 is engraved as per IBR Regulation 1950.

SPACER LOCK NUT FOR RV 107-C



ALL DIMENSIONS ARE IN MM.

SAFETY RELIEF VALVES OVERHAULING & SERVICING:

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

Sr. NO	RV Tag NO.	Valve Size (inch)	Set Pressure (kg/cm2g)	Reset pressure (kg/cm2g)
1	RV – MS 9	4" x 6"	42.2	38.0
2	RV – S 7	4" x 6"	14.8	13.3
3	RV – LS 1	4" x 6"	12.70	11.40
4	RV – 123 CA (2 Nos)	3" x 6"	122.0	110.0
5	RV – BFW 1	1.5" x 2.5"	92.0	82.8
6	RV – S 26	2.5" x 4"	14.10	12.6
7	RV – 103 JAT (2 Nos)	4" x 6"	46.4	42.0
8	RV – 103 JAT	¾" x 1"	46.4	41.7
9	RV – 104 JAT	6" x 8"	0.37	0.30

10	RV – 112 CA	1.5” x 3”	10.50	9.5
11	RV – 112 CB	1.5” x 3”	10.50	9.0
12	RV – 109 F	6” x 8”	19.0	17.0
13	RV – 110 F N & S (2 Nos)	3” x 4”	7.0	6.3
14	RV – 111 F	4” x 6”	6.3	5.6
15	RV – 112 F	4” x 6”	6.30	5.7
16	RV – 101 D	3” x 4”	43.9	39.6
17	RV – 102 D	3” x 4”	43.9	39.5
18	RV – 117 JLP	1.5” x 2”	15.8	14.2
19	RV – 115 JB AOP	1” x 2”	11.0	10.0
20	RV – 101 J	4” x 6”	36.90	33.20
21	RV – 129 C	1” x 2”	8.4	7.5
22	RV – 104 D1	6” x 8”	35.0	33.0
23	RV – 104 D 2	1.5” x 2”	34.10	30.6
24	RV – 101 E	1” x 2”	30.6	27.5
25	RV – PG 39	4” x 6”	5.3	4.7
27	RV- 123 CA	3” x 6”	122.0	110.0
28	PSV-986	4” x 6”	45.0	40.5
29	PSV-987	4” x 6”	46.3	41.7
30	PSV-117	0.5”x1”	57.08	------
31	PSV- 111	0.5” x 1”	4.01	----
32	103-JAT Sentinel RV	1” x 2”	46.40	-------
33	RV-104-F	1” x 2”	49.20	-----

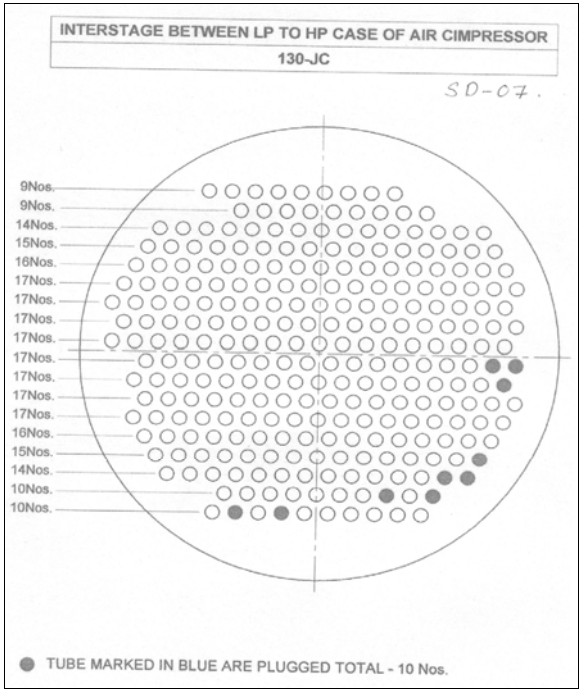
The following Pilot Operated RVs were overhauled and serviced and tested on test bench.

Sr. NO	RV Tag NO	Valve Size (inch)	Set Pressure (kg/cm2g)	Reset pressure (kg/cm2g)
1	RV – 102 F (Anderson Green)	6" x 8"	29.5	26.5
2	RV-105-D (Anderson Green)	3"x 4"	152.95	----
3	RV-105-D (Tyco)	3"x 4"	152.95	----
4	RV – 103- J (Anderson Green)	3" x 4"	158.93	------
5	RV – 103- J (Tyco)	3" x 4"	158.90	------
6	RV – 106-F (Anderson Green)	1.5' x 2"	157.94	------

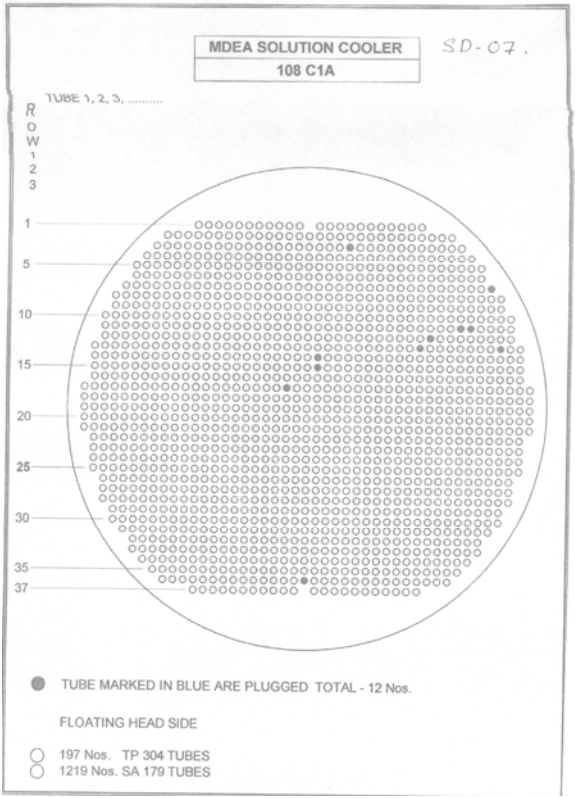
HEAT EXCHANGERS & COOLERS CLEANING BY HYDROJETTING:

The Following Heat Exchangers were opened; tube bundle pulled out for hydro jetting of shell, tube bundle & channel covers were boxed up.hydrotest was carried out as follows:

SR NO.	EQUIP. No.	Qty. (No.)	Total NO. OF TUBES	TUBE SIDE PRESSURE (KG/CM^2)		SHELL SIDE PRESSURE (KG/CM^2)		REMARKS
				DESIGN	TEST	DESI	TEST	
1	108-C1A	1	1415	5.27	8.1	8.0	8.1	12 tubes are plugged (See attached sketch below)
2	108-C2A	1	1415	5.27	8.1	8.0	8.1	
3	109-C1A	1	1150	30.58	46.0	5.29	8.1	
4	109-C1B	1	1150	30.58	46.0	5.29	8.1	
5	109-C2A	1	1150	30.58	46.0	5.29	8.1	
6	109-C2B	1	1150	30.58	46.0	5.29	8.1	
7	115-C	1	649U	29.9		10.6	15.8	
8	116-C	1	300U	66.4		10.4	15.8	
9	124-C	1	775 U	158		17.6	26.5	
10	130-JC	1	264	5.82		5.27	8.0	10 tubes are plugged(See attached sketch below)


INTERSTAGE BETWEEN LP TO HP CASE OF AIR CIMPRESSOR
130-JC
SD-07.
9Nos.
9Nos.
14Nos.
15Nos.
16Nos.
17Nos.
17Nos.
17Nos.
17Nos.
17Nos.
17Nos.
17Nos.
16Nos.
15Nos.
14Nos.
10Nos.
10Nos.
TUBE MARKED IN BLUE ARE PLUGGED TOTAL - 10 Nos.

Tube sheet layout of 130 JC



Tube sheet layout of 108 C1A

THE FOLLOWING HEAT EXCHANGERS WERE OPENED FOR HYDROJETTING OF SHELL/TUBES.HYDROTEST WAS CARRIED OUT AS FOLLOWS:

SR NO	EQP	Qty. NO.	Total No. of Tubes	TUBE SIDE PRESSURE (KG/CM^2)		SHELL SIDE PRESSURE (KG/CM^2)		REMARKS
				Design	Test	Design	Test	
1	105-CA	1	2790	5.27	8.1	30.9	46.4	
2	105-CB	1	2790	5.27	8.1	30.9	46.4	
3	110-CA	1	763	5.60	8.1	5.27	8.1	
4	110-CB	1	763	5.60	8.1	5.27	8.1	
5	127-CA	1	3516	5.60		21.10	31.5	
6	127-CB	1	3516	5.60		21.10	31.5	
7	128-C	1	1200	5.60		8.09		
8	129-JC	1	290	2.3		5.29		
9	131-JC	1	348	11.90		5.27		
10	173-C	1	294	10.60		5.27		

THE FOLLOWING LUBE OIL COOLERS WERE HYDROJETTED:

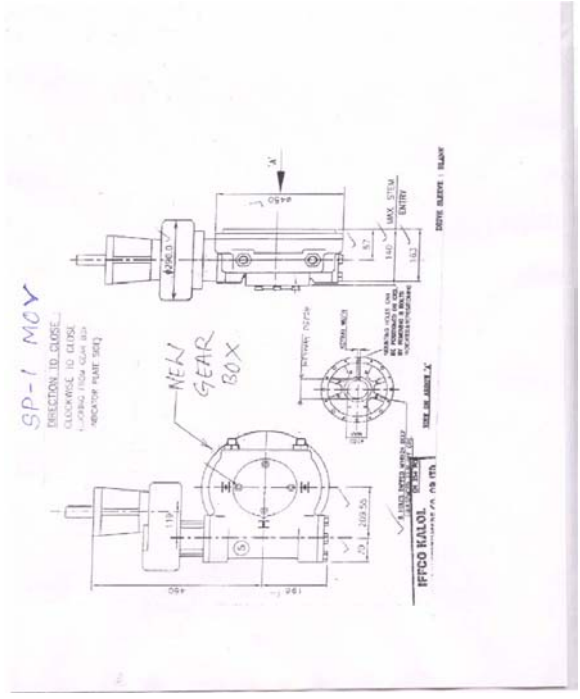
SR. NO.	EQUIPMENT NO.	Qty. NO.	DESCRIPTION	REMARKS
1.	101-JLC 1,2	2	Lube Oil Cooler For 101-J	
2	103-JLC 1,2	2	Lube Oil Cooler For 103-J	
3	101-BJ LOC	3	Lube Oil Cooler For 101-BJ	
4	107-J/JA LOC	2	Lube Oil Cooler For 107-J/JA	

THE FOLLOWING GLAND CONDENSER AND SURFACE CONDENSER WERE OPENED CLEANED BY HYDROJETTING AND BOXED UP :

SR. NO.	EQUIPMENT	NOS	DESCRIPTION	REMARKS
1.	101-JCA/JCB	2	Surface Condenser	
2	101-JCA I/A	1	Condenser	
3	101-JCB I/A	1	Condenser	
4	101-JT GC	1	Gland Condenser	
5	103-JBT GC	1	Gland Condenser	
6	105-JT GC	1	Gland Condenser	

MOTOR OPERATED VALVE SP – 1 GEAR BOX REPLACEMENT

The gear box of the motor operated valve SP – 1 had long cracks and hence new gearbox was procured from M/S Rotorks Control Ltd. for replacement. During the Shut down the gear box was replaced successfully.



SKETCH FOR SP – 1 MOV GEAR BOX

PRIMARY REFORMER 101-B RADIANT ZONE:

The panel plate having bulging was replaced by new plate. All elbow and union leaks on atomizing steam line were attended. The damaged burner blocks as per production list were attended. The passing needle valves were replaced. Those air registers which were hard to operate were attended.

Photograph of Primary Reformer after 1st Year of Revamp:

AUXILIARY BOILER, ITS BURNERS JOBS:
Preventive maintenance of all burners was carried out. External cleaning of tubes was done with wire brush. The AG and Naphtha filter were cleaned. Arrangement for installation of Oxygen Analyzers by the instrumentation was provided on the wall of the Auxiliary Boiler.

VALVE GLAND REPLACEMENT:

The gland packing of the following valves were replaced by new packing.

- V-5 up stream block valve.
- PT-21 T X isolation valve.
- PIC 1A up stream block valve.
- 101 F Eye Hye top isolation valve.
- Start up heater plug valve.

- 103-J MOP steam isolation valve block valve.
- TRC -10.
- 101-J/105-J lube oil turbine steam outlet valve.
- 38 kg steam to NGBC isolation valve.
- PIC 1 A up stream.
- 105 kg to 103-JA near FIC 9, 10, 11, TX 1st vent valve.
- 38 kg steam to Pre Reformer vent valve above PICV 20 vent silencer rack area
- HCV 12
- 107-C high level switch top isolation valve.

FLANGE LEAK ATTENDED:

The following flange leak jobs were attended.

- 101 J discharge to mix feed coil line blind flange.
- LTS inlet line RV upstream flange.
- LTS Guard inlet line isolation valve upstream flange.
- BFW to 123 C (above 106 J) valve D/S flange.
- 142 CA/CB BFW outlet valve upstream flange.
- 101J/105J lube oil cooler bottom cooling tower side channel cover flange.
- 107 C south side top isolation valve flange.
- 107C vessel extra tapping flange.
- 107 C south side LG and its top flange.
- 107 C low level switch bottom tapping isolation valve upstream and downstream flange.
- 107 C, LT 485 top tapping flange.
- 107 C RV upstream flange.
- 107C LAL-487 bottom flange.
- 107 C Blind flange.
- MICV-16 flange.
- 38 kg steam to NGBC block valve upstream flange.
- 112 C outlet to LTS guard 1st isolation valve U/S flange.
- 101-BJT exhaust line de-superheating station DM water collect line flange.
- PRC 25 U/S block valve U/S flange.
- 101-F south side LG lower nozzle (for LG) flange leak.
- 3.5kg steam to after condenser ejector d/s flange.
- HCV 12 flange.
- 181 C steam inlet main I/V flange.
- PIC 14U/S Flange.
- 101CA Chemical dozing flange.

VALVE BONNET LEAK JOBS ATTENDED:

The following valves were attended for bonnet leak.

- 101 F steam drum O/L valve bonnet.
- LT 13 top I/V bonnet.
- 106 F levels troll bottom I/V bonnet.
- 103 JAT MOV valve bonnet.
- R112 sample line valve bonnet and gland leak.

- 116 JT steam inlet flow TX HP tapping root I/V bonnet leak.
- MIC-61 B/V 2nd isolation valve bonnet.
- 116-JAT steam inlet flow T X HP tapping root isolation valve bonnet.
- 116 JAT PT – 924 HP tapping isolation valve bonnet.
- 105-kg steam drain 1st isolation valve behind PIC-15.
- P-110-B A.O.P outlet to small lube oil cooler outlet isolation valve.
- 121-C south side tube side drains isolation valve.

FABRICATION JOBS:

The major fabrication jobs carried out during this shut down is as below:

Replacement of Elbows of New Synthesis Gas Converter (108-D) & old Synthesis Gas Converter (105-D) lines:

New Synthesis Gas Converter (108-D) Elbow
(14" NB x Sch120, P22 material Elbow)

During plant operation, New Synthesis Gas Converter (108-D) outlet to Synthesis gas waste heat MP boiler inlet Elbow had developed a crack in the parent metal. The crack was immediately attended by welding with a pad support after arresting gas leak by peening in position. However the elbow itself was decided to replace in the shut down.

In the pre shut activity, thorough NDT of the spare elbow was carried out vide radiography, 100% UT and DPT of edges, and it was found okay.

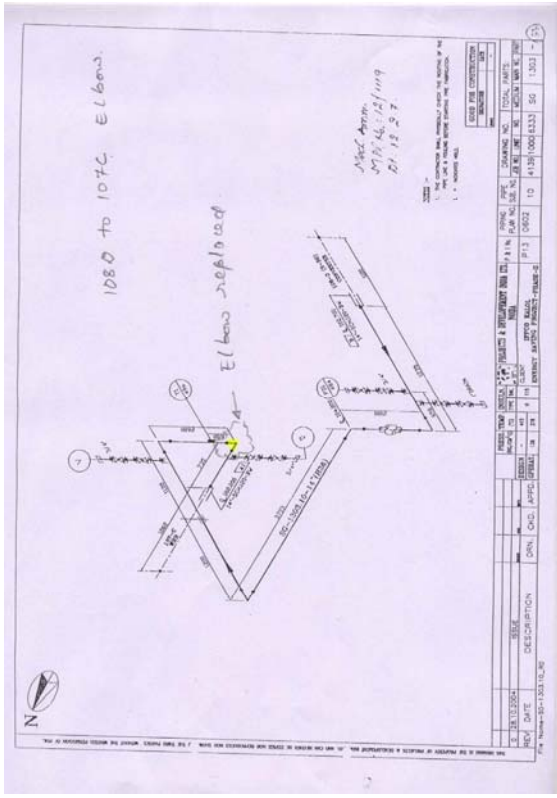
Purging and protection of the catalyst of converters was of great concern before executing the above job. For purging, Nitrogen tankers were hired and a feed of 10 to 15 m3/hr was kept to make positive pressure in the catalyst bed of the converter. To do job safely, blinds at the following points were provided:

- 105D Inlet –HCV-11 D/S & Bypass
- 122-C Inlet
- SP-1
- SP-70
- FIC-13 (Purge Gas)
- 105-E – NH3 Inlet and outlet
- 121-C Common flange blind
- 107-F NH3 Inlet from 106-F.

Following major activities were carried out:

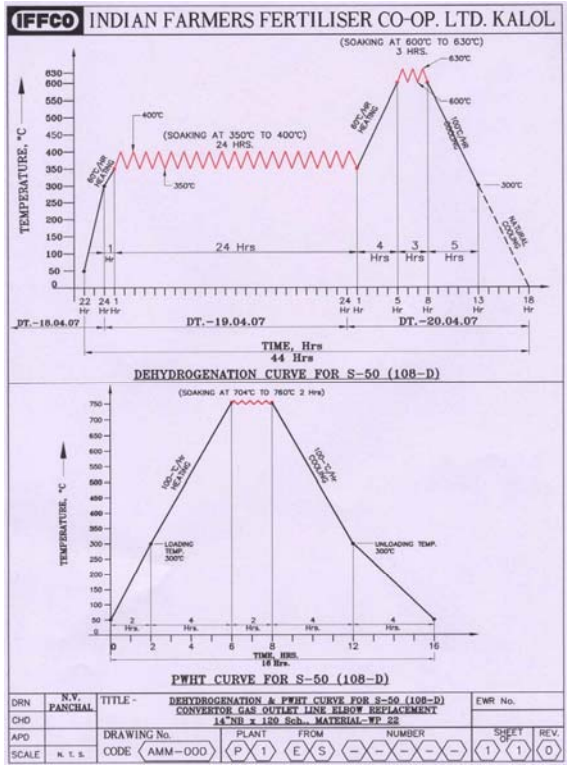
- Cutting of existing Elbow.
- Weld edge preparation
- Dehydrogenation of old edges
- Set up & welding of new elbow
- Post weld heat treatment of joints

Position of the Elbow is as shown below in the Isometric:



Sketch for Isometric of S-50 Elbow

As the elbow was in the Hydrogen service, Dehydrogenation of both the edges was carried out. After welding, PWHT was also carried out. Curve attached below:



Temperature - time curve for Dehydrogenation and PWHT

Dehydrogenation, Welding and PWHT for Repair of Elbow was done as per attached procedure (Welding and PWHT was done as per QW -201.1 Section IX, ASME BPVC which is attached below):

14" NB Schedule 120, ASTM A335 Gr-P22 Seamless Pipe to 14" NB Schedule 120, ASTM A234 Gr-WP22 Seamless Elbow.

Welding Process :GTAW + SMAW
Type :Manual

- JOINT DESIGN (QW - 402)
  Groove design: As per Drawing No: P1-ES-13068, Sheet 1 of 1,Rev 0.
- BASE METALS (QW - 403)
  P-No. 5A Group No. 1 to P-No. 5A Group No.1
  Specification : ASTM A 335 P22 to ASTM A234 Gr-WP22.
  Thickness Range : 32 mm maximum
  Pipe dia Range : 2-7/8" N.B. and above
- FILLER METALS (QW - 404)
  Weld metal analysis : A No. 4
  Filler Metal F No. : As per QW -432.1 (SFA 5.5)
  AWS No. (Class) : Electrode SFA/AWS A 5.5-96 (E 9018 B3)
  Filler SF A5.28 /AWS A 5.28-96 (ER 90SB3)
  Size of electrode : 2.4 mm (Filler wire) for root & hot pass
  2.5, 3.15, 4 mm (Electrode) for fill up and capping
- POSITION (QW - 405)
  Position of Groove : 2G/5G
  Welding Progression: Uphill
- DEHYDROGENATION
  Loading Temp : 300 degree C/hr
  Heating Rate : 60 degree C/hr
  Ist Soaking Temperature : 400 degree C
  Soaking time : 24 hours
  Heating Rate : 60 degree C/hr
  2nd Soaking Temperature : 620 degree C
  Soaking time : 3 hours
  Cooling Rate : 100 degree C/hr
  Loading/Unloading Temperature: 300 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

- GAS (QW - 408)

Shielding gas	:	Argon
Gas purity	:	99.995 %
Flow rate	:	6 to 12 liters / min
Purging gas	:	Argon
Gas purity	:	99.995 %
Flow rate	:	10 to 15 liters / min

- ELECTRICAL CHARACTERISTICS (QW - 409)

Current	:	DC
Polarity	:	Straight for GTAW and Reverse for SMAW
Ampere (Range)	:	90 to 120 for GTAW and 100 to 160 for SMAW

- TECHNIQUE (QW - 410)

String or weave bead	:	String and weave
Initial & Inter pass cleaning	:	Grinding & brushing
Single or multiple pass	:	Multiple

Travel Speed (Range):4 to 6 cm/min for GTAW, 8 - 16 cm/min for SMAW

- WELD INSPECTION

Bevel Edge	:	DP Test
Root weld	:	DP Test & 100 % radiography
Final weld	:	DP Test & 100 % radiography

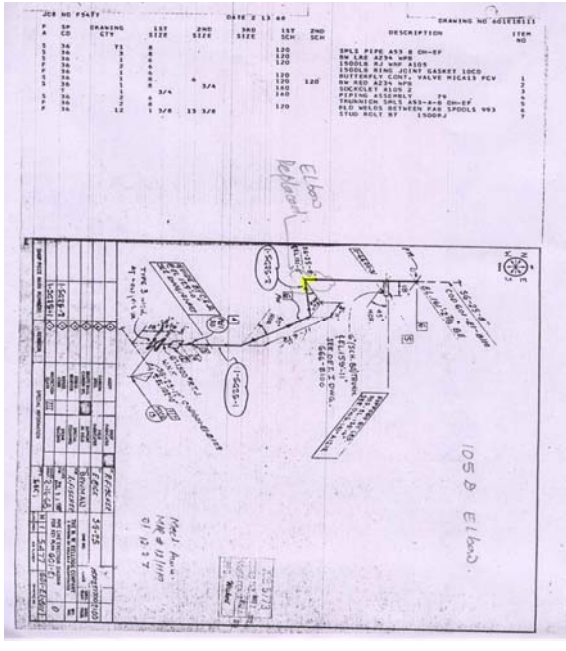
- Hardness measurement after PWHT : 241 BHN Max.

Replacement old Synthesis Gas Converter (105-D) line Elbows (8" NB x Sch 120, CS Elbow):

In the above Elbow, lamination was observed in UT in the last turn around inspection. Hence the same was decided to replace in this shut down.

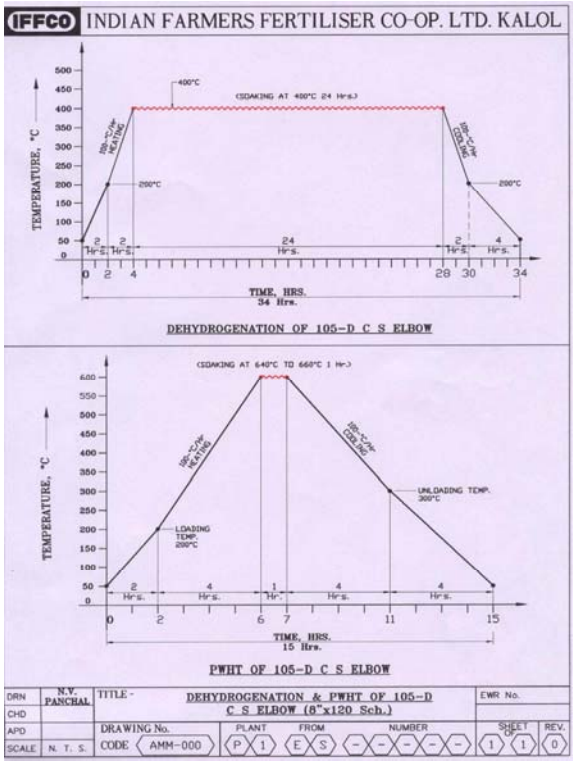
For isolation, the same blinds and method were used as explained for the 108D Elbow replacement.

Position of the Elbow is as shown below in the attached Isometric:



Sketch for Isometric of 105-D Elbow

As the elbow was in the prolong service of Hydrogen, Dehydrogenation of both the edges was carried out. as per Temperature - time curve below.



Temperature - time curve for Dehydrogenation and PWHT

Dehydrogenation, Welding and PWHT for Repair of Elbow was done as per attached procedure (Welding and PWHT was done as per QW -201.1 Section IX, ASME BPVC which is attached below):

8" NB X Schedule 120, ASTM A53 Gr. B Seamless Pipe to 8" NB X Sch. 120, ASTM A234 WPB Seamless Elbow.

Welding Process : GTAW + SMAW
Type : Manual

- JOINT DESIGN (QW - 402)

Groove design : As per Drawing No: P1-ES-13068, Sheet 1 of 1,Rev 0.

- BASE METALS (QW - 403)

P-No. 1 Group No. 1 to P-No. 1 Group No.1
Specification : ASTM A53 Gr. B to ASTM A234 WPB
Thickness Range : 18 mm maximum
Pipe dia Range : 2-7/8" and above

- FILLER METALS (QW - 404)

Weld metal analysis : A No. 1
Filler Metal F No. : As per QW -432.1 (SFA 5.5)
AWS No. (Class) : Electrode SFA/AWS A 5.5-96 (E 7018 B2 L)
Filler SF A5.28 /AWS A 5.28-96 (ER 70SB2 / ER515)
Size of electrode : 2.4 mm (Filler wire) for root & hot pass
2.5, 3.15, 4 mm (Electrode) for fill up and capping
Type of electrode flux : Low hydrogen, heavy coated

- POSITION (QW - 405)

Position of Groove : 2G/5G
Welding Progression : Uphill

- 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 : 100 - 150 ^{O} C
Inter pass Temperature maxm. : 250 ^{O} C

- POST WELD HEAT TREATMENT (QW - 407)

Temperature	:	625^{O} C
Soaking time	:	01 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

- GAS (QW - 408)

Shielding gas	:	Argon
Gas consumption	:	99.995 %
Flow rate	:	6 to 12 liters / min
Purging gas	:	NA

- ELECTRICAL CHARACTERISTICS (QW - 409)

Current	:	DC
Polarity	:	Straight for GTAW Reverse for SMAW
Ampere (Range)	:	90 to 120 for GTAW 70 to 190 for SMAW

- TECHNIQUE (QW - 410)

String or weave bead	:	String and weave
Initial & Inter pass cleaning	:	Grinding & brushing
Oscillation	:	N.A.
Method of back gouging	:	N.A.
Contact tube to work distance	:	N.A.
Single or multiple pass	:	Multiple
Travel Speed (Range)	:	4 to 6 cm/min for GTAW 8 to 16 cm/min for SMAW

- WELD INSPECTION

Bevel Edge	:	DP Test
Root weld	:	DP Test & 100 % radiography
Final weld	:	DP Test & 100 % radiography Hardness measurement after PWHT

REPLACEMENT OF LETDOWN STATION VALVES (PIC 13A, PIC 13B & MIC 22 ISOLATION GATE VALVES):

- Size : 150 NB x 1500 # (IBR)
- End Connection : 150 NB , Sch.120 , Butt Weld
- MOC : ASTM A 217 Gr WC 6
- Service : Super Heated Steam

Entire HP Steam line was replaced with P11 material during KEP. However three CS gate valves were remain to be replaced. There was failure of one valve body during operation. Hence it was decided to replace the three valves with up graded material.

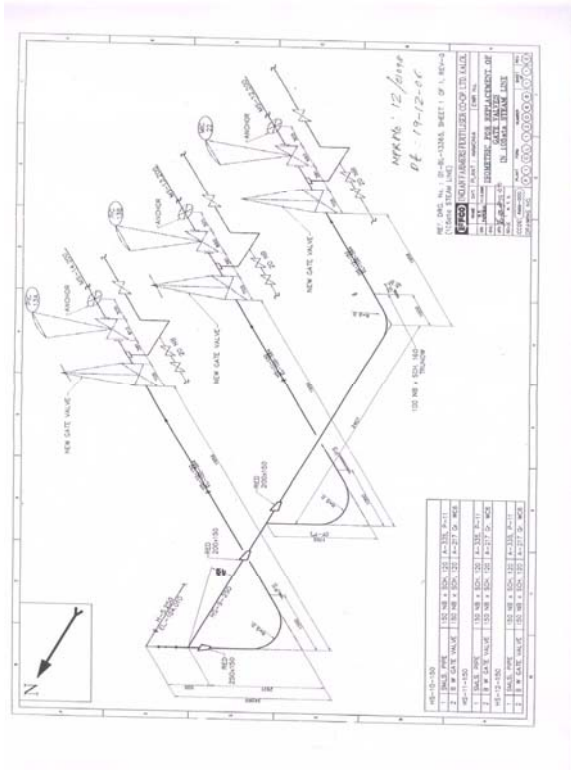
Hence following major replacement activities were carried out:

- Cutting of existing valves.
- Weld edge preparation
- Set up & welding of new valves
- Post weld heat treatment of joints

Photograph of Letdown station showing replaced valves:

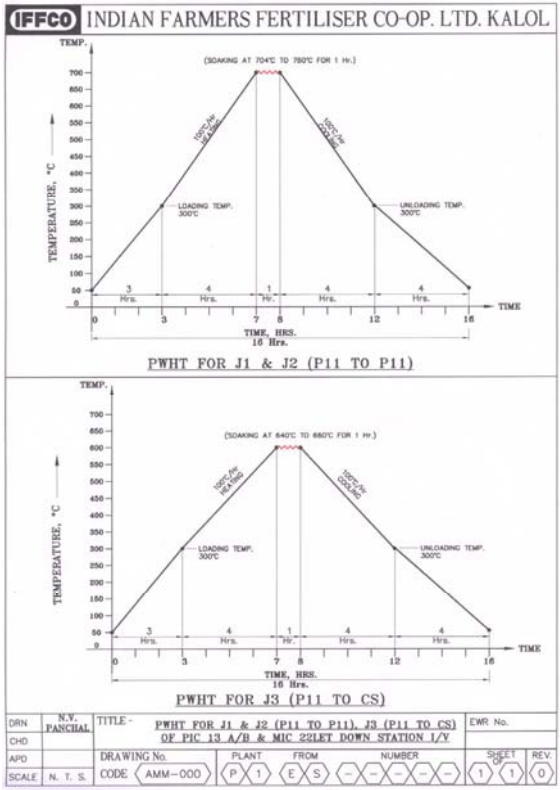
Photograph of Letdown station

Position of the Valves is as shown below in the attached Isometric:



Sketch for Isometric of Letdown valves

After welding, PWHT was carried out as per attached time- temp. curve;



Temperature - time curve for PWHT

Welding and PWHT was done as per QW - 201.1 Section IX, ASME BPVC procedure which is given below:

150 NB Schedule 120, ASTM A335 Gr. P11 Seamless Pipe to 150 NB, 1500#, Sch. 120, ASTM A217 Gr. WC6 Butt Welded Gate Valve.

Welding Process	:	GTAW + SMAW
Type	:	Manual

- JOINT DESIGN (QW - 402)

Sketch	:	IBR Fig. No. 28 (VIII)
Groove design	:	Single 'V' Butt Weld as per Drawing No P1-ES-13067, Sheet 1 of 1, Rev 1 (Enclosed)

- BASE METALS (QW - 403)

P-No. 4 Group No. 1 to P-No. 4 Group No.1
Specification : ASTM A 335 P 11 to ASTM A217 Gr. WC6
Thickness Range : 18 mm maximum
Pipe dia Range : 2-7/8" and above

- FILLER METALS (QW - 404)

Weld metal analysis : A No. 3
Filler Metal F No. : As per QW -432.1 (SFA 5.5)
AWS No. (Class): Electrode SFA/AWS A 5.5-96 (E 8018 B2 L)
Filler SF A5.28 /AWS A 5.28-96 (ER 80SB2 / ER515)
Size of electrode: 2.4 mm (Filler wire) for root & hot pass
2.5, 3.15, 4 mm (Electrode) for fill up and capping
Type of electrode flux : Low hydrogen, heavy coated

- POSITION (QW - 405)

Position of Groove	:	6G
Welding Progression	:	Uphill

- PREHEAT (QW - 406)

Preheat Temperature min.	:	150 ^{O} C
Inter pass Temperature min.	:	300 ^{O} C

- POST WELD HEAT TREATMENT (QW - 407)

Temperature	:	704 to 760^{O} C
Soaking time	:	01 Hour minimum
Heating Rate	:	100 ^{O} C / hr. max
Cooling Rate	:	100 ^{O} C / hr. up to 300^{O} C, then natural cooling under asbestos.

- GAS (QW - 408)

Shielding gas	:	Argon
Gas consumption	:	99.995 %
Flow rate	:	10 to 12 liters / min
Purging gas	:	Argon
Gas consumption	:	99.995 %
Flow rate	:	6 to 10 litres / min

- ELECTRICAL CHARACTERISTICS (QW - 409)

Current	:	DC
Polarity	:	Straight for GTAW Reverse for SMAW
Ampere (Range)	:	80 to 130 for GTAW 70 to 190 for SMAW

- TECHNIQUE (QW - 410)

String or weave bead	:	String and weave
Initial & Inter pass cleaning	:	Grinding & brushing
Oscillation	:	N.A.
Method of back gouging	:	N.A.
Contact tube to work distance	:	N.A.
Single or multiple pass	:	Multiple
Travel Speed (Range)	:	4 to 6 cm/min for GTAW 8 to 12 cm/min for SMAW

- WELD INSPECTION

Bevel Edge	:	DP Test
Root weld	:	DP Test & 100 % radiography
Final weld	:	DP Test & 100 % radiography Hardness measurement after PWHT

103-D – AIR NOZZLE

103-D Top cover (Air Nozzle) was removed for internal inspection. While taking out the Air Nozzle, it was stucked and fouling with the liner. Air nozzle was removed with the help of chain pulley blocks with care. After removal, it was found that the liner was slightly bulged at certain locations. Grinding was done to remove the bulging. Air Nozzle fins were also trimmed 5 to 6 mm by grinding.

Other Fabrication jobs are as tabulated below:

JOB NO	DESCRIPTION	REMARKS
1	Replaced 116-JA discharge line flange at down stream of NRV by SORF flange of size 8'' x 150 # , MOC SS	
2	Replaced 107-JT & JAT steam inlet valve by new valve of higher rating i.e.6'' x 900 #	Increased Rating valve
3	Replaced 101-JT steam inlet valve by new valve of higher rating i.e.6'' x 900 #	Increased Rating valve
4	Flange was provided at 142 CA/CB gas inlet line for blinding purpose during Hydro testing.	
5	Provided isolation valve foe the two Nos RV of 123-C.	
6	Removed 123-C RV outlet line which was extended to drain near 101C	
7	101-F north side level trolls top isolation valve replaced.	1-1/2'' x 1500 # CS angle valve
8	FIC 470 transmitter HP&LP tapping thread leak repaired and the box provided was removed	
9	117-J HP case Inverted Bucket Moisture Trap was replaced by new Floating Ball type Trap.	The Ball Trap was a spare of PB Compressor of Urea Plant.
10	Hydrogen sample collecting valve of 108-D position to be changed as it is fouling	
11	107 JA discharge valve bypass line check and if required replaced because of welding leaks two times	
12	FICV 14 Down stream line pin hole leak. Box to be removed and line support to be	
14	Modified 101-L a MDEA filter shell to develop interchangeability of filter with 103-L and 104-L	
15	Provided Mono rail arrangement for easy removal of 101-F steam drum R.V.	
16	Step ladder was provided for 101-F RVs	
17	Primary Reformer front side panel plate near tunnel burner was replaced	The plate had bulginess.
18	101 JT condensing RV replacing and its exhaust line was extended for safety.	For safety
19	110 CA CO2 outlet line pin hole leak was attended.	
20	116 JAT steam inlet line vent was extended	For safety
21	103 J degassing tank was connected to oil console directly. The existed connection ,to lube oil discharge line of train, was removed	

22	109-C-2A tube side outlet flange was replaced by SORF flange.	
23	127-CA/CB cooling water outlet line repair / Replacement.	
24	Provided MS Chequered Platforms as per production department's requirement	
25	Replaced the passing steam trap as per production department's requirement.	
26	The valves of size less than 1", having gland leak / bonnet leak were replaced by new ones as per production department's list.	

ROTATING EQUIPMENT

CO2 COMPRESSOR- HITACHI MAKE (K-1801)

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

- Decoupled the HP case from Gear box
- Alignment readings were taken and recorded. Details follow.
- Measured the rotor position.
- Installed the hydraulic jig to dismount the coupling hub, turned the Guide at the shaft end, attached the oil system, installed the nipple joint, and connected the flexible tube between oil system and bracket. Poured the oil (mixing ratio: castor oil 1: Paraffin oil 1) in pump system, gradually increase the oil pressure, at 18000 psi, coupling hub removed.
- Journal bearing pads on Free end were opened for inspection. Clearances values Found within acceptable limit. (Clearance values were measured are given in Table-2).
- Journal bearing pads on Gear Box side were opened for inspection. Replaced by new one, as the same were found to have higher clearances value. (Clearance values measured are given in Table-2).
- Thrust bearing was opened for inspection. Thickness of the thrust pads was measured and found clearances value within acceptable limits. (Clearance values measured are given in Table-2).
- Disassembled the gas seal labyrinth and free end side head flange.
- Prepared the jig for removal of inner casing assembly. Installed the Guide rail, and fixed to the casing with box nut, attached the four puller bolts to the inner casing assembly with puller jig, turned the Traveling nuts equally to remove the inner casing assembly and confirmed the inner casing assembly was properly guided till it was removed.
- Disassembled inner case assembly. Removed the stage diaphragms (lower side & upper side) one by one and rotor.
- Condition of labyrinths was good however increased clearances were found on some labyrinths.. Measured the clearance values of all stage eye labyrinths, all inter stage labyrinths, balance drum labyrinth. (Clearance values measured are given at Table-1).

- Replaced complete set of labyrinths by new one. Measured the clearance values of all new stage eye labyrinths, inter stage labyrinths and balance drum labyrinth. (Clearance values measured are given in Table-4).

- Gauss measurement of pads , Thrust collar, journal shaft & bearing housing were carried out by Inspection section and necessary demagnetization was carried out by Inspection Section.

- DP testing of pads, thrust collar and shaft journal and the same were found satisfactory.

- Reassembled the inner casing. Attached the jigs to the casing. Put the inner casing assembly on the guide rail, attached the special tools to casing, tightened the traveling nut uniformly and confirmed that the inner casing assembly was fully assembled.

- Reassembled the free end side head flange, gas seal labyrinth & bearings. Mounted the thrust collar and checked the rotor float. Rotor float was found to be 5.38 mm.

- Prepared the jig for mounting the coupling Hub. Jig was attached to the shaft. Turned the guide on the shaft, attached the oil system, nipple joint & flexible pipe. Attached the dial indicator on the end of sleeve. Measured and recorded the initial position with dial gauge. Increased the thrust pressure to 1000 psi until the coupling hub came in contact with shaft tightly. Increased the expansion pressure to 11000 psi. Again increased the thrust pressure to 4200 psi and held for 15 minutes. Finally the coupling was installed with expansion pressure of 15000 psi and thrust pressure of 16000 psi. Axial travel of coupling hub was ensured to be 2.15 mm.

  Travel = 2.15 mm (Design limit: 1.95 mm to 2.15 mm)
  Diametral Expansion = 0.068 mm (Design limit: 0.060 mm to 0.068 mm)

- Alignment between HP Case and Gear box was checked and corrected as per OEM reference values. Details are given in this report.

- The Coupling spacer between HP Case & gearbox was assembled.

Table 1: Labyrinth Clearance (Diametrical) details for HP case

Description		Design value (mm)	Max. Allow-able (mm)		Impeller eye OD (mm)	Old Laby. ID (mm)	New Laby. ID (mm)	Before O/H (mm)	After O/H (mm)
A	1st stage Impeller eye labyrinth	0.72 – 0.96	1.16	A1	209.87	210.60	210.63	0.73	0.86
				A2	211.96	212.65	212.74	0.70	0.84
				A3	213.92	214.62	214.75	0.70	0.83
				A4	215.94	216.70	216.73	0.76	0.79
				A5	217.91	218.72	218.72	0.75	0.75
B	2nd stage Impeller eye labyrinth	0.72 – 0.94	1.1	B1	183.91	184.71	184.72	0.79	0.80
				B2	185.92	186.68	186.73	0.76	0.81
				B3	187.96	188.70	188.72	0.74	0.76
				B4	189.96	190.70	190.73	0.74	0.77
				B5	191.94	192.69	192.74	0.75	0.80
C	3rd stage Impeller eye labyrinth	0.72 – 0.94	1.1	C1	177.93	178.67	178.73	0.74	0.81
				C2	179.93	180.66	180.73	0.73	0.80
				C3	181.95	182.66	182.74	0.73	0.79
				C4	183.96	184.66	184.72	0.70	0.76
				C5	185.94	186.70	186.74	0.76	0.80
D	4th stage Impeller eye labyrinth	0.72 – 0.94	1.1	D1	177.40	178.65	178.73	0.70	0.83
				D2	179.92	180.68	180.73	0.76	0.81
				D3	181.94	182.65	182.74	0.71	0.80
				D4	183.96	184.66	184.73	0.70	0.76
				D5	185.93	186.70	186.74	0.77	0.81

E	5th stage Impeller eye labyrinth	1.02 – 1.26	1.4	E1	151.94	153.14	153.04	1.20	1.10
				E2	153.46	155.12	155.03	1.16	1.07
				E3	155.47	157.15	157.15	1.18	1.09
				E4	158.00	159.12	159.14	1.12	1.14
				E5	160.01	161.15	161.14	1.14	1.10
F	6th stage Impeller eye labyrinth	1.02 – 1.26	1.4	F1	147.96	149.08	149.13	1.12	1.12
				F2	149.94	151.08	151.04	1.14	1.10
				F3	151.96	153.11	153.13	1.14	1.15
				F4	153.98	155.06	155.13	1.08	1.07
				F5	156.01	157.01	157.14	1.00	1.07
					Impeller eye OD (mm)	**Old Laby. ID (mm)**	**New Laby. ID (mm)**		
G	1st inter stage labyrinth	0.20 – 0.44	0.56	-	195.38	195.77	195.65	0.40	0.27
H	2nd inter stage labyrinth	0.20 – 0.44	0.56	-	184.32	184.79	183.65	0.47	0.30
I	3rd inter stage labyrinth	0.20 – 0.44	0.56	-	174.25	175.68	175.56	0.48	0.31
J	4th inter stage labyrinth	0.20 – 0.44	0.56	-	167.26	167.71	167.47	0.45	0.21
K	5th inter stage labyrinth	0.20 – 0.42	0.54	-	152.18	152.72	152.40	0.56	0.22
L	Balance Drum labyrinth	0.20 – 0.44	0.56	L1	185.05	185.62	-	0.56	-
				L2	187.09	187.64	-	0.56	-
				L3	189.00	189.65	-	0.54	-

Table 2: Bearing Clearance (Diametrical Clearance) Details for HP case

Description		Before PM (mm)	Design Value (mm)	After PM (mm)
Journal bearing clearance on Free end		0.13	0.11 to 0.14	0.13
Journal bearing clearance on Gear Box side		0.17	0.11 to 0.14	0.11(Bearing Replaced)
Thrust bearing clearance		0.27	0.25 to 0.35	0.29
Observations	Oil/wax deposit was found on Bearing pads & thrust pads			
Spares replaced	Journal bearing pads of gear box side, All labyrinths of Impeller eye and interstage labyrinths, balance drum labyrinth.			
Inspection:				
DP Test	Found ok			
Magnetism Check	Performed by Inspection section			
Demagnetization	Performed as per the requirements by inspection Section			

PREVENTIVE MAINTENANCE OF CO_2 COMPRESSOR LP CASE (K-1801-1):

- Decoupled the LP case at both ends from Turbine & Gear box.
- Alignment readings were taken and recorded.
- Journal bearing pads on Turbine side were opened for inspection. Replaced by new one as the same were found to have higher clearances value. (Clearance values measured are given in Table-3).
- Journal bearing pads on Gear Box side were opened for inspection. Replaced by new one, as the same were found to have increased clearances. (Clearance values measured are given in Table-3).
- Thrust bearing was opened for inspection. Thickness of the thrust pads were checked and found clearances value within acceptable limits. (Clearance values measured are given in Table-3).
- Gauss measurement of pads, Thrust collar, journal shaft & bearing housing were carried out by Inspection section and found within acceptable limit.
- DP testing of thrust pads, thrust collar and l shaft journal and the same found ok.
- Final alignment readings were taken and recorded. Alignment between LPS – Turbine & LP-Gearbox was checked and corrected as per OEM reference values.
- The Coupling spacer between HP casing & gearbox was assembled.

Table 3: Bearing Clearance (Diametrical) Details for LP Case:

Description		Before PM (mm)	Design Value (mm)	After PM (mm)
Journal bearing clearance on Turbine side		0.17	0.11 to 0.15	0.15
Journal bearing clearance on Gear Box side		0.15	0.11 to 0.15	0.13
Thrust bearing clearance		0.29	0.28 to 0.38	0.33
Observations	Oil/wax deposit was found on Bearing pads & thrust pads.			
Spares replaced	Journal bearing pads of gear box side and HP case side			
Inspection:				
DP Check	Found ok			
Magnetism Check	Found high on Journal bearing pads (North and south bearings), thrust collar			
Demagnetization	Done			

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

- Decoupled the Turbine at LP case end.
- Alignment readings were taken and recorded. Details are given in this report.
- Journal bearing pads on free end were opened for inspection. Found clearance values within acceptable limit. (Clearance values measured are given in Table-4).
- Journal bearing pads on LP case side were opened for inspection. Found clearances values were within acceptable limit. (Clearance values measured are given in Table-4).
- Thrust bearing was opened for inspection. Thickness of the thrust pads were checked and found clearances value within acceptable limits. (Clearance values measured are given in Table-4)
- Gauss measurement of pads, Thrust collar, journal shaft & bearing housing were carried out by Inspection section and rectified (kept below 2 gauss).
- DP testing of pads, thrust collar and journal shaft and the same were found ok.
- Final alignment readings were taken and recorded. Alignment was corrected as per OEM reference values.
- The Coupling spacer between LP casing & Turbine was assembled.

Table 4: Bearing clearance for Turbine

Description		Before PM (mm)	Design Value (mm)	After PM (mm)
Journal bearing clearance on free end		0.20	0.18 to 0.31	0.20
Journal bearing clearance on LP side		0.32	0.24 to 0.35	0.32
Thrust bearing clearance		0.23	0.25 to 0.35	0.23
Observations	Oil/wax deposit was found on Bearing pads & thrust pads.			
Spares replaced	Nil			
Inspection:				
DP Test	Found ok			
Magnetism Check	Max. Gauss value found on journal (LP side). After demagnetization, gauss value came within acceptable limit.			
Demagnetization	Done			

PREVENTIVE MAINTENANCE OF GEAR BOX M-1801:
High-speed Pinion Shaft and Bearings:

- Decoupled the High-speed pinion shaft at HP case end.
- Alignment readings were taken and recorded.

- Both Pinion shaft bearings (Offset Halves Type) were inspected and found to have higher clearance values at minor dia. Wax deposit and scattered pitting was observed on the white metal lining, which was more prominent on the bottom half of both the bearings. Replaced both bearings by new one. Bearings manufactured and supplied by M/S. Kanpur Metal Works were used. (Clearance values were measured as given in Table.5).

- Gauss measurement of shaft journal & bearing housing was carried out by Inspection section and found within acceptable limit.

- DP testing of shaft journal & bearing housing was done and the same was found ok.

Low-speed Gear Shaft and Bearings:

- Decoupled the Low-speed gear shaft.
- Alignment readings were taken and recorded.
- Both Low speed shaft bearings (Elliptical Type) were inspected and found clearances values within acceptable limit. (Clearance values measured are given in Table-5).

- Gauss measurement of pads, journal shaft, thrust collar & bearing housing were carried out by Inspection section and found within acceptable limit.

- DP checking of pads, thrust collar, journal shaft & bearing housing and the same found ok

Table 5: Bearing clearance for Gear Box

Description		Before PM (mm)	Design Value (mm)	After PM (mm)
Low speed shaft	Journal bearing clearance on LP side	0.17	0.12 to 0.17	0.17
	Journal bearing clearance on HP side	0.18	0.12 to 0.17	0.18
	Thrust bearing clearance	0.43	0.38 to 0.61	0.41
High speed shaft	Journal bearing clearance on LP side	0.27	0.14 to 0.18	0.14
	Journal bearing clearance on HP side	0.30	0.14 to 0.18	0.14
Gear backlash		0.54	0.383 to 0.608	0.54
Observations	Oil/wax deposit was found on Bearing pads & thrust pads.			
Spares replaced	Both side Journal bearings of high speed pinion were replaced by new one.			
Inspection :				
DP Check	Found ok			
Magnetism Check	Found high on Low Speed and High Speed shaft bearings. However, bearings were replaced with new ones.			
Demagnetization	Done.			

LUBE OIL CONSOLE, T-1801:

In view of the wax deposits observed on all the bearings, it was decided to replace the oil Servo Prime 46 T. In all, 43 drums, each of 210 Litre capacities were used at the time of refilling.

After removal of oil, console walls and floor were cleaned thoroughly to remove the wax adhered to the walls and floor. One no. gauge glass was replaced.

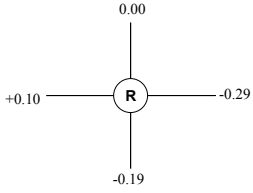
Lube oil pump drive turbine bearing cooling water supply lines were replaced with higher size. Tapping of cooling water was also shifted from bottom to sidewise to avoid clogging of the line because of accumulation of debris inside.

ALIGNMENT READINGS: GEAR BOX TO LP COMPRESSOR:

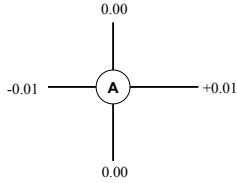
Dial on LP Compressor Coupling
1 Div = 0.01mm

Before PM:

RADIAL



AXIAL



After PM

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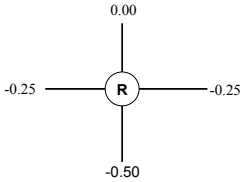

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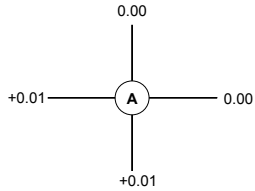
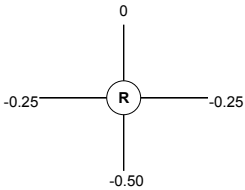


Protocol Values

RADIAL



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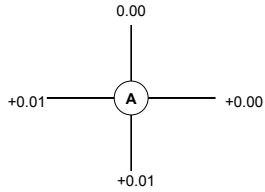
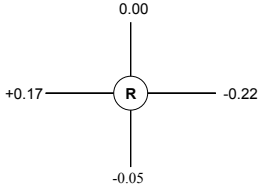


ALIGNMENT READINGS: GEAR BOX TO HP COMPRESSOR:

Dial on HP Compressor Coupling
1 Div = 0.01mm

Before PM

RADIAL



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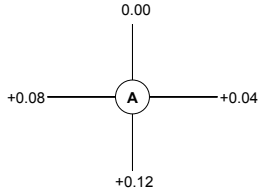

After PM

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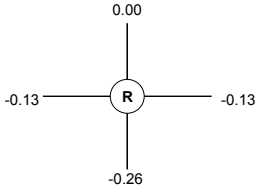

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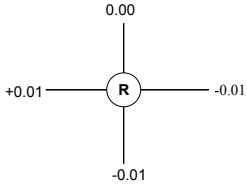

Protocol Values

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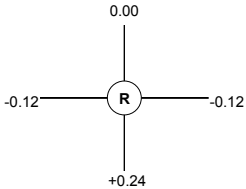

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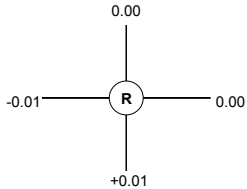


HP VESSELS:

M/S. Stamicarbon inspectors were called for inspection of HP Vessels vide Work Order No. 9920122 Dated 19/02/2007 for inspection of HP Vessels (Reactor V-1201, Stripper H-1201 and Condenser H-1202) for a total period of 9 days including travel (7 days stay at site).

Scope of work of Stamicarbon (As per WO)

Visual inspection:

- Visual Inspection of all the three High Pressure Equipments H-1201, H-1202 & V-1201 from Inside and outside (wherever feasible).

- Visual inspection of all the HP Nozzles / pipe lines wherever possible.

Thickness measurement:

- Liners of all the Three High Pressure Equipments.
- Weld overlays
- Tube sheet, Tube etc.
- Any other internals like Trays, Down comer etc.

Dimensional Measurement:

- Whole diameters of reactor trays, ferrules of HP Stripper etc.
- Gap between tray and liner etc.
- Any other items as per requirement.

Eddy Current testing:

HP Stripper (H-1201)

To undertake the Eddy Current Testing of tubes of newly installed HP Stripper H-1201 from inside, including the interpretation of test results for detection of tube thickness, internal defects of the tubes etc. Top 3.0 to 4.0 meters of all the 2600 Nos. of tubes shall be checked from the top tube sheet.

Replacement of the old stripper by a new stripper with 2600 tubes was carried out during March - 2002. New Urea Stripper was designed by M/s. Stamicarbon and manufactured by Larsen & Turbo Limited, Mumbai India.

HP Carbamate Condenser (H-1202)

To undertake the Eddy Current Testing of selected 220 nos. of tubes of HP Condenser H-1202 for complete length, including the interpretation of test results for detection of tube thickness, internal and external defects of the tubes along the complete length including tube sheet thickness area etc.

REACTOR V-1201

Vessel manufacturer : Foster Wheeler John Brown Boilers LTD, USA
Year of fabrication : 1972
Liner : 5 mm X2CrNiMo17.13.2 Urea Grade
Trays : 11 HE-trays (8 mm BC.01) replaced in 1997

All the nozzles at the bottom and off gas line at the top were opened including all the steam tracing lines. The top man way over was opened using hydraulic bolt tensioner at 500-kg/cm2 pressures. The cover was shifted by mono-rail and chain block towards cooling tower side grating area and was put on wooden sleepers. Clearance was taken from Production that the temperature inside is suitable for vessel entry. Compressed air was provided from the bottom end and vacuum blower hose was arranged in the top compartment. Aluminum ladders & hand lamps were provided in each compartment and both the domes.

M/S. Stamicarbon inspectors carried out visual and NDT examination of liners and shell areas. The bulged liners were inspected for any abnormal increase. All J-bolts were checked for tightness and attended wherever required.

Conclusion of Stamicarbon report is reproduced below:

The top hemi-head was re-lined during TA-2002. In the gas phase the liner and welds show a blue grey oxide layer. Small condensation spots have been observed. The liquid level is about 5-10 cm above the tangent line. The top tangent weld has been checked for SIIC. No indications have been observed.

In the liquid phase the BC.01 liner is brown to dark/brown. In the top area the liner is slightly rough and changes to smooth in the bottom area. This indicates normal uniform corrosion. The lowest wall thickness of the liner was found in compartment 2 (about 4.1 mm). Given the corrosion rate of about 0.05-0.10 mm/year, the remaining life will still be considerable.

Next to the top tangent weld a new BC.05 segment was replaced in 2002. This segment is slightly rough. In compartments 3, 4, 8, 9, 10 and 11 the circumferential welds are patched (partly or completely). These patches or inserts liners (BC.05) are grey and slightly etched. Bulging has not been observed anymore, except for some small portion in compartment 5.

The trays are brown; rough in the top area and changes to smooth in the bottom area. In the top and middle compartments the thickness of the trays has decreased some 2 mm in 6 years, which corresponds to a corrosion rate of 0.17 mm/year (per side). Also, the tray holes show considerable corrosion in the top to middle compartments. The trays in the top to middle compartments may need replacement after some 6-8 years from now (but future measurements will give more accurate predictions).

GENERAL REMARKS

- Additionally measure the liner wall thickness in compartments 2, 3, 4 during next inspections.
- Keep attention for bulging of the liner during next inspections.
- Improve the insulation of the top cover and the reactor top.
- Check all J-bolts of the trays and tighten them as necessary.

HP STRIPPER H-1201

Vessel manufacturer: Larsen & Toubro, India

Year of fabrication: 2001/2002
Tubes : 2600 tubes (Ø31 x 3.0 mm) BC.05
Overlay : 8 mm overlay welding BC.05
Liner : 8 mm BC.05

The top and bottom covers of the HP Stripper (H-1201) were opened using "Hydra Tight Sweeny" make bolt tensioner at hydraulic pressure of 1000 kg /cm2. The top cover was shifted below the platform using monorail hoist and chain blocks. The bottom cover was lowered onto the wooden sleepers.

Conclusion of Stamicarbon report is reproduced below:

A thin blue grey oxide layer covers the overlay welding and liner in the gas phase completely, except for the areas between the strip beads. The liner and liquid inlet box in the liquid phase are grey and slightly etched. Corrosion has not been observed in top and bottom compartments.

The wall thickness of the heat exchanger tubes has been measured by EC-technique. The average thickness is 2.93 mm and the minimum is 2.70 mm. The corrosion rate could not be determined since this is the first measurement by Stamicarbon.

The differences between the Stamicarbon and Testex measurements are caused by differences in probes, calibration tubes and test frequencies.

Some 10% of the tubes have been measured over the full length. These measurements showed that the wall thickness was between 3.2 mm and 3.3 mm in the non-corroded parts. Between the tubes sometimes heavy oxide deposition is present on the top tubesheet. It is advised to remove these thick deposits since they may interfere with the liquid divider tubes.

The tubes are smooth inside. However, about 100-200 tubes show corrosion and slight loss of wall thickness (< 0.5 mm) inside the tube at the location of the tube sheet welds. This is due to excessive heat input and/or lack of backing gas during manufacturing. This corrosion may limit the life of the stripper and should be kept under attention during next inspections.

Tube #2531 shows an internal defect just below the tube sheet weld (see photo's). This tube needs to be plugged (for procedure see Appendix 2). The scaling thickness inside the heat exchanger tubes is between 0.5 and 1.0 mm.

As per the recommendation of Stamicarbon, one no. tube #2531 was plugged. Due to lack of access, tube was not machined out as per the STAC procedure; however, plugging was done on the tube after puncturing the same using portable flexible grinder FF-2. 30 nos. liquid divider tubes were replaced due to higher Delta P reported by production Deptt.

After inspection by production department and getting clearance, the bottom manhole was boxed up using new "Kempchen" gasket. After the bottom manhole was boxed up, pressure drop measurement was carried out for each tube and the same was found acceptable. After clearance from Production, the top man way cover was boxed up using new "Kempchen" gasket (Size: 860 mm OD x 800 mm ID x 4 mm thick with 0.5 mm thick PTFE envelop)

Manhole tightening pressures for top and bottom covers

1st tightening round….. 400kg per /cm^2
2nd tightening round….. 700kg per/cm^2
3rd tightening round…... 1000kg per/cm^2
Final tightening round/checking round 1000kg per/cm^2

HP CARBAMATE CONDENSER H-1202

Tubes : 1970 tubes (Ö25 x 2.5 mm) X2CrNiMoN25.22.2 (BC.05)
Liner : 7 mm X2CrNiMoN25.22.2 (BC.05)
Vessel manufacturer : Larsen & Toubro, India
Year of fabrication : 1993

The top flange of H-1202 (off gas line) was opened. Then the top cover and Bottom cover was opened with bolt tensioner at 500 kg/cm2 hydraulic pressure and shifted from position. The partition plates, basket, segments and rasching rings were removed.

Conclusion of Stamicarbon report is reproduced below:

The corrosion resistant surfaces in the top and bottom compartments are in good condition. The liners show some overall corrosion (about 0.05 mm/year in the top section and nearly nil in the bottom section). About 10% of the heat exchanger tubes have been measured over the entire length for minimum wall thickness by EC-technique. The average wall thickness is 2.50 mm.

The corrosion rate is nearly nil. The tubes show burn-through defects at the top and bottom tubesheets. Two tubes (#982 and 1214) need to be plugged this TA. These defects need permanent attention during future inspections.
Small defects were observed and need to be repaired.

Two tubes (#982 and 1214) as recommended by stamicarbon were plugged. Tube plugging was done after puncturing the tubes using FF-2 Flexible grinder.

After inspection & clearance from production the top and bottom covers were boxed up. Both gasket seats of the vessel were thoroughly cleaned. The top and bottom cover were lifted and put into position, provided new "Kempchen" gaskets (Size: 839 mm OD x 800 mm ID x 4 mm thick with 0.5 mm thick PTFE envelop) and hand tightened the nuts. The gap between two flanges of the vessel was checked and tightening was done at following hydraulic pressures.

1st tightening round……. 250 kg/cm^2
2nd tightening round…... 350 kg/cm^2
3rd tightening round……. 450 kg/cm^2
4th/final checking round….. 450 kg/cm^2
Connected liquid outlet line at Condenser bottom and tightened it.

General repair procedure (recommended by Stamicarbon) for small repairs in BC.01(SS-316 L Modified) and BC.05 (2RE69)

- Clean the area with a stainless steel brush
- Remove the defect with a pencil grinder
- Clean and degrease carefully
- Reweld by GTAW, using filler wire 18005 BC.05 (25/22/2 High Mn)
- Brand names : Sandvik 25.22.2.LMn or Thermanit 25/22H
- Use HF (high frequency) start-unit
- Use stringer bead technique
- Keep the heat input low
- Interpass temperature < 150°C
- Do not apply more weld deposit than needed
- Hold the torch for a few seconds at the stop position (to protect the end-crater against oxidation)
- Check by dye penetrant testing for surface defects
- Check ferrite content : ferrite content < 0.6%
- Clean, if necessary, the repair by washing with 10% HNO3 and rinse with chloride free condensate. Omitting of washing with 10% HNO3 can be considered if there is no risk of embedding iron particles in the passive
- oxide layer of the stainless steel during the repair work.

Heat exchanger tube plugging procedure recommended by Stamicarbon:

The way of plugging differs from top and bottom tubesheet.

Stamicarbon suggested:

- To use cylindrical and flexible plugs.
- To plug always the top and bottom end of the referring tube.
- A positive leak should be made in the affected heat exchanger tube to allow leak detection in case of a leaking plug.
- Leaking tube.
- Insufficient tube wall thickness.

When to plug a tube:

- Tube to tubesheet seal weld defect.
- Tube end selectively attacked.
- No tube protrusion.
- Serious burn through defect.

Plugging procedure

To plug in top tubesheet (Tubehole plugging in tubesheet)

- Always plug in tube hole.
- Machine the tube end down 5 mm deeper than the bottom of the plug to install. This is required to create a positive leak in the affected tube.
- Clean the tube hole by reaming or by grinding over the length of the plug.
- Machine the plugs, material quality equal to material of heat exchanger tube
- Clean and degrease the plug and tube hole.
- Insert the plug.
- Protect the surrounding tube ends very careful with help of the old PTFE bushing. This is extremely important at the top tube ends of a H.P. Stripper.]
- Weld the plug in two layers, GTAW (material quality filler wire equal to aterial of heat exchanger tube; rod diameter 1.2 mm to 2.0 mm); start / stop points staggered to each other.
- After each layer of welding perform a penetrant test, an air soap test and a ferrite check.

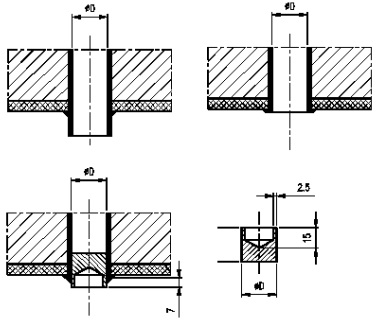
To plug in bottom tubesheet (IFFCO followed this procedure for plugging tube on top and bottom tubesheet after discussions with)

- Always plug in tube end.
- Machine the tube end down until 50% of the tube to tubesheet weld metal is removed.
- Clean the tube inside by reaming or by grinding at the location where the plug will be positioned.
- Determine the inner tube diameter.
- Machine the plugs, material quality equal to material of heat exchanger tube
- Clean and degrease the plug and the inner tube hole.
- Insert the plug.
- Protect the surrounding tube ends very careful.
- Weld the plug in two layers, GTAW (material quality filler wire equal to material of heat exchanger tube; rod diameter 1.2 mm to 2.0 mm); start / stop points staggered to each other.
- After each layer of welding perform a penetrant test, an air soap test and a ferrite check. General remarks regarding the execution of the plugging
- In order to be sure that the execution of the plugging is correctly welded we strongly advice to perform a welding and welders qualification. For that reason we advise to simulate in a workshop the conditions as present in the HP equipment.
- To simulate position, tube protrusion, including the limitations as a result of the presence of the surrounding tube ends.

Examine this plug by macro examination of two cross sections, perpendicular.

TUBE PLUGING SKETCH OF HP VESSELS SUGGESTED BY

M/S STAMICARBON



Dismantling of Existing CO_2 Spray Cooler & Erection of New CO_2 Spray Cooler

Dismantling:

This involved removal of existing Spray Cooler vessel including various piping and structural platforms connected to CO_2 Spray cooler as well as pipelines above CO_2Spray cooler for creating space to facilitate the removal of CO_2Spray cooler in assembled condition. Drawing No. P2-BS-04089 (For Existing H-1104) & Drawing No. TF/IFFCO/32 (For New H-1104) were referred.

Following activities were involved for carrying out the dismantling:-

- Provided blinds in the existing pipe lines for hot work permit to carry out job i.e. C-1 (30"x150#), C-2 (30"X150#), C-3 (8"x150#) C-4 (18"x150#) etc.
- Made temporary scaffolding around the vessel to facilitate removal and erection job. The same was removed after completion of job.
- Disconnected all the piping connected to the vessel viz. C-1 (30"x150#), C-2 (30"X150#), C-3(8"x150#), C4 (18"x150#) and bypass line (12"x150#)
- Hydronyl Hold down Plate (Part no.143) & Hydronyl Support ring (Part No. 144) were removed from the old vessel for reuse. (These were re-fixed in new vessel after erection.)

- Distributor Tray (Part No.200) was also removed from old vessel. The same was re-fixed in new vessel.

- Demisters & Grids (Part No. 141) were removed. (These were re-fixed in new vessel.)

- Structural members & platforms, and valves etc were removed. Ladders were removed after shifting the vessel on ground.

- Exposed the vessel base plate from PCC/RCC cover, released the base pipes (8 nos. of SS-304 material) etc.

Vessel was cut from bottom of the shell.

- Old Vessel was lifted by Kobelco **crane**.

The details of lifting arrangement are as under:
Name of Crane : Kobelco
Boom Length : 42.7 Mtr.
Crane Radius : 25.7 Mtr.
Boom Angle : 56.7 Deg
lifting Weight : 7.67 Ton(as per the screen of Crane)

- The base plate was grouted and concrete was filled up to 2 feet height. This foundation was required to be removed by Power Chisel i.e. pneumatic & electric chisel Preparation of foundation to erect new vessel.

- All the pipelines connected to Co2 Spray Cooler removed after proper marking before dismantling, so that identification of the same could be done easily at the time of re-erection.

Erection of New CO_2 Spray Cooler:

New Cooler skirt was placed on the same foundation bolts on which the old vessel was kept. Modified plates were fabricated and placed on the foundation bolts to accommodate the dimension of the base ring of the skirt of the new vessel. New vessel skirt base ring was welded with the 8 nos. foundation plates. After installation of new Spray cooler skirt shell, the Skirt Base Ring was covered under concrete. Dimensions & elevations were checked to decide the actual length of the skirt so as to match the nozzle elevations after placement of the new vessel on the skirt shell. The activities involved in erection of new CO_2 Spray cooler are given below.

Following activities were involved for carrying out the above job :-

- Leveling of floor by Power Chisel for removing concrete & and other fouling.
- Fixing and grouting of modified base plate.
- Welding of two lifting lugs.
- After erection, leveling of the equipment was maintained to achieve it within plumb, 1 mm per mtr.
- Installation of Skirt shell on foundation.

- Full circumferential cutting of skirt shell (2150 mm O.D. X 8 mm Thick) was done after confirming the elevation requirements of the vessel. Skirt Shell was cut by 600mm to adjust vessel nozzle elevations.
- Installation of main vessel on foundation using Kobelco Crane.
- Welding of main shell dish end with skirt shell.
- Fixing up Hydronyl Hold Down Plate (Part no.29) & Hydronyl support ring (Part No. 30A) inside the vessel.
- Fixing up distributor Tray (Part No.30B) inside the vessel.
- Fixing up Demisters & Grids (Part No. 28) inside the vessel.
- Fabrication and Re-erection of removed pipelines and structures.

Dismantling of Existing 20" NB CS Vent Stack & Erection of New SS Vent Stack:

Dismantling of 20" NBx Sch STD. CS Pipe , Fabrication & Erection of 20" NB SS304L Sch.10S Piping from elevation 129.23 mtr. to Elevation 175.50 mtr. was carried out. This job was performed by M/S. ganesh Engineering, Ahmedabad against WO No. 9920369 Dtd. 30-03-2007 . Details of the complete job are given below: (Reference Isometric Drg No. P2-DL-13168 sheet 1/1 Rev 0).

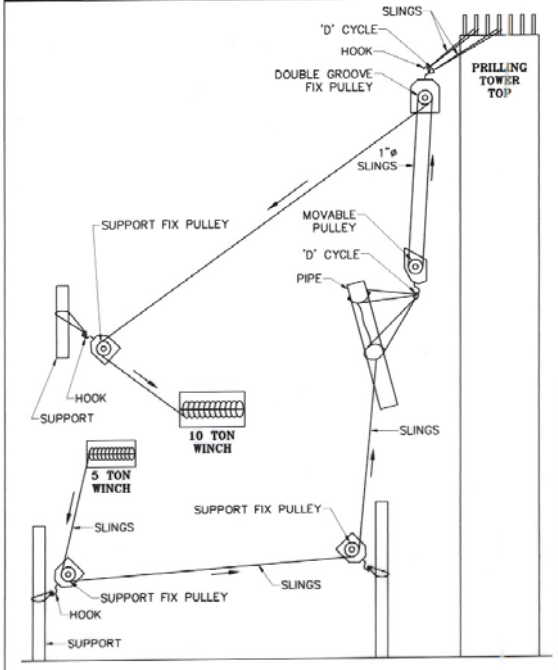
Activities involved:-

- Prefabrication of the 20" NB Sch 10 pipe line was done at site in three segments of 18 metre each. Root was TIG welded and final fill up with Arch welding. 10 % radiography was carried out and repairs were attended prior to lifting the pipe segments.
- Suitable lifting lugs were provided on new pipe segments for ease of rigging.
- Erected Scaffolding at site at two locations to facilitate cutting, removal and erection of pipeline job as per site requirement.
- Cutting of existing 20" NB x Sch STD. CS Pipe line after elbow at 129.93 mtr elevation & 8" NB tapping as shown in the isometric drawing Isometric Drg No. P2-DL-13168 sheet 1/1 Rev 0 into three segments. Cs pipe was cut into three segments. Each segment was removed separately using the two nos. winch in tandem starting from the top segment.

- The **lowering and lifting arrangement is shown in schematic view**.

- Erection of prefabricated piping was done by Winch arrangement. Initially top pipe segment was lifted and placed at site to meet the elevation requirement of the pipe top end. Subsequently middle pipe segment was erected and placed in position. Lastly, the bottom pipe segment was cut into the exact length requirement and placed in position. The existing miter bend at the bottom was repaired from inside due to poor penetration, prior to installing the pipe. Thickness of existing fabricated bottom elbow was checked and found O.K.
- Field welds were DP tested after root run and 100 % radiographed after complete welding. Repairing of weld joints was carried out based on NDT results.
- Fabrication of pipe supports and 8" branch pipes as per site requirement.
- One no. thermowell and one no. sample collection points were provided on 20 " NB pipe near 4 ata steam drum elevation.
- Construction of special components of piping like trunnion & guide supports were made out of C.S. and S.S pipes/ plates.

IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL



DRN	N.V. PANCHAL	TITLE	LIFTING ARRANGEMENT FOR 20" NB VENT STACK		EWR No.
CHD					
APD		DRAWING No.	PLANT / FROM / NUMBER	SHEET	REV.
SCALE	N. T. S.	CODE UREA-186	P 2 / E S / 2 0 0 0 7	1	0

LP VESSELS:

V-1101 (CO2 Knock out Drum):

Manhole was opened for internal inspection. Demister pads were found intact in position. After getting clearance from production department the vessel manhole was boxed up using new gaskets

V-1102 (NH3 Suction Filter):

Top cover was opened for internal inspection. Condition of Filter cloth was not satisfactory hence changed the filter cloth (synthetic nylon, nyfil-80). After getting clearance from production department the vessel top cover were boxed up using new gaskets.

V-1103 (NH3 Suction Vessel):

Manhole was opened for internal inspection. The condition of longitudinal and circumferential weld joints was found satisfactory. After getting clearance from production department the vessel manhole and top cover were boxed up using new gaskets

V-1202 (Rectifying Column):

Top cover and Manhole were opened for internal inspection. Condition of trays was found satisfactory and intact in position. Welded the distributor plate support as it was found damaged. After getting clearance from production department the vessel manhole and all connected pipe lines were boxed up using new gaskets.

V-1203 (L. P. Absorber):

Perforated support grid just below top hand hole was displaced from its position and was found distorted. The same was repaired and placed back in position after providing additional support angle. Condition of weld joints of the vessel was found satisfactory. After getting clearance from production department, the vessel manhole was boxed up using new gaskets.

V-1207 (L. P. Scrubber):

Grating condition was satisfactory. Welded the distributor plate support. After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets.

V-1301 (2ND Disrober):

Nozzle condition was found satisfactory. One loose clamp of the tray was tightened. After getting clearance from production department the vessel manhole was boxed up using new gaskets.

V-1351 (Hydrolyser):

Fasteners of trays were found intact in position. Three nos. of bolt/nuts of steam inlet flange were provided. One of Clamping loose bolt of steam inlet pipe to shell was tightened. After getting clearance from production department the vessel manhole was boxed up using new gaskets.

V-1352 (First Disrober):

Weld joint condition was found satisfactory. One missing clamp of the tray was provided. All internals were found intact in position. After getting clearance from production department the vessel manhole was boxed up using new gaskets.

V-1418 (Pre Evaporator Separator):

Tube to tube sheet weld condition was found satisfactory condition. Impingement cone was found in intact condition. After getting clearance from production department, the vessel manhole was boxed up using new gaskets.

V-1423 (1 ST Stage Evaporator Scrubber):

one no of missing J Bolt provided After getting clearance from production department, the vessel manhole was boxed up using new gaskets.

V-1424 and H-1424(2nd Stage Evaporator Separator):

Flushing arrangement (Sparger) was provided on top dome. 1 ½ " NB (SS 316) pipe was bent into four pieces. The flange end connection of pipe pieces was made for ease in removal and installation inside the vessel. 1.5 mm dia holes at 6" pitch on complete circumference of pipe were provided. Orientation of hole was kept at 30° and 90° alternatively towards inside wall of vessel. After getting clearance from production department the vessel manhole was boxed up using new gaskets .

V-1501 (4 ATA STEAM DRUM): (Boiler No. GT-1664)

All the internals were found intact in position. Demister pads were found intact in position. Condition of all weld joints was found satisfactory. Steam drum loop was hydraulically tested at 11 kg/cm2 on 30.4.07, and the same was witnessed by IBR Inspector. Also, IBR Inspector witnessed testing of Safety Relief Valves at test bench. The set pressure was kept 7.12 kg/cm2 as per IBR guide line.

After getting clearance from production department, the vessel manhole was boxed up using new gaskets.

V-1502 (23 ATA Steam Drum):
All the internal fittings were found in good condition. After getting clearance from production department, the vessel manhole was boxed up using new gaskets.

V-1503 (9 ATA Steam Drum):

Nut of the south side U-clamp of inlet steam header was found loose, tightened it. Welded the clit support of BFW line. After getting clearance from production department, the vessel manhole was boxed up using new gaskets.

V-1811 (Ist Stage Separator):

Demister pads were found intact in position. Vortex breaker was found intact in position. Overall condition of the vessel was found satisfactory. After getting clearance from production department, the vessel manhole was boxed up using new gaskets.

V-1812 (IInd STAGE SEPARATOR):

Demister pads found intact in position. Vortex breaker found intact in position. Overall condition of the vessel was found satisfactory. After getting clearance from production department, the vessel manhole was boxed up using new gaskets.

V-1813 (IIIrd STAGE SEPARATOR);

Demister pads found intact in position. After getting clearance from production department, the vessel manhole was boxed up using new gaskets.

TANKS:

T-1301 (Ammonia Water Tank):

Weld joints and nozzle condition was found to be satisfactory. Minor bulging was noticed on the bottom plate of the tank, as has been found in the past. After getting clearance from production department, the vessel manhole was boxed up using new gaskets.

T-1301-A (New Ammonia Water Tank):

All weld joints and nozzle condition was found satisfactory. After getting clearance from production department, the vessel manhole was boxed up using new gaskets.

T-1401 (Urea Solution Tank):

Weld joints condition was found satisfactory. Stiffener provided on top roof plate was found intact in position. Minor bulging was noticed on the bottom plate of the tank, as has been found in the past. Minor bulging was noticed on the bottom plate of the tank, as has been found in the past. After getting clearance from production department, the tank manhole was boxed up using new gaskets.

T-1401-A (New Urea Solution Tank):

Nozzles and weld joint condition was satisfactory. After getting clearance from production department, manhole was boxed up using new gaskets.

T-1501 (Condensate Tank):

Condition of Weld joint was found satisfactory. Condition of the patch plate and its weld joints found satisfactory. After getting clearance from production department, manhole was boxed up using new gaskets.

CLEANING AND HYDROJETTING OF HEAT EXCHANGERS:

The Hydrojetting job was awarded to M/s Delux Hydroblasting services, Mumbai vide W.O. No. 16/00194/9916832 dated 16/03/2005. Following heat exchangers were opened for cleaning by hydro jetting. After cleaning, exchangers were boxed up with new gaskets.

- Surface condenser (H-1815)
- Main lube oil coolers (H-1814-A)
- Main lube oil coolers (H-1814-B)
- Flash tank condenser (H-1421)
- First Evaporator (H-1422) with DM water.
- First Evaporator condenser (H-1423)
- Second Evaporator (H1424) with D.M. water.
- 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/C
- Reflux condenser (H-1352)
- Pre-evaporator condenser (H-1419)
- 3rd Inter Stage Cooler, H-1813 of Hitachi Train: Tube bundle pulled out after soaking the same with special chemical solution arranged by laboratory Section , Despite of soaking, heating and pulling was required to be done due to heavy fouling of the bundle inside the shell.
- CCS - II Cooler (H-1207) : Tube bundle was pulled out as there was leakage noticed from the shell side face of the tubesheet. New gasket was provided and the bunle was inserted back after hydrojetting.

RELIEF VALVE OVERHAULING AND TESTING:

Following RV's were removed, overhauled and tested on valve test bench by M/s Flotec Engineering Services, Surat vide W.O.No. 9920319 .

SR. NO.	RV NO.	EQPT. NO. & NAME	SET PRESSURE	RESET PRESSURE
1	RV-1101 A	Liquid Ammonia line from H-1102 to V-1102	31Kg/cm2	27.9 Kg/cm2
2	RV-1101 B	Liquid Ammonia line from H-1102 to V-1102	31Kg/cm2	27.9 Kg/cm2
3	RV-1102 A	Ammonia suction Vessel (V-1103)	31Kg/cm2	28 Kg/cm2
4	RV-1102 B	Ammonia suction Vessel (V-1103)	31Kg/cm2	28 Kg/cm2
5	RV-1103 A	P-1102 A discharge	150 Kg/cm2	135 Kg/cm2
6	RV-1103 B	P-1102 B discharge	150 Kg/cm2	135 Kg/cm2

7	RV-1103 C	P-1102 C discharge	150 Kg/cm2	135 Kg/cm2
8	RV-1106 A	Liquid Ammonia line from Ammonia Plant to Ammonia filter.	31Kg/cm2	27.9 Kg/cm2
9	RV-1106 B	Liquid Ammonia line from Ammonia Plant to Ammonia filter.	31Kg/cm2	27.9 Kg/cm2
10	RV-1107 A	Liquid Ammonia line (hot) before Ammonia filter	31Kg/cm2	27.9 Kg/cm2
11	RV-1107 B	Liquid Ammonia line (hot) before Ammonia filter	31Kg/cm2	27.9 Kg/cm2
12	RV-1108 A	Cold Ammonia line from Ammonia storage tank to H1102	31Kg/cm2	27.9 Kg/cm2
13	RV-1108 B	Cold ammonia line from Ammonia storage tank to H1102	31Kg/cm2	27.9 Kg/cm2
14	RV-1110	Liquid ammonia line from Atm. Ammonia .storage tank to H-1102	31Kg/cm2	27.9 Kg/cm2
15	RV-1129 A	4 ata Steam Header	6 Kg/cm2	5.4 Kg/cm2
16	RV-1129 B	4 ata Steam Header	6 Kg/cm2	5.4 Kg/cm2
17	RV-1130	24 ata steam header	26 Kg/cm2	23.4 Kg/cm2
18	RV-1181	K-1801 final discharge	177 Kg/cm2	160 Kg/cm2
19	RV-1184 (CCS-I)	H-1102 outlet NH3 outlet	6 Kg/cm2	5.4 Kg/cm2
20	RV-1201 A	V-1201 off gas line	165 Kg/cm2	150 Kg/cm2
21	RV-1201 B	V-1201 off gas line	165 Kg/cm2	150 Kg/cm2
22	RV-1201 C	V-1201 off gas line	165 Kg/cm2	150 kg/cm2
23	PSV-1201 A	P-1201 A suction line	8.5 Kg/cm2	7.5 Kg/cm2
24	PSV-1201 B	P-1201 B suction line	8.5 Kg/cm2	7.5 Kg/cm2
25	PSV-1201 C	P-1201 C suction line	8.5Kg/cm2	7.5 Kg/cm2
26	RV-1202 A	V-1202 off gas line LP System	6 Kg/cm2	5.4 Kg/cm2
27	RV-1202 B	V-1202 off gas line LP System	5.7 Kg/cm2	5.13 Kg/cm2
28	RV-1202 C	V-1202 off gas line LP System	6 Kg/cm2	5.4 Kg/cm2
29	RV-1203	P-1201 A suction line	8.5 Kg/cm2	7.5 Kg/cm2
30	RV-1205	P-1201 A discharge	165 Kg/cm2	148 Kg/cm2
31	RV-1206	P-1201 B discharge	165 Kg/cm2	149 Kg/cm2
32	RV-1206	P-1201 C discharge	170 Kg/cm2	154 Kg/cm2
33	RV-1209	V-1203 Vessel	10 Kg/cm2	9 Kg/cm2
34	RV-1221 (CCS-II)	P-1204 discharge to H-1203	16.5 Kg/cm2	15 Kg/cm2

35	RV-1224	C.W from utilities	6 Kg/cm2	5.4 Kg/cm2
36	RV-1301	RV of V-1301	6 Kg/cm2	5.4 Kg/cm2
37	RV-1351	RV of V-1351	24 Kg/cm2	22 Kg/cm2
38	RV-1351 A	RV of P-1351 A	10 Kg/cm2	9 Kg/cm2
39	RV-1351 B	RV of P-1351 B	10 Kg/cm2	9 Kg/cm2
40	RV-1352	RV of V-1352	6 Kg/cm2	5.4 Kg/cm2
41	RV-1501 A	4 ata Steam Drum	7.12 Kg/cm2	6.75 Kg/cm2
42	RV-1501 B	4 ata Steam Drum	7.12 Kg/cm2	6.6 Kg/cm2
43	RV-1503	23 ata Steam	25 Kg/cm2	23 Kg/cm2
44	RV-1504	9 ata Steam Drum	12 Kg/cm2	10.8 Kg/cm2
45	RV-1901	Ist stage discharge of K-1801.	7 Kg/cm2	6.3 Kg/cm2
46	RV-1902	II stage discharge (Hitachi)	28 Kg/cm2	26 Kg/cm2
47	RV-1903	K-1801 IIIrd stage discharge	111Kg/cm2	100 Kg/cm2
48	RV-1904	H-1811 First stage gas cooler	7 Kg/cm2	6.3 Kg/cm2
49	RV-1905	H-1812 Second stage gas cooler	7 Kg/cm2	6.3 Kg/cm2
50	RV-1906	H-1813 Third stage gas cooler	7 Kg/cm2	6.3 Kg/cm2
51	RV-1913	Ejector system of Q-1801	0.20 kg/cm2	0.18 kg/cm2
52	RV-1914	Ejector system of Q-1801	0.20 kg/cm2	0.18 kg/cm2
53	RV-1916	23 ata Steam extraction	28 Kg/cm2	25 Kg/cm2
54	RV-1917	4 ata Steam exhaust	4 Kg/cm2	3.6 Kg/cm2
55	RV-NH3	RV to NH3 Plant Line	85 Kg/cm2	77 Kg/cm2

PRILL TOWER ID FAN K-1401/1:

During visual inspection, all the blades of this fan were found to be badly damaged. Hammering marks were observed on the blades. It was decided to perform complete overhauling of this fan and to replace the blades.

The scaffolding was provided in the fan cell. Replaced all the blades with new ones and set the blade angle 10^0 with the help of protractor spirit level. All blade locking bolts of K-1401/2, 3, 4 were loosened and blade angle was set at 10^0. The blades were tightened.

The roller bearing (22220 EK , SKF make) were removed and replaced with Cooper make Split type bearing (308 EX SI SRS and 308 EX GR SRS). V-belts (SPC 4000, 1set = 3 nos) were replaced.

Alignment of fan motor w.r.t. fan was carried out and the all V belts were fully tensioned.

Scaffolding was removed after completion of job. All internal and external surfaces were cleaned by power tool and painting was carried out with 1 coat of epoxy primer and 2 coats of epoxy paint.

PRILL TOWER ID FAN K-1401/2,3 and 4:

Preventive maintenance of all these fans was carried out. Bearings were inspected. Found OK. Fresh grease provided and boxed up. The blades were checked for tightness.

V-belts (SPC 4000, 1set = 3 nos) were replaced. Alignment of fan motor w.r.t. fan was carried out and the all V belts were fully tensioned.
All internal and external surfaces were cleaned by power tool and painting was carried out with 1 coat of epoxy primer and 2 coats of epoxy paint.

INLET AIR FAN (K-1701) & EXHAUST AIR FAN (K-1702):

Bearings of both fans were opened, cleaned and checked. Found in good condition and hence boxed up. Fresh lube oil charged. Rotor and casing of fans were cleaned. Bigger size fan pulley of K-1701 was replaced by smaller size fan pulley. Fan pulley and motor pulley of K-1702 were also replaced. Alignment of fan pulleys of K-1701 & K-1702 was checked and corrected. Painting of internal surfaces of casing carried out.

Inlet air fan Discharge Damper and exhaust air fan Suction Damper were replaced with new ones procured from M/S. C.Doctor India Pvt Ltd, Ahmedabad vide PO No. 9919807 Dtd. 27.11.2006.

The condition of the fabric of the expansion joints of K-1701 Discharge duct and K-1702 Suction duct was found to be deteriorated. The fabrics of these joints were replaced which were procured from M/S. Urja Products Pvt Ltd vide Po No. 8820526 Dtd. 10.4.2007.

FLUIDIZED BED COOLER (H-1701) :

Fluidized bed cooler, dust Silos and cyclone separators were opened for inspection. After inspection and cleaning, the same were boxed up.

CONVEYOR SYSTEM :

UREA PRODUCT CONVEYOR (M-1403) :

Preventive maintenance of Gear box was carried out. Oil seals were replaced. 12 nos of plain return rollers were replaced with rubber lined return rollers. Skirt rubber pads were replaced wherever found damaged. Alignment was checked and coupling bush were replaced before boxing up the couplings.

LINK CONVEYOR (M-1419) :

The condition of the belt was deteriorated. Top rubber cover was found peeled off from many locations. Belt was replaced by new one made of 4 ply Nylon, Grade HR-T1 & width 800 MM.

All plain return rollers were replaced with rubber lined return rollers. Skirt rubber was replaced wherever found damaged. Preventive maintenance of Gear box was carried out. Alignment was checked and coupling bush were replaced before boxing up the couplings.

PRILL COOLING SYSTEM LINK CONVEYOR (M-1421) :

Belt condition was found satisfactory. The joint of the belt was repaired by M/S. JK Rubber. Preventive maintenance of Gear box was carried out. Alignment was checked and coupling bush were replaced before boxing up the couplings.

DUST CONVEYOR SYSTEM (M-1703):

One rotary valve (M-1703/1) was replaced by new one. Bearing condition was found ok.

BUCKET CHANGE OVER MECHANISM (M-1401 A/B):

Bucket change over mechanism was cleaned. Pulley of the mechanism checked and found OK. Replaced the Bearings (6314 & 6020) of mechanism.

SCRAPPER (M-1402 -1/2):

Scrapper arms were inspected for tightness. Checked scrapper floor slit plates. Cleaned scrapper surface by power tool and applied one coat of epoxy Primer and two coats of epoxy paint. Covered the scraper surface with aluminum sheets to prevent corrosion. Fluid Couplings of scrapper arm was checked and found OK. Fluid coupling oil was flushed. Checked condition of V belts (B 69, 1set = 4nos.) and tightened the belts. V-belts of M-1402/2 replaced with new ones. Alignment checked and tightened belts. Removed oil from scrapper main gear box, flushed the oil and opened the inspection window of both the gear boxes and maintained the oil level. No abnormality was observed during inspection of the gear box.

CHEMICAL CLEANING OF PLATE TYPE HEAT EXCHANGER (H-1206)

During shut down 2007, we had carried out chemical cleaning of plate type heat exchanger in presence of M/s Alfa Laval (I) Ltd, engineer.

Prior to shutdown, one no. old SS vessel was modified to suit the site requirements. The vessel was erected at site. Ne no. old pump (P-1106, removed from service in the past) was overhauled and installed at site. Suitable pipe line fabrication was carried out using 6 " NB piping and fittings. Pipe layout was made in such a way that forward as well as reverse flow conditions can be established as desired by Alpha Laval engineer for effective chemical cleaning. Suitable NRVs, Strainers and isolation valves were provided. Arrangements were also made for heating the vessel from outside using Electric Heating Coils using SR Equipment. Since the circulation was continued for long hours, the temperature of the solution reached 60 Deg C of its own and hence SR Heating coiles were not required to be switched on.

The chemical cleaning procedure was given by M/s Alfa Laval. The details of Chemical cleaning procedure is described below

- The indicative reading viz. Flow Rate, Temperature Program and Differential Pressures shall be noted prior to taking the Plate Heat Exchanger for cleaning. Plate Heat Exchanger to be taken out of duty, by closing all inlet and outlet valves and by placing blind flanges wherever necessary.

- Plate Heat Exchanger to be drained completely. Arrangement and connection of Pump, Hoses and interconnecting flanges etc. to be done and an open circuit from Dosing Tank to Plate Heat Exchanger on one of the circuits (Primary or Secondary) and back to be done. Arrangement done to have flow in counter current as well as normal flow direction.

- Plate Heat Exchanger to be flushed with soft Water (at room temperature) on both the sides in reverse condition i.e. flow from outlet to inlet. (DM Water was circulated in Reverse Direction for one hour.)

- One of sides (Primary or Secondary) to be closed out while the second is taken in circuit. (Only CW Circuit was taken up for Chemical cleaning)

- Hot Water / Condensate at around 70 Deg. Cent. to be circulated in the Plate Heat Exchanger for 1 hour. (Due to hot ambient conditions, the Heating elements (SR Equipment) were not switched on as temperature was achieved(60 Deg C, which was considered sufficient as per Alpha Laval Engineer) due to continuous circulation.

- 6% - 8% Caustic solution to be circulated in the Plate Heat Exchanger for 3 hours. The inlet should always be from bottom and outlet from the top.(46% Concentrated NaOH was issued from Utility and was diluted to 6.57 % concentration DM Water level was filled up in the tank equivalent to 3500 kg. 500 Kg Caustic Solution(46 %) was added.

  500 X 0.46 = 230 Kg NaOH
  230 / 4000 X 100 = 5.8 % Concentration)

- Neutralization of Plate Heat Exchanger by draining (initially) and then flushing till pH value of water coming out of Plate Heat Exchanger is around 7-8. (DM Water was used for flushing the exchanger from both the directions i.e. Counter current as well as regular flow direction, each for 15 minutes. pH value was ensured using pH measuring strips)
- Chemical Cleaning of Plate Heat Exchanger using patented Alfa Laval Chemicals by circulating the same for 3 hours (IFFCO may use sulphamic acid 8-10 %). The solution should be prepared using 1:2 (Alfa Laval Cleaning Chemical: Water) proportion of Chemicals provided by Alfa Laval at around 60 Deg. Cent. (IFFCO used sulphamic acid procured vide PO No. 9920202 Dtd. 12.02.2007 from M/S. Impex Corporation)
- The inlet should always be from bottom and outlet from top. (Sulphamic Acid was used for circulation in Reverse direction initially. Flow was maintained for 1 hour. 300 Kg of Sulphamic acid was added in 3500 kg water. Concentration was maintained at 8.5 %.)
- Neutralization of Plate Heat Exchanger by draining (initially) and then flushing till pH value of water coming out of Plate Heat Exchanger is around 7.
- The indicative reading viz. Flow Rate, Temperature Program and Differential Pressures shall be noted to judge the cleaning of Plate Heat Exchanger. (The operating conditions were checked and found satisfactory after plant startup.)

STEAM /CONDENSATE JOBS:

Following Steam/Condensate jobs were carried out.

SR. NO.	DESCRIPTION
1	PICV-1181 d/s drain I/V was passing and replaced by new one (Gate valve, ¾" x 800#)
2	60 ata battery limit I/V (main) u/s drain I/V was passing and replaced by new one (Gate valve, ¾" x 800#)
3	PICV-1128 u/s drain I/V was passing and replaced by new one (Gate valve, ¾" x 800#)
4	P-1401A/B common condensate flushing I/V was passing and replaced by new one (Gate valve, ¾" x 800#).
5	FI-1128 Sensing line to be shortened (relocated)
6	replaced P-1408 both condensate flushing valve (ball valve, 1" x 800#)
7	Changed the gasket to attend the trap body leak (near P-1408 motor fan side)
8	Steam tracing 'T' joint was found leak, tightened with new taflon tape(Near LRCV-1201 d/s condensate I/V)
9	P-1701-A Suction strainer condensate flushing I/V was passing and replaced by new one (Gate valve, ¾" x 800#).
10	P-1401-B condensate flushing 1st I/V was passing and replaced by new one (Gate valve, ¾" x 800#).
11	P-1401 A discharge condensate flushing I/V was passing and replaced by new one (Ball valve, ¾" x 800#)
12	Leak was found inside the Insulation box near H-1201. Welded and after DP check found Ok.
13	F-1206 – B drain I/V hard to operate and replaced by new one (Gate valve, ¾" x 800#).
14	H-1206 C.W. common drain I/V hard to operate and replaced by new one (Gate valve, ¾" x 800#).
15	P-1201 suction condensate flushing 1st I/V was passing and replaced by new one (Gate valve, ¾" x 800#).
16	V-1418 condensate level pot level glass was found leaking, replaced the gasket
17	Flushing arrangement (Sparger) was provided for H-1424 (Dome inside flushing)
18	H-1502 channel cover leak , opened the channel cover and changed the gasket by new one
19	H-1422 dome flushing I/V was passing and replaced by new one (Gate valve, ¾" x 800#).
20	HPF to NH3 to V-1201 first flange was found leak, changed the gasket.
21	Needle valve tapping, H-1208 downstream line was leaking and replaced by new one (¾" x 800#).
22	To attend the vibration of LICV-1502A line, tighten the support fasteners.
23	Tracing o/l (3rd from V-1201) of H-1201 liquid out let line flange was found leak, replaced the gasket.
24	Flash tank ejector 4 ata steam condensate outlet trap bottom cover was found leak, replaced the gasket.
25	4 ata steam to H-1205 1st I/V was passing and replaced by new one (Gate valve, ¾" x 800#).
26	Steam I/V valve near Autoclave was passing and replaced by new one (Gate valve, ¾" x 800#).

27	Autoclave weep holes steam I/V was passing and replaced by new one (Gate valve, ¾" x 800#).
28	Melt return line HICV-1422 bypass I/V was passing and replaced by new one (Gate valve, 2" x 800#).
29	Trap was provided u/s of HICV-1401 (for M-1401)
30	Condensate to melt return I/V u/s bottom flange was found leak, replaced the gasket.
31	Pinhole leak was found near trap out let condensate line (HICV-1401), Welded and after DP check found Ok.
32	RV-1201 A/B steam flushing inlet union leak. Rerouted the line

PROCESS JOBS :

Following Process jobs were carried out.

SR. NO.	DESCRIPTION
1	H-1811 channel cover was leaking , replaced the gasket
2	C.W. In/Out to I/V/s Q-1814 bearing, to be shifted from bottom to top. Rerouted the line
3	P-1102B dis. line I/V was passing and replaced by new one (Gate valve, 4" x 900#).
4	P-1201C I st Dis. I/V. was passing, lapped the body seat and replaced the bonnet.
5	P-1201C Suction I/V bonnet was found leak and replaced the gasket
6	Needle valve tapping, H-1208 d/s. was leaking and replaced the valve (½" x 800#).
7	P-1204A mech. Seal was attended and replaced the old pump with reconditioned pump.
8	Hot NH3 supply RV u/s of MOV was passing and lapped the valve seat, tested and fixed in the position.
9	3 way valve of N/C ratio u/s flange was found leaked and replaced the flange gasket.
10	R.V. -1201 B was Passing badly. Overhauled the RV , tested and fixed the position.
11	Pin hole leak was found in P-1352 A pump's drain I/V (at u/s of discharge I/V) line. Welded it and after DP check found ok.
12	H-1201 sample 1st I/V is passing
13	P-1204 – B suction flange and pump casing leak
14	H-1207 channel cover flange was leaking, opened the channel cover, removed the tube bundle, cleaned it from inside and outside, finally boxed up with new gasket.
15	P-1102-A packing flushing sample I/V was passing , opened, lapped the body seat and finally boxed up
16	P-1102-B packing flushing sample I/V was passing, opened , lapped the body seat and finally boxed up.
17	HICV-1208 d/s sample I/V was broken, replaced it with new one (¾" x 2500#).
18	RV's tail header drain line (½") replaced to (1") and provided I/V (¾" x 800#).
19	H-1425 Condensate flushing line was loosed from thread (C R Side), tightened with new taflon tape.
20	H-1425 Condensate flushing I/V not operatable and replaced by new one (Gate valve, ¾" x 800#).

21	P-1401 A/B suction drain I/V was passing and replaced by new one (Gate valve, ¾" x 800#).
22	P-1352A Dis. drain I/V (at u/s of dis. I/V) was passing and replaced by new one (Gate valve, ¾" x 800#).

GLAND REPAIR JOB :

Following Gland repair job were carried out by M/s Amrutha Engineering, New Panvel vide W.O. No. 14/00750/9920053 dated 18/01/2007.

SR. NO.	DESCRIPTION
1	Q-1801 60 ata chest valve g/l (D M water plant side)
2	PICV-1129 u/s drain (both line) I/V is passing and its trap u/s I/v g/l.
3	PICV -1810 body steam coil I/V g/l
4	H-1205 drain steam injection I/V g/l
5	FIC-1302 (4 ata to V-1301) sensing line root I/V g/l
6	9 ata drum pressure tapping I/V g/l
7	4 ata steam to H-1205 1st I/V is passing (3rd floor) & g/l
8	H-1202 top steam tracing I/V g/l. (C. R. Side)
9	Steam tracing to PRCV-1201 I/V g/l near HICV-1202
10	Stem tracing I/V g/l at the bottom of H-1203 near CO2 inlet line
11	23 ata flushing to V-1351 level troll i/v g/l.
12	FIC-1352 by pass I/V flange leak and g/l.

COOLING WATER PUMP (P-4401/A):

Both the journal Bearings were checked and found okay.

The clearances were checked & following are the readings:

Sr. No.	Description	Design Value	Actual Value (AM)
1	Total Float of the pump	10 mm	8.0 mm
2	Radial bearing Clearance coupling end	0.20 mm	0.16 - 0.18 mm
3	Radial bearing Clearance free end	0.20 mm	0.18– 0.20mm

Total Axial Float of the pump is 8.0 mm.

Both side glands of pump was repacked with 25 mm PTFE packing (454801214).

Coupling of pump with gear box was cleaned, checked and found O.K.

Alignment between pump and gear-box were checked, greasing is done & box-up the coupling.

Elliott Turbine Q-4411:

Lufkin Gear-Box Maintenance:

Opened the GB Top cover by using RT-760 crane (from Admn. Side), checked the gearwheel and pinion found O.K.

Removed the journal bearings and DP checked, found O.k.

The clearances were checked & following are the readings:

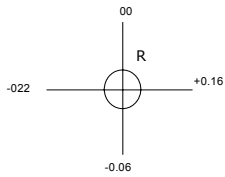
Gear wheel front brg. Clearance	0.26mm
Gear wheel rear brg. clearance	0.28mm
Pinion front brg. clearance	0.16mm
Pinion rear brg. clearance	0.19mm

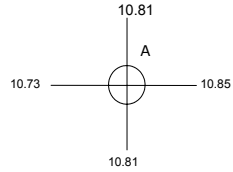
Elliott Turbine Maintenance:

- Both the journal Bearings and thrust bearing were DP checked and found okay.
- Oil Cooler tubes were cleaned by Hydro jetting. Oil Cooler shell side was cleaned by diesel.
- Fresh oil was charged in Governor (SERVO-PRIME 32).
- Oil console was drained; cleaned and fresh oil charged (SERVO-PRIME 32) Approximately 620 ltrs of Oil was used.
- Main oil pump suction strainer was cleaned & boxed up.
- Auxiliary oil pump two nos suction strainers (336002060) were replaced & boxed up.
- The surface condenser was opened. Hydro jetting was carried out and boxed –up.
- The clearances were checked & following are the readings:

Sr. No.	Description	Actual Value
1	Axial Float on the turbine	0.25mm
2	Radial bearing Clearance coupling end	0.30mm
3	Radial bearing Clearance Governor end	0.23mm

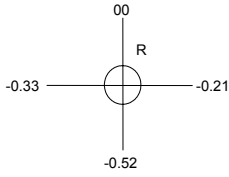
Alignment readings between Gear Box & Cooling Water Pump

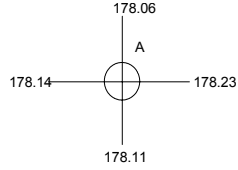




By Slip Gauge

Turbine to Gear box Alignment readings:





COOLING WATER PUMP (P-4402):

Preventive Maintenance of Urea Cooling Water Pump:

a) Coupling between the pump and motor was decoupled.

b) Both the journal bearings were checked & found okay.

c) The clearances were checked & following are the readings. Free end side : 0.17 to 0.21 mm , Coupling side : 0.18 to 0.24 mm

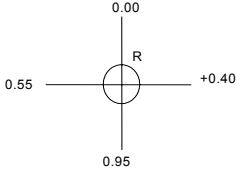
d) Both the bearing housing was flushed with oil & fresh oil (SERVO-PRIME 68) charged.

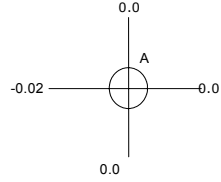
e) Radiator cooling water line opened and box-up after cleaning of radiator.

f) Coupling oil paper replaced and new grease filled.

g) The Discharged line NRV was opened for attending passing. The seal ring (Neoprene rubber) was found damaged. This was local purchased from M/s Bhavana Enterprises, A'bad and installed.

Checked the alignment between pump & motor and following are the readings:





Triveni Turbine Q-4403:

The Preventive Maintenance was carried out on Triveni Turbine. The following are the observations and action taken.

1. Speed governor, main steam valve, relay, over speed trip bolt, Main Oil Pump, governor were overhauled and assembled back.
2. The hand oil pump was dismantled, cleaned and boxed up.
3. Journal bearings were checked, polished and assembled.
4. Exhaust Line Relief Valve was replaced with "cross-by" new RV.
5. The 10" gate type isolation valve installed on exhaust line was replaced with "AUDCO' make new gate valve.

BEARING CLEARENCES:

SR.NO	POSITION	CLERANCE
1.	Front	0.18 / 0.19mm
2.	Rear	0.21 / 0.23 mm

Rotor thrust float: 0.30 mm

Triveni Gear-box:

Pinion front bearing cl.	0.18 /0.19 mm
Pinion rear bearing cl.	0.18 / 0.19 mm
Gear wheel front end	0.21 mm
Gearwheel rear end	0.21 mm
Backlash	0.40 mm

COOLING WATER PUMP (P-4403):

1. The foundation base frame of cooling water pump was planned for replacement due to heavy corrosion on the frame.

2. Due to non-availability of dimensional drawing of base frame, only MS channels were kept ready for fabrication of base frame.

3. The complete Pump Assembly (Weight: 6.6 Tons) was lifted with Kobelco crane placed at other end of cooling water sump. The boom length was 110 feet and radius was @ 27 mtrs during rigging of pump. The capacity of crane was 24 tons at this radius & boom length.

4. After removal of pump, the base frame dimensions were picked-up & foundation frame level was transferred by water column for final leveling.

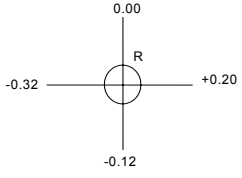
5. New bolts were grouted for base frame.

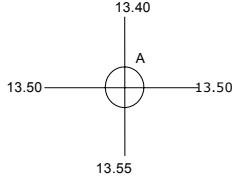
6. Meanwhile, the pump was taken for preventive maintenance. The following activities were carried out on pump.

   - The journal bearings were opened, cleaned and checked for clearances.
   - The coupling side journal was found damaged & the same was replaced. The rear bearing was found ok.
   - Journal bearing front cl. 0.15mm
   - Journal bearing rear end cl. 0.16mm
   - The rotor float was measured as 0.24 mm.
   - Both side gland was repacked.

7. After readiness of RCC job for base frame, the frame was lowered on foundations & level was maintained with previously transferred level by water column.

8. The pump was erected on foundation frame by Kobelco crane and alignment was carried out. The alignment readings are as under ;-





COOLING WATER PUMP (P-4401 / C):

(a) Checked the journal bearing Clearance at both ends

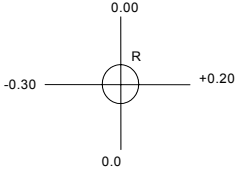
(b) Coupling end 0.17 to 0.20mm

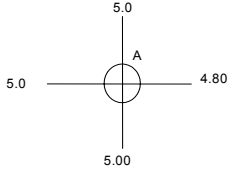
(c) Free end 0.22mm. The bearing was replaced. The existing cl is 0.14 to 0.15 mm

(d) The rotor float was measured as 0.35 mm.

(e) Cleaned & greasing done after coupling.

(f) Checked the alignment.





COOLING WATER PUMP (P-4401 / D) :

(a) Checked the bearing Clearance at both end

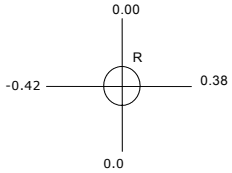
(b) Coupling end 0.18 to 0.20 mm

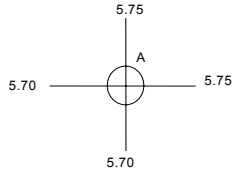
(c) Free end 0.17 to 0.20 mm

(d) The rotor float was measured as 0.60 mm.

(e) Cleaned & greasing done after coupling.

(f) Checked the alignment:





COOLING WATER PUMP (P-4404-E) :

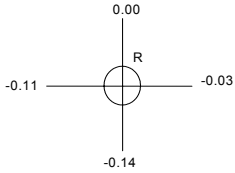
(a) Coupling float was checked after de-coupling and observed as 0.14 mm

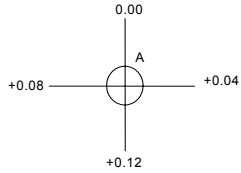
(b) The pump to motor alignment was checked and corrected.

(c) Both bearing top half opened. Both side bearing checked, found in healthy condition.

(d) Bearing housing cleaned and fresh oil (SERVO PRIME 68) charged.

(e) The following are the alignment reading





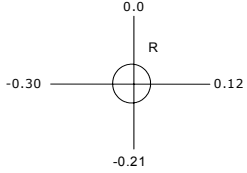
Raw water Pump P-4101 B:

The corroded base frame was replaced with MS base Frame. After removal of old base frame, all foundation bolts were found in broken condition.

Preventive Maintenance of BFW Turbine Q - 5111:

a) Cleaned the Radial & Thrust bearings.
b) Checked the radial clearances of bearings using lead wire.
c) Alignment readings were checked.
d) The oil cooler covers were opened and hydro- jetting was carried out.
e) Cleaning / replacing oil filters and oil in the oil console.
f) Checked the oil lines, water line for leaks.
g) Suction filter of the MOP was cleaned.
h) The oil console was cleaned and fresh oil (servo-68) was charged.

Alignment Readings: Pump To Turbine



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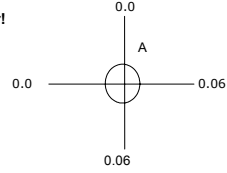


Clearance Details :

Sr. No.	Description	Design Value (mm)	Actual Value(mm)
1	Axial Thrust	0.28 - 0.33	0.21
2	Radial bearing Clearance coupling end	0.13 - 0.18	0.21
3	Radial bearing Clearance free end	0.13 - 0.18	0.29

BFW Pump P-5111:

a) Preventive maintenance was carried out on Pump.
b) Bearing top halves were removed.
c) Coupling end and free end bearing clearances were measured using lead wire.
d) Bearing pads were cleaned and polished using green rouge.
e) Bottom halves of the bearings were assembled, clearance checked & recorded.
f) Oil filter was removed, cleaned and re-installed.
g) Oil cooler was opened and cleaned by Hydro jetting.
h) Oil of the console was drained, cleaned and boxed up.
i) Very little chocking was observed in the BFW suction strainer with compared to previous shut-downs. It was cleaned and assembled.

Sr. No.	Description	Actual Value(mm)
1	Axial Thrust	0.22
2	Coupling end Bearing Clearance	0.15
3	FE Bearing Clearance	0.16 to 0.17

BFW Pump (MOTOR DRIVEN) P-5112:
Preventive Maintenance:

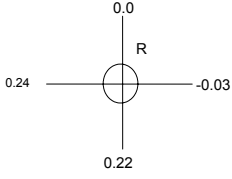
a) Couplings between the Pump and Gear Box were decoupled after recording the necessary match marks.
b) Initial alignment readings and axial float were measured and recorded.
c) Bearing top halves were removed.
d) Coupling end and free end bearing clearances were measured using lead wire and recorded.
e) Bearing halves were cleaned and polished using green rouge.
f) DP check of all bearings and coupling hubs and found ok.
g) Thrust collar and the bearings assembled, clearance checked and recorded.
h) Oil tank & filter was cleaned.
i) Oil cooler was opened and cleaned.
j) Suction filter of the pump was cleaned.
k) Gear Box oil was replaced with new oil. (Servo -68)
l) Gearbox cooler cleaned.

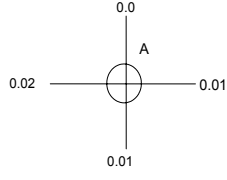
Preventive Maintenance of Gear Box:

a) Coupling between the Gear Box and Motor was decoupled after recording the necessary match marks.
b) Initial alignment readings and axial float were measured and recorded.
c) Bearing top halves were removed.
d) Coupling end and free end bearing clearances were measured using lead wire and recorded.
e) Bearing halves were cleaned and polished using green rouge.
f) Gears were taken out, cleaned and inspected.
g) Gears were re installed. Backlash was checked and noted.
h) Bearings were assembled, clearance checked and recorded and boxed up.
i) Gear Box cover O rings were replaced.
j) Coupling is aligned with reference to match mark.

ALIGNMENT DATA :

Gear Box & Boiler Feed Pump

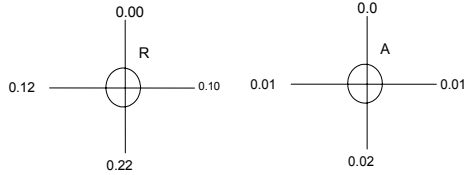




By inside micrometre

Alignment reading between Gear Box to Motor

By slip gauge



Clearance Details of P-5112:

All the values are in mm

Sr. No.	Description	Actual value (mm)
1	Radial bearing clearance coupling end	0.15
2	Radial bearing clearance free end	0.14
3	Gear wheel front bearing clearance	0.18
4	Gear wheel rear bearing clearance	0.17
5	Pinion gear front bearing clearance	0.17
6	Pinion gear rear bearing clearance	0.17
7	Gear wheel thrust float	1.60
8	Pinion Gear thrust float	2.76
9	Gear backlash	0.50
10	Axial thrust of pump (after adjustment)	0.30

F. D. FAN TURBINE Q-5113 & F.D. FAN:

1. Between turbine and fan coupling rubber pads were checked and found OK.

2. Gearbox cover is opened and checked the gears and brings. The same was cleaned; D.P. test was carried and assembled back.

3. Light dust was observed at main oil console. The same was cleaned and refilled with new oil (SERVO PRIME 68).

4. The sentinel warning valve was checked and found OK.

5. The air dampners were attended for proper working. The Fan inlet air mesh screen was changed.

6. The clutch oil (Servo Transfluid-A) was replaced.

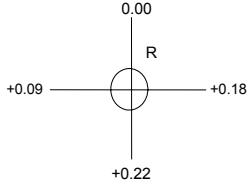
BEARING CLARENCES:

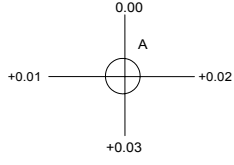
SR. NO	POSITION	CLERANCE	REMARKS
1.	Pinion thrust end journal bearing	0.13	Same bearing re-used
2.	Pinion opp thrust end journal bearing	0.15	Same bearing re-used.
3.	Gear wheel thrust end journal bearing clearance	0.15	Same bearing re-used.
4.	Gear wheel opp thrust end journal bearing clearance	0.16	Same bearing re-used.
5.	Fan turbine end roller bearing clearance	0.13	Same bearing re-used.
6.	Fan motor end roller bearing clearance	0.12	Same bearing re-used.

Pinion thrust float: 0.23
Gear wheel thrust float: 0.21

ALIGNMMENT BETWEEN GEAR BOX AND FAN:

FD Fan to Gear box: Clamp on fan & Dial on Gear Box:





STEAM LEAK & FABRICATION JOBS:

1. All Steam leak jobs attended as per the Shutdown job list. Seven nos ½" x 800 # & two nos ¾" x 800# passing valves were replaced on Steam Traps lines on stem header.
2. ¾" dia steam line was replaced at piller no 39.
3. One 3" x 150 # tapping was arranged for Chlorination system for Narmada water project.
4. New cooling tower Water sample line root isolation valve(Size : ½") was replaced with new 1" gate valve.
5. Fabrication jobs in Compressor house area was carried out as per job list.
6. Complete SS 304 patching was welded on Hogging ejector of Q-4411 to avoid external corrosion on shell.
7. Weld joints of by-pass lines of discharge line of P-4401/C & D was reinforced with SS 304 Pads.

RUBBER BELLOW REPLACEMENT

The following rubber bellows were replaced on suction & Discharge lines of Cooling Water Pumps.

24" rubber bellows on discharge line of P-4404/E Pump.

32" rubber bellows on suction line of P-4401/C.

32" rubber bellows on suction line of P-4401/D.

BHEL BOILER JOBS (F-5111) :

BHEL BOILER INSPECTION:

Boiler was inspected by Boiler Inspector in open condition on 23.04.2007 & Hydrotest was carried out at 89 Kg/cm2 pressure on 27.04.2007 and witnessed by Boiler Inspector.

The nozzle seats of all three safety relief valves were in-situ machined by hand lapping, overhauled & assembled. The RVs were floated on 30.04.2007 and their readings were as follows.

Description	Popping Pressure Kg/cm2g	Reset Pressure Kg/cm2g
Drum Rear R.V.	72.0	69.80
Drum Front R.V.	69.0	66.70
Super Heater R.V.	64.60	61.80

The following safety valves were overhauled, tested with nitrogen medium at test bench. The services of M/s Flotec Engg Services, Surat were taken for overhauling of Relief valves. (Ref W.O. 9920391 dtd 23.03.2007)

F.D.Fan turbine Exhaust line 4 ata Header R.V.

14 ata Automisation line R.V.. This RV setting has been increased to 16.5 ata as per modified burner requirements.

40 ata Soot Blower Header R.V.

40 ata steam line RV of Q-5114.

BFW turbine exhaust 4 ata R.V.

LSHS supply pump turbine exhaust R.V.

Steam drum connected all first and second isolation valves gland packing were repacked. The services of M/s.Amrutha Engineering, New Panvel were taken for valve gland repacking job. (Ref : WO No 9920053 dtd 18.01.2007)

As per Five Year action plan of RLA Study 2005 of BHEL Boiler, The replacement of Primary & Secondary Super Heater Coils and Associated headers was due in Year 2007. Due to long delivery period of materials indented on M/s BHEL Triuchy, Re-Examination study was carried out on Primary & Secondary Super Heater Coils and Associated headers through M/s TBW ltd, Pune. (Ref WO No 9920340 dtd 16.03.2007). for assessment of metal health. Preliminary report indicates no further deterioration in the metallurgy of Coils.

All inspection window glasses were cleaned and replaced where ever found broken.

All dampers of air duct were checked and made free by greasing for smooth operation.

LRB-1 was taken for complete overhauling. The nozzle of lance tube of LRB was found burn out. The feed pipe & lance tube (146012459210) were replaced and assembled.

The seal air line NRVs were checked and found working normal.

RE - GENERATIVE AIR PRE-HEATER H-5111:

1) General condition of Cold End & Hot End baskets was found ok.
2) Hot End & Cold End side circumferential seals and radial seals were checked and found healthy.
3) Both End Rotor Bearings (Spherical self aligning, withdrawal sleeve 22330 CCK /C3 / W 33) housing were open for inspection. The condition of bearings were found o.k. Boxed-up and fresh oil (C :100 , 5 ltrs) charged.
4) RAH Gear Box with sprocket with electric motor was replaced. Re conditioned gearbox lying in stores was used. (Code : 335702001)
5) Bearings Clearances were checked by feeler gauge and this is the readings :
   Clearance hot end bearing : 0.012"(0.30mm)
   Clearance cold end bearing :0.008"(0.20mm)
6) Steam nozzle for swivel type soot blower of RAH unit was cleaned. The coupling bolts of motor of this unit was replaced. Coupling pad (L-95) was also replaced.
7) The Cold end baskets were observed burn-out. The complete set (12 Nos) of cold end baskets (141110503330) were replaced by opening the top cover of RAH unit.

Cooling Tower Jobs:

1) The wooden structure of all Cooling tower cells was inspected by M/s Paharpur Cooling Tower Pvt Ltd, Vadodara and a committee of IFFCO Officials duly nominated by GM. Scheduled preventive maintenance is planned over a period of three years for revamping of cells as recommended by M/s PCTL.
2) The cooling tower distribution valves were attended for smooth operation and isolation. One valve of Ammonia tower -1 (Lab side) was replaced.
3) The horizontal distribution header on Ammonia Cooling Tower was coated with Corrosion Protection coating " Regina-900" through M/s United Engineers, Vadodara. (Ref : WO No : 9920545 dtd 17/04/2007)
4) The 52" dia under ground pipe interconnecting old & new cooling tower sumps was epoxy painted from inside. Metal shot blasting & spray painting was used to carry out this job. M/s Ashish Enterprises, Vadodara was engaged for execution of this painting job (Ref : WO No 9920485 dtd 23.03.2007)

DM PLANT JOB:

(1) S-1 & S-2 tank outlet & Drain valve diaphragm were replaced.
(2) The diaphragms of all five SMB units inlet lines were replaced.
(3) The Degasser tower sump was opened and all first valves were attended.

PAINTING JOBS CARRIED OUT ON:

(1) Cooling water return header on the top of new cooling tower.
(2) All safety valves exhaust cylinders.

RECLAIM MACHINE (M - 2116)

Reclaim machine was taken for overhauling. Overhauling was carried out in the supervision of M/s EMTICI, V.V. Nagar against PO No.: 9920259 dtd 01/03/2007. The following major jobs were carried out:

Overhauling of Bucket Elevator Assembly

The following activities were carried out after thorough inspection of complete bucket elevator assembly:

- Chain links were inspected by rotating the complete assembly. Damaged Circlips were replaced at scattered locations based on their condition.
- Buckets were found in good condition.
- Bucket elevator drive shaft and top shaft bearings were inspected and were found in good condition.
- Take-up unit was overhauled - complete set of Cone Washer replacement (28 nos.) & checking of bearings, shaft & sprockets was carried out.
- Bucket elevator assembly was rotated and links & pins were lubricated.

Overhauling of scraper chain Assembly

The following activities were carried out after thorough inspection of complete scraper chain assembly.

- The scrapper blades were removed during service on as and when required basis. There were 43 blades installed on the scrapper chain. In order to rearrange the scrapper blades, three nos. blades were installed on the chain so that distribution of the blades on the chain could be uniformly maintained as four blades followed by one blank. Total 46 nos. blades are installed on the chain.
- The scrapper blades were rearranged so that equal gaps are left out between the blade missing areas.
- Complete chain was dismantled and taken out for the purpose of inspection and cleaning. Chain was reassembled in position after thorough inspection. No abnormalities were detected during examination of the chain and its components.
- Proper tightening and tack welding of nuts to avoid looseness during running.
- Replaced the Main Boom chain tightening device (take-up device) spring washers (complete set consisting of 14nos. washers) and tightened the chain as per requirement.
- Greasing of bearing of take-up unit of scraper chain was carried out.
- Tail end side sheave pulleys- two nos. with bearings were replaced .

King Post Assembly

Inspection and checking of King post Rollers at bottom end were found ok and filled its housing by grease. Top end rollers were degreased.

Link conveyor

Pivot assembly of link conveyor was replaced with hardened pin and square block. Pin and block were surface hardened by Nitriding.

Link conveyor tail end pulley bearings were greased.

Head end pulley was removed from position, its shaft was machined at the north side , remachined to required dimensions, replaced both the plummer blocks alongwith bearings.

The gear box of link conveyor was taken up for complete overhauling.

Cleaning & over hauling of return rollers of Link conveyor carried out. All the carrying rollers were replaced. 5 nos, return rollers were also replaced. Skirt sealing system checked & adjusted.

Thorough cleaning of accumulated Urea inside the supporting structure of Link conveyor belt carried out. Painting of the structure was also carried out. Grills of the walk way towards South side were partly replaced as per the condition.

Traveling Gear box

Preventive maintenance of the gear box was carried out. Coupling bush were replaced with new one. Oil was flushed. SS coupling guard was fabricated and installed. Gear box coupled with motor after alignment.

Slewing Gear box

Slewing Gear box which was procured from M/S. Elecon against PO No. 9919535 was replaced. Also, the base plate for the gear box as well for the drive motor were replaced in view of corrosion of motor base and also due to the the distortion of the bolt holes/threads of gear box base plate. 12 teeth pinion, hub and pins were replaced.

Main Drive Gear box

Coupling bush of main drive gear box (FC 20) were replaced with new one. Plummer block bearing was cleaned, checked and greasing was done. Main drive Gear box coupled and alignment done. Fluid coupling oil- Servo Prime 32 Qty: 13.5 Litres , replaced

Duplex chain of main drive was replaced with Diamond Make BS Chain procured from M/S. Industrial Chain Concern, Chennai against PO No. 9920129. Jockey pulley for tension adjustment of duplex chain was replaced.

Main gear train

Replaced the main drive shaft and main drive gears (02nos.) Pinions could not be installed due to non-availability of required backlash. Old pinions were placed back and the new pinions were taken up for Profile cutting at M/S. Tech Drive, Ahmedabad so that they can be replaced later on at the earliest. Replaced the pinions after profile cutting appx. 10 days after shutdown.

Replaced Idlers Pin –02nos with extended length as compared to original length as given below:

Original Length of the pin: 347 mm
Modified length of the new pin: 375 mm

Centre distance between the shafts was carried out. The following readings were measured:

Centre Distance between Main Drive Shaft and first idler: 374.2 mm.
Centre Distance between first idler and second idler: 372.5 mm
Centre Distance between second idler and Bucket Elevator Shaft:375.3 mm.

All bearings were replaced with new one.
Scraper blades were synchronised with bucket elevator .

Other jobs

Thruster oil replaced and brake shoes checked.

Cardium compound provided on wire rope of hoisting mechanism.

Complete greasing carried out at all points of bearings of Reclaim machine.

Complete cleaning and painting of Reclaim machine carried out.

After completion of overhauling "no load" and "load" trial of Reclaim machine was carried out in the presence of engineer of EMTICI and the machine was found working satisfactorily. Machine was handed over after inspecting the limit switch.

Parts replaced in Reclaim machine

The following parts were replaced during overhauling:

A) MAINDRIVE

Main Drive Shaft & Housing	1 set
Main Drive Shaft Male Housing Needle Bearing NA 4824	4Nos
Boom Shaft Female Housing Needle Bearing NA 4824	4Nos
Main Drive Tension Jockey Pulley	1No
Main Drive Tension Jockey Pulley Needle Bearing NA 4908	2Nos
Duplex Chain for Main Drive	1No
Driving and driven sprockets for duplex chain of main drive	1 Set
Taper Roller Bearing for outer end of Scraper and Elevator Shaft (One Each) SKF 33019	2Nos
Idler Shaft Pin 375 mm Long	2Nos
Spur Gear for Shaft of Scraper	1No
Spur Gear for Shaft of Bucket Elevator	1No

B) BOOM HOISTING AND ELEVATOR LIFTING DRIVE

Bottom Boom Hoisting Pulley	2Nos
Scrapper Blades	4Nos
Pin of Scrapper Blade's Sprocket	10Nos
Boom Tail Pulley Spring washer	14Nos
Bucket Elevator Take-up Assy. Spring washer 2 sets	28Nos

C) SLEWING DRIVE

Slewing Gear Box Sr. No. WHG 31775 Model CVS 280	1No
Hub for Slewing	1No
Gear Pinion for Slewing	1No

D) LINK CONVEYOR DRIVE

Conveyor Pivot Link Bracket	1No
Head Pulley Plummer Block NTN	2Nos
Return Rollers	1No
Carrying Rollers	16Nos

PREVENTIVE MAINTENANCE OF PACKER SCALES

Replaced the Packer scale no. 10A & 10B with PBL make Machine. These packer scales were procured against PO No. 9918971 Dtd. 19.4.2006 From M/S. PBL, Vidhyanagar.

Following preventive maintenance jobs were carried out in the Packer Scales i.e. Packer scales No. 1, 2,3,4,7 & 8.

Over hauling of coarse and fine feed gate assembly. Bearings were replaced.

Repairing of doors.

Over hauling of bottom flapper assembly. Bearings were replaced.

Servicing of all cylinders.

Overhauling of sack grip assembly. Bearings were replaced. Sack grip belts- 2no and springs- 4 nos. were also replaced on each sackgrip assembly.

Alignment of stabilizer plate.

Overhauling of bucket assembly. Bearings and rubber packings were replaced.

2 nos.Toggle bearings of bucket assembly and 2 nos. toggle bearings of Load cell fork were replaced.

Calibration of packer scales.

Cleaning and painting of all Packer Scales.

STITCHING MACHINES:

All the Stitching machines were completely overhauled.

Following spares were replaced in all the stitching machines:

Needle
Looper
Pressure Foot
Throat Plate
Feed Dog

Also needle bar, looper holder, pressure bar, pressure bar spring regulator knob, thread Eyelet assembly, tension disk and thread cutter were also replaced in the stitching machines as per the requirements.

PLANT TRANSFER CONVEYOR M-2110:

Inspection of Gear-box is done and checked the alignment between gearbox and motor.
Oil flushing of gearbox is carriedout and new Oil is filled in the gearbox.
All the coupling rubber bushes replaced with new bushes.
All damaged Impact rollers, Carrying rollers, return rollers and self aligning rollers were replaced.
All pedestal bearings of snub pulley, head pulley, tail pulley and gravity pulley checked and greasing done.
Servicing of Head pulley Brush Roller was Carried out.
Repairing of Conveyor belt joint was carried out through M/S J. K. Rubber Industries.
Complete cleaning and painting of structure done.

FRESH UREA SHUTTLE CONVEYOR M – 2112:

Following jobs were carried out:

Replaced the existing worm drive gearbox with helical power saving Gear-box with new coupling. This gear box was procured against PO No. 9918469 Dtd. 10.2.2006. Complete Base frame was replaced after preparing foundation by civil section.

Coupling was done after proper alignment.

All noisy and damaged carrying , guide and return rollers replaced with new rollers. Replaced 400 no. carrying rollers with new rollers .

Greasing done in all brgs. of head pulley, tail pulley, snub pulley and gravity pulley.

Complete cleaning of conveyor structure done.

M-2112 conveyor Tripper Gear box overhauled and realigned with motor. Checked it's drive chain.

Gravity take up weight box was badly corroded , so replaced with new SS Weight box.

RECLAIM CONVEYOR M-2117:

Following jobs were carried out:

Replaced the existing worm drive gearbox with new Helical power saving Gear-box. This gear box was procured against PO No. 9918469 Dtd. 10.2.2006. Complete base frame was replaced. Coupling was replaced with new and Coupling done after proper alignment.

Replaced the Full length of belt of width 800mm in place of existing 750 mm.

All damaged and noisy return rollers, carrier rollers , guide rollers and impact rollers replaced with new rollers.

Replaced the bed plate below the carrying rollers, where ever it was found damaged.

Gravity take up weight box was badly corroded , so replaced with new SS Weight box.

Complete greasing of all bearings of head pulley, tail pulley, snub pulley and gravity pulley done.

BAGGING FEED CONVEYOR M-2121:

Following jobs were carried out:

Replaced the Gear box with repaired gearbox. Coupling and bushes were checked. Gear box oil and coupling rubber bushes were replaced. Coupling was done after proper alignment.

Nylon brush near head pulley was replaced.

Air cylinders overhauled.

Complete skirt board sealing system repaired and replaced damaged skirt blocks.

Replaced all damaged and noisy Return rollers, carrier rollers , guide rollers and belt tracking rollers.

Complete greasing of all pedestal bearings done.

Complete cleaning and painting of structure done.

BAGGING HOPPER FEED CONVEYOR M – 2122:

Following jobs were carried out:

Replaced the complete gearbox with new Gear box .New foundation was made by Civil section.

Coupling rubber bushes and gearbox oil was replaced.

Complete cleaning and painting of gear box done.

Coupling was done after proper alignment.

Arrangement for hoisting the gearbox was fabricated.

Diverter plate of hopper no. 3 and 4 overhauled.

In order to remove the Tripper of M-2122 , chutes were suitable modified and fixed at one place.

Complete length of conveyor belt was replaced . For this purpose, used belt of M-2117 conveyor was used.

Skirt rubber with inner rubber sheet replaced.

.All return rollers, guide rollers and carrying rollers replaced by new rollers.

Complete greasing in all bearings done.

CONVEYOR M - 2122 A/B:

Following jobs were carried out:

Both gear boxes preventive maintenance done. Oil seals of gear box were replaced. Checked the alignment and replaced the coupling rubber bushes.

Replaced the Gearbox oil with new .

Replaced the Skirt rubber.

Complete greasing in all pedestal bearings done.

DUST CONVEYOR:

Following jobs were carried out

Gear box overhauled, replaced the coupling rubber bushes and oil with new. Coupling was done after proper alignment.

All damaged return rollers replaced.

All carrying rollers attended for free operation.

New skirt rubber with inner rubber sheet provided.

Complete greasing of all bearings done.

SLAT CONVEYOR M-2124 (1 to 8 & 9,10):

Following jobs were carried out :

Replaced the Slats and Slat conveyor chain of slat conveyor No. 10A with new one.

Gear Box of all the slat conveyors were undertaken for preventive maintenance. Coupling bush were replaced. Gear Box oil was replaced. Gear Box painting was carried out.

Gear Box Slat Conveyor No. 8 was replaced including motor.

Base structure of Gear Box of Slat Conveyor no. 4 was replaced due to high corrosion.

Coupling was done after checking alignment.

Complete greasing and servicing of all links and pedestal bearings.

Conveyor adjusting mechanism servicing was performed for all conveyors.

All Slats and chain of the damaged bag conveyor on platform were replaced. Its gear box was undertaken for preventive maintenance and coupling bushes were replaced.

Cleaning and painting of all slat conveyors.

WAGON LOADER, TRUCK LOADER AND FLAT CONVEYOR M-2142:

Gear box of all the conveyors were subjected to preventive maintenance. Coupling bush were replaced. Oil was replaced.

PAY LOADER CONVEYOR M-2113:

Following jobs were carried out.

All the carrying and return rollers were replaced with new ones.

Skirt frame was replaced with new skirt rubber and inner rubber sheet.

Overhauling of the gear box was carried out. Coupling bushes were replaced.

Replacement of gearbox oil and checking of alignment was done.

VIBRATING SCREEN:(A,B,C&D):

Following jobs were carried out on the Vibrating Screen,

Replacement of Mild steel spacing frame with Stainless Steel discharge domes with cascade arrangement were replaced for Vibrating Screen no. A, C and D. This was procured from Pennwalt against PO No. 9919119 dtd. 1.7.2006.

In order to suit the discharge spouts of new frames of the vibrating screens, modifications were required to be carried out for proper discharge of urea on M-2121 Belt. Angles of all the spouts were required to be modified in the new assemblies as they were not matching the site requirements.

All the screens were cleaned thoroughly. All the screen gaskets/ V seals were replaced.

Complete overhauling of Vibrating Screen no. B was also carried out.

Cleaning and painting of frame and structure for all the screens was carried out.

AMMONIA PLANT

The following major inspection activities were performed in Ammonia Plant.

1. Inspection of primary reformer, catalyst tubes and risers with various NDT Techniques. Details are given at **Annexure-1 to 5**

2. Automatic ultrasonic scanning of all the Catalyst and Riser tubes of primary reformer after one year of operation, first time after revamp-III. Details are given at **Annexure-2**

3. Visual inspection of equipments.

4. Inspection of steam drum (GT-1632) and its related pipelines and equipment based on RLA study action plan.

5. Ultrasonic flaw detection on selected weld joints of critical pipelines and equipments. Details are given at **Annexure-6**

6. Thickness measurement of various equipment was carried out .Details are attached at **Annexure-7**

7. Thickness measurement of various pipelines was carried out .Details are attached at **Annexure-8**

8. Measurement of residual magnetism at various parts of rotating equipments and demagnetization of the same wherever required. Details are given at **Annexure-9**

9. Insitu metallography of selected equipment and pipelines were carried out. Line no. HS-2H-12" (from steam drum to LT steam super heater coil) has shown presence of micro cracks at the grain boundaries on parent metal just at the outlet of steam drum and Line no. SG-1-12" (from Methanator to 114-C) has shown presence of creep cavities & initial stage of cracking and approaching 3rd stage of creep damage on the parent metal of one elbow. Both the lines will be inspected at more locations to check its condition during next turnaround. Detailed summary of observations and microstructure analysis is given at **Annexure-10**

10. Magnetic Particle Inspection of weld joints of LT shift converter (104-D), Refrigerant Flash Drums 110-F, 111-F and 112-F from inside of the vessels.

11. Inspection of newly fabricated pipelines and fabrication jobs carried out departmentally by Maintenance and Technical department.

12. Qualification tests of welders employed by contractors.

13. Low speed balancing of 103-JAT & 103-JBT rotor before & after installation of coupling lock nut.

14. RFET of tubes of 102-C, 108C1A, 108 C2A and 142-CA.

15. Eddy current testing of SS tubes of 108 C1A and 108 C2A.

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.

1.0 PRIMARY REFORMER 101-B:

1.1 RADIANT ZONE:

VISUAL INSPECTION:

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

OTHER NDT ACTIVITIES:

- Automatic ultrasonic scanning of all the 336 Catalyst tubes and 8 Risers tubes was carried out during Shutdown by PDIL. Amongst all 336 tubes, 39 tubes are placed in A grade,297 tubes are placed in B grade. Amongst 8 risers, 2 risers are placed in A grade & 6 risers are placed in B grade. Details are attached at **Annexure-2.**

- Radiography of 1st weld joint from top of all 8 risers was carried out to assess the condition of the weld. No service defects were observed in any joint.

- DP test of 16 nos. of outlet manifold field weld joints, riser tube to weldolet weld-joints was carried out for all the risers. NO service defect was revealed.

- DP test of 1st weld joint from top of selected catalyst tube in each row was carried out randomly.

- The tubes numbers selected were,

- 121,122,220,222,321,322,421,422,519,522,619,622,723,821 & 822.

- NO service defect 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 327 nos. of tubes and between 0.17 to 0.92 % in 09nos. of tubes. The detailed report is enclosed at **Annexure-3**.

- Clearance measurement of outlet headers from the bottom floor was carried out. The report is attached at **Annexure-4**.

- Spring hanger readings of catalyst tubes in cold condition were taken. The report is attached at **Annexure-5**.

1.2 CONVECTION ZONE:

Visual inspection of HTand LT convection zone from bottom and top manhole was carried out and observations made are as under:

H.T. CONVECTION SECTION:

From Bottom Manhole:

- Fiber Blanket protection sheet was found badly buckled and burnt off all around the duct. Heavy lumps of burnt protection sheet was found sticked near the tunnel burners
- All the tubes of mixed feed coil were found to have hard scaling on the entire surface, and on some places the scale was loose also.
- All the Tunnel thermo wells were found in satisfactory condition.
- **From Top Manhole:**
- Incoloy protection sheet in the middle of south wall was found burnt off.
- One of the incoloy protection sheet in the bottom south-west side wall was slipped from its position.
- HT and LT super heater coils were found in satisfactory condition.
- Supports of LT/HT steam super heater coils were found in satisfactory condition.
- Extreme South side duct distribution plate was fall down while the other was bent and hanged down.
- Insulation protection sheet inside the duct was badly distorted and burnt off.
- One of the insulation protection sheet just before the dampener was hanging down.
- Dampener blades were found in satisfactory condition.

L.T.CONVECTION SECTION:

- Tube supports of BFW coil & NG feed preheater coil were found in satisfactory condition as seen from the bottom.
- Few fins of tubes of NG feed preheater coil were found covered with refractory debris at scattered locations.
- Loose refractory debris was found on the bottom floor of LT convection zone.

2.0 AUXILIARY BOILER:

Hot Well Area:

- Cladding sheet has got distorted at its East-South and West –South junction with distributor plate.

- Distributor plate for the flue gas has got distorted at its bottom portion and at West side.The stiffeners had badly damaged at scattered locations.

Furnace Area:

- Burner wall refractory was found to have cracks at scattered locations including cones of the burners.

- Refractory bricks were found displaced inward at the North half of the wall located at the bottom of the Coil –B.

- Blackish deposits were observed at the top half of North-West corner tubes. (15 tubes in each coil approx.)

- C-coil refractory was found to have cracks at scattered locations and at the bottom of its both end refractory found damaged.

- In-situ metallography of selected tubes from replaced tubes in 2005 turnaround and old tubes was also carried out and observations are mentioned at **Annexure-14**

3.0 RLA STUDY RELATED EQUIPMENTS:

Visual inspection of the following equipment / pipelines / structures was carried out as per the five year action plan recommended after RLA study carried out during June 2003. Observations made are mentioned as below.

Steam Drum:

- Grayish black colouration 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.
- All the weld joints were found in satisfactory condition.

Steam Super Heater Coils:

- Supports were found in satisfactory condition.
- No surface defects or physical damage was observed.
- Overall condition of the coils was found satisfactory.

High Temperature Headers:

- Both inlet and outlet headers of high temperature coils were found in satisfactory condition.
- No surface defect observed.

Auxiliary Boiler Coils:

- Coil-C tubes were found in satisfactory condition.
- Tubes of Coil-A were found in satisfactory condition.
- Tubes of "Coil-B" were observed to have minor pitting on tubes at scattered locations. In general condition of the tubes was found satisfactory.

Main steam Pipes:

No major abnormality was observed on pipe line. Minor scales & pitting were observed. The overall condition of the pipeline found satisfactory.

Heat Exchangers (101 CA/CB, 102-C, 103-C):

Nozzles weld joint of BFW inlet and outlet line were checked visually, no abnormality was observed. Condition of the weld joints were found satisfactory.

Structure and Supports:

- The structural support of steam drum, heat exchangers (viz., 101 CA/CB, 102-C, 103-C) were found in satisfactory condition.
- The structural supports and hangers provided at the main steam pipe line were found to be in satisfactory condition.

4.0 VESSELS AND OTHER EQUIPMENT:

Visual inspection/NDT of the following equipments was carried out. The detailed observations/recommendations on individual equipments are given below:

103-D, SECONDARY REFORMER:

Bottom Dome:

- Erosion of refractory and scattered cracks was observed at few locations and same were found more around both the gas inlet nozzles.
- Skirt liner was found slightly buckled inward (away from shell) at scattered locations.
- Some of refractory brick slots were found chocked with alumina balls.
- Upper layer of refractory was found slightly damaged at scattered locations.
- Bottom floor refractory was found to have loosened.

Top Air and Gas Entry:

- Zig - Zag superficial scattered cracks were observed on the refractory lining all over dome and shell.
- At few scattered locations cracks having approx. 3mm width were observed.
- Thermo well pipe was found bent/inclined upwards approx. 45 deg. from horizontal axis.
- Shift liner observed slightly buckled particularly more on 3rd segment from top.
- Gap of approx.1" dia. was observed between shift liner of top shell to transfer line liner location 5 deg. Clock to 9 deg. Clock position. Liner patch to transfer line welding observed to have cracked (3" long appx.)
- Target hexagonal bricks and alumina balls were found in satisfactory condition.

101-CA/CB GAS INLET NOZZLE:

- Inward bulging of approx. 20 - 40mm was observed at the ID of liner segment in scattered length but upto approx. 250mm length was maximum at the different liner segments.
- Minor outward buckling was observed at the top half of both the inlet nozzle end.

102 - C ,WASTE HEAT EXCHANGER:

Tube leakage was observed from 07 nos. of tubes and 74 nos. of seal welding at bottom tube sheet during hydro test at 41 kg/cm2 after plant shutdown. For further assessment of condition of tubes RFET was carried out. Inside of the tubes was cleaned by hydro jetting to remove scaling. However 100 nos. of tubes could not be tested as probe for the testing could not be passed through ID of the tubes due to scaling. Total 605 nos. of tubes could be tested by RFET. Based upon the result of RFET 06 nos. of tubes was plugged. Leakage was observed from 02 Nos. of tubes and 18 nos. of seal weld at top tube sheet during hydro test at 125 kg/cm2 after tube plugging and seal weld repair. The same were plugged. In all, total 92 Nos. of seal welds were found leaky which were repaired. As on date total 60 nos. of tubes are plugged as detailed given below. Tube /Plug seal welding was inspected by DP test.

Tubes are counted from South to North and Row nos. counted from West to East

Row. No.	Tube nos. plugged based on RFET result	Tube nos. plugged based on hydro test	Seal welds repaired (Bottom tube sheet)	Seal welds repaired (Top tube sheet)
1				
2				
3	8,13			
4				
5				
6				
7			4,16	
8			3,9,15,16,17,18	
9			2,3,11,12,13,14,15,16,17	8
10		9	8	13,16,18
11		13	6,7,9,14,16,17,18,19	7,8
12	15,22		5,6,15,16,17,18,19	7,11,21
13	9	8	5,6,7,8,10,11,16,17	19
14		10,15,16,18	6,10,11	23
15		20,22	7,8,10,11,12,13,14,15	
16				
17			11,12	16,23
18			4,10,11,16	14
19	25		4,5,10	20
20			3,4,9,10	
21			17	17
22				3
23			6,13	3
24			3,5,6	
25			7,12	
26			4	
27				
28				
29				
30				
31				
32				
Total Tubes	06	09	74	18

Total tube plugged as on date =60

WPS for repairing of tube to tube sheet seal weld and plug weld is attached at **Annexure-11**

104-D, LT SHIFT CONVERTER:

Catalyst of LT shift converter was replaced. The following inspection activities were carried out.

- Magnetic particle examination of all the weld joints was carried out from the inside of the vessel. Minor indications observed during testing were removed by sandering and reexamined and were found satisfactory.

- Ultrasonic flaw detection of all the T-joints was carried out. No service defect was observed.

- Hardness measurement was carried out at various locations and was found as mention below.

  a. On parent metal : 117 to 149 BHN
  b. On HAZ : 117 to 167 BHN
  c. On weld : 166 to 181 BHN

- Insitu metallographic was carried out and the observation is mentioned at Annexure-10.

107 - D ,TRANSFER LINE:(From outside)

- Minor buckling of the liner was observed at scattered locations throughout the length of the transfer line.

- Minor damage of the refractory was observed at flange (entry) of the transfer line.

101-F, STEAM DRUM:

- Grayish black colouration 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.

- South side hole of phosphate dozing line (1" NB) found enlarged.
- BFW distribution pipe to pipe thread coupling fixing bolt was found loose and its fastening nut was found missing from one end. Proper fastening was recommended. Two nos. bolt of flange at the inlet of this pipe were also found loose.

- One no. clamp of cover plate of riser located on East side was found loose.

- Hot vapour was found coming from the second down comer counting from South side.

- Loose grayish black deposits were found all around the inside surface. Proper cleaning was recommended.

102-F , RAW GAS SEPARATOR:

- Epoxy paint condition was found satisfactory, except at 2-3 locations where it was found peeled off.
- Demister pads were found intact in position.
- Corrosion attack was observed on the repaired weld at the inside face of manhole nozzle. Suitable protective coating may be applied at this location.
- Putty applied on the circumferential weld joint of manhole nozzle with shell was found peeled off at some places where as in other places gap was observed at the edges of the putty.
- Corrosion attack was observed on the weld joint at the face of liquid out nozzle weld joint with shell. Suitable corrective action is recommended.
- 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.
- Minor corrosion has started at the weld joint of Co2 inlet flange weld joint with vessel stub end and on the face of Man way nozzle, suitable corrective action is recommended.

104-F, SYN GAS COMPRESSOR SUCTION SEPARATOR:

- Demister pad condition was found satisfactory.
- Scattered thin scales were observed at bottom dish end.
- Weld joint condition was satisfactory.
- Grayish black coloration was observed on bottom area, whereas brownish coloration was observed on remaining surface.

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.

107-F, PRIMARY AMMONIA SEPARATOR:

- Colouration of vessel internals was found blackish brown.
- Scattered thin scales were observed on the shell and dished end.
- Entire internal surface was found oily.
- The condition of all the weld joints of the shell, dished ends and nozzles was found to be satisfactory.

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.
- Overall condition of the vessel was found to be satisfactory.

110-F, FIRST STAGE REFRIGERANT FLASH DRUM:

- Brownish black colouration was observed inside the drum.
- Oil layer was found on the surface of shell.
- The Demister pad was found intact in position.
- Scattered mill scales were observed on the surface of the dish ends and shell.
- Overall condition of the vessel was found to be satisfactory.
- Magnetic particle examination of all the weld joint was carried out from inside. Minor indications observed were removed by sandering and reexamined, No recordable service defect was found.

111-F, SECOND STAGE REFRIGERANT FLASH DRUM:

- The shell inside surface had assumed blackish gray coloration.
- Entire internal surface was found oily.
- The demister pads were found intact in position.
- Scattered scales were observed on both the dished ends.
- Condition of all nozzle and shell weld joints was found satisfactory.
- Overall condition of the shell was satisfactory.
- Magnetic particle examination of all the weld joint was carried out from inside. Minor indications observed were removed by sandering and reexamined, No recordable service defect was found.

112 - F, THIRD STAGE REFRIGERANT FLASH DRUM:

- The demister pads were found intact in position.
- The coloration of the inside surface of shell was dark blackish.
- Surface of the vessel was found oily.
- Hard scales were observed in the shell which were more prominent on the dished ends.
- Condition of all nozzles was found satisfactory.
- Condition of all weld joints was found satisfactory.
- Magnetic particle examination of all the weld joint was carried out from inside. Minor indications observed were removed by sandering and reexamined, No recordable service defect was found.

LP FLASH VESSEL (103-E2 LP):

TOP MANHOLE COMPARTEMENT:

- Demister pad was found intact in its position in satisfactory condition.
- Condition of weld joints was found satisfactory however these weld joints were observed as if etching has occurred resulting in slightly differing colour in comparison to adjacent shell surface.
- Bubble cap and its tray holding bolts were found loose at various locations.
- Grinding mark (2mm deep x 3 mm wide x 1.5 feet long appx) was observed on top dished end on south side.
- 1 no bolt of 2"NB flange located on west side of shell was found loose(108J discharge line to LP flash vessel)
- Overall condition of the compartment was found satisfactory.

SECOND (FROM TOP) MANHOLE COMPARTEMENT:

- Rectangular riser box and other fittings were found intact in position.
- Condition of weld joints was found satisfactory however these weld joints were observed as if etching has occurred resulting in slightly differing colour in comparison to adjacent shell surface.
- Holding bolts of tray fixing beam were found loose at scattered locations.
- External supports of surrounding pipelines of LP flash vessel were found to have support bolt missing particularly on the bottom side of support. It was recommended to check the same with support design.

B-201, FLARE STACK:

Bottom Compartment. (Knock Out Drum):

- Shell had assumed blackish Coloration.
- Epoxy coating observed to have peeled off all around the inside surface of knuckle radius of bottom dished end and area surrounding the bottom drain nozzle.
- Loose metallic strips of gasket was observed hanging inside the I.D. of gas inlet nozzle.
- Minor pitting was observed on circumferential weld joint between shell to bottom dished end on south-east side and also surrounding 1.5"NB nozzle on south-east side.
- Bottom dished end has not been painted from outside.

TOP COMPARTMENT(WATER SEAL DRUM)

- Bottom dished end could not be inspected as it was filled with water.
- Several scattered wide spread spots of brownish colour were observed on top half of shell and top cone.
- The perforated conical round plate of seal pot was found to have buckled/distorted throughout the circumference and seal pot duct pipe had considerable corrosion attack on its OD.
- Considerable rust scales/corrosion scales was observed on the shell surface all around, predominant around manhole located on south side. Ultrasonic Thickness measurement was carried out to assess the corrosion attack on shell and seal pot.
- Suitable protective coating was recommended on internal surface of shell and dished end to avoid further corrosion.

5.0 MISCELLANEOUS JOBS:

WELDER QUALIFICATION TESTS:

- Performance qualification test of 20 Nos. welders offered by M/s General Engineering was carried out. 07 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical departmental welding jobs in the plant.
- Performance qualification test of 11 Nos. welders offered by M/s Ganesh Engg. was carried out. 08 nos. of welders were qualified during the test. These welders were allowed to perform welding on various steam and process line modification work.

- Welder qualification test of 05 Nos. welders of M/S. Sayyed & Co. was carried out. 02 welders were qualified. These welders were qualified for performing general purpose welding jobs.

- Performance qualification test of 03 Nos. welders offered by M/s. Skywin Erectors was carried out. 02 nos. of welders were qualified during the test. These welders were allowed to perform welding HP steam line and 102-C tube/plug welding job.

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.

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 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 and welds , weld joints of dissimilar material, Insitu metallographic examination was carried out. List of the lines/equipment checked along with observations and remarks are mentioned at **Annexure-10**

ULTRASONIC FLAW DETECTION OF WELDS:

Weld joints (selected only) of the critical pipe lines and equipment were ultrasonically examined for assessing any development of service defects/growth of the acceptable defects. No abnormalities were observed in any of the weld joints inspected. No discontinuity was required to be repaired. The detailed list of pipeline inspected is mentioned at **Annexure-6**

ULTRASONIC THICKNESS MEASUREMENT:

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

GAUSS MEASUREMENT:

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

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:

Before startup, speed measurement and vibration measurement of 101-BJ Turbine, 104-JAT,104JT, 103-JAT were carried out.

BALANCING:

During this turnaround rotor of Syn. Gas compressor drive turbines 103-JBT and 103-JAT were provided with lock nut at its coupling end. The same was checked for its balancing condition before and after assembly of locknut and the balance condition before assembly of locknut was restored on both the rotors.

HARDNESS MEASUREMENT:

During this shutdown one no. elbow of line SG-1303-10-14"(Syn. Loop boiler inlet line) & SG-25-8"(Quench line to converter) was replaced by new one. Also distance piece & block valve for HS-10,HS-11 & HS-12-6"(letdown station lines) was replaced. The post weld heat treatment was carried out for the weld joints of above. The hardness observed as mentioned below. WPS for the above are attached at Annexure-12 to 14.

LINE NO.	HARDNESS IN BHN			
	MOC	PARENT METAL	WELD METAL	HEAT AFFECTED ZONE
SG-1303-10-14,J-1	P-22	125 – 160	145 – 180	119 – 176
SG-1303-10-14,J-2	P-22	125 – 189	132 – 162	131 – 162
SG-25-8, J-1	CS	114 – 157	116 – 140	114 – 134
SG-25-8, J-2	CS	120 – 135	128 – 144	132 – 157
HS-10-6, J-1	P-11	128 – 142	158 – 199	131 – 171
HS-10-6, J-2	P-11	121 – 141	182 – 217	133 – 138
HS-10-6, J-3	P-11	124 – 142	202 – 225	135 – 149
HS-11-6, J-1	P-11	122 – 129	185 – 203	145 – 159
HS-11-6, J-2	P-11	126 - 133	174 – 205	132 – 145
HS-11-6, J-3	P-11	121 – 126	169 – 205	130 – 138
HS-12-6, J-1	P-11	120 – 140	180 – 195	132 – 172
HS-12-6, J-2	P-11	119 – 134	202 – 209	128 – 146
HS-12-6, J-3	P-11	134 – 141	181 – 224	145 – 163

ANNEXURE-1

1.0 **BURNER BLOCKS:** No damage observed

2.0 **BOTTOM HEADER INSULATION:**

Outer insulation layer between tube no. 4 to 8 and 13 to 15 found fallen, rest of the insulation was found intact in position.

3.0 **ROOF INSULATION:**

one no. block found fallen near the tube no. 133 and 134 in burner row no.1.In general, the condition of the roof insulation is found to be satisfactory

4.0 All Canister base rings of risers found intact in position

5.0 **REFRACTORY WALLS:**

In general, Gap has increased between panel of bricks at many locations on all wall.

- West Wall :

  Inward bulging of 2nd brick panel counting from bottom was observed and few bricks were found loose in this area.

- North Wall:

  Vertical zig-zag cracks were observed at many locations and around the cracks and at the junction of brick walls loose bricks were also observed.

- South Wall:

  Insulation found fallen at tunnel slab level at scattered location and at same location plate was found exposed.

  Excessive gap observed at the vertical joint of brick panel at the location of burner row no. 4.

  Minor erosion of top panel of refratory brick was observed at the location of burner row no. 4.

  Peep hole bricks were found displaced inside for peep hole no. 3,4 and 5 counting from West side.

6.0 **TUNNEL SLAB**: All tunnel slabs were found intact in their position.

Annexure - 2 (1/5)

GRADATION OF TUBES BY AUS CARRIED OUT BY PDIL

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

Annexure – 2 (2/5)

GRADATION OF TUBES BY AUS CARRIED OUT BY PDIL

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

Annexure – 2 (3/5)

GRADATION OF TUBES BY AUS CARRIED OUT BY PDIL

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

Annexure – 2 (4/5)

GRADATION OF TUBES BY AUS CARRIED OUT BY PDIL

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

Annexure – 2 (5/5)

GRADATION OF RISER TUBES BY AUS CARRIED OUT BY PDIL

ROW NO.	RISER NO.	AUS GRADE
1	1	B
2	2	A
3	3	B
4	4	A
5	5	B
6	6	B
7	7	B
8	8	B

Annexure – 3 (1/4)
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			Total	42		

Annexure – 3 (2/4)

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			Total	40	02	

Annexure – 3 (3/4)

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		Total	41	01	

Annexure – 3 (4/4)

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			Total	37	05	

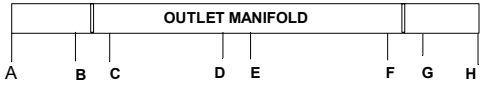
ANNEXURE- 4

CLEARANCE OF OUTLET MANIFOLD FROM GROUND FLOOR IN COLD CONDITION

HEADER NO.	LOCATION OF MEASUREMENT							
	A	B	C	D	E	F	G	H
1	160	175	175	170	185	190	180	190
2	190	165	185	200	200	165	170	190
3	175	185	180	185	190	170	185	180
4	190	200	195	190	200	170	170	200
5	185	200	200	180	180	170	175	180
6	190	170	165	190	180	170	185	200
7	170	190	180	200	190	170	180	180
8	160	190	200	200	200	200	200	170

NOTE : (1) All readings are in MM

(2) **Readings are taken with insulation.**



Annexure - 5

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

COLD LOAD READINGS IN MM:

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

TRANSFER LINE SPRING HANGER LOAD READINGS

ROW	1	2	3	4	5	6	7
READINGS	22	21	17	23	36	18	17

BOTTOM DRAIN READINGS

ROW	1	2	3	4	5	6	7	8
READINGS	97	97	97	98	97	97	95	95

AUXILIARY BOILER SPRING READINGS

SPRING	S-E	N-E	S-W	N-W
READINGS	60	60	62	60

Annexure - 6

UFD OF WELD JOINTS OF FOLLOWING PIPELINES WAS CARRIED OUT:

SR. NO	LINE NO	SIZE	SCH	FROM	TO	NO. OF WELD JOINTS	REMARKS
1	SG-1303-09-10”	10	120	SG-1303-08-14” (105-D)	108-D	11	No significant defect was observed.
2	SG-1303-08-14”	14	120	SG-33-14 (105-D)	108-D	10	
3	SG-1303-08-10”	10	120	SG-1303-08-14” (105-D)	108-D	02	
4	SG-1303-12-10”	10	120	SG-1303-08-14” (105-D)	108-D	02	
5	SG-1303-11-14”	14	140	107-C	123-C	12	
6	SG-1303-10-14”	14	120	108-D	107-C	09	
7	SG-1303-06-14”	14	100	121-C	124-C	15	
8	A-21-10”	10	120	101B	103D	1	
9	NG-9-12”	12	100	101B	103D	1	
10	SG-62A-4”	4	XXS	102-B	105-D, SG-32-6”	3	
11	SG-62B-4”	4	XXS	102-B	105-D, SG-32-6”	3	

Annexure - 7

THICKNESS MEASUREMENT SUMMARY OF EQUIPMENT: S/D-2007

Sr. No	Equipt . No.	Equipment Description	Shell			Dish End			Channel		
			Nom./ Design	Min. Measured	% Red.	Nom./ Design	Min. Measured	% Red	Nom./ Design	Min. Measured	% Red.
1	103 - C	Primary Shift Effluent Waste Heat Exchanger	55.56	58.80	-	20.63	29.90	-			
2	104 - C	Methanator Feed Heater	17.46	17.70	-	19.05	23.60	-	19.05	21.0	-
3	106-C	Shift Effluent Feed Water Heater	6.35	6.50	-	15.08	16.10	-	15.08	20.0	-
4	108-CA2	aMDEA Solution Cooler	12.70	12.60	0.79	12.70	12.90	-	12.7	13.2	-
5	108-CB2	aMDEA Solution Cooler	12.70	12.60	0.79	12.70	12.80	-	12.7	13.1	-
6	109-CA-1	aMDEA Solution Exchanger	12.70	12.20	3.94	12.70	14.30	-	25	25.3	-
7	109-CA-2	aMDEA Solution Exchanger	12.70	12.20	3.94	12.70	14.30	-	25	25.1	-
8	109-CB-1	aMDEA Solution Exchanger	12.70	13.00	0.79	12.70	22.70	-	25	24.2	-
9	109-CB-2	aMDEA Solution Exchanger	12.70	13.00	0.79	12.70	15.60	-	25	24.1	-
10	110-CA	CO2 Stripper Condenser	15.87	16.40	-	15.87	15.30	-	15.87		
11	110-CB	CO2 Stripper Condenser	15.87			15.87	11.70	-	15.87		
12	114-C	Methanator Effluent Feed Water Heater	58.00	57.30	1.21	18	18.20	-	15.87	20.7	-
13	115-C	Methanator Effluent Cooler	12.50	12.40	0.80	12.50	14.40	-	17.46	20.2	-
14	116-C	Synthesis Gas Compressor Interstage Cooler	11.11	9.90	10.9	11.11	12.60	-		9.20	
15	124-C	Synthesis Gas Compressor After Cooler	20.00	20.00	0.00	16.00	19.30	-	88.9	93.6	-
16	127-CA	Refrigent Condenser	18.00	16.90	6.11				16.00	15.3	4.4
17	127-CB	Refrigent Condenser	18.00	16.60	2.22				16.00	15.1	5.6

18	128-C	Refrigerant Compressor Inter Cooler	NA	11.30						11.4	
19	129-JC	Air Compressor Inter Stage Cooler No.1	12.00	11.90	0.83						
20	131-JC	Air Compressor Inter Stage Cooler No.2	15.80	15.4	2.53						
21	136-C	Synthesis Gas Methanator Feed Exchanger	15.80	15.40	2.53						
22	150-C	Fuel Preheat Exchanger	8.38	11.40	-	12.70			12.7	12.4	2.4
23	151-C	Fuel Preheat Exchanger	8.38	10.70	-	9.52			8.38	10.6	-
24	170-CA	Condensate Stripper Feed Bottom Exchanger	9.50	9.20	3.2						
25	170-CB	Condensate Stripper Feed Bottom Exchanger	9.50	9.00	5.2						
26	174-C	Boiler Blowdown Cooler	NA	10.10							
27	173-C	Stripped Condensate Cooler	9.50	8.40	11.6	NA	8.40			8.00	
28	106-D	Methanator	44.50	45.00	-	43.70					
29	104-E	Condensate Stripper	12.50	11.30	9.6	11.10	13.70	-			
30	110-F	1St Stage Ref. Flash Drum	9.52	9.00	5.4	9.52	11.00	-			
31	111-F	Second Stage Refrigent Flash Drum	9.52	10.10		19.05	22.60				
32	112-F	Third Stage Refrigent Flash Drum	9.52	10.20		19.05(E) 9.52(W)	22.6(E) 12.5(W)				
33	114-F	aMDEA Storage Tank	4.76	4.50	5.5	4.76	4.40	7.60			
34	118-F	Inhibitor Tank 118-F	6.00	10.20	-	NA	10.10				
35	142-F	New Instrument Air Receiver	NA	13.90		NA	13.00				
36	156-F	Blow Down Drum	11.11	10.70	3.7	NA	11.70				
37	157-F	Process Gas Separator	19.84	22.40	-						

38	158-FA	Natural Gas Separator	24.00	23.20	3.3	24.00	23.30	2.9			
39	158-FB	Natural Gas Separator	24.00	23.80	0.8	24.00	23.10	3.7			
40	172-F	Ammonia Liquor Tank	12.00	11.40	5.0						
41	2005-F	New Instrument Air Receiver	8.00	8.30	-	8.00	7.10	11.2			
42	2000-SL,AD-A	New Instrument Air Drier	NA	7.00		NA	8.10				
43	2000-SL,AD-B	New Instrument Air Drier	NA	7.50		NA	8.00				
44	F-101	Naptha Deaerator	12.7	13.80	-	12.0					
45	E-110A	Process Feed Stock Preheater	NA	14.10							
46	E-110-B	Process Feed Stock Preheater	NA	14.10							
47	B-110	Condensate Drum for E-110	8.00	8.00	-	8.00	11.20	-			
48	R-110	Naptha Hydrogenator	31.80	31.30	1.6						
49	B-111	Knock Out Drum For R-110	6.00	6.30	-	6.0	9.10	-			
50	R-111	Sulphur Absorber	35.00	35.70	-						
51	R-112	Pre Reformer	86.9	85.7	1.4		48.9				
52	B-112	Knock Out Drum For H-111	NA	6.50							
53	E-218	Naptha Condenser	NA	6.40		NA	11.20				
54	E-3	Gas Exchanger	5.00	4.60	8.0	5.00	5.00				
55	E-4	Regeneration Heater	5.00	5.90	-						
56	K-1	Washing Tower	18.00	18.00	-						
57	R-1	Drying Vessel	36.00	35.90	0.3	36.00	36.20				
58	R-2	Drying Vessel	36.00	35.90	0.3	36.00	35.90				
59	B-201	K.O.Drum	10	9.7	3.0						
60	B-201	Water Seal Drum for B-201	10	9.7	3.0						

CONVECTION SECTION COILS

SR NO	DESCRIPTION	COIL			INLET HEADER			OUTLET HEADER		
		DESIGN	MEAS.	%RED	DESIGN	MEAS.	%RED	DESIGN.	MEAS	%RED
1	BFW COIL OFFSITES (LT Convection, bottom most)	5.54	4.2	24.1	--	--	--	--	--	--
2	BFW COIL OFFSITES (LT Convection, 2nd from bottom)	5.54	4.1	25.9	--	--	--	--	--	--
3	NG FUEL FEED COIL	3.9	3.4	12.8	7.0	7.0	--	7.0	7.0	--
4	BFW COIL AMMONIA	5.5	4.9	10.9	27	25.2	6.66	--	--	--
5	HT STEAM SUPER HEATER COIL	8.0	7.7	3.77	--	--	--	--	--	--
6	LT STEAM SUPER HEATER COIL	7.01	6.7	4.28	40.46	--	--	40.46	--	--
7	AUXILLIARY BOILER, COIL-A	7.0	6.7	4.28	--	--	--	--	--	--
8	AUXILLIARY BOILER, COIL-B	7.0	6.8	2.85	--	--	--	--	--	--
9	AUXILLIARY BOILER, COIL-C	7.0	6.7	4.28	--	--	--	--	--	--
10	H-111(RADIANTCOIL)	7.11	7.30	-	--	--	--	--	--	--
11	H-111(CONVECTION COIL)	7.11	7.60	-	--	--	--	--	--	--
12	H-110 (RADIANTCOIL)	8.56	7.70	10.0	--	--	--	--	--	--
13	H-110 (CONVECTION COIL)	5.49	5.10	7.10	--	--	--	--	--	--

ANNEXURE- 8
AMMONIA PLANT PIPELINE THICKNESS MEASUREMENT SUMMARY

Sr. No.	Line No	Nom Bore (inch)	Nom thick (mm)	Line Description		Min Thk observed	% Red.
				From	To		
1	A-20	10	6.35	101-J	101B	5.2	18.11
2	A-21	10	21.41	101-B	103-D	21.6	-
3	BF-02	10	6.35	BF-1	104-J	7.6	-
4	BF-03	10	6.35	BF-1	104-JA	7.9	-
5	BF-35	4	8.56	SPEC.BREAK	BF-22	8.7	-
6	BW-01H	14	23.8	101-CA	101F	23.5	1.26
7	BW-05H	14	23.8	101-CB	BW-43HA,HB	24.4	-
8	BW-11H	8	15.06	BW-14H	103-C	14.4	4.38
9	BW-12H	8	15.06	BW-14H	103-C	14.3	5.05
10	BW-21H	18	29.36	101-F	101-CB	38.4	-
11	BW-35H	14	23.8	101-CA	101-F	22.3	-
12	BW-36H	14	23.8	101-CB	101-F	24.5	-
13	HS-10	6	14.27	HS-5	PIC-13A	13.2	7.49
14	HS-11	6	14.27	HS-5	PIC-13B	13.7	3.99
15	HS-12	6	14.27	HS-5	MIC-22	13.5	5.39
16	LS-10	8	6.35	PIC-17 D/S		8.5	-
17	LS-10	4	6.02	PIC-17 D/S		13.5	-
18	MS-1304.02	8	10.31	107-C	101-B	10.1	2.04
19	NG-01	6	7.11	BATT.LIMIT	NG-2	7.1	0.14
20	NG-02	6	7.11	NG-1	101-D	7	1.55
21	NG-03	6	7.11	NG-1	102-D	6.3	11.39
22	NG-04	6	7.11	101-D	NG-6A	6	15.61
23	NG-05	6	7.11	102-D	NG-6A	6	15.61
24	NG-06	8	8.18	150-C	101-D	7.3	10.75
25	NG-09	12	21.4	101-B	NG-11A TO H	21	1.87
26	NG-11A	6	14.3	NG-9	101-B	12.4	13.29
27	NG-11B	6	14.3	NG-9	101-B	12.3	13.99
28	NG-11C	6	14.3	NG-9	101-B	12.6	11.89
29	NG-11D	6	14.3	NG-9	101-B	13.3	6.99
30	NG-11E	6	14.3	NG-9	101-B	11.9	16.78
31	NG-11F	6	14.3	NG-9	101-B	12.1	15.38
32	NG-11G	6	14.3	NG-9	101-B	11.1	22.38
33	NG-11H	6	14.3	NG-9	101-B	13.5	5.59
34	NH-20	18	7.92	NH-21	128-C	6.7	15.4
35	NH-21	18	7.92	105-J	128-C	7.4	6.57
36	NH-23	12	6.35	105-J	NH-33	6.0	5.51
37	NH-24A	12	6.35	NH-33	127-CA	6.3	-
38	NH-24B	12	6.35	NH-33	127-CB	6.4	-
39	NH-33	14	7.92	NH-23	NH-24 A/B	7.4	6.56
40	PW-01	6	10.97	102-F	PW-4	10.5	4.28
41	PW-02	2	3.91	PW-3	PW-12	2.7	30.95
42	PW-03	2	3.91	PW-1	PW-12	5	-
43	PW-04	2.5 CS	5.16	PW-1	106-J	5.1	18.6
44	PW-04	2.5 SS	3.05	PW-1	106-J	2.4	21.31
45	PW-17	4	6.02	PW-1	171-C	4.5	25.24
46	PW-20	6	10.97	PW-20	170-J	10.4	5.20
47	PW-20A	6	10.97	PW-20	170-JA	7.7	29.81

48	PW-21	4	11.13	170-J	170-C	10.4	6.56
49	PW-21A	4	11.13	170-JA	PW-21	12.1	-
50	PW-22	4	11.13	170-C	173-C	10.4	6.56
51	PW-28	4	11.13	PW-27	171-C	11.5	-
52	PW-28A	4	11.13	PW-27	171-C	11.3	-
53	PW-30	14	11.13	PW-29	PW-31	12.5	-
54	S-8	6	7.11	PIC-17 U/S		8.8	-
55	S-8	4	6.02	PIC-17 U/S		12.3	-
56	SG-09	10	9.27	116-C	129-C	9	2.91
57	SG-25	8	18.24	SG-23	SG-32(105D)	17.3	5.15
58	SG-29	4	11.13	SG-21-14''	SG-76A/B-4''	10.4	6.56
59	SG-35	12	21.41	SG-1303.01.14	103-J	20	6.59
60	SG-42	4	8.56	FICV-8	VENT STACK	8.6	-
61	SG-42	3	7.62	FICV-8	VENT STACK	13.0	
62	SG-44	4	6.02	SG-11	FICA-7 U/S (SG-45)	6.4	-
63	SG-44	3	5.49	SG-11	FICA-7 U/S (SG-45)	7.0	-
64	SG-45	6	7.11	FICA-7 D/S(SG-44)	SG-6	7.2	-
65	SG-45	3	7.62	FICA-7 D/S (SG-44)	SG-6	8.5	-
66	SG-51	8	15.06	SG-1303.04-8''	SG-35-12''	14.1	6.37
67	SG-62A	4	17.12	102-B	SG-32	16.8	1.86
68	SG-62A	4	17.12	102-B	SG-32	16.4	4.20
69	SG-32	6	21.95	SG-62A/B	SG-25	21.4	2.55
70	SG-76A	4	11.1	SG-25	102-B	10.6	4.50
71	SG-76B	4	11.1	SG-21	102-B	10.4	6.31
72	SG-1303.01.14	14	23.83	120-C	SG-35	20	16.07
73	SG-1303.04.08	8	15.06	137-C	SG-51	14.2	5.71
74	SG-1303.06.14	14	23.83	121-C	124-C	21	11.87
75	SG-1303.08.10	10	21.44	SG-1303.08.14	108-D	22.6	-
76	SG-1303.08.14	14	27.79	SG-33-14(105-D)	108-D	25.4	8.60
77	SG-1303.09.10	10	21.44	SG-1303.08.14	108-D	21.0	2.05
78	SG-1303.10.14	14	27.79	108-D	107-C	25.2	9.31
79	SG-1303.11.14	14	31.75	107-C	123-C	27.8	12.44
80	SG-1303.12.10	10	21.44	SG-1303.08.14	108-D	21.8	-
81	FIC-14	10	9.53	U/S	D/S	10	-
82	FIC-14	16	4.57	-	-	5	-
83	PRC-1A	8	8.18	PRC-1A	D/S	6.1	25.43
84	PRC-1A	6	7.11	U/S	D/S	5.8	18.42
85	PRC-1A	3	7.62	-	-	7.2	5.51
86	PRC-1	6	7.11	6''U/S	PRCV-1	5.8	18.42
87	PRC-1	3	5.5	-	-	5.7	-
86	PRC-1	2	5.54	PRCV-1	FRCV-1	4.4	20.58
87	PIC-1A	4	6.02	-	-	6	0.33
88	PIC-1A	6	7.11	-	-	6	15.61
89	PIC-5	12	9.53	V-6	VENT(SP-73)	10.7	-
90	PIC-5	6	7.11	-	-	6.8	4.36

Annexure-9

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

Sr. No.	Component Description	Max. gauss reading	
		Before	After
101-J AIR COMPRESSOR			
1	**Turbine South Bearing**		
1.1	Journal bearing housing	2.0	
1.2	Journal bearing shaft	0.6	
1.3	Journal bearing pads	0.9	
1.4	Journal bearing base ring	T:4.0 B:3.8	
1.5	Thrust collar	2.2	
1.6	Thrust pads	0.6	
2	**Turbine North Bearing**		
2.1	Journal bearing shaft	2.3	
2.2	Journal bearing pads	0.8	
2.3	Journal bearing base ring	3.1	
3	**H P Case South Bearing**		
3.1	Journal Bearing Shaft	2.9	
3.2	Journal bearing pads	4.7	1.2
3.3	Journal bearing base ring	5.0	
4	**H P Case North Bearing**		
4.1	Journal Bearing Shaft	8.8	1.5
4.2	Journal Thrust Collar	8.2	1.6
4.3	Journal Bearing Pads	2.1	
4.4	Journal Bearing Base Ring	3.0	
4.5	Thrust pads	2.0	
5	**L P Case Compressor Thrust End**		
5.1	Journal Bearing Shaft	2.6	
5.2	Journal Bearing Pads	4.8	1.3
5.3	Thrust Collar	3.6	
5.4	Journal Bearing Base Ring	2.8	
5.5	Thrust pads	15.9	1.3
5.6	Thrust Bearing Base Ring	20	1.4
6	**L P Case Compressor Turbine Side**		
6.1	Journal Bearing Shaft	3.5	
6.2	Journal Bearing Pads	9.5	2.0
6.3	Journal Bearing Base Ring	T:2.3, B- 3.5	

7	**Gear Box**		
7.1	Shaft Journal (Low speed)	2.0	
7.2	Journal Bearing (Low speed)	3.8	
7.3	Shaft Journal (High speed)	1.3	
7.4	Journal Bearing (High speed)	3.2	
103-J SYN GAS COMPRESSOR			
1	**JAT Thrust End Bearing**		
1.1	Base Ring	2.0	
1.2	Target plate	1.2	
1.3	Thrust Pads	4.6	0.8
1.4	Shaft Journal	5.3	0.7
1.5	Thrust Collar	2.5	
2	**JAT Opposite Thrust End Radial Bearing**		
2.1	Journal Bearing Shaft	0.7	
2.2	Journal Bearing Pads	0.8	
2.3	Base Ring	2.0	
3	**JBT Non Drive (Thrust End) Radial Bearing**		
3.1	Base Ring	1.2	
3.2	Pads	2.4	
3.3	Bearing Housing	20	3.5
4	**JBT Opposite Thrust End Radial Bearing**		
4.1	Base Ring	1.3	
4.2	Pads	2.4	
4.3	Thrust Collar	3.2	
4.4	Journal Bearing Shaft	1.4	
4.5	Thrust Side Journal Area	3.0	
4.6	Thrust Side Shaft End	2.5	
5	**HP Case Thrust End**		
5.1	Pads	0.8	
5.2	Thrust Shaft Area	1.0	
6	**HP Case Journal Bearing**		
6.1	Base Ring	8.8	1.9
6.2	Pads	2.0	
6.3	Shaft Journal	2.7	
7	**LP Case Thrust End**		
71	Pads	0.8	
7.2	Thrust Shaft Area	0.8	
8	**LP Case Journal Bearing**		
8.1	Base Ring	1.3	
8.2	Pads	2.2	
8.3	Shaft Journal	2.6	

Sr. No.	Component Description	Max. gauss reading	
		Before	After
105-J, REF. GAS COMPRESSOR:			
1	**Turbine Free End Journal Bearing**		
1.1	Base Ring	1.1	
1.2	Pads	1.3	
1.3	Shaft Journal	2.6	
2	**Turbine Coupling End Journal Bearing**		
2.1	Shaft Journal Portion	2.6	
2.2	Thrust Collar	2.8	
2.3	Base Ring	4.0	
2.4	Pads	6.0	0.2
2.5	Thrust Bearing	1.4	
3	**HP Case Coupling End Journal Bearing**		
3.1	Shaft Journal Portion	3.9	2.3
3.2	Pads	3	
3.3	Bearing Base Ring	1.4	
4	**HP Case Free End Thrust Bearing**		
4.1	Thrust Bearing Shaft	12	3.1
4.2	Thrust Bearing Pads	2.0	
4.3	Thrust Collar	5	0.9
5	**LP Case Free End Thrust Bearing**		
5.1	Thrust Bearing Shaft	0.6	
5.2	Thrust Bearing Pads	1.2	
5.3	Thrust Bearing Base Ring	5.2	2.0
5.4	Thrust Collar	0.9	
6	**Gear Box**		
6.1	LS Shaft South side	1.4	
6.2	LS Shaft South side Bearing	3.7	1.4
6.3	LS Shaft North side	2.0	
6.4	LS Shaft North side Bearing	2.1	
6.5	HS Shaft South side	0.9	
6.6	HS Shaft South side Bearing	12.0	3.2
6.7	HS Shaft North side	1.3	
6.8	HS Shaft North side Bearing	4.2	1.6
115-JAT			
1	**Turbine Thrust End**		
1.1	Thrust Pads	1.8	
1.2	Thrust collar	1.2	
1.3	Shaft Journal	0.8	
1.4	Journal Bearing	2.2	
2	**Turbine coupling end**		
2.1	Shaft Journal	2.9	
2.2	Journal Bearings	2.6	

Sr. No.	Component Description	Max. gauss reading	
		Before	After
3 115 - JA			
3.1	Thrust Bearing Pads	7.0	1.6
3.2	Thrust Collar	2.9	
3.3	Journal bearing	3.4	
3.4	Shaft Journal	0.5	
104 - JA Thrust cum journal bearing			
1	**Thrust End**		
1.1	Journal bearing	2.2	
1.2	Thrust Pads	5.8	1.7
1.3	Shaft Journal	2.7	
1.4	Thrust collar	2.4	
2	**Coupling End**		
2.1	Shaft Journal	1.7	

ANNEXURE-10
DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1.	Location: 1 (Parent Metal) On face of 1st Bend of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure shows ferrite and spheroidial carbide structure. Degradation of pearlite observed in terms of spheroidzation. Possibilities of isolated creep cavities are observed. (Plate: 1 & 2)	IInd stage of creep degradations. Monitor after 1 year of service.
2.	Location: 2 (Weld/Haz) On weld betn. Pipe & Bend of NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure at weld shows ferrite and bainite in dendritic form where as at HAZ shows fine-grained bainite and ferrite structure. Microstructure at parent metal shows ferrite and spheroid carbide structure. Degradation of bainite is observed. Possibilities of isolated creep cavities are observed. (Plate: 3 & 4)	IInd stage of creep degradations. Monitor after 1 year of service. SEM analysis showed few isolated creep cavities.
3.	Location: 3 (Weld/Haz) Between Pipe & bend NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11	Microstructure at weld shows ferrite and bainite in dendritic form where as at HAZ shows fine-grained bainite and ferrite structure. Microstructure at parent metal shows ferrite and spheroid carbide structure. Degradation of pearlite observed in terms of spheroidzation. Possibilities of isolated creep cavities are observed. (Plate: 7 & 8)	IInd stage of creep degradations. Monitor after 1 year of service. SEM analysis confirms the presence of oriented creep cavities.
4.	Location: 4 (Weld / HAZ of P-11) On dissimilar Weld between pipe & Nozzle of header NG-9-12" (101B-mixed feed coil outlet to NG-11)	P 11 to 304H	Microstructure at parent metal (P11) shows essentially ferrite structure with carbides. Where as at HAZ microstructure shows fine and coarse-grained ferrite and carbide structure. Possibility of creep damage is observed at P11 side. Weld metal shows dendritic structure of solid solution of nickel. (Plate: 11 & 12) SEM examination –evaluation is kept on next page	Fusion is normal, no cracking observed at interface/alloyed region. AT P11 side approaching 3rd stage of creep damage. Monitor after 1 year of service.
5.	Location: 5 (Weld/Haz) On dissimilar Weld Between pipe & Nozzle of Header NG-9-12" (101B-mixed feed coil outlet to NG-11)	304H to 304H	Microstructure at parent metal (SS 304H) shows austenite grains with twins. Carbide precipitation observed at the grain boundaries. At HAZ microstructure shows coarse-grained austenitic structure, carbide precipitations. Weld metal shows dendritic structure of solid solution of nickel. (Plate: 15 & 16)	The oxalic acid etching confirmed the presence of carbide at the grain boundaries. Monitor after 2 years of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
6.	Location: 6 (Weld/Haz) On Weld Between BFW outlet Nozzle BW-9H-8" & 103-C Shell at top towards East side	Carbon Steel	Microstructure at weld metal shows ferrite and carbides in dendritic form. Where as at HAZ microstructure shows fine and coarse-grained ferrite/pearlite structure. Parent metal shows fine-grained ferrite/pearlite structure. Initial stage of in-situ spheroidzation of pearlite is observed. (Plate: 17 & 18)	IInd stage of creep degradations. Monitor after 1 year of service.
7.	Location: 7 (Weld/Haz) On weld betn. 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. Where as at HAZ microstructure shows fine and coarse-grained ferrite/pearlite structure. Parent metal shows fine grained essentially ferrite structure. Indications of creep cavities are observed at grain boundaries. (Plate: 19 & 20)	2nd stage of creep damage. Monitor after 1 year of service.
8.	Location: 8 (Weld/Haz) PG 7-10 (103C Gas outlet line 1st bend weld & Haz with pipe towards 106D)	P 11	Microstructure at weld metal shows ferrite and carbides in dendritic form. Where as at HAZ microstructure shows fine and coarse-grained ferrite/pearlite structure. Parent metal shows fine grained essentially ferrite structure. (Plate: 23 & 24)	Monitor after 2 years of service.
9.	Location: 9 (Parent Metal) HS-2H-12 (Parent metal) , 120 mm below the bottom butt weld of valve	Carbon Steel	Microstructure sows ferrite and spheroidized pearlite structure. (Plate: 25 & 26)	Needs replacement. Presences of micro cracks are observed at the grain boundaries.
10.	Location: 10 (Parent Metal) SG-34-14 On face of gas outlet bend	P 11	Microstructure sows fine-grained ferrite and pearlite structure. In situ spheroidzation of pearlite observed. (Plate: 29 & 30)	Monitor after 2 years of service.
11.	Location: 11 (Weld/Haz) SG-34-14 On weld & Haz of gas outlet bend	P 11	Microstructure at weld metal shows ferrite and bainite in dendritic form. Where as at HAZ microstructure shows fine and coarse-grained ferrite/ bainite structure. Parent metal shows fine-grained ferrite/pearlite structure. Initial stage of in-situ spheroidzation of pearlite is observed. (Plate: 31 & 32)	No significant degradation observed. Monitor after 2 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
12.	Location: 12 (Weld/Haz) SG-34-14 On weld & Haz of pipe of gas outlet bend	P 11	Microstructure at weld metal shows ferrite and bainite in dendritic form. Where as at HAZ microstructure shows fine and coarse-grained ferrite/ bainite structure. Parent metal shows fine-grained ferrite/pearlite structure. Of in-situ Spherodization of pearlite is observed. Indications of creep cavities are observed. (Plate: 33 & 34)	IInd stage of creep degradations. Monitor after 1 year of service.
13.	Location: 13 (Weld/Haz) A-21-10 On 1st weld/Haz of coil outlet header	P 11	Microstructure shows fine-grained ferrite and pearlite structure at HAZ. In-situ spheroidzation of pearlite is observed. Parent metal microstructure shows ferrite and spheroidized pearlite. Possibilities of creep degradations in form of creep cavities are observed at grain boundaries.(Plate: 37& 38)	IInd stage of creep degradations. Monitor after 2 years of service.
14.	Location: 14 (Weld/Haz) A-21-10 On 1st pipe of coil outlet header	P 11	Microstructure shows fine-grained ferrite and pearlite structure at HAZ. In-situ spheroidzation of pearlite is observed. Parent metal microstructure shows ferrite and spheroidized pearlite. Possibilities of creep degradations in form of creep cavities are observed at grain boundaries.(Plate: 39 & 40)	IInd stage of creep degradations. Monitor after 2 years of service.
15.	Location: 15 (Parent Metal) 101B Harp On field weld of outlet manifold between tube no.27-28, Raw No.8	G-4859	Microstructure at weld shows ferrite pools in austenite matrix with carbides. Microstructure at parent metal shows primary and secondary carbides in austenitic matrix in cast form. (Plate: 41 & 42)	No significant degradation is observed. Monitor after 2 year of service.
16.	Location: 16 (Weld/Haz) 101B Harp On weld of weldolet tube no.28, Raw No.8	G-4859	Microstructure at weld shows ferrite pools in austenite matrix with carbides. Microstructure at parent metal shows primary and secondary carbides in austenitic matrix in cast form. (Plate: 43 & 44)	No significant degradation observed. Monitor after 2 year of service.
17.	Location: 17 (Weld/Haz) 101B Harp On weld of weldolet to riser between tube no.21-22, Raw No.8	G-4859	Microstructure at weld shows ferrite pools in austenite matrix with carbides. Microstructure at parent metal shows primary and secondary carbides in austenitic matrix in cast form. (Plate: 45 & 46)	No significant degradation is observed. Monitor after 2 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
18.	Location: 18 (Weld/Haz) 101B Harp On weld of riser weldolet to outlet manifold Raw No.8	G-4859	Microstructure at weld shows ferrite pools in austenite matrix with carbides. Microstructure at parent metal shows primary and secondary carbides in austenitic matrix in cast form. (Plate: 47 & 48)	No significant degradation is observed. Monitor after 2 year of service.
19.	Location: 19 (Parent Metal) PIC 13B inlet spool piece	Carbon Steel	Microstructure shows fine gained ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 49 & 50)	IInd stage of creep degradations. Monitor after 1 year of service.
20.	Location: 20 **(Parent Metal)** 104D LTS On shell	SA516 Gr.70	Microstructure shows fine gained ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 51 & 52)	IInd stage of creep degradations. Monitor after 1 year of service.
21.	Location: 21 (Weld/Haz) 104D LTS On bottom DE Weld	SA516 Gr.70	Microstructure shows fine gained ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 53 & 54)	IInd stage of creep degradations. Monitor after 1 year of service.
22.	Location: 22 (Weld/Haz) 104D LTS On Longitudinal Weld & shell	SA516 Gr.70	Microstructure at weld shows fine dendritic structure of ferrite and carbides. Where as HAZ microstructure shows fine-grained ferrite and pearlite structure. (Plate: 55 & 56)	IInd stage of creep degradations. Monitor after 1 year of service.
23.	Location: 23 (Weld/Haz) SG-1303, 09-10 (H-36) On 108D converter inlet nozzle	P-22	Microstructure at HAZ shows fine-grained ferrite/bainite/pearlite structure. Where as parent metal microstructure shows ferrite and bainite/pearlite structure. (Plate: 57 & 58)	Monitor after one year of service.
24.	Location: 24 (Weld/Haz) SG-1303, 09-10 (H-36) On 108D converter inlet nozzle of bend at bottom	P-22	Microstructure at HAZ shows fine-grained ferrite and bainite structure. Where as parent metal microstructure sows ferrite and bainite structure. Bainite is observed degrading in to carbides and ferrite. (Plate: 59 & 60)	IInd stage of creep degradations. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
25.	Location: 25 (Parent Metal) MIC-22 Up stream piece (**At Crack**)	Carbon Steel	Microstructure shows fine grained essentially ferrite structure. Presence of coarse and fine aligned cracks in the longitudinal direction observed. These cracks are having typically characteristics thermal degradations. (Plate: 63,64 & 65)	With SEM analysis it indicates degraded microstructure under Creep mechanism. However exact cause is not clear. Recommended to evaluate for defect root cause investigation.
26.	Location: 26 (Weld/Haz) SG-1303 08-14 (H-36) On 108D converter inlet line bend at up stream of HV-487 HAZ of bend (North side of control valve)	P-22	Microstructure at HAZ shows fine-grained bainite and ferrite structure. Parent metal microstructure shows in situ spheroidzation of pearlite/bainite structure. Indications of isolated creep cavities are observed. (Plate: 68 & 69)	IInd stage of creep degradations monitor after 1 year of service.
27.	Location: 27 (Weld/Haz) SG-1303 08-14 (H-36) On 108D converter outlet nozzle	P-22	Microstructure at HAZ shows fine-grained bainite and ferrite structure. Parent metal microstructure shows in situ spheroidzation of pearlite/bainite structure. Indications of isolated creep cavities are observed. (Plate: 70 & 71)	IInd stage of creep degradations. Monitor after 1 year of service.
28.	Location: 28 (Weld/Haz) SG-1303 08-14 (H-36) On 108D converter outlet nozzle Haz of pipe	P-22	Microstructure at HAZ shows fine-grained bainite and ferrite structure. Parent metal microstructure shows tempered bainite structure. (Plate: 72 & 73)	No significant degradations. Monitor after 2 years of service.
29.	Location: 29 (Weld/Haz) SG-1303 10-14 (H-36) On 107C Gas inlet nozzle of pipe	P-22	Microstructure at HAZ shows fine-grained bainite and ferrite structure. Parent metal microstructure shows in situ spheroidzation of pearlite/bainite structure. Indications of isolated creep cavities are observed. (Plate: 74 & 75)	IInd stage of creep degradations. Monitor after 1 year of service.
30.	Location: 30 (Weld/Haz) SG-1303 11-14 (H-34) On 107C Gas outlet nozzle	P-11	Microstructure at HAZ shows fine-grained bainite and ferrite structure. Parent metal microstructure shows in situ spheroidzation of pearlite/bainite structure. Indications of isolated creep cavities are observed. (Plate: 76 & 77)	IInd stage of creep degradations. Monitor after 1 year of service.

SR. NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
31.	Location: 31 (Weld/Haz) SG-1303 11-14 (H-34) On 107C Gas outlet nozzle & Haz of pipe	P-11	Microstructure at HAZ shows fine-grained bainite and ferrite structure. Parent metal microstructure shows in situ spheroidzation of pearlite/ bainite structure. Indications of isolated creep cavities are observed. (Plate: 78 & 79)	IInd stage of creep degradations. Monitor after 1 year of service.
32.	Location: 32 (Weld/Haz) SG-1303 11-14 (H-34) On 123C Gas outlet inlet nozzle	P-11	Microstructure at HAZ shows fine grained bainite/ferrite structure, (Plate: 80 & 81)	IInd stage of creep degradations. Monitor after 1 year of service.
33.	Location: 33 (Weld/Haz) SG-1303 11-14 (H-34) On 123C Gas intlet nozzle Haz of bend	P-11	Microstructure at weld shows dendritic structure ferrite/carbides and bainite structure. Where as parent metal microstructure shows ferrite and spheroidized pearlite structure. Indications of isolated creep cavities are observed at grain boundaries. (Plate: 82 & 83)	IInd stage of creep degradations. Monitor after 1 year of service.
34.	Location: 34 (Parent Metal) SG-1-12 On face of 3rd bend of gas intlet line to 114-C	P-11	Microstructure shows essentially ferrite structure with few grain boundary carbides. Indication of creep damage in form of cavitation and cracks are suspected. (Plate: 84 & 85)	Presence of creep cavities and initial stage of cracking is confirmed by SEM analysis. Approaching 3rd stage of creep damage. Monitor after six month of service
35.	Location: 35 (Weld/Haz) NG-11 /H-6 On P11 to ss304H Dissimilar joint of inlet manifold Raw No.8	P-11 to 304H	Microstructure shows proper fusion between parent metal and weld. No significant defect observed. HAZ microstructure shows fine-grained ferritic structure. Indication of creep cavities at suspected at P11 side.(Plate: 88 & 89)	IInd stage of creep damage monitor after one year of service.
36.	Location: 36 (Parent Metal) Aux. Boiler Coil- B side south to north (west side) old tube no.5 Counting from south to north	106 Gr.B	Microstructure shows fin grained ferrite and pearlite structure. (Plate: 90 & 91)	No significant degradation observed. Monitor after 2 years of service.

SR.NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
37.	Location: 37 (Parent Metal) Aux. Boiler A side (west side) New tube no.7 Counting from south to north	106 Gr.B	Microstructure shows fine-grained ferrite and pearlite structure. (Plate: 92 & 93)	No significant degradation observed. Monitor after 2 years of service.
38.	Location: 38 (Parent Metal) Aux. Boiler B side (east side) old Tube no.15 Counting from south to north	106 Gr.B	Microstructure shows fine-grained ferrite and pearlite structure. (Plate: 94 & 95)	No significant degradation observed. Monitor after 2 years of service.
39.	Location: 39 (Parent Metal) Aux. Boiler A side (east side) New tube no.7 Counting from south to north	106 Gr.B	Microstructure shows fine-grained ferrite and pearlite structure. (Plate: 96 & 97)	No significant degradation observed. Monitor after 2 years of service.
40.	Location: 40 (Weld/Haz) 102B SG-62 B-4 line	Carbon Steel	Microstructure at HAZ shows coarse-grained ferrite and pearlite structure with initial stage of spherodization Where as parent metal microstructure shows ferrite and in-situ spherodized pearlite. (Plate: 98 & 99)	IInd stage of creep degradations. Monitor after 1 year of service.
41.	Location: 41 (Weld/Haz) 102B SG-62 A-4 line	Carbon Steel	Microstructure shows fine-grained ferrite and pearlite structure. In situ spheroidzation observed both at HAZ and parent metal. (Plate: 102 & 103)	IInd stage of creep degradations. Monitor after 1 year of service.
42.	Location: 42 (Weld/Haz) NG-11 A/H-6 On SS304H to ss304H Dissimilar joint of inlet manifold Raw No.8	304H to 304H	Microstructure shows fine-grained worked austenitic structure with twins. Carbide precipitations are observed at the grain boundaries. (Plate: 106 & 107)	Carbide precipitations are expected during service. However during shut down due care may be taken by avoiding sulfur related impurities from external source to avoid IGSCC attack.

Annexure-11

WELDING PROCEDURE SPECIFICATIONS
(SEE QW -201.1 SECTION IX, ASME BPVC)

WPS NO.: 102-C T/TS

Welding Process	:	GTAW
Type	:	Manual

1. JOINT DESIGN (QW - 402)

Groove design	:	As per Tube bundle drawing
Backing	:	N.A.
Others	:	N.A.

2. BASE METALS (QW - 403)

P.No. 4 to P. No. 4		
Specification	:	SA 182 Gr. - F11 to SA 213 Gr.-T11
Thickness Range	:	Tube Sheet 165mm (6 ½"), Tube: - 4.191 mm (8BWG) Tube projection 4.76 - 6.35 mm Fillet of 4.76 mm

3. FILLER METALS (QW - 404)

Weld metal analysis	:	A No. 3
AWS No. (Class)	:	Filler: SFA 5.28 (ER 80SG)
Size of Filler wire	:	2.4 mm

4. POSITION (QW - 405)

Position of Groove	:	ALL
Welding Progression	:	
Other	:	

5. PREHEAT (QW - 406)

Preheat Temperature min.	:	125 to 150 degree C
Interpass Temperature max.	:	300 degree C
Preheat Maintenance	:	150 degree C

6. DEHYDROGENATION

6.1	Soaking Temperature	:	350 degree C
	Soaking time	:	24 hours
6.2	Soaking Temperature	:	620 degree C
	Soaking time	:	04 hours
	Heating Rate	:	50 degree C/hr
	Cooling Rate	:	50 degree C/hr
	Loading/Unloading Temperature	:	300 degree C

7. GAS (QW - 408)

Shielding gas	:	Argon
Gas consumption	:	99.995 %
Flow rate	:	10 to 12 litters / min
Purging gas	:	NA
Gas consumption	:	NA
Flow rate	:	NA

8. ELECTRICAL CHARACTERISTICS (QW - 409)

Current	:	DC
Polarity	:	EP for GTAW
Ampere (Range)	:	80 to 130
Other	:	

9. TECHNIQUE (QW - 410)

String or weave bead	:	String and weave
Initial & Interpass cleaning	:	Grinding & brushing
Oscillation	:	N.A.
Method of back gouging	:	N.A.
Contact tube to work distance	:	N.A.
Single or multiple pass	:	Multiple
Travel Speed (Range)	:	4 to 6 cm/min for GTAW

10. WELD INSPECTION

Root weld	:	DP Test
Final weld	:	DP Test

11. STRESS RELIEVING PROCEEDURE

Soaking Temperature	:	650 degree C
Soaking time	:	1 hour
Heating Rate	:	50 degree C/hr (Max.)
Cooling Rate	:	50 degree C/hr (Max.)
Loading Temperature	:	300 degree C
Unloading Temperature	:	300 degree C

Annexure-12

WELDING PROCEDURE SPECIFICATIONS
(SEE QW -201.1 SECTION IX, ASME BPVC)

FOR REPLACEMENT OF 14" NB x Sch 120 Elbow:

14" NB Schedule 120, ASTM A335 Gr-P22 Seamless Pipe to 14" NB Schedule 120, ASTM A234 Gr-WP22 Seamless Elbow.

Welding Process : GTAW + SMAW

Type : Manual

1. JOINT DESIGN (QW - 402)

Groove design : As per Drawing No: P1-ES-13068, Sheet 1 of 1,Rev 0.

2. BASE METALS (QW - 403)

P-No. 5A Group No. 1 to P-No. 5A Group No.1

Specification : ASTM A 335 P22 to ASTM A234 Gr-WP22.

Thickness Range : 32 mm maximum

Pipe dia Range : 2-7/8" N.B. and above

3. FILLER METALS (QW - 404)

Weld metal analysis : A No. 4

Filler Metal F No. : As per QW -432.1 (SFA 5.5)

AWS No. (Class) : Electrode SFA/AWS A 5.5-96 (E 9018 B3)

Filler SF A5.28 /AWS A 5.28-96 (ER 90SB3)

Size of electrode : 2.4 mm (Filler wire) for root & hot pass

2.5, 3.15, 4 mm (Electrode) for fill up and capping

4. POSITION (QW - 405)

Position of Groove : 2G/5G
Welding Progression: Uphill

5. DEHYDROGENATION

Loading Temp : 300 degree C/hr
Heating Rate : 60 degree C/hr
Ist Soaking Temperature : 400 degree C
Soaking time : 24 hours
Heating Rate : 60 degree C/hr
2nd Soaking Temperature : 620 degree C
Soaking time : 3 hours
Cooling Rate : 100 degree C/hr
Loading/Unloading Temperature: 300 degree C

6. PREHEAT (QW - 406)

Preheat Temperature : 175 - 200 ^{O} C
Inter pass Temperature max.: 250 ^{O} C

7. 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

8. GAS (QW - 408)

Shielding gas: Argon

Gas purity	:	99.995 %
Flow rate	:	6 to 12 liters / min
Purging gas	:	Argon
Gas purity	:	99.995 %
Flow rate	:	10 to 15 liters / min

9. ELECTRICAL CHARACTERISTICS (QW - 409)

Current	:	DC
Polarity	:	Straight for GTAW and Reverse for SMAW
Ampere (Range)	:	90 to 120 for GTAW and 100 to 160 for SMAW

10 TECHNIQUE (QW - 410)

String or weave bead	:	String and weave
Initial & Inter pass cleaning	:	Grinding & brushing
Oscillation	:	N.A.
Method of back gouging	:	N.A.
Contact tube to work distance	:	N.A.
Single or multiple pass	:	Multiple
Travel Speed (Range)	:	4 to 6 cm/min for GTAW, 8 - 16 cm/min for SMAW

11. WELD INSPECTION

Bevel Edge	:	DP Test
Root weld	:	DP Test & 100 % radiography
Final weld	:	DP Test & 100 % radiography

12 Hardness measurement after PWHT : 241 BHN Max

Annexure-13

WELDING PROCEDURE SPECIFICATIONS
(SEE QW -201.1 SECTION IX, ASME BPVC)

FOR REPLACEMENT OF 8" NB x Sch 120 Elbow:

8" NB X Schedule 120, ASTM A53 Gr. B Seamless Pipe to 8" NB X Sch. 120, ASTM A234 WPB Seamless Elbow.

Welding Process : GTAW + SMAW
Type : Manual

1. JOINT DESIGN (QW - 402)

Groove design : As per Drawing No: P1-ES-13068, Sheet 1 of 1,Rev 0.

2. BASE METALS (QW - 403)

P-No. 1 Group No. 1 to P-No. 1 Group No.1
Specification : ASTM A53 Gr. B to ASTM A234 WPB
Thickness Range : 18 mm maximum
Pipe dia Range : 2-7/8" and above

3. FILLER METALS (QW - 404)

Weld metal analysis : A No. 1
Filler Metal F No. : As per QW -432.1 (SFA 5.5)
AWS No. (Class) : Electrode SFA/AWS A 5.5-96 (E 7018 B2 L)
Filler SF A5.28 /AWS A 5.28-96 (ER 70SB2 / ER515)
Size of electrode : 2.4 mm (Filler wire) for root & hot pass
2.5, 3.15, 4 mm (Electrode) for fill up and capping
Type of electrode flux : Low hydrogen, heavy coated

4. POSITION (QW - 405)

Position of Groove : 2G/5G
Welding Progression : Uphill

5. 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

6. PREHEAT (QW - 406)

Preheat Temperature	:	100 - 150 ^{O} C
Inter pass Temperature maxm.	:	250 ^{O} C

7. POST WELD HEAT TREATMENT (QW - 407)

Temperature	:	625^{O} C
Soaking time	:	01 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

8. GAS (QW - 408)

Shielding gas	:	Argon
Gas consumption	:	99.995 %
Flow rate	:	6 to 12 liters / min
Purging gas	:	NA

9. ELECTRICAL CHARACTERISTICS (QW - 409)

Current	:	DC
Polarity	:	Straight for GTAW Reverse for SMAW
Ampere (Range)	:	90 to 120 for GTAW 70 to 190 for SMAW

10. TECHNIQUE (QW - 410)

String or weave bead	:	String and weave
Initial & Inter pass cleaning	:	Grinding & brushing
Oscillation	:	N.A.
Method of back gouging	:	N.A.
Contact tube to work distance	:	N.A.
Single or multiple pass	:	Multiple
Travel Speed (Range)	:	4 to 6 cm/min for GTAW 8 to 16 cm/min for SMAW

11. WELD INSPECTION

Bevel Edge	:	DP Test
Root weld	:	DP Test & 100 % radiography
Final weld	:	DP Test & 100 % radiography Hardness measurement after PWHT

Annexure-14

WELDING PROCEDURE SPECIFICATIONS
(SEE QW -201.1 SECTION IX, ASME BPVC)

FOR REPLACEMENT OF GATE VALVES:

150 NB Schedule 120, ASTM A335 Gr. P11 Seamless Pipe to 150 NB, 1500# , Sch. 120, ASTM A217 Gr. WC6 Butt Welded Gate Valve.

Welding Process	:	GTAW + SMAW
Type	:	Manual

1. JOINT DESIGN (QW - 402)

Sketch	:	IBR Fig. No. 28 (VIII)
Groove design	:	Single 'V' Butt Weld as per Drawing No P1-ES-13067, Sheet 1 of 1, Rev 1 (Enclosed)

2. BASE METALS (QW - 403)

P-No. 4 Group No. 1 to P-No. 4 Group No.1

Specification	: ASTM A 335 P 11 to ASTM A217 Gr. WC6
Thickness Range	: 18 mm maximum
Pipe dia Range	: 2-7/8" and above

3. FILLER METALS (QW - 404)

Weld metal analysis	: A No. 3
Filler Metal F No.	: As per QW -432.1 (SFA 5.5)
AWS No. (Class)	: Electrode SFA/AWS A 5.5-96 (E 8018 B2 L) Filler SF A5.28 /AWS A 5.28-96 (ER 80SB2 / ER515)
Size of electrode	: 2.4 mm (Filler wire) for root & hot pass 2.5, 3.15, 4 mm (Electrode) for fill up and capping
Type of electrode flux	: Low hydrogen, heavy coated

4. POSITION (QW - 405)

Position of Groove	:	6G
Welding Progression	:	Uphill

5. PREHEAT (QW - 406)

Preheat Temperature min.	:	150 ^{O} C
Inter pass Temperature min.	:	300 ^{O} C

6. POST WELD HEAT TREATMENT (QW - 407)

Temperature	:	704 to 760^{O} C
Soaking time	:	01 Hour minimum
Heating Rate	:	100 ^{O} C / hr. max
Cooling Rate	:	100 ^{O} C / hr. up to 300^{O} C, then natural cooling under asbestos.

7. GAS (QW - 408)

Shielding gas	:	Argon
Gas consumption	:	99.995 %
Flow rate	:	10 to 12 liters / min
Purging gas	:	Argon
Gas consumption	:	99.995 %
Flow rate	:	6 to 10 litres / min

8. ELECTRICAL CHARACTERISTICS (QW - 409)

Current	:	DC
Polarity	:	Straight for GTAW
		Reverse for SMAW
Ampere (Range)	:	80 to 130 for GTAW
		70 to 190 for SMAW

9. TECHNIQUE (QW - 410)

String or weave bead	:	String and weave
Initial & Inter pass cleaning	:	Grinding & brushing
Oscillation	:	N.A.
Method of back gouging	:	N.A.
Contact tube to work distance	:	N.A.
Single or multiple pass	:	Multiple
Travel Speed (Range)	:	4 to 6 cm/min for GTAW
		8 to 12 cm/min for SMAW

10. WELD INSPECTION

Bevel Edge	:	DP Test
Root weld	:	DP Test & 100 % radiography
Final weld	:	DP Test & 100 % radiography
		Hardness measurement after PWHT

UREA PLANT

During Shutdown 2007, the following major inspection activities were performed in the Urea plant.

1 Internal inspection of High-pressure vessels by M/S Stamicarbon Viz Autoclave (V-1201), H. P. Stripper (H-1201) and H.P. Condenser (H- 1202).

2 Eddy Current testing of H. P Condenser and H.P Stripper tubes was carried out by M/S Stamicarbon.

3 Internal inspection of other vessels in the Plant.

4 Ultrasonic thickness measurement of HP lines in the Plant. Detailed report is attached at **Annexure-1.**

5 Ultrasonic thickness measurement of lines other than H.P lines in the plant. Detailed report is attached at **Annexure-2.**

6 Ultrasonic thickness measurement of various equipment in the Plant. Detailed report is attached at **Annexure-3.**

7 Dye Penetrant examination and radiography of weld joints of lines fabricated, erected and offered by Mech. Maint. / Technical Department as per the requirement.

8 Qualification tests of welders employed by contractors.

9 Residual magnetism measurement and demagnetization, wherever required of Hitachi compressor (K-1801) Train. Detail report is attached at **Annexure-4.**

10 Degaussing of 60 ata steam line joint from 200 gauss to 60 gauss. and then root weld carried out by E 6013 electrode and fill up by E-7018 using welding transformer unit. Detail report is attached at **Annexure-5.**

10. Insitu-Metallography of selected equipment and pipelines was carried out. Summary of observations and microstructure analysis is given in **Annexure-6**.

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

1.0 HIGH PRESSURE VESSELS:

High-pressure equipment of the Urea Plant was inspected by Stamicarbon from April 20. to April 25. 2007. Main observations are listed here :

AUTOCLAVE (V-1201):

VISUAL INSPECTION:

Thorough visual inspection of the liner, its welds, trays and internals was carried out by M/S Stamicarbon. The observations made by them are reproduced below.

Top cover

- The sealing face has a circumferential groove. Further the condition is satisfactory.
- The overlay welding is covered with a thick blue grey oxide layer and shows open craters up to 2-3 mm depth.
- The sleeve of nozzle R3 (renewed in 2002) show some condensation corrosion inside and around the weld to the cover.
- The gas outlet nozzle C2 shows inside scaling and some minor corrosion.

Gas Phase:

- The sealing face has a circumferential groove.
- The manway shows a blue grey oxide.
- No corrosion observed at the knuckle radius.
- The liner in the hemi-head shows a thin blue grey oxide layer & Small condensation spots are observed.
- The top tangent weld has been checked for SIIC (stress induced intergranular cracking) by a specialized EC-gap technique. No indications have been observed.

Liquid Phase:

- Liquid level is about 5-10 cm above the tangent line.
- Top shell liner of BC.05 material is grey and slightly rough.
- Next to BC.05 liner is old liner of BC.01 material and is brown to dark brown.
- In the top area the liner is slightly rough and changes to smooth in the bottom area. This indicates normal uniform corrosion slightly higher in top than in bottom.

- In compartment no-2 at a spot opposite to the downcomer shows a thickness of 3.8 mm just below the circumferential weld.(Exact location between 5th and 6th clit counting from west to southside looking from manyway).

- Patches or inserts liners in compartments 3, 4, 8, 9, 10 and 11 are grey and slightly etched.

- Bulging has not been observed anymore, except for some small portion in compartment 5 which is very small and it is advised to keep it under attention.

- The longitudinal and circumferential welds are grey and rough in the top compartments and changes to smooth in the bottom compartments.

- The downcomer is brown (BC.01); slightly rough in the top going to smooth in bottom.

- The funnel is grey (BC.05) and slightly rough.

- In compartments 3 and 5 some parts of the downcomer have been made of BC.05 material, which is grey and etched. The welds of the downcomer show hardly any corrosion.

- A gas cushion (blue/reddish oxides) has been observed around the liquid boxes in compartments 2 to 6.

- The I-clips (BC.05) are bright grey and show some cross-cut end attack, specially in the top area.

- The J-bolts and nuts are slightly etched. Some J-bolts are loose and should be tightened.

- The HE-trays are brown; rough in the top area and changing to smooth in the bottom area.

- The tray holes show considerable corrosion in the top to middle compartments.

- Wall thickness of the trays has decreased in top to middle compartments.

Liner thickness and other measurements:

The weld overlay thickness is measured with a Fischer DualScope MP4 (accuracy ~0.5 mm). The wall thickness of the liner was measured using a Panametrics Epoch LT with a 5 MHz DA-301 probe (accuracy 0.1 mm). The measurements have been taken at the same location as during previous inspections. Also, some measurement were taken in compartment 2 and 3.

Main Liner Thickness				
Location	**Min. (mm)**	**Max. (mm)**	**Remarks**	**Design/ Installed Thk.(mm)**
Compartment 1 Liner	4.64		Corrosion Rate as observed by Stamicarbon is 0.08 (mm/Year)	6.50 (new) 5.00 (old)
Compartment 2 Liner	3.8	4.7	Installed thickness 5 mm.	5.00
Compartment 3 Liner	4.2	4.4	Installed thickness 5 mm.	5.00
Compartment 5 Liner	4.82		Corrosion Rate as observed by Stamicarbon is 0.09 (mm/Year)	5.00
Compartment 9 Liner	4.67		Corrosion Rate as observed by Stamicarbon is 0.06 (mm/Year)	5.00
Downcomer Thickness				
Downcomer in Compartment 5	8.1	8.4	The replaced downcomer part in compartment 5 has a wall thickness of 9.8-10.0 mm.	9.50
Downcomer in Compartment 9	8.9	9.3		9.50
Tray Thickness				
Tray Thickness in Compartment 1	5.8	6.0		8.00
Tray Thickness in Compartment 5	6.0	6.3		8.00
Tray Thickness in Compartment 9	7.3	7.7		8.00
Hole Diameter of Trays				
Compartment 1	10.0	11.0		8.00
Compartment 5	10.0	11.0		8.00
Compartment 9	9.0	9.5		8.00

Top Cover	7.5	8.5	Overlay welding	
Man way	6.8	6.9	Replaced 2002	6.5
Top dome	6.5	6.7	Replaced 2002	6.5
Liner below dome	6.5	6.7	750 mm section BC.05 – replaced 2002	6.5
Bottom Dome	6.1	6.5	Replaced 1993	7.00

Other Areas

Note: These corrosion rates of the liner are normal for Stamicarbon reactors.

INSERT LINER:

Compartment Nos.	Thickness observed(MM)	Installed Thickness (MM)	Year of Replacement
3	6.5-6.8	-	1997
4	6.2-6.3	-	1999
8	6.4-7.0	-	2000
9	-	-	2001
10	6.3-6.5	-	2002
11	6.5-6.8	-	2002

HP STRIPPER (H-1201):

VISUAL INSPECTION:

Top cover :

- The sealing face has some minor mechanical damage but condition is satisfactory.
- The overlay welding is grey and smooth (machined) but no defects have been observed.
- The center plate is covered with oxides but no corrosion has been observed.

Top channel :

- The sealing face is satisfactory.
- A thin blue grey oxide layer covers the overlay welding and liner in the gas phase (man way, dome and part of cylinder) completely, except for the areas between the strip beads. The liner and liquid inlet box in the liquid phase are grey and slightly etched. Corrosion has not been observed.
- The overlay welding on the tube sheet is grey and slightly etched.
- The tube welds are bright and smooth. Between the tubes sometimes heavy oxide deposition is present. It was advised to remove these deposits at the locations where they may interfere with the liquid divider tubes.
- The tubes are smooth inside.
- However, about 100-200 tubes show corrosion and slight loss of wall thickness (< 0.5 mm) inside the tube at the location of the tube sheet welds.
- Tube #2531 shows an internal defect just below the tubesheet weld (see photo's). This to be plugged (top in tubesheet; bottom in tube).
- The liquid divider tubes are grey and etched. Some urea deposits and oxide flakes obstruct some of the liquid holes.

Bottom channel :

- The sealing face is satisfactory.
- The overlay welds in the manway are grey and slightly etched.
- There are gaps of 1-2 mm depth present between the strip beads.
- The overlay welds in the hemi-head are grey and etched; at the start/stop locations slightly rough.
- The liner in the cylindrical section is grey and slightly etched.
- The tubesheet is covered with a thin blue grey oxide layer, which indicates the presence of a gas cushion up to some 50 mm below the tubesheet.
- Some black coloration at the gas/liquid interface indicates some oil fouling.
- The tubes inside are smooth.
- Some etching is present at the cross section.
- The liquid outlet pipe and the gas inlet pipe are bright shiny and showed no defects. Their nozzles and welds are in satisfactory condition.

BOTTOM COVER:

- The sealing face is in good condition.
- The overlay welding is very smooth and shows no defects.
- The vortex strips are in good condition.

SCALING MEASUREMENT:

- The scaling measurement was done in 30 nos tubes.
- The scaling thickness inside the heat exchanger tubes is between 0.5 and 1.0 mm.

Thickness Measurement:

Wall thickness of tubes:

All stripper tubes were measured for minimum wall thickness by Eddy Current technique in the top 3-4 m. The accuracy of the measurement is 0.05 mm. The main results are :

- Lowest minimum wall thickness : 2.70 mm
- Highest minimum wall thickness : 3.05 mm
- Average minimum wall thickness : 2.93 mm

Also, some 234 tubes (~10%; rows 1,11,23,32,41,53,63) have been measured over the full length. These measurements showed that the wall thickness was about 3.27 mm in the non-corroded parts (bottom).

	Minimum Thickness mm	Maximum Thickness mm	Design Thickness mm (Minimum)
Man way (Overlay)	13.00	15.00	8.00
Dome area (Overlay)-minimum 7.5 mm betn.the strip beads	8.00	10.00	8.00
Cylindrical area (Liner)-Gas phase	8.10	8.80	8.00
Cylindrical area (Liner)-Liquid phase	8.10	8.20	8.00
Tube sheet-Overlay weld	9.50 (Machined)	10.00 (Machined)	8.00
Top Cover (Overlay)	9.00	10.00	8.00

Wall thickness of overlay welding and liner :

The weld overlay thickness is measured with a Fischer DualScope MP4 (accuracy 0.5 mm).The wall thickness of the liner was measured using a Panametrics Epoch LT with a 5 MHz DA-301 probe (accuracy 0.1 mm).

BOTTOM DOME:

	Minimum Thickness mm	Maximum Thickness mm	Design Thickness mm (Minimum)
Man way (Overlay)	13.00	15.00	8.0
Dome area (Overlay)	9.00	12.00	8.0
Cylindrical area (Liner)	8.20	8.60	8.0
Tube sheet-Overlay weld	9.00 (Machined)	10.00 (Machined)	8.0
Bottom Cover (Overlay)	11.50	13.50	8.0

TOP DOME:

* One no tube(# 2531) which was plugged on top & bottom tubesheet was DP tested after Seal run & final welding.Ferrite measurement was carried out.Nil ferrite was observed on welds.

H.P. CONDENSER H-1202:

VISUAL INSPECTION:

Top cover:

- The sealing face is satisfactory.
- The liner is grey and show some etching.
- The liquid inlet line and welds are bright grey and smooth.

Top channel :

- The internals (liquid inlet box with pall rings and liquid/gas divider plate) are grey and slightly etched.
- The tray holes are 7.5 to 8.0 mm.
- The gasket sealing face is satisfactory.
- The liner and welds in the man way are grey and smooth.
- The liner and welds in the channel are grey and slightly rough.
- The liner around the gas inlet is partly covered with a blue grey oxide scale.
- The tray support clips are grey and slightly etched.
- The weld of one patch plate is penetrated and needs to be repaired. Because a clip is partly located on top of the patch plate, it is necessary to remove the clip, repair the weld and re-install the clip. In order to avoid future problems, please cut in the weld metal (and not in the liner). Same was removed by grinding and no corrosion was observed. Clit was again welded.
- The tube-to-tube sheet welds are bright grey and smooth.
- The tubes in the outer circumference are grey and etched; in the inner circumference they are blue/brown and smooth. This indicates slightly more corrosion at the outer circumference.
- A lot of tubes show burn-through defects. Some burn-through defects were repaired during manufacturing.
- Also some tubes show inside some grinding spot around the burn through defects. Keep attention to these spots during next general shutdowns.

Bottom Channel :

- The sealing face is satisfactory, but it has 3 grooves in circumferential direction.
- The manway liner is grey and smooth.
- In the hemi-head and cylindrical area the liner is grey and etched.
- All liner welds and repairs are bright and smooth (end craters slightly etched).
- The tubesheet welds are bright shiny and smooth; the tube sheet overlay is slightly etched.
- Also at the bottom section many tubes show burn-through defects (some already repaired during manufacturing).
- Two tubes (# 982 and 1214) show heavy burn through spots and wall thickness loss at the burn through spot. These two tubes were plugged.

Bottom cover :

- The sealing face is satisfactory, but there are 3 circumferential grooves present at the sealing face.
- The liner is grey metallic and hardly etched.
- The vortex breaker and welds are smooth.
- However, the welds vortex breaker of the supports to the liner were not fully seal welded.Same were seal welded and DP tested

* Two nos tubes (# 982 & 1214) which was plugged on top & bottom tubesheet was DP tested after Seal run & final welding.Ferrite measurement was carried out.Nil ferrite was observed on welds.

THICKNESS MEASUREMENT

Wall thickness of tubes

About 11% of the tubes (219 tubes) of the condenser have been measured over the entire length for minimum wall thickness by Eddy Current technique (accuracy 0.05 mm). The main results are:

- Lowest minimum wall thickness : 2.45 mm
- Highest minimum wall thickness : 2.55 mm
- Average minimum wall thickness : 2.50 mm
- Average minimum wall thickness in April 2001 : 2.52 mm

Average corrosion rate since April 2001 : 0.00 mm/year

Weld Overlay and Liner thickness measurement:

The wall thickness of the liner was measured using a Panametrics Epoch LT with a 5 MHz DA-301 probe (accuracy 0.1 mm).
The weld overlay thickness has been measured using a DualScope MP4 (accuracy 0.5 mm).

BOTTOM DOME:

	Minimum Thickness (mm)	Maximum Thickness (mm)	Design Thickness (mm)
Man way (Liner)	**5.60***	7.10	6.0
Dome area (Liner)	6.70	7.10	6.0
Cylindrical area (Liner)	6.50	7.10	6.0
Tube sheet-Overlay weld	8.00	9.00	8.0 (Min)
Bottom Cover (Liner)	19.0	20.0	18.0

- **One spot near vertical seam is 4.6 mm**

TOP DOME:

	Minimum Thickness mm	Maximum Thickness mm	Design Thickness mm (Minimum)
Man way (Liner)	6.10	7.40	6.0
Dome area (Liner)	6.40	6.80	6.0
Cylindrical area (Liner)	6.30	6.80	6.0
Tube sheet-Overlay weld	7.00	10.00	8.0 (min)
Top Cover(Liner)	19.0	20.0	18.0

2.0 INSPECTION OF OTHER VESSELS:

H-1131 A (L.O COOLER FOR P-1102 A)

- Rusting and pittings were observed on the tube sheet.
- 2-3 mm deep pittings were observed on the channel divider plate.
- Minor scaling was observed inside the tubes.

H-1131 B (L.O COOLER FOR P-1102 B/C)

- Tube to tube sheet joints were found satisfactory.
- Minor scaling was observed inside the tubes.

H-1204 (Recirculation Heater):

- Cleaning of bottom tube sheet was not proper as hard scaling was observed on entire surface of tube sheer and orifice plugs.
- Orifice plugs at bottom of tube sheet was found intact in position.
- Brownish coloration was observed on top tube sheet.
- Tube to tube sheet joint at top tube sheet was observed satisfactory.
- Thin brownish scale was observed on the inside of all tubes.

H-1207 (Circulation System-II Cooler):

- Heavy corrosion/ pitting and scaling were observed on the tube sheet area.
- Corrosion & pittings were observed on the inside of end covers.
- Scaling was observed on the inside of all tubes.
- Outside surface of the tubes was found satisfactory. Tube bundle was pulled out from the shell.
- Inside surface of shell was grayish in colour and all weld joints were found in satisfactory condition.

H-1231 A/B (L.O COOLER FOR P-1201 A/B)

- Tube to tube sheet joints were found satisfactory.
- Minor scaling was observed inside the tubes.

H-1352 (Reflux Condenser):

TOP TUBE SHEET:

- Scaling was observed on the tube sheet and the cleaning was not proper.After hydrojetting tube to tubesheet welding was inspected and found satisfactory
- Hard scaling were observed on the inside surface of all the tubes looking from the top end.

BOTTOM TUBE SHEET:

- Tube to tube sheet welding was found satisfactory on CW inlet side.
- Thick scaling was found on the CW outlet side tube sheet which was recommended to clean properly.
- (c) On cooling water outlet side, grey scaling & dust was observed inside almost all the tubes. Proper cleaning was recommended.
- Entire inside surface of cooling water outlet line was found covered with thick gray color scales.
- Brownish rusting scales were observed on entire surface of Inlet & Outlet channel and also on the inner surface of CW inlet line.

H-1419 (Pre-evaporator Condenser) :

BOTTOM TUBESHEET:

- Tube to tube sheet weld wasfound satisfactory.
- Scaling was observed on the inside surface of tubes on CW outlet side.
- 1 ½ " nozzle pipe was observed partially choked.

TOP TUBESHEET:

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

H-1420 (FINAL CONDENSER) :

- Bottom tube to tube sheet welding was found satisfactory.
- Rusting/ brownish scaling was observed on inside surface of channel covers.

H-1421 (Flash Tank Condenser):

- Tube to tube sheet welding was found satisfactory.
- Minor scales were observed inside the some tubes.
- All 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.

- Grayish hard scales were observed at scattered locations.
- Colouration of the tube sheet was grayish.
- (d))Tube to tube sheet weld joints were found satisfactory.

- Grayish scales were observed on the inside surface of tubes.

- Condition of impingement cone was found satisfactory.

- Impingement cone to support welding was found satisfactory.
- Condensate distributor was found satisfactory.

- Water was found accumulated at the bottom of the dish end.

H-1423 (First Stage Evaporator Condenser):

- Tube to tube sheet welding was found satisfactory.
- Minor scales were observed inside few tubes.
- Tube sheet was found brownish in coloration.
- All tubes were found filled with water.

H-1424 (2 nd Stage Evaporator) :

- Colouration of vessel was found black in coloration just above the dish end welding. Rest of the surface was found bright.

- Tube to tube sheet weld joints were found satisfactory.

- Impingement cone was found bent in downward direction at two locations, one is in north-west direction and the other is in south-east direction

- Thin whitish scaling was observed inside of all tubes.

- Water and debris was found on the bottom of the dish end.

H-1425 (Second Evaporator First Condenser):

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

H-1426 (Second Evaporator Second Condenser):

- Tube to tube sheet welding was found satisfactory.
- Tube sheet was found brownish in coloration.
- All tubes were found filled with water.

H-1814-A and H-1814 B (L.O. Cooler of Hitachi Compressor):

- Tubes and tube sheet were found satisfactory.
- Epoxy coating was found damaged in the dome cover of H-1814A.

H-1815 (Surface Condenser for Hitachi Compressor):

SOUTH SIDE HALF (West side channel)

Bottom half:

- Tube sheet found in satisfactory condition.
- Minor scaling was observed inside the tubes.

Top half:

- Tube sheet was found in satisfactory condition.
- Minor scaling was observed inside the tubes.
- Epoxy coating was found damaged at some localized spots.

SOUTH SIDE HALF (East side channel)

Top half:

- Tube sheet was found in satisfactory condition.
- Minor scaling was observed inside some of the tubes.
- Epoxy coating was found damaged at the edge of the tube sheet.

Bottom half:

- Tube sheet was found in satisfactory condition.
- Minor scaling was observed inside some of the tubes.
- Water was found coming out from some of the tubes

North side Half (East side cover)

- Tubes and tube sheet surface condition was found satisfactory.
- Epoxy coating was found peeled off at several locations from seating surface, edge of partition plate and adjacent area near tube sheet, channel cover. .

North side Half (West side cover)

- Tubes and tube sheet surface condition found satisfactory.
- Epoxy coating was found damaged at many locations resulting in minor corrosion of shell material underneath.

T-1301 (Ammonia Water Tank):

- Brownish coloration on bottom plate and bottom half of shell and silver bright coloration on top half of shell was observed.
- Bottom plate was found bulged up side at different locations. Same was observed in past also.
- Weld joints and nozzle condition was found to be satisfactory.

T-1301-A (New Ammonia Water Tank) :

- Brown coloration on bottom plate and bottom half of shell and silver bright coloration on top half of the shell was observed.
- All weld joints and nozzle condition was found satisfactory.

T-1401 (Urea Solution Tank):

- Bottom plate is having bulging upward as has been observed in the past.
- Weld joints condition was found satisfactory.
- Dark brown coloration was observed inside the tank.
- Stiffener provided on top roof plate was found intact in position.

T-1401-A (New Urea Solution Tank):

- Brownish gray coloration was observed on the inside of the shell.
- Nozzles and weld joint condition was satisfactory.

T-1501 (Condensate Tank):

- Brownish black coloration was observed inside the tank.
- Condition of Weld joint was found satisfactory.
- Condition of the patch plate and its weld joints was found satisfactory.
- North side support to clit welding of west side return condensate line was found cracked.
- In general, condition of the tank was found satisfactory.

V-1101 (CO_2 Knock Out Drum):

- Epoxy paint was found peeled off from few locations, however primer at these locations was found intact and no sign of corrosion was observed.
- Demister pads were found intact in position. At few locations it was found chocked (covered) with yellow color debris.
- Grey debris was found at the bottom dished end, proper cleaning was recommended.

V-1102 (NH3 Suction Filter) :

- Oily surface was observed inside the vessel.
- Overall condition of the equipment was found satisfactory.
- Colouration of vessel was found brownish from inside.

V-1103 (NH3 Suction Vessel):

- Coloration of vessel inside was blackish.
- The condition of longitudinal and circumferential weld joints was satisfactory.
- Oil layer and debris were found on the bottom-dished end.
- Proper cleaning was recommended.

V-1202 (Rectifying Column):

From Top Manhole:

- Coloration of vessel was grayish at man hole position and blackish at dome and shell portion.
- Black hard scales were observed at the top dish end and also at the shell portion.
- Brownish grey hard scales were observed on the surface of trays.
- Condition of trays was found satisfactory and intact in position.

From Bottom manhole:

- Colouration of top cone was silver with black patches where as brownish coloration was found on bottom-dished end.
- Condition of the weld joints was found satisfactory.
- Overall condition of the vessel was found satisfactory.

V-1203 (L. P. ABSORBER):

From Top End:

- Colouration of shell was observed grayish black.
- Perforated support grid just below top hand hole was found intact in position.

From Bottom End:

- Colouration of shell was observed brownish black whereas in some areas it was grayish.
- Condition of weld joints was found satisfactory.

V-1207 (L. P. Scrubber):

From Top Manhole :

- Colouration of shell portion was observed grayish black.
- Grating condition was satisfactory.

V-1301 (2ND Desorber):

Bottom Compartment:

- Brownish coloration was observed inside the vessel.
- One clamp of the tray was found loose.
- Nozzle condition was found satisfactory.

Top Compartment:

- Brownish coloration was observed inside the vessel.
- All fasteners and its clamp of the tray were found in good condition.
- Top nozzle was found satisfactory.
- Scaling inside the 4" nozzle at south end was observed.

V-1351 (HYDROLYSER) :

Visual inspection of only top and bottom compartment was carried out.

Top Compartment:

- Top dish end and shell has assumed brownish black coloration and brownish sludge was found sticking on the edge of trays.
- Trays had brownish coloration.
- Fasteners were found intact in position.
- Condition of top tray was found satisfactory.

Bottom Compartment:

- Brownish coloration was observed from inside.
- Fasteners of trays were found intact in position
- Oil layer was observed all around the bottom compartment.
- Three nos. of bolt/nuts of steam inlet flange were found missing/loose.
- Clamping bolt of steam inlet pipe to shell was found loose.

V-1352 (First Desorber):

From Bottom Manhole:

- Brownish coloration was observed inside the vessel.
- One clamp of the tray was found missing.
- 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.
- Water was found leaking from the inlet flange of reflux line.

V-1418 (Pre Evaporator Separator):

- Colouration of the vessel was found grayish at the top and brownish at the bottom dish end.
- Condition of the cone and weld joints were found satisfactory.
- Grayish hard scales were found on the entire surface of tube sheet.
- Grayish hard scaling was observed on inside surface of all the tubes.
- Tube to tube sheet weld appeared to be in satisfactory condition.
- Impingement cone was found in intact condition.
- Water was found on the bottom of the dish end.

V-1423 (1 ST Stage Evaporator Scrubber):

- Brownish coloration was observed inside the vessel.
- Minor damage of the demister pads was observed, also its supporting ring was slightly lifted upward at few locations
- Solidified urea solution particles were found adhered at demister pads at few locations.
- Nut of one no. J Bolt was found missing.

V-1501 (4 ATA STEAM DRUM):

- Coloration of shell and Dish ends was found brownish black.
- Distribution sparger was found intact in position.
- Demister pads were found intact in position and condition of the same was found satisfactory.
- Water was found at bottom of the vessel.
- Condition of all weld joints were found satisfactory.
- Hard scaling was observed at both dished ends.

V-1502 (23 ATA Steam Drum):

- Brownish black coloration was observed inside the vessel.
- All the internal fittings were found in good condition.
- Overall condition was found satisfactory.

V-1503 (9 ATA Steam Drum):

- Coloration of Shell and dished end was observed grayish black for the bottom half where as brownish gray for top half.
- Scattered scales were observed on both the dished ends.
- Undercuts of approx. 0.5 mm depth were observed on the Manhole flange to dished end welding at scattered locations.
- Nut of the south side U-clamp of inlet steam header was found loose.
- Welding of the clit support of BFW line was found cracked and the same was marked for repair.

V-1811 (Ist Stage Separator):

- Demister pads were found intact in position.
- Vortex breaker was found intact in position.
- Overall condition of the vessel was found satisfactory.

V-1812 (IInd STAGE SEPARATOR):

- Demister pads were found intact in position.
- Vortex breaker was found intact in position.
- Overall condition of the vessel was found satisfactory.

V-1813 (IIIrd STAGE SEPARATOR);

As seen from the manhole no abnormality was observed.

Miscellaneous jobs:

- Inspection of damaged prill tower fan.Report and photographs.Detailed report is attached at **Annexure-7.**
- Ultrasonic flaw detection of journal bearing of pinion shaft of K-1801 gearbox to check its bonding.

ANNEXURE-1

UREA PLANT PIPELINE THICKNESS MEASUREMENT SUMMARY OF HP LINES

Sr. No.	Line No	Nom Bore (inch)	Nom Thick (mm)	Line Description		Min Thik. Observed (mm)	% Red
				From	To		
1	CO-2124-8"F10	8	23.01	K-1801-4TH STAGE DISCHARGE	GA-1602-8"-F2	22.80	0.91
		4	13.49			13.0	3.63
		3	11.13			11.7	
2	CO-2122-6"E10	6	10.97	H-1813	V-1813	10.10	7.93
3	CO-2129-8"F10	8	23.01	K-1801,HP CASE-3 RD STAGE DISCHARGE	H-1813	22.40	2.65
4	CO-2140-PP25F-10	4	13.49	CO-F10-2199-PP25	CO-E10-2139-PP25	12.80	5.11
		0.75	5.56	CO-F10-2140-PP25	DRAIN	6.10	
5	GA-1112-F2	6	14.27	K-1101-2	GA-1201	16.00	
		1.5	7.14	BYEPASS LINE		6.60	7.56
		0.75	5.54			6.90	
6	GA-1201X4-6"	6"	13.33	GA-1112-6"-F2	H-1201	14.80	NIL
7	GA-1202-1"-F2	1"	6.35	GA-1112-6"F2	GA-1203-1"-X1	5.70	10.24
8	GA-1203-1"-X1	1"	4.55	GA-1202-1"-F2	HP SCRUBBER	4.00	3.94
9	GA-1204-1"F2	1"	4.55	GA-1202-1"-F2	PR-1231	3.70	18.68
10	GA-1602-F2	8	23.01	K-1801,CO-2124-8"-F10	H-1201,GA-112-6"-F2	21.70	5.69
11	GA-1603-4"-F2	4"	11.13	GA-1602-8"-F2	PIC-1810	11.60	NIL
12	MA-1106/A-4"-E2	4"	8.56	P-1102ADISCH.	MA-1123-4"-E2	8.50	0.70
		1"	4.55			4.70	
13	MA-1106-B-4"-E2	4"	8.56	P-1102-A,MA-1605-6"	MA-1123-4"-E2,MA-1203-4"	7.20	15.89
15	MA-1123-4"-E2	4"	8.56	P-1102B	MA-1605-6"-E2	8.1	5.37
16	MA-1201	3	8.56	P-1102/B	MA-1605-6"	6.200	18.64
		2	5.54			4.80	13.36
17	MA-1202-3"-X4	3"	7.62	MA1201/MA-1605-6"-E2	V-1201	7.30	4.20
18	MA-1203-4"-X4	4"	11.13	MA-1106/B-4"-E2	PR-1230-6"-X1	9.00	19.14
19	MA-1603-C2	6	7.11	MA-1122-6"	MA-1603-4"	6.40	9.99
		4	6.02	MA-1603-4"	P-1102/CSUCT.	4.90	18.60
20	MA-1604	3	7.62	P-1102/CDISH.	MA-1604 -4"	6.20	18.64
		4	8.56	MA-1604-3"	MA-1605-6"	7.00	18.22
		1.5	5.08	MA-1604-3"	MA-1605-6"	3.80	25.20
21	MA-1605-6"-E2	6"	14.27	MA-1123-4"-E2	MA-1106/B-4"-E2	13.30	6.80
22	MA-1607-4"-C2	4"	6.02	MA-1604-4"-E2	MA-1116-4"-E2	5.60	6.98
		0.75	3.91			3.00	23.27
23	MA-1609-4"-C2	4"	6.02	RV OF P-1102C	MA-1503-6"-C2	5.10	15.28
		1.5"	5.08	RV OF P-1102C	REDUCER(1.5"X 1")	4.60	9.45

24	PR-1201-8”-X1	8”	19.58	V-1201	H-1201	12.80	34.62
25	PR-1202-10”-X1	10”	24.33	HP-STRIPPER H-1201	HP-CONDENSER H-1202	21.10	13.28
26	PR-1203-8”-X1	8”	19.58	HP-CONDENSER H-1202	V-1201(VAPOR LINE)	19.0	2.96
27	PR-1204-8”-X1	8”	19.58	HP-CONDENSER H-1202	V-1201(LIQUID LINE)	19.40	0.92
28	PR-1205-8”-X1	8”	19.58	STRIPPER BOTTOM H-1201	V-1202	13.00	33.61
29	PR-1205-6”-X1	6”	15.24	PR-1205-8”	V-1202	12.20	19.95
30	PR-1208-4”-X1	4”	10.40	AUTO CLAVE TOP	PR-1206-4-X1	8.0	23.08
31	PR-1212-4”X1	4”	10.40	SCRUBBER-H1203	AUTO CLAVE BOTTOM	8.70	16.35
32	PR-1213-2”-X4	2”	5.54	PR-1201-8”-X1	PR-1205-6”-X1	6.60	
33	PR-1224-3”-X4	3”	7.62	P-1201-B-(DISCH.)	PR-1638-4”	5.40	29.13
34	PR-1225-3”-X4	3”	7.62	P-1201A/B,PR-1638-4”	H-1203	6.90	9.45
35	PR-1226-2”-X4	2”	5.54	PR-1224-3”-X3	PR-1666-2”-X4A	6.10	
36	PR-1230-6”,X1	6”	15.24	MA-1203-4”-X1	H-1202 HP CONDENSER	15.0	1.7
37	PR-1231-3”-X1	3”	8.12	H-1203 HP SCRUBBER	PRCV-1201,V-1203	7.90	2.71
38	PR-1234-3”-X4	3”	7.62	P-1201-A-(DISCH.)	PR-1638-4”	6.20	18.64

ANNEXURE-2

UREA PLANT PIPELINE THICKNESS MEASUREMENT SUMMARY(OTHER PIPELINES)

Sr. No	Line No	Nom Bore	Nom Thk. (mm)	Line Description		Min Observed thk.(mm)	% Red
				From	To		
1	PR-1354-4"-X7	4	3.05	P-1351A/B	H-1351A/B/C	3.10	
2	PR-1357-6"-X3	6	3.40	V-1352	P-1351A/B	3.80	
3	PR-1404-4"-X3	4	3.05	P-1401	V-1409	2.50	18.03
4	PR-1637-3"-X4A	3	9.14	P-1201/C	PR-1638-4"	9.00	1.53
5	PR-1638-4"-X4A	4"	13.49	P-1201A/B/C, PR-1637-3"-X4A	PR-1230-6"	12.20	9.561
6	PR-1666-2"-X4A	2"	5.54	PR-1367-3"-X4A	PR-1226-2"-X4	6.50	
7	PW-1601-4"-B1	4"	6.02	PW-1352	H-1303	5.70	5.32
8	PW-1602-4"-B1	4	6.02	H-1303	PW-1354	5.30	11.96
9	PW-1603-4"-B1	4	6.02	PW-1352	T-1301/A	5.20	13.62
10	PW-1604-2"-B6	2	2.77	DW-4302	2"- WN1(HITACHI SCOPE)	3.00	
11	SC-1102-14"-B1	14	9.53	SC-1228	SC-1101	9.10	4.46
12	SC-1210-8"-C2	8	8.18	P-1204	SC-1210-10"-C2	9.00	
13	SC-1210-10"-C2	10	9.27	SC-1210-8"-C2	H-1207	8.80	5.07
14	SC-1216-4"-B4	4	6.02	LICV-1204	SC-1407	4.80	20.27
15	SC-1216-2"-B4	2	3.91	V-1204	LICV-1204	4.40	
16	SC-1501-4"-B4	4	6.02	T-1501	P-1501 & P-1506	4.70	21.93
17	SC-1505-6"-B4	6	7.11	V-1503	T-1501	7.00	1.55
18	SC-1512-4"C1	4	6.02	SC-1213	LCV-1501	5.20	13.62
19	SC-1523-3"B4	3	5.49	HEADER	SC-1409-4"-B4	4.00	27.14
20	SC-1601-10"-C2	10	9.27	SC-1211	H-1418	8.20	11.54
21	SC-1602-2"-B4	2	3.91	SC-1603	PR-1616	2.90	25.83
22	SC-1604-1"-B4	1	4.55	SC-1411	PR-1663	4.20	7.69
23	SC-1605-1.5"-B4	1.5	5.08	H-1418/A	SC-1407	4.70	7.48
24	SC-1606-10"-C2	10	9.27	H-1418	SC-1211	9.20	0.76
25	SC-1607-1"-B4	1	4.55	SC-1226	PR-1636	3.10	31.87
26	SC-1610-4"-B4	4	6.02	ST-5152(EXISTING)	HITACHI BATT.LMT	5.50	8.64
27	SC-1617-0.5-B4	0.5	3.73	DISCH.DAMPNER	SC-1609	3.70	0.80
28	ST-1123-14"	14	9.53	PICV-1129	ST-1106	10.20	
29	ST-1205-6"-C1	6	7.11	V-1502	H-1201	6.50	8.58
30	ST-1206-8"-B4	8	8.20	ST-1506-16"-B4	H-1204	7.80	4.88
31	ST-1502-2"-B4	2	5.54	ST-1502-8"	PICV-1502A	4.60	16.97
32	ST-1502-8"-C1	8	8.18	ST-1116	ST-1503-12"	8.50	
33	ST-1502-3"-B4	3	7.62	PICV-1502A	ST-1502-12"	5.90	22.57
34	ST-1603-8"-B4	8	8.18	ST-1506-18"-B4	H-1418/A	8.10	0.98
35	ST-1606-12"-E3	12	17.48	60 ATA HEADER	HITACHI BATTERY LMT	17.30	1.08
36	ST-1607-12"-C1	12	9.52	HITACHI BATTERY LMT	23 ATA HEADER	9.00	5.46
37	ST-1608-16"-B4	16	9.53	ST-1128(EXISTING)	HITACHI BATTERY LMT	9.60	
38	ST-1612-12"-C1	12	9.53	ST-1607	ST-1181	8.90	6.61
39	ST-1618-0.5-B4	0.5	3.73	ST-1611	VOL-BOT,P-1201/C		
40	MA-1119-1"-B2	1	4.55	FS-1101,VAPOR ELIMINATOR	MA-1110-1"-B2	3.90	14.29

Annexure - 3

THICKNESS MEASUREMENT OF EQUIPMENT DURING S/D-2007

Sr. No.	Equip. No.	Equip. Description	Shell			Dish End			Channel		
			Nom./ Design	Min./ Measured	% Red.	Nom./ Design	Min./ Measured	Red	Nom./ Design	Min./ Measured	Red.
1	T-1501	STEAM COND. TANK	10.0	9.8		10.00	10.0				
2	T-1418	MAIN LO TANK	06.0	5.8							
3	V-1813	3RD STAGE EVAPORATOR	30.0	29.3		30.00	28.4				
4	V-1812	2ND STAGE EVAPORATOR	10.0	9.8		12.0	11.4				
5	V-1811	1ST STAGE EVAPORATOR	6.0	6.0		6.0	5.9				
6	V-1418	PRE-EVAPORATOR	12.0	12.0		12.0	10.2				
7	V-1409/A	UREA SOLUTION FILTER	6.0	6.5							
8	V-1409/B	UREA SOLUTION FILTER	6.0	6.4							
9	V-1406	FLASH DRUM	8.0	8.4							
10	V-1353	LEVEL TANK FOR REFLUX CONDENSER	6.0	5.8		6.0	6.0				
11	V-1202	RECTIFYING COLUMN	9.0	9.7		11.0	11.5				
12	V-1103	NH3 SUCTION VESSEL	21.0	20.4							
13	V-1102	AMMONIA FOLTER	11.0	10.8							
14	V-1101	CO2 K.O DRUM	10.0	8.8							
15	H-1815	SURFACE CONDENSER		14.4							
16	H-1812	2ND STAGE GAS COOLER	10.0	9.8		12.0	11.1				
17	H-1811	1ST STAGE GAS COOLER	12.0	11.9		12.0	10.7				
18	H-1426	2ND STAGE EVAPORATOR 2ND CONDENSER	7.0	7.7		9.0	8.9				

19	H-1425	2ND STAGE EVAPORATOR 1ST CONDENSER	12.0	13.4			18.3				
20	H-1424	2ND STAGE EVAPORATOR	10.0	11.6		12.0	10.8				
21	H-1423	1ST STAGE EVAPORATOR	8.0	10.8		10.0	13.0				
22	H-1421	FLASH TANK CONDENSER	8.0	7.6		11.0	11.6				
23	H-1207	CCS-II COOLER	10.0	9.9		10	7.8				
24	H-1204	RECIRCULATIO N HEATER	11.0	11.0		9.0	9.2				
25	H-1102	LP NH3 PREHEATER		9.4							
26	H-1813	3RD STAGE GAS COOLER	10.0	9.6		10.0	9.2				

Annexure- 4

GAUSS MEASUREMENT & DEMAGNETIZATION REPORT

Sr. No.	Component Description	Max. gauss reading	
		Before	After
K-1801,CO2 COMPRESSOR			
1	**Turbine South Bearing**		
1.1	Journal bearing shaft	1.5	
1.2	Journal bearing pads	0.7	
1.3	Journal bearing base ring	1.3	
1.4	Thrust bearing base ring	1.6	
1.5	Thrust collar	1.2	
1.6	Thrust pads	1.4	
2	**Turbine North Bearing**		
2.1	Journal bearing shaft	**20**	**0.9**
2.2	Journal bearing pads	**4.5**	**0.9**
2.3	Journal bearing base ring	**5.2**	**1.8**
3	**H P Case South Bearing**		
3.1	Journal Bearing Shaft	2.2	
3.2	Bearing Pads	2.2	
3.3	Bearing base ring	**12**	**2.1**
4	**H P Case North Bearing**		
4.1	Journal Bearing Shaft	1.8	
4.2	Journal Thrust Collar	1.8	
4.3	Thrust Pads	**3.8**	**0.6**
4.4	Journal Bearing Pads	**5.2**	**1.2**
4.5	Journal Bearing Base Ring	**15**	**3.0**
5	**L P Case South Bearing**		
5.1	Journal Shaft Portion	2.0	
5.2	Journal Bearing Pads	**6.3**	**0.6**
5.3	Journal Bearing Base Ring	2.3	
6	**LP Case North Bearing**		
6.1	Journal shaft Portion	2.0	
6.2	Journal Bearing Pads	**6.3**	**1.0**
6.3	Journal Bearing Base Ring	1.0	
6.4	Thrust Collar	**5.2**	**3.0**
6.5	Thrust Pads	**16**	**2.0**
7	**Gear Box**		
7.1	High Speed Pinion Shaft	2.9	
7.2	Pinion Shaft Bearing	**4.6**	**2.3**
7.3	Low Speed Pinion Shaft	0.9	
7.4	Gear Bearing	**10.2**	**2.8**
7.5	Sleeve bearing	**7.9**	**2.0**

ANNEXURE-5

Report of Magnetization of 60 ata steam pipeline (From BHEL Boiler to P.B. Compressor Turbine)weld joints and its repair work

(1) Bevel edges of weld joints W2 and W3 were found to be heavily magnetized leading to difficulty in welding.

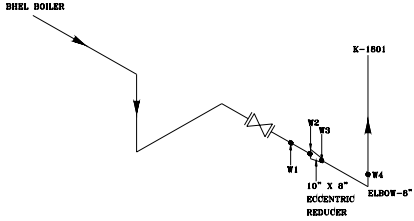
(2) Gauss measurement was carried out on the bevel edges of W1 and W3 and was found to be around 200 gauss.

(3) Degaussing was carried out with coil method & electromagnet Yoke method and was reduced to 28 - 30 gauss.

(4) As further degaussing could not be achieved, root and hot pass welding was done with E-6013 electrode. DPT and root radiography was carried out.

(5) Final fillup was carried out with E-7018. DPT and radiography of final weld was carried out.

(6) Welding was carried out using AC transformer.



LEGEND: W1,W2,W3,W4 –BUTT WELD JOINTS

NOTE: Modification of pipeline from Weld joint W1 to W4 Carried out for isolation of PB compressor Steam Turbine

ANNEXURE-6

DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

SR.NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
1.	Location: 1 (Parent Metal) **HP STRIPPER H-1201** Stub end gas outlet top side	Carbon Steel	Microstructure shows fine gained ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 108 & 109)	IInd stage of creep degradations. Monitor after 1 year of service.
2.	Location: 2 (Weld/Haz) **HP STRIPPER H-1201** Stub end gas outlet top side	2RE69	Microstructure at weld shows fine dendritic structure of austenite solid solution with carbide precipitations at inter dendritic regions, where as at parent metal microstructure shows coarse austenite grains without any carbide precipitants. (Plate: 110 & 111)	No significant degradations. During next available opportunity internal inspection of welding is recommended.
3.	Location: 3 (Parent Metal) **HP STRIPPER H-1201** Stub end Liquid inlet top side	Carbon Steel	Microstructure shows ferrite and pearlite structure, in situ spheroidzation of pearlite is observed. Indications of creep cavities are observed. (Plate: 112 & 113)	Monitor after one year of service.
4.	Location: 4 (Weld/Haz) **HP STRIPPER H-1201** Stub end Liquid inlet top side	2RE69	Microstructure at weld shows fine dendritic structure of austenite solid solution with carbide precipitations at inter dendritic regions, where as at parent metal microstructure shows coarse austenite grains without any carbide precipitants (Plate: 116 & 117)	No significant degradations. During next available opportunity internal inspection of welding is recommended.
5.	Location: 5 (Parent Metal) **HP STRIPPER H-1201** Stub end gas Inlet bottom side	Carbon Steel	Microstructure shows fine gained ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 118 & 119)	IInd stage of creep degradations. Monitor after 1 year of service.
6.	Location: 6 (Weld/Haz) **HP STRIPPER H-1201** Stub end gas Inlet bottom side	2RE69	Microstructure at weld shows fine dendritic structure of austenite solid solution with carbide precipitations at inter dendritic regions, where as at parent metal microstructure shows coarse austenite grains with few carbide precipitants (Plate: 120 & 121)	No significant degradations. During next available opportunity internal inspection of welding is recommended.
7.	Location: 7 (Parent Metal) **HP STRIPPER H-1201** Stub end Liquid outlet bottom side	Carbon Steel	Microstructure shows fine gained ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 122 & 123)	IInd stage of creep degradations. Monitor after 1 year of service.

SR.NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
8.	Location: 8 (Weld/Haz) **HP STRIPPER H-1201** Stub end Liquid outlet bottom side	2RE69	Microstructure at weld shows fine dendritic structure of austenite solid solution with carbide precipitations at inter dendritic regions, where as at parent metal microstructure shows coarse austenite grains with few carbide precipitants (Plate: 126 & 127)	No significant degradations. During next available opportunity internal inspection of welding is recommended.
9.	Location: 9 (Parent Metal) **HP CONDENSER H-1202** Stub end Liquid outlet bottom side	Carbon Steel	Microstructure fine grained relativity uniform ferrite and pearlite structure with few widmanstaten ferrite structures. In situ spheroidzation of pearlite is observed. (Plate: 128 & 129)	Monitor after 2 years of service
10.	Location: 10 (Weld/Haz) **HP CONDENSER H-1202** Stub end Liquid outlet bottom side	SS 316	Microstructure at weld shows fine dendritic structure of ferrite pools in austenite solid solution with carbide precipitations at inter dendritic regions, where as at parent metal microstructure shows coarse austenite grains without any carbide precipitants (Plate: 130 & 131)	No significant degradations. During next available opportunity internal inspection of welding is recommended.
11.	Location: 11 (Parent Metal) **HP CONDENSER H-1202** Stub end Gas outlet bottom side	Carbon Steel	Microstructure shows fine gained ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 132 & 133)	IInd stage of creep degradations. Monitor after 1 year of service.
12.	Location: 12 (Weld/Haz) **HP CONDENSER H-1202** Stub end Gas outlet bottom side	SS 316	Microstructure at weld shows fine dendritic structure of ferrite pools in austenite solid solution with carbide precipitations at inter dendritic regions, where as at parent metal microstructure shows coarse austenite grains without any carbide precipitants.(Plate: 134 & 135)	No significant degradations. During next available opportunity internal inspection of welding is recommended.

SR.NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
13.	Location: 13 (Parent Metal) **HP CONDENSER H-1202** Stub end Liquid Inlet top side	Carbon Steel	Microstructure fine grained relativity uniform ferrite and pearlite structure with few widmanstaten ferrite structures. In situ spheroidzation of pearlite is observed. (Plate: 136 & 137)	Monitor after 2 years of service.
14.	Location: 14 (Weld/Haz) **HP CONDENSER H-1202** Stub end Liquid Inlet top side	SS 316	Microstructure at weld shows fine dendritic structure of austenite solid solution without carbide precipitations, where as at parent metal microstructure shows coarse austenite grains without any carbide precipitants (Plate: 138 & 139)	No significant degradations.
15.	Location: 15 (Parent Metal) **HP CONDENSER H-1202** Stub end Gas Inlet top side	Carbon Steel	Microstructure fine grained relativity uniform ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 140 & 141)	IInd stage of creep degradations. Monitor after 2 year of service.
16.	Location: 16 (Weld/Haz) **HP CONDENSER H-1202** Stub end Gas Inlet top side	SS 316	Microstructure at weld shows fine dendritic structure of ferrite pools in austenite solid solution with carbide precipitations at inter dendritic regions, where as at parent metal microstructure shows coarse austenite grains without any carbide precipitants.(Plate: 142 & 143)	No significant degradations. During next available opportunity internal inspection of welding is recommended.
17.	Location: 17 (Parent Metal) **H-1203** Stub end Liquid outlet top side	Carbon Steel	Microstructure shows fine gained ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 144 & 145)	IInd stage of creep degradations. Monitor after 2 year of service.
18.	Location: 18 (Weld/Haz) **H-1203** Stub end Liquid outlet top side	SS 316	Microstructure at weld shows fine dendritic structure of ferrite pools in austenite solid solution without carbide precipitations, where as at parent metal microstructure shows coarse austenite grains without any carbide precipitants (Plate: 146 & 147)	No significant degradation observed. Monitor after 2 years of service.
19.	Location: 19 (Parent Metal) **H-1203** Stub end Liquid Inlet top side	Carbon Steel	Microstructure shows fine gained ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 148 & 149)	IInd stage of creep degradations. Monitor after 2 year of service.

SR.NO.	LOCATION	MOC	MICROSTRUCTURE OBSERVATION	REMARK
21.	Location: 21 (Parent Metal) **H-1203** Stub end Gas Inlet bottom side	Carbon Steel	Microstructure shows fine gained banded ferrite and pearlite structure. In situ spheroidzation of pearlite is observed.(Plate: 152 & 153)	IInd stage of creep degradations. Monitor after 2 year of service.
22.	Location: 22 (Weld/Haz) **H-1203** Stub end Gas Inlet bottom side	SS 316	Microstructure at weld shows fine dendritic structure of ferrite pools in austenite solid solution with carbide precipitations at inter dendritic regions, where as at parent metal microstructure shows coarse austenite grains without any carbide precipitants. (Plate: 154 & 155)	No significant degradations. During next available opportunity internal inspection of welding is recommended.
23.	Location: 23 (Parent Metal) **H-1203** Stub end Gas outlet bottom side	Carbon Steel	Microstructure shows fine gained ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 156 & 157)	IInd stage of creep degradations. Monitor after 2 year of service.
24.	Location: 24 (Weld/Haz) **H-1203** Stub end Gas outlet bottom side	Carbon Steel	Microstructure shows fine gained ferrite and pearlite structure. In situ spheroidzation of pearlite is observed. (Plate: 158 & 159)	IInd stage of creep degradations. Monitor after 2 year of service.

ANNEXURE-7

Inspection Report of damaged Prill tower fan(K-1401/1)

(a) All the 9 nos blades of fan observed to have been severely damaged/blades broken on the non-cutting side edges. Photograph of damaged fan attached below.

(b) 3 nos Nut/bolts fastened on the drilled holes for balancing purpose found bent and 2 nos were intact in position.

Prill Tower fans 2,3 and 4 found in satisfactory condition.

OFFSITES & UTILITY PLANT

During Shutdown 2007, the following major inspection activities were performed in Utility Plant.

- Inspection of BHEL boiler drums and furnace tubes.
- Re-examination of Primary & Secondary Super heater tubes by M/S Thermax, Pune.
- Inspection of deaerator.
- Inspection of RAH
- Inspection of Cooling Towers structures.

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.

1.0 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 all accessible tubes, steam drum, mud drum and super heater tubes was carried out. The following observations were made during visual examination.

STEAM DRUM:

- The internal surface of the drum had assumed blackish brown coloration.
- All the weld joints were found in good condition and free from any corrosion attack.
- One no. angle support nut of distribution pipe (3rd counting from West side) found loose.
- One no fastener of bottom plate just opposite 4th C clamp was found missing. Overall condition of the steam drum was found to be satisfactory.

- Ultrasonic thickness measurement was carried out. Min. thickness was observed to be 102.9 mm against nominal specified thickness of 97 mm in cylindrical shell area and 83.2 mm on dished end against nominal specified thickness of 77 mm.

  Detailed report is attached at **Annexure- 1**

MUD DRUM:

- The shell had assumed blackish brown coloration.
- The condition of the weld joints was found satisfactory.

The tube stub ends were free from any defect.

In general, the overall condition of the mud drum was found satisfactory.

Ultrasonic thickness measurement was carried out. Min. thickness was observed to be 82.2 mm in cylindrical shell area against nominal specified thickness of 78 mm and 58.4 mm on dished end against nominal specified thickness of 57 mm. Detailed report is attached at **Annexure - 2**

DEAERATOR:

Inspection of the deaerator head and the storage shell was carried out. Observations are as under.

Deaerator Head :

- Two nos. spring loaded safety valve located on the top observed to have leakage from "O" ring.

- 5th sieve trays(counting from bottom) was found lifted dislocated from its position and crack was also observed at the north corner of its East side segment.

Deaerator Storage Shell :

- Brownish coloration was observed inside the shell.
- Condition of the weld joint was found satisfactory.
- One no. nipple was found fallen inside the shell.

Regenerative Air heater (RAH):

- Cold End : All the buckets were found to have many loose/displaced fins.
- Hot End : All the buckets were found intact in position.

FURNACE TUBES:

In general, the condition of the furnace tubes and super heater tubes exposed to flue gases was satisfactory. The thickness measurement of Stage-I & Stage-II Primary and Secondary Super heater tubes, Bank tubes, Sidewall tubes, Baffle wall tubes, D-Panel tubes, Cut corner tubes, Rear wall tubes and Front wall tubes was carried out. Two nos. tubes sample from primary & secondary super heater tubes was taken for lab analysis purpose for re-examination by M/S Thermax, Pune and new piece of tube welded at these locations, weldjoints of the same were inspected by DP test and radiography and were found satisfactory. Thickness measurement of 1"NB vent line at Primary super heater outlet header was carried out & the same was found to be 2.43 mm against the nominal thickness of 4.55 mm, replacement of the same was suggested. The Summary indicating the thickness of individual type of the tubes is given below:

SR, NO.	DESCRIPTION	MIN. THK. (MM)	DESIGN THK.(MM)	%RED	REFER ANNEXURE
1	**SOUTH MANHOLE:**				
(A)	BAFFLE WALL TUBES	4.4	4.5	2.22	**Annexure - 3,7**
(B)	D-PANEL TUBES	4.8	4.5	-	**Annexure - 3,7**
(C)	CUT CORNER TUBES	5.0	4.5	-	**Annexure - 3,7**
(D)	REAR WALL TUBES	5.0	4.5	-	**Annexure - 3,7**
(E)	FRONT WALL TUBES	4.2	4.5	6.66	**Annexure - 3,7**
2	**NORTH MANHOLE:**				
(A)	BANK TUBES	3.5	3.6	2.78	**Annexure - 4,7**
(B)	BAFFLE TUBES	4.4	4.5	2.22	**Annexure - 4,7**
(C)	NORTH SIDE WALL TUBES	5.0	4.5		**Annexure - 4,7**
3	PRIMARY SUPERHEATER TUBES INSIDE FURNACE(STAGE-I)	6.1	7.1	14.08	**Annexure - 5,7**
4	SECONDARY SUPERHEATER TUBES INSIDE FURNACE (STAGE-II)	5.2	5.6	7.14	**Annexure - 6,7**

2.0 General Manager IFFCO Kalol unit had constituted a committee for detailed health study of cooling towers at IFFCO Kalol Unit. The detailed observations of the same are summarized below.

Committee has inspected the following cooling towers

- **H-4401** (6 cells for Ammonia plant, i.e. A-1 to A-06)
- **H-4402** (3 cells for Urea plant, i.e. U-1 to U-3)
- **H-4403** (2 cells for Ammonia plant, i.e. A-7,A-8)
- **H-4404** (3 cells for Ammonia/Urea plant, i.e. New Cooling Tower, NT-1 to NT-3)

Major thrust of inspection was given on the following areas.

- Exterior wooden structures.
- Interior wooden structures.
- Exterior steel structures.
- CT Return risers and distributor headers.
- Concrete structure

Exterior wooden structures:

Sr.No.	Item	Satisfactory	Repair/ Replace
H-4401	**(6 cells for Ammonia plant)**		
1	Endwell casing & access doors	√	
2	Stairway	√	
3	Fan Deck	√	
4	Fan Deck railing/supports	√	
5	Ladders	√	
6	Distribution deck	√	
7	Distribution deck covers	√	
8	Louvers	x	Louvers are cracked / damaged at several locations. It is recommended to replace the louvers by FRP material.
H-4402	**(3 cells for Urea plant)**		
1	End wall casing & access doors	√	
2	Stairway	√	
3	Fan Deck	√	
4	Fan Deck railing/supports	√	
5	Ladders	√	
6	Distribution deck	√	
7	Distribution deck covers	√	
8	Louvers	x	Louvers are cracked/ damaged at several locations. It is recommended to replace the louvers by FRP material.
H-4403	**(2 cells for Ammonia plant, i.e. A-7,8)**		
1	End wall casing & access doors	x	Cracked at many places. Both the end walls need replacement by FRP material.
2	Stairway	√	
3	Fan Deck	√	
4	Fan Deck railing/supports	√	
5	Ladders	√	
6	Distribution deck	√	
7	Distribution deck covers	√	
8	Louvers	x	Louvers are cracked/damaged at several locations. It is recommended to replace the louvers by FRP material.

H-4404	(3 cells for Urea Plant, i.e. New Cooling Tower)		
1	End wall casing & access doors	√	
2	Stairway	√	
3	Fan Deck	x	Deck wooden flooring TG planks has started deterioration & needs replacement within 1-2 years.
4	Fan Deck railing/supports	√	
5	Ladders	√	
6	Distribution deck	√	
7	Distribution deck covers	√	
8	Louvers	x	Louvers are cracked/damaged at several locations. It is recommended to replace the louvers by FRP material.

Interior wooden structures (Plenum area and distribution area)

Sr.No.	Item	Satisfactory	Repair/ Replace
H-4401	**(6 cells for Ammonia plant)**		
1	Load bearing Columns	√	
2	Diagonals	√	
3	Partition and doors	√	
4	Drift eliminators	√	
5	Walkway	√	
6	Long rails	x	CS fastening bolts/nuts of lap joints of joining members has got corroded at several places.
H-4402	**(3 cells for Urea plant)**		
1	Load bearing Columns	√	
2	Diagonals	√	
3	Partitions and doors	x	Partition wall wooden planks are dislocated at several places.
4	Drift eliminators	√	
5	Walkway	√	
6	Long rails	√	
H-4403	**(2 cells for Ammonia plant, i.e. A-7,A-8)**		
1	Load bearing Columns	√	
2	Diagonals	√	
3	Partitions and doors	√	
4	Drift eliminators	√	
5	Walkway	√	
6	Long rails	x	CS fastening bolts/nuts of lap joints of joining members has got corroded at several places.
H-4404	**(3 cells for Urea plant, i.e. New Cooling Tower)**		
1	Load bearing Columns	X	One column of cell no.1 and one column in cell no. 2 has got bent.
2	Diagonals	√	
3	Partitions and doors	√	
4	Drift eliminators	x	At few locations drift eliminators has got dislocated/removed from its place.
5	Walkway	√	
6	Long rails	√	

Exterior steel structures:

Sr. No.	Item	Satisfactory	Repair/ Replace
H-4401 (6 cells for Ammonia plant)			
1	Steel structures a) Pipes supports b) Cable trays c) Ladders and hand railings d) Connecting platform for H-4403	X	At few places corrosion is observed and repair / replacement / painting is required.
H-4402 (3 cells for Urea plant)			
1	Steel structures a) Pipes supports b) Cable trays c) Ladders and hand railings	X	At few places corrosion is observed and repair/ replacement /painting is required.
H-4403 (2 cells for Ammonia plant, i.e. A-7,A-8)			
1	Steel structures a) Pipes supports b) Cable trays c) Ladders and hand railings Connecting platform for H-4403	X	At few places corrosion is observed and repair/ replacement/painting is required
H-4404 (3 cells for Urea plant, i.e. New Cooling Tower)			
1	Steel structures a) Pipes supports b) Cable trays c) Ladders and hand railings	X	At few places corrosion is observed and repair/ replacement/painting is required

CW Return risers and distribution headers:

Sr. No.	Item	Satisfactory	Repair/ Replace
H-4401 (6 cells for Ammonia plant)			
1	Return Risers	√	
2	Horizontal distribution headers	√	
H-4402 (3 cells for Urea plant)			
1	Return Risers	√	
2	Horizontal distribution headers	√	
H-4403 (2 cells for Ammonia plant, i.e. A-7,A-8)			
1	Return Risers	√	
2	Horizontal distribution headers	√	
H-4404 (3 cells for Urea plant, i.e. New Cooling Tower)			
1	Return Risers	√	
2	Horizontal distribution headers	√	

Concrete structure:

Sr. No.	Item	Satisfactory	Repair/ Replace
H-4401 (6 cells for Ammonia plant)			
1	Inside basin	√	
2	Outside basin	√	
H-4402 (3 cells for Urea plant)			
1	Inside basin	√	
2	Outside basin	√	
H-4403 (2 cells for Ammonia plant, i.e. A-7,A-8)			
1	Inside basin	√	
2	Outside basin	√	
H-4404 (3 cells for Urea plant, i.e. New Cooling Tower)			
1	Inside basin	√	
2	Outside basin	√	

3.0 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.

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 by all contractors as well as departmentally wherever required.

HARDNESS MEASUREMENT:

Measured the core hardness of pinion shaft for gear box of C.W. Pump, P-4403 and found to be 286 to 320 BHN.

ANNEXURE -1

THICKNESS MEASUREMENT REPORT OF STEAM DRUM

SHELL	Design Thickness : 97 mm			
POINT NO.	TOP	BOTTOM	NORTH	SOUTH
(W to E)				
1	103.6	104.5	104.4	104.8
2	-	-	104.7	105.3
3	-	-	104.5	104.3
4		-	104.2	104.3
5	-	-	104	104.4
6	102.9	105.3	103.6	104.7
DISH END:	Design Thickness : 77 mm			
POINT NO.	TOP	BOTTOM	NORTH	SOUTH
East	83.2	83.5	83.3	83.2
West	83.3	83.2	83.7	83.3

ANNEXURE -2

THICKNESS MEASUREMENT REPORT OF MUD DRUM

SHELL:	Design Thickness : 78 mm			
POINT NO.	TOP	BOTTOM	NORTH	SOUTH
(W to E)				
1	82.7	82.8	82.8	82.2
2	82.5	82.8	82.9	82.7
3	83.1	83.1	83.0	82.9
4	83.0	83.6	82.9	83.2
5	83.1	83.2	83.0	83.2
6	82.7	83.3	82.9	83.3
DISH END	Design Thickness : 57 mm			
POINT NO.	TOP	BOTTOM	NORTH	SOUTH
East	58.4	58.9	59.1	59.1
West	59.3	58.6	59.3	59.2

ANNEXURE -3

THICKNESS MEASUREMENT REPORT OF D-PANELTUBES ,CUT CORNER TUBES, REAR WALL TUBES, FRONT WALL TUBES AND BAFFLE WALL TUBES:

D-PANEL TUBES			FRONT WALL TUBES:		
TUBE NO.	**TOP**	**BOTTOM**	**SL. NO.**	**TOP**	**BOTTOM**
1	5.2	5.3	1	5.0	5.1
8	5.2	5.2	7	5.0	5.1
14	5.0	5.0	13	5.0	4.9
20	5.1	5.2	21	5.0	5.1
26	4.9	5.0	29	4.2	4.5
32	5.0	5.1	35	5.1	5.1
48	5.1	5.1	41	5.2	5.0
44	5.0	5.1	44	5.2	5.4
50	5.1	5.0	**BAFFLE WALL TUBES:**		
56	5.0	4.9	**SR. NO.**	**TOP**	**BOTTOM**
62	5.1	5.3	1	5.2	5.2
68	4.9	5.1	8	5.1	5.2
72	5.3	5.4	14	4.8	4.8
			21	4.5	4.5
			27	4.8	4.8
CUT CORNER TUBES:			35	4.6	4.6
TUBE NO.	**TOP**	**BOTTOM**	43	4.5	4.4
73	5.1	5.1	50	4.8	4.8
80	5.1	5.3	55	4.9	4.9
86	5.2	5.3	62	4.7	4.8
92	5.1	5.1			
98	5.0	5.0			
105	5.3	5.2			
REAR WALL TUBES:					
TUBE NO.	**TOP**	**BOTTOM**			
106	5.0	5.0			
113	5.3	5.5			
116	5.2	5.4			

Note : 1. All readings are in MM
2. Refer annexure-7 showing tube layout & numbers identifying the individual tubes.
3. Design thickness of tubes : 4.5 mm

ANNEXURE -4

THICKNESS MEASUREMENT REPORT OF BANK TUBES, BAFFLE WALL TUBES AND SIDE WALL TUBES:

BANK TUBES "A" WALL(Design Thickness : 3.6 mm)		
TUBE NO.	**TOP**	**BOTTOM**
2	3.5	3.9
7	3.8	3.7
12	3.6	3.7
BANK TUBES "B" WALL(Design Thickness : 3.6 mm)		
TUBE NO.	**TOP**	**BOTTOM**
17	3.5	3.6
BANK TUBES "C" WALL(Design Thickness : 3.6 mm)		
TUBE NO.	**TOP**	**BOTTOM**
22	3.9	3.5
23	3.6	3.5
BAFFLE ("D") WALL TUBES (Design Thickness : 4.5 mm)		
TUBE NO.	**TOP**	**BOTTOM**
32	5.2	5.1
37	5.1	5.2
42	5.2	5.1
NORTH SIDE WALL TUBES: (Design Thickness : 4.5 mm)		
TUBE NO.	**TOP**	**BOTTOM**
2	5.0	5.2
7	5.2	5.5
12	5.5	5.0
17	5.1	5.0

Note : 1. All readings are in MM
2. Refer annexure-7 showing tube layout & numbers identifying the individual tubes.

ANNEXURE -5

THICKNESS MEASUREMENT REPORT OF PRIMARY SUPERHEATER TUBES (STAGE-1):

BEND-A	
TUBE NO.	**Minimum Measured Thickness**
3	6.1
9	6.7
13	7.0
16	6.8
19	6.9
22	6.5
29	7.0
33	6.9
36	7.1
BEND-B	
TUBE NO.	**Minimum Measured Thickness**
3	7.1
9	7.2
15	7.3
21	7.3
27	7.0
33	7.3
39	7.3
BEND-C	
TUBE NO.	**Minimum Measured Thickness**
3	6.3
9	6.3
15	6.5
21	6.6
27	6.6
33	6.8
39	6.7
BEND-D	
TUBE NO.	**Minimum Measured Thickness**
3	7.2
9	6.2
15	6.7
21	6.8
27	6.8
33	6.5
39	6.2

Note : 1. All readings are in MM
2. Refer annexure-7 showing tube layout & numbers identifying the individual tubes.
3. Design thickness of tubes : 7.1 mm

ANNEXURE -6

THICKNESS MEASUREMENT REPORT OF SECONDARY SUPERHEATER TUBES (STAGE-2):

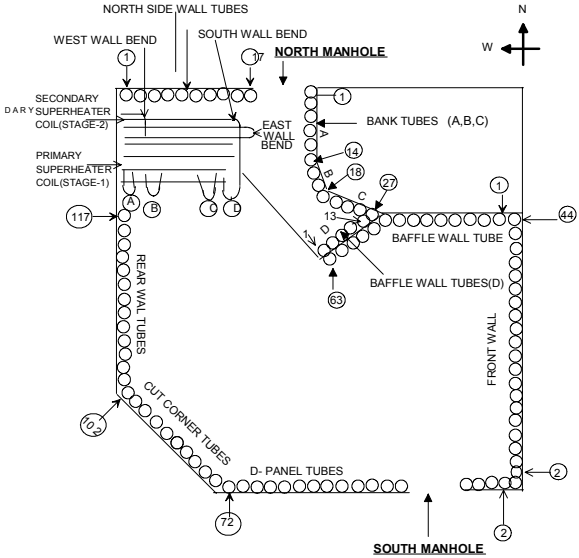
WEST WALL BEND	
TUBE NO.	**Minimum Measured Thickness**
1	5.6
7	5.6
13	5.6
19	5.5
23	5.6
29	5.7
SOUTH WALL BEND	
TUBE NO.	**Minimum Measured Thickness**
1	5.3
7	5.4
13	5.5
19	5.4
25	5.5
31	5.7
37	5.5
EAST WALL BEND	
TUBE NO.	**Minimum Measured Thickness**
1	5.9
7	5.2
13	5.4
19	5.4
25	5.2
31	5.4
1	5.9

Note : 1. All readings are in MM.

2. Refer annexure-7 showing tube layout & numbers identifying the individual tubes.

3. Design thickness of tubes : 5.6 mm

ANNEXURE-7



BHEL BOILER FURNACE LAYOUT
(GT-2068)

Control valve : Maintenance jobs

FRCV- 1 : C/V diaphragm was opened and checked, C/V bottom flange was opened and cleaned. General cleaning was done in positioner. C/V stroke was checked.

FRCV-2 : Replaced all gland packing. Actuator diaphragm was opened and checked, found ok. Finally checked stroke.

FRCV-3 : C/V bottom flange was opened and cleaned trim part & refixed. Actuator diaphragm was opened and checked found ok, same was refixed. All parts were cleaned and overhauled. General cleaning of valve positioner was done. Replaced gland packing. C/V stroke was checked.

ARCV-3 : C/V was opened from bonnet. Plug and seat taken out for inspection did machining on plug. All parts were cleaned and overhauled & checked it for tight shut off on test bench. Provided new gland packing and stroke was checked.

PICV-14 : C/V was opened from bonnet. Inspected Plug and seat. All parts were cleaned, overhauled and assembled checked it for tight shut off on test bench. Serration work on flange was carried out. Provided new gland packing & gaskets, finally C/V stroke was checked.

FiCV-485: C/V was opened from bonnet. Inspected Plug and seat & machining were done on plug/seat & Cage.Lapping was carried out & checked it for tight shutoff on test bench. Finally reinstalled & checked stroke.

LCV-490: C/V was opened from bonnet. Inspected Plug and seat & machining were done on plug/seat & checked it for tight shutoff on test bench. Finally reinstalled & checked stroke.

PICV-181: Control valve was opened from line. Replaced bonnet & Line gaskets to attend leakage. General cleaning was carried out & finally checked stroke online.

LCV-21: Control valve was opened from line. Inspected plug/seat ,machining carried out & tight shutoff was checked on test bench. General cleaning was carried out & finally checked stroke online.

MICV 1A TO 9A : General cleaning & checking was carried out & finally checked the stroke.

MICV 1 TO 9 : General cleaning & checking was carried out & finally checked the stroke. Replaced the diaphragm of MICV-1.

MICV 24 TO 32 : General cleaning & checking was carried out & finally checked the stroke.

MICV- 32 : C/V was opened from line flanges. Diaphragm was opened and checked and replaced and refixed. Plug and seat were machined and lapped . All parts were cleaned, overhauled & assembled and stroke was checked.

LCV-105 : Control valve was opened from line, all parts were cleaned and overhauled. C/V assembled & reinstalled and finally stroke was checked.

LCV-103 : Control valve was opened from line. All parts were cleaned and overhauled. C/V assembled & reinstalled and finally stroke was checked.

FRCV-5 - Actuator diaphragm was opened and checked. Provided new gland packing. & stroke was checked. Modified the feedback lever & provided new positioner of Masoneilan make.

LCV-16 : General cleaning was carried out & provided new gland packing & checked stroke.

LCV-18 : General cleaning was carried out & provided new gland packing & checked stroke.

LCV-19 : General cleaning was carried out & provided new gland packing. & checked stroke.

TRCV-142 : General cleaning was carried out & provided new gland packing & checked stroke.

TRCV- 10 : C/V diaphragm was opened and replaced by new one. General cleaning was done in positioner. C/V stroke was checked.

PICV-13A,13B & MICV-22 : C/V preventive Maintenance was done. Finally C/V stroke was checked. Opened all tubing & CVs were dropped from line for flushing & reinstalled & reconnected the tubing. Removed the grease nipple & plugged it.

FICV-9,10,11 : Preventive maintenance was carried out of all three valves. Checked the stroke found ok.

FICV-7, 8, 15 : Preventive maintenance was carried out of all three valves. Checked the stroke found ok.

PICV-3 & PICV-3a (old PICV-1027) : Opened the positioner & linkage of the PICV-3 valve & realigned the positioner & linkage system & finally checked stroke of both the control valves.

PICV-1027: New control valve was installed by tech. dept. Cabling & tubing was done & finally checked the stroke.

PICV-6 ; (V-27) : General cleaning was carried out & provided new gland packing & checked stroke.

PRCV-4 : General cleaning was carried out & provided new gland packing & checked stroke.

FICV-14 : C/V was opened from line. Plug, seat, cage were taken out, All parts were cleaned, overhauled, finally assembled & reinstalled and checked stroke.

MICV-61 : CV was opened from bonnet & replaced the gasket. Provided new gland packing and checked stroke.

MICV-56,57: Both the valves were removed from line overhauled all the parts & Positioner then reinstalled with new gaskets & checked the stroke.

PCV-103J(Lube oil console): Opened the CV from line overhauled all the parts, found actuator spring damaged ,replaced it with new one also replaced the diaphragm, assembled & installed & adjusted it for 1.5 Kg/cm2 pressure in start up.

Sour oil Valve (103J HP) : Removed the valve from line overhauled the parts & reinstalled & finally stroke was checked. Shaft of the valve replaced.

MICV-13 : Butterfly C/V was opened from line. Inspected internals(baffle) & cleaned, & removed welding burs from line finally reinstalled and checked stroke.

USY-400 : Removed the valve from line overhauled the parts, checked it for passing on test bench & reinstalled. Finally stroke was checked.

General Maintenance & stroke checking :

For total 88 nos. control valves general /cleaning, greasing & preventive maintenance were carried out . Provided new gland packings wherever required. Also valve positioner was cleaned and air header & regulator also flushed finally stroke was checked.Tag no. of important control valves are as below :

1.	TRCV-142,142A	11.	LICV -416	21.	LCV-134
2.	V-7	12.	FICV-470	22.	LIC-185
3.	V-5	13.	PRCV-25	23.	MICV-13,14,15,16
4.	PRC-23	14.	PRCV-24	24.	PICV-20
5.	V-18	15.	PRCV-18	25.	PICV-1016A & B
6.	FCV-1017	16.	LCV-1007:	26.	PICV-7
7.	V-4	17.	PICV-002	27.	TRC-12
8.	V-1	18.	PICV-006	28.	TRCV-11
9.	V-16	19.	LCV-5	29.	LCV-2
10.	PIC-28	20.	PIC-17	30.	V-102

COMPRESSOR HOUSE JOBS :

Air Compressor (101J) :-

1. Removed all Radial , Axial and key-phasor probes along with relevant junction boxes, speed pick-ups, T/C, pressure gauges and THI's to facilitate mechanical jobs. After completion of jobs the same were fixed back after cleaning/functional checking and gap voltage adjustments for radial and axial probes were carried out.

- Replaced the probe of Probe Pt. No. EA
- Replaced the probe conduits of Probe Pt. No. 3V ,3H & AV,AK

2. HIC-101J : General cleaning and overhauling of governor positioner carried out , replaced its gauges, and air regulator, and checked lock out relay, cylinder leakage . Positioner was fixed and stroke checking was performed.

3. ZSH-101J : Limit switch cable was replaced from LS to JB & wiring work & LS installation work done.

4. PT-79 (Vacuum Tx.): Relocated the transmitter, for that related cabling, wiring & impulse tubing work carried out.

5. Trip system of all compressors were checked with production people as per design trip value.

6. All the Compressor Trip Sol. Valves coils were checked. Also all the JBs were opened and termination were checked. Finally provided new sealing.

7. Beacon makes speed indicators of 101J,105J,103J were removed & shifted to electronic workshop & modification & repairing work was carried out by company service engineer to match the speed of local indication and control room display(4 to 20 mA. Output)

Ammonia Refrigeration Compressor (105J):-

1. Removed all Radial , Axial and Key-Phasor probes along with relevant junction boxes, speed pick-ups,T/C, pressure gauges and THI's to facilitate mechanical jobs. After completion of jobs the same were fixed back after cleaning/functional checking and gap voltage adjustments for radial and axial probes were carried out.
   - Replaced the probe of Probe Pt. No. 8V

2. **PRC-9** – 105J Governor's pneumatic actuator assembly was checked . Replaced complete actuator assembly. Checked Its stroke and lockout relay function.

Synthesis Gas Compressor (103J) :-

1. Removed all radial , axial and key-phasor probes along with relevant junction boxes, proximeters , speed pick-ups,T/C, pressure gauges to facilitate mechanical jobs. After completion of jobs the same were fixed back after cleaning/functional checking and gap voltage adjustments for radial and axial probes.
   - Replaced the probe of Probe Pt. No. 1H, 9B
   - Replaced the probe conduits of Probe Pt. No. 3V ,3H .
   - Removed & refixed 103JBT probes & governor positioner to facilitate mech. for turbine OST work.

2. **PRCV-12:** Replaced the Piston/Cylinder & Positioner assembly with spare one. Its air regulator, gauges was replaced. Checked air failure function. Stroke-checking from control room was performed.

3. **MIC-23**: Replaced the Governor Positioner with calibrated one. stroke was checked from control room . Controller action was reversed from DCS.

4. **Probe Pt. No.BA.BB (103JAT Axial) :** Prepared probe brackets as per new mech. Coupling design & internal available space & provided new probes & checked the float with mech. and adjusted the gap voltage.

5. Removed unused gauges/switches/cables/JB. From local panel of lube oil console.

6. Referruling & Cable glands sealing were provided for all T/C head of LP & HP case.

7. Calibration of all I/P convertor of Governor Positioners were carried out. (HIC-101J,PRC-9,MIC-23,PRC-12)

8. Repaired the sol. Valve cable of FICV-7 control valve.

FIELD INSTRUMENTS JOBS :

1. TI-147: Replaced the heater outlet RTD with the new RTD.
2. LIC-105 and LIC-103 controller's general maintenance were carried out.
3. Replaced TI-0046 and TI-0047 with new T/W and T/C of 102-C.

4. TI-61, 63, 64: Provided new junction box to remove pipe conduit & K type TC cable laid from T/C head to new installed JB & wiring & checking was carried out.

5. 16 nos. Primary reformer bottom header thermocouple taken out and replaced all by new T/Cs with new thermo wells.

6. Removed the entire tunnel T/Cs for inspection and refixed and replaced TI-69, 71, 74, 76, 77 T/Cs with new T/Cs.

7. Removed & reinstalled the instruments of ID fan and 104J to facilitate mech. Job.

8. Removed the 115JA and B instruments (Speed pickup, probes, T/Cs) to facilitate mech. Work for the inspection of bearings.

9. TICV-406: Repaired the Hand jack assembly & checked operation of control valve.

10. 11. USY-930: Removed the Sol. valve & Pneumatic connection & reconnected to facilitate mech. Work.

11. Mechanical DP measurement / Hydro testing machine tubing done. Provided high range pressure gauges for hydro test of vessels and lines.

12. Removed & refixed the Thermocouples & instrument of 103D, 112C, 108C2A & 109C2A to facilitate mech. Work.

13. Instrument air headers flushing were carried out in different areas.

14. LTS/HTS 3/8" SS. sample tubing from sample point to Lab. was done & provided needle valves for isolation as per requirement of Lab.

15. Boiler Inspection: Provided Pressure gauges on HP pump and steam drum, 102C, pressure transmitter flushing and zero checking and other related work with Boiler Inspection were carried out.

16. Provided new 4" flange connection for the installation of new coming O2 analyser, at Auxiliary Boiler. Tapping was closed with blind flange.

17. Provided Rota meters and help to facilitate mech. for welding work at elbow leakage of S-50 (Syn. Converter)

18. 105D Metal temp. : All 12 Metal temperatures points (tag nos. MTI-105-1 to MTI-105-12) from local panel to control room DCS were shifted as per requirement of production people , for that provided all new thermocouples, Junction box and related cabling and wiring work was carried out at T/C head, JB. And control room. New configuration at DCS was done.

19. Annunciator -D : New Minillec make annunciator was commissioned and for that necessary fabrication and wiring work carried out. Its functional testing for individual group alarm was performed and found satisfactory.

20. 101F: Steam drum level monitoring system- "LEVELSTATE".: Repairing work at card level was carried out by Hitech service engineer. Finally performance was checked. Found satisfactory.

21. ARC-3, LICV-12 control valve copper tubing was replaced with new SS. Tubing.

22. FT-934, FT-470, FT-471: Transmitter orifice tapping leakage was attended by welding job and FT-935, FT-936 leakage was attended by providing new fittings.

23. 22. H-110-C: Faulty Cable of Flame scanner from local panel to Scanner was replaced & necessary cable glanding /wiring done.

24. H-111: Ignitors were removed from furnace & cleaned & checked. Provided 2 nos. new spark plug.

25. 24. MIC-7 New cable laid from J.B to I/P converter as old one was faulty.

26. Two Junction Boxes near 107C were removed and shifted to new pole to facilitate technical people to restructure the ladder fabrication job.

27. Removing and refixing of instruments at different location to facilitate mech. job and as per requirement of production people were carried out.

28. C.G.Circulator : Rota meters removed from line then overhauled & fixed back. General cleaning of other instruments were carried out & checked performance.

29. Provided new sample tubing in LP flash vessel.

Following ISO related quality/Safety affecting instruments were calibrated:-

1.	PT-7	9.	PT-8	17.	PT-10	25.	PT-80
2.	PT-150	10.	PT-5	18.	PT-4	26.	FT-1
3.	PT-62	11.	PT-9	19.	PT-36	27.	TI-104E
4.	FT-2	12.	FT-3	20.	FT-100	28.	FT-1005
5.	AR-1	13.	PT-1027	21.	FT-1006	29.	TI-0011
6.	PIC-1A	14.	TI -0117	22.	TI-0007 (TRC-10)	30.	TIC-1025
7.	TI-0026	15.	TI-0039	23.	TI-0036		
8.	PT-501	16.	PT-503	24.	PT-28		

Following CDM related instruments were calibrated:-

1.	FR-33	3.	FR-6	5.	FQI-181
2.	PI-82	4.	FI-65	6.	PI-676

CONTROL ROOM JOBS :

1. Bently Vibration monitoring Panel to DCS(ALR-121 card) communication cable was repaired by resold ring the wires on new D connector.

2. SP-4 : New MOV : Removed the interface Relay for indication in PLC and provided direct wiring for MOV closing/Opening indication.

Technical Dept. Jobs :

1. PICV-1027 : Installed new control valve at pre-reformer and necessary cabling, wiring & tubing job carried out. Finally checked the stroke.

2. FI-104E (Vortex) : New installation work for flow meter & related cabling, wiring work and Configuration in DCS work carried out.

3. Provided 02 nos. new THIs for newly installed CNG preheater

Annual Maintenance of UPSS, DCS and PLC .

FUJI make UPSS

1. The preventive maintenance of UPSS was carried by M/s IL, Jaipur against the AMC. General cleaning, servicing and configuration of parameter checking were done.

2. UPSS to AVR Auto changeover was checked and found OK.

AMCO Battery

1. 7 nos. of Battery cells were replaced with the new cells in battery bank. (cell no. 167,168,169,170,171,172,173,).

2. Cleaned all battery cells , terminals , inter cell connections. Did Topping of distilled water in cells and tightened all inter cell connections and cables and measured the Sp.gr and Voltage of each cell . Found total Voltage 246.8 V .

3. Battery bank was charged. After charging , Measured the Voltage of each cell . Total Voltage reading was found to be 288 V .

4. 2 cycles of charging and 2 cycle of discharging were carried out . Reading of each battery cell was taken.

5. Checking of UPSS & Battery operation was carried out and found ok. Details are as under :

• Duration of discharging	20 minutes*
• AC load current	105 A
• AC output voltage	115 V ac
• Battery discharge up to	192 V dc
• Alarm settings for UPS-1	201 VDC
• Trip setting for UPS-1	192 VDC
• Alarm settings for UPS-2	202 VDC
• Trip setting for UPS-2	195 VDC

* Battery bank Performance is not satisfactory as per service engineer & recommended to replace batteries Bank

YIL DCS:

DCS shutdown maintenance activities were carried out as per the AMC procedure.
The following activities were carried out in Ammonia plant.

1. Before starting preventive maintenance activities / AMC, Images of all control stations were saved by on-line option on EOPS. Updated all EOPS parameters on ENGS station. Saved tuning parameters of all control stations on ENGS. Taken total HDD back up through boot loader & builder tools back up of both ENGS.Save tuning parameters of BCV and FCS0101 on CS3K ENGS. Taken project back up and kept on other HIS HDD.

2. 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 (SCN and I/O cards), FCS, CTBC, ENGS and OPS were cleaned thoroughly. PCBs were inspected and inspection of data bus and connectors were done. No abnormality was observed.

3. Printers and ECHU were cleaned / overhauled, wherever applicable. EFCD/ENGS/EOPS/EFMS system and CPU back-up battery voltages and grounding was checked and the same were found within specified limits in all stations.

4. Function of each component of the DCS was checked. YOKOGAWA diagnostic software was run on FCS and BCV, the results of the test Program indicated the healthiness of the system.

5. Calibration of I/O cards of selected 2 cards in each nest was checked and found OK.

6. Redundancy checks were performed on HF-BUS, Vnet, CPU, PS, AAB841 and MAC-2 cards wherever applicable. As per redundancy feature, control transfer is taking place to the standby properly. Presently left CPU and MAC-2 cards are in control in all stations While checking I/O card redundancy in FCS0101, It was noticed that all AAB841 loop card was not defined as duplex card in IO builder. Defined all redundant card as a duplex in builder and check the redundancy feature, same was found satisfactory except one AAB841 of location F4-3, which is presently showing fail due to ELCO board problem.

7. The following components were replaced which were identified faulty during Preventive maintenance. HKU of EFMS#03 of Centum-XL not working properly. Replaced the HKU with the spare HKU brought by YIL . One MAC2 card was found faulty, same was collected by YIL for repair/replacement on returnable basis. Replaced faulty 24DC nest cooling fan of EFCD-2 and faulty Roof fan of ETBC panels of Centum-XL and system cabinet of FCS0101 (provided connector TB for roof fan connection). Presently all fans are functioning ok. Faulty HDD of HIS161 was replaced with spare HDD brought by YIL

8. Replaced 06 Nos. Battery of EFCD/EFMS with new battery . All HIS was upgraded with R3.07 revision.

9. One Spare PC was loaded with HIS0164(Engs Station CS3000) key code and kept ready for standby use. Other spare PC was checked for OS and found working satisfactory. These PCs can be used as a spare for any running HIS by loading with respective key codes.

10. Latest backup both total HDD and builder tools were taken for Centum XL and CS3000 Latest project back up was taken on HDD and CD .

11. 105D metal temperature(12Nos) configured /defined in DCS .

12. LIC-480 (Dehydrator level) scheme was modified and implemented as per IOC of production people and taken trial for the same. Found ok.

HIMA PLC

HIMA PLC shutdown/ preventive maintenance activities were carried out as per the AMC procedure.

1. Cleaning of filters, fans, cabinets etc. was carried out for all the four PLC stations.

2. Checked the redundancy of all the four PLC at card ,CPU and power supply level.

3. Modification was done in logics I-302, I-307 as per the MWO.

4. Faulty F-3237 card at locations 1314 in PLC-2 was replaced by new card.

5. Back up copy of all the programs (ELOP and Wizcon) were taken.

ABB CO2 and CH4 Analyser(AR-1 & AR-2)

1. Preventive maintenance of ABB make CO2 and CH4 analyser was carried out.

   CO2 and CH4 Analyzer were checked. Condition of sample cell was very good. Optical alignment and phase alignment performed and sensor CPU board, detector and cell were checked.

2. Manual Calibration of CO2 and CH4 analyser was performed & found ok.

CAPITAL JOBS CARRIED OUT IN ANNUAL TURNAROUND:

1. **LIC-1, LIC-13, LIC-3, LI-101 :** Replaced pneumatic head assembly by electronic head assembly. Laid single pair cables of level troll and I/P for the respective valve to JB's.Configured the level trolls in DCS. Performed calibration and checked stroke through DCS.

- Laid new cable from J.B to LRC-1 transmitter & termination done.

2. **PEAK-150 FOR 101J/105J LUBE OIL CONSOLE:** Installed new Peak-150 Woodward governor in control room and Pick up probes on pump and necessary cabling, JB. mounting, wiring work was carried out. Finally checked the operation of pump from Peak-150 found satisfactory. All the work was carried out in presence of supplier service engineer and mech. Staff.

ISO 9001:2000

PREVENTIVE MAINTENANCE JOBS WERE CARRIED OUT As per the ISO 9001:2000

1. **FUJI UPSS :** The preventive maintenance of UPSS was carried by M/s I/L, Jaipur. The general cleaning, servicing and configuration and parameter checking were done as per AMC. The trip setting noted down using the hand held configurator. Battery back up test carried out. Redundancy test and smooth change over function for the UPS1 and 2 were checked.

2. **YIL DCS :**The preventive maintenance of DCS was carried by M/s YBL as per the AMC. All EFCD, EOPS, EFMS and Engineering station cards were removed from cabinet / panel and cleaned. Replaced the fans, cleaned the filter, panels and cabinets. Checked the redundancy for CPUs, MAC2 cards, power supply and HF buses. Engineering station and EOPS healthiness checked through software.

3. **HIMA PLC :**The preventive maintenance of HIMA PLC was carried out by M/s L & T Ltd.as per the AMC. Cleaned filters, fans, cabinet and physical inspection were carried out. Checked the redundancy for CPU, input and output cards, power supply cards and HIMA buses.

4. **AMCO BATTERIES BANK:** The preventive maintenance of batteries was carried out by M/s AMCO Ltd. as per the AMC.

5. **CONTROL VALVES :** Preventive maintenance of control valves were carried out by general cleaning, greasing, positioner & I/P checking, gland replacement / tightening, stroke checking.

6. **TURBINE GOVERNOR CONTROLLERS:**

   - HIC-101J for 101JT: Carried out general cleaning and overhauling. Changed air regulator of Governor positioner, stroke checked and overhauled.

   - PRC-12 & MIC-23 for 103JAT & JBT : Carried out general cleaning and overhauling of Governor positioner, stroke checked and completely overhauled.

   - PRC-9 for 105JT : General cleaning, overhauling of governor positioner was carried out and checked stroke.

7. **CONTINUOUS IMPROVEMENT:**

   - Replaced old pneumatic level transmitters with new SMART electronic transmitters for better reliability & performance. (LIC-1,13,3,101)

   - Replaced old mechanical governor of 101J/105J lube oil console pump with new Woodward make Peak-150 for better performance of compressors.

   - **CALIBRATION OF INSTRUMENTS :** Safety & Quality affecting instruments were checked and calibrated.

HITACHI (CO2) COMPRESSOR:

1. All RTDs and Thermocouples removed to facilitate Mech. Maintenance jobs. Checked and installed back after mech. Maintenance job was over/ completed.

2. All vibration probes extension cables, Proximeter were removed, checked, and installed back to facilitate Mech. Maintenance jobs. Probe for XE-1808 B was replaced by new one.

3. Followings transmitters were calibrated:-

   LICT-1821, LICT-1803, LICT-1805, LICT-1807, PI-1809, LT-1809, PT-1836, FT-1801 (Antis urge), PT-1802A & B

4. Local Control Panel and Turbine ` Control Panel was cleaned. All wiring connection were tightened.

5. TI – 1803 (Local indicator) was replaced by new one.

6. Followings Trip and Alarm Switches were cleaned, and checked for setting :-

   PSLL-1838A,B,&C, PSL-1812, PSL-1813, PSLL-1844, PSHH- 1839A,B,&C, PSHH-1843A,B,&C, PSLL-1801A,B,&C,PSL-1816, LSHH-1804, LSHH-1808, LSHH-1806, PSL-1843, PSLL-1818A, B&C, LSHH-1822.

7. All junction boxes were cleaned, terminal tightened.

CONTROL/ MARSHALLING ROOM:

1. Annual preventive maintenance of DCS, under A.M.C. with Yokogawa India,was carried out by Yokogawa Engineers. Batteries for FCS were replaced by new ones. Battery Voltage of all ICS and FCS were taken and found O.K. Functionality checking of FCS and all ICS by diagnostic soft - ware was carried out, by Yokogawa representatives and found to be O.K.

2. DCS Scan time was more as compared to recommended scan time. Control loops' assigned priority / scan time were properly changed, considering plant requirement, and recommended idle time was achieved.

3. Annual preventive maintenance of OMRON PLC, under A.M.C. with "Masibus" Gandhinagar was carried out. PLC CPU Battery of both CPU was replaced by new ones.

4. Cleaning "Woodward" Governor console, for Siemens turbine in the control room, was carried out.

5. Autoclave level measuring System's Radiac Relay unit for LR- 1201 was calibrated. The spare radiac relay also was calibrated.

OTHER PLANT JOBS:

1. LRC-1201 and LH-1201 detectors were removed and installed back to facilitate Mech. Maintenance jobs.

2. Stripper source of LRCV-1201 was removed and was shifted to the storage pit and source was refixed after Mech. Maint. Work was over and put in line.

3. Radio active source of LR-1201 (Auto clave) was removed and source was shifted to the storage pit. Source was refixed after Mech. Maint. Work was over, & put in line.

4. 8 nos. HP Thermowell removed and hydro tested. And all thermo well were refixed. Following Thermo well were replaced by new one. TR-1205 Auto clave bottom and TR-1206 Auto clave top.

5. Preventive maintenance of turbine flow meter for cooling water to Urea Plant was carried out.

6. Following ISO Quality affecting instruments were calibrated:-

   PT-5303, PT-4405, PT-1121, PT-1145, PT-1201, PT-1202, PT-1422, PT-1421, PT-1105, PT-1802, SI-1401A, SI-1401B, FT-1201.

7. O2 Analyzer Panel was shifted to the new location near sample point at Hitachi Comp. on ground floor, and put in line.

8. P-1102C: - Cables with J/B, for lubes oil pressure switches & Speed Indicator and process high pressure discharge switches, were relocated at suitable place by replacing them with new ones as the old cables were not in good condition.

9. LICT-1353 Transmitter (Pneumatic) was replaced by new Electronic Transmitter.

10. Following Transmitters were calibrated :

    LT-1481, LT-1421, LICT-1207, LICT-1203, LICT-1202, LT-1481, PT-1282, PT-1481, LT- 1701 A & 1701 B. LRCV-1201. PT- 1202. PT -1201C.

11. Following alarm and trip switches were calibrated :

    PAHH-1194, PAH-1193, PHCO-1363A&B, PLCO-1102A, PLCO-1201A, PALL-1195, PLCO-1102B, PSLL-1101, LSL-1357.

12. Coordinated with Production / Maintenance people for miscellaneous plant Jobs related Production requirement, Mechanical maintenance's requirements and instruments maintenance jobs.

13. I/P Converters of following control valves were replaced by new. PRCV-1504, HICV-1581, TICV-1701A.

14. PT-1130 and PT-1131 Both Transmitter were shifted in new location as line is re-routed.

15. Instrument air header was flushed at various point.

TECHNICAL AND GENERAL ENGINEERING RELATED JOBS:

Coordinated and worked for the jobs, pertaining to instrumentation area, with General Engineering, mechanical maintenance, and production staff for installation and commissioning of the Approved Schemes for 2006-07 and executed by

- General Engineering section, and,
- Mechanical Maintenance section.

Following was done for the above jobs:

1. Engineering work in DCS for new instrument loops was completed.

2. Input and output cards, required for these new control loops, were provided and related signal cables were connected and all these new loop were checked for proper functioning.

3 Existing instruments and control valves were removed and re fixed at new location as per new P & I diagram or as required in the plant, and necessary cabling, tubing were rerouted / relayed. Hard wiring, cabling, and engineering modification / changes required at the DCS end for these job were completed and the loops were re commissioned.

WEEP WHOLE CHECKING OF HP VESSELS:

1. Coordinated with production persons for weep holes tubings.

CONTROL VALVES:

1. Following control valves' complete overhauling was carried out by dropping them from line. Necessary parts were replaced. Trim parts were repaired by metal filling and machining, surface finishing with turning and lapping. Hydraulic pressure testing was carried out after complete assembly of the valves.

   HICV-1202, LRCV-1201, HICV-1201, PRCV-1201, TICV-242, PICV-1353,PCV-1221, PCV-1501, HICV-1422, FICV-1102, LCV-1501, LICV-1101,PCV-1979A, LICV-1501, TICV-1701B, HICV-1101, FICV-1282, LICV-1401.

2. Following control valves' partial overhauling and necessary parts replacement was carried out by opening from the bonnet without dropping them from line. Necessary parts were replaced. Trim parts were repaired by metal filling and machining, surface finishing with turning and lapping :

   LICV-1201, PICV-1201, FRCV-1201, FICV-1281, LICV-1204, LRCV-1421,TRCV-1101, HICV-1421, HICV-1801, PICV-1810.

3. 30 nos. of the control valves' preventive maintenance and oil painting was carried out & valve stroke were checked including some of these important control valves:

   LICV-1420, FRCV-1421, TICV-1201, TRCV-1201, HICV-1221A&B, LICV-1203, PICV-1481, LICV-1430, PICV-1301, LICV-1425, LICV-1281,FICV-1385, PRCV-1421, PICV-1421, PICV-1422, HICV-1425, PICV-1129,LICV-1504, PICV-1128, LICV-1204, HICV-1101, LICV-1201, PICV-1131,PICV-1502A&B, TRCV-1422, LICV-1502B, HICV-1422, PICV-1424

4. Monoblock valve of N/C Ratio meter was replaced by a new one, and put in line.

OFFSITES & UTILITY PLANT

BOILER PLANT:

CONROL ROOM JOBS:

1. Cleaning of DCS & PLC panels & hardweres were done under the CAMC Contract. Following jobs are carried out.

   - Replaced the 3 nos. of FANS making abnormal sounds.
   - Upgraded the HIS software version from R 3.05 to R3.07. This is required for Boiler and DM DCS Connectivity.
   - Shifted the DCS and PLC engineering station at new location (Engireering room is made under the control room renovation.)
   - Redundency check of DCS and PLC were done. Found o.k.
   - OPC connectivity between PLC to DCS HIS was found lost.
   - Recovered the OPC connectivity after re-installing the Windos operating System Windos XP SP -1 and configurating the OPC servers in HIS0161.

2. Operation of 2 nos. of MOVs were checked from DCS operator panel and after that taken in line

3. Eye-Hye Drum Level indicator Relay Board was relocated.

FIELD JOBS:

1. Following field switch set value were checked.

   - LSLL-1, LSL-2, LSL-3 of steam drum level .
   - LLCO-5111, LAL-5111 and LAH-5111 of Deareator.
   - PSL-1 F.D. Fan lube oil pressure low AOP START.
   - PSL-11,PSH-12 of Furnace pressure.
   - PSL-24, PSL-25, PSN-26 & PSL-27 of Ignition and fuel gas line.
   - PSL-21 ,PSL-22 & PSL-23 fuel oil header

2. Checked set value of following lube oil system switches of motor and turbine driven BFW pump.

   - PAL-5114, PLCI-5113, PLCO-5112 for P-5111
   - PAL-5113, PLCI-5112, PLCO-5111 for Q-5111
   - PAL-5115, PLCI-5114, PLCO-5113 for P-5112
   - PLCI-5115 M-5112 AOP

3. Sample Filter of O2 Analyser was replaced with new one.

4. TR-13 Furnace Temp. T/C was replaced with a new one.

5. Following Damper's limit switches, solenoids valves, air regulators etc. were overhauled and checked its operation.

6. F.D. fan inlet damper and F.D. fan outlet damper.
7. Air heater inlet damper and Air heater outlet damper.
8. EYE-HYE Electrodes were checked and tighten all the terminal.

9. Press.gauges PI-2, PI-3, PI-4 & PI-5 were calibrated w.r.t. Boiler Inspection.

10. Installed F/I conv. & proxi switch for speed measurement of BFW pump P-5111 & taken it in DCS.

11. Installed F/I conv. & proxi switch for speed measurement of LSHS Oil charge pump P-5114 & taken it in DCS.

12. LNG heating temp. c/v TCV-25 was installed by Tech. deptt.Carried out necessary cable connections in field JB & DCS marshalling cabinet. Temp. control loop was taken in DCS.

13. Carried out all instrument jobs as per mech. requirement. BFW pump (Motor/ Turbine driven) pressure switches, tacho generator, TI & PI were removed and installed back.

14. Checked instruments as per ISO calibration schedule.

CONTROL VALVES:

1. Following control valves were removed from line for complete overhauling. (Inspection/maint. of Seat/Plug, valve positioner, I/P Convertor, Actuator diaphragm,Gland packing, cleaning of Air supply regulator,replacement of gasket as required, c/v stroke checking etc.)

2. TCV-1(increased cv of valve), PCV-3065B, PCV-3(light machining of seat/plug was carriedout), MICV-4401, FCV-1, PRCV-50, FRCV-22, PCV-3008, PCV-25, PICV-5153, PICV-5151, GHTV, BTV-4A, BTV-4B, pHCV-4401

3. Following control valves were opened from Bonnet for partial maintenance.(Inspection of Seat/Plug, valve positioner, Actuator diaphragm,Gland packing, c/v stroke checking etc.)

4. TCV-3201A, TCV-3201B, TCV-3201C, PCV-1, LCV-5111, LCV-3064A, B/F Fire & Safety, HOHTV, HORV, LRCV-4, PICV-1, LCV-3051B, LCV-3058B, LCV-3056B, LCV-3053B, LCV-3064B

5. Following control valve's preventive maintenance was carriedout.(General cleaning & c/v stroke checking.)

6. PCV-3009, LCV-3051A, LCV-3058A, LCV-3065A, LCV-3053A, LCV-01, LCV-02, Fire Hydrant, MICV-4401, PCV-50, PCV-2, TCV-2, FCV-2, BTV1-1,BTV1-2, BTV1-3, , BTV-2-1.

IGNITORS:

Both Burner's ignitor gun, spark plug, and gas & Oil flame scanners were cleaned and checked. All furnace draft PI impulse lines were flushed with 7.0 kg/cm2 air.

D.M. WATER TREATMENT PLANT:

1. **DCS RELATED JOB:**

- Laid Cable trays & Instrument cables for field Instruments(I/P Convertors, Transmitters) from local Junction Box to control room, Operator Consoles to Marshalling and system cabinet. Laid the power cables from MCC indications & controls from DM Marshalling room to MCC-2A/2E. Terminated the all cables with lugs, ferrules .as per termination details & drawings.

- Laid the system cables between Operator consoles and system cabinet. Laid V-net & OFC cables from Boiler Control Room to D.M. Control Room inside the HDPE Conduit. Connected Vnet & OFC at both ends.

- Installed DCS Operator Consoles, Marshling and system cabinets , Other system accessories (like Ethernet switches , LIU, Print server etc.).

- Laid & Terminated UPS Power supply cable (110 VAC) from Urea PDB to D.M. PDB through Isolator switch & MCB.

- 3 Nos. of Earth pits (System Earth, Panel Earth & Shield Earth) were made. Earthing cables from Marshalling, system cabinet are connected to Earthing strips located at marshalling room.

- 19 Nos.of new Electronic transmitters and 4 Nos. of I/P converters were calibrated and installed.

- Erected and commissioned the DCS system for the D.M. Plant . All the Sequence logic , Motor controls, Open loops and close loops are taken in line through DCS. Performance of DCS system was observed found satisfactory.

Note : All the above mentioned activities were carriedout under guidence and supervision of installation and commissioning engr. from M/S YIL, Bangalore.

NH3 STORAGE:

- Replaced Amm. Vapour press. Controller(440R) of new Amm. Storage tank.
- Installed 3 nos. of UT-350 Electronic Temp. Controller for LSHS tank-A/B/C

COOLING TOWER:

- Q- 4411 (Eliot Turb.) All radial vibration probes , speed pick-up unit were removed & reinstalled to facilitate mech. maint.
- Q-4411 Gear box pump side radial vibration probe no:3 was replaced with new one.
- 2 nos. of new thermowell were fixed on disch. line of P-4401B and P-4403
- FI-96 (C.W. to Amm. plant) flow transmitter was replaced with new one.
- Q-4401B turbine steam flow transmitter was relocated.
- R.W. inlet flow element (ANNUBAR) was removed from line. Same was cleaned & fixed back.

I.G. PLANT:

Attended all running jobs.
Servicing and calibration of ABB make H_2 analyzer of new I. G.
Plant. (Service engineer From M/s ABB has completed this work.)

WEIGH BRIDGE:

- Calibrated the Ashbee make weigh bridge with standard weights
- upto 30 tones (near main gate)
- Calibrated the Mettler -Toledo make weigh Bridge with standard
- weights upto 25 tones (near pilot lab.)

EFFLUENT TREATMENT PLANT:

- Overhauling of SBA control valve and its valve positioner.
- Cleaning of sampling system and calibration of Ammonia analyzer.

B&MH PLANT

BAGGING & MH PLANT:

1. **POWER BUILD MAKE AUTOMATIC BAGGING M/C. (P/S No. 1,2,3,4,7 & 8)**

- Checked wiring terminals in the main panel, local panel, Solenoid boxes, and loadcell boxes.
- Cleaned and checked CIC-25, relays board, fuses, and all sensors.
- Checked function and calibration of all Packer Scales.

2. **J.R.S.L MAKE AUTOMATIC BAGGING M/C (Computpak) Packer Scale No: 10A & 10B)**

- Installation & commissioning of new PBL make automatic bag filling machine in place of JRSL make bag filling m/c No.10A
- and 10B panels are taken in line and checked performance of
- both m/c's was observed, found satisfactory.
- All PCB's of computpak panels 9A/9B were removed and cleaned.
- Calibrated Computapak(UBM) 9A/9B
- Cleaned/checked all sensors of both auto bag placers.
- Cleaned the local panels and PLC Panels.and tightened all wiring
- terminals of local / PLC Panels.
- All oil lubricator was overhauled.

3. **WEIGH SCALES:** (Mettler-Toledo/Libra make)

- Cleaned the weighing scales , Digital Indicators.
- Cleaned the PCB of digital indicator.
- Calibrated all weighing scales.

4. **BELT WEIGHER SYSTEM:**

- Cleaned/Overhauled the tacho-meter assembly.
- Checked the healthiness of loadcells, tacho-meter, digital indicator.
- Checked the load cell performance by actually putting weights and checking milli volts, the performance was found satisfactory.

5. **DUST EXTRACTION SYSTEM:**

- Cleaned the Dust Extraction Panel.
- Cleaned all field instruments (C/V,FlowTx,LevelTx etc.)related to
- DES.

AMMONIA PLANT

1. Preventive maintenance carried out on transformers: TR-6, TR-21 & TR-22 and the job details are as under:

   - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connections.
   - Measurement for Insulation resistance, BDV of transformer oil.
   - 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.

2. Preventive maintenance carried out on all the feeder compartments in MCC-5, MCC-5 A/B, MCC-13 & MCC-16 and the job details are as under:

   - Checked the tightness of outgoing terminals.
   - Cleaned the feeder compartments.
   - Replaced damaged/ worn out contacts, etc.

3. Overhauled the following motors:
   101J, 104J, 104 JA, 104 JT, 104JTA, 106J, 107 JT, 118J, 118JA and 118 JB

4. Following existing Limitorque MOVs are replaced with new ROTORK actuator and commissioning, testing and modification in wiring is done accordingly.

   SP-152, SP-158,SP-159 and SP-4

5. Replacement of heating elements of PGR heater and carried out preventive maintenance of local panels..

6. Preventive maintenance of TMG Breakers installed in MCCs was carried out.

UREA PLANT

1. Preventive maintenance carried out on transformers: TR-7A, TR-17, TR-18, TR-20 and the job details are as under:

   - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
   - Measurement for Insulation resistance, BDV of transformer oil.
   - 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.

2. Preventive maintenance of all the feeder compartment in MCC 6 and MCC 14, MCC 15 were carried out.

   - Checked the tightness of cable & wiring terminals in the feeders.
   - Cleaned the feeder compartments.
   - Replaced damaged/ worn out contacts, etc.
   - Preventive maintenance of following MOVs were carried out: MOV1101, MOV 1102, MOV 1201, MOV 1202, MOV 1203, MOV 1501 & MOV 1801.

3. Overhauled the following motors.

   P1814 B, P1501, P1408, M1402 /1, M1402/2, P1131A, P1131 B, P1231 A, P1231 B, M1403/1,P1817, M1419, M1421, M1403/2, P1401 A, P1401 B, P-1231 C, K1401/1, K1401/2, K1401/3 and K1401/4

4. Preventive maintenance carried out on all rope switches installed on conveyors: M1402, M1403, M1419 & M1421 and replaced defective one with new.

5. Laying of power & control cables, Commissioning and testing of new chemical cleaning pump, motor P-1206 and circulation pump motors P-1210 A & B.

6. Shifting, Commissioning and testing of P-1304 C & D motors at new location.

7. Retrofitting with Siemens 3WL breakers in feeders of K-1701 & K-1702 of PCS MCC No-14 by removing 3WE old outdated breakers.

8. Overhauled the transformer TR-7B to improve the IR values of windings by lifting the entire core. Inspection and cleaning of winding and replaced transformer oil. Painted the transformer to arrest leakages with special anti-corrosive paint.

9. Preventive maintenance of TMG Breakers installed in MCCs was carried out.

OFFSITES & UTILITY PLANT

OFFSITES :

1. Preventive maintenance carried out on transformers: TR-1A, TR-1B, TR-1C, TR-4A, TR-4B, TR-15, and job details are as under:

   - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
   - Measurement for Insulation resistance, BDV of transformer oil were 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 were replaced.

2. Preventive maintenance of all the feeder compartments in MCC-3, DG MCC were carried out:

   - Checking the tightness of cable & wiring terminals in the feeders.
   - Cleaned the feeder compartments.
   - Replaced damaged / worn out contacts, etc.
   - Tightness of the bolts of bus bars in DG Panel was checked.

3. 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.

4. Preventive maintenance jobs were carried out in 11 KV MPSS:

   - Checked the tightness of outgoing terminals.
   - Cleaned the feeder compartment of both Jyoti & siemens panel.
   - Replaced damaged /worn out contacts, etc.

UTILITY :

1. Preventive maintenance carried out on transformers: TR-2A, TR-3A, TR-3B, TR-8, TR-11, TR-12, TR-13 & TR-14 and the job details are as under:

   - Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
   - Measurement for Insulation resistance, BDV of transformer oil were 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.

2. Overhauled the transformer TR-2B to improve the IR values of windings by lifting the entire core. Inspection and cleaning of winding and replaced transformer oil.

3. Preventive maintenance of all the feeder compartment in MCC 1, 2, 2B/2E, 2A, 2F, were carried out.

   - Checked the tightness of cable & wiring terminals in the feeders.
   - Cleaned the feeder compartments.
   - Replaced damaged / worn out contacts, etc.

4. Overhauled the following motors.
   P4401/B, P5111/A, 5111/B, P5112/A, P5112/B, P-5113, P-5118/A, P-5118/B, P-5117, P-5119, P4411B, P4403, P4412, P-4215/A, & P-4215/B.

5. Checking of terminal box of all HT Motors i.e. P4402B, P4401C, P4401D, P4404 and E5112.

6. Following existing defective / worn-out MOVs are replaced with new ROTORK actuator and commissioning, testing and modification in wiring is done accordingly.

   S-5, 4401/C & 4401/D

7. Electrification of renovated Boiler control room.

8. Replacement of old MCC-1, SECTION-A panel with new SIEMENS panel and commissioning & testing of the same.

5. Preventive maintenance of HT JYOTI Breakers installed in 11KV MPSS & 66KV Switchyard were carried out.

6. Preventive maintenance of Minimum Oil circuit Breakers (MOCB) installed in 66KV Switchyard was carried out.

7. Complete servicing of CTR make OLTC of TR-1C was carried out.

B & MH PLANT

1. Preventive maintenance carried out on transformer: TR-5A, TR-5B, and the job details are as under:

- Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.
- Measurement for Insulation resistance, BDV of transformer oil were carried out on each transformer.
- Alarm & tripping contacts of Buchholz relay and MOG were checked. Servicing of Buchholz Relay of Tr-5B 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 were replaced.

2. Preventive maintenance of all the feeder compartments in MCC 4, & 9 were carried out:

- Checked the tightness of outgoing terminals.
- Cleaned the feeder compartment.
- Replaced damaged /worn out contacts, etc.

3. Overhauled the following motors.

   Dust Conveyor motor, M2110, M2112, M2116/1,M2116/2, M2116/3, M2116/5, M2114, M2117 ,M2122, M2122/A1, M2122/A2, M2123, P2704A, P2704B, P2163A, P2162A, P2162B and P2142.

4. Preventive maintenance carried out on all rope switches installed on conveyors: M2110, M2112, M2117, M2121, M2122 & M2123 and replaced defective one with new.

AMMONIA PLANT

1. AUXILIARY BOILER:

- Repairing of burner blocks for burner no. 3, 4 and 5.
- Repairing of Header and other refractory work inside the auxiliary boiler.
- Repairing existing hot point panels on north side of auxiliary boiler by insulating castable materials.

2. PRIMARY REFORMER:

- Repair of insulation bricks along with back up insulation after the removal of old damaged refractory.
- Removing / reconstruction of tunnel walls in primary reformer including bottom floor, tunnel slabs.
- Repair of nozzle refractory repair for secondary reformer 104-J.
- Replacement of AC sheets roofing for pent house area of primary reformer.

UREA PLANT

1 Repairing of scrapper floor of Prill tower by filling the joints of existing tiles and replacement of damaged acid proof brick lining, repair of vatas by epoxy system.

2 Providing and laying IP Net painting on outside surface of bucket room, lift cabin, RCC structure for top area of Prill Tower, IP Net coating for first floor and second floor area of Urea plant including column, slab, beam etc.

3 Epoxy painting of RCC structure of Prill bucket room, lift cabin room, stair case at Prill Tower top level .

4 Painting of conveyor gantry from Prill tower to Silo.

5 Bitumastic flooring of stair case and first floor and second floor area of Prill cooling system area.

6 Repairing of floor by filling epoxy joints for Mandana stone for ground floor area of urea plant.

7 Replacement of damaged AC sheets for prill cooling system, Hitachi compressor shed and control room shed area.

8 Bitumastic lining for top floor of prill tower.

9 Making RCC pedestal for modification of conveyor at prill tower.

10 Repair of damaged precast slab near Urea plant.

11 Breaking of RCC for dismantling of old foundation of Make up sump and grouting / concreting for new foundation of Make up sump assembly.

OFFSITES & UTILITY PLANT

1 WATER TREATMENT PLANT:

- Repairing of supports for pipeline in Water treatment plant & floor of H_2SO_4 tank near cooling tower sump side.
- Repairing of floor by bitumastic lining for SB assembly unit and around Anion tank in water treatment plant.
- Epoxy grouting of nozzle in new cooling tower sump.
- Outside/Inside RCC repairing work in new cooling tower sump.
- Replacement of water proof ply wood on cooling water spreading area of Ammonia side cooling tower.
- Breaking of concrete for the and grouting of

2 BOILER HOUSE:

- Repairing of castable refractory for burner's side, floor and superheated zone inside BHEL boiler.
- Replacement of AC sheets in BHEL Boiler roof.
- Interior and exterior renovation of Control room by civil work.

3 COOLING TOWER:

- Repairing of damaged top cover plywood sheets of cooling tower
- Filling of coal tar for leakage water planks of cooling towers.
- Strengthening of wooden structure for new cooling tower.
- Making line open by carryout excavation for the repair of leakge cooling tower line near sand filter,
- Repair and grouting of pump foundation for raw water pump near raw water storage tank and cooling tower sump area.
- Dismantling of HCl tank foundation.

B & MH PLANT

1 Repairing of Walk way for conveyor belt No. 2117 inside the Silo by Bitumastic work.

2. Epoxy painting of Transfer tower and conveyor gantry from Silo to B & MH.

3 Repairing of Hopper floor / Packer scale floor with epoxy monolithic plaster.

4 IP Net coating of RCC columns, ceiling, slab, beams and other RCC structure in Bagging plant (Hopper floor) at first floor and ground floor area.

7 Replacement of AC sheets roofing for waste bags storage area and truck loading area and roof replacement of contractor cabin in B & MH.

8 Replacement of AC sheet for Loco shed.

9 Making new Gear Box foundation for M-2110, M-2112, and M-2117

10 Epoxy painting to RCC column, beam, slab at GF,FF SF and track loading area.

INSTALLATION OF LNG PREHEATER FOR PREHEATING OF LNG TO AUX. BOILER:

As per approved scheme (Ref. Suggestion No. SS/Amm/05/05) , redundant lube oil cooler of GHH compressor in Urea plant was modified in work shop as per drawing no. 03-EL-13576-SG1 OF 1-REV1 to make it fixed tube sheet design from floating head design.

After hydro testing , It is installed on reverse saddle welded at the shell of 173-C and tapping of gas inlet to tube side has been taken from down stream of PRCV-18 with bypass arrangement.

The tapping of steam inlet to shell side has been taken from LP stem header to 104-E and condensate outline has been connected to condensate out let line of 150-C/151-C with steam trap.

Size of gas inlet /outlet line: 150mm NB XSch40, CS
Size of steam inlet line: 1-1/2'' NB x Sch 80, CS
Size of condensate outlet line: 1''NB, CS/SS

INSTALLATION OF BIGGER SIZE INTER/ AFTER CONDENSER FOR 101-JCA:

It was observed that some uncondensed steam was coming out from after condenser of 101-JCA even after adjusting the LP steam header pressure.

To overcome above problem bigger size inter-after condensers(852-C) of NG booster compressor was removed and installed in place of existing inter-after condensers of 101-JCA.

The details of inter-after condensers are as follows:

1 **101-JCA inter/after condenser(Existing):**
Inter condenser 42no. , 19 mm OD tubes of 2438mm length, Area=6.13m2
After condenser 32no. , 19 mm OD tubes of 1219mm length, Area=2.33m2

2 **Installed NGBC Inter/After condenser:**
Inter condenser 120no. , 19 mm OD tubes of 2500mm length, Area=17m2
After condenser 120no. , 19 mm OD tubes of 1500mm length, Area=10m2
The existing ejectors of 101-JCA are used with this bigger size inter-after condenser.

With higher area, the problem of uncondensed steam in existing after condenser of 101JCA will be removed.

REPLACEMENT OF 6 NOS. CS FLANGES BY SS FLANGES:

With reference to Drawing No. 4132-1013-6318, During ESP-Phase-I, CS flanges was installed in control valve FV-470 and its isolation valves in discharge line of 115JA/JB. The same was replaced by SS flanges . The size and rating of replaced flanges are as follows:

- Size of control valve mating flanges: 16''NB X600#,Sch XS, Material: SS304
- Size of isolation valve mating flanges: 16''x300# , Sch XS, Material : SS304

INSTALLATION OF ISOLATION VALVES IN U/S & D/S OF SAFETY RELIEF VALVES : (Ref : EWR NO.A240 , A251 /A252)

Full bore isolation valve with locking arrangement has been provided in following RVs for ease of maintenance even in normal running plant.

- RV-104-D1: Inlet to HTS converter
- RV-106F: Outlet from secondary ammonia separator 106-F
- RV-110-F, 111-F & 112-F: 1st, 2nd and 3rd stage refrigerant flash drum.
- RV-MS-9: In MS -2-12'' line from MS steam header
- RV-101-D &RV-102-D **:** Inlet to Desulphuriser
- RV-103-J: Outlet from Syn gas compressor after cooler 124-C
- RV-105-D: Recycles gas from ammonia converter feed/effluent exchanger(121C)
- RV-104D2: Inlet to LTS Converter
- RV-102-F**:** Raw gas separator outlet

Total 25 nos. valves of different sizes has been installed to complete the above referred EWR.

INSTALLATION OF ADDITIONAL CONVENTIONAL RVs(EWR- A241) :

Additional conventional RVs (with isolation valves) in parallel to existing Pilot operated relief valves in 103 discharge and recycle lines has been installed to improve the reliability of the system.

Normally pilot operated valves shall remain in line and newly installed conventional safety relief valves will be taken in line in case of malfunctioning of pilot operated relief valves.

Inlet size: 3''NB X1500#, RTJ, Outlet size: 4''x300#, RF
Existing platform has been extended to operate the newly installed isolation valves and for ease of maintenance.

ERECTION OF STAIR CASE STRUCTURE FOR CONVERTER(S-50)& BOILER(107-C) :

Staircase structure of approx. 26 meter height has been fabricated and erected to reach converter and waste heat boiler top.

Also, total five connecting pathways have been provide to reach other vessels in nearby vicinity. The above job was carried out M/s J & J.

ERECTION OF VENT CONTROL VALVE AND SILENCER(SM-387) ON START UP VENT LINE OF WASTE HEAT BOILER (107-C): EWR-A-248Dated 22/05/2006.

In existing system manual isolation valves are used for controlling the steam venting during start up of waste heat boiler and vent line is connected to exhaust of RV on waste heat boiler top.

Vent control valve of size 80mm NB has been installed on 50mm NB vent line of waste heat boiler (107-C). Connection of vent line has been providing to silencer installed at new stair case structure. The silencer installed was redundant final stage silencer of NP/PB CO2 compressor having following details:-

Type: Straight through type flanged both end, Flow Rate: 38772Kg/Hr.
Inlet : 16''NB X150# , Outlet : 16'' NBX150#
Body Dia: 30-3/8'' , Overall length: 112''
Total Weight : 590 Kgs.

By implementing the above modification will avoid noise pollution and unsafe condition by spillage from vent line, if any.

OTHER MODIFICATION JOBS IN AMMONIA PLANT:

1. New control valve PICV-1027 of size 6''NBX1500# has been installed in place of spool piece in vent line of Pre-Reformer.during Shutdown 2006 , the existing control valve PICV-1027 was installed in parallel to PICV-3 at HTS inlet and spool piece was provided.

2. Tapping of 3'' NB from desul-phuriser exit line of 6''NB , has been provided for sending R-LNG to prereformer unit for pre-reformer unit operation with R-LNG.

3. Erection of 3'' NB by pass line of E-110 with connection to u/s of flow orifice in pre-reformer unit. This will help in measuring flow of R-LNG going to Pre-reformer unit.

4. Modification in 6'' inlet line (6''-NV-1102.01-F34) to R-111 for taking sulphur bed absorber in line with R-LNG operation of pre-reformer unit.

5. For carried out this job total 9 joints of 6''NB has been fabricated.

6. The outlet system of the LT shift converter has been modified to decrease the pressure drop across the reactor. The originally designed "elephant stole "outlet system has been modified as suggested by M/s Haldor Topsoe.

7. The lower pressure drop across reactor will result in a higher suction pressure for the synthesis gas compressor and thereby reduce the power consumption of the compressor.

ISOLATION OF NP/PB CO2 COMPRESSOR:

Following modification job was carried out for the isolation of NP/PB compressor:-

1. 60 ATA steam supply line to NP CO2 compressor turbine(Q-1101-1) has been cut off by removing connection of line ST-1105-100-E3 from line ST-1104-200-E3 and spool piece with vent has been provided.

2. 60 ATA steam supply to PB CO2 compressor turbine (Q-1101-2) has been cot off by removing tee connection and providing reducer and elbow.

3. 23 ATA steam exhaust line from PB CO2 compressor turbine9Q-1101-2) has been cut off by providing elbow at the tapping point in line no. ST-1116-300-C1.

4. 4 ATA steam inlet to NP CO2 compressor turbine(Q-1101-1) has been removed by providing elbow and reducer at tapping point in line no. ST-1106-350-B4.

5. Main lube oil pump turbine (Q-1113) exhaust line (ST-1120-150-B4) has been cut off by removing tapping point and spool piece of size 20 inch has been provided in line no. ST-1128-5000-B4.

6. P-114A-B condensate discharge to H-1115/6 has been cut off by providing elbow at tapping point in line no. SC-1106-100-B4.

7. 40ata steam line from Urea plant to inlet of fuel oil pump turbine (Q-5114) in utility has been cut off by providing elbow at tapping point.

8. 40ATA steam header to Urea plant (ST-5155-150-D1) has been cut off at tapping point and elbow has been provided in line no ST-5153-150-D1.

9. PB CO2 compressor(K-1101-2) final discharge to HP stripper (H-1201) has been cut off by providing cap at tapping point.

10. NP PB CO2 compressor cooling water supply line has been cut off by cutting and blinding tapping point from supply header(CWS-4410-30''-B13) and return header(CWR-4410-30''-B13)

    Following isometric drawings has been approved by IBR Inspector for carrying out above modification job:-

    - Drg. No. 02-DL-13456-SH 1 Of 1- Rev.1
    - Drg. No. 02-DL-13457-SH 1 Of 1- Rev.1
    - Drg. No. 02-DL-13458-SH 1 of 1- Rev.1
    - Drg. No. 02-DL-13459-SH 1 of 1- Rev.1 :
    - Drg. No. 02-DL-13460-SH 1 Of 1- Rev.1
    - Drg. No. 02-DL-13461-SH 1 Of 1- Rev.1
    - Drg. No. 03-DL-13579-SH 1 Of 1- Rev.0
    - Drg. No. 03-DL-13581-SH 1 Of 1- Rev.1

By above modification , steam losses will be saved by total isolation of steam lines and steam traps. Cooling water circulation to inter/after coolers of NP/PB CO2 compressor and surface condenser(H-1114) will stop. Power will be saved by stopping lube oil pumps and oil centrifuge for main L.O. console.

INSTALLATION OF TWO BED ATMOSPHERIC SCRUBBER (V-1206):

Existing atmospheric vent scrubber(V-1206) has been removed and new two bed atmospheric scrubber with internals and associated piping modification has been installed by foundation support modification on 3-1/2 floor of Urea plant.

Details of new V-1206 are as follows:-
O.D. =1510mm, Overall Length: 6925mm, Weight: 2080 Kgs.(Empty)
Design Pressure: 1.2Kg/Cm^2g, Design temp. : 200 Deg C
Hydro test pressure: 1.8 Kg/Cm^2g
Design Code: ASME SEC. VIII. Div. 1 Edition 2004
Main shell: SA240 TP 304L, 5thk
Internals: By M/s Kevin enterprises.

As build drawings no. : AEV-06042 SH 1OF 1& SH 2 OF 2 of M/s Aero Engineers. The piping modification was done as per isometric drawings nos. 02-DL-13452 Sheet 1 of 13 to Sheet 13 of 13. By installation of new vent scrubber, ammonia venting to atmosphere will reduce.

INSTALLATION OF PLATE TYPE HEAT EXCHANGER H-1301:

Existing Desorber heat exchanger (3nos.) of shell & tube type has been removed and new plate type procured from M/s GEA, Germany has been installed in hydrolyser section.

Details of removed desorber heat exchanger are as follows:

1. H1301-A(Overall length : 7069mm , O.D. =655mm , Weight =4175Kgs)
2. H1301B (Overall length : 10180mm , O.D. =356mm , Weight =1800Kgs)
3. H1301C (Overall length : 10180mm , O.D. =356mm , Weight =1800Kgs)

Details of new Plate type heat exchanger are as follows:

Overall dimensions: 1423mmx1190mm, Weight: 1250Kgs
Installation of PHE will improve the flexibility in Hydrolyser system's operation and improve effluent quality on consistent basis from hydrolyser system.

INSTALLATION OF CIRCULATION COOLER(H1210):

Removed desorber heat exchanger (H1301A) has been installed as circulation cooler (H-1210) at 1st floor after modification of shell inlet/ outlet nozzles. The size of inlet and outlet nozzle has been increased from 100mm NB to 200 mm NB. The associated cooling water piping has been completed with inch dia welding as follows:-

CW outlet line: Approx. 295 inch-Dia welding
CW Inlet line: Approx. 312Inch –Dia welding

The above tapping of cooling water has been taken from cooling water header near pre-evaporator condenser (CW-1607-18''-B13 and CW-1608-18''-B13)

SHIFTING OF PROCESS WATER PUMP (P-1304C/D) AND INSTALLATION OF NEW CIRCULATION PUMP(P-1210 A/B):

Existing process water pump (P-1304C/D) has been removed from its location and shifted to location of removed lean Carbamate pump(P-1200A/B) after necessary foundation modification and associated piping modification.

New circulation pumps (P-1210A/B) , procured from M/s Jyoti has been installed at the location of process water pump (P1304C/D) along with associated piping modification.

TAPPING FOR NEW PLATE TYPE EXCHANGER (H-1206) IN PARALLEL TO CCS-I COOLER: (EWR: U233 Dated 14/03/2006):

Tapping has been taken from lines of existing CCS-I cooler for the piping of new H-1206 along and foundation for additional CCS –I cooler has also been prepared.

The sizes of tapping are as follows:

1. CW inlet of 16''Φ size with butterfly valve.
2. CW outlet of 14'' Φ size with butterfly valve
3. Condensate inlet of 16''Φ with butterfly valve
4. Condensate outlet of 14''Φ with butterfly valve

Isolation valves in CW inlet and outlet line of existing cooler has also been provided.

Availability of spare CCS-1 cooler will facilitate total removal of heat from CCS-1 maintaining CCS-1 inlet temperature to LPCC throughout the year and this will improve the performance of LP system on consistent basis for the whole year.

All the tapping has been taken form the existing system for the hook up of new system of Narmada water supply scheme. The material for the above taping has been arranged from the in house stock and the job has been completed by SOR contractor.

INSTRUMENT JOBS:

1. Installation of LICV-1206 control valve along with its air line.
2. Installation of HICV-1210 control valve along with its air line
3. Installation of FI-1208 vortex flow meter.
4. Installation of FICV-1284 control valve along with its air line.
5. Installation of HICV-1418 control valve along with its air line.
6. Installation of pressure gauges, temperature gauges & thermocouple and its wiring up to existing junction boxes on different floors in Urea plant.