MTC / REPORT / 01
REPORT NO. 26 / 2006

KALOL UNIT

PLANT TURNAROUND REPORT

(APRIL - MAY - 2006)

INDIAN FARMERS FERTILISER CO - OPERATIVE LIMITED

INDEX

PREFACE

The Annual Plant Turnaround for the year 2006 was taken from 29th March to 6th May for carrying out Primary Reformer Revamp-III, ESP-Phase II, Preventive maintenance of static & rotary equipments and for attending various jobs pending for Plant Shut down. Under the ESP-Phase II (energy saving scheme), revamping of Synthesis gas LP & HP compressors including installation & commissioning of various equipments, vessels & piping was carried out.

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 Plant on 29th March 2006. This shutdown report contains details of the jobs carried out Plant wise and section wise. Ammonia Plant was put back into operation on 6th May'2006 after a shutdown period of 36 days from production to Production.

The Turnaround was carried out smoothly due to meticulous planning of all activities like planning of manpower, material and other resources. Due to exemplary efforts put in by all Personnel at all levels, turnaround jobs could be completed in the scheduled period of 36 days for Ammonia Plant and 37 days for Urea Plant.

Safety was one of the major aspect, 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.

AMMONIA MECHANICAL:

- The Primary Reformer Revamp-III was carried out during this annual turnaround. The existing Catalyst tubes were in service for last 13 years, since 1993. The tubes had already provided service beyond their design life of ten years and hence the probability of failure was high. Reformer Revamp-III was necessary to replace the ageing Harp Assemblies.

  All harp assemblies and transition cones were replaced with new ones received from M/S S+C Germany. In the new set up the Catalyst tube inner diameter has been increased from 82mm to 90 mm with minimum sound wall thickness (MSW) decreased from 12mm to 11mm, for enhanced future plant load. MOC of New harp assembly top piece has been upgraded to SS 304H to avoid dissimilar joint. Inlet header and pigtail were also replaced with SS 304 H materials.

- Synthesis Compressor was revamped as part of the Energy Saving Project under Consultation of M/S HTAS Denmark; to take care of higher synthesis efficiency and reduction of recycle gas flow. OEM M/s Dresser Rand, France, supplied the new modified parts for this revamp. In the revamp the following parts were upgraded:

Floating End Wind back for LP & HP oil seal, Hole Pattern seal with Swirl Break for balancing piston of HP case, 2B High efficiency internals for make up section and DATUM internals for recycle section, Conversion of keyed lubricated gear coupling to hydraulically shrink fitted dry shim pack couplings, Conversion of keyed thrust collar to Hydraulically fitted thrust collar, Provision of new thermocouples for bearings to measure the bearing metal temperature and Relocation of the vibration probes for obtaining reliable readings.

- Synthesis Gas Compressor Drive Turbines 103-JAT & 103-JBT were taken for preventive maintenance. During float checking, the coupling hub of 103 JAT towards 103 JBT side was found slipped out and deep scoring marks were observed on the rotor end. Therefore, complete turbine was taken for major repair. Repairing of shaft end and operating speed balancing of rotor was carried out indigenously at M/s Man Turbo, Baroda and the repaired rotor was assembled back.

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

- High Shaft Vibration of 103-JLP due to thrust collar face run out was rectified by taking shut down of Back end of Ammonia Plant after Plant start up.

- Elliot turbines 101 BJT and 107 JT were de-rated with new modified nozzle rings for energy saving.

- 130 JC & 131JC Basco, USA make Heat Exchanger Tube Bundles replaced with indigenously designed, developed and manufactured at M/S Patel Airtemp, Ahmedabad.

- Impeller trimming of 116J was carried out for reducing the head.

- Tube seal weld leakages of 102 C were attended.

- Boiler (101-F), Both Waste Heat Boiler (101-CA/CB) and 112-C were offered for IBR inspection.

- Under the energy saving scheme (ESP), Phase – II, the following new equipments were installed, commissioned and were taken in system at the time of startup of the ammonia plant:

  - 108 D - S-50 Converter and basket
  - 108 H - S-50 Converter Heater
  - 107 C - MP Boiler
  - 105 E - Dehydrator
  - 137 C - Recycle gas cooler
  - BFW Coil for Auxiliary Boiler

UREA MECHANICAL:

- Hitachi compressor Train, BHEL Nuovo Pignone Compressor Train and PB reciprocating Compressor drive Turbine were taken for preventive maintenance.
- 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. However due to criticality of the equipment, these plates were replaced with new reconditioned channel plates.
- Inspection of HP Vessel and LP Vessels were 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.
- Chemical resisting coating was applied on channel covers of LO coolers (H-1814 A/B) & surface condenser (H-1815) end covers, to prevent corrosion and on blades of PT fan to minimize urea dust settlement.

OFFSITE MECHANICAL:

- Cooling water pump drive turbine (Q-4403) was overhauled.
- All cooling water pumps, BFW pumps and turbine were taken for preventive maintenance.
- IBR Inspection of BHEL Boiler, (GT-2068) was carried out.
- Study for assessment of BOM for replacement of Primary & Secondary Superheater coils along with associated Header was carried out by M/s BHEL , Trichi.

B & MH MECHANICAL:

- Existing worm Gear box of M-2110 was replaced with helical Gear box.
- Overhauling of Reclaim machine was carried out.
- All Conveyors and drive Gearbox were taken for preventive maintenance.

ELECTRICAL:

All the feeders of MCCs panel were thoroughly cleaned. Burnt out / damaged components of feeders were replaced. Tightness of connections was checked. All the protective relays were cleaned, checked, tested and calibrated. Relays found defective during testing were sent to authorized service center for repairing. Soot blower panel shifted to new location as per requirement by production department. New mimic panel was installed and commissioned at new location in Bagging plant to protect it from Urea dust.

Preventive maintenance of all transformers was carried out. Marshaling boxes were checked. Insulation resistance values of primary and secondary winding were taken between phase to phase and between phases to earth. Maintenance of on load tap changer of 12.5 MVA transformer carried out. Low value transformer oil filtered / replaced by new oil.

Maintenance of isolators in 66 KV yard was carried out. All porcelain insulators were cleaned. All vacuum circuit breakers were attended in 66 KV control room. Servicing of all vacuum circuit breakers in 11 KV substations were carried out. Hook up of DG supply in 11 KV panel was successfully carried out. All LT circuit breakers of TMG make in various MCCs were attended for trouble free operation.

All critical motors of plant were overhauled and defective bearings were replaced. All motor operated actuators were checked for their operation.

Rope switch of all conveyors in bagging plant attended for their operation. New switches replaced defective rope switches.

INSTRUMENTATION:

AMMONIA PLANT

- ESP – Phase II related instrumentation jobs for hooking up with existing HIMA PLC & DCS were carried out successfully.
- Compressor related jobs were carried out for 103J for the revamping of 103J LP and HP case. Mechanical Maintenance introduced new bearing pad thermocouples and the same were connected to the DCS system.
- Obsolete 7200 series Vibration Monitoring System of 105-J was replaced by the latest microprocessor based M/S Bently Neveda VMS systems of 3500 series.
- Old " differential pressure pneumatic transmitters " were replaced with new "smart electronic " types in various areas of the plant.
- Old type EYE HYE level monitoring system on HP steam drum (101F), were replaced by "LEVELSTATE" make Electronic type dual display systems.
- New Radar type level transmitters were installed for 103J seal oil systems in place of old pneumatic type measuring systems.
- Preventive maintenance of Control Valves was done for better reliability.

- Annual servicing of DCS/PLC systems, Analyzers, UPS and batteries were carried out to ensure better reliability.

UREA PLANT

- New control valves of PICV-1351 and FICV-1351 were installed.
- Servicing & overhauling of Control valves were carried out for better reliability.
- DCS/PLC servicing was carried out to ensure better reliability.

OFFSITE PLANT

- The BHEL Boiler control room old instrument panel removed for the modernization of the control room.
- The Stardom PLC taken in line for the BMS system for BHEL Boiler in place of the obsolete relay based system.
- Radar type level measuring system installed and commissioned for the old Ammonia tank as an additional level measuring system. Now there are 3 different type of level indications are available with the old Ammonia storage tank.
- Servicing/overhauling of all important control valves were carried out for better reliability.
- Servicing of PLC/DCS & various analyzers were carried out to ensure better reliability.
- Installed new weigh scale plateform & load cells with new indicator for the Ashbee make main gate Weigh Bridge of 40 MT capacity.
- Two Nos. of advanced type Modified Main Control Panels with CSC model controller of Power Build make Bag filling machines were installed in place of old & obsolete main control panels in bagging plant.
- Installed new electronic digital controllers with dual input type, Model US-100 were introduced in the Storage control room for the Ammonia compressors by replacing the old obsolete SLPC analog single input type controllers.

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.
- Providing and applying epoxy monolithic plaster on RCC Suspenders, walkways for conveyors, beams, columns and staircase of transfer tower of silo building and misc. work in B & MH building.

- Providing and applying IP Net protective coating on RCC wall of Conveyor gallery and other structures (Silo, B & MH, Urea plant etc.)
- F.R.V. lining on floor drain in water treatment plant and repairing of open channel near lagoon Phase-B and other plant area.
- Shifting of debris etc from various locations at plant site.
- Providing & applying 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, Auxiliary Reformer and BHEL boiler.
- 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 Plant :

- The equipments of ESP Phase-II viz. S-50 Converter, MP Waste Heat Boiler, Kick Back Cooler, Dehydrator, which were erected during running plant were hooked up, commissioned and taken into line.
- 142-CA BFW Pre-heater that was left over during Phase-I was erected, hooked up and commissioned.
- Additional BFW Coil was installed in the suction of ID Fan.
- High Pressure Ammonia Line from discharge piping of Ammonia Pumps of Urea Plant to Dehydrator of Ammonia Plant was hooked up. This line is required during start up of ammonia plant after ESP Phase-II.
- Additional Control valves parallel to PICV-3 was installed at the inlet of HTS in ammonia plant.
- Start up heater provided in S-50 Converter was commissioned.
- Hook up of ESP Piping was carried out.
- Revamping job of 103-J was carried out.
- Following equipments which were become redundant after completion of ESP Phase-II were removed.

  a. 175-C aMDEA Cooler.

Urea Plant:

For performance improvement of LP Absorber following jobs were carried out.

- LP absorber feed cooler (H-1208) has been installed at discharge of process water pump P – 1302 C/D.
- Existing cooler (H-1304) has been removed, and piping of inlet and outlet of cooling water changed to 6"NB.
- Control valve (HICV-1206) has been installed in 3" line from LP absorber out let line.
- Direct connection of P-1305 A/B discharge line going to existing H-1304 & outlet line going to H1352/H1205A has been carried out.
- Necessary piping was carried out for installation of following control valves.
  - PIVC-1221A – BFW water makeup to CCS-II.
  - PICV-1106 – 2" x 300# Ammonia Vapor Line of ammonia suction vessel.
  - LCV-1504A – 1 ½" x 300# D M Water makeup to steam condensate.

  Control Valves which were not available, shall be installed after receipt.
- Flash Tank No.V-1421 has been removed as part of performance improvement of Flash Tank Condenser H-1421. An associated piping job has carried out.
- Water Seal system as suggested by M/s Stami Carbon was installed on top of T-1401.

OFFSITE PLANT:

- Heat Exchanger removed from GHH Lub Oil System, modified and installed for heating of Gas for Burners of Boiler. Associated piping was carried out.

PLANT TURNAROUND APRIL - MAY - 2006

GENERAL - DETAILS

SR. NO.	CATEGORY	QUANTITY
(A)	**EQUIPMENT UTILIZED :**	
	IFFCO :	
	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
	14 T Escort Lift-N-Shift	01 No
	03 T Forklift	03 Nos.
	10 T 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	85
2	General Fitter	1065
3	Rigger	1218
4	S.S. Rigger	3799
5	Fabricator	188
6	Grinder	268
7	Gas Cutter	125
8	IBR Welder	81
9	Non-IBR Welder	122
10	Carpenter	81
11	Mason	84
12	Machinist	96
13	Draftman	06
14	Master Rigger	45

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

MAINTENANCE JOBS CARRIED OUT BY OUTSIDE AGENCIES

SR. NO.	WO NO. & DATE	DESCRIPTION OF JOB	VENDOR'S NAME
1	9918680 22/02/2006	Insitu valve repairing	M/s EFCO , Hyderabad
2	9918964 21/03/2006	Scaffolding, Blinding, Deblinding.	M/s .Anu Engineers., Vadodara
3	9918718 13/06/2006	Insitu retubing of 102-C	M/s EMKAY Construction, Vadodara
4	9916659 09/02/2005	Revamp of 103-JLP/ HP Case	M/s Swamina International, Vadodara
5	S-00141/P/ 108-A / ICB 15/02/2006	Revamp of 103-JLP/ HP Case	Ms Dressor Rand, France
6	9918727 16/02/2006	RV testing & Floating	M/s Dembla valves pvt.Ltd, Thane
7	9918564 18/01/2006	RV testing & Floating Boiler	M/s Flotech , Surat
8	9918857 31/12/2006	Erection contract for Reformer Revamp-III	M/s Neo Structo, Surat
9	9918855 28/02/2006	Insulation contract for Primary Reformer.	M/s Balaji Insulation, Thane
10	9918538 18/01/2006	Arch Roof insulation	M/s Unifrax, Mumbai
11	9918909 21/03/2006	Overhauling & preventive maint.of Rotary equipments	M/s SPIC-SMO Ltd, Mumbai.
12	9918910 21/03/2006	Over hauling and preventive maint. of rotary machines.	M/s Turbo Engg. Services Pvt.Ltd, Hyderabad.
13	9918970 20/03/2006	Plate type Heat Exchanger cleaning	M/s Alfa Leval , Vadodara
14	9918601 17/01/2006	Overhauling of Sluice Gates	M/s Jash Engineering Ltd, Indore
15	9918728 06/02/2006	Insitu Repacking of Glands of valves	M/s Amrutha Engineering Ltd,. New Panvel
16	9918776 08/02/2006	Insitu machining, overhauling & on line testing of Safety valves of BHELBoiler	M/s Flowtech Engineering services, Surat
17	99171777 12/05/2005	Replacement of wooden components of urea cooling tower	M/s Paharpur cooling tower, Vadodara
18	9918888 07/03/2006	Study of Super Heater coils & associated headers of BHEL Boiler.	M/s BHEL, Trichi
19	9916604 10/02/2005	Repair of Gas burners in BHEL Boiler	M/s Thermax, Pune
20	9918497 07/01/2006	Overhauling of Reclaim Machine	M/s EMTICI Engineering Ltd, V.V.Nagar
21	9918276 12/12/2005	Rubber lining on pulleys	M/s J.K.Rubber works, Ahmedabad
22	9915252 12/05/2005	Splicing & making diamond type Vulcanizing joint of Belt conveyor	M/s J.K.Rubber works, Ahmedabad
23	9916832 16/03/2005	Hydro jetting of Heat Exchangers tubes	M/s Delux Hydro Services , Mumbai
24	9918478 13/01/2006	Opening & Boxed up of Heat Exchangers.	M/s General Engineering works ,Bharuch

25	9918917 21/03/2006	Assisting IFFCO during shut down /plant turnaround jobs	M/s Ram Bahadur & company, Pali Babuganj
26	9918919 21/03/2006	Assisting IFFCO during shut down /plant turnaround jobs	M/s Saiyed & co, Saij
27	9916820 30/03/2005	Hot & cold insulation in Urea & B& MH Plant.	M/s Khandelwal Insulation Pvt ltd Mumbai.
28	9916324 22/01/2005	Hot & cold insulation in Ammonia & Offsites Plant	M/s Balaji insulations, Thane
29	9918070 24/11/2005	Fabrication & erection of piping & steel structure	M/s Aneesh Engineers, Kalol
30	9918078 24/11/2005	Fabrication & erection of piping & steel structure	M/s J & J Engineers, Shertha
31	9915231 15/05/2004	Supply & application of anti corrosive paint U & B&MH	M/s B Chauhan & Company, Kalol
32	9918214 7/12/2005	Supply & application of anti corrosive paint Ammonia & Offsites	M/s B Chauhan & Company, Kalol
33	9918571 01/02/2006	RFET of 102-C Tubes	M/s Testex NDT, Mumbai
34	9918808 21/02/2006	Rediography team, on round the clock basis	M/s NDT Services, Ahmedabad
35	9918299 17/01/2006	In-Situ metlography	M/s.TCR Advance, Vadodara
36	9918903 09/03/2006	Thickness Teams	M/s NDT Services, Ahmedabad
37	9918702 02/02/2006	Dye Penetrant Teams	M/s.NDT Services, Ahmedabad
38	9918286 14/12/2005	MPI Teams	M/s.NDT Services ,Ahmedabad
39	9918402 03/01/2006	UFD Teams	M/s.NDT Services, Ahmedabad
40	9918595 02/02/2006	Eddy Current testing of HP Stripper & HP Condenser tubes	M/s Testex NDT, Mumbai
41	9918637 28/01/2006	Welding Inspector	M/s Quality Industrial X-Ray Co, Mumbai
42	9918655 07/02/2006	Servicing of L&T ACBs.	M/s. K.J. Electronic corporation, Chhatral
43	9918943 31/03/2006	Maint.of transformers at plant site	M/s.Volt AMP transformers Pvt.Ltd,Vadodara
44	9918717 09/02/2006	Servicing of Siemens make VCBs	M/s. Siemens Ltd, Vadodara
45	9918654 28/02/2006	Servicing of Siemens make LT ACBs	M/s Siemens Ltd, Vadodara
46	9918627 31/01/2006	Relay testing.	M/s Torrent Power AEC Ltd, Ahmedabad
47	9918816 07/03/2006	Overhauling of OLTC of Transformer	M/s Easun-MR Tap Changers Pvt. Ltd,Chennai ,Chennai
48	9918105 24/11/2005	Replacement of Rotork MOVs.	M/s Rorork controls Pvt Ltd, Mumbai
49	9918037 10/11/2005	Pre.Maint.of Ammoni & Urea Plant DCS	M/s.Yokogawa India Ltd, Vadodara
50	9918861 03/04/2006	Pre.Maint.of Amm.plant PLC	M/s. L & T L td, Navi Mumbai

51	9916234 27/11/2004	Pre.Maint./ Checking of Amm.plant UPSS	M/s.Instrumentation Ltd, Kota
52	9918223 07/12/2005	Installation / Commissioning of 3500 series vibration monitoring system for Refrigeration Gas Compressor of Ammonia plant	M/s.GE India Industrial Pvt.Ltd, New Delhi
53	9916725 18/02/2005	AMC UPS Batteries	M/s.AMCO Power System Ltd,Banglore
54	9916636 29/03/2005	Maint.of Control Valves	M/s.Hi-tech Controls, Vadodara
55	9918774 22/02/2006	Assisting IFFCO in S/D Jobs	M/s.A-Z Instruments Servics,Vadodara
56	9917069 20/03/2005	Boiler drum monitoring system	M/s High tech Systems & Services Ltd, Kolkata
57	9918467 04/01/2006	Providing & applying epoxy monolithic plaster on RCC Supenders ,walkway for conveyor, beams,columns and staircase of transfer tower of silo building & misc work in B&MH building.	M/s.Shreeji Chem Ent., Vadodara
58	9918707 10/02/2006	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
59	9918754 11/01/2006	Repairs of Refractory lining work Inside Primary, Auxilary Reformer and BHEL Boiler.	M/s.Nu Consult, Kolkata
60	29918731 08/02/2006	To carry out repair of damaged Top cover Plywood sheets of cooling Towers	M/s Akruti, Ahmedabad
61	9918629 24/01/2006	Repair & Maintenance of Biumastic 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
62	9918709 11/02/2006	F R V lining on floor drain in water treatment plant and repairing Of open channel near lagoon phase-B and other plant area.	M/s Gayatri Construction, Ahmedabad
63	9918628 21/01/2006	Shifting of debries /malvas etc. From various location at plant site.	M/s Perfact Handlers, Gandhi dham
64	9918473 04/01/2006	Providing and applying epoxy painting in RCC structure of bagging plant transfer tower, prill cooling systems and hydrolizer urea plant area.	M/s B.Chauhan and company. Kalol
65	9918504 04/01/2006	Repair of damaged flooring of urea plant prill cooling system	M/s Gayatri Construction, Ahmedabad
66	9918631 24/01/2006	Repair of damaged AC sheet of cooling tower, Reformer and other area in plant.	M/s J.H.Corparation, Ahmedabad
67	9918935 11/03/2006	Installation of BFW Coil	M/s Shree Ganesh ,Ahmedabad

AIR COMPRESSOR TRAIN (101-J)

101-JT Air Compressor Drive Turbine Preventive Maintenance

Turbine was decoupled and both the journal bearings as well as thrust bearing were inspected and found O.K. Gauss measurement of rotor shaft & bearings carried out. Gauss reading of thrust end shaft journal (5.29 Gauss), thrust collar (6.0 Gauss), Opposite thrust journal shaft (5.4 Gauss) was higher and the same was reduced below 3 Gauss by degaussing. Bearing clearances were taken and found within the design values. Greasing of the Governor linkages was carried out. The governor drive GB at front end of the turbine was also overhauled and boxed up.

101-JLP Air Compressor Preventive Maintenance

Journal bearings and thrust bearings were inspected and found O.K. Gauss measurement of rotor shaft and bearings carried out. Gauss reading of opposite thrust end journal shaft (6.5 Gauss) and pads (10.2 Gauss) was higher and the same was reduced below 3 Gauss. The entire bag filters as well as Roll-O-Matic filters were replaced.

101-JR Gearbox Preventive Maintenance

All the bearings were inspected and found O.K. Both the gear as well as Pinion were inspected and found to be O.K. Gauss measurement of gear shaft and bearings carried out and found above limits and hence demagnetized. The thrust bearing of the gear was replaced.

101-JHP Air compressor Preventive Maintenance

Journal bearings as well as thrust bearings were inspected and found O.K. Gauss measurement of rotor shaft and bearings carried out and found above limits and hence demagnetized to reduce to less than 3 Gauss.

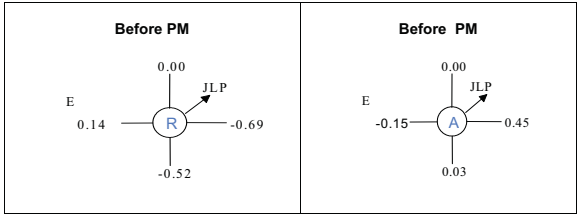
The readings taken during the preventive maintenance of 101J train are recorded as under:

Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
101 JT			
Thrust end Bearing	0.007 - 0.009	0.008	0.008
Opp. thrust end bearing	0.007 - 0.009	0.008	0.008
Axial Thrust	0.008 - 0.012	0.010	0.010
Thrust end oil guard ‘A’	0.002”-0.004”	0.006	0.006
Thrust end oil guard ‘A’	0.002”-0.004”	N.A	N.A
Thrust end oil guard ‘C’	0.015”-0.021”	N.A	N.A
Opp thrust end oil guard ‘C’	0.015”-0.021”	0.016	0.016
Opp thrust end oil guard ‘G’	0.058”-0.097”	N.A	N.A

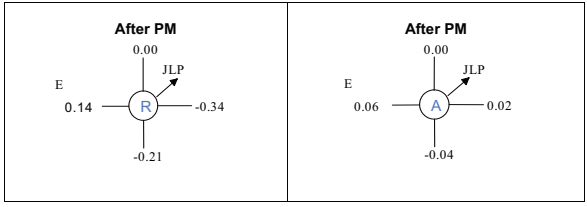
Governor Drive Gear Box			
Gear thrust	N.A	0.009	0.009
Gear bearing (inside)	N.A	0.0025	0.0025
Gear bearing (outside)	N.A	0.0025	0.0025
Backlash	N.A	0.006	0.006
Pinion thrust	N.A	0.024	0.024
Pinion bearing (inside)	N.A	0.002	0.002
Pinion bearing (outside)	N.A	0.002	0.002
101 JLP			
Thrust end bearing	0.006 - 0.008	0.008	0.008
Opp. Thrust end bearing	0.006 - 0.008	0.008	0.008”
Axial Thrust	0.011 - 0.015	0.014”	0.014”
Thrust end oil guard ‘G’	0.021”-0.027”	0.006-0.008”	0.006-0.008”
Thrust end oil guard ‘H’	0.002”-0.004”	N.A	N.A
Thrust end oil guard ‘H’	0.002”-0.004”	N.A	N.A
Thrust end oil guard ‘G’	0.021”-0.027”	N.A	N.A
Opp. Thrust end oil guard ‘G”	0.021”-0.027”	0.004”	0.004”
Opp. Thrust end oil guard ‘G”	0.021”-0.027”	N.A	N.A
101 JR			
Drive gear North bearing	0.008 - 0.011	0.012	0.011
Drive gear South bearing	0.008 - 0.011	0.011	0.011
Axial Thrust	0.014-0.024	0.014	0.012
Pinion North bearing	0.009 - 0.011	0.009	0.009
Pinion South bearing	0.009 - 0.011	0.010	0.010
Free float	N.A	0.041	0.043
Backlash	N.A	0.015”	0.016”
101 JHP			
Thrust end bearing	0.004 - 0.007	0.005	0.006
Opp Thrust end bearing	0.004 - 0.007	0.0055	0.006
Axial Thrust	0.008 - 0.012	0.010	0.010
Thrust end oil guard ‘F’	0.002”-0.004”	0.006-0.008	0.006-0.008
Thrust end oil guard ‘F’	0.002”-0.004”	N.A	N.A
Thrust end oil guard ‘E’	0.015”-0.022”	N.A	N.A
Opp Thrust end oil guard ‘E’	0.015”-0.022”	N.A	N.A
Opp Thrust end oil guard ‘E’	0.015-0.015”	N.A	N.A

101-J Train alignment readings (Dimensions in mm):

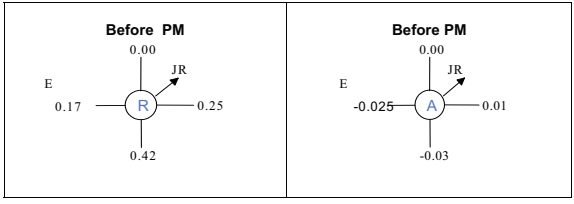
101-JT to 101-JLP



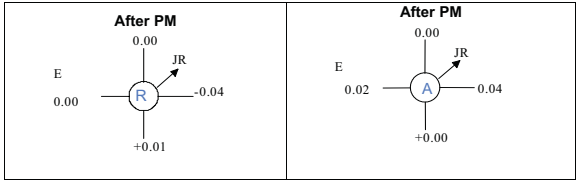
101-JT to 101-JLP



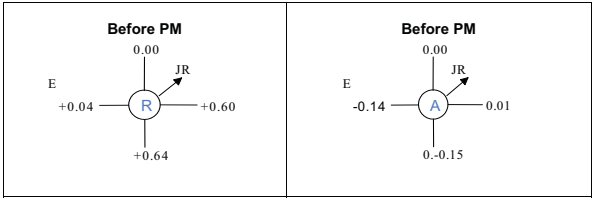
101-JLP to 101-JR



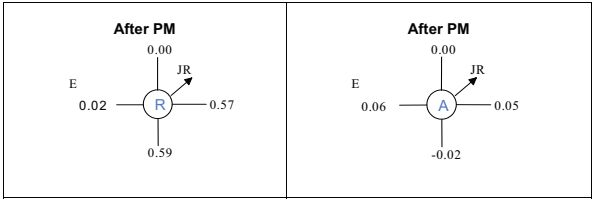
101-JLP to 101-JR



101-JR to 101-JHP



101-JR to 101-JHP



SYNTHESIS COMPRESSOR TRAIN (103-J)

During Preventive maintenance of 103 JBT and 103 JAT Turbines, gear coupling between 103 JBT and 103 JAT was checked for its free float. While the inspection of the coupling it was noticed that very less float in the spool piece. Opening the spool piece it was found the hub of 103JAT shaft slipped out and overhung by 6-7 mm.

On measurement, the coupling Hub face was found projected by 7.1 mm from shaft face. This excessive projection of coupling Hub from the shaft face clearly indicated slippage of coupling Hub from the shaft. (Normally the Hub face should be flush with shaft face OR it may be ± 0.5 mm after hydraulically fit up) The hub could not be removed with expander pressure up to 35000 psi. The hub was taken out by cutting with hand grinding machine. The coupling shaft area found badly damaged due to the metal flow by the coupling hub slippage. (Rotor Sr.No.TR 444)

We do not have a spare rotor for this Turbine as new spare rotor, which is on order, is not expected to reach us before September'2006. Hence it was very much necessary to get the damaged rotor (Sr. No. TR 444) repaired through a competent repairer.

Turbine was taken for overhauling to attend the shaft taper and casing parting plane leak

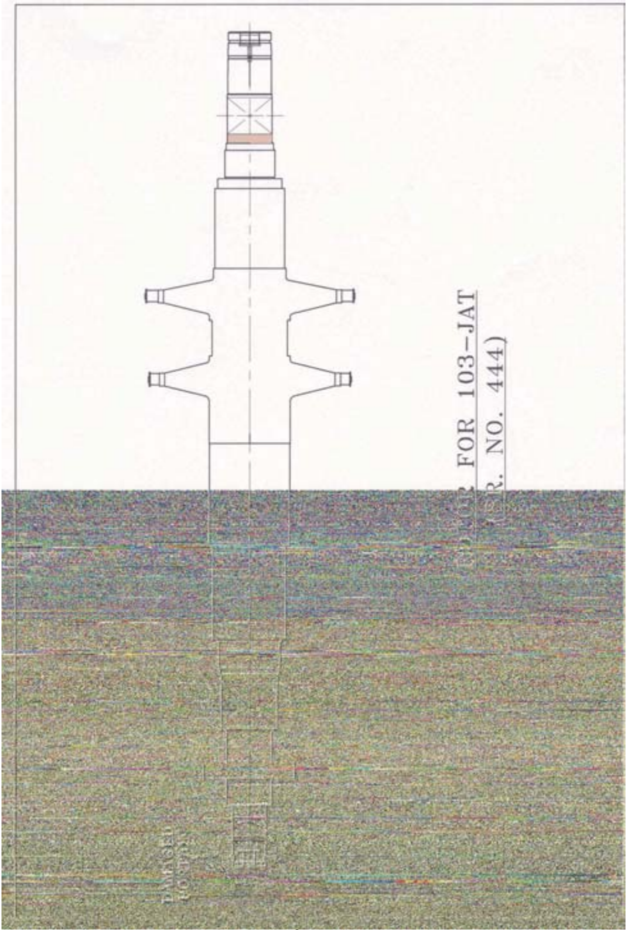
In past we had carried out such type of repairs at the OEM's works in USA. However as we had to reinstall the rotor at the earliest to meet the shutdown schedule, the same was to be repaired in India. M/s Man Turbo India Pvt. Ltd., Vadodara is an MNC vendor who has recently established full fledged repair shop for turbo machinery components and also has High Speed Balancing Tunnel for operating speed balancing of the rotor.

Dismantling of Turbine

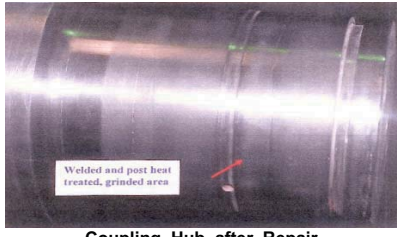
Turbine was decoupled at both ends. Both journal bearing clearances and axial thrust was recorded and alignment readings were taken. Turbine steam outlet pipe and steam chest valve was removed. Turbine casing was removed and labyrinth clearances were found within the design value

Hence, on dismantling of the turbine, we had called the representatives of M/s Man Turbo India Pvt. Ltd., Vadodara for the inspection and feasibility of the repair of the damaged rotor at their works. After their preliminary inspection at our site, the rotor was sent to their works for final inspection.

Earlier High Velocity Oxygen Fuel Thermal Spray Process suggested it to repair the damage. But the depth of the damage was more than 1 mm deep which is not repairable by HVOF as there is possibility of peeling off the material deposited, due to torsion stress during running of the turbine. Hence it was decided to repair the damage area by welding process as per API-687, Rotor repair.


FOR 103–JAT
NO. 444)

Coupling Hub before Repair



Coupling Hub after Repair

REPORT ON REPAIRS PERFORMED ON 103-JAT ROTOR SHAFT AT M/S.MAN TURBO CO. LTD., VADODARA

The damaged rotor was sent to M/s.Man Turbo after removal of coupling hub by grinding (103-JAT to 103-JBT coupling). The following activities were performed during 16-04-2006 to 29-04-2006 on the rotor by M/s.Man turbo, Vadodara.

1.0 Preparation of mock up test piece for qualifying WPS & PQR.

2.0 Preparation of mockup shaft end for qualifying WPS/PQR and to find out distortion.

3.0 Welding on old damaged rotor shaft at 103JAT-JBT coupling end taper using approved WPS according to 1.0 & 2.0.

4.0 Actual welding operation, machining and final lapping on the rotor, followed by coupling installation. Detailed activities performed are described below:-

1.0 MOCK-UP TEST FOR QUALIFYING WPS-PQR:-

1.1 Chemical analysis of rotor shaft was performed using two methods, (1) PMI (2) Wet analysis.

- The PMI (Positive Material Identification) test revealed the chemical composition of the rotor shaft as follows. (Readings were taken on five different spots).
  Cr :0.45 to 0.52% ,
  Ni :2.20 to 2.44% ,
  Mo :0.42 to 0.46%
  Mn :1.25 to 1.57% ,
  v : 0.00 to 0.02%

- The wet analysis was also performed on the sample chips collected during machining the groove on the coupling taper end for the purpose of welding. The wet analysis results are given below:
  C0.27%
  Cr0.61%
  Mn1.20% ,
  Mo0.60%,
  Ni2.39%

1.2 A mock up test piece of 3.5 inch OD x 5 inch long was cut from En-24 material forging. Welding was performed on the OD of this mock up test piece as follows:

- Filler wire 1.6 mm dia
- Filler wire composition : C 0.11,Mn 0.5, Si 1, Cr 29, Ni 9, MG 600, (E 312-16 equivalent properties)
- Welding method : TIG welding
- Travel Rate : 15-20 mm/minute
- Current : 90 – 100 Amps, Volt Range : 9 – 11 volts
- Position of test piece : 2G
- Preheat Temp. : 150 deg.C

1.3 On completion of welding, DP test was performed on the weld deposit. No defects were observed. The piece was then released for PWHT.

1.4 Heat treatment was performed as follows:-
- Soaking Temperature:550 deg.C
- Soaking Period:1 Hour
- Heating & Cooling Rats:100 deg.C / hour
- Unloading temp.:200 deg.C
- Interpass Temperature:200 deg.C

1.5 On completion of the Heat Treatment, the mockup test piece was subjected to various examinations. Details of tests performed and the results of the tests is given below:-

- **Dye Penetrant Inspection**:- No defects were detected on weld. HAZ and parent material after SR.

- **Metallography**:- Sample was cut from the mockup test piece and it was submitted to M/s.TCR Advanced Laboratory, Vadodara for metallurgical analysis, hardness profile etc. The following results were observed:-
- **HARDNESS TEST**:- Micro hardness profile was taken on the cross section. The following hardness values were observed as under:

Distance from surface (Microns)	Micro hardness in "VPN" at 500 gm load	Micro hardness in "VPN" at 100 gm load
On weld	248	291
500(on weld)	242	253
1000(HAZ)	381	325
1500(HAZ)	367	318
2000(HAZ)	322	330
3000(HAZ)	290	303
3500(PM)	260	271

- **MICROSTRUCTURE EXAMINATION** (at 1200X):- Micro structure HAZ revealed tempered martensite / bainite structure. Near fusion line between weld and HAZ, presence of ferrite was observed. Parent metal structure showed fine tempered martensite structure.
-

1.6 **Discussion On Test Results:-**

Based on the findings, the following changes were considered for further mockup.

- Heating/cooling rate was reduced to 60 deg.C /hr.
- Soaking temperature was increased from 550 degC to 640 degC.
- Soaking period was increased from 1.hr to 3 hrs.
- No changes were proposed in weld filler wire. However, weld travel speed was proposed to be increased to reduce heat input.
- Welding sequence was proposed to be changed to staggered welding with 90 deg.C circumferential deposition to avoid overheating.

2.0 MOCK-UP TEST ON TEST PIECE AS PER SHAFT DIMENSIONS:-

2.1 In order to ensure that minimal distortion is taking place on the shaft, it was decided to make a test piece as per the shaft dimensions matching with coupling taper end and also the length according to actual taper end. The WPS for this mockup test was the same as done during first attempt, except the following changes made based on the observations of different tests conducted on previous mockup test piece:-

- The mockup test piece was kept in vertical position.
- The dead weight of 6 kg was hanged on the test piece from the bottom. This was done to avoid distortion of the test piece during welding and preheating.
- The welding travel speed was increased from 15-20 mm/min to 50-60 mm/min.
- Soaking temperature was increased from 550 deg C to 640 deg C. All other changes were implemented as mentioned in Para 1.5.2.3

2.2 On completion of the welding and Heat treatment, testing was carried out as follows:-

- Dye Penetrant Examination : No defect observed.
- Magnetic Particle Examination : --- do –

- Ultrasonic flow detection : After performing flush grinding of the weld, normal beam scanning was carried out to detect any defects at the bonding layer. No defect was detected.
- Runout was checked. No distortion was measured.
- Cross section of the welded test piece was taken to M/s.TCR Advanced Laboratory, Vadodara. Following examinations were done and findings were observed after the test:-

Micro Hardness Profile:

Distance from surface (Microns)	Micro hardness in "VPN" at 500 gm load	Micro hardness in "VPN" at 100 gm load
On weld	276	277
500(on weld)	293	316
1000(HAZ)	310	313
1500(HAZ)	306	289
2000(HAZ)	264	241
3000(HAZ)	245	214
3500(PM)	210	210

Micro Structure Examination (At 1200x):
Micro structure at HAZ showed tempered martensite / bainite structure. Fusion was found to be normal.

2.3 **Discussion On Test Results:-**

Based on the findings, the following changes were considered for further mockup to be conducted on old rotor shaft assembly available with IFFCO Kalol.

- Soaking Temperature to be reduced from 640 deg.C to 600 deg.C in order to control possible distortion of the rotor shaft.

- Soaking period was increased to 3 hrs to 5 hrs.
  No other changes were suggested.

3.0 MOCKUP TEST ON OLD ROTOR SHAFT OF 103-JAT:-

We had one no damaged rotor shaft available, which was removed from service due to failure of the shaft on coupling end towards 103-JLP case. It was proposed by M/s.Man turbo to have confirmatory weld on the actual rotor shaft prior to executing weld repairs on the job. This was done due to following two major reasons:-

- The chemistry of the mockup pieces used for qualifying WPS was EN-24 whereas the chemistry of actual rotor shaft deviated slightly from En-24 composition. To ensure defect free welding and to confirm suitability of filler wire, welding on actual shaft material will help.

- The possible distortion due to Heat Treatment and Heat input during welding on the actual rotor shaft which was removed from service can be simulated with better accuracy.

3.1 In view of the above, mockup test was conducted on old rotor shaft after creating the groove on taper end, having 8mm width x 2mm depth.

3.2 All the parameters during welding were maintained except those listed below:-

- Soaking period was increased from 3hrs to 5hrs.
- Soaking temperature was changed from 640 degC to600degC.
- On completion of welding, insitu non destructive tests were only performed.

3.3 **Test Results**:-

The following tests were carried out on completion of welding & PWHT.

- **Runout Check**:
  Runout was found to be less than 7 microns.

- **MPI & LPI**
  Fluorescent MPI & liquid penetrant inspection were carried out on the weld area. No defects were detected.

- **Ultrasonic Test**:
  Using normal beam probe, scanning was done on complete periphery to detect any defects in fusion zone. No defects were detected.

- **Insitu Metallography**:
  Microstructure examination was performed using replica. No abnormalities were detected.

- **Hardness Test:**
  Using ultrasonic hardness tester, MIC-20 hardness measurement was performed on weld and parent metal and HAZ before PWHT. Readings are given below:

Parent material	:	280-289 HV
HAZ	:	259-284 HV
Weld	:	281-285 HV

3.4 **Discussion On Test Results:**

Based on the findings, the following changes were considered for final welding operation on the actual rotor shaft.

- Soaking period was increased form 5 hrs to 7hrs
- Soaking temperature was increased from 600 deg.C to 620 deg.C to control weld hardness.
- Staggered welding was ensured in eight quadrants and travel speed was maintained to 50 mm/minute.

4.0 ROTOR REPAIR:

Based on the results of various tests conducted after two mockups on sample pieces and one mock up on actual old rotor shaft of the same turbine and based on subsequent results of various test performed, parameters for welding, parameters for PWHT after welding and subsequent testing methodology were decided. Welding operation was performed using the following welding parameters.

4.1 Welding Parameters:

- Weld method :TIG with filler wire deposition
- Filler wire dia :1.6 dia mm
- Filler wire grade & compositionMG 600
- Weld deposition speed :50 mm/min
- Job orientation :Vertical
- Weld position :2G
- Weld :Stringer bead
- Groove size to be filled :
- Circumferential Groove - 8mm wide x 2 mm deep
- Longitudinal Groove 3mm wide x 2mm deep x 25mm length

4.2 PWHT:

- Prior to PWHT, hardness was measured and found as follows.
  Parent material: 240-259 HV
  HAZ : 238-250 HV
  Weld : 254-319 HV
- PWHT was performed keeping the following parameters:-
  PWHT temperature (Soaking Temp.) : 620 deg.C
  Soaking period :7 Hrs.
  Heating & Cooling Rate:35 deg.C / hour
  Unloading temperature:200 deg.C
- Insulation was removed after attaining 100 deg.C temperature. Rotor position was kept vertical until the temperature came down to room temperature.

4.3 On completion of the PWHT, mechanical runout was checked on "V" blocks. Max. runout was observed to be 8 microns. Runout before PWHT (after welding) was also limited to 8 microns max.

4.4 All the test viz. LPI,MPI,Ultrasonic flaw detection, Hardness measurement were performed as per the earlier procedures and the results were satisfactory. Hardness readings are given below:-

- Parent material: 236-255 HV
- HAZ : 230-255 HV
- Weld : 298-320 HV

Finally, the weld deposit reinforcement was machined and followed by manual lapping to ensure proper blue match. Special cast iron fixtures were prepared for lapping of the shaft taper.

5.0 <u>COUPLING HUB INSTALLATION ON 103-JAT ROTOR</u>

The following coupling hub were fitted on the rotor at M/S Man Turbo works before the dispatch.

- Gear coupling Hub towards 103-JBT side (for gear coupling between 103-JAT & 103-JBT)
- Shim pack coupling Hub towards 103-JLP side (for Shim pack coupling between 103-JAT & 103-JLP)

The following procedure was followed for installation of above both the coupling Hubs:

- The shaft end & coupling bore was polished and check the blue match. It was found to be more than 85 %.
- The coupling hub was inserted on shaft with and without O-ring & back-up washer and respective stand off were noted for calculating the final travel of hub on the shaft. Dial indicator was set to hub face to measure travel of hub.
- The pusher & expander pump were connected to the shaft end with adaptor and removed the entrapped air.
- A positive pressure was developed in the pusher pump and then the expander pressure was increased gradually to ensure smooth push of the hub over the shaft by increasing the pusher pressure slightly. At every stage of expander and the pusher pump pressure, the travel of the hub was observed in the dial indicator to ensure the movement of hub travel over the shaft.
- After attaining the final hub position as per the requirement, the expander pump pressure was gradually released and maintained positive pressure in the pusher pump. The pusher pump pressure was retained for additional 20 minutes and finally released.

5.1 Installation of Gear coupling hub (for the coupling between 103-JAT to 103-JBT) on 103-JAT rotor towards 103-JBT side

The readings recorded during the hub fit up at M/S Man Turbo are given below:

Sr. No	Description	Design Value	Actual Value
1	Blue match of coupling hub on the shaft with out 'O' ring and back up washer	-	85%
2	Dry fit stand off W/O O-ring(Hub face to Shaft face)	N.A.	6.50 mm
3	Drive required	8.73 mm	8.73 mm
4	Expander pressure	23000 - 25000 psig	23000 psig
5	Pusher pressure	500 psig	1000 psig
6	Over-ride after the drive(hub on shaft)		2.23 mm

5.2 Installation of Shim pack coupling hub (for the coupling between 103-JAT to 103-JLP) on 103-JAT rotor towards 103-JLP side

The readings recorded during the hub fit up at M/S Man Turbo are given below:

Sr. No	Description	Design Value	Actual Value
1	Blue match of coupling hub on the shaft with out 'O' ring & back up washer	-	85%
2	Dry fit stand off W/O O-ring(Hub face to Shaft face)	N.A.	11.8 mm
3	Drive required	10.16 mm	10.52 mm
4	Expander pressure	23000 -25000 psig	23000 psig
5	Pusher pressure	500 psig	1000 psig
6	Over-hung after the drive(hub on shaft)	N.A	1.28

6.0 PROVISION OF LOCKING NUT FOR COUPLING HUB

The problem of slippage of hydraulically fitted coupling during the running of the machine was discussed with M/S Man Turbo. They suggested that, it is Man Turbo's normal practice to provide **LOCK NUT** on the face of coupling hub after its hydraulically fitting. This will prevent the movement of the coupling hub during running. IFFCO requested M/S Man Turbo to design the suitable lock nut for following coupling hubs:

- Lock Nut for Gear Coupling hub for 103-JBT rotor
- Lock Nut for Gear Coupling hub (103-JBT side) for 103-JAT rotor
- Lock Nut for Shim Pack Coupling hub (103-JLP side) for 103-JAT rotor

Accordingly **LOCK NUTS** as mentioned above were designed and manufactured by M/S Man Turbo out of EN 24 forged material. The lock nuts on repaired rotor were provided after fitting both the coupling hub on the rotor at Man Turbo works and rotor was brought to site. M/S Man Turbo also supplied the lock nut for 103-JBT rotor as loose supply which was to be fitted on the 103-JBT rotor at site.

After assembly of the 103-JAT rotor, following problems were observed:

- The loose **LOCK NUT** supplied for 103-JBT rotor could not be fitted because of space constraint in the Gear Coupling assembly. It was not possible to modify this **LOCK NUT** and hence the same was not provided.
- The OD of the **LOCK NUT** provided for the gear coupling hub (103-JBT side) of rotor was found fouling in the spacer. Hence the same was removed from the rotor and its OD was reduced from 110mm to 80mm with modification on drilled holes provided during balancing.
  High speed balancing of the rotor was carried out at MAN Turbo Works along with LOCK NUT fixed on the rotor, hence while reducing OD of LOCK NUT from 110mm to 80mm following revised drilled hole diameter end depth were calculated to have appropriate mass removal to avoid balancing after fixing the modified LOCK NUT.

Sr. No.	Hole location	Clockwise direction drill location (from Zero mark)	Drill size & depth (actual)	Weight (calculated) at 110mmØ (55R)	Weight (Required) at 80mmØ (40R)	Drill size & depth (Required at 80mm Ø OD)
1	P1	1 (55^0)	7ø x 4.5deep	1.35 Grams	1.86 Grams	7ø x 6.2 deep
2	P2	2 (90^0)	8ø x 3.2 deep	1.28 Grams	1.76 Grams	8ø x 4.4 deep
3	P3	3 (188^0)	7ø x 0.5 deep	0.15 Grams	0.21 Grams	7ø x 0.7 deep
4	P4	4 (242^0)	7ø x 3.5 deep	1.05 Grams	1.44 Grams	7ø x 4.8 deep
5	P5	5 (276^0)	6ø Counter sunk	-	-	6Ø Counter sunk
6	P6	6 (288^0)	7ø x 5.0 deep	1.5 Grams	2.1 Grams	7ø x 7.0 deep

TYPICAL CALCULATION FOR HOLE NO.P1:

Formula used for calculating the new weight correction is given below.

$M_1 \times R_1 = M_2 \times R_2$ 1= Before modification (110 mm Ø)

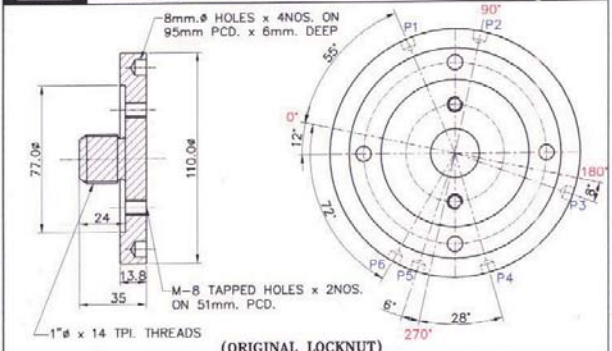
$1.35 \times 55 = M_2 \times 40$ 2= After modification (80 mm Ø)

M_2 = 1.86 Grams

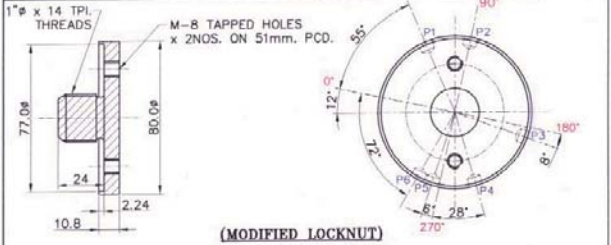
Hence, Revised depth of holes was calculated as follows:-

Weight Removal by 7 Ø hole and 1mm depth = 0.3 Grams therefore for 1.86 Grams with 7 Ø new depth required = 1.86 ÷ 0.3 = 6.2mm

IFFCO INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL



(ORIGINAL LOCKNUT)

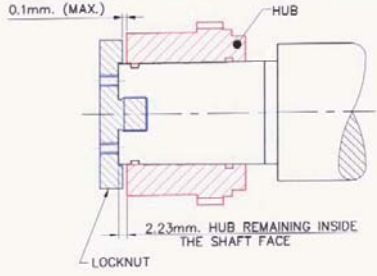


(MODIFIED LOCKNUT)

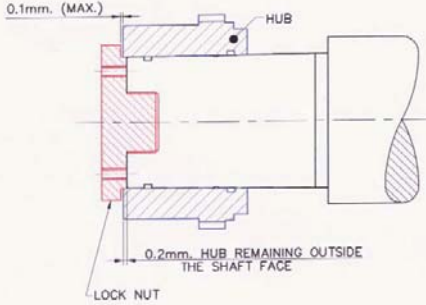
DETAIL OF DRILL HOLES PROVIDED ON PERIPHARY FOR BALANCING

	ORIGINAL (110.0ø LOCKNUT)	MODIFIED (80.0.ø LOCKNUT)
P1	7ø x 4.5mm. DEEP	7ø x 6.2mm. DEEP
P2	8ø x 3.2mm. DEEP	8ø x 4.4mm. DEEP
P3	7ø x 0.5mm. DEEP	7ø x 0.7mm. DEEP
P4	7ø x 3.5mm. DEEP	7ø x 4.8mm. DEEP
P5	6ø COUNTERSHUNK	6ø COUNTERSHUNK
P6	7ø x 5.0mm. DEEP	7ø x 7.0mm. DEEP

DRN	કુમારી	TITLE - "LOCK NUT" (ORIGNAL & MODIFIED) FOR COUPLING HUB OF 103-JAT ROTOR (SR. NO. TR-444) FOR GEAR COUPLING (TOWARDS 103-JBT SIDE)		EWR No.
CHD				
APD		DRAWING No.	PLANT / FROM / NUMBER	SHEET OF / REV.
SCALE	1 : 1.75	CODE AMM-000	P 1 E S - - - - - -	1 1 / 0



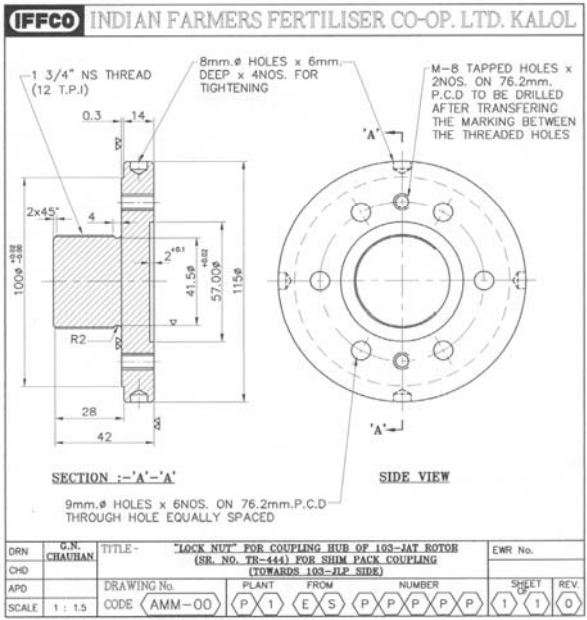
"LOCKNUT" ARRANGEMENT
FOR GEAR COUPLING HUB TOWARDS 103-JBT SIDE
(FOR GEAR COUPLING BETWEEN 103-JAT TO 103-JBT)



"LOCKNUT" ARRANGEMENT
FOR SHIM PACK COUPLING HUB TOWARDS 103-JLP SIDE
(FOR SHIM PACK COUPLING BETWEEN 103-JAT TO 103-JLP)

DRN	N. V. Panchal	TITLE - "LOCKING NUT" ARRANGEMENT FOR COUPLING HUBS OF 103-JAT ROTOR (SR. NO. TR-444) (REPAIRED AT MAN TURBO APRIL-2006)	EWR No.
CHD			
APD		DRAWING No. CODE INM-000 PLANT P1 FROM ES NUMBER 08----	SHEET OF 1 1 REV. 0
SCALE	1 : 2.5		

- The **LOCK NUT** of shim pack coupling (103-JLP side) provided on 103-JAT rotor could be retained with out any modification.



103 JAT Casing Parting Plane Leak & Its Repair :-

The parting plane was repaired by metal spray technology of L&T. The build up surface ground finish after the spray. M/S L&T was given contract for the repair and successfully carried out as given below:

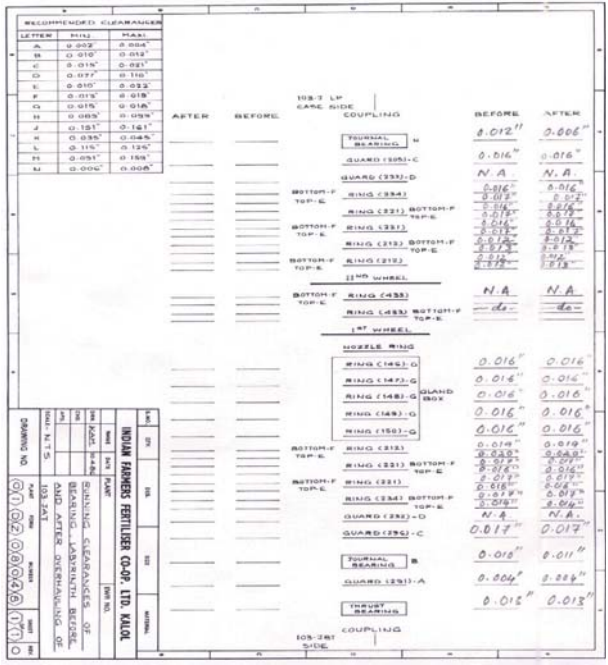
- Surface Preparation at worn out area with grinding
- Preheating of the parting plane.
- Spraying and fusing of EWAC 1005 EC, L&T powder
- Grinding and lapping to make the surface plane

Gauss measurement of casing, inner casing, rotor and bearings were carried out and maximum Gauss readings obtained in 10 Gauss in the casing and bolts which reduced to 3 Gauss by degaussing. Rotor was checked at our site after the repair and found the Gauss readings below 3 Gauss.

Reassembly of Turbine

Turbine parting plane was cleaned and polished with oil stone. Rotor was assembled in inner casing with existing HP gland labyrinth rings after taking the clearances. Rotor along with the inner casing placed in the bottom half casing and clearances were recorded. Top casing was assembled and tightened the bolts. Placed the steam chest valve and boxed.
Additional flange (12" X 1500#, RTJ Flange) was provided near the turbine in the steam inlet piping running over the turbine so that the same inlet pipe can be taken out to facilitate easy removal of the 103-JAT rotor, casing and steam chest valve during the maintenance
of the turbine.

The Clearances recorded are as follows :



103-JBT (Condensing Turbine) Preventive Maintenance

Journal and thrust bearings were opened checked and found normal. Gauss measurement of rotor shaft and bearings was carried out Gauss reading of thrust bearing holder (7.9 Gauss) and thrust bearing pads (8.9 Gauss) was above limit and the same was reduced below 3 Gauss.
Reading taken during the maintenance of 103-JAT & JBT are recorded as under

Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
103-JAT			
Thrust end Bearing	0.010 - 0.012	0.011	0.011
Opp. thrust end bearing	0.006 - 0.008	0.006	0.007
Axial Thrust	0.008 - 0.012	0.008	0.008
103-JBT			
Thrust end Bearing	0.010 - 0.012	0.010	0.010
Opp. thrust end bearing	0.010 - 0.012	0.011	0.011
Axial Thrust	0.008 - 0.012	0.008	0.008

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

Introduction

Synthesis Compressor was revamped as part of the Energy Saving Project under Consultation of M/S HTAS Denmark. 103-JLP & JHP revamp contract was awarded to OEM M/S Dresser Rand France. Contract for the Site work involving dismantling and assembly during the revamp was awarded to M/S Swamina Engg, Services Baroda. The site job of revamp was carried out under the supervision of two Dresser Rand field service Supervisors, deputed from Malaysia field service office, under separate Work order on Dresser Rand India. IFFCO received the new modified internals for LP and HP cases supplied by Dresser-Rand, France in the month of Jan 2006. Preliminary inspection was carried out by IFFCO personnel and the assembly was kept ready for replacement during the shut down 2006.

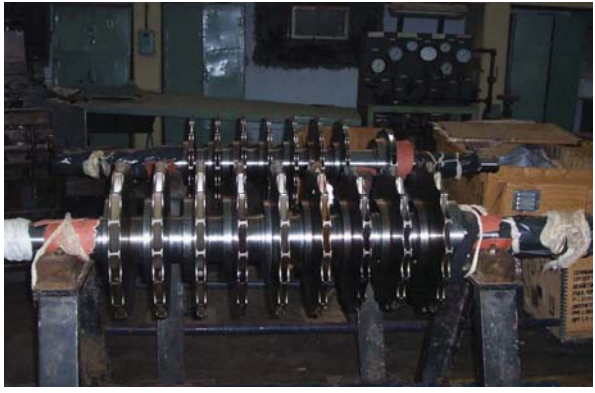
Purpose of Revamp:

IFFCO added one Smaller Converter and Ammonia wash tower for more ammonia conversion in Ammonia synthesis section during the implementation of the Energy Saving Scheme Phase-II (ESP) in the year 2006 as recommended by M/S HTAS, Denmark.

After implementation and commissioning of the above equipments of ESP in Ammonia plant, more conversion of Syn. Gas to Ammonia will take place in the Converter resulting into substantial reduction of recycle gas flow to recycle wheel in the HP case of Synthesis compressor. Due to this change in inlet condition, the compressor will have to be operated at lower efficiency, resulting into more energy consumption in the plant. Hence, the revamp of the Recycle wheel was necessary. In view of this it was proposed to revamp LP & HP case togather to improve the train efficiency and to meet the revamped process condition in the plant.

Major Upgraded Parts For LP & HP Compressor Revamp:

- Floating End Wind back for LP & HP oil seal
- Hole Pattern seal with Swirl Break for balancing piston of HP case
- 2B High efficiency internals for make up section and DATUM internals for recycle section
- Conversion of keyed lubricated gear coupling to hydraulically shrink fitted dry shim pack couplings
- Provision of new thermocouples for bearings, to measure the bearing metal temperature
- Relocation of the vibration probes for obtaining reliable readings



(Fig.) New modified Rotor assembly with scallop impellers for LP & HP Cases

Site activities carried out on LP & HP Case:

Ammonia plant was stopped for Annual turnaround at 08 AM on 31.03.06. The 103-J train was handed over to maintenance at 06 PM on 31.03.06. All vibration probes and TIDs were disconnected from the casing to facilitate the removal of the barrels.
The recycle line, other process lines and lube oil lines were dismantled during 2nd shift on 01.04.06.
Blinds were provided in lube oil lines & Gas lines. Decoupled HP case, LP case and the steam turbine on 2nd day of plant shut down. Suction & discharge piping to the compressor were then disconnected.
Dresser Rand Field Service Supervisors from their Malaysia office arrived at IIFCO site on 02.04.06.

Parameters recorded before decoupling:

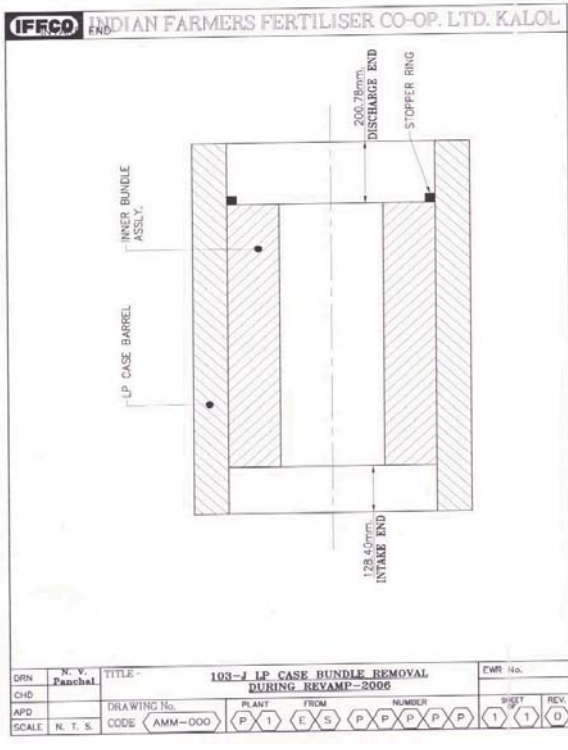
Sr. No.	Description	Readings
1	Coupling Free Float between LP to HP (gear coupling)	5.40 mm
2	Coupling Free Float between 103JAT and JLP (gear coupling)	3.82 mm
3	HP Case thrust bearing clearance	0.35 mm
4	LP Case thrust bearing clearance	0.42 mm
5	JAT thrust bearing clearance	0.26mm
6	DBSE between LP & HP case (When shafts were taken away)	454.95 mm
7	DBSE between LP & HP case (When shafts were taken in)	454.20 mm
8	DBSE between JAT turbine & LP case (When shafts were taken away)	446.73 mm
9	DBSE between JAT turbine & LP case (When shafts were taken in)	446.05 mm

Pedestal bolts of the casings were opened. The barrel assembly were hoisted with help of HM Crane. At the time of hoisting, the HM Crane Capacity was 16 ton at 80 feet boom length. (Approximate weight of HP and LP case barrel was 10.8 Tons and 9 Ton respectively). The barrel assembly was then boxed up separately on especially fabricated stand for respective assembly. The same was loaded in the truck, tied with nylon rope and shifted to main workshop one by one. The Barrels were unloaded in main workshop from the truck with the help of 2 hydras.
Separate group was engaged for cleaning LP and HP foundation at site. Two separate groups were engaged for dismantling of compressors at workshop.

DISMANTLING OF LP CASE (2BC9):

Dismantling of LP case was started from coupling hubs and subsequently removal of LP Intake, discharge ends, bearing cover, journal bearings and out board thrust bearing along with base ring was carried out.
Brown clour marks were observed on thrust bearings active pads. Reference of rotor position measured from shaft end to thrust disk outer face was 219.60 mm. The thrust collar was pull out with the help of new Hydraulic tool supplied by Dresser Rand as per disassembly procedure given in the DR manual page No.M.18 (7) for HP Rev. 01. Maximum 25000 Psig hydraulic pressure was applied in the expander to remove the thrust collar, keeping the pusher pressure just positive.
Similarly, the intake & discharge end seal assemblies were taken out with the help of new tool supplied by DR applying the procedure given in the manual, page no. M.3 (1). Rev.01. After the removal of one seal from one end, shaft was locked for arresting the axial movement, to facilitate the removal of second seal on other shaft end. Finally bearing housings from both ends were removed. LP Case intake & discharge heads were removed with the help of jacking bolts and EOT crane.

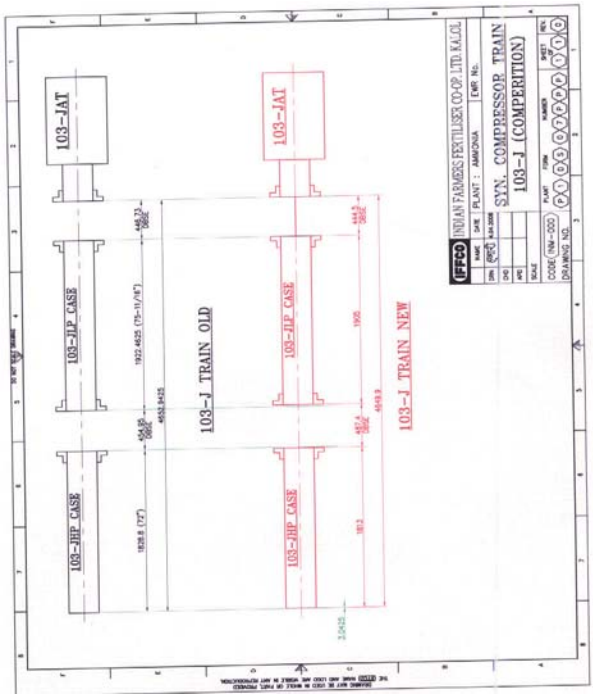
References recorded after removal of the LP Case heads



- Distance from LP Bundle face to barrel face (discharge end): 200.70 mm
- Distance from LP Bundle face to barrel face (intake end): 128.40 mm

After removing 4 plugs, tie rods were inserted through the bundle to lock it before taking out the bundle assembly. Locking pin was removed to slide out the bundle assembly. LP Case inner bundle assembly was removed with the help of forklift through intake end side. After cleaning the barrel, head covers and studs, DPT was carried out and found no defects.

Rotor overall length was recorded to establish DBSE with LP case



- Old LP Case Rotor Length: 72.000”
- New LP Case Rotor Length: 71.343”

Measuring ID of Barrel & OD of New Inner Bundle Assembly for comparison & fitment, it was found as per Drg. 596-597-201- for 2BC9.

Rework carried out in LP case

- Machining of LP discharge head to fit the volute. After inserting the ring plate again machined the face to required height. The LP discharge head needed skim cut in order to maintain volute wide, by insertion the ring plate on the volute then skim cut to dimension required.
- Seal welded the screw cap and filled up the remaining hole by TIG welding. DPT carried out and cleared. (Ring Material: CS Plate S275JR/ASTM A 36 Screw Material: CS bar C22E/AIS 1020. Filler Metal: ER70S-X)
- Drilling and threading for tapped holes in the bearings for fit up of new thermocouple
- Made bracket provision for the vibration monitoring probes

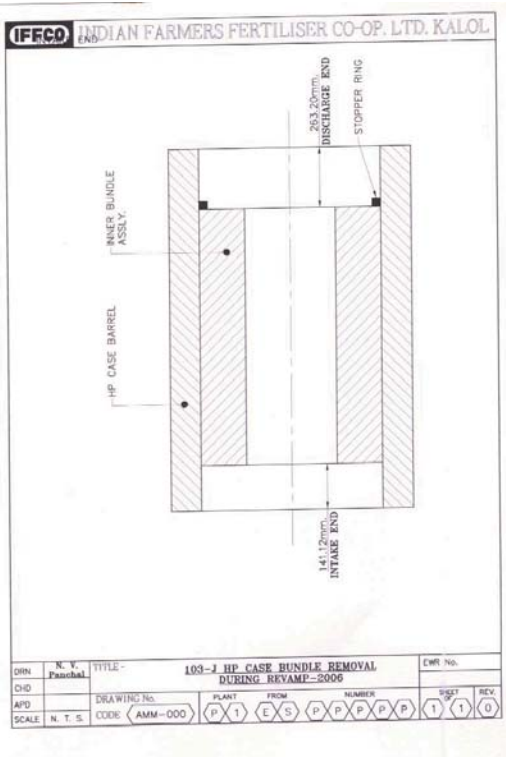
- Machining of LP case volute (Rework drg. 439-724-201) was done at Local vendor's works (Ahmdabad) while the HP volute was machined at our work shop. During machining the discharge volute on discharge head during machining was found very thin on the volute tip (the thinnest was 1.2 mm). The volute tip was cut with the help of grinding machine followed by DPT. One hairline crack was left as it was in the cast volute location at the start of the volute. Minimum thickness was maintained as 4.5 mm as recommended by DR and cutting was done to follow the contour.
- Thrust end side bearing housing (drg 405-386-202) drilling was done as per drg 596-830-001 for TID and Axial Probe.
- Thrust end side bearing cage (drg 439-393-202) drilling was done as per drg 596-814-001 for TID.
- Thrust end side bearing cover (drg 403-476-202) drilling was done as per drg 596-787-201 Axial Probe.
- Non-thrust end side bearing housing (drg 405-387-201) drilling was done as per drg 596-831-001 for TID.
- Non thrust end side bearing cage (drg 439-393-202) drilling was done as per drg 596-814-001 for TID.

DISMANTLING OF HP CASE (2BF9-8)

Dismantling of HP Case started from coupling removal and subsequently removed HP Intake & discharge ends, bearing cover, journal bearings and out board thrust bearing along with base ring. HP compressor thrust bearings active thrust bearings removed and found brown colour marks on the thrust pads. Position of rotor reference measured from shaft end to thrust disk outer face and recorded as 93.80 mm.
Removed HP Thrust collar with the help of new Hydraulic tool supplied by Dresser Rand as per disassembly procedure given in the DR manual, page no.M.18 (7) for HP Rev.01. Hydraulic Pressure of 25000 psig in the expander for the removal of thrust collar keeping the pusher pressure just positive.

Removed intake and discharge end seal assemblies with the help of new tool supplied by D-R applying the procedure given in the manual, page no. M.3 (1), Rev.01. After removal of one seal, shaft was locked for arresting the movement of the shaft to facilitate the removal of second seal on other shaft end. Bearing Housings were taken out after the seal assembly removal. HP Case intake & discharge heads were removed with the help of jacking bolts and EOT crane.

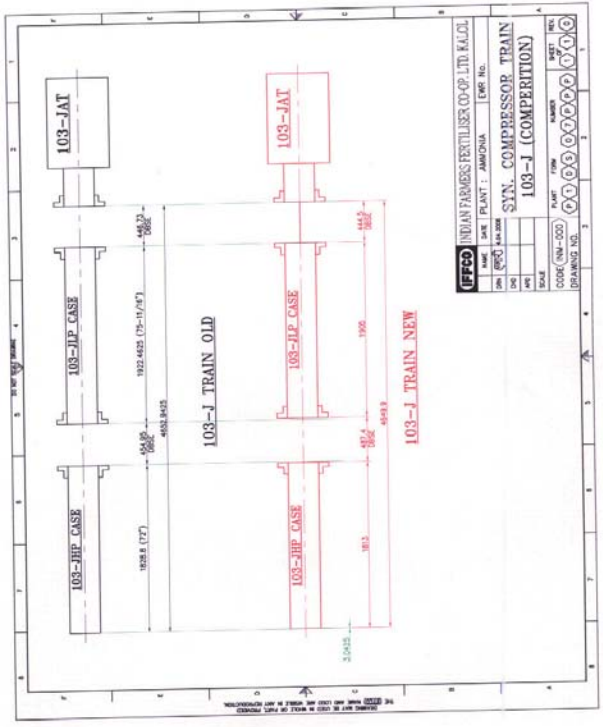
References recorded after removal of the HP Case heads



- Distance from HP Bundle face to barrel face (discharge end): 263.20 mm
- Distance from HP Bundle face to barrel face (intake end): 141.12 mm

Bundle tie rods were assembled after taking out the plugs (4 Nos. on LP side). Locking pin was removed before taking out the bundle. HP Case inner bundle assembly was removed with the help of fork-lift through intake end side. Cleaning of barrels and studs and DPT carried out on inside the barrel, covers and studs.

Rotor overall length was recorded to establish DBSE with HP



- Old HP Case Rotor Length: 75.6875”
- New HP Case Rotor Length: 75.0310”
-

Measurement of ID of existing barrel & OD of New Inner Bundle Assembly done to confirm the fitment and it was found to be as per Drg. 596-143-201-for 2BF9-8.

Rework carried out in HP case

Machined the HP discharge head to fit the volute. After inserting the ring plate again machined the face to required height. The HP discharge head need to be skim cut in order to maintain volute width, by inserting the ring plate on the volute then again skim cut to dimension required.

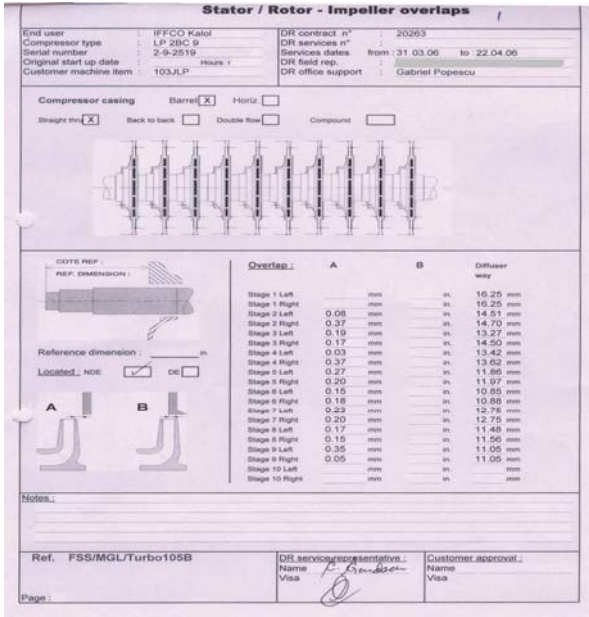
- Seal welded the screw cap and filled up the remaining hole by TIG welding. DPT was carried out and cleared. (Ring Material: CS Plate S275JR/ASTM A 36 Screw Material: CS bar C22E/AIS 1020. Filler Metal: ER70S-X).
- Drilled and tapped holes in the bearings for new thermocouple.

- Made bracket provision for the vibration monitoring probes.

- Machining of HP discharge head to fit the volute. Volute machining (drg 435-127-202) was done as per drg 596-320-201. Machining was done on vertical boring machine by clamping in fixures at Ahmedabad.
- Thrust end side bearing housing (drg 403-467-203) drilling was done as per drg 596-785-001 for TID and Axial Probe.
- Thrust end side bearing cover (drg 403-476-202) drilling was done as per drg 596-787-201 Axial Probe.
- Non thrust end side bearing housing (drg 403-466-201) drilling was done as per drg 596-821-001 for TID.
- Non thrust end side bearing cage (drg 439-393-202) drilling was done as per drg 596-814-001 for TID.
- In this revamp, the seal was changed with wind back seal on LP and HP case. The HP discharge inner seal was machined to maintain inner seal labyrinth clearance. The machining job had been carried out to maintain the clearances.

ASSEMBLY OF NEW INNER BUNDLE ASSEMBLY OF LP CASE

Run out of the new rotor assembly (Drg. No. 596-285-201) was verified on balancing machine and fund to be conforming to the DR specification and drawing. Verified the blue matching of new John Crane Coupling Hubs on new Rotor without O-ring and found more than 95% blue impression and other dimensions found conforming to the Drg. No. TSGE-2100-FB33-F035 & TLGE-1000-FB33-F013.
Labyrinth clearances (Drg. No. 597-032-201) were measured and recorded.
Overlap clearances of Rotor with respect to stator and impeller as per drg-597-032-201, sheet 2 of 3 were measured and recorded after placing the rotor on dummy labyrinth.



Stator / Rotor - Impeller overlaps

End user	: IFFCO Kalol	DR contract n°	: 20263
Compressor type	: LP 28C 9	DR services n°	:
Serial number	: 2-9-2519	Services dates	from : 31.03.06 to 22.04.06
Original start up date	: Hours :	DR field rep.	:
Customer machine item	: 103JLP	DR office support	: Gabriel Popescu

Compressor casing — Barrel [X] Horiz [ ]

Straight thru [X] Back to back [ ] Double flow [ ] Compound [ ]

COTE REF :
REF. DIMENSION :

Reference dimension : ____ in

Located : NDE [✓] DE [ ]

A B

Overlap :	A		B		Diffuser way
Stage 1 Left		mm		in.	16.25 mm
Stage 1 Right		mm		in.	16.25 mm
Stage 2 Left	0.08	mm		in.	14.51 mm
Stage 2 Right	0.37	mm		in.	14.70 mm
Stage 3 Left	0.19	mm		in.	13.27 mm
Stage 3 Right	0.17	mm		in.	14.50 mm
Stage 4 Left	0.03	mm		in.	13.42 mm
Stage 4 Right	0.37	mm		in.	13.62 mm
Stage 5 Left	0.27	mm		in.	11.86 mm
Stage 5 Right	0.20	mm		in.	11.97 mm
Stage 6 Left	0.15	mm		in.	10.85 mm
Stage 6 Right	0.18	mm		in.	10.88 mm
Stage 7 Left	0.23	mm		in.	12.78 mm
Stage 7 Right	0.20	mm		in.	12.75 mm
Stage 8 Left	0.17	mm		in.	11.48 mm
Stage 8 Right	0.15	mm		in.	11.56 mm
Stage 9 Left	0.35	mm		in.	11.05 mm
Stage 9 Right	0.05	mm		in.	11.05 mm
Stage 10 Left		mm		in.	mm
Stage 10 Right		mm		in.	mm

Notes :

Ref. FSS/MGL/Turbo105B

DR service representative : Name Visa

Customer approval : Name Visa

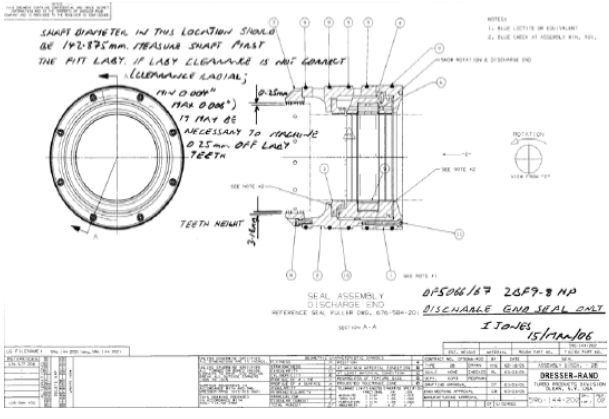
Page :

Free float was recorded as 5.95 mm. Upper half of inner bundle was placed on the bottom half with rotor resting on the bottom half.

Tightened the upper half and bottom half of inner bundle assembly together with fasteners. Intake ring (inlet wall, part - 1, drg 596-369-201) was assembled and key (part - 27, drg 407-208-006) were assembled. Overall length & OD of the assembled bundle was measured and found as per drg-596-597-201. O-ring (part - 24, drg 002-271-806) & back up ring (part-25, drg-002-310-015) were installed on intake ring. Hylomer and grease were applied inside the barrel after properly cleaning the inside. Carefully the bundle assembly was inserted in barrel with help of proper fixtures. Tie rods (4 Nos.) were removed and opening was plugged. Suction Head to bundle face distance was measured and it was found that the compression on o-ring of volute was: 0.75 mm. Inlet head & outlet head drg-597-021-201 with new gasket-part 15, drg-424-363-001 were installed. Placing dummy bearing halves in the bottom half of the bearing housing to support the rotor shaft on normal center. The rotor was checked for its free rotation.

End seal assembly of LP

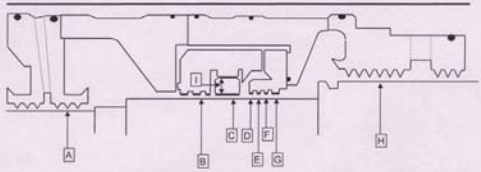
Intake and discharge end wind back seal assemblies as per drg-597-032-201, 596-357-201 & 596-357-202 were installed. Seal assemblies were installed with the help of new tool supplied by D-R with revamp as per assembly procedure given in the manual, page no. M.3 (1), Rev.01.
After installation at one side seal, shaft was locked this side to facilitate installation of other side of seal. Discharge side seal is assembled as a cartridge hence installation is quite easy. Suction side seal is in loose condition hence a great care as required so that smaller parts like spring should not fall inside. LP wind back seal clearances recorded.



Model: Syn Gas Compressors	Order #: 20263	S/N: 2-9-2519/2-8-2520
Equipment ID: 2BC-9	Job Number:	
	Date Checked: 12.04.06	

☒ Assembly ☐ Disassembly

103 JLP- WIND BACK SEAL CLEARNACES



LOCATION	SHAFT OD		SEAL ID		CLEARANCE	
	DESIGN	ACTUAL	DESIGN	ACTUAL	DESIGN	ACTUAL
DISCHARGE						
A						
B		114.29		114.45		0.16
C						
D		114.29		114.44		0.15
E		114.29		114.44		0.15
F		114.29		114.41		0.12
G		114.29		114.36		0.07
H		124.79		124.07		0.28
SUCTION						
A						
B		114.29		114.44		0.15
C						
D		114.29		114.44		0.15
E		114.29		114.44		0.15
F		114.29		114.40		0.15
G		114.29		114.37		0.06
H		123.82		124.07		0.25

PAD THICKNESS (I)	DESIGN:		ACTUAL:	

COMMENTS: Pad thickness was not measured due to the windback seal shipped from LE HARVE as a complete set.

Journal Bearings were boxed up. After assembly of Dummy Disc, it was observed that the top half of the bearing was fouling in the housing. This problem persisting from the day the machine was installed in 1974. DR engineer recommended this rectification during the revamp. Some of the bearing housing cage material removed by grinding in the inner portion of the housing to make clearance for removal of the top half without removing Thrust Disc.

Thrust Disc was installed after calculating thrust disc spacer value with help of dummy disc, drg-596-285-201 and 597-032-201. Keeping Rotor in running position, i.e. total free float at this location was 5.35, kept Rotor 3.25 mm from discharge end and 2.10 from intake end. The Rotor was locked in that position towards discharge end side with the help of tools. After measurement and calculation, LP thrust spacer final thickness reduced to 7.7 mm from 11.10 mm (actual supply of DR) by grinding.

Installed the thrust Disc with the help of new tool supplied by D-R as per assembly procedure given in the manual, page no. M.18 (1), Rev.01. Hydraulic pressure of 22500 Psig was applied in the expander keeping pusher pressure up to 3100 psig.

The distance was checked from rotor shaft end to thrust disc face was recorded as 206.30 mm. Rotor position after installation of thrust bearing assembly, as per drg 596-887-201 checked and the axial Float of 0.44 mm (0.017") was measured.

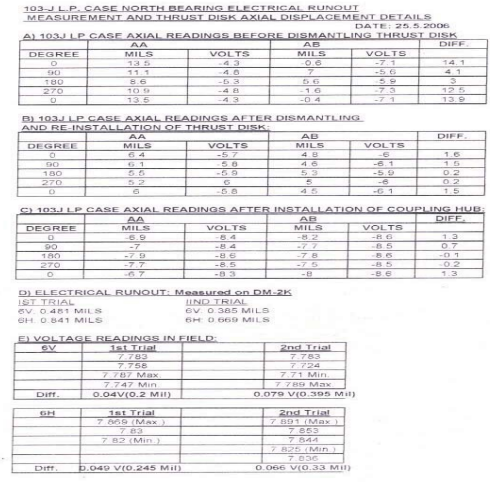
Checked rotor assembly for its free rotation and found the rotor moving freely.

Verified run out of the thrust disk before & after the coupling installation to avoid chances of pressurized oil to entry in the disk area which may misalign the collar.

During operation, we faced radial vibration of 6 mills magnitude at the journal bearing (6V/6H). Compressor was stopped after 18 days running. Thrust face run out of 0.30 mm (0.012", @ 180^0) was recorded during the inspection in the presence of DR Representative.

The thrust disc was made true by re-applying hydraulic pressure of 25500 psig in the expander and pusher pressure 4000 Psig. Mechanical run out of thrust disk checked with help of 2 dial indicators and it was found maximum 0.02 mm after the rectification.

Electrical run out of thrust disc was checked after probe installation and was found maximum 1.3 mills in place of 12 mills as found earlier.



103-J L.P. CASE NORTH BEARING ELECTRICAL RUNOUT
MEASUREMENT AND THRUST DISK AXIAL DISPLACEMENT DETAILS
DATE: 25.5.2006

A) 103-J LP CASE AXIAL READINGS BEFORE DISMANTLING THRUST DISK:

	AA		AB		DIFF.
DEGREE	MILS	VOLTS	MILS	VOLTS	
0	13.5	-4.3	-0.6	-7.1	14.1
90	11.1	-4.8	-7	-5.6	4.1
180	8.6	-5.3	5.6	-5.9	3
270	10.9	-4.8	-1.6	-7.3	12.5
0	13.5	-4.3	-0.4	-7.1	13.9

B) 103-J LP CASE AXIAL READINGS AFTER DISMANTLING AND RE-INSTALLATION OF THRUST DISK:

	AA		AB		DIFF.
DEGREE	MILS	VOLTS	MILS	VOLTS	
0	6.4	-5.7	4.8	-6	1.6
90	6.1	-5.8	4.6	-6.1	1.5
180	5.6	-5.9	5.3	-5.9	0.2
270	5.2	-6	5	-6	0.2
0	6	-5.8	4.5	-6.1	1.5

C) 103-J LP CASE AXIAL READINGS AFTER INSTALLATION OF COUPLING HUB:

	AA		AB		DIFF.
DEGREE	MILS	VOLTS	MILS	VOLTS	
0	-6.9	-8.4	-8.2	-8.6	1.3
90	-7	-8.4	-7.7	-8.5	0.7
180	-7.9	-8.6	-7.8	-8.6	-0.1
270	-7.7	-8.5	-7.5	-8.5	-0.2
0	-6.7	-8.3	-8	-8.6	1.3

D) ELECTRICAL RUNOUT: Measured on DM-2K

1ST TRIAL	1IND TRIAL
6V: 0.481 MILS	6V: 0.385 MILS
6H: 0.841 MILS	6H: 0.669 MILS

E) VOLTAGE READINGS IN FIELD:

6V	1st Trial		2nd Trial
	7.783		
	7.758		7.724
	7.787 Max.		7.71 Min.
	7.747 Min.		7.789 Max.
Diff.	0.04V(0.2 Mil)		0.079 V(0.395 Mil)

6H	1st Trial		2nd Trial
	7.869 (Max.)		7.891 (Max.)
	7.83		7.863
	7.82 (Min.)		7.844
			7.825 (Min.)
			7.836
Diff.	0.049 V(0.245 Mil)		0.066 V(0.33 Mil)

Fig: Thrust Disc Electrical and Mechanical run out

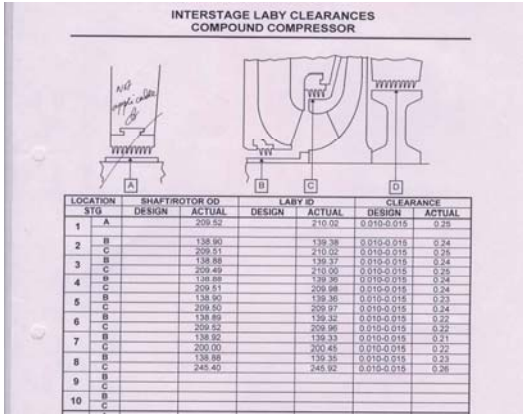
Compressor bearing housing was boxed up. During operation, vibration reduced to 1.5 mills as against 6 mills at the same location (6V/6H).
Gauss measurement of different components was carried out. Maximum Gauss reading obtained after degaussing are given in the table below:

Sr. No.	Location	Initial (Gauss)	Final (Gauss)
1	Thrust cage active	40	2.3
2	Thrust cage non active	15.2	1.2
3	Thrust brg pads active	0.9	0.9
4	Thrust brg pads non active	1.2	1.2
5	Thrust collar	2.6	2.6
6	Shaft Journal	1.6	1.6
7	Journal brg pad top half	1.5	1.5
8	Journal brg cage top half	2.2	2.2
9	Journal brg pad bottom half	2.2	2.2
10	Journal brg cage bottom half	2.6	2.6

New thermo couples for taking metal temperature and vibration-monitoring probes were installed and their setting was checked in workshop itself by instrument.

ASSEMBLY OF NEW INNER BUNDLE ASSEMBLY OF HP CASE

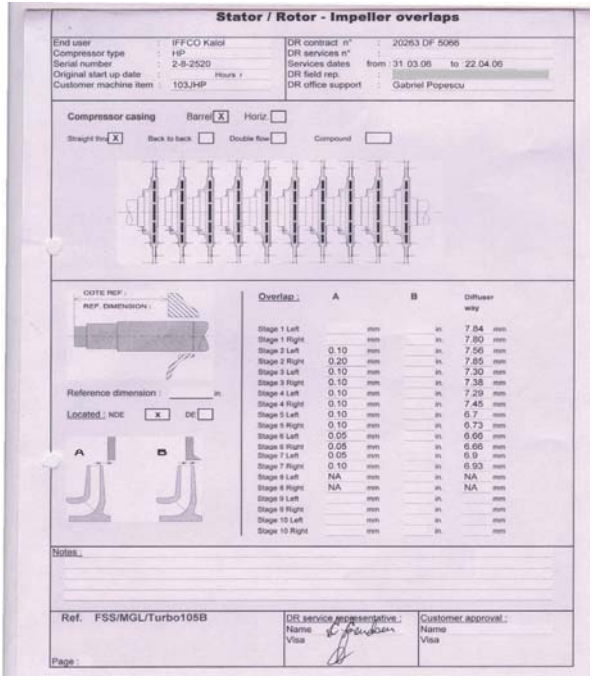
Run out of the new rotor assembly (Drg. 595-145-201) verified on the balancing machine was found to be conforming as per drawing. Verified the blue matching of new John Crane Coupling Hubs on new Rotor without O-ring and found more than 95% blue impression and other dimensions found as per drg TLGE-1000-FB33-F013. Labyrinth clearances (drg-596-139-201) were recorded.



INTERSTAGE LABY CLEARANCES
COMPOUND COMPRESSOR

LOCATION STG		SHAFT/ROTOR OD DESIGN	SHAFT/ROTOR OD ACTUAL	LABY ID DESIGN	LABY ID ACTUAL	CLEARANCE DESIGN	CLEARANCE ACTUAL
1	A		209.52		210.02	0.010-0.015	0.25
2	B		138.90		139.38	0.010-0.015	0.24
	C		209.51		210.02	0.010-0.015	0.25
3	B		138.88		139.37	0.010-0.015	0.24
	C		209.49		210.00	0.010-0.015	0.25
4	B		138.88		139.36	0.010-0.015	0.24
	C		209.51		209.98	0.010-0.015	0.24
5	B		138.90		139.36	0.010-0.015	0.23
	C		209.50		209.97	0.010-0.015	0.24
6	B		138.89		139.32	0.010-0.015	0.22
	C		209.52		209.96	0.010-0.015	0.22
7	B		138.92		139.33	0.010-0.015	0.21
	C		200.00		200.45	0.010-0.015	0.22
8	B		138.88		139.35	0.010-0.015	0.23
	C		245.40		245.92	0.010-0.015	0.26
9	B						
	C						
10	B						
	C						

Stator and Rotor Impeller overlap (drg-596-139-201 sheet 3 of 3) on dummy labyrinth in the above position measured and recorded.



Stator / Rotor - Impeller overlaps

End user	: IFFCO Kalol	DR contract n°	: 20263 DF 5066
Compressor type	: HP	DR services n°	:
Serial number	: 2-8-2520	Services dates	from : 31.03.06 to 22.04.06
Original start up date	: Hours :	DR field rep.	:
Customer machine item	: 103,IHP	DR office support	: Gabriel Popescu

Compressor casing Barrel [X] Horiz. [ ]

Straight thru [X] Back to back [ ] Double flow [ ] Compound [ ]

COTE REF. :
REF. DIMENSION :

Reference dimension : _____ in.

Located : NDE [X] DE [ ]

A B

Overlap :	A		B		Diffuser way
Stage 1 Left		mm		in.	7.84 mm
Stage 1 Right		mm		in.	7.80 mm
Stage 2 Left	0.10	mm		in.	7.56 mm
Stage 2 Right	0.20	mm		in.	7.85 mm
Stage 3 Left	0.10	mm		in.	7.30 mm
Stage 3 Right	0.10	mm		in.	7.38 mm
Stage 4 Left	0.10	mm		in.	7.29 mm
Stage 4 Right	0.10	mm		in.	7.45 mm
Stage 5 Left	0.10	mm		in.	6.7 mm
Stage 5 Right	0.10	mm		in.	6.73 mm
Stage 6 Left	0.05	mm		in.	6.66 mm
Stage 6 Right	0.05	mm		in.	6.66 mm
Stage 7 Left	0.05	mm		in.	6.9 mm
Stage 7 Right	0.10	mm		in.	6.93 mm
Stage 8 Left	NA	mm		in.	NA mm
Stage 8 Right	NA	mm		in.	NA mm
Stage 9 Left		mm		in.	mm
Stage 9 Right		mm		in.	mm
Stage 10 Left		mm		in.	mm
Stage 10 Right		mm		in.	mm

Notes :

Ref. FSS/MGL/Turbo105B

DR service representative : Name Visa

Customer approval : Name Visa

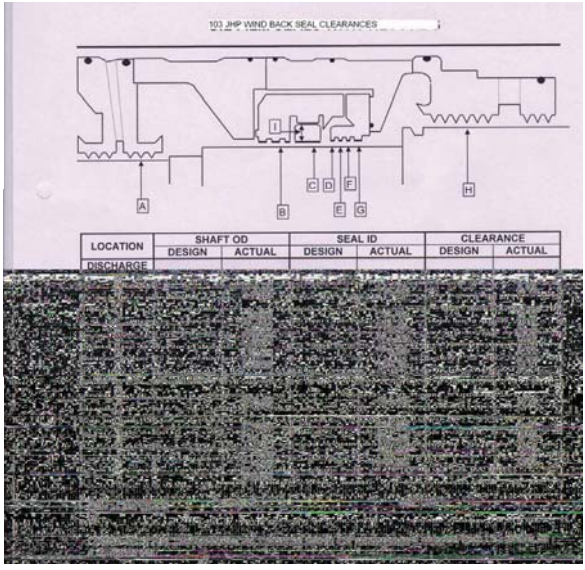
Page :

Free float was recorded as 5.98 mm. The above activities were repeated in the bottom half of the bundle as well. Dummy labyrinth was removed and original labyrinth was installed. Upper half of inner bundle was placed on the bottom half with rotor resting on the bottom half. Tightened the upper half and bottom half of inner bundle assembly together with fasteners. Intake ring (inlet wall, part - 1, drg 596-366-201) was assembled. Key (part - 29, drg 407-208-006) was assembled. Overall length & OD of the assembled bundle was measured and found as per drg-596-143-201. O-ring (part - 31, drg 002-271-806) & back up ring (part-32, drg-002-310-015) were installed on intake ring. Hylomer and grease were applied inside the barrel.

The bundle assembly was carefully inserted in barrel with the help of proper fixtures. Tie rods (4 Nos.) were removed and opening was plugged. Suction Head to bundle face distance measured and it was found that the compression on o-ring of volute by 0.75 mm. Inlet head & outlet head drg-596-140-201 with new gasket-part 19, drg-424-467-001 were installed. Placing dummy bearing halves in the bottom half of the bearing housing to support the rotor shaft on normal center. Checked for Free rotation of the rotor was checked and found okay.

End seal assembly of HP

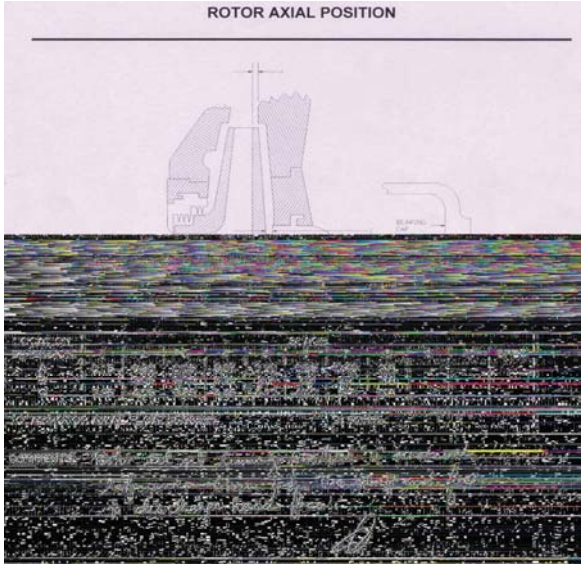
Intake and discharge end wind back seal assemblies as per drg-596-139-201, 596-144-201 & 596-144-202 were installed. Installed seal assemblies with the help of new tool supplied by D-R as per assembly procedure given in the manual, page no. M.3 (1), Rev.01.
After installation at one side seal, shaft was locked this side to facilitate installation of other side of seal. Discharge side seal is assembled as a cartridge hence installation is quite easy. Suction side seal is in loose condition hence a great care as required so that smaller parts like spring should not fall inside. Clearances obtained are given in the table below:



LOCATION	SHAFT OD		SEAL ID		CLEARANCE	
	DESIGN	ACTUAL	DESIGN	ACTUAL	DESIGN	ACTUAL
DISCHARGE						

Thrust Disc was installed after calculating thrust disc spacer value with help of dummy disc, drg-595-145-201 and 596-139-201. Keeping Rotor in running position, i.e. total free float was 5.98, out of which, rotor position was kept 3.11 mm from discharge end and 2.87 from intake end.

The Rotor is locked in this position towards discharge end side with help of tools. With the help of measurements and calculation, HP thrust spacer final thickness was finalized to 7.89 mm. Reduced the thickness of the spacer from 11.10 mm (original supply of DR) to 7.89 mm by grinding. Fitted thrust disc by hydraulically. Expander pressure of 24500 Psig was applied keeping pusher pressure up to 3700 psig. Distance from rotor shaft end to thrust disk face measured and recorded as 139.60 mm. Rotor axial float after installation of thrust bearing assembly, (drg 596-921-201) was checked and found 0.35 mm (0.014").
Verified the run out of the thrust disk before & after the coupling installation to avoid chances of pressurized oil to enter in the disk area may misalign the collar. The rotor was checked for its free rotation.
New thermo couples and vibration-monitoring probes were installed and their settings were checked in workshop by instrument.



In-Situ Machining of Bearing Housing at 103 JAT Exhaust end

During coupling conversion from gear coupling to John Crane shim pack coupling, it was noticed that due to larger diameter of NEW shim pack coupling, the outer face of hub was fouling in the coupling tunnel at turbine bearing housing. To facilitate proper clearances between the coupling with existing bearing housing, in-situ machining was done. A cut of approximately 2 mm had been taken with the help of pneumatically operated Portable Machine developed by workshop.
Since the bearing housing is an integral part of the turbine housing, it was not possible to dismantle the housing separately for machining. There is no other option but to machine the housing in-situ. The portable machine designed, manufactured and assembled in our workshop within house available facilities was used for in-situ machining. The machining job was carried out in 3-4 days including the set up and machining to required accurate size.

Coupling hub installation in 103-JLP & JHP

New John Crane coupling hubs were installed on the rotors as per drg TSGE-2100-FB33-F035 & TLGE-1000-FB33-F013. Two dial gauges were mounted to confirm the travel. 20 mm travel dial gauge was procured for this particular job. Coupling hubs installation done with the help of new tool supplied by D-R with revamp as per assembly given in the manual, under special tools heading.

Parameters for Coupling Hub Installation 103-JHP DE & JHP NDE

Sr. No.	Steps / Activity	Coupling Hub	
		103 J HP NDE (Suction Side)	103 J HP DE (Discharge Side)
1	Dry Fit (w/o O-Rings)	8 mm	8 mm
2	Wet Fit (with O-Rings)	11.95 mm	13.30 mm
3	Pull up Reqd. (design)	4.57+0.25/-0.0 (4.57 to 4.82 mm)	4.57+0.25/-0.0 (4.57 to 4.82 mm)
4	Overhang Target (1-3) (Hub face to shaft face)	3.18 to 3.43 mm	3.18 to 3.43 mm
5	Travel Reqd. (2-4)	8.77 to 8.52 mm	10.12 to 9.87 mm
6	Expander Pressure	22000 psi	24000 psi
7	Pusher Pressure	1600 psi	1750 psi
8	Actual Overhang	3.18 mm	3.18 mm

Parameters for Coupling Hub Installation 103-JLP DE & JLP NDE

Sr. No.	Steps / Activity	Coupling Hub	
		103 J LP DE (Discharge Side)	103 J LP NDE (Suction Side)
1	Dry Fit (w/o O-Rings)	10 mm	8 mm
2	Wet Fit (with O-Rings)	12 mm	10 mm
3	Pull up Reqd. (design)	6+0.21/-0.0 mm (6 to 6.21 mm)	4.57+0.25/-0.0 (4.57 to 4.82 mm)
4	Overhang Target (1-3) (Hub face to shaft face)	3.79 to 4 mm	3.18 to 3.43 mm (actual measured before removal of the hub 3.22 mm)
5	Travel Reqd. (2-4)	8.21 to 8 mm	7.78 mm
6	Expander Pressure	25500 psi	22000 psi
7	Pusher Pressure	2950 psi	1600 psi
8	Actual Overhang	3.74 mm	3.14 mm

Electrical run out of thrust disk checked after hub installation and it was found maximum 1.2 mils.

LP and HP barrels were shifted to location and were hoisted one by one on their respective foundations. Barrel foundation bolts were tightened. Alignment was done after adjusting DBSE

Parameters for Coupling between 103 JAT & 103 JLP and 103 JLP & 103 JHP

Sr. No.	Steps / Activity	103 JAT to 103 JLP	103 JLP to 103 JHP
1	DBSE	444.61 mm	487.54 mm
2	Hub Flange to Flange Distance measured (construction length)	342.63 mm Keeping turbine in running position i.e. extreme south side and compressor at North side	450.00 mm Keeping both the compressors in running position i.e. extreme North side
3	Spacer Length	340.90 mm	445.70 mm
4	Gap (2-3)	1.73 mm	4.30 mm
5	Prestretch Required (Design)	1.50 mm	2.10 mm
6	Still Gap (4-5)	0.23 mm	2.20 mm
7	Shim of 0.4 mm each installed	1 shim towards 103 JLP Side (0.40mm)	3 shims each side (1.2 mm + 1.2 mm) = 2.40mm
8	Actual Prestretch (4-7)	1.33 mm	1.90 mm
9	Coupling shims will be under compression while running (5-8) (Compression Allowed up to 0.40 mm)	0.17 mm	0.20 mm

Coupling guards were boxed up and fitting of instrument probes & all instrument / electrical connections / earthling brush were carried out. Start up of oil pump / oil circulation was done. Short loop was and 103 JAT exhaust was deblinded were carried out and equipment was handed over.

The various clearances recorded are as follows :

CLEARANCE CHART OF LP CASE -2 BC 9

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

All clearances are radials running clearances, Unless otherwise specified

Sr. No.	Component	Detail on Drg.	Design Clearances	Actual Clearances
	Bearings			
1	Journal Bearing, Part No. 7,(Intake & Dis. End)	**C**	0.002" to 0.004"	0.002"
2	Seal Ring Journal Bearing,(Intake & Dis. End)	**C**	0.008" to 0.013"	0.008"
3	Thrust Bearing, Part No. 6 (Axial)	**B**	0.015" to 0.022"	0.017"
4	Seal Ring Thrust Bearing	**A**	0.003" to 0.004"	0.003"
	Inlet Guide Labyrinth			
5	**Small, Part No. 21-1st**	**F** (All Stages)	0.008" to 0.012"	0.010”
6	Stage - 2nd from Intake End	**F**	0.008" to 0.012"	0.010”
7	Stage - 3rd from Intake End	**F**	0.008" to 0.012"	0.010”
8	Stage - 4th from Intake End	**F**	0.008" to 0.012"	0.010”
9	Stage - 5th from Intake End	**F**	0.008" to 0.012"	0.010”
10	Stage - 6th from Intake End	**F**	0.008" to 0.012"	0.010”
11	Stage - 7th from Intake End	**F**	0.008" to 0.012"	0.010”
12	Stage - 8th from Intake End	**F**	0.008" to 0.012"	0.010”
13	Stage - 9th from Intake End	**F**	0.008" to 0.012"	0.010”
14	**Large, Part No. 18- 1st**	**G**-1-2-3-4	0.0130" to 0.0195"	0.014”
15	Stage - 2nd from Intake End	**G**	0.0130" to 0.0195"	0.014”
16	Stage - 3rd from Intake End	**G**	0.0130" to 0.0195"	0.014”
17	Stage - 4th from Intake End	**G**	0.0130" to 0.0195"	0.014”
18	**Large, Part No. 19- 5th**	**G**-5-6-7-8-9	0.0110" to 0.0165"	0.012”
19	Stage - 6th from Intake End	**G**	0.0110" to 0.0165"	0.012”
20	Stage - 7th from Intake End	**G**	0.0110" to 0.0165"	0.012”
21	Stage - 8th from Intake End	**G**	0.0110" to 0.0165"	0.012”
22	Stage - 9th from Intake End	**G**	0.0110" to 0.0165"	0.012”
23	Balance Piston Labyrinth, Part No. 20	**H**	0.0070" to 0.0105"	0.012”

Wind back Seal Assembly Intake End (Drg. No. 596-357-201, Sh. 1 of 1, Rev.0, Main Part No.-4) & Wind back Seal Assly Discharge End (Drg. No. 596-357-202, Sh. 1 of 1, Rev.0, Main Part No.-5)				
24	Seal Labyrinth, Part No. 10	**E / I**	0.004" to 0.006"	0.003"
25	Inner Seal Ring, Part No. 3 (Inner Side),	**D**	0.002" to 0.003"	0.002"
26	Inner Seal Ring, Part No. 3 (Outer Side)	**D**	0.003" to 0.005"	0.003"
27	Middle Floating Ring, Part No. 4	**D**	0.005" to 0.007" (Typ. 3 places)	0.005"
32	2nd	**D**	0.005" to 0.007"	0.005"
33	3rd	**D**	0.005" to 0.007"	0.005"
34	**Stage - 1st from Intake End (over lap)**	**J**	+0.055"/-0.00	
35	Stage - 2nd from Intake End	**J**	+0.055"/-0.00	+0.014"
36	Stage - 3rd from Intake End	**J**	+0.055"/-0.00	+0.006"
37	Stage - 4th from Intake End	**J**	+0.055"/-0.00	+0.014"
38	Stage - 5th from Intake End	**J**	+0.055"/-0.00	+0.008"
39	Stage - 6th from Intake End	**J**	+0.055"/-0.00	+0.007"
40	Stage - 7th from Intake End	**J**	+0.055"/-0.00	+0.008"
41	Stage - 8th from Intake End	**J**	+0.055"/-0.00	+0.006"
42	Stage - 9th from Intake End	**J**	+0.055"/-0.00	+0.002"

CLEARANCE CHART OF HP CASE -2 BF9-8

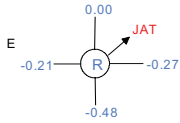
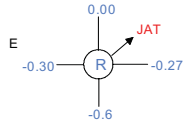
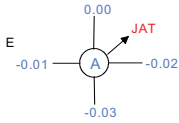
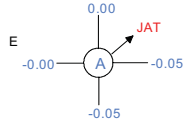
REF DRG . NO. 596-139-201 Sh. 1, 2 & 3 of 3, Rev. 2

All clearances are radials running clearances, Unless otherwise specified

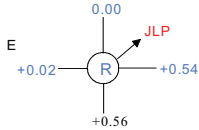
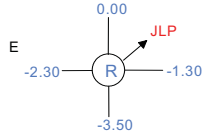
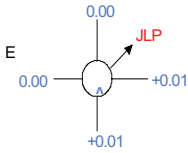
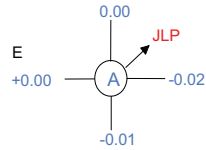
Sr. No.	Component	Detail on Drg.	Design Clearances	Actual Clearances
	Bearings			
1	Journal Bearing, Part No. 5, (Intake and Discharge End)	**A**	0.0023" to 0.0033"	0.002"
2	Seal Ring Journal Bearing, (Intake and Discharge End)	**A**	0.0085" to 0.0115"	0.008"
3	Thrust Bearing, Part No. 4 (Axial)	**F**	0.015" to 0.022"	0.017"
4	Seal Ring Thrust Bearing	**F**	0.00250" to 0.00375"	0.003"
	Inlet Guide Labyrinth			
5	**Small, Part No. 16- 1st**	**D** (All Stages)	0.0100" to 0.0150"	0.010"
6	Stage - 2nd from Intake End	**D**	0.0100" to 0.0150"	0.010"
7	Stage - 3rd from Intake End	**D**	0.0100" to 0.0150"	0.010"
8	Stage - 4th from Intake End	**D**	0.0100" to 0.0150"	0.010"
9	Stage - 5th from Intake End	**D**	0.0100" to 0.0150"	0.010"
10	Stage - 6th from Intake End	**D**	0.0100" to 0.0150"	0.010"

11	Stage - 7th from Intake End	**D**	0.0100" to 0.0150"	0.009"
12	Stage - 8th from Intake End	**D**	0.0100" to 0.0150"	0.012"
	Large, Part No. 18- 1st	**E** (All Stages)	0.0100" to 0.0150"	0.010"
13	Stage - 2nd from Intake End	**E**	0.0100" to 0.0150"	0.010"
14	Stage - 3rd from Intake End	**E**	0.0100" to 0.0150"	0.011"
15	Stage - 4th from Intake End	**E**	0.0100" to 0.0150"	0.010"
16	Stage - 5th from Intake End	**E**	0.0100" to 0.0150"	0.012"
17	Stage - 6th from Intake End	**E**	0.0100" to 0.0150"	0.010"
18	Stage - 7th from Intake End	**E**	0.0100" to 0.0150"	0.010"
19	Stage - 8th from Intake End	**E**	0.0100" to 0.0150"	0.014"
20	Balance Piston Labyrinth,	**C**	0.0075" to 0.0112"	0.008"
21	Balance Piston Labyrinth	**C**	0.0070" to 0.0105"	0.008"
Wind back Seal Assembly Intake End (Drg. No. 596-357-201, Sh. 1 of 1, Rev.0, Main Part No.-6) & Wind back Seal Assly Discharge End (Drg. No. 596-357-202, Sh. 1 of 1, Rev.0, Main Part No.-7)				
22	Inner Labyrinth, Part No. 7	**B**	0.004" to 0.006"	0.003"
23	Inner Seal Ring, Part No. 3 (Inner Side)	**B**	0.0010" to 0.0015"	0.0015"
24	Inner Seal Ring, Part No. 3 (Outer Side)	**B**	0.0015" to 0.0020"	0.002"
25	Tilt Pad Seal Ring, Part No. 4 (Inner Side)	**B**	0.0030" to 0.0035"	0.003"
26	Tilt Pad , Part No. 5	**B**	0.0020" to 0.0030"	0.003"
27	Tilt Pad Seal Ring, Part No. 4 (Outer Side)	**B**	0.0030" to 0.0035"	0.003"
28	**Stage - 1st from Intake End (over lap)**	**J**	.+0.055/-0.00	
29	Stage - 2nd from Intake End	**J**	.+0.055/-0.00	+0.008"
30	Stage - 3rd from Intake End	**J**	.+0.055/-0.00	+0.004"
31	Stage - 4th from Intake End	**J**	.+0.055/-0.00	+0.004"
32	Stage - 5th from Intake End	**J**	.+0.055/-0.00	+0.004"
33	Stage - 6th from Intake End	**J**	.+0.055/-0.00	+0.002"
34	Stage - 7th from Intake End	**J**	.+0.055/-0.00	+0.004"
35	Stage - 8th from Intake End	**J**	.+0.055/-0.00	

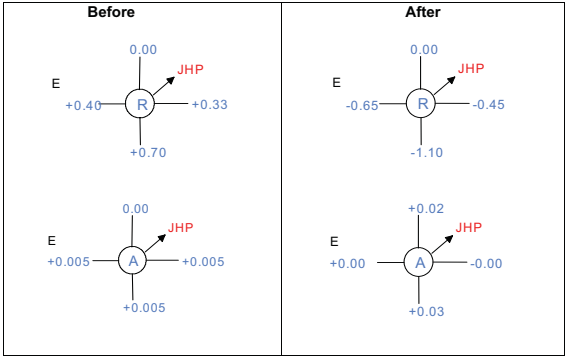
103 JBT to JAT

Before	After
	
	

103 JLP to JAT

Before	After
	
	

103 JHP to JLP



REFRIGERATION COMPRESSOR TRAIN

105-JT Turbine Preventive Maintenance

Journal & thrust bearings was opened, checked and found normal. Gauss measurement of rotor shaft & bearings was carried out and found normal.

105-JLP Refrigeration Compressor Preventive Maintenance
Thrust bearing was opened and cleaned. Both journal-bearing clearances were recorded by dial gauge since it is a single piece design. Gauss measurement of bearings & rotor was carried out and found within limits.

105-JR Gear Box Preventive Maintenance
All the bearings were inspected and found OK. Both the gear as well as Pinion were inspected and found to be O.K. Gauss measurement of gear shaft & bearings carried out and were found to be above limit .The same was reduced below 3 Gauss by degaussing.

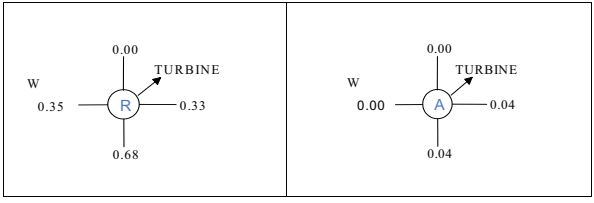
105-J HP Refrigeration Compressor Preventive Maintenance
Thrust bearing was opened and cleaned. Both journal bearing clearances were recorded by dial gauge since it is a single piece design. Gauss measurement of rotor & bearings was carried out and found above limits.The same was reduced bolow 3 gauss by degaussing.

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

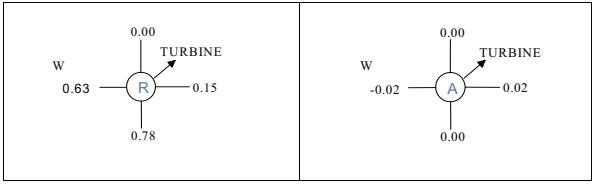
Description	Design Clearances (Inch)	Before	After
105 JT			
Coupling Float	N.A	0.440”	0.440”
Thrust end bearing	0.007 - 0.009	0.008-0.010”	0.008-0.010”
Opp Thrust end bearing	0.007 - 0.009	0.007-0.010”	0.007-0.010”
Axial Thrust	0.008 - 0.012	0.013”	0.013”
105 JLP			
Coupling Float	N.A	0.356”	0.356”
Thrust end bearing	0.006 - 0.008	0.010”	0.010”
Opp Thrust end bearing	0.006 - 0.008	0.009”	0.009”
Axial Thrust	0.011 - 0.015	0.014”	0.014”
105 JR			
Drive gear North bearing	0.014- 0.016	0.013”	0.011”
Drive gear South bearing	0.014- 0.016	0.012”	0.012”
Axial Thrust	0.014 “-0.024”	0.012”	0.012”
Pinion North bearing	0.013- 0.015	0.009”	0.009”
Pinion South bearing	0.013- 0.015	0.010”	0.010”
Free float	N.A	0.041”	0.043”
105 JHP			
Coupling Float	N.A	16.22mm	16.22mm
Thrust end bearing	0.004 - 0.007	0.007”	0.007”
Opp Thrust end bearing	0.004 - 0.007	0.005”	0.005”
Axial Thrust	0.008 - 0.012		

Train Alignment Reading

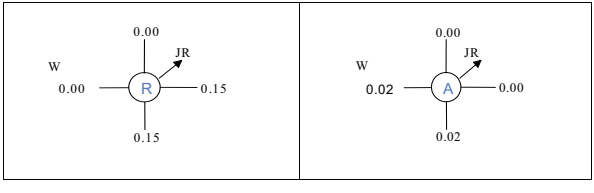
105-JT to 105-JLP (BEFORE)



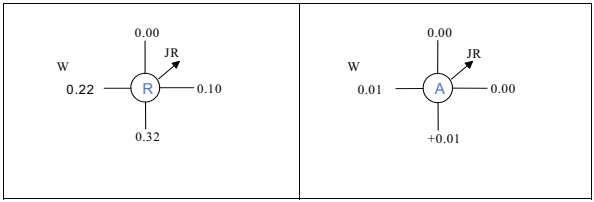
105-JT to 105-JLP (AFTER)



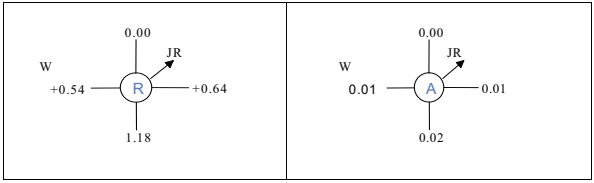
105-JLP to 105-JR (BEFORE)



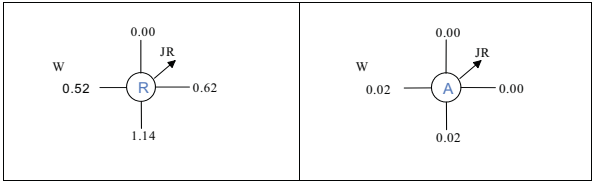
105-JLP to 105-JR (AFTER)



105-JR to 105-JHP (BEFORE)



105-GB to 105-JHP (AFTER)



101-BJ I. D FAN TRAIN

101-BJT Turbine Overhauling and Derating

During the shut down April-May 2005 this turbine was converted into condensing. But after the Energy Saving Project implementation (ESP) the Power required by turbine has been reduced due to the reduced load on the I D Fan. Turbine was rerated for energy saving by replacement of few modified components supplied by M/S Kirloskar Ebara, Pune, who is the Indian agents for M/S Elliot.

Turbine was derated as below:

- Existing Rating : 1000 HP at 4059 rpm
- Modified Rating: 738 HP at 3650 rpm

OEM recommended to replace the following modified spares in the turbine

- Smaller Nozzle ring with 11 nos nozzles (Old nozzle ring has 7 Nos nozzles)
- Modified Governing valve seat & Stem
- New Sentinel valve suitable for vaccum
- New Carbon rings for the casing gland
- New Journal bearings
- Trip assembly for derated tripping speed (OST)

Decoupled the turbine, Gear box and I D Fan. Opened the bolts and removed the turbine top cover and noted nozzle clearance. Removed rotor assembly, carbon rings and journal bearings. Removed the old nozzle ring. Blue match impression of the new nozzle ring taken by placing in the steam chest and found to be having more than 98 % blue impression. Installed the new nozzle ring in place of old one. Fitted new carbon ring assembly in the gland. Replaced Journal bearing and thrust bearing (KSF 6310 C3). Installed the new OST assembly with clearance of 1.6mm between the trip lever and OST fly ball. Placed the top casing and tightened casing bolts.

NOTE: During the testing of Over Speed Trip (OST) the new OST assembly was replaced by old one to make original tripping speed (4700 rpm) as required by the Production. The new one being lighter was unable to give a higher OST.

GEAR Box Preventive Maintenance

Bearings checked and found to be in good condition. The clearances taken found within the design value and GB was boxed up after cleaning the parting plane.

I D Fan Preventive Maintenance

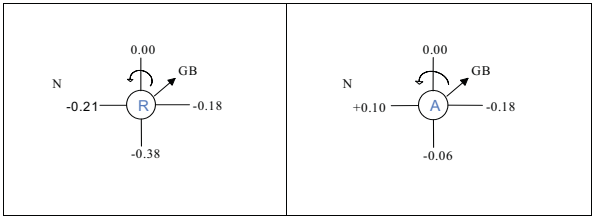
Both Journal Bearings were opened and checked the clearances found within the design value. Oil rings cleaned and fitted back. Boxed up the top half after confirming no cooling water leakage.

Readings taken during the maintenance of the train is recorded as under

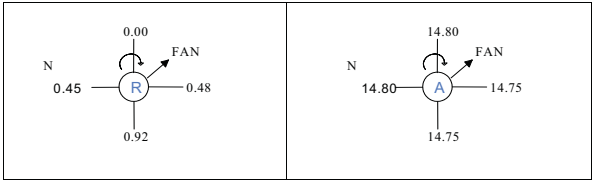
Description	Design Clearances (Inch)	Before (Inch)	After (Inch)
101 BJT			
Thrust end bearing	0.006 - 0.009	0.011"	0.009”
Opp Thrust end bearing	0.006 - 0.009	0.010"	0.009”
Axial Thrust	0.014 "	0.018”	0.014”
Nozzle clearance	0.042”-0.072”	0.80-1.3mm	1.28mm
Carbon ring clearance	0.001”-0.0035”	0.002”	0.002”
101 BJR			
Coupling Float	N.A.	3.20mm	3.2mm
Pinion bearing(Turbine side)	0.005”0.008”	0.012”	0.011”
Pinion bearing(Fan side)	0.005”0.008”	0.012”	0.010”
pinion float	N.A.		0.55mm
Gear Turbine side bearing (O/P)	0.005”0.008”	0.011”	0.010”
Gear Fan side bearing	0.005”0.008”	0.011”	0.010”
Gear Thrust	N.A	N.A	0.013”
Back lash	0.013”-0.017”	N.A	0.25mm
101 BJ			
Thrust end bearing (coupling side)	0.008 - 0.012	0.012	0.012”
Opp Thrust end bearing	0.008 - 0.012	0.012	0.011”
Axial Thrust	0.010”-0.015”	N.A	0.033”

Train Alignment reading is as under :

101 BJT to 101 BJR



101 BJR to 101 BJ



BOILER FEED WATER PUMP AND DRIVE TURBINE (104-JAT/JA/JT/J)

104-JAT BFW Pump Drive Turbine (Terry) Overhauling

Turbine was decoupled. The coupling shims were found broken and and hence replaced with new shim pack assembly. Turbine steam end journal bearing replaced since the bearing clearance found to be more than the design value. Thrust bearings opened and found in good condition and it is float also found within the design value. Repacked the governor valve gland since it was leaking. Turbine OST assembly cleaned and boxed up.

104-JA BFW Pump Preventive Maintenance

Both the journal bearings as well as thrust bearing were inspected, clearances found within recommended value.
Main oil pump (MOP) checked and found in good condition. Changed the lube oil and cleaned the oil strainer & filters.

Reading taken during the maintenance of the train

Description	Design Clearances (Inch)	Actual (Inch)
104-JAT (Terry)		
Thrust end Bearing	0.005-0.007	0.0065
Opp Thrust end Bearing	0.005-0.007	0.005
Axial Thrust	0.011-0.0016	0.014
104-JA (Pacific Pump)		
Thrust end Bearing	0.006-0.008	0.008
Opp Thrust end Bearing	0.006-0.008	0.006
Axial Thrust	0.014	0.0135

104-JT BFW Drive Turbine (Elliot) Overhauling

Turbine was opened for attending the gland leakage and casing leakage. Turbine was decoupled and removed the casing top half. Opened the bearings and checked the clearances. Removed gland carbon rings. Removed the rotor, checked for any scoring at gland area and found smooth & in good condition. Casing parting plane was checked by blue match and found high spots which were removed by scrapping and oil stoning. Replaced the old gland carbon because clearance was more than recommended value. Boxed up the casing applying Birkosit compound at the parting plane. Same bearings used and boxed since the clearances are found within the recommended value.
The governing valve bonnet was unbolted to attend leakage. The flange surface was properly cleaned and polished. 0.5mm thick copper gasket was used after annealing the same.

104-JA BFW Pump Preventive Maintenance

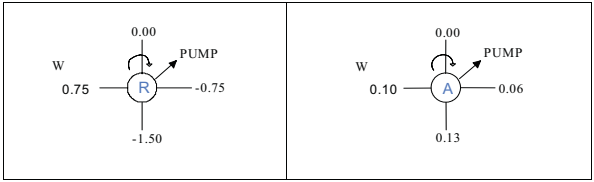
Both the journal bearings as well as thrust bearing were inspected, clearances found within recommended value.
Main oil pump (MOP) checked and found in good condition. Changed the lube oil and cleaned the oil strainer and filters.

Description	Design Clearances (Inch)	Before	After
104 JT (ELLIOT)			
Thrust end bearing	0.006 - 0.009	0.008”-0.012”	0.008”
Opp Thrust end bearing	0.006 - 0.009	0.008”	0.008”
Axial Thrust	0.014 "	0.015”	0.011”
Nozzle clearance	0.042”-0.072”	0.033”-0.055”	0.059”-0.042”

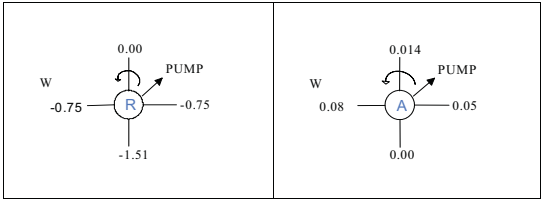
Description	Design clearances (Inch)	Before (Inch)	Actual (Inch)
104 JA			
Thrust end bearing	0.006 - 0.008	0.006	0.005-0.010”
Opp Thrust end bearing	0.006 - 0.008	0.006	0.007-0.010”
Axial Thrust	0.014 "	0.010	0.007”

Train Alignment readings recorded as under

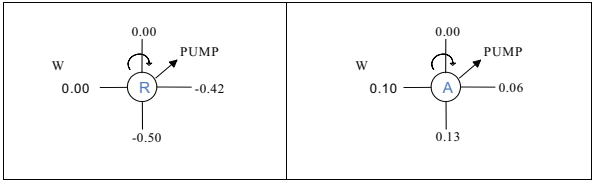
104-JATT to 104-JA (BEFORE)



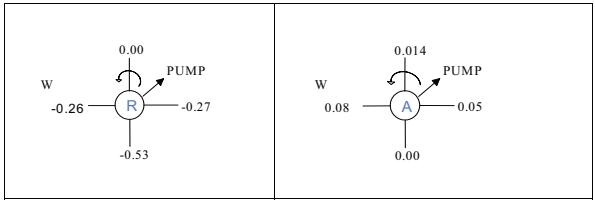
104-JAT to 104-JA (AFTER)



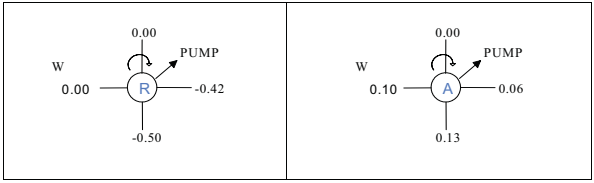
104-JT to 104-J (BEFORE)



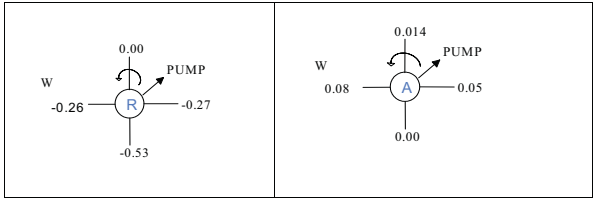
104-JT to 104-J (AFTER)



104-JT to 104-J (BEFORE)



104-JT to 104-J (AFTER)



aMDEA SOLUTION PUMP TRAIN

Derating Of 107-JAT (Elliot) Turbine and overhauling

During shut down May-2005 ,one pump was removed from service due to reduction in fow requirement after the Energy Saving Poject implemenation. This resulted in power reduction in turbine. Hence it was proposed to derate the turbine by modification recommeded by OEM. The turbine was derated by replacing with smaller nozzle assembly M/S Kirloskar Ebara pune the Indian agent for M/S Elliot.

Turbine was derated as below:

- Existing Rating : 1575 hp @ 3560 RPM
- Modified Rating: 655 hp @ 3560 RPM

OEM recommended to replace the following modified spare in the turbine

- Smaller Nozzle ring with15 Nos Nozzle(The old Nozzle Ring has 12 Nos Nozzles)

Decoupled the turbine and Pump. Opened the bolts and removed the turbine top cover and noted nozzle clearance. Removed rotor assembly, carbon rings and journal bearings. Removed the old nozzle ring. Blue match impression of the new nozzle ring taken by placing in the steam chest and found to be having more than 98 % blue impression. Installed the new nozzle ring in place of the old one. Fitted new carbon ring assembly in the gland. Replaced Journal bearing and thrust bearing since the existing bearing was having more clearances than the recommended value. Cleaned the OST and fitted back. Placed the top casing and tightened casing bolts.

Over Speed Trip was checked after the replacement of smaller nozzle ring. Turbine tripped at speed of 4052 RPM.

107-JA aMDEA Pump Preventive Maintenance

Pump bearing lube oil was flushed.

107-JT(Murray) aMDEA Drive Turbine Preventive Maintenance

Opened both journal bearings and thrust bearing. Clearances were on the higher side. Since the spares were not available, assembled with same bearings. Lube oil & Governor oil cooler was cleaned. Lube oil console was cleaned and filled with new oil. Lube oil filter was replaced with new one.

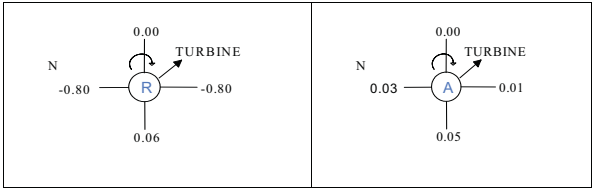
107-J aMDEA Pump Preventive Maintenance

Pump mechanical seal (NDE) was attended for leakage. Reconditioned seal available was used to replace the leaky seal.
Reading taken during the maintenance is recorded as under :

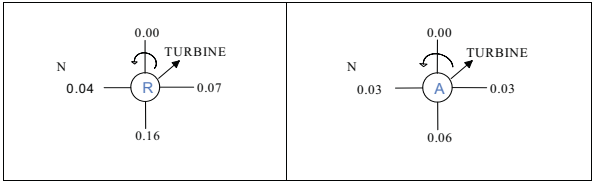
Description	Design clearances (Inch)	Before	After
107-JAT (Elliot)			
Coupling float		8.7mm	8.7mm
Thrust end bearing	0.006 - 0.009	0.012	0.010"
Opp Thrust end bearing	0.006 - 0.009	0.010"	0.010"
Axial Thrust	0.014 "	0.012"	0.016"
Nozzle clearance	0.042"-0.072"	2.25-2.80mm	2.25-2.5mm
Carbon ring clearance	0.001"-0.0035"		0.0025"
107-JT (Murray)			
Thrust end bearing	0.004 - 0.006	0.006"	0.006"
Opp Thrust end bearing	0.004 - 0.006	0.006"	0.006"
Axial Thrust	0.007-0.013 "	0.013"	0.013"

Alignment reading of the train is as under

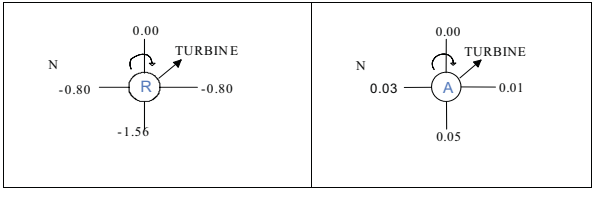
107-JAT to 107-JA (BEFORE)

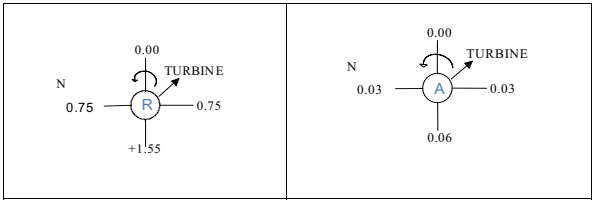


107-JAT to 107-JA (AFTER)



107-JT to 107-J (BEFORE)





LEAN aMDEA SOLUTION PUMP TRAIN

115-JAT Turbine Preventive Maintenance

Both ends journal bearings were opened and clearances noted and found within limit. Gauss readings were also taken and found within limit.

Hydraulic Turbine Preventive Maintenance

Bearings were opened, the clearances noted and found within limit. Gauss reading taken and found within limit.

115-JA Pump Preventive Maintenance

Bearing opened, clearance noted and found to be within limit. Gauss measurement taken and found to be within the limits.

Readings taken during the maintenance is recorded as under

Description	Before (Inch)	After (Inch)
Thrust end bearing	N.A	0.008"-0.009"
Opp Thrust end bearing	N.A	0.006"-0.007"
Axial Thrust	0.0137"	0.0145"
Thrust end bearing	N.A	0.0047"
Opp Thrust end bearing	N.A	0.005"
Thrust end oil guard	N.A	0.011-0.013"
Opp thrust end oil guard	N.A	0.011"
Axial Thrust	N.A	0.015"
Coupling side bearing	N.A	0.009-0.014"
Governor side bearing	N.A	0.010-0.011"
Coupling side oil guard(inboard)	N.A	0.005-0.006"
Coupling side oil guard(outboard)	N.A	0.007"
Governor side oil guard	N.A	0.004"

115-JB Pump Preventive Maintenance

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

Description	Before (Inch)	After (Inch)
Thrust end bearing	N.A	0.006-0.007”
Opp Thrust end bearing	N.A	0.006-0.007”
Axial Thrust	N.A	0.017”

Lean Pump Drive Turbine (116-JAT) Preventive Maintenance

The axial thrust was measured and found within limit. Both ends bearings were opened, clearance measured and found within the limit. Gauss measurement taken and found within limit. The oil guard clearances were measured and found within limit.

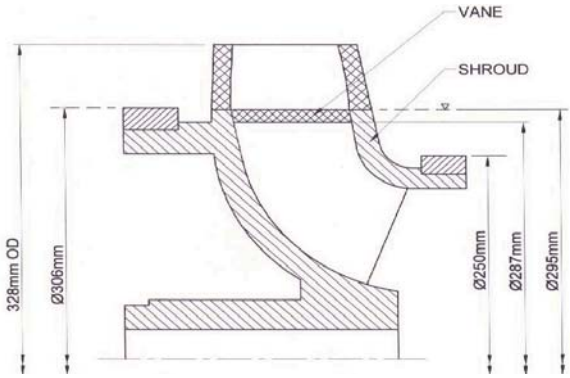
Reading taken during the maintenance is recorded as under

Description	Before	After
Thrust end bearing	N.A	0.010”
Opp Thrust end bearing	N.A	0.008”
Governor side oil guard	N.A	0.009”
Coupling side oil guard	N.A	0.008”
Axial Thrust	N.A	0.024”

116-JA Pump Preventive Maintenance and Derating for energy saving

Opened the pump for impeller trimming. The impeller was machined to trim to reduce the head as under

- Shrouds OD was machined to **295mm (Original OD = 328 mm)** as per sketch.
- The vane OD was machined to **287mm**
- The sharp corners of vane were removed.
- After machining the impeller was balanced.
- Finally the rotor was installed and casing boxed up



TRIMMING OF IMPELLER OF 116 – J (TURBINE DRIVEN)

After dismantling following parts were found not in good condition

- Mechanical seal.
- Key for impeller.
- Gasket for casing.

Replaced the above spares assembled the pump. Details of capacity before and after trimming the impeller is as under

SRL NO	PARAMETERS	BEFORE	AFTER
1	DISCHARGE PRESSURE	78 psi	64psi
2	FLOW	N.A.	550 m^3/hr

101/105-J LOP Pump Drive Turbine Overhauling

Taken out the turbine along with pump from the console. Opened the turbine and changed the rotor with reconditioned one. Replaced the Gland Carbon Rings, Trip valve spring, Bearings (7312 BEC BJ & 6308 C3).

SECONDARY WASTE HEAT EXCHANGER 102-C

Secondary waste heat exchanger (102-C) was taken for retubing. 100 Nos seamless tubes T11 materials were procured for the same. Contract for retubing was awarded to M/S EMKEY Engrs, Vadodara for retubing job. Contractor could replace only 7 Nos. tubes though the target was for 50 Nos. It was noticed that the old tubes were getting sheared inside the skeleton assembly while pulling from the exchanger.

It was proposed to plug the defective tubes and repair tube to tube sheet seal welding since the replacement was not possible. All tubes having loss of more than 25% wall thickness according to the REFT conducted in 2005 and tubes which failed in hydro test were plugged.

Dehydrogenation was carried out before the start of the repair welding and PWHT was carried out after the repair .

Dehydrogenation

This shall be carried out by electrical heating of Bottom and Top tube sheet before the welding of new tubes.

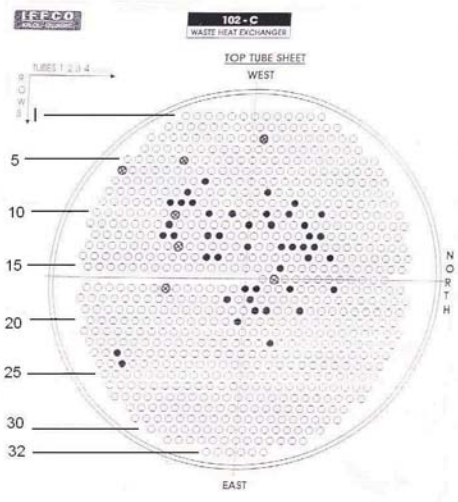
- Heating up to 350 deg C and soaking for 48 Hrs.

Post Weld Heat Treatment (PWHT)

This shall be carried out by electrical heating of Bottom and Top tube one after the other and not simultaneously of both the tube sheets as follows:

- Loading temperature 350 deg. C
- Heating rate 35 deg. C per Hr
- Soaking temperature 675 deg.C
- Soaking period 1 Hr
- Cooling rate 35 deg. C per Hr
- Unloading temperature 300 degree C

Status of the repair is recorded as under



TOTAL NO OF TUBES : 750

NO OF TUBES PLUGGED: 45 •

NO OF TUBES REPLACED: 07 ⊗

WASTE HEAT BOILER (GT-1632-101-F) INSPECTION BY IBR

Waste Heat Boiler was inspected in open test condition and also hydro tested at 145 kg/cm^2 pressure. Both tests were witnessed by Boiler Inspector.

All 4 relief safety valves of steam drum 101-F were steam tested / floated and their readings are as follows:

	R.V. (North)	R.V. (Middle)	R.V. (South)	R.V. (Super Heater)
Popping Pr. Kg/cm2	116.6	118.5	119.5	113.0
Reset Pressure Kg/cm2	109.9	110.8	114.7	108.6

Following Safety Relief Valves Overhauled & Servicing Carried Out By M/S Dembla

SR. NO	RV Tag NO	SERVICE	Valve Size	Set Pr (Kg/cm^2)	Reset Pr (Kg/cm^2)
1	RV – MS 9	Ms Steam Header	4" x 6"	42.2	38.0
2	RV – S 7	11 Kg Steam Header	4" x 6"	14.8	13.3
3	RV – LS 1	LS Steam Header	4" x 6"	12.70	11.40
4	RV – 123 CA (2 Nos)	BFW Outlet Line From 123-C	3" x 6"	122.0	110.0
5	RV – BFW 1		1.5"x2.5"	92.0	82.8
6	RV – S 26	Atomizing Steam To Aux Boiler	2.5" x 4"	14.06	12.6
7	RV – 103 JAT (2 Nos)	103-JAT Exhaust	4" x 6"	46.4	42.0
8	RV – 103 JAT	103-JAT Exhaust	¾" x 1"	46.4	41.7
9	RV – 104 JAT	104-JAT Exhaust	6" x 8"	0.35	0.30
10	RV – 111 C	3.5 Kg Steam To 111-C	1" x 2"	5.3	4.8
11	RV – 112 CA	3.5 Kg Steam To 112-CA	1.5" x 3"	10.5	9.5
12	RV – 112 CB	3.5 Kg Steam To 112-CB	1.5" x 3"	10.0	9.0
13	RV – 109 F	105-J Discharge	6" x 8"	19.0	17.0
14	RV – 110 FN & S (2 Nos)	Ammonia Vapour	3" x 4"	7.0	6.3
15	RV – 111 F	Ammonia Vapour	4" x 6"	6.3	5.6
16	RV – 112 F	Liquid Ammonia	4" x 6"	6.30	5.7
17	RV – 101 D	NG Inlet to 101-D	3" x 4"	44.0	39.6

18	RV – 102 D	NG Inlet to 102-D	3” x 4”	43.9	39.5
19	RV – 117 JLP	117-JLP Outlet	1.5” x 2”	15.8	14.2
20	RV – 115 JB AOP	115-JB AOP Outlet	1” x 2”	11.0	10.0
21	RV – 101 J	101-J Discharge	4” x 6”	37.0	33.20
22	RV – 105 JLO	101/105-JlOT Exhaust	2” x 3”	5.3	4.7
23	101 JT Sealing Steam RV	101-JT Sealing Steam	1.5” x 2”	0.7	0.63
24	RV – 129 C	103-J Interstage Cooler	1” x 2”	8.4	7.5
25	RV – 104 D1	PG Inlet to HTS	6” x 8”	35.0	33.0
26	RV – 104 D 2	PG Inlet to LTS	1.5” x 2”	34.0	30.6
27	RV – 101 E	PG Inlet to 101-E	1” x 2”	30.6	27.5
28	RV – PG 39	PG to Fuel Header	4” x 6”	5.3	4.7
29	RV – 102 F	102-F outlet	6” x 8”	29.5	26.5
30	RV – 106 F	106-F outlet	1.5” x 2”	158.0	142.2
31	PSV-986	MP Boiler 107-C	4” x 6”	45.0	40.5
32	PSV-987	MP Boiler 107-C	4” x 6”	46.3	41.7
33	PSV-177		15mm x 20mm	57.08	52.0

HEAT EXCHANGERS & COOLERS CLEANING BY HYDROJETTING:

The Following Heat Exchangers Were Opened , The 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	NOS.	NO OF TUBES	TUBE SIDE PRESSURE (KG/CM^2)		SHELL SIDE PRESSURE (KG/CM^2)		REMARKS
				DESIGN	TEST	DESIGN	TEST	
1	124-C	1	775 U	158		17.6	26.5	
2	109-C1A	1	1150	30.58	46.1	5.29	8.1	
3	109-C1B	1	1150	30.58	46.1	5.29	8.1	
4	109-C2A	1	1150	30.58	46.1	5.29	8.1	
5	109-C2B	1	1150	30.58	46.1	5.29	8.1	
6	115-C	1	649U	29.9		10.6	15.8	38 NO OF TUBES EXPANDED
7	116-C	1	300U	66.4		10.4	15.8	

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

SR NO	EQP	NO.	NO. OF TUBE	TUBE SIDE PRESSURE (KG/CM^2)		SHELL SIDE PRESSURE (KG/CM^2)		REMARKS
				Design	Test	Design	Test	
1	108-C1A	1	1415	5.27	8.1	8.0	8.1	3 NOS OF TUBES PLUGGED (From Bottom to top & Silo side to C.T.) ROW NO 2 TUBE NO 15 ROW NO 6 TUBE NO 2 ROW NO 8 TUBE NO 38
2	108-C2A	1	1415	5.27	8.1	8.0	8.1	
3	110-CA	1	763	5.60		5.27		
4	110-CA	1	763	5.60		5.27		
5	127-CA	1	3516	5.60		21.10	31.50	
6	127-CB	1	3516	5.60		21.10	31.50	
7	128-C	1	1200	5.60		8.09		
8	129-JC	1	290	2.3		5.29		
9	130-JC	1	264	5.82		5.27		
10	131-JC	1	348	11.90		5.27		
11	173-C	1	294	10.60		5.27		

THE FOLLOWING LUBE OIL COOLERS WERE TAKEN FOR HYDRO JETTING :

SR. NO	EQUIPMENT	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 HYDRO JETTING 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	

FABRICATION JOBS:

Sr. No.	Item Description	Size
1	Steam to air coil LP tapping root isolation valve replaced.	½" x 800 #
2	LS header trap above 108-J isolation valve replaced.	¾" x 800 #
3	103-JAT exhaust drain valve replaced.	¾" x 800 #
4	FIC-13 TX LP & HP tapping isolation valve replaced.	½" x 1500 #
5	101-F high level switch top & Bottom isolation valve replaced.	1" x 1500 #
6	FIC-13 U/S line vent valves replaced.	1" x 1500 #
7	101-F sample line 1st isolation valve replaced.	¾" 1500 # 1" x 1500 #
8	115-JAT steam inlet C/V D/S drain main isolation valve replaced.	¾" x 800 #
9	PCV 181 U/S trap isolation valve replaced.	½" x 800 #
10	116-J discharge USV-discharge flange replaced	8" x 150 #
11	116- JAT steam inlet flow TX(FT.934) LP tapping root isolation valve replaced	½" x 800 #
12	116-JAT steam inlet PI isolation valve replaced.	1" x 800 #
13	V-5 U/S trap isolation valve replaced.	½" x 800 #
14	103-JAT steam exhaust block valve bypass valve replaced.	1" x 800 #
15	FRC-2 D/S line vent valve replaced.	¾" x 800 #
16	115-JA coupling guard modified.	

17	LP flash vessel pulley fixed for ring removal.	
18	MIC-22 package pump and its pipe line removed.	
19	Suitable repositioned 101-CB IBD drain valve to make it access able.	
20	Repaired B3A overflow line in PGR area.	
21	Steam trap near MK-111B replaced.	
22	127-C north side channel cover lifting support welded with pad.	
23	Drain line removed near absorber foundation (underground drain line).	
24	De-Super heating station above 103-C internal pipes removed and refabricated the pipe to stop regular leak during start-up.	
25	114-C D/S second drain valve broken wheel repaired by tack weld.	
26	Fabrication job for sour oil drain trap for instrumentation purpose.	
27	Provided permanent ladder for operating 111-J discharge to old co_2 absorber inlet vessel valve.	
28	107-J/JA discharge main isolation valve to flushing fluid line platform provided.	
29	Provided support for 108-J/JA discharge to LP vessel line at vessel side.	
30	Provided isolation valve provision at LP flash vessel drain line (At ground level by relocating the existing isolation valve).	
31	103-J to 105-J platform extended & DM water line rerouted.	
32	103-D hoist platform modified.	
33	Platform for isolation valve at 117-J provided.	
34	123-C BFW outlet to utility main isolation valve replaced	
35	PIC-20 vent silencer drain line elbow joint pin hole leak attended	
36	116-JBT TTV U/S drain trap isolation valve replaced..	
37	3.5 kg steam to PGR under ground line across the road near PGR leak attended.	
38	38-kg steam to auxiliary boiler atomizing steam header drain line valve near 156-F replaced.	
39	103-JAT inlet MOV bypass valve replaced.	
40	SP 74 leak towards south side M-Seal removed and patch welded.	

41	PIC-410-B vent to be connected with SP-74 silencer.	
42	101-EA sample point welding leak attended.	
43	Provided new level transmitter in steam drum 101-F.	
44	Modified 107-J suction and discharge line as per requirement.	
45	Provided new flanges in 103-JAT inlet line.	
46	Isolation valve provided for 115-JAT/JBT strainer.	
47	116-JA discharge line flange of NRV was replaced by SORF flange.	

GLAND RE-PACKING OF VALVES: The following valves were taken to attend gland leak .The old gland packing was replaced by new one. The job was performed by M/S Amrutha engineering

Sr. No.	Description of Job	Size	Remarks
1	SP-39 sealing steam isolation valve	18" x 300 #	
2	SP-39		
3	101-D inlet bypass valve	2" x 300 #	
4	HP air to utility isolation valve	2" x 300 #	
5	TRC-10	14" x 1500 #	Both sides.
6	101-F North side L/G isolation valve	1-½" x 1500#	
7	101-F cooling tower side isolation valve	1" x 1500 #	
8	108-F to PGR isolation valve	4" x 300 #	
9	115-JBT inlet isolation valve	4" x 300 #	
10	LIC-14 level troll top isolation	3" x 1500 #	
11	38 kg steam to ESP main isolation valve	8" x 600 #	
12	116-JBT exhaust RV D/S drain mail isolation valve		
13	105-D outlet line sample isolation valve		
14	108-F gas outlet line to PGR isolation valve	3" x 1500 3	
15	LC-13 level troll top and bottom valve		
16	HCV-11	2" x 1500 #	
17	106-F middle tray check 1st isolation valve	½" x 1500 #	
18	USV 934 D/S trap main isolation valve	¾" x 800 #	
19	MIC 22 U/S block valve	6" x 1500 #	
20	NG to 101-EA isolation valve	2" x 300 #	
21	38-kg snuffing steam to PRC-4 vent silencer isolation valve	2" x 300 #	

FLANGE LEAKAGE/ BONNET LEAK / VALVE PASSING JOBS:

Sr. No.	Description of Job	Size
1.	Auxiliary boiler No-1 labyrinth sealing steam line union leak attended.	
2.	MIC-61 U/S flange leak attended.	3" x 600#
3.	101-CB riser pipe chemical cleaning flange leak attended.	
4.	101-F north side LG isolation valve flange leak attended.	1½"x1500#
5.	156-F RV upstream flange leak attended.	3" x 150 #
6.	101-CB down comer pipe chemical cleaning flange leak attended.	
7.	115-JBT steam inlet strainer flange leak attended.	6" x 600 #
8.	117-J discharge line check valve near 101-E2 passing attended.	
9.	122-C outlet line middle flange leak attended	
10.	115-JAT steam leak from bottom of casing flange leak attended.	
11.	116-JBT TTV U/S drain trap passing attended	¾" x 800 #
12.	Amreal charging pot old charging funnel leak attended	
13.	101/105-J lube oil cooler (bottom) cooling tower side channel cover leak	
14.	38 kg steam to pre-reformer battery limit isolation valve bonnet leak attended	12" x 600#
15.	101-F level troll bottom isolation valve bonnet leak attended	2" x 1500#
16.	PICV-13A U/S block valve bonnet leak attended	6" x 1500#
17.	PICV-13A control valve bonnet leak attended	6" x 1500 #
18.	106-F level troll drain valve bonnet leak attended	¾" x 1500 #
19.	LIC-14 level troll top isolation valve bonnet leak attended	3" x 1500 #
20.	107-JAT steam inlet valve bonnet leak	6" x 400 #
21.	Amreal charging pot drain isolation valve bonnet leak	1" 300 #
22.	108-F level troll top isolation valve bonnet leak	2" x 1500 #
23.	HCV-11 bonnet attended	2" x 1500 #

1.0 REFORMER REVAMP INTRODUCTION

The Revamp-II of Primary Reformer was carried out in the year 1993. Reformer was in service satisfactorily without any major leakage. But during the inspection of the tubes in the annual turn-around Apr-May 2003, cracks were noticed in 'C' joint. 18 tubes were replaced in the year 2003. This deterioration limited the safe operation of reformer. During its service, total 54 nos. tubes were replaced by 2005.

Also, the existing Catalyst tubes were in service for last 13 years, since 1993. The tubes have already provided service beyond its design life of ten years (1000000 hrs.) and hence the probability of failure was high.

2.0 NEW HARP ASSEMBLY FOR PRIMARY REFORMER

New Harp assembly was procured from M/S S+C Germany vide PO No. 9916779 dtd. 02/02/06. New harp assembly top piece was replaced with SS 304H material to avoid dissimilar joint. Inlet header and pigtail also replaced with SS 304H material. Total 24 Nos harp assembly from M/S S+C Germany received at IFFCO Kalol.

3.0 INSPECTION OF NEW PRIMARY REFORMER HARP ASSEMBLY

Radiant tube rack was erected near laboratory building for initially storing the new Catalyst tubes. Old catalyst tubes were stored in it after installation of new Harp assembly during Turnaround.

The following Inspection were carried out in the new harp assembly:

- Visual Inspection - Defects found during visual inspection of weld joints were removed by grinding
- Dye Penetrant test - DPT of all weld joints of all tube segments were carried out. Defects found were removed by Welding.
- Ferrite measurement of spare tube segment - Sample piece of approx. 1" length was cut from the new spare Reformer tube segment and was heated to 1093^{O}C and held for 24 hrs. followed by water quenching. Then superficial metal/oxide layer was removed and Ferrite content was checked and the same was found nil.

Welders of M/s. S+C, Malaysia, repaired the weld defects found above at Kalol site.

4.0 PRE SHUT DOWN ACTIVITIES

The erection contract of Primary Reformer Revamp-III was awarded to M/s Neo Structo, Surat. The Party mobilized their manpower at site one month before shut down to carry out Pre shut down activities. The following activities were carried out prior to shut down:

Welding of New Inlet Manifold sections

New inlet Manifolds were supplied in two halves by M/s Precision Eqts., Chennai . (Size – 6" NB, Sch 80S, Material : ASTM A 312 TP 304 H). These sections were welded together and made ready for erection. The welding was carried out by TIG welding using ER 308 H filler wire. Weld inspection were carried out : Root and final DP, Root and final radiography.

Insulation of Pig tail

Insulation Contract of Revamp was awarded to M/s Balaji Insulation, Mumbai. Insulation of new Pig tail was completed using Ceramic fibre blankets (2½" thk.) except at both ends. A length of 6" at top portion and the length after the elbow of bottom end (576 mm) was kept uninsulated. This was necessary to provide easy access for welding.

Fabrication of Suspended scaffolding

Fabrication of 27 Nos. of suspended scaffolding to cover the entire area under the arch roof, were required for carrying out Roof Insulation jobs in Primary Reformer.

The frame of scaffolding was made of ISA 40 x 40 x 6 mm angles. CS / G.I sheet of 1.6 mm thk. was welded to the frame.

The size in mm and quantity of the scaffolding used are given below:

Sr. No.	Size of Scaffolding	Qty (Nos.)	Remarks
1	4065 X 900	4 nos.	Length of wire rope-3600 mm
2	4085 X 900	2 nos.	
3	4065 X 1200	14 nos.	Length of wire rope-3650 mm
4	4085 X 1200	7 nos.	

- Slings for suspended scaffolding were made from 8 mm dia wire rope. The same was clamped using bull dog clamp and D-shackle of 1.6 Ton capacity.

- Fabrication of beams for hanging the suspended scaffolding from Primary Reformer platform. Qty - 54 nos.

Fabrication of Spreader & Lifting beams and Support / Structure for erection of Harp Section

- Fabrication of lifting beams for removal of old harps and insertion of new one. Qty -48 sets
- Fabrication of one no. spreader beam for lifting of Harp sections.

- Harp installation tracks (8 nos.) were fabricated using channel of ISMC 175 and the same were laid below each harp row on reformer ground level. Channel was tack welded between these tracks to prevent movement of Harp installation tracks during shifting of Harp

- Wooden Blocks for supporting the outlet manifold during shifting of B & C sections of harps by Hillman Roller, Qty – 12 nos.

- Flat was welded on top plate of Hillman roller and these wooden blocks were kept on them.

- Greasing of Hillman Roller was done and made ready for use, Qty – 12 nos.

- Flange (3½" X # 600) with pipe (length – 1150 mm) welded on it for rolling of harps was fabricated. Qty - 18 nos.

❖ Fabrication of beams for providing support to the reformer floor beams which were required to be cut for the removal of Harp assembly.

❖ Fabrication of Cleats and Clamps for fit up of Riser to Transition cone welding joint

❖ Fabrication of Cleats and Clamps for fit up of Outlet manifold weld joint.

❖ Fabrication of patch plates for water jacket.

❖ Fabrication of backing ring for Transition cone to Transfer line stub weld joint, size – 18mm width X 6 mm thk.

❖ Fabrication of patch plates for welding of holes made for refractory filling of Transition cone. Size: 3" X 3" X ½" thk.

❖ Suitable funnel & pipe for vent during Refractory filling of Pressure Shell was prefabricated.

❖ Screw jacks, 48 Nos. (Store code - 100101015) for supporting the I beam of bottom floor of reformer were issued from Stores. The same was kept ready below the floor plate of reformer as per plan. Screw jack was loaded only after cooling down of furnace after shut down.

❖ Guide plates of catalyst tubes are to be welded by keeping proper clearance with tube. For maintaining proper clearance while welding of guide plate, a template was made in Workshop and kept ready. (Total three different types are required)

- New spring hanger assemblies were supplied by M/s Sarathi Engg., Hyderabad. Spring hangers and hanger rods were issued from stores, were assembled and kept ready.

- Spring hangers and pigtail required for two rows, guide plate, gas cutting sets etc were shifted to the top floor of Pre-Reformer.

- Removal of Asbestos sheet from penthouse & from north end was planned before shut down. But the same was not carried out since clearance was not available from Production Dept. The clearance was given only after Plant shut down.

- Railing of Primary Reformer platform near tunnel burners was cut and removed for easy removal and installation of Refractory bricks.

- Blower piping was removed for easy access of Tractor for shifting of Refractory bricks.

- The electricallyoperated hoist of Primary Reformer and hoist near 101-C was overhauled and made ready for shifting material.

- Two pulleys were installed for shifting material to & fro from pent house, one pulley at Pre reformer and the other at east side of Reformer.

- Catalyst loading of new Harp was completed & ΔP was checked by Production department before shut down.

- Welders qualification test was carried out and sufficient nos. of qualified welders were made ready prior to shut down.

Load Test of Crane

Load test of crane of M/s Neo Structo was carried out prior to shut down. The details of crane and load test is given below:

Details of Crane

Capacity	:	75 MT
Model	:	TATA 955ALC
Serial No.	:	S0229 LT 1042

Details of load test

Boom length	:	140 ft
Radius	:	12.6 m
Lifting Capacity	:	10.8 MT
Lifted wt.	:	11.2 MT (Along and Perpendicular to crawler)

5.0 SHUT DOWN ACTIVITIES

Ammonia Plant was shut down at 08:00 hrs. on 31st March, 2006.The following activities were carried out during Primary Reformer Revamp:

- Spring hangers of all catalyst tubes were locked before taking out from their position so that their removal is easier.

- Readings of transfer line spring hangers were noted down and the same were locked after cooling down of furnace for ensuring the same position of transfer line during riser welding. Locking of transfer line spring hanger was done before draining of water Jacket.

❖ **Removal Of Insulation**

- Insulation of pigtails at both ends was removed for facilitating the cutting of Pigtail. The pigtail insulation was removed only at two places. One at the vertical portion coming out from inlet header & second near the catalyst tube to pigtail connection.

- The insulation of inlet manifold was removed at the location where cutting was to be carried out.

- Insulation of catalyst tube just above arch plate were removed for facilitating the removal of Harps.

- Priority was given to row No 1 & 8 as these harps were to be removed first.

❖ All the tunnel burners were removed. This was done for proper ventilation inside the furnace and for making way for removal of floor and tunnel bricks through the opening of tunnel burners.

❖ **Removal of Arch burners**

There are nine rows of burners in the pent house, each having fourteen burners. Six burners were removed per row for hanging of suspended scaffolding through their openings. Burner nos removed for this purpose were 1,5,6,9,10 & 14. One extra burner of 1st and 8th row was also removed for entering the hanging scaffolding. Priorities were given from row No.1 & 8 during burner removal.

Before removing from position, all these burners and their connecting lines were properly tagged to avoid the problem of thread mismatch while re-fixing the same.

❖ **Fixing of bottom floor support of Reformer**

Load was taken on screw jacks, which were kept below bottom floor of reformer after cooling down of furnace. This was done as per the location plan made for the screw jacks. Because of this the load of the harps that will be coming on the reformer floor during shifting of harps was transmitted to the foundation via these screw jacks.

- The following blinds were provided for Reformer Isolation

1) 3 " Naphtha liquid old plug valve down stream
2) AG to Ammonia battery limit
3) PG Inlet at PRC-2 down stream at up stream of block valve.
4) Sour gas from 102 / 103 J common header.
5) F-110 outlet tail gas
6) Naphtha from Naphtha deaerator to Arch burner.
7) AG line fig 8 up stream of 800-J near separator
8) PRCV-2 by pass valve down stream
9) FRC-1 down stream
10) FRC-2 Process steam down stream orifice flange
11) 102-C gas outlet common flange
12) De superheating station

- **Cutting of Pig tail and guide Plates**

Pigtail was cut at two places by gas cutting. At top, it was cut in the vertical portion coming out from the inlet header and at bottom it was cut near the catalyst tube.

All guide plates of the tubes were removed by gas cutting for making way for rolling and removal of the harps.

❖ Draining of Water Jacket

Water Jacket for secondary reformer transfer line and risers of the primary reformer is common. The water inlet is from the secondary reformer. The water that circulates in the water Jacket was drained after cooling down the secondary reformer. It was ensured before draining the water jacket that the transfer line spring hangers were locked in their position.

Clearance was given to Production dept. for water draining (Water jacket temp. -100^{O}C) after locking of spring hangers at 01:30 hrs on 01/04/06. Draining was completed by 05:30 hrs.

- **Opening of Manhole**

Manholes of the reformer as well as that of the convection zone were opened at 05:00 hrs on 1st April,2006 and entry into the furnace was obtained.

❖ **Removal of Refractory and Tunnel of Reformer**

After getting entry permit of furnace, the following clearances were measured:

- Clearance between refractory wall and both the ends of outlet manifolds of each harp.
- Clearance between outlet header insulation and floor bricks at three positions for all the rows.

After recording the above clearances, tunnel slab and refractory bricks removal was started. The refractory was removed from tunnel burner openings. An opening of approx. size of 2 m x 2 m was made in wall No.3 of reformer for facilitating material removal & insertion. Removal of refractory was started at 08:00 hrs on 1st April and cleaning was completed by 08:00 hrs. on 3rd April

❖ **Lifting of Hanging Scaffolding**

Hanging scaffoldings were shifted to the furnace through the opening made in the wall no.3. The scaffolding were then shifted by sliding them through the gap between the outlet header and reformer floor to their respective position.

These were then pulled below the arch roof plate with the help of pulley and manila ropes through the burner openings. The slings were then fixed on the hooks of the channels put on the burner openings with the help of 1.6 ton D Shackles. The scaffoldings were kept approx. 2080 mm below arch plate.

❖ **Cutting and removal of AG pipe and Control valve**

AG pipeline (9 nos.) at North end of Reformer was cut and removed along with Control valve for erection of inlet header.

❖ **Cutting and removal of Inlet header**

Inlet header was cut by gas cutting at the required distance from the elbow at South end. Before cutting the header, the header was locked by welding channel near elbow to prevent any movement from its actual position. The header was cut at approx 260 mm from the South end support.

❖ **Removal of Outlet header Insulation**

Outlet header insulation was removed completely and clearances were taken at following places:

- Between refractory wall and harp ends
- Between outlet header and reformer floor at three places in each row.

❖ **Removal of Arch Insulation and Arch plate**

The contract for Supply and Erection Ceramic Fibre Z Section Modules for roof of reformer and side wall for Insulation of Reformer roof was awarded to M/s Unifrax Ltd., Mumbai. They removed the arch panel insulation. Arch plates of all tube rows were also removed for facilitating the removal of harps. Priority was given for rows near wall. Insulation of Reformer wall upto 1m below roof was also removed for application of new insulation.

❖ **Supporting of Outlet header from bottom**

Each outlet header was supported at six places on wooden slippers. These slippers were kept on the I-Beam of the structure of reformer floor reformer floor, so that the load of the harps after removal of spring hangers does not come on the plate of the reformer floor. All the slippers were placed in such a manner that every harp was supported equally at two places.

❖ **Cutting Riser joint of Harp Assembly**

The riser of each harp was cut between SF-10 to SF-11 joint using cut rod. For cutting at this joint, insulation can was cut out and then insulation was removed.

❖ **Removal of Transition cone**

Following procedure was followed for removal of Transition cone.

- 2 nos. lifting lugs were welded to Transition cone for holding transition cone by chain block while cutting and for lifting it for removal.
- Water jacket was cut and Pressure shell was exposed.
- Transition cone was cut at two locations- at the centre line of existing field weld El 145' 7") and 2" the below the joint. This was required for easy removal of refractory and cutting of liner.
- After removal of refractory, liner sleeve and old guide ring was cut and removed.
- Then transition cone was removed by crane.
- Blanking plates were welded to water jacket for filling of water.
- Filling of water jacket was started after blanking plate were welded to all rows.

❖ **Cutting of Outlet header, drains and Thermowells**

The Outlet manifold of each row was cut with cut rods at field weld joints and Harp assembly was made into three segment i,e. section A (North side) section B (Middle) and section C (South side). Also the 3 nos protective sleeve, 1 No drain and 2 Nos. thermowell connections of each Harps were cut and removed.

❖ **Removal of Spring Hangers and fixing of lifting beam**

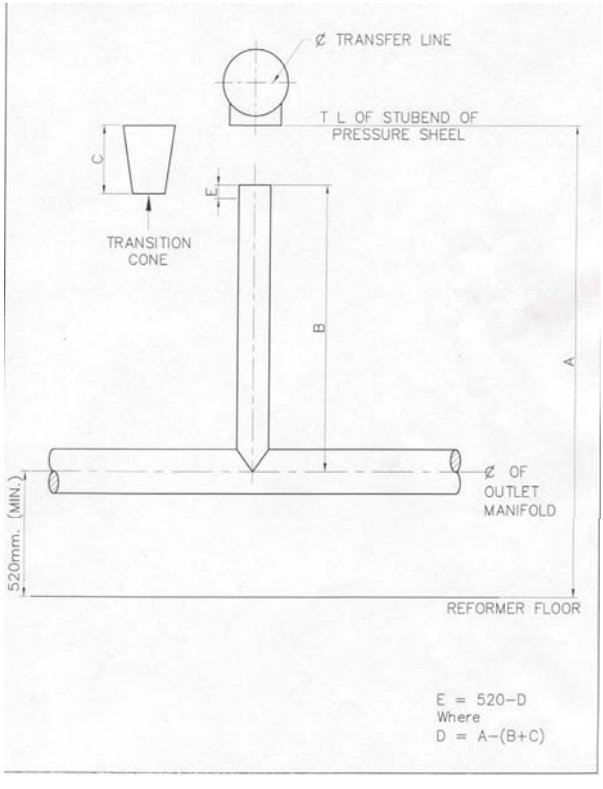
For removing old spring hangers, each harp was pulled up with the help of 2 Nos, 5 Ton chain blocks. In the case of Section A, complete beam along with spring hangers were lifted and removed by crane (except for Row no.2 & 7) as this beam was in any case required to be removed for facilitating harp removal form top. For Row no. 2& 7, the beam was supporting the Truss and hence, individual spring hangers were removed by loosening the bolts of hanger rods. For Section B & C of all rows, each spring hangers was removed by loosening the bolts of hanger rods.

After removal of spring hangers, lifting beam for removal of Harp section was fixed on each section. The harps were lowered and supported on wooden slippers or on Hillman rollers.

❖ **Measurement of Riser length of new Harp assembly**

The new riser of new Harp section was supplied with extra length of 40 mm. To determine the required length of riser, the actual height was measured from bottom floor beam of Reformer and the cut portion of stub end of pressure shell. The new riser length and Transition cone length was also measured. The distance of Centre line of outlet manifold is 520 mm from bottom floor for maintaining the the required clearance at outlet manifold bottom. The required length to be cut was calculated as per Table-1 given below. (Refer Drg. No.: 01)

The cutting was made on the riser and not on transition cone to maintain SF-10 to SF-11 weld joint below arch beam level. The required cutting was carried out by grinding. Grinding was carried out on riser before lifting the new Harp assembly for installation.


℄ TRANSFER LINE
T L OF STUBEND OF
PRESSURE SHEEL
C
E
TRANSITION
CONE
B
A
℄ OF
OUTLET
MANIFOLD
520mm. (MIN.)
REFORMER FLOOR
E = 520−D
Where
D = A−(B+C)

Drg. No.: 01

Table –I

Row No.	Distance between Reformer floor & TL stub end of Pressure shell	New Riser length from CL of Outlet header	Length of new Transition cone assbly	Total length	Difference	Length to be cut
	A (mm)	B (mm)	C (mm)	B + C (mm)	D = A - (B+C) (mm)	E = 520-D (mm)
1	12810	9980	2365	12345	465	55
2	12810	9985	2357	12342	468	52
3	12790	9980	2357	12337	453	67
4	12760	9990	2353	12343	417	103
5	12800	9980	2360	12340	460	60
6	12800	9975	2365	12340	460	60
7	12810	9980	2362	12342	468	52
8	12810	9980	2365	12345	465	55

Note:

Length of new Riser as per drg (from CL of Outlet header including 40 mm extra) : 9984 (+6, -0)

Length of new Transition cone assembly as per drg : 2361 (+6, -0)

❖ **Harp Removal and Installation**

Following procedure was followed for removal and installation of Harp Sections:

- Harp section A of Row no. 1 was lifted from the top of reformer roof by crane. After clearing the roof, the crane boom was swung to 180 degree. Crane was then marched towards radiant tube rack.
- It was then lowered on the floor near Rack.
- The reformer floor plate below the harp row was removed and the cross beams supporting the plates were cut for rolling the sections.
- The cross beams were strengthened by providing additional support at both ends of the cross beams.
- Before lowering the Harp Section B & C, 2 nos. flange with pipe was bolted to catalyst tube top for holding the harp section during rolling.
- Harp Section B & C were lowered using chain block and it was then placed on the wooden block kept on each Hillman rollers of harp installation track.
- The harp section B was then rolled to the position of Harp section A, from where it was lifted by crane.

- It was then lowered on the floor near Rack.
- Similarly, harp section C was also removed and kept on the floor near rack. These old harp section A,B & C of row no. 1 were shifted to scrap yard by trailer. Later, after installation of all the new harp section these harp section were shifted again to the Radiant Tube Rack.
- For other Rows, the old harps removed after lifting were kept directly in the Radiant tube Racks
- For installation of new harp section of Row no. 1, the new harp section C was lifted first from the radiant tube rack, the crane was then marched to its position, the boom was swung to 180 degree and the harp section was lowered on the Hillman roller at the position of harp section A of that particular row.
- Then harp section C was rolled into its position.
- Meanwhile, the harp section B was lifted from tube rack and lowered on Hillman rollers in position of harp section A.
- The harp section B was then rolled to its respective position.
- Finally harp section A was inserted into the reformer. Orientation of pigtail position on harp was checked while inserting all three segments.
- The same procedure was followed for removal and installation of harp sections of other rows also.
- However for removal of section B & C of row no. 2 & 7, channel and beam at arch roof level was cut and removed.

Priority was given to the rows at the wall end so that the roof insulation jobs can be started from wall side and completed towards center.

On completion of installation of harp sections of each row, the Arch plates that were removed was installed and marking for stud welding was done in each rows.

Note : Harp assembly removal was started at 08:00 hrs on 2nd April and insertion of Harp section was completed by 08: 00 hrs. on 7th April.

❖ **Replacement of Reformer Floor Plate**

After all the new harp sections of respective rows were installed, the floor plates below them were placed into respective position after lifting the sections on spring hangers. Also floor beams beneath floor plates were welded back into position.

Reformer plates, which were bend and damaged were replaced with new one. Ref Drg.214 D3 of M/s MW Kellog for details of welding of floor plate.

❖ **Fixing of Spring Hangers**

This was done in parallel to the harp installation. All the new spring hangers and their Stir-ups were hanged. In the case of Section A, the new spring hangers were installed in the removed beams at ground floor and then the beam was lifted by crane and bolted in position. The harps were lifted up with the help of 2 nos. 5 Ton chain block. The lifting beams were then removed and the Stir-ups were hooked up below the trunnion on catalyst tubes and wooden slippers or Hillman rollers, below the harp section were removed. Now the harps were freely suspended on the spring hangers.

❖ **Installation of new Transition Cone & welding of Transition Cone with Pressure shell**

The following procedure was followed for alignment and welding of transition cone with Pressure shell:

- Old back up ring of Pressure shell stub end was removed by grinding.
- Bevel of Pressure shell stub end was carried out by grinding and DP was done. Spirit level of stub end was checked.
- New backing rings were tack welded to the Pressure shell stub end.
- New Transition cone was lifted by crane using the temporary lifting lug welded to it and the same was held in position using 5 T chain block.
- The liner sleeve was then inserted into 107-D stub end and 1/8" thk cardboard was wrapped around it.
- The existing liner sleeve was reused. It was observed that the sleeve was fouling with the liner of Transfer line. After Inspection of Transfer line from inside, it was observed that the liner of Transfer line was having bulging at the gas inlet portion. Hence the liner of Transfer line fouling with the Transition cone liner was cut by grinding and removed.
- Liner sleeve was welded to transition cone assembly liner and DP was carried out.
- Verticality of Transition cone was checked in both planes by using plumb.
- Spirit level was checked at 90^{O}
- Root gap of min. 3 mm was maintained for welding of transition cone with Pressure shell (Elevation of 145' 7") and welding was completed.
- DP was carried out.

- For casting the Bubbled Alumina Castable refractory, marking was made on the Transfer line water jacket at required level. After completion of all welding jobs, and draining of water in the jacket, 2 nos. holes was made on water jacket and Pressure shell for filling of refractory. Refractory filling was carried out by using hose at one end and providing vent pipe at other end. The filling was carried out in this manner for proper flow of castable and also to fill refractory at portions above the weld joint of Pressure shell. Tabcast 97L of M/s ACE Refractory was used for filling.

- Patch plates were then welded at places where cutting was done for refractory filling and DP was carried out.

❖ **Welding of Outlet Manifold**

The following procedure was followed for alignment and welding of outlet manifold.

- The harps were freely suspended on the spring hangers with scale of spring hangers facing platform.

- The verticality of the spring hanger rods was brought nearest to plumb line. (Note: The springs kept at locked condition)

- The verticality of riser was checked in both planes and it was brought to acceptable limit of less than 12 mm for the length of riser.

- The water level of outlet manifold of riser section (Section B) was brought to 0-0 (Max. permissible is ±10 mm per 2500 mm) by lifting spring hangers with the help of spring hanger rods and not by turning turn buckles.

- The riser section harp (Section B) was then blocked from bottom by welding channels and I beams to floor plates that it does not go out of alignment.

- Now harp section A and harp section C were lifted or lowered with the help of spring hanger rods till their outlet manifold matched with that of harp section B.

- The harp section A & C were then moved towards harp section B by pushing the spring hanger from rods of respective section, if necessary for making proper weld gap. This was done by maintaining the verticality of each individual hanger rod. After making proper weld gap both the harp sections were blocked for any movements.

- The water level of Section A & C was then made to zero.
- All the three sections were made in line along horizontal plane.

- Clamp was provided between each sections and root gap of 4 mm was kept.

- Then soluble dam paper were prepared at joints and purging tube was pulled from the drain point.

- Root welding of each section was completed one by one as it was difficult to carry out root welding simultaneously. The reason being, only one purging tube could be inserted through the drain point.

- Welding was carried out by UTP 6170 Co (AWS ER NiCrCoMo-1) filler wire.

- Following inspections were carried out for outlet manifold welds:
  Root and Final DP, root and final radiography.

❖ **Welding of Riser with Transition cone**

Before starting the welding, the transfer line water jacket and secondary reformer water jacket was filled with water to the operating levels and then, transfer line spring hangers were unlocked.

The following procedure was followed for alignment and welding of riser with Transition Cone.

- The entire harp was raised with the help of spring hanger rods to the required elevation for welding of riser tube to transition cone assembly.

- The verticality of the spring hanger rods was checked again for plumb. (Note: The springs kept at locked condition)

- The verticality of riser was re-checked in both planes and it was brought to acceptable limit of less than 12 mm for the length of riser. (If the riser was not centered with the Transition cone, harps and spring hanger were pulled to the required direction. If required, the bolt hole of the beam was made bigger by gas cutting for pulling of spring hanger)

- Then soluble dam paper was provided on riser and Transition cone and purging tube was given through Transfer line end cover.

- Checked water level of outlet manifold and the clearances at sides and bottom.

- Spring hanger was unlocked and readings noted down. Then value of column # 9 of Table 2 given below was calculated and reading of all the spring hangers were set as per this column.

- Water level of outlet manifold was checked again. The readings was adjusted, if required using hanger rods.

- Clamp was provided and weld gap was maintained at 4 mm.
- If the weld gap was more then 10 mm, the harp was lifted.

- For lifting the harp, riser was pulled to side, spring hangers were locked and Harp was jacked at the bottom and springs were made free.

- Spring hanger rods were adjusted, and the harp was lifted as per requirement. It was ensured that the scale was facing platform.
- Jack was released and load was taken on spring. Then spring hanger was unlocked.
- If disturbed, the spring hanger readings are to be set as per column # 9 of Table 2.
- Root gap was checked. If it was within 10 mm, 3 nos. spring hangers at each end of riser were tightened and 4 mm root gap was maintained.
- Riser verticality and water level of outlet manifold reconfirmed.
- Clearances at sides and bottom of outlet manifold was measured and noted down, Ref drg. No.: 01-ES-03401.

- Welding was completed by TIG using UTP 6170 Co(AWS ER NiCrCoMo-1) filler wire.
- These inspections were carried out for outlet manifold welds -Root and Final DP, root and final radiography.

- After completion of welding of 8 nos. risers, water was drained from Effluent chamber and riser lug stubs.
- Annular ring was removed and water jacket patch plate was welded.

Table-2

ROW NO.-		RADIANT HARP WEIGH-IN TABULATION SHEET										
DATA FROM SPRING HANGER		STEP # 1(BEFORE RISER WELDING)							STEP # 2 (AFTER RISER WELDING)			
1	2	3	4	5	6	7	8	9	10	11	12	13
Spring no. (From South to North)	Spring no. (As per Sarathi)	spring constant	Calibrated load (Zero Mark) CL	Spring scale reading from CL mark	Load Deviation from calibration Load	Actual Load on spring Hangers	Initial balanced load per spring (BEFORE RISER WELDING)	Initial balanced load Setting (BEFORE RISER WELDING)	Additional Load per spring weight (Pig tail+Insulation etc.)	Riser Load per spring (-)	Final Calculated operating load	Operating load setting from CL Mark
		Kg/mm	Kg	mm	Kg	Kg	Kg	mm	Kg	Kg	Kg	mm
	From spring	From	From	From			{Total sum of (7)}/42		Calcul	Calcul		
					(5) X (3)	(4) +/-(6)		(8-4)/3			8+10	{(12)-(4)} / (3)

Note:

- Spring nos. are to be counted from South to North
- Weight of Pigtail without Insulation is 4.3 Kg
- All catalyst tube are filled with catalyst before inserting the Harp inside the furnace
- Weight of catalyst inside each tube Approx.= 62.59 Kg
- Weight of Riser = 440 Kg (Actual measured)
- Weight of Riser, Weldolet, proportionate Outlet manifold section is considered as 620 Kg (Column 11)
- Total weight of Pigtail, insulation of Pigtail, Top tube, Inlet header per tube = 21.8 Kg (Actual measured)

❖ **Cold Balancing of Harps**

All the catalyst tube springs were set to their net spring load settings (Column # 13 of Table 2). This was done by pulling up or lowering down the catalyst tubes from turn buckles of their spring hangers.

❖ **Welding of Riser Insulation Can**

The insulation can was replaced with new one. Insulation was carried out with two layers of ceramic fibre blanket of 1" thick followed by ½" thk of ceramic fibre blanket. (i.e. total thickness – 2 ½ "). It was covered by 3 mm thk Inconel 601 Plate. (Ref drg. no. :01-BL-13447)

The insulation job was carried out by M/s Balaji Insulation, Mumbai. All the joints of riser insulation can were carried out by arc welding and were inspected by dye penetrant test.

❖ **Welding of Inlet manifold**

Inlet manifold were erected in a single piece with the help of one crane and 2 nos. chain block and 1 no. pull lift. The manifold was positioned at its position. The following procedure was followed for welding of new inlet manifold. (Dissimilar joint between)

- Edge preparation of the existing manifold was carried out by grinding.
- Then DP test of edge was carried out.
- The P-11 pipe was preheated upto 150 - 175Deg C.
- Root run hot pass with ER 309 L filler wire. DP test and Radiography of root run was carried out.
- The final welding was done with ER 309 L filler wire. The inter pass temperature was maintained below 300 deg C.
- Final DP and Radiography was carried out.
- Hardness was checked.

- Stress relieving of joint was carried out at 705 to 745 deg C with a soaking time of min. 2 hour. Rate of heating and cooling - 100 deg C / hour. Loading/unloading temperature - 300 deg C / hour.

- Hardness testing was done. It was found to be less than 225 BHN

- DP and Radiography was carried out again.

❖ **Installation of Arch plate and Roof Insulation**

The arch plates around all the 8 Nos Harp rows were removed for facilitating harp erection. The ID of the Arch plates near catalyst tubes were increased by and made 117 mm by grinding from Work shop to accommodate the increase in the OD of catalyst tube. This was required as it will be easy for removal of catalyst tube in future.

Installation of arch plates was done starting from wall No.1 and No.3 towards centre. This was done to facilitate arch insulation fixing from wall. For details of roof and side wall Insulation Ref drg. No. UIL/IFFCO-KAL/W-121/101 Rev 1 of M/s Unifrax. The arch plates around the harp rows were fitted after riser welding of particular harp was over. The arch plate around the riser was the last to be fitted after welding of riser insulation can.

The job of removal and installation of Arch plate insulation was awarded to M/s Unifrax, Mumbai. They did the job in following phases.

- Removal of old insulation
- Removal of arch plates near catalyst tubes,
- Marking for location of studs after re fixing the arch plates,
- Welding of studs for fixing insulation,
- Installation of 25 mm thk. Ceramic fiber back up insulation below roof,
- Wrapping of Ceramic fiber insulation blanket around burner blocks,
- Installation of 200 mm thk. Z-section modules on Arch plates,
- Finishing of insulation modules and application of ceramic fiber packing for filling the gaps.

  The modules near catalyst tube was modified to “Cermax Modules”. Maintenance of this module is easy & quick and even one damaged module can be replaced without disturbing neighboring modules.(Refer Drg. No. 02 below)

  Insulation of side wall at about 1m from roof was also removed and replaced with new Z-section modules. The following procedure was followed for side wall insulation :

- Removal of old insulation,
- Marking for location of studs,
- Welding of studs for fixing insulation,
- Installation of 25 mm thk. Ceramic fiber back up insulation on side wall,
- Installation of 137.5 mm thk. Z-section modules,
- Finishing of insulation modules and application of ceramic fiber packing for filling the gaps.

Drg. No. 02

- **Burner block replacement**

  All burner blocks were replaced with new one. The new burner blocks, ALFIBOND-2800 are having vaccum formed ceramic fibre, size – 21" X 21" X 11". They are supplied by M/s.Christy Refractory, USA.

- **Welding of Guide Plate**

  Guide plates of a particular row were welded after fixing of its arch plates and fixing of tube insulation below the guide plates. Proper clearances as per the drawings were kept between guide plates and catalyst tubes. This was for taking up the expansions of the harp.

  During welding of guide plate for maintaining the clearances, a template was made. This was kept between catalyst tube and guide plate and then guide plate was tack welded.

❖ **Welding of Pigtail**

New Pigtail is of ASTM A 213 TP 304 H material. The Pigtail was supplied with extra length of 2" at both ends. The verticality of pigtails was checked by plumb before welding. It was decided to cut a length of 50 mm at bottom portion of Pigtail.

Welding of pigtail was done at two positions. Upper joint welding was done between the pigtail socket while lower joint welding was done between the pigtail and catalyst tube. The welding was carried out by providing a gasket of 3 mm thk at both ends for provision of expansion. Welding was carried out by TIG using ER 308 H filler wire, Ø2.4mm. Pigtail welding was started using E 308H electrode. It was observed that during arc welding, there was chance of undercut in pigtail / lack of fusion of sockolet and hence welding was carried out by TIG. Both fillet weld joints were inspected by DP test.

❖ **Welding of Drains, Thermo well and Protective sleeves**

The drain line and thermo well were welded to the outlet manifold. Root pass and final welding for both drain line and thermo well was done with TIG welding using ER NiCrCoMo-1 filler wire. Root and final DP and final radiography was carried out. After welding all these three points, their protective sleeves were also welded to them.

Drain valve welding was carried out with TIG using ER NiCr-3 filler wire. Root and final DP and final radiography was carried out.

The floor stops and guides were also welded on the reformer floor for guiding the protective sleeves. (Ref Drg. No.: 214 A15)

❖ **ΔP checking of Catalyst tube**

The differential pressure drop inside each catalyst tube was checked after installation of catalyst tube (Required ΔP –3.2 kg/cm^2). The catalyst was loaded / unloaded as per requirement till the differential pressure across it was found OK. All the catalyst tube were boxed up after the ΔP checking.

❖ **Removal of Suspended Scaffolding and Installation of Burner**

All the suspended scaffolding were lowered on the reformer floor after completion of arch insulation by means of pulleys and manila rope and then slided on reformer floor below the outlet manifold and removed out of the furnace through the opening made in the Wall # 3.

After removing scaffolding, the Arch burners, which were removed for suspended scaffolding installation, were re installed. Leak test of naphtha lines and atomizing steam lines of burner was done by I.G. The leaking union joints, threaded joints were then tightened to attend the leaks found.

❖ **Air Blowing**

After completion of all welding jobs, air blowing was carried out by running Air compressor (101-J). Blowing of Inlet manifold was carried out by opening its end plugs. After boxing up inlet manifold end plugs, Catalyst tubes were individually blown by opening top plug one by one. While carrying out blowing, a gasket whose ID was matching with the ID of catalyst tube was placed inside catalyst tube by string to prevent any dust particle from falling on catalyst.

All catalyst tube top plugs and end plugs of inlet manifolds were finally boxed up after air blowing was done. Also hot tightening of all the bolts of catalyst tube top plugs and end plug of inlet manifolds were carried out during start up.

Blowing of Transfer line was carried out and then its end cover was boxed up.

❖ **Fixing of Refractory, Tunnel walls and Tunnel slabs**

Old refractory bricks and tunnel slabs were taken to scrap yard area after removal. Bricks and Tunnel slabs in good condition were reclaimed.

Refractory damaged near Tunnel burners were repaired. The floor refractory and tunnel walls were installed after removal of scaffolding. The damaged portion of the wall refractory was also repaired.

Refractory job of reformer was carried out as given below :

- Bottom Floor refractory consists of Insulating bricks, Size- 228 X 114 X 63 mm with back up of Calcium silicate block (Grade H-1000), Size- 36" X 24" X 2" thk. Inside tunnels, refractory fire bricks, Size- 228 X 162 X 63 mm were laid upto a length of 10 ft. near Tunnel burner.

- Tunnel walls were made of refractory fire bricks, Size- 228 X 162 X 63 mm. Tunnel slabs were placed above Tunnel wall. 243 nos. new tunnel slab were used. Old tunnel slab of approx. 260 nos. were re used.

Floor refractory and tunnel installation were carried out as per drg. No.: 210-D1, 214D1, 213D3, 214D5, 215B of M/s M W Kellogg.

After installation of refractory and tunnel wall, the opening made at Wall # 3 was closed by re-welding the plate. Refractory job at that portion for wall & tunnel were carried out.

❖ Installation of Tunnel Burners

Tunnel burners were fixed when all the refractory inside the furnace was completed. Care was taken to see concentricity of the burner blocks with burners. Also some of the burner blocks that were damaged were re-cast by Civil section using Whytheat A of M/s ACE Refractory and were replaced.

❖ **Leak Test of Pig tail**

The system was charged with IG of 6.6 Kg/cm^2 pressure for leak test of pigtail weld joints, catalyst tube flanges and inlet header end plugs. No Pigtail weld joint leakages were observed during the leak test.

Catalyst tube top flange were also checked for any leakages and the leakages found were attended.

❖ **Insulation Job of Reformer**

- Insulation of top portion of Catalyst tube (Insulation of 0.8m length) and tube top cap was carried out by two layers of ceramic fibre blanket of 1" thick followed by ½" thk of ceramic fibre blanket covered by Aluminium sheet cladding. Thickness of Aluminium sheet : 22 G (0.7 mm)

- The insulation of Outlet Manifolds, bottom portion of Catalyst tube and bottom portion of Riser was carried out in three layers as given below:

  - 1st layer of 1" thick ceramic fibre blanket
  - 2nd layer of 1" thick ceramic fibre blanket
  - 3rd layer of ½" thick wet felt for outlet manifold (i.e. total thickness– 2 ½") and ¼" thick wet felt for catalyst tube and riser (i.e. total thickness – 2 ¼ ").

- Insulation of Inlet Manifolds was carried out by four layers of ceramic fibre blanket of 1" thick covered by Aluminium sheet cladding.

- The portion of Pigtail that was left uninsulated for ease of welding job, was carried out after leak test. It was difficult to provide Aluminium sheet at the bottom portion of Pigtail due to space constraints.

- Insulation of AG line of burners were also carried out using ½" thk. Ceramic fibre blanket covered by Aluminium sheet cladding.

M/s Balaji Insulation, Mumbai, carried out the insulation job of Primary Reformer. Ceramic fibre blanket, (Density -128 kg/m^3) and wet felt (Dry density – 320Kg/m^3) was supplied by M/s Lloyd Insulation, Mumbai.

❖ **Final Inspection and Furnace box up**

Before boxing up all the all the insulation material and other debris were removed. The reformer furnace was checked for following.

- The condition of outlet manifold insulation,
- Floor refractory, wall refractory and tunnels,
- Clearance between outlet manifold ends & furnace walls,
- Clearance between outlet manifold & floor refractory.

The furnace was boxed up on 27th April 2006.

6.0 CONSUMPTION OF FILLER WIRE AND ELECTRODE

The approximate consumption of filler wire and electrode used for Pressure joints during Revamp are given below. This list does not include CS filler wire / electrodes and electrodes used for structural jobs.

Sr. No.	Description	Weld Joint	Size (mm)	Approx. Qty consumed (Kg)
1	ER 309 L	FW 11	2.4	4.5
2	ER 309 L	FW 11	3.15	6.2
3	ER NiCrCoMo-1	FW 3	2	0.5
4	ER NiCrCoMo-1	FW 1, FW 4	2.4	15.1
5	ER NiCrCoMo-1	FW 1, FW 4	3.15	21.4
6	ER 308H	FW 8, FW 9	2.4	17.7
7	ER 308H	FW 8, FW 9	3.15	9.0
8	ER NiCr-3	FW 2	2.4	2.6
9	ER NiCr-3	FW 2, FW 12, FW 13,FW 14	3.2	8.0
10	E NiCrFe-2	FW 15,FW 16	3.2	2.0

7.0 PROBLEMS FACED DURING REVAMP-III

- For welding of outlet manifold joints, purging was given through catalyst tube top near the joint. After carrying out welding, following defects were observed- Oxidation, Porosity, Lack of penetration / fusion of root edge. Hence the purity of Argon cylinders was checked. It was observed that purity of some of these cylinders were 93% whereas required purity is 99%. Hence medical grade argon cylinders were procured and used for welding of these joints. Also the purging was given through drain point of outlet manifold.

- Sufficient manpower of M/s Unifrax, Mumbai was not available at site for removal and installation of arch plates and Z-section modules. Hence the job was continued only till 23:00 hrs and was not carried out during Night shift. Due to the delay in installation of arch plates and modules, the removal of hanging scaffolding and refractory job were delayed subsequently and hence affected the progress of erection activities.

8.0 VENDORS FOR SUPPLY OF MATERIAL

Sr. No.	Description	Vendor
1	**Complete Harp Assembly**	M/s S+C , Malaysia
2	**Inlet Manifolds**	M/s Precision Engineers, Chennai
3	**Pigtails**	M/s Heavy Metal Tubes, Chhattral
4	**Spring Hangers**	M/s Sarathi Engg., Hyderabad
5	**Z-Section Modules**	M/s Unifrax, Mumbai
6	**Burner Blocks & Tunnel Slabs**	M/s Christy Refractories, USA.
7	**Bricks & Mortar**	M/s ACE Refractories, Ahmedabad
8	**Bubbled Alumina Castable**	M/s ACE Refractories, Ahmedabad
9	**Calcium Silicate Blocks**	M/s Hyderabad Industries, Faridabad
10	**Ceramic Fibre Blanket and Wet felt Blanket**	M/s Lyods Insulation, Mumbai

9.0 VENDORS FOR EXECUTION

Sr. No.	Description	Vendor
1	Execution of Revamp-III Jobs	M/s Neo Structo, Surat
2	Replacement of Roof Insulation	M/s Unifrax, Mumbai
3	Insulation Jobs of Primary Reformer	M/s Balaji Insulation, Mumbai
4	Replacement of Refractory & Tunnel Walls	M/s Nu Calcutta Const. Co., Culcutta
5	Removal and Replacement of Asbestos sheet of Reformer	M/s J.H. Corporation, Ahmedabad

10.0 ATTACHED DRAWINGS AND DOCUMENTS

The following drawings and documents are attached:

1. Annexure-I, Detailed construction activities of Primary Reformer Revamp-III jobs.

2. Annexure-II, Comparison of Reformer Revamp-I, II & III.

3. Plot plan for Primary reformer revamp – III.

4. Supporting arrangement of Reformer floor beam for rolling of Harp section B & C.

5. Schematic Rigging arrangement for Installation / Removal of Harp Section.

6. Schematic Rigging arrangement for Lifting / Removal of Harp Section from Radiant Tube Rack.

7. Requirement of Electrode for reformer harp assembly, Drg.NO.P1-DS-03451.

8. Measurement sheet for Reformer Revamp-III, Drg. No. : 01-ES-03401.

ANNEXURE-I

DETAILED CONSTRUCTION ACTIVITIES OF PRIMARY REFORMER REVAMP-III JOBS

SR. NO.	Description of Activity	Action By	Remarks
Prior to Shut down Activities (3 days in advance)			
1	Removal of insulation of all pigtails at two places for cutting from tubes	M/s Balaji	
2	Removal of tube caps & Insulation of Catalyst tube above arch panel.	M/s Balaji	
3	Removal of Insulation of Inlet Header for facilitating cutting / removal	M/s Balaji	
4	Shifting of necessary chain blocks, slings, D-shackles,other tools tackles, gas cylinders, lifting channels, beams for suspended scafolding, studs nuts etc. on reformer	M/s Neo Structo	
5	Putting concreate blocks and screw jacks in position as per the floor plan	M/s Neo Structo	
6	Cutting & removal of blower piping and Railing of Platform of Reformer near Tunnel burner	M/s Neo Structo	
SHUT DOWN ACTIVITIES			SD taken on 08:00 on 31st March, 2006.
Activities taken up immediately after stoppage of plant)			
7	Removal of AC sheets above reformer	M/s Nu Culcutta	
8	Removal of Angle / channels etc. for all 8 no. s harp rows towards control roomside for making way for removal of harp section	M/s Neo Structo	Prodn. Dept. had not given clearence for carrying out the job before SD
9	Removal of Control room side AC sheet and angle / channels for facilitating removal of Inlet Header and transition cone assembly.	M/s Nu Culcutta	
10	Cooling down the furnace	IFFCO	
11	Spring Readings of Transfer line in cold condition	M/s Neo Structo IFFCO	23:00 hrs, 31st March 2006
12	Locking of springs of transferline and spring Hangers	M/s Neo Structo	
13	Taking load of bottom floor on screw supports as per the floor plan- 48 nos.	M/s Neo Structo	
14	Putting the harp installation tracks in position	M/s Neo Structo	
15	Removal of gratings for facilitating Arch Panel cutting and removal and storing the same for re-use	M/s Neo Structo	

16	Removal of seven no. of Arch Burners from each row for facilitaing roof insulation job (1,5,6,9,10,14 and one extra)	M/s Neo Structo	
17	Placing of scafolding lifting beams on the burner openings (Total 6 x9 = 54 No.s).	M/s Neo Structo	
18	Putting process side and Gas blinds for the reformer	M/s Neo Structo	
19	Opening of Transferline end cover	M/s Neo Structo	
20	Draining of water jacket of 107-D from individual drain lines	M/s Neo Structo	Started at 02:30hrs completed by 05:30 hrs, 1st April
21	Cutting of LNG pipe and removal of control valves installed towards control room side as per requirement for making way of Inlet Header romoval.	M/s Neo Structo	
22	Opening of reformer manholes on completion of cooling	M/s Neo Structo	1st April, 05:00 hrs
23	Cutting of CT side wall for insertion of hanging scaffolding	M/s Neo Structo	
24	Remove Tunnel Burners	M/s Nu Culcutta	
25	Removal of Tunnel slabs and storing the same at safe place for future use	M/s Nu Culcutta	
26	Removal of floor refractory/tunnels and shifting the same to scrap yard. (Side wall #3)	M/s Nu Culcutta	
27	Inserting the suspended scafolding and lifting the same for removal arch level jobs	M/s Neo Structo	
28	Removal of Arch Insulation around the tubes	M/s Unifrax	
29	Removal of arch plates around the tubes	M/s Unifrax	
30	Shifting of Arch plates to W/s for Rectification of Arch plates	M/s Unifrax	ID increased
31	Removal of Arch roof insulation of remaining arch roof	M/s Unifrax	
32	Replacement of burner blocks with new ones.	M/s Neo Structo	
33	Disconnect thermowells of each outlet manifold, Removal of cable pipe below Sec B	IFFCO / Instrument Section	
34	Removal of blowdown pipe below Sec C	M/s Neo Structo	
35	Removal of Plate and Cutting of thermowell and drain pipes as well as their protective sleeves.	M/s Neo Structo	

Following Activities performed (most of these are sequential) for each 8 No. rows of harps as per priorities given from 1st Row All concerned			
36	Cutting of pigtails by gas cutting for complete row	M/s Neo Structo	
37	Removal of pigtails alongwith their old insulation to the ground floor and shifting the same to scrap yard	M/s Neo Structo	
38	Cutting of guide plates	M/s Neo Structo	
39	Cutting of inlet header from field weld locations. 2 places	M/s Neo Structo	
40	Removal of inlet header and shifting the same to scrap yard	M/s Neo Structo	
41	Edge Preperation of existing inlet header and carry out DP	M/s Neo Structo	
42	Installation of New Inlet Header in single piece	M/s Neo Structo	
43	Provide support for Inlet header section for alignment	M/s Neo Structo	
44	Alignment and welding of New Inlet Header	M/s Neo Structo	
45	Completion of welding of inlet header	M/s Neo Structo	
46	Inspection of weld joint (Root & Final DP &Final X-ray) of Inlet Header	M/s Neo Structo	
47	Stress Relieving of dissimilar joint of Inlet Header	M/s Neo Structo	
48	Supporting the Harps from bottom floor by wooden sleeper and Hydraulic Jacks - 2nos.	M/s Neo Structo	
49	Cutting of water jacket and exposing riser pressure shell joint above transition cone	M/s Neo Structo	
50	**Welding of blanking plate to facilitate filling of water in the water jacket. Note : Cutting and blanking to be carried out in all rows as soon as it is available.**	M/s Neo Structo	Started on 2nd April and welding of all rows completed by 20:00 hrs. 7th April,
51	Cutting of outlet manifold	M/s Neo Structo	
52	Holding the transition cone assembly by chain block and cutting from joint at SF-10. This act. & act.51 may be carried out simultaneously.	M/s Neo Structo	
53	Lifting Harp Sections by Jacks and removing spring hanger harness from harps	M/s Neo Structo	
54	Fixing of lifting beams on harps section A for removal	M/s Neo Structo	
55	Fixing of lifting beams on harps section B & C for removal	M/s Neo Structo	

56	Removal of beam with spring hangers for Harp Section A (Except for Row no 2 & 7) from the harps and bringing the same on the ground floor	M/s Neo Structo	
57	Removal of individual spring hangers for Harp section B & C	M/s Neo Structo	
58	Removal of individual spring hangers for Harp section A in the case of row no 2& 7	M/s Neo Structo	
59	Cutting of riser pressure shell joint above transition cone	M/s Neo Structo	
60	Edge Preparation and DP checking of CS edge of stub end	M/s Neo Structo	
61	Welding of backing ring on CS stub end	M/s Neo Structo	
62	Fixing of tube flange pipe pieces for rolling of harp section B & A	M/s Neo Structo	
63	Remove the Harp section -A with the help of crane (75 Tons capacity , 140' Boom length)	M/s Neo Structo	Started at 08:00 hrs on 2nd completed by 08: 00 hrs. on 7th April.
64	Lifting lugs welded to Transition cone for holding during removal	M/s Neo Structo	
65	Remove Transition Cone assembly with help of crane	M/s Neo Structo	
66	Lifting lugs welded to New Transition cone Assembly for holding the same during installation and welding		
67	Insert New transition cone assembly with the help of crane	M/s Neo Structo	
68	Hold Transition Cone in its respective position with help of chain blocks	M/s Neo Structo	
69	Inserting liner sleeve with card board wrapping and welding the same to transition assembly.DP Checking the same.	M/s Neo Structo	
70	Weld liner to transition assembly.DP Checking the same.	M/s Neo Structo	
71	Marking position of 2 No. holes for refractory filling on transfer line water jacket & transfer line		
72	Welding the pressure shell with transferline	M/s Neo Structo	Started at 08:00 hrs on 6th all completed by 08:00 hrs on 9th April
73	Inspection of the weld joint (DP) and repairs, if any	M/s Neo Structo	
74	Cutting 2 No. holes for refractory filling on marked position	M/s Neo Structo	
75	Filling of refractory	M/s Nu Calcutta	
76	Welding of patch plates at two places where cutting is done. (3"X3"X1/2"thk)	M/s Neo Structo	

77	Inspection of welding of patch plates (DP)	M/s Neo Structo	
78	Take the load of harp section B & C on 2 No.s 5 ton each chain blocks and cut & remove the reformer floor plates below the row of harp	M/s Neo Structo	
79	Lower Harp Section - B & C on Hillman Rollers placed in Harp Installation track on Ground Floor	M/s Neo Structo	
80	Cutting of channels and beams at Arch Roof level to facilitate removal of harp sections of Row No. 2 & 7.	M/s Neo Structo	
81	Roll Harp section B to the position of Harp section A for removal	M/s Neo Structo	
82	Remove the Harp Section -B with the help of crane	M/s Neo Structo	
83	Roll Harp-Section -C to the position of Harp-Section-A for removal	M/s Neo Structo	
84	Remove the Harp Section - C with the help of crane	M/s Neo Structo	
85	Insert New Harp Section-C and roll the same into its' respective position (Note: Ensure pigtail orientation location)	M/s Neo Structo	
86	Insert New Harp Section-B and roll the same into its' respective position (Note: Ensure pigtail orientation location)	M/s Neo Structo	
87	Insert New Harp Section-A (Note: Ensure pigtail orientation location)	M/s Neo Structo	
88	Installation of new spring hangers for Harp Section B & C		
89	Installation of beam with new spring hangers for Section A	M/s Neo Structo	
90	Welding of channels and beams at Arch Roof level which were cut to facilitate removal of harp sections of Row No. 2 & 7.	M/s Neo Structo	
91	Welding the floor plates of the relevant row	M/s Neo Structo	
92	Support Harp by wooden slippers and jacks from floor	M/s Neo Structo	
93	Then remove lifting Beam from Harp sections	M/s Neo Structo	
94	Hanging all Harp Sections on the Spring Hangers. Note : Spring hangers not to be unlocked	M/s Neo Structo	
95	Centering of Riser Section B	M/s Neo Structo	
96	Aligning of Harp section B with with Harp Section A & C	M/s Neo Structo	
97	Welding of outlet manifold	M/s Neo Structo	Started at 20:00 hrs on 4th, completed by 20:00 hrs on 10th

98	Root & Final DP & X-ray of weld joints and repairs, if any.	M/s Neo Structo	
99	Raising of complete harp with the help of spring hanger rods & making the weld gap for welding of riser joint at SF-10.	M/s Neo Structo	
100	**Fill up the water in the complete water jacket upto the operating level.**	M/s Neo Structo	
101	**After filling water, Transfer line spring unblocked**		
102	**Unblock catalyst tube springs and adjust readings to Column 9- Initial Balance load settings**	M/s Neo Structo	
103	**Check vertical alignment of riser in both the plane, check Water level and CL distance from floor plate of outlet manifold and**	M/s Neo Structo	
104	Complete the weld of the Transition Cone Bottom	M/s Neo Structo	Started at 08:00 hrs on 11th, completed by 20:00 hrs on14th
105	Recored dimensions A,C & D as per drg no. 01-ES-03401	M/s Neo Structo	
106	Root & Final DP & X-ray of weld joints and repairs, if any.	M/s Neo Structo	
107	**Adjust Catalyst tube spring readings to Column 13- Final operating load settings**	M/s Neo Structo	
108	Riser Can Insulation	M/s Neo Structo	
109	Welding of Insulation Can	M/s Neo Structo	
110	DP of completed welding	M/s Neo Structo	
111	Installation of Arch Plates around tube and welding of stud for Module fixing	M/s Unifrax	Started at 08:00 hrs on 12th April
112	Insulation of Arch plate around the tubes	M/s Unifrax	
113	Welding of Guide Plates of relevant row	M/s Neo Structo	
114	Insulation of tubes above arch plates and Outlet manifold	M/s Neo Structo	
115	Weld all the pigtails of relevant row.	M/s Neo Structo	
116	Inspection(DP) of pigtail welds and repairs if any	M/s Neo Structo	
117	Weld Thermowells and Drain Pipe	M/s Neo Structo	
118	Inspection of the weld Joint (DP & X-Ray) and repairs, if any	M/s Neo Structo	
119	Weld Guide Pipes for Thermowells and Drain	M/s Neo Structo	
120	Cold Balancing of Harp	M/s Neo Structo	
	Repeat all above activities (27 to 94) for all the Rows from Row No. 1 to Row No.8	**All concerned**	
	Remaining activites Inside the Furnace	**All concerned**	

121	Installation of balance Z - Section Modules	M/s Unifrax	Started at 08:00 hrs on 14th April & completed by 20:00 hrs on 19th
122	Removal of suspended scafolding	M/s Neo Structo	
123	Repair Wall refractory after welding plate removed for scaffolding insertion	M/s Neo Structo / M/s Nu Culcutta	
124	Build Tunnel Walls / Slabs & Floor Refractories of all rows	M/s Nu Culcutta	
125	Repair / Replace Tunnel Burner Block	M/s Nu Culcutta	
126	Fixing back the Tunnel Burners	M/s Neo Structo	
127	Cleaning of Reformer Floor	M/s Neo Structo	
128	Boxing up of the Furnace	M/s Neo Structo	**27th April,2006**
129	Removing concreate blocks / harp installation tracks from under the furnace.	M/s Neo Structo	
	Remaining activities Inside the Penthouse	**All concerned**	
130	Fixing back burners removed for hanging scaffolding	M/s Neo Structo	
131	Fixing back the floor gratings	M/s Neo Structo	
132	Insulation of Inlet Header and any remaining insulation of Catalyst Tube	M/s Balaji	
133	Installation of all the Control valves Towards Control room side back into position	M/s Neo Structo	
134	Welding of water jacket & drain Lines	M/s Neo Structo	
135	DP Checking of 336 No.catalyst tubes & final box up of the same	IFFCO / Prod. Deptt.	
136	Run the Process Air Compressor and Blow Inlet Header and catalyst tubes.	IFFCO / Prod. Deptt.	25th April,2006
137	Box up the Inlet Header and catalyst tubes.	M/s Neo Structo	26th April,2006
138	Blow the the Transferline	M/s Neo Structo	26th April,2006
139	Box up the the Transferline	M/s Neo Structo	26th April,2006
140	**Pressurise the Harp System and do the leak test for pigtail joints at 6.6 Kg/cm^2 by IG**	M/s Neo Structo	**No leakage**
141	Repair of pigtail welds , if any.	M/s Neo Structo	
142	Completion of Insulation of pigtails	M/s Neo Structo	
143	Reinstallation of Angle / channels / Control valves etc.above all 8 no. s harp sections towards control roomside removed for making way for removal of harp section	M/s Neo Structo	
144	Removal of all Tools / tackles from the pent house on completion of their use	M/s Neo Structo	
145	Reinstallation of AC sheets above reformer	M/s Neo Structo	
146	Reinstallation of Control room side AC sheet and angle / channels removed for facilitating removal of Inlet Header and transition cone assembly.	M/s Neo Structo	
147	Hot Balancing of Each Harps after Start up	M/s Neo Structo IFFCO	Not required

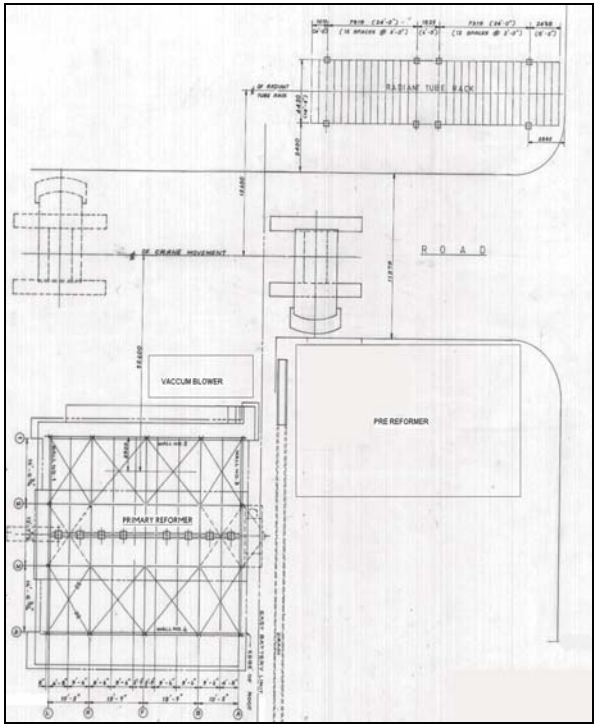
ANNEXURE-II

COMPARISON BETWEEN REFORMER REVAMP-I, II & III

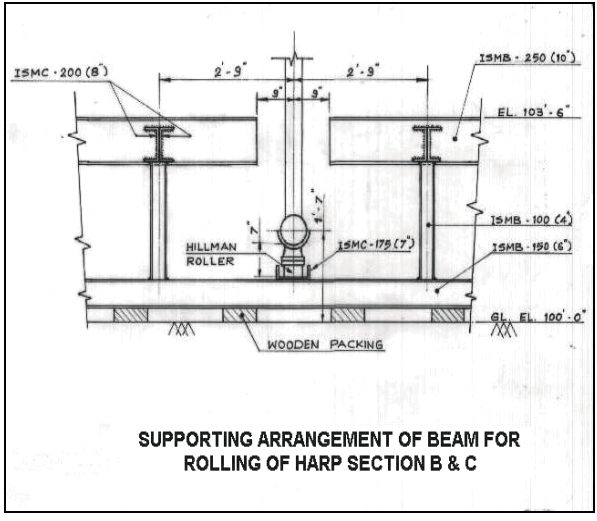
Description	Material of Construction and Dimensions in mm		
	Revamp-I 1986	**Revamp-II 1993**	**Revamp-III 2006**
Catalyst tubes	ASTM A 351 GR.HK 40	G-4852 Mod	G-4852 Micro
	2.91" ID x 0.615" MSW (Machined ID)	82mm ID X 12 mm MSW X 9550.4 mm Length	90 mm ID X 11 mm MSW X 9550.4 mm Length
Catalyst tube top	ASTM A 106 Gr.B	SA -213 Gr T11	SA -213 Gr TP 304H
	3 1/2" OD x 0.571" AW	101.6 OD X 12.7 MW	101.6 OD X 12.7 AW
Trunnion	ASTM A 106 Gr.B	ASTM A 335 P 11	ASME SA 106 Gr.B
	2 ½" x Sch 40	2 ½" NPS x Sch. 40	2 ½" NPS x Sch. 40
Flange	ASTM A 105	SA - 182 Gr F11	SA - 182 Gr, F304H
	3 ½" x 600# RF WN ANSI B 16.5	3 ½" x 600# RF WN ANSI B 16.5	3 ½" x 600# RF WN ANSI B 16.5
Blind Flange	ASTM A 105	SA - 182 Gr F11	SA - 182 Gr, F304H
	3 ½" x 600# RF ANSI B 16.5	3 ½" x 600# RF ANSI B 16.5	3 ½" x 600# RF ANSI B 16.5
Sockolet for pigtail	ASTM A 105	SA - 182 Gr F11	SA - 182 Gr, F304H
	¾" x Sch. 40 x 3000 #	3 ½" x ¾" x Sch. XXS	3 ½" x ¾" x Sch. XXS (Machined for 7/8"OD x 17mm ID tube)
Riser Tube	ASTM A 351 Gr. HK 40	91.44 mm ID X 16.5 MSW x 9538 length (Machined ID)	91.44 mm ID X 16.5 MSW x 9538 length (Machined ID)
	3.6" ID x 0.787" / 0.8125" MSW (Machined ID)	G-4852 Mod	G-4852 Micro
Riser tube top (SF-10)	ASME SB 564 (Incoloy 800H)	ASME SB 564 UNS 8811 (Incoloy 800 HT)	SB 564 / 408 UNS 8811 (Incoloy 800 HT)
	-	91.44 X 20.64 MW x 266 length	91.44 MM X 20.64 MW
Transition cone	Incoloy 800	Not replaced	SB 409 UNS 8811 (Incoloy 800 HT)
Liner, Transition cone	Incoloy 800 H	Not replaced	SB 564 / 408 UNS 8811 (Incoloy 800 HT)
Outlet Manifold	ASTM SB-407 (Incoloy 800H)	G-4859	G-4859
	5.5625"OD x 0.72 MW	141.3 mm OD X 18 MSW 3975.1 & 4118.8 length	141.3 mm OD X 18 MSW X 3975.1 & 4118.8 length
Weldolet (Cat tube)	ASME SB 564	ASME SB 564 UNS 8811 (Incoloy 800 HT)	SB-564 / 408 UNS 8811 (Incoloy 800 HT)
	5.5625"OD x 4.25" OD x 0.72MW x 0.615MW	141.3" x 4"	141.3" x 4"
Weldolet (Riser)	ASME SB 564	ASME SB 564 UNS 8811	SB 564 / 408 UNS 8811 (Incoloy 800 HT)

	5.5625"OD x 5.25" OD x 0.72MW x 0.787MSW	141.3" x 5"	141.3" x 5"
Pigtail	ASTMA 335 Gr. P11	A213 T11	A213 T 304 H
	¾" x Sch.40	25.4 mm OD X 11 SWG	7/8" OD X 17mm ID
Inlet Manifold	A 106 Gr.B	A335 P11	A312 TP 304H
	6" Sch.160	6" dia x Sch.120 (168.3 mm OD X 14.3 AW)	6" dia x Sch. 80S
Guide pipe	A 312 Gr. 304 H	A 312 TP-310	ASTM A 312 TP 310
	4" XXS Sch.	4" x Sch.XXS x 500 length	4" x SCH. XXS x Seamless
Drain pipe	Incoloy 800H	ASME SB 407 (800HT)	SB407 UNS 8811 (Incoloy 800 HT)
	1" x Sch. XXS	1" x Sch. XXS x 500 length	1"NPS x Sch. XXS Seamless
Drain pipe piece	Incoloy 800H	ASME SB 407 (800HT)	SB407 UNS 8811 (Incoloy 800 HT)
	1" x Sch. XXS	1" x Sch. XXS x 122.6 length	1"NPS x Sch. XXS Seamless x 122.35
Thermowell pipe	Incoloy 800H	ASME SB 407 (800HT)	SB407 UNS 8811 (Incoloy 800 HT)
	½" x Sch.80	½" x Sch.80 x 500 length	½" x Sch.80 x 450 length
Top of Thermowell	Incoloy 600	ASME SB 407 (800HT)	ASME SB 408 UNS 8811 (Incoloy 800 HT)
		22 dia X 205 length	22 dia X 205 length
Insulation Container (SF-6)	CS	A 387 Gr 11	A 240 Gr 304 H

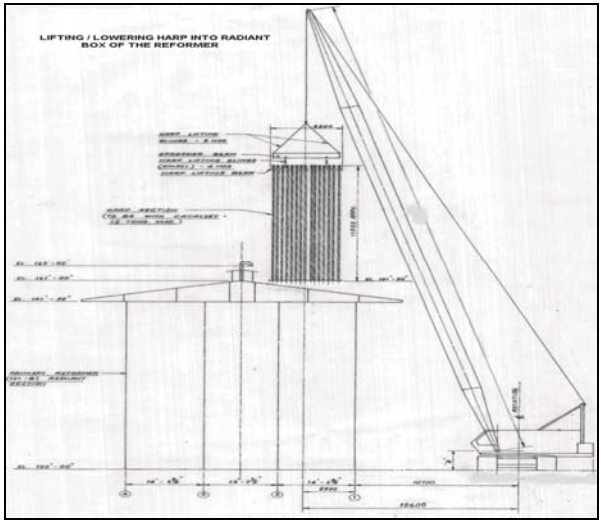
3.Plot plan for Primary reformer revamp – III



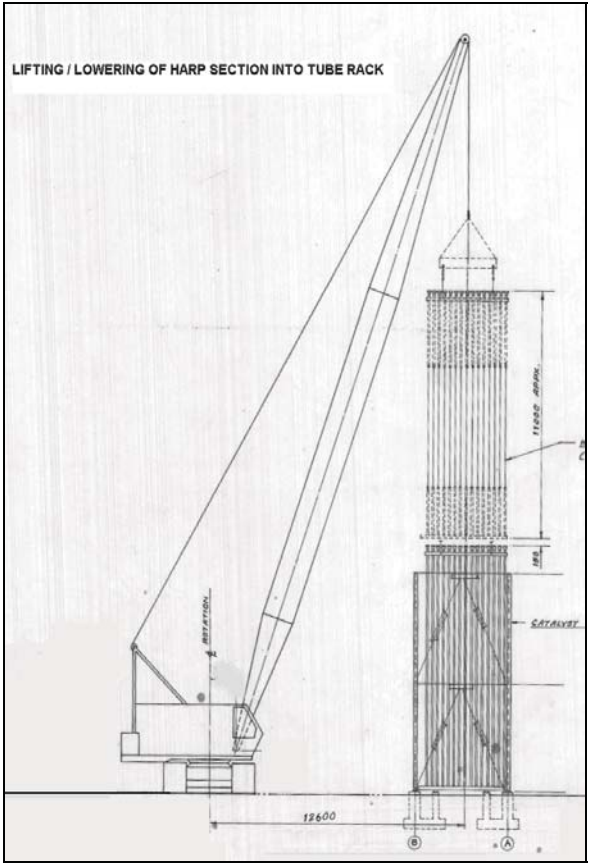
4 Supporting arrangement of Reformer floor beam for rolling of Harp section B & C



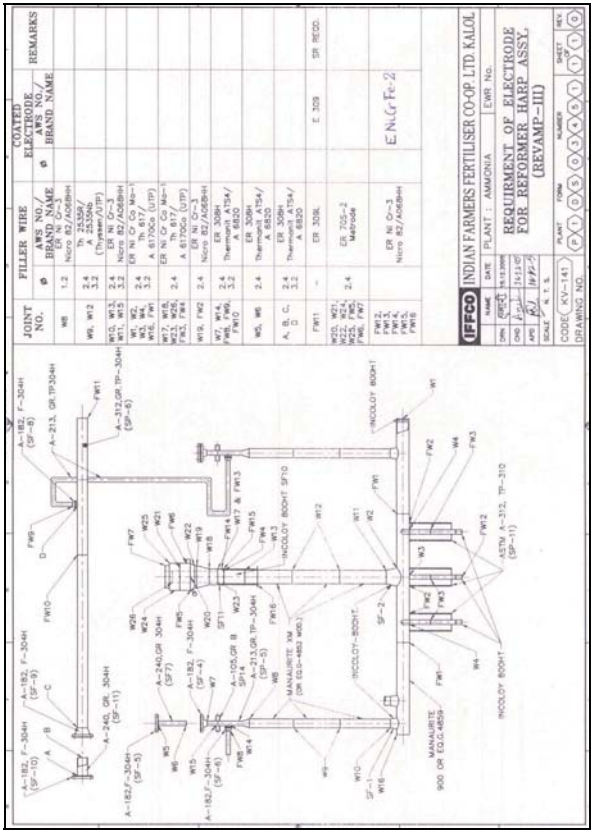
5 Schematic Rigging arrangement for Installation / Removal of Harp Section



6 **Schematic Rigging arrangement for Lifting / Removal of Harp Section from Radiant Tube Rack**

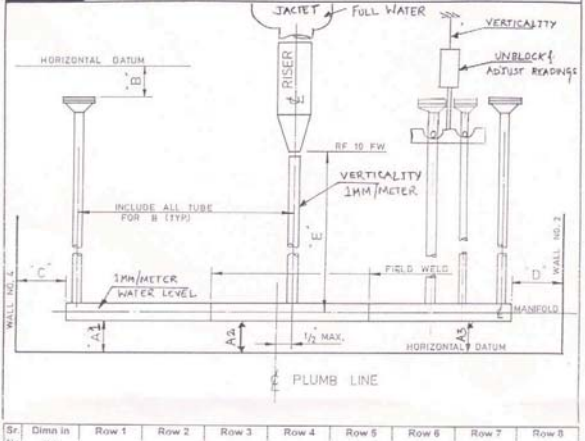


7 Requirement of Electrode for reformer harp assembly, Drg.NO.P1-DS-03451



Measurement sheet for Reformer Revamp-III, Drg. No. : 01-ES-*03401*

IFFCO **INDIAN FARMERS FERTILISER CO-OP. LTD. KALOL**



Sr. No	Dimn in mm	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
1	A1	545	545	525	565	532	535	538	520
	A2	540	533	522	550	528	525	526	535
	A3	545	545	512	550	542	545	538	535
2	B Average	-	-	-	-	-	-	-	-
3	C Average	275	266	290	275	280	260	225	255
4	D Average	255	235	208	235	230	265	250	228
5	E Average	-	-	-	-	-	-	-	-
6	Verticality of riser	±5	±5	±1	±7	±4	±5	±5	±10
7	Water level of Outlet	OK	OK	OK	OK	OK	OK	OK	OK

PREVENTIVE MAINTENANCE OF "HITACHI" MAKE CO_2 COMPRESSOR (K-1801)

LP CASE (K-1801-1):

Following activities were carried out. (All dimensions are in mm)

1) Decoupled the LP case at both ends from Turbine & Gear box.

2) Alignment readings were taken and recorded.

3) Journal bearing pads on T.B side were opened for inspection and found ok. Readings were measured and recorded as follows.
   Journal bearing shell : Ø 185.00
   Average pad thickness : 32.45
   Journal : Ø 119.96

4) Journal bearing pads on O. T.B side were opened for inspection and found ok. Readings were measured and recorded as follows.
   Journal bearing shell : Ø 185.00
   Average pad thickness : 32.45
   Journal : Ø 119.96

5) Thrust bearing was opened for inspection and found ok. Final readings were measured and recorded as follows

Sr. No.	Description	Before PM	Design Value	After PM
1	T.B. Side Journal Bearing Clearance	0.14	0.11 to 0.15	0.14
2	O.T.B. Side Journal Bearing Clearance	0.14	0.11 to 0.15	0.14
3	Thrust bearing clearance	0.32	0.28 to 0.38	0.32

6) DP testing on all the thrust pads was carried out & was found OK. Thickness of the thrust pads was checked and found within acceptable limits.

7) Thrust bearing pads were thoroughly cleaned, polished and reassembled.

8) The journal bearings were cleaned, polished and then reassembled back.

9) Gauss was measured in shaft, journal bearing, thrust collar & bearing pads, found below 4 gauss.

10) Final alignment readings were taken and recorded. Alignment between LP casing & gearbox was checked and corrected as per OEM reference values.

11) The Coupling spacer between HP casing & gearbox was assembled.

HP CASE (K-1801-2):

Following activities were carried out. (All dimensions are in mm)

1) Decoupled the HP case from Gear box.

2) Alignment readings were taken and recorded.

3) Journal bearing pads on T.B side were opened for inspection and found ok. Readings were measured and recorded as follows.

Journal bearing shell	: Ø 132.12
Average pad thickness	: 26.00
Journal	: Ø 79.99

4) Journal bearing pads on O.T.B side were opened for inspection and found ok. Readings were measured and recorded as follows.

Journal bearing shell	: Ø 132.07
Average pad thickness	: 25.98
Journal	: Ø 79.99

5) Thrust bearing was opened for inspection and found ok. Final readings were measured and recorded as follows.

Sr. No.	Description	Before PM	Design Value	After PM
1	T.B. Side Journal Bearing Clearance	0.16	0.11 to 0.14	0.12
2	O.T.B. Side Journal Bearing Clearance	0.18	0.11 to 0.14	0.11
3	Thrust bearing clearance	0.27	0.25 to 0.35	0.27

6) Both side Journal Bearing Clearance found beyond maximum limit. Hence old bearing replaced with new bearings.

7) DP testing on all the thrust pads was carried out & was found OK. Thickness of the thrust pads was checked and found within acceptable limits.

8) Thrust bearing pads were thoroughly cleaned, polished and reassembled.

9) The new journal bearings were cleaned, polished and then reassembled back.

10) Gauss measurement was done by Inspection section and the readings were recorded. Found within acceptable limits.

11) Alignment between HP casing & gearbox was checked and corrected as per OEM reference values.

12) The Coupling spacer between HP casing & gearbox was assembled.

PREVENTIVE MAINTENANCE OF GEAR BOX M-1801

Gear Wheel Bearings:

Following activities were carried out. (All dimensions are in mm)

1) Decoupled the Gear box from both end LP case and HP case.

2) Alignment readings were taken and recorded.

3) Journal bearing on T.B side were opened for inspection and found OK

Gear wheel journal	: Ø 99.87
Journal bearing clearance	: 0.18
Design value	: 0.125 to 0.169
Allowable abrasion limit	: 0.1859
Interference gear wheel journal to bracket	: 0.01

Bearing clearance found beyond maximum limit. Hence old bearing replaced with new bearings.

New journal bearing clearance after PM : 0.16

4) Journal bearing on O.T.B side were opened for inspection and found OK.

Gear wheel journal	: Ø 99.86
Journal bearing clearance	: 0.20
Design value	: 0.125 to 0.169
Allowable abrasion limit	: 0.1859
Interference gear wheel journal to bracket	: 0.02

Bearing clearance found beyond maximum limit. Hence old bearing replaced with new bearings.

New journal bearing clearance after PM : 0.15

Pinion Bearings:

Following activities were carried out. (All dimensions are in mm)

5) Journal bearing on T.B side were opened for inspection and found OK .

Journal bearing clearance	: 0.20
Design value (mm)	: 0.14 to 0.184
Allowable abrasion limit	: 0.2024
Interference pinion journal to bracket	: 0.01

The clearance value was increased to 0.20 by M/s Hitachi representative in May 2004 to avoid the bearing failure, so bearing was not replaced.

Journal bearing clearance after PM : 0.20

6) Journal bearing on O.T.B side were opened for inspection and found OK .

Journal bearing clearance	: 0.20
Design value	: 0.14 to 0.184
Allowable abrasion limit	: 0.2024
Thrust bearing Clearance	: 0.32
Interference pinion journal to bracket	: 0.01

The clearance value was increased to 0.20 by M/s Hitachi representative in May 2004 to avoid the bearing failure, so bearing was not replaced.

Journal bearing clearance after PM	: 0.20
Axial thrust after PM	: 0.32
Backlash between gear and pinion	: 0.54

7) DP testing on all the thrust pads was carried out & found OK.

8) Thrust bearing pads were thoroughly cleaned, polished and reassembled.

9) Gauss was measured in shaft, journal bearing, thrust collar & bearing pads, found below 4 gauss.

10) Alignment between HP casing & gearbox was checked and corrected as per OEM reference values.

11) The Coupling spacer between gearbox & HP casing and gear box & LP casing was assembled.

PREVENTIVE MAINTENANCE OF TURBINE OF "HITACHI" CO_2 COMPRESSOR (Q-1801)

Following activities were carried out. (All dimensions are in mm.)

1) Decoupled the Turbine from LP case of CO2 compressor.

2) Alignment readings were taken and recorded.

3) Journal bearing pads on Front side were opened for inspection and found OK .

Journal bearing shell	: Ø 159.94
Average pad thickness	: 17.47
Journal	: Ø 124.80
Bearing clearance	: 0.20
Design value	: 0.18 to 0.31
Journal bearing clearance after PM	: 0.23
Turbine Oil Gland Clearance	:
Right	: 0.15
Bottom	: 0.05
Left	: 0.12

4) Journal bearing pads on Rear side were opened for inspection and found OK .

Journal bearing shell	: Ø 205.02
Average pad thickness	: 22.50
Journal	: Ø 159.73
Bearing clearance	: 0.29
Design value	: 0.24 to 0.35
Journal bearing clearance after PM	: 0.30
Turbine Oil Gland Clearance:	
Right	: 0.15
Bottom	: 0.05
Left	: 0.12

5) Thrust bearing was opened for inspection. DP testing on all the thrust pads was carried out & found OK. Thickness of the thrust pads was checked and found within acceptable limits.

Thrust bearing clearance	: 0.32
Design value	: 0.25 to 0.35

6) Thrust bearing pads were thoroughly cleaned, polished and reassembled.

7) The journal bearings were cleaned, polished and then reassembled back.

8) Gauss measurement was done by Inspection section and the readings were recorded. Found within acceptable limits.

9) Alignment between Turbine & LP casing was checked and corrected as per OEM reference values.

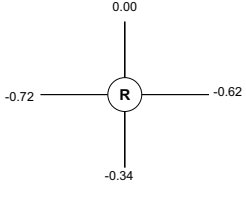
10) The Coupling spacer between Turbine & LP casing.

ALIGNMENT READING: LP COMPRESSOR TO TURBINE:

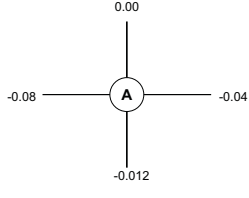
Dial on LP Compressor Coupling
1 Div = 0.01mm

Before PM:

RADIAL

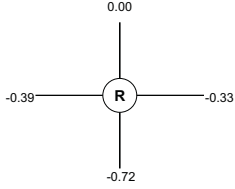


AXIAL

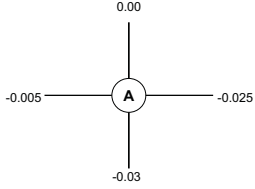


After PM:

RADIAL

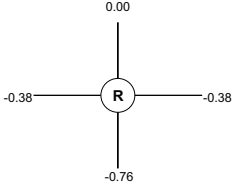


AXIAL

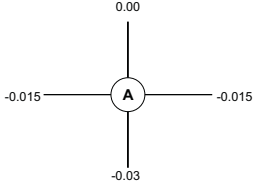


Design Values:

RADIAL



AXIAL

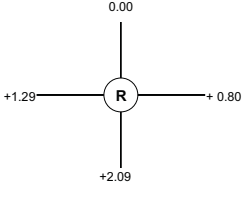


ALIGNMENT READINGS: GEAR BOX TO LP COMPRESSOR:

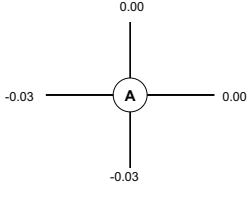
Dial on LP Compressor Coupling
1 Div = 0.01mm

Before PM:

RADIAL

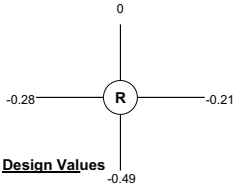


AXIAL

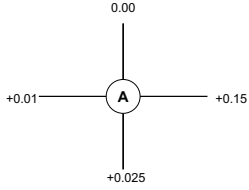


After PM

RADIAL

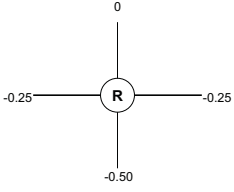


AXIAL

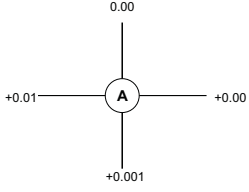


Design Values

RADIAL



AXIAL

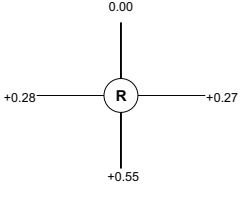


ALIGNMENT READINGS: GEAR BOX TO HP COMPRESSOR:

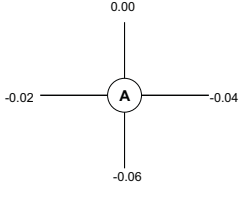
Dial on HP Compressor Coupling
1 Div = 0.01mm

Before PM

RADIAL

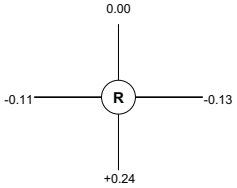


AXIAL

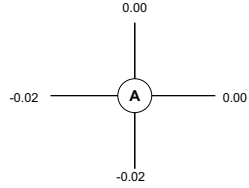


After PM

RADIAL

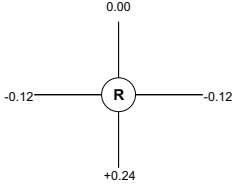


AXIAL

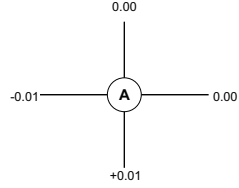


Design Values

RADIAL



AXIAL



PREVENTIVE MAINTENANCE OF PB RECIPROCATING COMPRESSOR DRIVE TURBINE

Following activities were carried out. (All dimensions are in mm.)

1) Decoupled the Turbine from Gear box.

2) Alignment readings were taken and recorded.

Journal bearing pads on front side were opened for inspection.

Journal Bearing on the Front Side	:	Ø70.00
Journal Bearing Clearance on the Front Side	:	0.17

3) Journal bearing pads on Rear side were opened for inspection

Journal Bearing on the Rear Side	:	Ø70.04
Journal Bearing Clearance	:	0.14

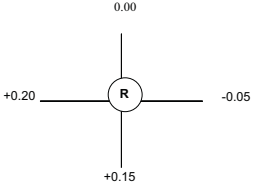
4) Thrust bearing was opened for inspection. DP testing on all thrust pads was carried out & found OK.

Thrust Bearing Clearance	:	0.26
Total Float of Rotor without Thrust Bearing	:	2.03
Rotor Pinion Wood Reduction Gear Backlash	:	0.32
Woodward Governor Rack & Pinion Backlash	:	0.30
Trip Lever Clearance	:	0.80
Front Side Axial Clearance	:	1.30
Trip lever radial Clearance	:	1.06
Turbine to Gearbox Coupling Float	:	9.60

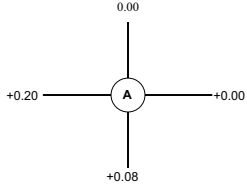
Alignment between Turbine and Gear Box:

Dial on Gearbox Coupling
1 Div = 0.01mm

RADIAL



AXIAL



PREVENTIVE MAINTENANCE OF BHEL, NUOVO PIGNONE COMPRESSOR (K-1101-1)

Following activities were carried out. (All dimensions are in mm.)

1) Decoupled the compressor both ends from Turbine & Gear box.

2) Alignment readings were taken and recorded.

3) Journal bearing pads on front side were opened for inspection and found OK.

Journal Bearing Clearance on the Front Side	:	0.15
Journal	:	Ø 79.87
Design Clearances	:	0.12 to 0.16

4) Journal bearing on Rear side was opened for inspection and found OK.

Journal Bearing Clearance on the Rear Side	:	0.20
Journal	:	Ø 99.83
Design Clearances	:	0.15 to 0.19

5) Thrust bearing was opened for inspection. DP testing on all thrust pad was carried out & was found OK.

Thrust bearing clearance	: 0.22
Design value	: 0.20 To 0.30

COMPRESSOR 2MCH 807:

1) Journal bearing pads on O.T.B. Side were opened for inspection and found Ok.

Journal bearing clearance O.T.B. Side : 0.20

2) Journal bearing pads on .T.B. Side were opened for inspection and found Ok.

Journal bearing clearance T.B. Side : 0.22

Since the clearance are maximum and beyond maximum limits. New bearing are assembled. Final clearance values are as follows.

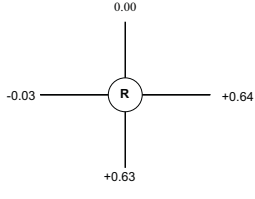
Journal Bearing Clearance on T.B. Side	: 0.16
Journal bearing Clearance on O.T.B. Side	: 0.18
Thrust Bearing Clearances	: 0.28
Design Value	: 0.25 to 0.35
Coupling Float (final)	: 6.6

Alignment between Turbine and Compressor:

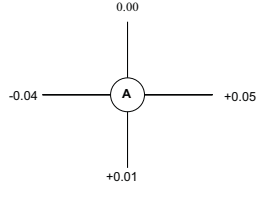
Dial on Turbine Coupling
1 Div = 0.01mm

Before PM:

RADIAL

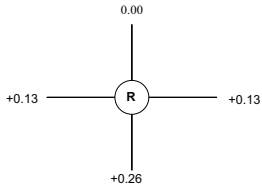


AXIAL

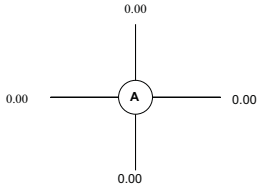


Design Value:

RADIAL

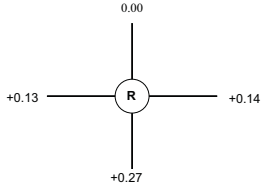


AXIAL

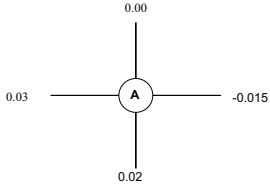


After PM:

RADIAL



AXIAL



HP VESSELS:

H-1201 (HP STRIPPER):

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.

TOP DOME:

The top liquid barrier was opened and then all the ferrules were removed. Some oil deposits and scaling was observed between the tube ends, on the top tube sheet. The same were carefully removed using SS chisel. Condition of weld joint was found satisfactory. The old PTFE gaskets were removed. Then all the ferrules were thoroughly cleaned by Production department. Subsequently, pressure drop measurement was carried out and 2700 nos of New PTFE gaskets were provided in the ferrules, which were found acceptable in the DP measurement. HP Stripper vessel was thoroughly cleaned with compressed air and then with DM water. The ferrules were fixed in position and liquid barrier plates were boxed up.

BOTTOM DOME:

4 nos. cavities of approx. 2 mm depth were observed on dome are weld overlay. These defects were repaired using TIG welding method with 25-22-2 L Mn filler wires. The weld repaired areas were passivated and washed with DM water.

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

H-1202 (HP CONDENSER):

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.

6 nos of undercut were observed on circumferential weld joint of shell. All these spots were repaired using TIG welding method and 25-22-2 L Mn filler wires. The repaired areas were passivated and washed with DM water.

After getting clearance, the segments and basket was boxed up after loading rasching rings in the basket. The partition plates on basket were boxed up. After getting clearance from production department boxed up top cover H-1202 with new "Kempchen" gasket (Size: 839 mm OD x 800 mm ID x 4 mm thick with 0.5 mm thick PTFE envelop) and tightened 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
Finally the offgas line was boxed up using new ring gasket.

After inspection & clearance from production the bottom cover was taken for box up. Both gasket seats of the vessel were thoroughly cleaned. The bottom cover was lifted and put into position, provided new "Kempchen" gasket (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 and tightened it.

AUTOCLAVE (V-1201)

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. Telephones were provided at the bottom end, top end and 5th compartment.

Inspection section carried out visual and NDT examination of liners and shell areas. The bulged liners were inspected for any abnormal increase. Based on the NDT examination, cracks, pinholes & weld under cuts. The compartment wise repair work are mentioned below:

Compartment No.1 (Top Compartment):

Crevice cavity of approx 13" long and 9" long on the south west side L-seam and Corrosion cavity of approx 2" long on North east side L-seam were observed. These spots were repaired using TIG welding method and 25-22-2 L Mn filler wires. The repaired areas were passivated and washed with DM water.

Compartment No.2:

3 Nos. of corrosion cavity in south west side longitudinal seam, 1 No. of crevice cavity in C-seam, 1 No. Spot welding and 1 No. old clit marked for repair . All these defects were repaired using TIG welding method and 25-22-2 L Mn filler wires. The repaired areas were passivated and washed with DM water.
Also, 7 Nos. of J-bolts were found loose, which were tightened.

Compartment No.3:

8 Nos. of undercuts/corrosion cavities were repaired using TIG welding method and 25-22-2 L Mn filler wires. The repaired areas were passivated and washed with DM water.
Also, 2 Nos. of 'J' bolts were found loose which were tightened.

Compartment No.4:

6 No. of corrosion cavities and 1 No. of old clit mark were observed to have corroded. All these spots were repaired using TIG welding method and 25-22-2 L Mn filler wires. The repaired areas were passivated and washed with DM water.
Also, 10 Nos. of 'J' bolts found loose which were tightened.

Compartment No.5:

There were no crevice corrosion surrounding welding area found.
4 Nos. of 'J' bolts and some tray holding nuts and bolts were also found loose which were tightened.

Compartment No.6:

6 Nos. of corrosion cavities were repaired using TIG welding method and 25-22-2 L Mn filler wires. The repaired areas were passivated and washed with DM water.3 Nos. of 'J' bolts and some tray holding nuts and bolts were found loose, which were tighten.

Compartment No.7:

3 Nos. of corrosion cavities and 2 nos. of spot welds were repaired using TIG welding method and 25-22-2 L Mn filler wires. The repaired areas were passivated and washed with DM water.
Also,1 No. of 'J' bolts was found loose which was tighten.

Compartment No.8:

2 nos. cavities and 9 Nos. of old clit marked for repair. All these spots were repaired using TIG welding method and 25-22-2 L Mn filler wires. The repaired areas were passivated and washed with DM water.
Also,1 No. of 'J' bolts was found loose which was tighten.

Compartment No.9:

3 Nos. of cavities and 5 Nos. of old clit were marked for repair. All these spots were repaired using TIG welding method and 25-22-2 L Mn filler wires. The repaired areas were passivated and washed with DM water. marks were observed to have corroded.
Also, 1 No. of 'J' bolt and some tray holding nuts and bolts were also found loose which were tighten.

Compartment No.10:

4 Nos. of corrosion cavities and 5 nos old clit welding marked for repair. All these spots were repaired using TIG welding method and 25-22-2 L Mn filler wires. The weld repaired areas were passivated and washed with DM water.

Compartment No.11:

2 Nos of corrosion cavities and down comer pipe L-seam becomes level to level after corrosion in the length of approx 12" just above the trays. All these spots were repaired using TIG welding method and 25-22-2 L Mn filler wires. The weld repaired areas were passivated and washed with DM water.

Compartment No.12 (Bottom Compartment.):

11 nos. of cavities and 15 nos. weld defects were observed on circumferential weld joint crown plates All these spots were repaired using TIG welding method and 25-22-2 L Mn filler wires. The repaired areas were passivated and washed with DM water.

After completion of repairs, clearance was taken from production(Urea) for the removal of ladders, hand lamps, telephones and air hoses and then top man way cover was boxed up with new "Kempchen" gasket using hydraulic bolt tensioner at following 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

All the nozzles at the bottom end and the off gas pipe line including the steam tracing lines were boxed after taking clearance from Production. RTJ ring gasket of non standard height was used for box up of flanges in the pipe line leading to H-1202 (6" x 1500#).

LP VESSELS:

V-1102 (NH3 SUCTION FILTER):

Visual inspection of the vessel was carried out from inside. Overall condition of the equipment was found satisfactory. After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets.

V-1202 (RECTIFYING COLUMN):

Condition of trays was found satisfactory and intact in position. After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets.

V-1203 (L. P. ABOSRBER) :

Top End:

Perforated support grid just below top hand found intact in position

Bottom End:

Packing supporting grid was found intact in the position.

After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets

V-1206 (ATMOSPHERIC VENT SCRUBBER):

Demister pads were found intact in position and condition of the same was found satisfactory. All fasteners were found intact. After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets

V-1207 (L. P. SCRUBBER):

The grill support was found damage and the same was repaired by welding .
After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets

V-1351 (HYDROLYSER):

Visual inspection of vessel top and bottom compartment was carried out by Inspection Department.

Top Compartment:

Trays fasteners were found intact in position.

Bottom Compartment:

Overall condition was satisfactory.

After getting clearance from production department the vessel manholes and all connected pipe lines were boxed up using new gaskets.

V-1352 (FIRST DESORBER):

Visual inspection was carried out from top manhole.

Top Manhole:

All internals were found intact in position.

After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets.

Bottom Manhole:

Provided one missing bolt and cleaned the vessels.

After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets.

V-1501 (4 ATA STEAM DRUM):

Demister pads were found intact in position and condition of the same was found satisfactory. Cavity was observed and the same was repaired

After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets

V-1503 (9 ATA STEAM DRUM):

Undercuts of approx. 0.5 mm depth were observed on the Manhole flange to dished end welding at scattered locations. The same was repaired.

After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets.

V-1811 (1ST STAGE SEPARATOR):

Demister pad found exact in position and vortex found. Overall condition was found satisfactory.

After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets.

V-1813 (3RD STAGE SEPARATOR):

Overall condition was found satisfactory.

After getting clearance from production department the vessel manhole and all connected pipe line were boxed up using new gaskets..

V-1423 (1st Stage Evaporator Scrubber):

Adhered solidified urea solution particles were cleaned at demister pad. Also, two missing bolts of bottom plate were provided.

After getting clearance from production department the vessel manhole and all connected pipe line were 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 exchanger were opened for cleaning by hydrojetting. After cleaning, boxed up with new gaskets.

1) Surface condenser (H-1815)
2) Main lube oil coolers (H-1814-A/B)
3) Flash tank condenser (H-1421)
4) First Evaporator (H-1422) with DM water.
5) First Evaporator condenser (H-1423)
6) Second Evaporator (H1424) with D.M. water.
7) Second Evaporator I condenser (H-1425)
8) Second Evaporator II condenser (H-1426)
9) First Evaporator Final condenser (H-1420)
10) Recirculation heater (H-1204) with D.M. Water.
11) LO Coolers of P-1102-A/C & L.O. Coolers of P-1201-A/B/C
12) CCS - II cooler (H-1207)
13) Reflux condenser (H-1352)
14) Pre-evaporator condenser (H-1419)
15) H-1301 A/B/C Heat Exchangers (Tube side)
16) H-1351 A/B/C Heat Exchangers (Tube side)
17) H-1303 Effluent cooler.
18) H1113 A/B Main lube oil cooler.
19) H-1123 C.C. LUBE OIL COOLER.

HEAT EXCHANGER TUBE BUNDLE PULL-OUT:

Following Heat Exchanger's Tube Bundles were Pulled out.

(1) H-1812 (2) H-1351 B

Tube bundles and shell were cleaned thoroughly by hydrojetting.

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

During shut down 2006, we had carried out chemical cleaning of plate type heat exchanger in presence of M/s Alfa Laval (I) Ltd, engineer on trial basis. The chemical cleaning procedure was given by M/s Alfa Laval. The details of Chemical cleaning procedure are described below.

1. Closed all inlet and outlet valves and by placing blind flanges wherever necessary.
2. Plate Heat Exchanger to be drained completely.
3. 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 / Secondary) and back to be done.
4. Plate Heat Exchanger to be flushed with DM Water (at room temperature) on both the sides.
5. One of sides (Primary / Secondary) to be blanked out while the second is taken in circuit as above.
6. Hot Water / Condensate at around 70 Deg. Cent. To be circulated in the Plate Heat Exchanger for 3 hours. The inlet should always be from top and outlet from bottom.
7. 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.
8. 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.
9. Chemical Cleaning of Plate Heat Exchanger using patented Alfa Laval Chemicals by circulating the same for 3 hours. The solution should be prepared using 1:2 (Cleaning Chemical: Water) proportion of Chemicals provided by Alfa Laval at around 60 Deg. Cent. The inlet should always be from bottom and outlet from top.
10. Neutralization of Plate Heat Exchanger by draining (initially) and then flushing till pH value of water coming out of Plate Heat Exchanger is around.

    PHE was opened after the chemical cleaning. It was found that 80-85 % portion of channel plates was cleaned. However due to the criticality of equipment, it was decided to put new reconditioned channel plates in place of chemical cleaned channel plates.

PRILL TOWER ID FANS K-1401/1-4

The scaffolding was provided in the fan cell. All blade locking bolts were loosened and blade angle was set at 10^0 with the help of protractor spirit level. The bladed were tightened.

Both bearings of fan were opened and inspected. Found OK. Fresh grease provided and boxed.
V-belts (SPC 4000, 1set = 3 nos) of K-1401/1 and k-1401/2 were replaced. Alignment of fan motor w.r.t. fan was carried out and the all V belts were fully tensioned.
Scaffolding was removed. All internal and external surfaces were cleaned by power tool and painting was carried with 1 coat of epoxy primer and 2 coats of epoxy paint

PRILL COOLING SYSTEM

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

The following preventive maintenance jobs were carried out.

- Bearings of both fans were opened, Cleaned and checked. Found in good condition and hence boxed up.
- Fresh lube oil charged.
- Damper made operational and provided fresh grease.
- Rotor and casing of fan were cleaned.
- Bigger size fan pulley of K-1701 was replaced by smaller size fan pulley
- V belts (SPC 6300, 1set = 8 nos) of K-1701 replaced with new ones and aligned with motor.
- Alignment of fan belt of K-1701 checked and corrected.
- Painting of internal surfaces of casing carried out.

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. Tighten the loose bolt of fluidized bed cooler and provided with lock nut.

CONVEYOR SYSTEM

UREA PRODUCT CONVEYOR (M-1403)

The following preventive maintenance jobs were carried out.

- Belt was replaced by new one made of 4 ply Nylon, Grade HR–T1 800 mm width.
- Gear box checked & found OK.
- 5 nos of plain return roller was replaced with rubber lined return roller.
- Skirt rubber replaced wherever found damaged.
- Aligned motor with gear box and after checking direction couple with gear box by new bushes

LINK CONVEYOR (M-1419)

The following preventive maintenance jobs were carried out.

- Belt condition was found satisfactory.
- Checked gear box found OK.
- Flushed gear box oil.
- All plain return roller was replaced with rubber lined return roller
- Skirt rubber replaced wherever found damaged.
- Aligned motor with gear box and after checking direction coupled
- with gear box by new bushes

PRILL COOLING LINK CONVEYOR (M-1421)

The following preventive maintenance jobs were carried out.

- Belt condition was found satisfactory
- Replaced bearings of Tail pulley (NTN – 75mm dia).
- Aligned motor (reconditioned) with gear box. New bushes provided
- in the coupling.

DUST CONVEYOR SYSTEM (M-1703)

The following preventive maintenance jobs were carried out.

- Belt was replaced by new one made of 3 ply Nylon, Grade HR-T1 & width 600 MM
- One rotary valve replaced by new one.
- Both bearings of head end pulley was replaced

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

Following preventive maintenance jobs were carried out.

- Bucket change over mechanism was cleaned.
- Pulley of the mechanism checked and found OK.
- Greasing of the bearings and chain was carried out.
- Toothed belts were replaced and alignment was carried out.

SCRAPPER (M-1402 -1/2):

Following preventive maintenance jobs were carried out.

- Scraper arms were inspected for tightness of nuts.
- Checked scraper floor slit plates
- Cleaned scraper 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 flushed.
- Checked condition of V belts (B 69, 1set = 4nos.) and tightened the belts.
- V- belts of M-1402/1 replaced with new ones.

- Alignment checked and tightened belts.
- Removed oil from scrapper main gear box, flushed the oil & maintained the oil level.

RELIEF VALVE OVERHAULING AND TESTING:

Following RV's were removed, overhauled and tested on valve test bench by M/s Dembla Valves Pvt. Ltd. Mumbai vide W.O.No.991872 dated 16-02-2006.

SR. NO.	RV NO.	EQPT. NO. & NAME	SET PRESSURE	RESET PRESSURE
1	RV-1201 A	V-1201 off gas line	165 Kg/cm2	150 Kg/cm2
2	RV-1201 B	V-1201 off gas line	165 Kg/cm2	150 Kg/cm2
3	RV-1201 C	V-1201 off gas line	165 Kg/cm2	148 Kg/cm2
4	RV-1205	P-1201 A discharge	165 Kg/cm2	148 Kg/cm2
5	RV-1206	P-1201 B discharge	165 Kg/cm2	148 Kg/cm2
6	RV-1206	P-1201 C discharge	170 Kg/cm2	152 Kg/cm2
7	RV-1103 A	P-1102 A discharge	150 Kg/cm2	135 Kg/cm2
8	RV-1103 B	P-1102 B discharge	150 Kg/cm2	135 Kg/cm2
9	RV-1103	P-1102 C discharge	150 Kg/cm2	135 Kg/cm2
10	RV-1181	K-1801 final discharge	177 Kg/cm2	159 Kg/cm2
11	RV-1903	K-1801 IIIrd stage discharge	111Kg/cm2	100 Kg/cm2
12	RV-1573 (Final)	P-1502 final disch. line	180 Kg/cm2	160 Kg/cm2
13	RV-1573 A	P-1502 disch.	185 Kg/cm2	160 Kg/cm2
14	RV-1573 B	P-1502 disch.	185 Kg/cm2	160 Kg/cm2
16	RV-1202A	V-1202 off gas line LP System	6 Kg/cm2	5.5 Kg/cm2
17	RV-1202B	V-1202 off gas line LP System	5.7 Kg/cm2	5.2 Kg/cm2
18	RV-1202C	V-1202 off gas line LP System	6 Kg/cm2	5.5 Kg/cm2

19	RV-1203	P-1201 A Suction line	8.5 Kg/cm2	7.5 Kg/cm2
20	PSV-1201A	P-1201 A Suction line	8.5 Kg/cm2	7.5 Kg/cm2
21	PSV-1201B	P-1201 B Suction line	8.5 Kg/cm2	7.5 Kg/cm2
22	PSV-1201C	P-1201 C Suction line	8.5Kg/cm2	7.5 Kg/cm2
23	RV-1101A	Liquid ammonia line from H-1102 to V-1102	31Kg/cm2	29 Kg/cm2
24	RV-1101B	Liquid ammonia line from H-1102 to V-1102	31Kg/cm2	29 Kg/cm2
25	RV-1102 A	Ammonia suc. Vessel (V-1103)	31Kg/cm2	29 Kg/cm2
26	RV-1102 B	Ammonia suc. Vessel (V-1103)	31Kg/cm2	29 Kg/cm2
27	RV-1108 A	Cold ammonia line from Amm storage tank to H1102	31Kg/cm2	29 Kg/cm2
28	RV-1108 B	Cold ammonia line from Amm storage tank to H1102	31Kg/cm2	29 Kg/cm2
29	RV-1106 A	Liquid amm, line from amm. Plant to amm. filter.	31Kg/cm2	29 Kg/cm2
30	RV-1106 B	Liquid amm, line from amm. Plant to amm. filter.	31Kg/cm2	29 Kg/cm2
31	RV-1107 A	Liquid anmmonia line(hot) before ammonia filter	31Kg/cm2	29 Kg/cm2
32	RV-1107 B	Liquid anmmonia line(hot) before ammonia filter	31Kg/cm2	29 Kg/cm2
33	RV-1110	Liquid ammonia line from atm. Amm.storage tank to H-1102	31Kg/cm2	28 Kg/cm2
34	RV-1901	Ist stage discharge of K-1801.	7 Kg/cm2	6.7 Kg/cm2
35	RV-1902	IInd stage discharge of K-1801	27 Kg/cm2	25.1 Kg/cm2
36	RV-1503	23 ata Steam	25 Kg/cm2	23.8 Kg/cm2
37	RV-1504	9 ata Steam Drum	12 Kg/cm2	11 Kg/cm2
38	RV-1129	4 ata Steam Header	6 Kg/cm2	5.4 Kg/cm2

39	RV-1501 A	4 ata Steam Drum	7.5 Kg/cm2	6.8 Kg/cm2
40	RV-1501B	4 ata Steam Drum	7.5 Kg/cm2	6.6 Kg/cm2
41	RV-1209	V-1203 Vessel	10 Kg/cm2	9 Kg/cm2
42	RV-1351	RV of V-1351	24 Kg/cm2	23 Kg/cm2
43	RV-1352	RV of V-1352	6 Kg/cm2	5.4 Kg/cm2
44	RV-1301	RV of V-1301	6 Kg/cm2	5.9 Kg/cm2
45	RV-1184 (CCS-I)	H-1102 outlet NH3 outlet	6 Kg/cm2	5.5 Kg/cm2
46	RV-1221 (CCS-II)	P-1204 disch. To H-1203	16.5 Kg/cm2	15 Kg/cm2
47	RV-1913	Ejector system of Q-1801	0.20 kg/cm2	0.20 kg/cm2
48	RV-1914	Ejector system of Q-1801	0.20 kg/cm2	0.20 kg/cm2
49	RV-1916	23 ata Steam extraction	28 Kg/cm2	26 Kg/cm2
50	RV-1917	4 ata Steam exhaust	4 Kg/cm2	3.6 Kg/cm2
51	RV-1351 A	RV of P-1351 A	10 Kg/cm2	9 Kg/cm2
52	RV-1351 B	RV of P-1351 B	10 Kg/cm2	9 Kg/cm2
53	RV-1130	24 ata steam header	26 Kg/cm2	22.5 Kg/cm2
54	RV-1902	II stage discharge (Hitachi)	28 Kg/cm2	26 Kg/cm2
55	RV-1904	H-1811 First stage gas cooler	7 Kg/cm2	6 Kg/cm2
56	RV-1905	H-1812 Second stage gas cooler	7 Kg/cm2	6 Kg/cm2
57	RV-1906	H-1813 Third stage gas cooler	7 Kg/cm2	6 Kg/cm2
58	RV-1224	C.W from utilities	6 Kg/cm2	5.4 Kg/cm2

INSPECTION OF CHECK VALVES

Sr. No.	EQUIPMENT
1	CO_2 to H-1201
2	NH_3 to H-1202
3	NH_3 to V-1201
4	Carbamate to H-1202
5	Carbamate to H-1203
6	CO_2 to H-1203
7	4 ata steam to V-1352
8	23 ata steam to V-1351
9	4 ata steam to V-1301
10	Condensate to melt return line
11	P-1201 A/B steam injection to discharge RV
12	9 ata steam injection to offgas line of V-1203/V-1207
13	9 ata steam injection to off gas line of V-1205
14	NH_3 water to V-1352
15	CO_2 to H-1353 (Hydrolyser section)
16	P-1351 A/B discharge

T-1301 (Ammonia Water Tank):

Overall condition of tank was found satisfactory. The manhole was boxed up with new gasket after getting clearance from Production Department.

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

Overall condition of tank was found satisfactory. The manhole was boxed up with new gasket.

T-1302 (Underground Waste Water Tank):

No abnormality was observed.
The manhole was boxed up with new gasket.

T-1401 (Urea Solution Tank):

No abnormality was observed
The manhole was boxed up with new gasket.

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

No abnormality was observed
The manhole was boxed up with new gasket

T-1501 (Condensate Tank):

One support of middle condensate inlet pipe out of three pipes was found bent. The same was repaired. The manhole was boxed up with new gasket.

FABRICATION JOBS:

Following fabrication jobs were carried out by **M/s J & J, Shertha** vide W.O. No. 16/00215/9918078 dated 24/11/2005

SR. NO.	DESCRIPTION
1	H-1206 in cooling water line , 6" nozzle provided at inlet/outlet for chemical cleaning
2	Q-1814 turbine drain & steam trap drains connected to common header
3	P-1401 Steam trap was replaced. (TD3 type)
4	P-1401/A/B mechanical seal steam injection main I/v was replaced (gate valve , 1/2" x 800#)
5	P-1502 A suction drain I/V replaced. (gate valve, ¾" x 800#)
6	PICV-1130 u/s drain line trap replaced (TD3 type)
7	4 ata header drain line near P-1201C removed & drain I/V provided. (3/4" x 800#)
8	P-1401 steam trap d/s was replaced (TD3 type)
9	P-1401A m-seal steam injection 1st i/v was replaced (gate valve,1/2" x 800#)
10	P-1201A top side cond. service station 2nd i/v was passing and it was replaced
11	4 ata steam tracing pin hole leak at top F-1206 was replaced (1/2" NB)
12	23 steam tracing (H.P. Condenser off gas Line) Second I/V bonnet leak. New valve was provided (gate valve, ½" x 800#)
13	P-1201C dis. RV steam injection o/l line extended upto ground floor (1/2" NB)
14	Near P-1201B suction I/V 2 nos. of Steam tracing were replaced (gate valve , ½" x 800#)
15	H-1205 o/l line of steam tracing was replaced. (1/2" NB)
16	P-904 A/B cond. suction chocked line replaced. (3/4" NB)
17	Steam tracing cond. o/l line were pinhole leak at 2 nos. points of H-1422 bottom and tracing line was replaced by new one. (½" NB)
18	H-1424 bottom steam tracing line i/v bonnet leak at H-1424 middle. It was replaced (piston valve, 1/2" x 800#)
19	9 ata steam tracing to V-1205 top side line pinhole leak nr. Its 1st i/v at H-1424 bottom (near H-1420 top) and it was replaced (½" NB)
20	H-1207 CCS-11 9 ata jacket o/l line with trap and i/v relocated nr. Pillar side.
21	3RD floor P.T side service station air i/v was replaced (1/2" x 800#)
22	V-1201 Bottom steam tracing trap leak and it was replaced (BPT type)
23	V-1201 bottom side steam tracing all lines relocated
24	4 ata steam to H-1205 2nd I/V was passing and it was replaced (¾" x 800#)
25	9ata injection to PRCV-1202 lint T joint welding pinhole leak at V-1205 top. It was attended
26	V-1205 top extra steam tracing line cut and replaced (1/2" NB) and new i/v provided. (1/2" x 800#)
27	V-1201 bottom steam tracing cond. trap i/v was replaced (piston valve, 1/2" x 800#).
28	4 ata steam to H-1205 drain i/v was replaced.
29	4 ata Steam tracing line pinhole leak at Behind V-1205 and it was replaced (1/2" NB) also provided new i/v (piston valve, 1/2" x 800#)

30	H-1205A gases line steam tracing line pinhole leak at H-1205A top side (middle line). it was replaced (1/2" NB)
31	H-1202 top steam tracing line union leak. It was replaced (1/2" x 3000#)
32	BFW line leakage near H-1203 bottom. . It was replaced
33	4 ata steam tracing line leakage of Carbamate overflow line of H-1203, near V-1201 top . It was replaced, (1/2" NB)
34	4 ata Steam for bucket heating HICV-1401 drain i/v was passing and replaced. (½" x 800#)
35	9 ata injection to V-1207 both i/v hard to operate at V-1207 top. It was replaced (gate valve, 1/2" x 800#)
36	9 ata injection to V-1203 top both i/v hard to operate. It was replaced (gate valve, 1/2" x 800#)
37	4 ata steam to bucket heating steam trap was not working in bucket room. It was replaced with new one (TD 3)
38	H-1203 top steam tracing i/v heavy leak and It was replaced (gate valve, 1/2" x 800#)
39	H-1203 top steam tracing i/v heavy leak, and It was replaced (gate valve, 1/2" x 800#)
40	H-1203 top drain i/v was passing and It was replaced (gate valve, 1/2" x 800#)
41	HPF to PRCV-1201 drain i/v wheel missing. And new valve provided (gate valve, ¾ " x 800#)
42	V-1351 old 23 ata steam tracing line removed as it was dead.(1/2" NB)

Following fabrication jobs were carried out by **IFFCO**

Sr. No.	Description
1	Provided 9 ata steam purging at d/s of PICV-1202 and sample point at a distance of 1 m from it on the V-1207 vent pipe.
2	Common vent line 20" NB was leaking above elbow. New SS jackete was provided on CS line
3	Steam traps of T-1701 A/B relocated for proper dressing of floor
4	FBC two drains extended for easy access by maintenance
5	Provided 9 ata steam injection instead of 4 ata steam in V-1353 gas outlet line
6	Provided steam trap near bend (at 2nd floor near staircase) of 9/4 ata steam header going to P.T.Top
7	Increased V-1205 gas outlet line size from 2" to 3".
8	Water-in- Carbamate ratio meter sample point provided at 2nd floor.
9	Provided new steam trap on d/s of PICV-1129
10	New raw water hose station provided near Spray cooler sump.
11	Provided 2" bypass line with I/V on cooling water outlet I/V of H-1814 - A/B.
12	PT top 4 ata headers (near RV-1201) were merged.
13	PICV-1130 PI tapping shifted from present location to 4 ata steam header going to Utility (just above P-1515)
14	Liquid outlet line (H-1202 to V-1201) was opened. Gasket area of flange was found corroded. It was replace with new one (8" x 1500#, RTJ, SS 316 L).

The following Valve passing and Bonnet leak jobs were carried out by **M/s EFCO**

SR. NO.	DESCRIPTION
1	60 ata steam Ist I/V of Q-1101/2 heavy bonnet leak. The bonnet was dismantled. The repair job was carried out by M/s EFCO and boxed-up with new gasket
2	60 ata steam Ist I/V of Q-1101/1 was passing. The valve seat area was lapped and blue matched by M/s EFCO and boxed-up.
3	60 ata steam i/v was passing near control room main door of Q-1101/1. The valve seat area was lapped and blue matched by M/s EFCO and boxed-up.
4	Q-1101/1 60 ata steam drains I/V were passing near pillar (near Instr. Room wall). It was replaced with new one. (3/4" x 800#)
5	P-1201/B Suction drain I/V was passing. It was replaced with new one. (3/4" x 800#)
6	MOV-1201 passing heavily-CO2 to H-1201, The valve seat area was lapped and blue matched by M/s EFCO and boxed-up.

FERMANITED JOBS

1	9 ata steam tracing main i/v g/l at 2nd floor was replaced with new one (½" x 800 #)
2	23 ata condensate o/l of H-1201 bonnet leak and it was replaced with new one.
3	PICV-1128 tapping I/V above main lube oil tank gland leak. Replaced with new one (3/4" x 800#)
4	23 ata steam tracing line to V-1351 top 1st i/v heavy g/l at HICV-1352 behind pipe rack. It was replaced with new one (½" x 800 #)

GLAND REPAIR JOB

Following Gland repair job were carried out by M/s Amurtha Engineering, New Panvel vide W.O. No. 14/00677/9918728 dated 06/02/2006

Gland repair job list for steam / condensate

SR. NO.	DESCRIPTION
1	Q-1101-1 60 ata 2nd I/V G/Land gland was repacked
2	4 ata main header to off-site plant First I/V,G/L and gland was repacked
3	PRCV-1504 bypass I/V,G/l and gland was repacked
4	V-1502 23 ata drum level troll H.P. Tapping (furmanited) I/V gland leak and gland was repacked.
5	9ata tracing 2nos. i/v g/l and trap u/s i/v g/l nr. H-1420 and gland was repacked.
6	4 ata steam tracing i/v g/l at H-1422 bottom and gland was repacked.
7	4 ata steam tracing i/v g/l at V-1103 top side and gland was repacked.
8	H-1422 top side steam tracing i/v g/l nr. LIC-1202 side and gland was repacked.
9	Cond. flushing to HICV-1208 line 2nd i/v heavy g/l and gland was repacked.

10	4 ata drum MOV u/s vent I/V g/l and hard to operate and gland was repacked.
11	4 ata steam tracing bellow CO2 to Scrubber main I/V ,1st and 4 th I/V gland leak and gland was repacked
12	9 ata steam old header below grill near HICV-1202 I/V g/l and gland was repacked
13	FICV-1351 d/s i/v g/l and gland was repacked

Gland repair job list for process jobs

SR. NO.	DESCRIPTION
1	CO2 to dry ice plant tapping 2nd I/v gland leak and gland was repacked.
2	C.T Make to H-1104 I/V gland leak and gland was repacked
3	4th stage suction IInd I/V gland leak and gland was repacked
4	P-1102B 1st & 2nd Disch I/V gland leak and gland was repacked
5	P-1426/B PI dis. i/v g/l and gland was repacked
6	V-1409/B Outlet both drain I/V, g/l and gland was repacked
7	V-1409/A Outlet I/V bonnet leak & Outlet first drain I/VG/l and gland was repacked
8	P-1426 disch to V-1421 Rota meter u/s I/V gland leak and gland was repacked
9	P-1426 disch to V-1423 Rota meter d/s I/V gland leak and gland was repacked
10	V-1205 drain i/v g/l and gland was repacked
11	P-1211 A/B both suction/discharge i/vs g/l and gland was repacked.
12	V-1205 Offgas PRCV-1202 u/s i/v g/l and gland was repacked
13	HICV-1208 d/s line sample point i/v g/l and gland was repacked
14	NH3/H20 to H-1421 i/v is g/l and gland was repacked
15	PICV-1351 bypass i/v g/land gland was repacked.
16	H-1352 CW o/l line i/v (big i/v) gland leak and gland was repacked
17	P-1351A/B dis. Line to H-1351A vent i/v g/l nr. LICV-1301and gland was repacked

Hydrotest of LP Carbamate Condenser (H-1205):

Due to low condensation duty of plate type heat exchanger (H-1206), pressure of LP system increases. Condensate of increased pressure passes through the tube side of H-1205 and increases the chances of tube failure of H-1205. Hydrotest of H-1205 was done to check the tube leakage.

Operating pressure : 3.5 kg/cm2 g
Design pressure : 6 kg/ cm2 g
Hydrotest pressure : 7.5 kg/cm2 g

One tube leakage found at row no. 4, tube no. 11.

Other Major Jobs:

1) Common isolation valve in discharge line of HP ammonia pump was replaced with new "Klinger" make bellow sealed globe valve, procured vide PO No. 9918258, dated 6/12/2005.

   Valve having following specification:

   Size & Rating : 4' X 900#
   Ring & Groove No. : R-37,
   End Connection : Flanged.

2) Loctite compound coating was done on trial basis. Chemical resistance coating was done at channel cover of lube oil coolers H-1814 A/B, ID fan of Prill Tower and cover (DM plant side) of surface condenser H-1815.

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.

Removed the broken threaded portion of thermowell from Top cover of GB.

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:

(a) Both the journal Bearings and thrust bearing were DP checked and found okay.
(b) 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

(a) Oil Cooler tubes were cleaned by Hydro jetting. Oil Cooler shell side was cleaned by diesel.

(b) Fresh oil was charged in Governor (SERVO-PRIME 32).

(c) Oil console was drained; cleaned and fresh oil charged (SERVO-PRIME 32) Approximately 620 ltrs of Oil was used.

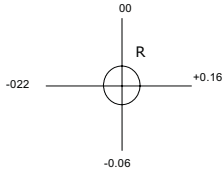
(d) Main oil pump and Auxiliary oil pump two nos suction strainers (336002060) were cleaned & boxed up.

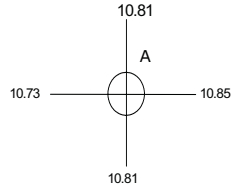
(e) The coupling bolts and rubber pads of AOP were found broken. New bolts machined and assembled.

(f) Gear box to Turbine alignment was checked.

(g) The surface condenser was opened. Hydro jetting was carried out and boxed –up.

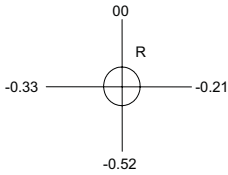
Alignment readings between Gear Box & Cooling Water Pump

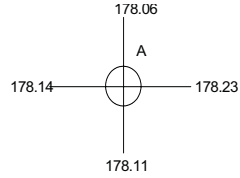




By Slip Gauge

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 : 0.18 mm , Coupling side : 0.15mm

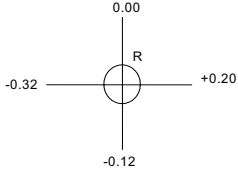
d) Both the bearing housing were flushed with oil & fresh oil (SERVO-PRIME 68) charged.

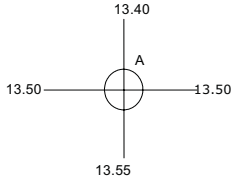
e) Radiator cooling water line opened and box-up after cleaning of radiator.

f) Coupling oil paper replaced and new grease filled.

Checked the alignment between pump

&motor and following are the readings:





Triveni Turbine Q-4403 :

The Turbine was taken for complete overhauling. The services of M/s Turbo Engineering Services, Hyderabad was taken for overhauling of turbine and preventive maintenance of pump. 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 rotor was removed, cleaned and checked for balancing. During balancing the precise alignment was carried out for drive coupling. The total un-balance observed was 4.0gm-mm

3. The 34 steam nozzles of bottom casing were observed slightly eroded at tips.

4. 04 nos casing studs (333202344, 5/8" BSF)and all 26 nuts were replaced.

5. The parting plane of top casing was found eroded at gland area. The same was repaired by welding with Er-70S , grinding ,lapping and blue match on surface plate.

6. The bottom casing diaphragm was opened, cleaned and assembled.

7. The spindle of overloading valve was observed bend. The same was machined and replaced.

8. The Gear Pump shaft of AOP was found worn out. The same was manufactured in our W/S and assembled.

9. The hand oil pump was dismantled, cleaned and boxed up.

10. Two copper oil lines {trip oil line and relay oil line} were replaced with SS 304 tubes.

11. The casing drain line was modified and new valve was welded.

12. The bottom seat of main steam stop valve was worn out. The same was welded with E-7018, grind and lapped. The seat of valve was assembled with 08 nos. allen head bolts. The cracks on seat was repaired and assembled.

13. The Speed governor fly weight bearing (333202109, 08 nos) replaced. The thrust bearing (SKF 51207) was found O.K. The oil seal size 32 x 50 x 10 of governor was replaced.

14. Journal bearings were checked, polished and assembled.

15. The carbon rings were replaced.

SPARES CONSUMED DURING THE OVERHAULING.

1. Front and rear carbon seals : 02set (14Nos.)
2. Speed governor fly wt. bearings : 08 Nos.
3. Steam stop valve piller stud : 02 Nos.
4 Steam stop valve bottom seat allen screw : 08 Nos.

BEARING CLEARENCES:

SR.NO	POSITION	CLERANCE
1.	Front	0.18 / 0.19mm
2.	Rear	0.20 / 0.21mm

Rotor thrust float : 0.25mm
Trip lever clearance : 1.60mm (over speed tripping has not done during the commissioning)

Carbon seal clearances:

Sr.No	Clearance(mm)	Sr.No	Clearance(mm)
1.	0.12	8.	0.15
2.	0.11	9.	0.15
3.	0.11	10.	0.14
4.	0.12	11.	0.15
5.	0.10	12.	0.14
6.	0.12	13.	0.15
7.	0.13	14.	0.15

ROTOR REFERENCE DIMENSION:

1. Nozzle segment to C1 : 2.15mm
2. C1 to turning segment : 3.45mm
3. Turning segment to C2 : 2.10mm

Note: while taking of rotor reference dimension, rotor was kept in center position.

Triveni Gear-box :

Pinion front bearing cl. : 0.16mm
Pinion rear bearing cl. : 0.15mm
Gear wheel front end : 0.23mm
Gearwheel rear end : 0.24mm
Backlash : 0.40mm

Pinion drawing no. found on pinion:

MC 5884 PB 769 34540/3 TD 5801/B ISS-2
No. of teeth on pinion : 22 Nos.
No. of teeth on gear wheel : 75 Nos.

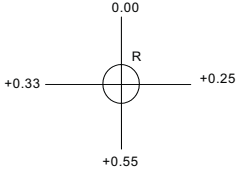
Bull gear drawing No.3454013 TD 5800

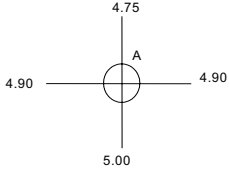
COOLING WATER PUMP (P-4403)

1. The journal bearings were opened, cleaned and checked for clearances.
2. The coupling side journal was found damaged & the same was replaced. The rear bearing was found ok.
3. Journal bearing front cl. 0.15mm
4. Journal bearing rear end cl. 0.16mm
5. The rotor float was measured as 0.24 mm.
6. During commissioning the pump rotor was found jammed at impeller and neck ring area. The upper casing was lifted & rust from neck ring area was cleaned. The pump casing was assembled.
7. Both side gland was repacked.

COOLING WATER PUMP (P-4401 / C) :

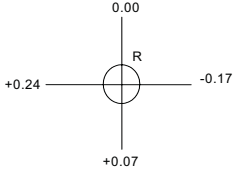
1. Checked the journal bearing Clearance at both ends
2. Coupling end 0.20mm
3. Free end 0.22mm.
4. The rotor float was measured as 0.35 mm.
5. Cleaned & greasing done after coupling.
6. Checked the alignment.

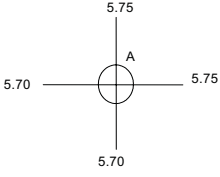




COOLING WATER PUMP (P-4401 / D) :

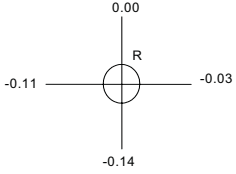
1. Checked the bearing Clearance at both end
2. Coupling end 0.17mm
3. Free end 0.20mm
4. The rotor float was measured as 0.60 mm.
5. Cleaned & greasing done after coupling.
6. Checked the alignment.

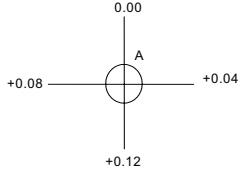




COOLING WATER PUMP (P-4404-E):

1. Coupling float was checked after de-coupling and observed as 0.14 mm
2. The coupling shim pack was found broken. The same was replaced.
3. The pump to motor alignment was checked and corrected.
4. Both bearing top half opened. Both side bearing checked , found in healthy condition.
5. Bearing housing cleaned and fresh oil (SERVO PRIME 68) charged.
6. The following are the alignment reading





Raw water Pump P-4101 A

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

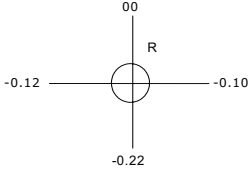
Raw water Pump P-4101 B

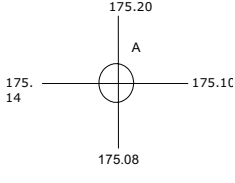
The top casing was opened and rotor assembly was removed.
The impeller OD was measured and found as per spare lying in stores. Ceramic coating was found on impeller.
The shaft sleeves were replaced.
New gland packing was carried out.
Neck ring clearance ,free end 0.80mm
Neck ring clearance ,coupling end 1.10mm

PREVENTIVE MAINTENANCE OF B. F. W TURBINE Q - 5111 :

1. Cleaned the Radial & Thrust bearings.
2. Checked the radial clearances of bearings using lead wire.
3. Alignment readings were checked.
4. The oil cooler covers were opened and hydro- jetting was carried out.
5. Cleaning / replacing oil filters and oil in the oil console.
6. Checked the oil lines, water line for leaks.
7. Suction filter of the MOP was cleaned.
8. The oil console was cleaned and fresh oil (servo-68) was charged.

Alignment Readings: Pump To Turbine





Clearance Details :

Sr. No.	Description	Design Value (mm)	Actual Value(mm)
1	Axial Thrust	0.28 - 0.33	0.24
2	Radial bearing Clearance coupling end	0.13 - 0.18	0.16
3	Radial bearing Clearance free end	0.13 - 0.18	0.15

B F W PUMP P-5111 :

1. Preventive maintenance was carried out on Pump.
2. Bearing top halves were removed.
3. Coupling end and free end bearing clearances were measured using lead wire.
4. Bearing pads were cleaned and polished using green rouge.
5. Bottom halves of the bearings were assembled, clearance checked and recorded.
6. Oil filter was removed, cleaned and re-installed.
7. Oil cooler was opened and cleaned by Hydro jetting.
8. Oil of the console was drained, cleaned and boxed up.
9. The BFW suction strainer was found chocked. It was cleaned and assembled.

Sr. No.	Description	Actual Value(mm)
1	Axial Thrust	0.21
2	Coupling end Bearing Clearance	0.14
3	FE Bearing Clearance	0.15

B F W PUMP (MOTOR DRIVEN) P-5112 :
PREVENTIVE MAINTENANCE :

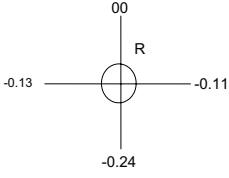
1. Couplings between the Pump and Gear Box was decoupled after recording the necessary match marks.
2. Initial alignment readings and axial float were measured and recorded.
3. Bearing top halves were removed.
4. Coupling end and free end bearing clearances were measured using lead wire and recorded.
5. Bearing halves were cleaned and polished using green rouge.
6. DP check of all bearings and coupling hubs and found ok.
7. Thrust coller and the bearings assembled, clearance checked and recorded.
8. Oil tank & filter was cleaned.
9. Oil cooler was opened and cleaned.
10. Suction filter of the pump was cleaned.
11. Gear Box oil was replaced with new oil. (Servo -68)
12. Gearbox cooler cleaned.
13. During start-up, excess coupling grease was came out between coupling hub & outer, because there is no provision of leak proof joint i.e O ring joint. This is normal.

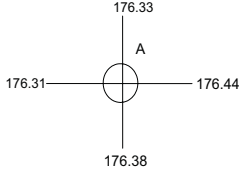
PREVENTIVE MAINTENANCE OF GEAR BOX:

1. Coupling between the Gear Box and Motor was decoupled after recording the necessary match marks.
2. Initial alignment readings and axial float were measured and recorded.
3. Bearing top halves were removed.
4. Coupling end and free end bearing clearances were measured using lead wire and recorded.
5. Bearing halves were cleaned and polished using green rouge.
6. Gears were taken out, cleaned and inspected.
7. Gears were re installed. Backlash was checked and noted.
8. Bearings were assembled, clearance checked and recorded and boxed up.
9. Gear Box cover O rings were replaced.
10. Coupling is aligned with reference to match mark.

ALIGNMENT DATA :

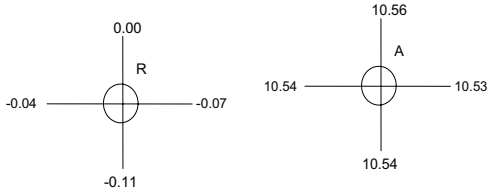
Gear Box & Boiler Feed Pump





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	0.14
2	Radial bearing clearance free end	0.17
3	Gear wheel front bearing clearance	0.18
4	Gear wheel rear bearing clearance	0.17
5	Pinion gear front bearing clearance	0.16
6	Pinion gear rear bearing clearance	0.15
7	Gear wheel thrust float	1.60
8	Pinion Gear thrust float	2.76
9	Gear backlash	0.55
10	Axial thrust of pump	0.42

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 (335401220) 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 Tran fluid-A) was replaced. Also oil level indicator was replaced.

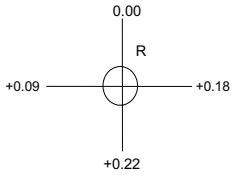
BEARING CLARENCES.

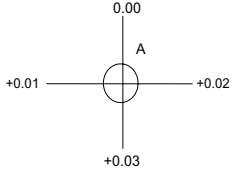
SR. NO	POSITION	CLERANCE (mm)	REMARKS
1.	Pinion thrust end journal bearing	0.13	same bearing re-used.
2.	Pinion opp thrust end journal bearing	0.15	same bearing re-used.
3.	Gear wheel thrust end journal bearing clearance	0.15	same bearing re-used.
4.	Gear wheel opp thrust end journal bearing clearance	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 r re-used.

Pinion thrust float: 0.23mm
Gear wheel thrust float: 0.21mm

ALIGNMMENT BETWEEN GEARBOX AND FAN:

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





STEAM LEAK JOBS :

1. All Steam leak jobs attended as per the Shutdown job list. Three nos ½" x 800 # passing valves were replaced on Steam Traps lines on stem header.
2. Root drain valves of steam trap line near piller no 41 was replaced.
3. New cooling tower Water sample line root isolation valve(Size : ½") was replaced with new 1" gate valve.
4. The passing isolation gate valve of 40 ata steam line of Q-4403 was replaced with 6" x 600# "Taylor" make gate valve.
5. The steam line(Size : 2") for RAH soot blower was replaced.

BHEL BOILER JOBS (F-5111) :

BHEL BOILER INSPECTION :

Boiler was inspected by Boiler Inspector in open condition on 10.04.2006 & Hydrotest was carried out at 89 Kg/cm2 pressure on 15.04.2006 and witnessed by Boiler Inspector.

The nozzle seats of all three safety relief valves were insitu machined by hand lapping, overhauled & assembled. The RVs were floated on 24.04.2006 and their readings were as follows.

Description	Popping Pressure Kg/cm2g	Reset Pressure Kg/cm2g
Drum Rear R.V.	72.1	68.8
Drum Front R.V.	69.0	65.6
Super Heater R.V.	64.3	62.6

The following safety valves were overhauled, tested with nitrogen medium at test bench. The services of M/s Dembla Valves, Thane were taken for overhauling of Relief valves. (Ref W.O. 9918727 dtd 16.02.2006)

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 Amrutha Engineering, New Panvel were taken for valve gland repacking job. (Ref : WO No 9918728 dtd 06.02.2006)

The Hot air leakage from periphery of 100% MCR Gas fired Burners were attended. The joint between burners and Boiler wall was cut removed to make space for thermal expansion of burners and new ms ring of size 100 width x 5 mm thk was welded at old location. The outside gasket was replaced and no of bolts were doubled.

Site measurements were taken for Primary & Secondary Super Heater Coils and Associated headers along with officials of M/s BHEL Trichi for finalizing the bill of material for procurement of coils.

Two BHEL make valves was attended by replacing High Pressure sealing ring. (Store code: 335816005) on 100% BFW feed water line. The high pressure seal rings were covered by graphite powder before installing. Also valve gland was re-packed with fresh packing material. The location of valves is as under.

Up stream isolation valve of control valve of 100% BFW feed water line at first floor up stream isolation valve of regulation valve of 100% BFW feed water line at first floor. All inspection window glasses were cleaned and replaced where ever found broken.

Man hole cover gasket was replaced with asbestos gland packing rope for proper sealing of the flange joint.

All dampers of air duct were checked and made free by greasing for smooth operation. LRB-1 was taken for complete overhauling. The steam injection nozzle at the end of feed pipe of LRB was found worn out. The feed pipe & lance tube were replaced and assembled.

The broken mounting bracket of both LRBs was re-welded with Boiler external wall.
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 were replaced. Coupling pad (L-95) was also replaced.

Cooling Tower Jobs:

1. The wooden structure of Old Urea Cooling tower was revamped by engaging M/s Paharpur cooling towers, Vadodara (Ref : WO No 9917177 dtd 12.05.2005). The damaged wooden columns of water fill area, GRP grid & TG of water basin were replaced.
2. The cooling tower distribution valves were attended for smooth operation and isolation. One valve of Ammonia tower -7 (Admn side) was replaced.
3. Cooling water supply & return lines to canteen AC unit from Urea CW header was disconnected & seal welded.
4. Complete overhauling of Sluice Gates of suction sumps of cooling water Pumps were carried out. (P-4401/A, P-4401/B, P-4402, P-4403) M/s Jash Engineering Ltd, Indore was engaged for this job. (Ref : WO No 9918601 dtd 17.01.2006)
5. The basin drain valves of New Cooling tower cells (H-4404/ 1 to 3) were removed and drain opening was sealed by RCC.
6. The sump isolation gates of New Cooling tower cells (H-4404/ 1 to 3) were removed.

7. During inspection of new Cooling tower cells (H-4404/ 1 to 3), deterioration was observed on some load bearing columns under water distribution header, wooden structure and structural wooden members. 30 nos of the load bearing columns & supporting wooden structural members were replaced partially to avoid failure during operation. The aging effects were observed on structural wooden members of louvers, drift eliminators and fill area.

DM PLANT JOB:

1. S-1, S-2 & S 3 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.

IG Plant JOB:

HP air interconnection line with 6" x 150# gate isolation valve to common instrument air drier header near K-5303 Knock out drum was provided.
Instrument air receiver (V- 5301) man hole was opened for inspection.

PAINTING JOBS CARRIED OUT ON :

1. Cooling water return header on the top of cooling tower (ammonia, old urea and new urea).
2. BHEL Boiler stack, 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.: 9918497 dtd 07/01/2006. 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:

- Loose / damaged Chain links were replaced- 10 nos.
- Broken pins (17 nos.), lock washers (23 nos.) and circlips (25 nos.) were replaced
- Buckets found in good condition
- Bucket elevator assembly was rotated and links & pins were lubricated.
- Take-up unit was overhauled - cone washer set replacement & checking of bearings, shaft & sprockets was carried out.

Overhauling of scraper chain Assembly

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

- Replacement of damaged scrapper blades-8 nos.
- Proper tightening and tack welding of nuts to avoid looseness during running.
- Chain was tightened and required tension was given by adjusting tie rod.
- Sprocket was damaged at the corner. Damaged portion was built up by welding and the same was made smooth by grinding. It was matched with chain link and was then assembled.
- Greasing of bearing of take-up unit of scraper chain was carried out.

King Post Assembly

Guide roller bracket assembly of bottom King-post inside the bunker of reclaim machine was removed and cleaned. The some portion of seating area was found worn out. The worn out area was built up by TIG welding process. Then grinding and buffing was carried out. A gauge was made and roller seating portion & diameter was checked and found OK. The rollers were assembled and greasing carried out.

Centering of king-post with respect to pivot centre kept within 20 mm.

Link conveyor

Pivot assembly of link conveyor was found in good condition
The bearing portion of link conveyor tail end pulley was damaged. The same was built up and the dia was made 40 mm and assembled with new bearing.

Cleaning & over hauling of carrier rollers and return rollers of Link conveyor carried out. Skirt sealing system checked & adjusted.

Thorough cleaning of accumulated Urea inside the supporting structure of Link conveyor belt carried out.

Traveling Gear box

Damaged oil seal replaced with new on, size – 35 X 47 X 7. Coupling bolt and bush were replaced with new one. Gear box coupled with motor after alignment.

Swing Gear box

Hub and pinion of out put shaft removed. Then output shaft was then removed. Cleaning of gear box carried out. After assembly of output shaft, thrust adjusted to 2 mm. Oil seal of output shaft, size- 130 X 150 X 13, store code- 339100174 was replaced and pinion and hub was assembled. Oil seal, size-62 X 40 X 10 , store code- 339100170 , and Coupling bush (total 6 nos.) of input shaft was also replaced with new one.

All pins of slewing rack were checked and greasing was done.

Main Drive Gear box

Coupling bush of main drive gear box (FC 20) was replaced with new one. Plummer block bearing was cleaned, checked and greasing was done. Duplex chain of main drive was replaced. Main drive Gear box coupled and alignment done. Fluid coupling oil replaced.

Main gear train

After draining oil, both side covers were opened, and gear and sprocket was removed. After removing the bearing housing, the shaft was checked and was found in good condition. All 8 nos bearing were replaced with new one. 2nd gear from drive side was replaced with new one, idler shaft, pin, bearing & sleeve were also replaced. Scraper blade was aligned with bucket .

Other jobs

Thruster oil replaced and brake shoes checked.

Cardium compound provided on wire rope of hoisting mechanism.

Limit switches set for maximum up / down and swing movements of scrapper arm.

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 and the machine was found working satisfactorily.

Parts replaced in Reclaim machine

The following parts were replaced during overhauling:

1. Scraper blades – 8 nos.
2. Fasteners of all scraper blades.
3. Spring washer- 2 sets, (One set contain 7 spring washers) of scraper tensioning unit.
4. Guide roller of king post-1 no.
5. Slewing drive pinion with distance piece, hub and shear pin – 4nos.
6. Swing gear box input shaft bearing – 1 no. and oil seal
7. Key of bucket elevator shaft- 1 no at top.
8. Pin – 2 nos. and spring washer- 2 sets, (One set contain 7 spring washers) at top of bucket elevator.
9. Duplex chain of main drive.
10. Idle gear pinion of main drive shaft – 1 no.
11. Idle gear pin – 1 no.
12. Bearings of scraper dive shaft- 1 no.
13. Bearing of idler gear pinion – 4 nos.
14. Sleeve- 84 mm dia – 2 nos.
15. Oil seal of Link conveyor gear box.
16. Thruster
17. Coupling of hoist motor.

PREVENTIVE MAINTENANCE OF PACKER SCALES

Following preventive maintenance jobs were carried out in all Packer Scales i.e. Packer scales No. 1, 2,3,4,7 8, 10A &10B.
Replacement of damaged doors.
Over hauling of coarse and fine feed gate assembly.
Over hauling of bottom flapper assembly.
Servicing of all cylinders.
Overhauling of sack grip assembly.
Alignment of stabilizer plate.
Overhauling of bucket assembly.
Calibration of packer scales.

CONVEYOR M-2110

Existing worm Gear box of M-2110 was replaced with helical Gear box. The base plate was modified accordingly. And Gear box and motor was installed. The Amperage readings was noted and they are given below:

Motor in decoupled condition : 11 A
Motor coupled with Gear box : 11.2 A
Gear box coupled with pulley and after starting conveyor on no load : 13 A
Gear box coupled with pulley and after starting conveyor on full load : 13 A

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.
Complete cleaning and painting of structure done.

CONVEYOR M - 2112

Following jobs were carried out:

M-2112 conveyor Gear Box coupling bolts, coupling rubber bushes and oil replaced with new one. Coupling done after proper alignment.

All noisy and damaged carrier, guide and return rollers replaced 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. Also one pulley bearing replaced with new one.

CONVEYOR M-2117

Following jobs were carried out:

Overhauling of gearbox and replacement of worm wheel bearing, 2 nos, (RHP - MJT 2-3/4, Store code – 455004144) and worm shaft bearing (RHP- LJT-4E,store code – 339500025), oil seals (Size- 65 X 90 X 13, Store code- 339200125), and both couplings ,FC-14,store code – 339200035 and FC-09, store code – 339200030 was carried out. Coupling done after proper alignment.

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

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

CONVEYOR M-2121

Following jobs were carried out:

Gear box decoupled and checked alignment. Coupling and bushes were checked. Gear box oil replaced. Nylon brush near head pulley was replaced.
Diverter flapper valve of M-2121 conveyor attended for free and easy operation.

Air cylinders overhauled.

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

Return rollers and carrier rollers removed and replaced with new rollers.

Complete greasing of all pedestal bearings done.

Complete cleaning and painting of structure done.

CONVEYOR M - 2122

Following jobs were carried out:

Gear box of M-2122 belt conveyor attended for replacement of coupling bolts, bushes, oil-seals and oil. Complete cleaning and painting of gear box done. Coupling done after proper alignment.

Diverter plate of 3 and 4 hopper overhauled.

Skirt rubber with inner rubber sheet replaced.

Gear box of tripper of M-2122 conveyor overhauled.

All damaged return rollers and carrier rollers replaced by new rollers.

Complete greasing in all bearings done.

Complete cleaning and painting of conveyor structure done.

CONVEYOR M - 2122 A/B

Following jobs were carried out:

Both gear boxes overhauled.
All damaged return rollers replaced with new rollers.
Skirt rubber replaced.
Cleaning and painting of complete structure.

DUST CONVEYOR

Following jobs were carried out

Replacement of oil, oil-seals, size – 52 X 40 X 7 – 2 nos., coupling bolts and bushes. Bearing portion of head pulley was damaged. The same was built up by welding and new bearings were provided. Bearing portion of tail pulley was also damaged. It was built up by welding and the dia was made to 75 mm and new bearings (MST 75) were provided.

All damaged return rollers overhauled.
All carrier rollers attended for free operation.

New skirt rubber with inner rubber sheet provided.

Complete greasing of all bearings done.

SLAT CONVEYOR M-2124 (1 - 6)

Following jobs were carried out on all six slat conveyors

Slat conveyor chain of slat conveyor No. 4 & 8 replaced with new one.

All wooden slats of slat conveyor No. 4 & 8 replaced with new UHMW-PE

(Ultra High Molecular Weight Poly Ethylene) material slats.

Preventive maintenance of Gear box done.

MPG and MHT-60 bearing servicing and greasing.

Conveyor adjusting mechanism servicing.

Cleaning and painting of all slat conveyors.

PAY LOADER CONVEYOR M-2113

Following jobs were carried out.

Overhauling of carrying and return rollers.

Replacement of gearbox oil, coupling bushes and checking of alignment was done.

HEAT EXCHANGERS & COOLERS HYDROJET CLEANING :

Refrigeration compressor condenser (K-3101) was opened, Hydrojet cleaning done & boxed up with new gasket.

AMMONIA PLANT

The following major inspection activities were performed in Ammonia Plant.

1. Harp balancing of Primary Reformer was carried out during 3rd Reformer Revamp. Different measurement readings are given at Annexure-1 to Annexture-9

2. Various NDT activities such as DP, radiography, stress relieving etc. were also carried out during 3rd Reformer Revamp.

3. Inspection of 103 D was carried out from bottom manhole.

4. Ultrasonic flaw detection on selected weld joints of critical pipelines and equipments. Details are given at Annexure-10

5. Thickness measurement of various equipment was carried out .Details are attached at Annexure-11

6. Thickness measurement of various pipelines was carried out .Details are attached at Annexure-12

7. Measurement of residual magnetism at various parts of rotating equipments and demagnetization of the same wherever required. Details are given at Annexure-13

8. Insitu metallographic of selected equipment and pipelines. Summary of observations and microstructure analysis is given at Annexure – 14

9. Inspection of newly fabricated pipelines for energy saving project and fabrication jobs carried out departmentally by maintenance department.

10. Qualification tests of welders employed by contractors.

11. Visual inspection of equipments.

12. Inspection of steam drum (GT-1632) and its related pipelines and equipment based on RLA study was carried out.

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

PRIMARY REFORMER 101-B:

Revamping of Primary Reformer was carried out in this shut down and following inspection activities were carried out during and after revamping work.

1. Calculation of spring hanger readings (Cold harp balancing) before and after riser welding. Spring hangers were adjusted as per cold set readings. The detailed report is attached at **Annexure- 2 to 9**

2. Root run and final run of welds were DP tested for all the weldings involved in revamp of reformer harps.

3. Butt weld joints carried out at site viz, inlet and outlet manifolds, riser welds, drain pipes and thermo well pipes were inspected by radiographic inspection. Defects observed were rectified before final acceptance of the joints.

4. All the dissimilar weld joints of Inlet header were stress relieving and hardness of the parent metal weld joint and HAZ were measured and were found within acceptable limits.

5. Clearance measurement of outlet headers from the bottom floor was carried out. The report is attached at **Annexure-1**

CONVECTION ZONE:

VISUAL INSPECTION

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

FROM BOTTOM MANHOLE

H.T. Convection Section:

1. Just below Mixed feed coil, SS Sheet covering fiber blanket had got badly buckled and burnt off, loosing its strength. Repair was recommended to avoid erosion of fiber blanket.

2. All the tubes of mixed feed coil were found covered with fine paper like refractory coating, proper cleaning was recommended.

3. Intermediate tube supports of mixed feed coil & tunnel thermo well were found in satisfactory condition.

L.T. Convection Section:

1. Tube supports of BFW coil & NG feed preheater coil were found in satisfactory condition as seen from the bottom.

2. Few fins of tubes of NG feed preheater coil were found covered with refractory debris at scattered locations.

3. Loose refractory debris were found on the bottom floor of LT convection zone.

FROM TOP MANHOLE :

1. All the incoloy protection sheets of insulation were found in satisfactory condition except near dampener, where it was found bent/distorted.

2. Bottom blade of dampener was found bent and opened on welding joint.

3. Supports of LT / HT steam superheater coils were found satisfactory.

4. Protection sheet of fibre blanket near east bottom end of south wall of LT section is slipped from the position .

5. East end of distribution plate between the two sections had got shifted from its position because all its fastening bolts were missing.

6. Loose insulation material and one metallic wedge was found from inside.

7. Protection sheet inside the ducting was found hanging at two locations.

AUXILIARY BOILER :

HOT WELL AREA OF AUXILIARY BOILER:

1. Cladding sheet of ceramic fiber blankets has got burnt off and distorted but it is intact in position.

2. Distributor plate for the flue gas has got slightly distorted. However the stiffeners had badly damaged.

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

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 (101-F):

1. Grayish black colouration was observed inside the drum.

2. All cyclone separators were found intact in position.

3. Demister pad were found intact in position.

4. Minor pittings were observed at scattered locations.

5. BFW distribution pipe to pipe thread coupling fixing bolt found loose. Proper fastening of the same was carried out.

6. Weld seams were found in satisfactory condition.

Steam Super Heater Coils :

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

High Temperature Headers:

1. Both inlet and outlet headers of high temperature coils were found in satisfactory condition.

2. No surface defect observed.

Auxiliary Boiler Coils:

1. Coil-C tubes which were replaced along with its headers with new one in May-June 05 were found in satisfactory condition.

2. Tubes of Coil-A which were replaced with new one in May-June 05 were found in satisfactory condition.

3. Tubes of "Coil-B" were inspected thoroughly. Minor pitting was observed on tubes at scattered locations. No physical damage was observed in these tubes. In general condition of the tubes was found satisfactory.

Main steam Pipes :

Main steam pipeline from steam super heater coil outlet to Syn. Gas compressor drive turbine was inspected visually for any physical damage after removal of insulation at various places. No major abnormality was observed. Minor scales & pitting were observed. The overall condition of the pipeline found satisfactory.

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

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

2. Weld joints of Gas outlet line from 101 CA/CB to 102-C , 102-C gas outlet & bypass line, and 103-C gas inlet and outlet line were inspected visually ,no abnormality was observed. Condition of the weld joints was found satisfactory.

Structure and Supports:

1. The structural support of steam drum, heat exchangers (viz., 101 CA/CB, 102-C, 103-C were found in satisfactory condition.

2. The structural supports and hangers provided at the main steam pipe line were found to be in satisfactory condition.

VESSELS AND OTHER EQUIPMENT:

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

103-D, SECONDARY REFORMER:

BOTTOM DOME:

1. Erosion of refractory and scattered cracks were observed at few locations and same were found more around both the gas inlet nozzles.

2. Skirt liner found slightly buckled inward (away from shell) at scattered locations.

3. Some of refractory brick slots found chocked with alumina balls.

4. Upper layer of refractory found slightly damaged at scattered locations.

5. Bottom floor refractory found to have loosened.

101-CA/CB GAS INLET NOZZLE:

1. 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.

2. Minor outward buckling was observed at the top half of both the inlet nozzle end.

102 - C ,WASTE HEAT EXCHANGER:

Tube leakage was observed in tubes of 102-C and for further assessment of condition of tubes RFET was carried out. Based upon the result of RFET 7 nos. of tubes were replaced and 11 Nos. of leaky tubes were plugged in addition to previously plugged tubes. During Hydro test 11 Nos. of seal welds were found leaky which were repaired. As on date total 45 nos. of tubes were 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 during S/D 2005	Tube nos. plugged during S/D 2006	Tubes Replaced during S/D 2006	Seal welds repaired during S/D 2006
1				
2				
3			11	
4				
5			6	7
6			1	
7	9			
8	8,15			4
9	7,8,9,18			
10	11,16,21	13,18	8	
11	15,20	8,17		
12	7,9,12,20	11,21		
13	15,18,19,20,21		9	
14	13,23	12,21		14
15	18			
16			2	
17	8**,15,16,19,23		8**	11,13,14
18	14,16			13,15
19	16	17,20		12
20	14			12
21				5
22	17			
23		3		
24		3		
25				
26				
27				
28				
29				
30				
31				
32				
Total Tubes	34	12	7	11

**** Replaced during Shutdown 2006, hence total tube plugged=45**

WPS for repairing of tube to tube sheet seal weld and plug weld is attached at **Annexure-15**

Dehydrogenation of tube sheet was carried out at 350 deg C for 36 hours.

107 - D ,TRANSFER LINE:

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

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

101-F, STEAM DRUM:

1. Grayish black colouration was observed inside the drum.

2. All cyclone separators were found intact in position.

3. Demister pads were found intact in position.

4. Minor pitting of approx. 0.5 to 0.75mm depth was observed at scattered locations.

5. South side hole of phosphate dozing line (1" NB) found enlarged.

6. BFW distribution pipe to pipe thread coupling fixing bolt found loose. Proper fastening is recommended.

7. Loose grayish black deposits found all around the inside surface. Proper cleaning is recommended.

102-F, RAW GAS SEPARATOR:

1. Epoxy paint condition was found satisfactory, except at 2-3 locations it was found peeled off.

2. Demister pads were found intact in position.

3. Corrosion attack was observed on the repaired weld at the inside face of manhole nozzle. Suitable protective coating may be applied at this location.

4. Circumferential weld joint of manhole nozzle with shell found porous at 5-6 spots having a depth of approx. 2-3 mm. Suitable corrective action is recommended.

5. Corrosion attack was observed on the weld joint at the face of liquid out nozzle weld joint with shell. Suitable corrective action is recommended.

6. Condition of Gas inlet nozzle located at East side was found satisfactory.

5.5 <u>103-F, REFLUX DRUM :</u>

1. Demister pads were found displaced from its position, it requires proper fixing and repairing.

2. 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.

3. Debris was found lying at the bottom dished end. Proper cleaning is recommended.

4. Minor corrosion has started at the weld joint of Co2 inlet flange weld joint with vessel stub end, suitable corrective action is recommended.

5.6 104-F, SYN GAS COMPRESSOR SUCTION SEPARATOR:

1. Demister pad condition was found satisfactory.

2. Scattered thin scales were observed at bottom dish end.

3. Weld joint condition was satisfactory.

4. Grayish black coloration was observed on bottom area, whereas brownish coloration was observed on remaining surface.

5.7 105-F, SYN. GAS COMPRESSOR 1ST STAGE SEPARATOR :

1. The coloration of vessel was brownish black from inside.

2. Demister pads were found intact in position.

3. Scattered minor pittings were observed throughout the shell surface, the same was observed in past also.

4. Entire internal surface was found oily.

5. The Overall condition of the vessel was found satisfactory.

106-F AMMONIA SEPARATOR :

1. Brownish black colouration was observed inside the vessel.

2. Demister pad was found intact and condition of the same was found satisfactory.

3. Scattered minor scales and pitting up to a depth of 1mm were observed throughout the shell surface.

4. Internal baffles and demister supports & its welding were found in satisfactory condition.

5. Magnetic Particle Inspection & ultrasonic flaw detection of accessible Tee weld joints and thickness measurement was carried out. No abnormality was observed.

6. Oil sludge and dust particles were found adhered to entire internal surface and on demisters. Proper cleaning is recommended.

7. Overall condition of the vessel was found satisfactory.

107-F, PRIMARY AMMONIA SEPARATOR:

1. Colouration of vessel internals was found blackish brown.
2. Scattered thin scales were observed on the shell and dished end.
3. Entire internal surface was found oily.
4. The overall condition of the vessel was found satisfactory.

109-F, REFRIGERANT RECEIVER :

1. The shell had assumed Grayish black coloration.
2. The condition of all the weld joints of the shell, dished ends and nozzles was found to be satisfactory.
3. Thin scales were observed on both the dished ends.
4. Minor scattered pittings / scales were observed in a width of approx. 250mm throughout the length of vessel at its bottom most portion.
5. Entire internal surface was found oily.
6. Overall condition of the vessel was found to be satisfactory.

110-F, FIRST STAGE REFRIGERANT FLASH DRUM:

1. Brownish black colouration was observed inside the drum.
2. Oil layer was found on the surface of shell and sludge was found at the bottom of vessel.
3. The Demister pad was found intact in position.
4. Scattered mill scales were observed on the surface of the dish ends and shell.
5. Overall condition of the vessel was found to be satisfactory

111-F, SECOND STAGE REFRIGERANT FLASH DRUM :

1. The shell inside surface had assumed blackish gray coloration.
2. Oil was found at east end of the vessel, which required proper cleaning.
3. The demister pads were found intact in position.
4. Scattered scales were observed on both the dished ends.
5. Three bolts of demister pad holding frame were found missing.
6. One loose plate of approx. 400mm x 100 mm size was found lying inside the vessel at east end.

112-F, THIRD STAGE REFRIGERANT FLASH DRUM :

1. The demister pads were found intact in position.
2. The coloration of the inside surface of shell was dark blackish.
3. Surface of the vessel was found oily.
4. Hard scales were observed in the shell which were more prominent on the dished ends.
5. All nozzles condition was found satisfactory.
6. One bolt of demister pad holding frame was found loose.

LP FLASH VESSEL (103-E2 LP) :

1.0 TOP MANHOLE COMPARTEMENT :

1.1 Demister pad was found intact in its position in satisfactory condition.

1.2 Condition of weld joints was found in good condition.

1.3 Bubble cap and its tray holding bolts were found loose at few locations.

1.4 Overall condition of the compartment was found satisfactory.

2.0 SECOND (FROM TOP) MANHOLE COMPARTEMENT:

2.1 South side half of the bubble cap trays were found removed from its position as few trays were fallen inside.

2.2 3" NB inter connecting pipe between top and bottom bubble trays located on North side were found completely detached from its welding with tray and its holding clamp.

2.3 Holding bolts of tray fixing beam were found loose.

2.4 Inter tray segment fixing and holding fasteners were found loose at many places.

2.5 One edge of rectangular riser box located at the centre of the central row found cracked from one of its edge in approx. 30 mm length.

AIR COMPRESSOR INTERSTAGE COOLER No.2 (130-JC) :

1. Colouration has assumed brownish.
2. Minor pitting corrosion observed on shell surface.
3. Thick rust scales observed inside the partition plate both on south and north ends.
4. Vertical support welding portion with partition plate found corroded.

AIR COMPRESSOR INTERSTAGE COOLER No.3 (131-JC) :

1. Colouration has assumed brownish.

2. Minor pitting corrosion observed on shell surface.

3. Thick rust scales observed inside the partition plate both on south and north ends.

6.0 MISCELLANEOUS JOBS:

WELDER QUALIFICATION TESTS:

1. Performance qualification test of 06 Nos. welders offered by M/s Ram Bahadur was carried out. 3 nos. of welders were qualified during the test. These welders were allowed to perform various miscellaneous non-critical departmental welding jobs in the plant.

2. Performance qualification test of 04 Nos. welders offered by M/s Ganesh Engg. was carried out. 04 nos. of welders were qualified during the test. These welders were allowed to perform welding on structural work.

3. Welder qualification test of 10 Nos. welders of M/S. Sayyed & Co. was carried out. 5 welders were qualified. These welders were qualified for performing general purpose welding jobs.

4. Performance qualification test of 32 Nos. welders offered by M/s Neo-structo, was carried out. 9 nos. of welders were qualified during the test. These welders were allowed to perform welding on Reformer revamp jobs.

5. Performance qualification test of 13 Nos. welders offered by M/s Neo-structo, was carried out. 10 nos. of welders were qualified during the test. These welders were allowed to perform welding on ESP 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, catalyst tubes site 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 . Radiography was carried out on all field welds of reformer revamp .

INSITU METALLOGRAPHY EXAMINATION:

In order to evaluate the condition of certain critical plant equipment and pipelines operating at more than 300 deg. C temperatures, 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-14**

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-10**

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-11** (for equipment) and **Annexure- 12**(for pipelines).

GAUSS MEASUREMENT:

During this shutdown 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-13**

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, during over speed trip test, speed measurement and vibration measurement of 101-BJ Turbine, 104-JAT,104JT, 107-JAT, and 107-JCT were carried out.

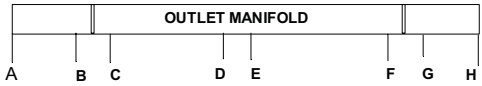
ANNEXURE- 1

CLEARANCE OF OUTLET MANIFOLD FROM GROUND FLOOR IN COLD CONDITION

HEADER NO.	LOCATION OF MEASUREMENT							
	A	B	C	D	E	F	G	H
1	170	175	175	175	180	175	180	180
2	170	170	175	185	175	170	170	165
3	170	175	175	190	195	185	180	175
4	175	170	170	170	185	170	170	170
5	175	170	170	170	175	175	175	180
6	185	180	180	175	180	175	175	185
7	185	185	185	185	190	190	195	180
8	170	180	175	210	210	190	195	180

NOTE : (1) All readings are in MM

(2) Readings are taken without insulation.



ANNEXTURE – 2

ROW NO. - 1		RADIANT HARP WEIGH-IN TABULATION SHEET									Date:	
DATA FROM SPRING HANGER				STEP # 1(BEFORE RISER WELDING)					STEP # 2 (AFTER RISER WELDING)			
1	2	3	4	5	6	7	8	9	10	11	12	13
Spring no. (From South to North)	Spring no. (As per Sarathi)	spring constant	Calibrated load (Zero Mark) CL	Spring scale reading from CL mark	Load Deviation from calibration Load	Actual Load on spring Hangers	Initial balanced load per spring (BEFORE RISER WELDING)	Initial balanced load Setting (BEFORE RISER WELDING)	Additional Load per spring weight (Pig tail+Insulation etc.)	Riser Load per spring (-)	Final Calculated operating load	Final Operating load setting from CL Mark
		Kg/mm	Kg	mm	Kg	Kg	Kg	mm	Kg	Kg	Kg	mm
	From spring	From spring	From spring	From spring	(5) X (3)	(4) +/-(6)	(Total sum of (7))/42	(8-4)/3	Calculate	Calculate	8+10+11	{(12) - (4)} / (3)
101	176	2.05	450	18	36.90	486.90	478.14	14	21.8		500	17
102	98	3.879	888	22	85.34	973.34	956.28	18	43.6	-31	969	27
103	52	3.879	888	18	69.82	957.82	956.28	18	43.6	-31	969	27
104	29	4	888	18	72.00	960.00	956.28	17	43.6	-31	969	27
105	49	4.129	888	19	78.45	966.45	956.28	17	43.6	-31	969	27
106	41	4.129	888	18	74.32	962.32	956.28	17	43.6	-31	969	27
107	16	4.129	888	19	78.45	966.45	956.28	17	43.6	-31	969	27
108	5	4	888	17	68.00	956.00	956.28	17	43.6	-31	969	27
109	44	3.879	888	19	73.70	961.70	956.28	18	43.6	-31	969	27
110	22	3.879	888	20	77.58	965.58	956.28	18	43.6	-31	969	27
111	87	3.879	888	15	58.19	946.19	956.28	18	43.6	-31	969	27
Riser												
112	78	3.879	888	15	58.19	946.19	956.28	18	43.6	-31	969	27
113	115	3.879	888	14	54.31	942.31	956.28	18	43.6	-31	969	27
114	77	4	888	14	56.00	944.00	956.28	17	43.6	-31	969	27
115	28	3.879	888	15	58.19	946.19	956.28	18	43.6	-31	969	27
116	55	3.879	888	15	58.19	946.19	956.28	18	43.6	-31	969	27
117	68	4	888	15	60.00	948.00	956.28	17	43.6	-31	969	27
118	95	4	888	17	68.00	956.00	956.28	17	43.6	-31	969	27
119	99	4.129	888	16	66.06	954.06	956.28	17	43.6	-31	969	27
120	93	4	888	17	68.00	956.00	956.28	17	43.6	-31	969	27
121	50	3.879	888	15	58.19	946.19	956.28	18	43.6	-31	969	27
122	161	2	450	22	44.00	494.00	478.14	14	21.8		500	17
						20081.86						

Note:-

1) Spring nos. are to be counted fron South to North

2) Weight of Pigtail without Insulation is 4.3 Kg

3) All catalyst tube are filled with catalyst before inserting the Harp inside the furnace

4) Weight of catalyst inside each tube Approx.:= 62.59 Kg

5) Weight of Riser = 440 Kg

6) Weight of Riser,Weldolet,proprotionate Outlet manifold section is consideredas 620 Kg (Column 11)

7) Total weight of Pigtail,insulation of Pigtail,Top tube,Inlet header per Tube = 21.8 Kg

ANNEXTURE – 3

ROW NO. - 2		RADIANT HARP WEIGH-IN TABULATION SHEET								Date:			
DATA FROM SPRING HANGER				STEP # 1(BEFORE RISER WELDING)					STEP # 2 (AFTER RISER WELDING)				
1	2	3	4	5	6	7	8	9	10	11	12	13	
Spring no. (From South to North)	Spring no. (As per Sarathi)	spring constant	Calibrated load (Zero Mark) CL	Spring scale reading from CL mark	Load Deviation from calibration Load	Actual Load on spring Hangers	Initial balanced load per spring (BEFORE RISER WELDING)	Initial balanced load Setting (BEFORE RISER WELDING)	Additional Load per spring weight (Pig tail+Insulation etc.)	Riser Load per spring (-)	Final Calculated operating load	Final Operating load setting from CL Mark	
		Kg/mm	Kg	mm	Kg	Kg	Kg	Mm	Kg	Kg	Kg	mm	
	From spring	From spring	From spring	From spring	(5) X (3)	(4) +/-(6)	{Total sum of (7)}/42	(8-4)/3	Calculate	Calculate	8+10+11	{(12) - (4)} / (3)	
201	171	2	450	34	68	518	449.277	0	21.8		471	7	
202	132	4	888	26	104	992	898.554	3	43.6	-31	911	8	
203	31	3.879	888	18	69.822	957.822	898.554	3	43.6	-31	911	8	
204	6	4	888	9	36	924	898.554	3	43.6	-31	911	8	
205	18	3.879	888	-5	-9.395	868.605	898.554	3	43.6	-31	911	8	
206	65	4	888	3	12	900	898.554	3	43.6	-31	911	8	
207	142	3.879	888	-3	-1.637	876.363	898.554	3	43.6	-31	911	8	
208	139	4	888	-2	-8	880	898.554	3	43.6	-31	911	8	
209	43	4	888	-25	-100	788	898.554	3	43.6	-31	911	8	
210	122	3.879	888	-2	-7.758	880.242	898.554	3	43.6	-31	911	8	
211	131	4	888	-26	-104	784	898.554	3	43.6	-31	911	8	
Riser													
212	130	3.879	888	15	58.185	946.185	898.554	3	43.6	-31	911	8	
213	138	4	888	10	40	928	898.554	3	43.6	-31	911	8	
214	14	4	888	-5	-20	868	898.554	3	43.6	-31	911	8	
215	153	4	888	1	4	892	898.554	3	43.6	-31	911	8	
216	17	3.879	888	-3	-1.637	876.363	898.554	3	43.6	-31	911	8	
217	141	3.879	888	-4	-5.516	872.484	898.554	3	43.6	-31	911	8	
218	157	4	888	-10	-40	848	898.554	3	43.6	-31	911	8	
219	140	4.18	888	6	25.08	913.08	898.554	3	43.6	-31	911	8	
220	148	3.879	888	10	38.79	926.79	898.554	3	43.6	-31	911	8	
221	156	4	888	14	56	944	898.554	3	43.6	-31	911	8	
222	173	2.1	450	17	35.7	485.7	449.277	0	21.8		471	7	
						18869.6							

Note:-

1) Spring nos. are to be counted fron South to North
2) Weight of Pigtail without Insulation is 4.3 Kg
3) All catalyst tube are filled with catalyst before inserting the Harp inside the furnace
4) Weight of catalyst inside each tube Approx.:= 62.59 Kg
5) Weight of Riser = 440 Kg
6) Weight of Riser,Weldolet,proprotionate Outlet manifold section is consideredas 620 Kg (Column 11)
7) Total weight of Pigtail,insulation of Pigtail,Top tube,Inlet header per Tube = 21.8 Kg

ANNEXTURE – 4

ROW NO. - 3		RADIANT HARP WEIGH-IN TABULATION SHEET								Date:		
DATA FROM SPRING HANGER					STEP # 1(BEFORE RISER WELDING)					STEP # 2 (AFTER RISER WELDING)		
1	2	3	4	5	6	7	8	9	10	11	12	13
Spring no. (From South to North)	Spring no. (As per Sarath)	spring constant	Calibrated load (Zero Mark) CL	Spring scale reading from CL mark	Load Deviation from calibration Load	Actual Load on spring Hangers	Initial balanced load per spring (BEFORE RISER WELDING)	Initial balanced load Setting (BEFORE RISER WELDING)	Additional Load per spring weight (Pig tail+insulation etc.)	Riser Load per spring (-)	Final Calculated operating load	Final Operating load setting from CL Mark
		Kg/mm	Kg	mm	Kg	Kg	Kg	mm	Kg	Kg	Kg	mm
	From spring	From spring	From spring	From spring	(5) X (3)	(4) +/-(6)	{Total sum of (7)}/42	(8-4)/3	Calculate	Calculate	8+10 +11	{(12) - (4)} / (3)
301	169	2.1	450	26	54.6	504.6	475.859	12	21.8		498	16
302	33	4	888	8	32	920	951.719	16	43.6	-31	964	25
303	123	4	888	8	32	920	951.719	16	43.6	-31	964	25
304	90	4	888	12	48	936	951.719	16	43.6	-31	964	25
305	39	4	888	10	40	928	951.719	16	43.6	-31	964	25
306	92	4	888	7	28	916	951.719	16	43.6	-31	964	25
307	144	4	888	18	72	960	951.719	16	43.6	-31	964	25
308	89	4	888	17	68	956	951.719	16	43.6	-31	964	25
309	84	4	888	25	100	988	951.719	16	43.6	-31	964	25
310	35	4.129	888	25	103.225	991.225	951.719	15	43.6	-31	964	25
311	67	3.879	888	25	96.975	984.975	951.719	16	43.6	-31	964	25
Riser												
312	179	4	888	21	84	972	951.719	16	43.6	-31	964	25
313	158	3.879	888	18	69.822	957.822	951.719	16	43.6	-31	964	25
314	155	3.879	888	10	38.79	926.79	951.719	16	43.6	-31	964	25
315	42	3.879	888	14	54.306	942.306	951.719	16	43.6	-31	964	25
316	63	3.879	888	15	58.185	946.185	951.719	16	43.6	-31	964	25
317	25	4	888	15	60	948	951.719	16	43.6	-31	964	25
318	53	4.129	888	17	70.193	958.193	951.719	15	43.6	-31	964	25
319	47	4	888	15	60	948	951.719	16	43.6	-31	964	25
320	146	4	888	19	76	964	951.719	16	43.6	-31	964	25
321	75	4	888	12	48	936	951.719	16	43.6	-31	964	25
322	170	2	450	16	32	482	475.859	13	21.8		498	16
						19986.1						

Note:-

1) Spring nos. are to be counted fron South to North
2) Weight of Pigtail without Insulation is 4.3 Kg
5) Weight of Riser = 440 Kg

ANNEXTURE – 5

ROW NO. - 4	RADIANT HARP WEIGH-IN TABULATION SHEET								Date:				
DATA FROM SPRING HANGER				STEP # 1(BEFORE RISER WELDING)					STEP # 2 (AFTER RISER WELDING)			
1	2	3	4	5	6	7	8	9	10	11	12	13
Spring no. (From South to North)	Spring no. (As per Sarathi)	spring constant	Calibrated load (Zero Mark) CL	Spring scale reading from CL mark	Load Deviation from calibration Load	Actual Load on spring Hangers	Initial balanced load per spring (BEFORE RISER WELDING)	Initial balanced load Setting (BEFORE RISER WELDING)	Additional Load per spring weight (Pig tail+Insulation etc.)	Riser Load per spring (-)	Final Calculated operating load	Final Operating load setting from CL Mark
		Kg/mm	Kg	mm	Kg	Kg	Kg	mm	Kg	Kg	Kg	mm
		From spring	From spring	From spring	(5) X (3)	(4) +/-(6)	{Total sum of (7)}/42	(8-4)/3	Calculate	Calculate	8+10 +11	{(12) - (4)} / (3)
401	175	2.1	450	1	2.1	452.1	470.608	10	21.8		492	14
402	159	4	888	-2	-8	880	941.215	13	43.6	-31	954	22
403	12	3.879	888	-5	-19.395	868.605	941.215	14	43.6	-31	954	22
404	126	4	888	11	44	932	941.215	13	43.6	-31	954	22
405	34	3.879	888	15	58.185	946.185	941.215	14	43.6	-31	954	22
406	147	3.879	888	21	81.459	969.459	941.215	14	43.6	-31	954	22
407	120	4	888	27	108	996	941.215	13	43.6	-31	954	22
408	110	4	888	28	112	1000	941.215	13	43.6	-31	954	22
409	61	3.879	888	27	104.733	992.733	941.215	14	43.6	-31	954	22
410	64	4.129	888	27	111.483	999.483	941.215	13	43.6	-31	954	22
411	150	4.129	888	25	103.225	991.225	941.215	13	43.6	-31	954	22
Riser												
412	69	4	888	20	80	968	941.215	13	43.6	-31	954	22
413	136	3.879	888	20	77.58	965.58	941.215	14	43.6	-31	954	22
414	13	4	888	14	56	944	941.215	13	43.6	-31	954	22
415	2	3.923	888	15	58.845	946.845	941.215	14	43.6	-31	954	22
416	86	4	888	14	56	944	941.215	13	43.6	-31	954	22
417	128	4.128	888	11	45.408	933.408	941.215	13	43.6	-31	954	22
418	81	4	888	4	16	904	941.215	13	43.6	-31	954	22
419	3	4	888	5	20	908	941.215	13	43.6	-31	954	22
420	54	4	888	2	8	896	941.215	13	43.6	-31	954	22
421	111	4	888	-2	-8	880	941.215	13	43.6	-31	954	22
422	174	2.1	450	-1	-2.1	447.9	470.608	10	21.8		492	14
						19765.5						

Note:-

1) Spring nos. are to be counted from South to North
2) Weight of Pigtail without Insulation is 4.3 Kg
3) All catalyst tube are filled with catalyst before inserting the Harp inside the furnace
4) Weight of catalyst inside each tube Approx.:= 62.59 Kg
5) Weight of Riser = 440 Kg
6) Weight of Riser,Weldolet,proprotionate Outlet manifold section is consideredas 620 Kg (Column 11)
7) Total weight of Pigtail,insulation of Pigtail,Top tube,Inlet header per Tube = 21.8 Kg

ANNEXTURE – 6

ROW NO. - 5		RADIANT HARP WEIGH-IN TABULATION SHEET							Date:			
DATA FROM SPRING HANGER				STEP # 1(BEFORE RISER WELDING)					STEP # 2 (AFTER RISER WELDING)			
1	2	3	4	5	6	7	8	9	10	11	12	13
Spring no. (From South to North)	Spring no. (As per Sarathi)	spring constant	Calibrated load (Zero Mark) CL	Spring scale reading from CL mark	Load Deviation from calibration Load	Actual Load on spring Hangers	Initial balanced load per spring (BEFORE RISER WELDING)	Initial balanced load Setting (BEFORE RISER WELDING)	Additional Load per spring weight (Pig tail+Insulation etc.)	Riser Load per spring (-)	Final Calculated operating load	Final Operating load setting from CL Mark
		Kg/mm	Kg	mm	Kg	Kg	Kg	mm	Kg	Kg	Kg	mm
	From spring	From spring	From spring	From spring	(5) X (3)	(4) +/-(6)	{Total sum of (7)}/42	(8-4)/3	Calculate	Calculate	8+10+11	{(12) - (4)} / (3)
501	164	2.1	450	12	25.2	475.2	467.453	8	21.8		489	13
502	9	4.129	888	9	37.161	925.161	934.905	11	43.6	-31	948	20
503	125	4	888	8	32	920	934.905	12	43.6	-31	948	20
504	36	3.879	888	10	38.79	926.79	934.905	12	43.6	-31	948	20
505	26	3.879	888	12	46.548	934.548	934.905	12	43.6	-31	948	20
506	107	3.879	888	11	42.669	930.669	934.905	12	43.6	-31	948	20
507	116	4	888	14	56	944	934.905	12	43.6	-31	948	20
508	11	4.129	888	10	41.29	929.29	934.905	11	43.6	-31	948	20
509	40	3.879	888	11	42.669	930.669	934.905	12	43.6	-31	948	20
510	70	4	888	12	48	936	934.905	12	43.6	-31	948	20
511	85	4.129	888	12	49.548	937.548	934.905	11	43.6	-31	948	20
Riser												
512	62	4.129	888	11	45.419	933.419	934.905	11	43.6	-31	948	20
513	133	4.129	888	12	49.548	937.548	934.905	11	43.6	-31	948	20
514	119	4	888	16	64	952	934.905	12	43.6	-31	948	20
515	60	4	888	11	44	932	934.905	12	43.6	-31	948	20
516	59	3.765	888	11	41.415	929.415	934.905	12	43.6	-31	948	20
517	124	3.879	888	8	31.032	919.032	934.905	12	43.6	-31	948	20
518	37	3.879	888	11	42.669	930.669	934.905	12	43.6	-31	948	20
519	96	3.879	888	17	65.943	953.943	934.905	12	43.6	-31	948	20
520	101	4.129	888	14	57.806	945.806	934.905	11	43.6	-31	948	20
521	66	4	888	11	44	932	934.905	12	43.6	-31	948	20
522	167	2.1	450	13	27.3	477.3	467.453	8	21.8		489	13
						19633						

Note:-

1) Spring nos. are to be counted fron South to North
2) Weight of Pigtail without Insulation is 4.3 Kg
3) All catalyst tube are filled with catalyst before inserting the Harp inside the furnace
4) Weight of catalyst inside each tube Approx.:= 62.59 Kg
5) Weight of Riser = 440 Kg
6) Weight of Riser,Weldolet,proprotionate Outlet manifold section is consideredas 620 Kg (Column 11)
7) Total weight of Pigtail,insulation of Pigtail,Top tube,Inlet header per Tube = 21.8 Kg

ANNEXTURE – 7

ROW NO. -6	RADIANT HARP WEIGH-IN TABULATION SHEET									Date:		
DATA FROM SPRING HANGER				STEP # 1(BEFORE RISER WELDING)					STEP # 2 (AFTER RISER WELDING)			
1	2	3	4	5	6	7	8	9	10	11	12	13
Spring no. (From South to North)	Spring no. (As per Sarathi)	spring constant	Calibrated load (Zero Mark) CL	Spring scale reading from CL mark	Load Deviation from calibration Load	Actual Load on spring Hangers	Initial balanced load per spring (BEFORE RISER WELDING)	Initial balanced load Setting (BEFORE RISER WELDING)	Additional Load per spring weight (Pig tail+Insulation etc.)	Riser Load per spring (-)	Final Calculated operating load	Final Operating load setting from CL Mark
		Kg/mm	Kg	mm	Kg	Kg	Kg	mm	Kg	Kg	Kg	mm
		From spring	From spring	From spring	(5) X (3)	(4) +/-(6)	{Total sum of (7)}/42	(8-4)/3	Calculate	Calculate	8+10 +11	{(12) - (4)} / (3)
601	168	2.15	450	15	32.25	482.25	467.113	8	21.8		489	13
602	58	4.129	888	-2	-8.258	879.742	934.226	11	43.6	-31	947	20
603	129	4	888	-10	-40	848	934.226	12	43.6	-31	947	20
604	105	4	888	13	52	940	934.226	12	43.6	-31	947	20
605	112	4	888	13	52	940	934.226	12	43.6	-31	947	20
606	97	4	888	13	52	940	934.226	12	43.6	-31	947	20
607	88	4.129	888	8	33.032	921.032	934.226	11	43.6	-31	947	20
608	104	4	888	13	52	940	934.226	12	43.6	-31	947	20
609	145	4	888	15	60	948	934.226	12	43.6	-31	947	20
610	74	4	888	16	64	952	934.226	12	43.6	-31	947	20
611	103	3.879	888	18	69.822	957.822	934.226	12	43.6	-31	947	20
Riser												
612	137	4	888	19	76	964	934.226	12	43.6	-31	947	20
613	106	3.879	888	19	73.701	961.701	934.226	12	43.6	-31	947	20
614	27	4.129	888	17	70.193	958.193	934.226	11	43.6	-31	947	20
615	57	3.879	888	12	46.548	934.548	934.226	12	43.6	-31	947	20
616	19	4.129	888	7	28.903	916.903	934.226	11	43.6	-31	947	20
617	46	3.879	888	6	23.274	911.274	934.226	12	43.6	-31	947	20
618	108	4	888	14	56	944	934.226	12	43.6	-31	947	20
619	21	4.129	888	10	41.29	929.29	934.226	11	43.6	-31	947	20
620	135	4	888	11	44	932	934.226	12	43.6	-31	947	20
621	83	4	888	17	68	956	934.226	12	43.6	-31	947	20
622	162	2	450	6	12	462	467.113	9	21.8		489	13
						19618.8						

Note:-

1) Spring nos. are to be counted from South to North
2) Weight of Pigtail without Insulation is 4.3 Kg
3) All catalyst tube are filled with catalyst before inserting the Harp inside the furnace
4) Weight of catalyst inside each tube Approx.:= 62.59 Kg
5) Weight of Riser = 440 Kg
6) Weight of Riser,Weldolet,proprotionate Outlet manifold section is consideredas 620 Kg (Column 11)
7) Total weight of Pigtail,insulation of Pigtail,Top tube,Inlet header per Tube = 21.8 Kg

ANNEXTURE – 8

ROW NO. -7	RADIANT HARP WEIGH-IN TABULATION SHEET										Date:		
DATA FROM SPRING HANGER				STEP # 1(BEFORE RISER WELDING)					STEP # 2 (AFTER RISER WELDING)				
1	2	3	4	5	6	7	8	9	10	11	12	13	
Spring no. (From South to North)	Spring no. (As per Sarathi)	spring constant	Calibrated load (Zero Mark) CL	Spring scale reading from CL mark	Load Deviation from calibration Load	Actual Load on spring Hangers	Initial balanced load per spring (BEFORE RISER WELDING)	Initial balanced load Setting (BEFORE RISER WELDING)	Additional Load per spring weight (Pig tail+Insulation etc.)	Riser Load per spring (-)	Final Calculated operating load	Final Operating load setting from CL Mark	
		Kg/mm	Kg	mm	Kg	Kg	Kg	mm	Kg	Kg	Kg	mm	
	From spring	From spring	From spring	From spring	(5) X (3)	(4) +/-(6)	{Total sum of (7)}/42	(8-4)/3	Calculate	Calc ulate	8+10 +11	{(12) - (4)} / (3)	
701	165	2.1	450	-8	-16.8	433.2	471.393	10	21.8		493	14	
702	138	4.129	888	7	28.903	916.903	942.787	13	43.6	-31	955	22	
703	151	4	888	24	96	984	942.787	14	43.6	-31	955	22	
704	24	3.879	888	14	54.306	942.306	942.787	14	43.6	-31	955	22	
705	160	3.879	888	26	100.854	988.854	942.787	14	43.6	-31	955	22	
706	1	3.949	888	28	110.572	998.572	942.787	14	43.6	-31	955	22	
707	102	4	888	33	132	1020	942.787	14	43.6	-31	955	22	
708	94	3.879	888	13	50.427	938.427	942.787	14	43.6	-31	955	22	
709	134	4.129	888	28	115.612	1003.61	942.787	13	43.6	-31	955	22	
710	80	3.879	888	16	62.064	950.064	942.787	14	43.6	-31	955	22	
711	45	4	888	-10	-40	848	942.787	14	43.6	-31	955	22	
Riser													
712	56	4.129	888	3	12.387	900.387	942.787	13	43.6	-31	955	22	
713	13	4	888	8	32	920	942.787	14	43.6	-31	955	22	
714	4	4	888	6	24	912	942.787	14	43.6	-31	955	22	
715	71	4.129	888	7	28.903	916.903	942.787	13	43.6	-31	955	22	
716	51	3.879	888	8	31.032	919.032	942.787	14	43.6	-31	955	22	
717	15	3.879	888	11	42.669	930.669	942.787	14	43.6	-31	955	22	
718	82	3.879	888	13	50.427	938.427	942.787	14	43.6	-31	955	22	
719	30	4.129	888	13	53.677	941.677	942.787	13	43.6	-31	955	22	
720	127	3.879	888	15	58.185	946.185	942.787	14	43.6	-31	955	22	
721	8	4	888	16	64	952	942.787	14	43.6	-31	955	22	
722	163	2.15	450	22	47.3	497.3	471.393	10	21.8		493	14	
						19798.5							

Note:-

1) Spring nos. are to be counted fron South to North
2) Weight of Pigtail without Insulation is 4.3 Kg
3) All catalyst tube are filled with catalyst before inserting the Harp inside the furnace
4) Weight of catalyst inside each tube Approx.:= 62.59 Kg
5) Weight of Riser = 440 Kg
6) Weight of Riser,Weldolet,proprotionate Outlet manifold section is consideredas 620 Kg (Column 11)
7) Total weight of Pigtail,insulation of Pigtail,Top tube,Inlet header per Tube = 21.8 Kg

ANNEXTURE – 9

ROW NO. - 8		RADIANT HARP WEIGH-IN TABULATION SHEET										Date:
DATA FROM SPRING HANGER				STEP # 1(BEFORE RISER WELDING)					STEP # 2 (AFTER RISER WELDING)			
1	2	3	4	5	6	7	8	9	10	11	12	13
Spring no. (From South to North)	Spring no. (As per Sarathi)	spring constant	Calibrated load (Zero Mark) CL	Spring scale reading from CL mark	Load Deviation from calibration Load	Actual Load on spring Hangers	Initial balanced load per spring (BEFORE RISER WELDING)	Initial balanced load Setting (BEFORE RISER WELDING).	Additional Load per spring weight (Pig tail+Insulation etc.)	Riser Load per spring (-)	Final Calculated operating load	Final Operating load setting from CL Mark
		Kg/mm	Kg	mm	Kg	Kg	Kg	mm	Kg	Kg	Kg	mm
	From spring	From spring	From spring	From spring	(5) X (3)	(4) +/-(6)	{Total sum of (7))/42	(8-4)/3	Calculate	Calculate	8+10 +11	{(12) - (4)} / (3)
801	172	2.1	450	12	25.2	475.2	473.81	11	21.8		496	15
802	117	3.879	888	8	31.03	919.03	947.62	15	43.6	-31	960	24
803	10	3.879	888	15	58.19	946.19	947.62	15	43.6	-31	960	24
804	73	4	888	15	60	948	947.62	15	43.6	-31	960	24
805	118	4.129	888	16	66.06	954.06	947.62	14	43.6	-31	960	24
806	109	4	888	16	64	952	947.62	15	43.6	-31	960	24
807	100	3.879	888	20	77.58	965.58	947.62	15	43.6	-31	960	24
808	20	3.879	888	22	85.34	973.34	947.62	15	43.6	-31	960	24
809	114	4	888	21	84	972	947.62	15	43.6	-31	960	24
810	121	4	888	19	76	964	947.62	15	43.6	-31	960	24
811	76	3.879	888	22	85.34	973.34	947.62	15	43.6	-31	960	24
Riser												
812	32	4	888	1	4	892	947.62	15	43.6	-31	960	24
813	152	3.879	888	-11	-42.67	845.33	947.62	15	43.6	-31	960	24
814	72	3.879	888	7	27.15	915.15	947.62	15	43.6	-31	960	24
815	113	3.879	888	12	46.55	934.55	947.62	15	43.6	-31	960	24
816	7	3.879	888	2	7.758	895.76	947.62	15	43.6	-31	960	24
817	149	4	888	10	40	928	947.62	15	43.6	-31	960	24
818	143	3.879	888	15	58.19	946.19	947.62	15	43.6	-31	960	24
819	48	4	888	22	88	976	947.62	15	43.6	-31	960	24
820	154	4	888	32	128	1016	947.62	15	43.6	-31	960	24
821	91	4	888	30	120	1008	947.62	15	43.6	-31	960	24
822	166	2.1	450	24	50.4	500.4	473.81	11	21.8		496	15
						19900						

Note:-

1) Spring nos. are to be counted fron South to North
2) Weight of Pigtail without Insulation is 4.3 Kg
3) All catalyst tube are filled with catalyst before inserting the Harp inside the furnace
4) Weight of catalyst inside each tube Approx.:= 62.59 Kg
5) Weight of Riser = 440 Kg
6) Weight of Riser,Weldolet,proprotionate Outlet manifold section is consideredas 620 Kg (Column 11)
7) Total weight of Pigtail,insulation of Pigtail,Top tube,Inlet header per Tube = 21.8 Kg

Annexure - 10

UFD OF WELD JOINTS OF FOLLOWING PIPELINES WAS CARRIED OUT

SR. NO.	LINE NO	SIZE	SCHEDULE	FROM	TO	NO. OF WELD JOINTS	REMARKS
1	PG-6-18"	18	40	104-D	103-C	1	
2	SG-1-12"	12	30	106-D	114-C	2	
3	HS-3H	12	100	HT SUPER HEATER COIL OUTLET	HS-4	1	
4	SG-25	8"	120	105-D	121-C	2	

Annexure - 11

THICKNESS MEASUREMENT OF EQUIPMENT DURING S/D-2006

Sr. No	Equip. No.	Equipment Description	Shell			Dish End	Channel				
			Nom./ Desg.	Min./ Meas.	% Red.	Nom./ Desig.	Min./ Meas.	% Red	Nom./ Desg.	Min./ Meas.	% Red.
1	106-F	Secondary Ammonia Separator	104.6	106.0		54.0	60.0				
2	101-F	Steam Drum	106.4	110.2		106.4	105.4				

ANNEXURE – 12

AMMONIA PLANT PIPELINE THICKNESS MEASUREMENT SUMMARY

Sr. No	Line No	Nom Bore (inch)	Nom thick (mm)	Line Description		Min Thk observed	% Red.
				From	To		
PROCESS AIR LINES							
	A-20	8	6.35	101-J	101B	5.1	19
	A-21	10	12.5	101B	103D	11.8	5.6
	A-22	4	6.02	A-20 SPEC. BRK	SPEC BRK 9	5.8	3
BOILER FEED WATER LINES							
	BF-06	6	10.97	BF-22	123-C	10.1	7.9
	BF-17	3	7.62	114-C	BF-3H	6.8	10.76
	BF-35	4	8.56	123-C	SPEC. BRK.	8.2	4.2
BOILER WATER LINES							
	BW-1H	14	23.8	101-CA	BW-40HA-HB	22.1	7
	BW-4H	10	18.24	101-F	102-C	18.20	0.2
	BW-43HA	12	21.4	BW-5H	101-F	22.6	
	BW-43HB	12	21.4	BW-5H	101-F	22.1	
COOLING WATER LINES							
	CW-04	10	7.8	CW-5	124-C	7.0	10.2
	CW-09	10	7.8	CW-23	115-C	7.4	5.1
HOT WATER RETURN LINES							
	HW-6	4	6.02	101-J/105-J	HW-10	6.4	
	HW-10	6	7.11	HW-36	HW-15	5.7	19.8
	HW-12	10	7.8	128-C	HW-41	5.9	24.35
	HW-17	10	7.8	115-C	HW-27	7.4	5.12
	HW-18	24	9.52	110-CA	HW-16	8.7	8.4
	HW-19	24	9.52	110-CA	HW-16	9.4	1.2
	HW-25	10	6.35	124-C	HW-5	4.6	27.5
	HW-34	6	7.11	130-JC	HW-15	5.4	23
LOW PRESSURE STEAM LINES							
	LS-12	6	7.11	LS-96		6.8	4.3
	LS-23	6	7.11	PIC-16	101-U	8.0	

Sr. No	Line No	Nom Bore (inch)	Nom thick (mm)	Line Description		Min Thk observed	% Red.
				From	To		
CO2 ABSORBER LINES							
	aMDEA-12B	12	6.35	aMDEA-11	109-C1B	5.9	7
	aMDEA-14	14	7.92	aMDEA-16	aMDEA-15A&B	7.3	7.84
	aMDEA-12B	16	7.92	aMDEA-17	aMDEA-18&B	9.8	
MEDIUM PRESSURE STEAM LINES							
	MS-13	8	15.06	PIC-13B	MS 9-10	13.9	7.3
AMMONIA LINES							
	NH-17	6	7.11	109-F	NH-15	6.6	7.1
PROCESS GAS LINES							
	PG-9	18	9.52	157-F	104-D BOTTOM	8.5	10.5
	PG-11B	16	9.52	PG-21	105-CB	9.8	
	PG-19	18	9.52	PG-8	PG-9	9.0	5.5
	PG-20	8	6.4	PG-9	PG-10	6.1	4.6
PROCESS WATER LINES							
	PW-17	4	6.02	PW-1	170-C	4.2	30.2
	PW-18	4	11.13	170-C	LC-3A	10.5	5
	PW-25	4	11.13	CONTROL VALVE	BATTERY LIMIT	10.4	6.5
11 STEAM LINES							
	S-13	4	6.02	S-10	NG-44S	5.2	13.3
STEAM CONDENSATE LINES							
	SC-70	1.5	5.1	S-20	103-DJKT	4.7	7.8

Annexure-13

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	3.4	
1.2	Journal bearing shaft	6.3	2.2
1.3	Journal bearing pads	1.6	
1.4	Journal bearing base ring	3.0	
1.5	Thrust collar	6.7	1.9
1.6	Thrust pads	1.0	
2	**Turbine North Bearing**		
2.1	Journal bearing shaft	3.3	
2.2	Journal bearing pads	3.3	
2.3	Journal bearing base ring	2.4	
3	**H P Case South Bearing**		
3.1	Journal Bearing Shaft	2.8	
3.2	Journal bearing pads	2.6	
4	**H P Case North Bearing**		
4.1	Journal Bearing Shaft	3.9	
4.2	Journal Thrust Collar	3.2	
4.3	Journal Bearing Pads	1.6	
4.4	Journal Bearing Base Ring	3.3	
5	**L P Case Compressor Coupling End**		
5.1	Journal Bearing Shaft	5.0	2.5
5.2	Journal Bearing Pads	6.3	0.3
5.3	Thrust Collar	11.6	3.0
5.4	Journal Bearing Base Ring	2.6	
6	**L P Case Turbine Side**		
6.1	Journal Bearing Shaft	7.6	3.0
6.2	Journal Bearing Pads	1.8	

Sr. No.	Component Description	Max. gauss reading	
		Before	After
7	Gear Box		
7.1	Shaft Journal (Low speed)	3.7	1.0
7.2	Journal Bearing (Low speed)	1.0	
7.3	Shaft Journal (High speed)	6.3	0.6
	103-J SYN GAS COMPRESSOR		
1	JAT Thrust Bearing		
1.1	Base Ring	0.5	
1.2	Thrust Plate	1.3	
1.3	Pads	0.5	
2	JAT Opposite Thrust End Radial Bearing		
2.1	Journal Bearing Shaft	3.5	
2.2	Journal Bearing Pads	1.0	
2.3	Base Ring	1.2	
2.4	Thrust pads	2.2	
2.5	Thrust Collar	2.7	
2.6	Thrust Side Coupling End	3.3	
2.7	Thrust Side Shaft End	3.0	
3	JBT Non Drive (Thrust End) Radial Bearing		
3.1	Base Ring	2.6	
3.2	Pads	1.2	
4	JBT Opposite Thrust End Radial Bearing		
4.1	Base Ring	1.1	
4.2	Pads	1.2	
4.3	Thrust Collar	2.3	
4.4	Journal Bearing Shaft	1.3	
4.5	Thrust Side Journal Area	3.4	
4.6	Thrust Side Shaft End	2.1	
	105-J, REF. GAS COMPRESSOR:		
1	Turbine Free End Journal Bearing		
1.1	Base Ring	0.9	
1.2	Pads	0.5	
1.3	Shaft Journal	2.5	
2	Turbine Coupling End Journal Bearing		
2.1	Rotor Journal Portion	3.4	

Sr. No.	Component Description	Max. gauss reading	
		Before	After
2.2	Thrust Journal Portion	1.3	
2.3	Thrust Collar	4.4	2.9
2.4	Base Ring	2.0	1.1
2.5	Pads	0.6	
3	**HP Case Coupling End Journal Bearing**		
3.1	Thrust Bearing Shaft	3.8	
4	**HP Case Free End Thrust Bearing**		
4.1	Thrust Bearing Shaft	1.3	
4.2	Thrust Bearing Pads	0.4	
4.3	Thrust Collar	2.4	
5	**LP Case Free End Thrust Bearing**		
5.1	Thrust Bearing Shaft	10.7	1.0
5.2	Thrust Bearing Pads	0.2	
5.3	Thrust Bearing Base Ring	3.0	
5.4	Thrust Collar	10.2	2.6
6	**Gear Box**		
6.1	Pinion shaft bearing(N)	1.4	
6.2	Pinion shaft bearing(S)	0.8	
115-JAT			
1	**Turbine Thrust End**		
1.1	Thrust Pads	1.0	
1.2	Thrust collar	0.9	
1.3	Shaft Journal	3.3	
1.4	Journal Bearing	3.5	
2	**Turbine coupling end**		
2.1	Shaft Journal	3.9	
2.2	Journal Bearings	3.0	
104-JA Thrust cum journal bearing			
1.1	Journal bearing	1.1	
1.2	Pads	1.8	
1.3	Shaft	6.0	1.4
1.4	Thrust collar	2.4	

ANNEXURE- 14
DETAILS OF INSITU-METALLOGRAPHIC INSPECTION

SR NO.	LOCATION	MOC	OPERATION DETAILS	ETCH -ANT	MICROSTRUCTURE OBSERVATION	REMARK
1.	Location: 1 (Parent metal) On auxiliary boiler tube no.3 at east side, counting from south	Carbon Steel A-106 Grade-B	314 °C 105 kg/cm2 Steam	2% Nital	Microstructure shows fine grained ferrite/pearlite structure. (Plate: 1 & 2)	No significant degradation observed. Monitor after 2 years of service.
2.	Location: 2 (Parent metal) On auxiliary boiler tube no.5 at east side, counting from south	Carbon Steel A-106 Grade-B	314 °C 105 kg/cm2 steam	2% Nital	Microstructure shows fine grained ferrite/pearlite structure. Few widm anstaten ferrite observed. (Plate: 3 & 4)	No significant degradation observed. Monitor after 2 years of service.
3.	Location: 3 (Parent metal) On auxiliary boiler tube no.13 at west side, counting from south	Carbon Steel A-106 Grade-B	314 °C 105 kg/cm2 steam	2% Nital	Microstructure shows fine grained ferrite/pearlite structure. Few widm anstaten ferrite observed. (Plate: 5 & 6)	No significant degradation observed. Monitor after 2 years of service.
4.	Location: 4 (Parent metal) On auxiliary boiler tube no.25 at west side, counting from south	Carbon Steel A-106 Grade-B	314 °C 105 kg/cm2 steam	2% Nital	Microstructure shows fine grained ferrite/pearlite structure (Plate: 7 & 8)	No significant degradation observed. Monitor after 2 years of service.
5.	Location: 5 (Parent Metal) On face of Bend of NG-9-12" (101B-mixed feed coil to NG-11)	P 11	525° C 38kg / cm^2 Natural Gas + Steam 38kg / cm^2 Natural Gas + Steam	2% Nital	Microstructure shows ferrite and spheroid carbide structure. Degradation of pearlite observed in terms of spheroidzation. Possibilities of isolated creep cavities are observed. (Plate: 9 & 10)	IInd stage of creep damage. Monitor after 1 year of service.
7.	Location: 7 (Weld/HAZ) Between Pipe & bend	P 11	525° C 38 kg / cm^2 Natural Gas + Steam	2% Nital	Microstructure at weld shows ferrite and bainate in dendritic form where as at HAZ shows fine grained bainate & 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: 13 & 14)	IInd stage of creep damage. Monitor after 1 year of service. SEM analysis confirms the presence of oriented creep cavities.

8.	Location: 8 (Weld / HAZ of P-11) On dissimilar Weld between pipe & Nozzle of header	P 11 to 304H	525° C 38 kg / cm^2 Natural Gas + Steam	10% Oxalic acid	. 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. Weld metal shows dendritic structure of solid solution of nickel. (Plate: 17 & 18)	SEM analysis confirmed initial level creep damage. Monitor after 1 year of service.
9.	Location: 9 (Weld/HAZ of SS304H) On dissimilar Weld Between pipe & Nozzle of Header	SS 304H to P 11	525° C 38 kg / cm^2 Natural Gas + Steam	10% Oxalic acid	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: 21 & 22)	SEM did not reveal any significant damage at grain boundaries. Monitor after 2 year of service.
10.	Location: 10 On Weld Between 101CB Steam Outlet Nozzle BW-36H-14"	Carbon Steel	314 °C 105 kg/cm2 BFW	2% Nital	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. (Plate: 25 & 26)	No significant degradation observed. Monitor after 2 year of service.
11.	Location: 11 (Parent metal) On Surface of steam outlet Nozzle BW-11H-14"	Carbon Steel	314 °C 105 kg/cm2 BFW	2% Nital	Microstructure shows non uniform ferrite pearlite structure. (Plate: 21 & 22)	No significant degradation observed. Monitor after 2 year of service.
12.	Location: 12 (Parent Metal) 102-C bottom Channel from inside at 1' below tube sheet level	SS 304	(594°C Maximum) 449°C Normal 32 kg/cm2 Reformed Natural Gas	2% Nital	Microstructure shows inter granular cracks. (Plate: 29 & 30)	Needs attention.
13.	Location: 13 (Weld/HAZ) On Weld Between BFW outlet Nozzle BW-11H-8" &103-C Shell at bottom towards East side	Carbon Steel	314°C 105 kg/cm2 BFW	2% Nital	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: 33 & 34)	No significant degradation observed. Monitor after 2 year of service.

14.	Location: 14 (Weld/HAZ) On Weld Between BFW outlet Nozzle BW-9H-8" & 103-C Shell at top towards East side	Carbon Steel	314°C 105 kg/cm2 BFW	2% Nital	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: 35 & 36)	IInd stage of creep damage. Monitor after 1 year of service.
15.	Location: 15 (HAZ / Weld) On Weld Between BFW outlet Nozzle BW-10H-8" & 103-C Shell at top towards west side	Carbon Steel	314°C 105 kg/cm2 BFW	2% Nital	Microstructure at weld shows 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. (Plate: 39 & 40)	No significant degradation observed. Monitor after 2 year of service.
16.	Location: 16 (Weld / HAZ) On weld bet^{n}. flange & Bend of gas inlet nozzle.PG-6 -18 towards east side of 103-C	P 11	430°C 30 kg/cm2 Reformed Natural Gas	2% Nital	Microstructure at weld metal shows ferrite and carbides in dendritic form. Where as at HAZ microstructure shows fine and coarse grained ferrite/bainate structure. Parent metal shows fine grained ferrite/pearlite structure. Indication of creep damage in form of cavities and thickening of grain boundaries are observed. (Plate: 41 & 42)	Oriented Creep cavities are present-confirmed by SEM. IInd stage of creep monitor after 1 year of service.
17.	Location: 17 (Parent Metal) On Bottom Header of LT superheater coil near 2nd tube from north side	P 11	314°C 105 kg/cm2 Steam	2% Nital	Microstructure shows non uniform ferrite pearlite structure. (Plate: 45 & 46)	. No significant degradation observed. Monitor after 2 year of service.
18.	Location: 18 (Parent Metal) On top Header of LT superheater coil near 2nd tube from north side	P 11	360°C 105 kg/cm2 Steam	2% Nital	Microstructure shows non uniform ferrite pearlite structure. (Plate: 47 & 48)	No significant degradation observed. Monitor after 2 year of service.
19.	Location: 19 (Weld / HAZ) On face of 2nd bend of SG-1-12" of 114-C	P 11	321° C 26 kg / cm^{2} $N_2 + H_2 + CO_2$	2% Nital	Microstructure shows essentially ferrite structure with few grain boundary carbides. (Plate: 49 & 50)	The surface decarburizat ion seems to be from manufactur e stage.

20.	Location: 20 (Parent Metal) On cut piece (forging & Annealing)	SS 316L	- - -	10% Ammonium persulphate	Microstructure shows relatively coarse grained worked austenitic structure. Few carbide precipitations observed at the grain boundaries. (Plate: 53 & 54)	No significant damage. Monitor after 2 years of service
21.	Location: 21 (Weld/HAZ) On 101CA to 102C Nozzle Pipe	A 387 Grade-C	449°C 32 Kg/cm2 Reformed Natural Gas	2% Nital	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: 55 & 56)	No significant degradation observed. Monitor after 2 year of service.
22.	Location: 22 (Weld / HAZ) On circumfe-rential Weld Between disc & Shell towards South Side	SA 515 GR.70	314°C 105 kg/cm2 BFW & Steam	2% Nital	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. Indication of creep cavities are observed at the grain boundaries. (Plate: 57 & 58)	IInd stage of creep monitor after 1 year of service.
23.	Location: 23 (Parent Metal) On circumfe-rential Weld Between Shell & disc towards north Side	SA 515 GR.70	314°C 105 kg/cm2 BFW & Steam	2% Nital	Microstructure shows 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. possibility of isolated creep cavies are seen. (Plate: 59 & 60)	IInd stage of creep monitor after 1 year of service.
24.	Location: 24 (Parent metal) On face of outlet bend SG34-14"	P 11	160°C 124 Kg/cm^2 $H_2 + N_2 + NH_3$	2% Nital	Microstructure shows fine grained ferrite and pearlite/bainate structure. Possibility of hydrogen attack is observed in the microstructure. (Plate: 61 & 62)	Needs attention. During next opportunity take microstructure after 300 microns grinding at the same location.

25.	Location: 25 (Weld/HAZ) On Weld between bend weld/HAZ (Out let) SG-34.14''	P 11	160°C 124 Kg/cm^2 $H_2 + N_2 + NH_3$	2% Nital	Microstructure at weld metal shows ferrite and bainate in dendritic form. Where as at HAZ microstructure shows fine and coarse grained ferrite/bainate structure. Parent metal shows fine grained ferrite/pearlite structure. Initial stage of in-situ spheroidzation of pearlite is observed. (Plate: 65 & 66)	No significant degradation observed. Monitor after 2 year of service.
26.	Location: 26 (Weld/HAZ) On Weld between bend weld/HAZ (Out let) SG-34.14''	P 11	160°C 124 Kg/cm^2 $H_2 + N_2 + NH_3$	2% Nital	Microstructure at weld metal shows ferrite and bainate in dendritic form. Where as at HAZ microstructure shows fine and coarse grained ferrite/bainate structure. Parent metal shows fine grained ferrite/pearlite structure. of in-situ spheroidzation of pearlite is observed. Indications of creep cavities are observed. (Plate: 67 & 68)	IInd stage of creep damage. Monitor after 1 year of service.
27.	Location: 27 (Parent metal) On face of bend 104D (PG-6-18'')	P 11	422° C 31 kg / cm^2 $N_2 + H_2 + CO + CO_2$	2% Nital	Microstructure shows ferrite and pearlite structure. Spheroidzation of pearlite is observed. (Plate: 71& 72)	Monitor after 2 years of service.
28.	Location: 28 (Parent Metal) On vertical pipe near weld with bend of SG 25-8'' (SG23 to 105D)	Carbon Steel	140°C 142 Kg/cm^2 $H_2 + N_2 + NH_3$ + Natural Gas	2% Nital	Microstructure shows non uniform ferrite/pearlite structure. Initial stage of pearlite degradation observed. (Plate: 73 & 74)	Monitor after 2 years of service.
29.	Location: 29 (Weld / HAZ) On weld bet^n. vertical pipe & bend of SG 25-8''(SG25 to 105D	Carbon Steel	140°C 142 Kg/cm^2 $H_2 + N_2 + NH_3$ + Natural Gas	2% Nital	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: 75 & 76)	Monitor after 2 years of service.
30.	Location: 30 (Parent Metal) On face of bend of SG 25-8'' (SG 23 to 105D)	Carbon Steel	140°C 142 Kg/cm^2 $H_2 + N_2 + NH_3$ + Natural Gas	2% Nital	Microstructure shows fine grained ferrite/pearlite structure. Initial stage of in-situ spheroidzation of pearlite is observed. (Plate: 77 & 78)	Monitor after 2 years of service.

31.	Location: 31 (Parent Metal) On weld between Bend & horizontal pipe of SG 23-8''	Carbon Steel	140°C 142 Kg/cm^2 $H_2 + N_2 + NH_3$ + Natural Gas	2% Nital	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: 79 & 80)	Monitor after 2 years of service.
32.	Location: 32 (Parent Metal) On Pipe near weld with Bend of SG 25-8'' (SG23 to 105D)	Carbon Steel	140°C 142 Kg/cm^2 $H_2 + N_2 + NH_3$ + Natural Gas	2% Nital	Microstructure shows fine grained ferrite/pearlite structure. (Plate: 81 & 82)	Monitor after 2 years of service.
33.	Location: 33 (Parent metal) On bend of SG-32-6'' near weld with reducer	P 5	400°C 146 Kg/cm^2 $H_2 + N_2 + NH_3$	2% Nital	Microstructure shows fine grained ferrite/pearlite structure. (Plate: 83 & 84)	Monitor after 2 years of service.
34.	Location: 34 (Weld/HAZ) On weld between bend of SG 32-6'' & reducer at top	P 5	400°C 146 Kg/cm^2 $H_2 + N_2 + NH_3$	2% Nital	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. (Plate: 85 & 86)	Monitor after 2 years of service.
35.	Location: 35 (Weld / HAZ) On circumferential-al weld bet^n. shell & bottom disc	P 1	321 Degree C 26.7 Kg/cm2 Synthesis Gas(Hydrogen,Nitrogen,CO2)	2% Nital	Microstructure at weld metal shows ferrite and bainate in dendritic form. Where as at HAZ microstructure shows fine and coarse grained ferrite/bainate structure. Parent metal shows fine grained ferrite/pearlite structure. Initial stage of in-situ spheroidzation of pearlite is observed. (Plate: 87 & 88)	Monitor after 2 years of service.
36.	Location: 36 (Parent metal) On knuckle portion of bottom dish (East side)	P 1	321°C 26.7 Kg/cm2 Synthesis Gas(Hydrogen,Nitrogen,CO2)	2% Nital	Microstructure shows coarse grained ferrite and pearlite structure. (Plate: 89 & 90)	Monitor after 2 years of service.
37.	Location: 37 (Parent Metal) On weld between top outlet bend of flange	P 22	327°C 124 Kg/cm^2 $H_2 + N_2 + NH_3$	2% Nital	Microstructure at weld metal shows ferrite and bainate in dendritic form. Where as at HAZ microstructure shows fine and coarse grained ferrite/bainate structure. Parent metal shows fine grained bainate structure. (Plate: 91 & 92)	Monitor after 2 years of service.

38.	Location: 38 (Parent metal) On valve near steam drum	Carbon Steel	314°C 105 kg/cm2 Steam	2% Nital	Microstructure shows coarse grained essentially ferrite structure. Presence of numan bands is observed. Presence of creep cavities are observed at gain boundaries. (Plate: 93 & 94)	Indications of thermal fluctuations are observed at this region. Needs replacement in the within six months.
39.	Location: 39 (Parent Metal) On Bend of 5th coil tube from South side	T 22	441°C 105 Kg/cm2 Steam	2% Nital	Microstructure shows fine grained ferrite and tempered bainate structure. (Plate: 97 & 98)	Monitor after 2 years of service.
40.	Location: 40 (Parent Metal) On circumfer-ential weld between dish of shell towards west side F-106	Carbon Steel	Minus 23.3°C 130.45 Kg/cm2 Ammonia & Process gas	2% Nital	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. (Plate: 99 & 100)	Monitor after 2 years of service.
41.	Location: 41 (Parent Metal) On shell of west side near circumferenti-al towards west side F-106	Carbon Steel	Minus 23.3°C 130.45 Kg/cm2 Ammonia & Process gas	2% Nital	Microstructure shows fine grained ferrite pearlite structure. (Plate: 101 & 102)	Monitor after 2 years of service.
42.	Location: 42 (Parent Metal) On top header north side ht. steam super heater header	P 22	441°C 105 Kg/cm2 Steam	2% Nital	Microstructure shows fine grained ferrite pearlite and bainate structure. (Plate: 103 & 104)	Monitor after 2 years of service.
43.	Location: 43 (Parent Metal) On circumfer-ential weld between shell & bottom disc towards east side	P 1	321°C 26.7 Kg/cm2 Synthesis Gas	2% Nital	Microstructure shows fine grained ferrite and pearlite structure. (Plate: 105 & 106)	Monitor after 2 years of service.
44.	Location: 44 (Parent Metal) On knuckle portion of bottom disc towards east side near damage	P 1	321°C 26.7 Kg/cm2 Synthesis Gas	2% Nital	Microstructure shows fine grained ferrite and pearlite structure. (Plate: 107 & 108)	Monitor after 2 years of service.
45.	Location: 45 (Weld/HAZ) On circumfer-ential weld between shell & bottom disc towards east side	P 1	321°C 26.7 Kg/cm2 Synthesis Gas	2% Nital	Microstructure shows fine grained ferrite and pearlite structure. (Plate: 109 & 110)	Monitor after 2 years of service.

46.	Location: 46 (Parent Metal) On knuckle portion of bottom disc towards east side	P 1	321°C 26.7 Kg/cm2 Synthesis Gas	2% Nital	Microstructure shows fine and coarse grained ferrite and pearlite structure. (Plate: 111& 112)	Monitor after 2 years of service.
47.	Location: 47 (Weld/HAZ) On outlet manifold between tube 27 & 28	G-4859	818°C 31.7 Kg/cm2 Natural Gas	10% Oxalic acid	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: 113& 114)	No significant degradation is observed. Monitor after 2 year of service.
48.	Location: 48 (Weld/HAZ) On tube No. 28 weld with weldolet	G-4859	818°C 31.7 Kg/cm2 Natural Gas	10% Oxalic acid	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: 115 & 116)	No significant degradation observed. Monitor after 2 year of service.
49.	Location: 49 (Weld/HAZ) On riser weld with weldolet	G-4859	818°C 31.7 Kg/cm2 Natural Gas	10% Oxalic acid	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: 117 & 118)	No significant degradation is observed. Monitor after 2 year of service.
50.	Location: 50 (Weld/HAZ) On outlet manifold to weldolet	G-4859	818°C 31.7 Kg/cm2 Natural Gas	10% Oxalic acid	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: 119& 120)	No significant degradation is observed. Monitor after 2 year of service.

Annexure-15

INDIAN FARMERS FERTILSER CO OPERATIVE LTD., KALOL UNIT

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 : 6	:	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	:	200 degree C

6. DEHYDROGENATION

Soaking Temperature	:	350 degree C
Soaking time	:	24 hours
Heating Rate	:	35 degree C/hr
Cooling Rate	:	35 degree C/hr
Loading/Unloading Temperature:		150 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	:	675 degree C
Soaking time	:	1 hour
Heating Rate	:	35 degree C/hr (Max.)
Cooling Rate	:	35 degree C/hr (Max.)
Loading Temperature	:	350 degree C
Unloading Temperature	:	300 degree C

UREA PLANT

During Shutdown 2006, the following major inspection activities were performed in the Urea plant.

1. Internal inspection of High-pressure vessels. Viz Autoclave (V-1201),H. P. Stripper (H-1201) and H.P. Condenser (H-1202).

2. Internal inspection of other vessels in the Plant.

3. Ultrasonic thickness measurement of various pipelines including HP lines in the Plant. Detailed report is attached at **Annexure-1.**

4. Dye reentrant examination and radiography of weld joints of lines fabricated, erected and offered by Mech. Maint. / Technical Department as per the requirement.

5. Qualification tests of welders employed by contractors.

6. Residual magnetism measurement of Hitachi compressor rotor (Q-1801), various parts of Old Co2 compressor (K-1101/1). Detailed report is attached at **Annexure-2**

7. Visual inspection, DP testing and thickness measurement was carried out for weld joints unto 1st isolation valve for all the Vent & Drains of all High Pressure lines. list of all such lines are given in **Annexure-3**

8. Eddy Current testing of H. P Condenser and H.P Stripper tubes was carried out by M/S Testex,Mumbai.

9. 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 based on the observations made.

HIGH PRESSURE VESSELS:

AUTOCLAVE (V-1201):

VISUAL INSPECTION:

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

Compartment No.1 (Top Compartment):

(a) Minor Roughening /corrosion of dome liner was observed and also grayish oxide layer was observed on dome and man way surface.

(b) Crevice cavities of approx 13" long and 9" long were observed on the south west side L-seam which was marked for repair.

(c) Corrosion cavity of approx 2" long was observed on North east side L-seam which was marked for repair.

Compartment No.2:

(a) Minor roughening of tray holding clits and grayish brown oxide layer was observed on bottom side of trays.

(b) 7 Nos. of J-bolts were found loose.

(c) 3 Nos. of corrosion cavity were observed in south west side longitudinal seam, 1 No. of crevice cavity was observed in C-seam, 1 No. spot welding and 1 No. old clit marks observed to have corroded which were marked for repair.

Compartment No.3:

(a) Very minor roughening was observed on insert liner.

(b) 8 Nos. of undercuts/corrosion cavities were observed which were marked for repair.

(c) 2 Nos. of 'J' bolts were found loose which were marked.

(d) Minor corrosion of J-bolts was also observed.

(e) Grayish and brownish oxide layer was observed on the bottom side of trays.

Compartment No.4:

(a) Slight roughening of insert liner plate and tray holding clits was observed.

(b) Approx. 30 mm below circumferential weld a depression of approx. 100 mm dia. and 3 mm depth was observed at west side liner. Same was observed during last inspection also.

(c) Convex bulging of liner plate observed just above circumferential weld by approx. 4 mm height from North to West side in approx. 300mm length.

(d) Concave depression of approx 2-5 mm depth observed at approx. 200mm below the C-seam in approx. 60% of the periphery.

(e) Grayish and brownish oxide layer was observed on the bottom side of trays.

(f) 6 No. of corrosion cavities and 1No. of old clit mark were observed to have corroded which were marked for repair.

(g) 10 Nos. of 'J' bolts and some tray holding nuts and bolts were also found loose which were marked.

Compartment No.5:

(a) Convex bulging of liner plate was observed just above the circumferential weld joint by approx. 3 to 9 mm height in almost all the periphery. The same was observed during last inspection also.

(b) Concave depression of approx 2-6 mm was observed at approx. 500 mm below the C-seam in full periphery . The same was observed during last inspection also.

(c) Grayish and brownish oxide layer was observed on the bottom side of trays.

(d) 04 Nos. of 'J' bolts and some tray holding nuts and bolts were also found loose which were marked.

Compartment No.6:

(a) Convex bulging of liner plate was observed above the circumferential weld joint by approx. 3 to 10 mm height, which starts from north-west to south-east direction in approx. Length of 4500 mm. The same was observed during last inspection also.

(b) Concave depression of approx. 5 mm depth was observed at approx. One meter below C-seam from East to west side L-seam though north side of the shell. The same was observed during last inspection also.

(c) 3 Nos. of 'J' bolts and some tray holding nuts and bolts were also found loose which were marked.

(d) 6 Nos. of corrosion cavities were also observed which were marked for repair.

Compartment No.7:

(a) Convex bulging of liner plate was observed above the circumferential weld joint by approx. 2-6 mm height in approx. 3 mtr. Circumference from North-East to West through south side. The same was observed during last inspection also.

(b) 3 Nos. of corrosion cavities and 2 nos. of spot welds observed to have corroded which were marked for repair.

(c) 1 No. of 'J' bolts was found loose which was marked.

Compartment No.8:

(a) 2 nos. cavities were observed which were marked for repair.

(b) 9 Nos. of old clit marks were observed to have corroded which were marked for repair.

(c) 1 No. of 'J' bolts was found loose which was marked.

Compartment No.9:

(a) 3 Nos. of cavities and one spot weld point were observed which was marked for repair.

(b) 5 Nos. of old clit marks were observed to have corroded which were marked for repair.

(c) 1 No. of 'J' bolt and some tray holding nuts and bolts were also found loose which were marked.

Compartment No.10:

(a) 5 nos. Old clit welding marks were found corroded which were marked for repair.

(b) 4 Nos. of corrosion cavities were also observed which were marked for repair.

(c) Concave depression of approx 5mm depth at approx 70mm below the C-seam in south side of shell in approx. 100 mm dia was observed.

(d) Concave depression of approx. 9 mm depth just above the C-seam towards the south side of man way and adjacent to L-seam in approx. 100 mm dia. was observed.

(e) Vertical bulging of approx. 2-3 mm height, 6" long & 10mm wide was observed at approx. 12" below the C-seam in north side of the shell.

Compartment No.11:

(a) Just below circumferential weld concave depression of approx. 4 to 6 mm depth in approx. 80mm dia. in North-West direction was observed. The same was observed during last inspection also.

(b) concave depression of approx. 5mm and 9mm deep in approx. 100mm dia. was observed just below the C-seam in north and west side of the shell respectively.

(c) 10 to 12 mm gap was observed between tray and shell liner from East to South side.

(d) On new liner segment convex bulging up to max. 3 mm height having width approx. 10 mm observed just above circumferential stitch welds (approx. 125 mm long). Same was observed in last S/D also.

(e) 2 nos. of corrosion cavities were marked for repair in long seams.

(f) Down comer pipe L-seam becomes level to level after corrosion in the length of approx 12" just above the trays which was marked for repair.

Compartment No.12 (Bottom Compartment.):

(a) Weld joints of all nozzles, petal plates, crown plates and the circumferential weld of the bottom dished end liner were DP tested. 15 nos. of defect indications were marked for repair.

(b) 11 nos. of cavities were observed which were marked for repair.

(c) Down comer pipe to reducer welding observed level to level and also down comer pipe L-seam becomes level to level which were marked for putting a weld layer.

(d) Concave depression of approx. 2-3 mm and approx. 5mm were observed at approx. 70mm above the C-seam in 4"dia in east and west direction of the shell respectively.

THICKNESS MEASUREMENT:

Ultrasonic thickness measurement was carried out on liner. The readings are summarized as below:

MAIN LINER THICKNESS:

	Month. (mm)	Max.Thk (mm)	Remarks
Man way	6.71	6.98	Replaced with 2 RE69 in April-02, with 6.5 mm thick liner plate.
Dome area	6.35	6.73	Replaced with 2 RE69 in April-02, with 6.5 mm thick liner plate.
Compartment 1 (New liner)	6.69	6.95	Replaced with 2 RE69 in April-02, with 6.5 mm thick liner plate.
Compartment 1 (Old liner)	4.38	4.82	Installed thickness 5 mm.
Compartment 2	3.92 *	4.78	Installed thickness 5 mm.
Compartment 3	4.38	4.69	Installed thickness 5 mm.
Compartment 4 Below C-seam north side	4.04 **	4.88	Installed thickness 5 mm.
Compartment 5	4.80	5.23	Installed thickness 5 mm.
Compartment 6	4.72	4.86	Installed thickness 5 mm.
Compartment 7	4.73	4.88	Installed thickness 5 mm.
Compartment 8	4.69	4.93	Installed thickness 5 mm.
Compartment 9	4.77	4.88	Installed thickness 5 mm.
Compartment 10	4.85	5.32	Installed thickness 5 mm
Compartment 11 old liner	4.62	4.79	Installed thickness 5 mm
Compartment 11 New (Partial)	6.62	6.76	Replaced with 2 RE69 in April-02 with 6.7 mm thick liner plate.
Compartment 12 Shell liner	4.73	4.79	Installed thickness 5 mm
Compartment 12 Dome liner	6.35	6.77	Fabricated from 7 mm thick 2RE69 plate.

Note :

- Observed just below the C-seam in north side of the shell.
- Observed just below the C-seam in north side of the shell.

INSERT LINER:

Compartment nos.	Minimum Thickness observed(MM)
3	**6.77**
4	**6.39**
8	**6.50**
9	**6.77**
10	**6.51**

Minimum thickness of insert liner of different compartments are as under:

1.2. DOWN COMER AND TRAYS:

Compartment No.	Down comer thickness (mm)		Tray thickness (mm)	
	Design thk.	Min.	Design thk.	Min.
1	10.0	--	8.0	6.16
2	10.0	8.41	8.0	6.41
3	10.0	8.60	8.0	6.05
4	10.0	8.78	8.0	6.28
5	10.0	8.82	8.0	6.39
6	10.0	8.74	8.0	6.77
7	10.0	8.66	8.0	6.66
8	10.0	8.59	8.0	7.12
9	10.0	9.0	8.0	7.29
10	10.0	9.40	8.0	7.59
11	10.0	9.39	8.0	7.95
12(10"NB) on Down comer pipe	10.0	9.67		
12(10"NB) on Reducer	10.0	9.67		
12(8" NB) on Reducer	10.0	8.69		
12(8"NB) on Distance pipe	6.00	4.65		

HP STRIPPER (H-1201):

The following inspection activities were performed.

a. Visual Inspection b. Thickness measurement

The observations on above inspections are as under. :

VISUAL INSPECTION:

BOTTOM DOME:

1. Foreign particles were found lying inside the dome portion.

2. Two nos. nuts and one bolt of flange of urea solution outlet line were observed blackish compared to other bolts.

3. Tube to tube sheet seal welds as well as shell to tube sheet overlay welds were found in satisfactory condition and observed to be covered with the oxide layer.

4. 4 nos. Cavities of approx. 2 mm depth were observed on dome area weld overlay, which was marked for repair.

5. Horizontal seam of two nos. liner plates was observed having no reinforcement.

6. Ferrite was measured and no ferrite was observed.

7. Co2 inlet line flanges have shown the sign of corrosion (looking from inside)

8. Coloration was found to be brownish, this was found predominant on man way, lower half of curved portion of dome and on tube to tube sheet weld area at scattered locations, the cylindrical liner was observed bright in coloration.

9. Welding of urea solution outlet line & Co2 inlet line flanges distance piece with the pipe coming from dished end was found below the O.D. of pipe by approx. 1mm.

10. Liquid inlet nozzle had shown sign of corrosion on the welding of flange to vessel stub end as seen from inside of the flange nozzle. same was marked for repair.

11. Liquid inlet nozzle(vertical line connected to control valve) had also shown sign of corrosion at the ID of pipe and circumferential weld, as seen from inside of the pipe flange nozzle.

Overlay weld and Liner thickness measurement was carried out and details are as under**:**

TOP DOME:

1. Condition of weld joints was found satisfactory.

2. Thin oxide layer was observed on top half portion whereas shiny surface.

3. was observed on bottom area of shell.

4. Thick oxide layer of approximately 3 to 4 mm thickness was observed on the tubesheet areas which is predominant in central portion.

Thickness Measurement:

Overlay weld and Liner thickness measurement was carried out and details are as under:

BOTTOM DOME:

	Minimum Thickness mm	Maximum Thickness mm	Design Thickness mm (Minimum)
Man way (Overlay)	18.65	23.80	8.0
Dome area (Overlay)	12.02	14.24	8.0
Cylindrical area (Liner)	8.20	10.60	8.0
Tube sheet-Overlay weld	20.05	24.52	8.0
Bottom Cover (Overlay)	14.86	18.88	8.0

TOP DOME:

	Minimum Thickness mm	Maximum Thickness mm	Design Thickness mm (Minimum)
Man way (Overlay)	13.10	23.80	8.0
Dome area (Overlay)	10.61	14.24	8.0
Cylindrical area (Liner)	8.40	10.60	8.0
Tube sheet-Overlay weld	14.13	24.52	8.0
Top Cover (Overlay)	14.86	18.88	8.0

H.P. CONDENSER H-1202:

The following inspection activities were performed.

a. Visual Inspection b. Thickness measurement

The observations on above inspections are as under. :

VISUAL INSPECTION:

Top Cover & Bottom Cover:

Sealing face was found satisfactory. Liner & welds were found smooth, except, 08 nos. spots on liner plate of top cover, which have got roughened. These were polished and passivated with 5% HNO_3 and finally cleaned with DM water.

Top Channel Head:

(a) The internal surface found to be silver shiny with light brownish band of approx. 75-80 mm width at approx. 300 mm above the tube sheet. Grayish passivation layer was found at very few scattered locations.

(b) Minor roughening of dome and cylindrical area liner was observed where as man way liner was found smooth.

(c) Minor roughening of all the circumferential and longitudinal welds was observed which were found more predominant on the fillet welds of patch plate.

(d) Tube to tube sheet weld had shown no sign of corrosion/ roughening and were found smooth.

(e) Ferrite content was checked on randomly selected spots at welds and parent metal. No ferrite was found.

(f) Thickness measurement of liner segments was carried out.

(g) 6 nos of undercuts were observed on the circumferential weld joint of the shell which were repaired.checked by DPT and found satisfactory. Ferrite was also checked and found nil

Bottom Channel Head:

(a) No sign of corrosion/ roughening observed on entire bottom dome area. All welding joints and liner surface found smooth.

(b) Tube to tube sheet seal weld shows no sign of corrosion.

(c) Thickness measurement of liner segments was carried out.

(d) Ferrite content was checked on randomly selected spots at welds and parent metal. No ferrite was found.

Overlay weld and Liner thickness measurement:

Top Section:

	Minimum Thickness, mm	Maximum Thickness, mm
Cover (Liner)	19.50	19.70
Man way (Liner)	5.67	7.49
Dome area (Liner)	6.47	6.78
Cylindrical area (Liner)	6.20	6.89
Tube sheet-Overlay weld	9.57	12.71

Bottom Section:

	Minimum Thickness, mm	Maximum Thickness, mm
Cover (Liner)	18.46	19.41
Man way (Liner)	4.45*	7.86
Dome area (Liner)	6.56	6.89
Cylindrical area (Liner)	6.18	6.78
Tube sheet-Overlay weld	10.29	11.99

❖ Observed at bottom of right hand side of longitudinal weld at west side.

INSPECTION OF OTHER VESSELS:

H-1104 (C02 SPRAY COOLER):

(a) Demister pad condition was satisfactory.

(b) At few locations minor epoxy paint layer was peeled off. May be repainted.

(c) Weld joint condition was satisfactory.

(d) Bottom trays were found intact in position.

H-1113 A/B (Main L.O.Cooler for K-1101/1):

The above cooler was offered for visual inspection of its tube sheet & channel cover after its hydro jetting.

The observations made are as under

(a) Tube and Tube sheet observed in satisfactory condition.

(b) Epoxy coating was seen to be in satisfactory condition at its channel covers as well as at end covers.

H-1204 (Recirculation Heater):

(a) Tube to tube sheet weld found in good condition.

(b) Orifice plugs at bottom of tube sheet found intact in position.

(c) Overall condition was found satisfactory.

H-1207 (Circulation System-II Cooler):

(a) Heavy corrosion/ pitting and scaling were observed on the tube sheet area.

(b) Corrosion & pitting were observed on the inside of end covers.

(c) Scaling was observed at the inside of all tubes.

(d) New Red oxide coating was applied at the side of end cover. Partition plate found deformed.

(e) Some portion of the bottom side of tube sheet was found wet and water was found inside of tubes.

H-1209 (L P Absorber Cooler) :

LP absorber cooler was offered for visual inspection without removing the tube bundle. The observations made are as under. :

(a) Tube to tube sheet weld joints were found satisfactory.

(b) Minor white colored depositions were observed on bottom half of the few tubes.

H-1301 A/B/C (Desorber heat exchanger):

Tube to tube sheet seal welding was found satisfactory, however on H-1301/B west side tube-to-tube sheet weld joints found to have grinding marks at few locations (This seems to be from beginning).

H-1351A/B/C (Hydrolyser feed preheater) :

(a) Tube to tube sheet seal welding was found satisfactory.

(b) Minor damages of few tube ends were observed.

H-1352 (Reflux Condenser):

TOP TUBE SHEET:

(a) Tube to tube sheet welding was found satisfactory.

(b) b) Hard scaling were observed on the inside surface of all the tubes looking from the top end.

BOTTOM TUBE SHEET:

(a) Tube to tube sheet welding was found satisfactory.

(b) On cooling water outlet side, grey scaling & dust was observed inside almost all the tubes, **proper cleaning is recommended**.

(c) Half tube sheet found wet on cooling water outlet & inlet side.

(d) Entire inside surface of cooling water outlet line found covered with approx. 2 mm thick gray color scales.

(e) Brownish rusting scales were observed on entire surface of Inlet & Outlet channel and also on the inner surface of CW inlet line.

H-1814-A and H-1814 B (L.O. Cooler of Hitachi Compressor):

(a) Tubes and tube sheet were found satisfactory.

(b) End cover were under maintenance for the purpose of application of protective coating.

H-1815 (Surface Condenser for Hitachi Compressor):

North side partition (East side cover)

(a) Tubes and tube sheet surface condition was found satisfactory.

(b) b) Minor scaling was observed in tubes. .

North side partition (West side cover)

(a) Minor scaling was observed at the inside surface of the tubes.

(b) Tubes and tube sheet surface condition found satisfactory.

(c) Epoxy coating found peeled off at few locations resulted in localized minor corrosion.

H-1419 (Pre-evaporator Condenser) :

BOTTOM TUBESHEET:

(a) Tube to tube sheet weld found satisfactory.

(b) Seal welding on 3" nozzle to bottom channel cover has not been found. Recommended for welding.

(c) 1 ½ " nozzle pipe observed completely choked.

(d) Holes of few tubes were found chocked, proper cleaning is suggested.

TOP TUBESHEET:

(a) Tube to tube sheet weld found satisfactory.

(b) Overall condition of vessel found satisfactory.

H-1420 (FINAL CONDENSER) :

(a) Tube to tube sheet welding found satisfactory of both the tube sheet.

(b) Overall condition found satisfactory.

H-1421 (Flash Tank Condenser):

(a) Tube to tube sheet welding was found satisfactory.

(b) Minor scales were observed inside the few tubes.

(c) All tubes were found filled with water.

H-1422 (1st Stage Evaporator) :

(a) The shell and Dish ends have assumed brownish black in coloration.

(b) Tube to tube sheet weld found satisfactory.

(c) Urea lumps were found accumulated on the inside surface of distributor at the top dished end. Proper cleaning is recommended.

(d) Impingement cone to support welding found in broken condition at two locations out of four supports.

(e) Condensate distributor was found satisfactory.

(f) Water found accumulated at the bottom along with urea lumps, proper cleaning is recommended.

H-1423 (First Stage Evaporator Condenser):

(a) Tube to tube sheet welding was found satisfactory.

(b) Minor scales were observed inside the few tubes.

(c) Tube sheet are was found brownish in coloration.

H-1424 (2 nd Stage Evaporator) :

(a) Vessel inside was found grayish black in coloration just above the dished end welding rest of the surface found bright.

(b) Tube to tube sheet weld joints were found satisfactory.

(c) One no. Urea lumps were found adhered at top dished end.

(d) Impingement cone found intact.

(e) Overall condition found satisfactory.

H-1425 (Second Evaporator First Condenser):

(a) Tube to tube sheet welding was found satisfactory.

(b) Overall condition of vessel found satisfactory.

H-1426 (Second Evaporator Second Condenser):

(a) Tube to tube sheet welding was found satisfactory.

(b) All tubes were found filled with water.

H-1701(FLUIDISED BED COOLER):

(a) Shiny surface was observed from inside.

(b) Clamping bolts of the dampener rod were found missing / loose.

(c) Corrosion was observed at east-north corner in ducting and pening was observed at this location.

(d) Foreign particles/ dirt was observed at south end of bottom floor.

(e) Few fasteners of trays at bottom floor were found missing.

T-1301 (Ammonia Water Tank):

(a) Brownish coloration on bottom plate and bottom half of shell and silver bright coloration on top half of shell was observed.

(b) Bottom plate was found bulged up side at different locations. Same has been observed in past also.

(c) Weld joints and nozzle condition was found to be satisfactory.

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

(a) a) Brown coloration on bottom plate and bottom half of shell and silver bright coloration on top half of the shell was observed.

(b) b) All weld joints and nozzle condition was found satisfactory.

(c) c) Some dent spots were observed on shell in approx 300 mm X 300mm area just opposite to man hole. (This for reference only)

T-1302 (Underground Waste Water Tank):

(a) Nozzles and weld joint condition was satisfactory.

(b) No abnormality was observed.

(c) Ultrasonic thickness measurement was carried.

T-1401 (Urea Solution Tank):

(a) Bottom plate is having bulging upward as has been observed in the past.

(b) Weld joints condition was found satisfactory.

(c) Dark brown coloration was observed inside the tank.

(d) Stiffener provided on top roof plate was found intact in position.

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

(a) Brownish gray coloration was observed on bottom half and bright silver coloration was observed on top half.

(b) Nozzles and weld joint condition was satisfactory.

T-1501 (Condensate Tank):

(a) Brownish black coloration was observed inside the tank.

(b) Weld joint condition was satisfactory.

(c) All nozzle condition was found satisfactory.

(d) One support of middle condensate inlet pipe out of three pipes was found bent.

(e) In general, condition of the tank was found satisfactory.

T-1701/A (UREA DUST DESSOLVING TANK):

(a) A lot of dirt, foreign particles and water were there inside the tank.

(b) Circular heating coil at the bottom floor was found slightly distorted.

(c) Weld joint condition was satisfactory.

(d) Supports of the coil were in good condition.

(e) Proper cleaning of the bottom plate ,heating coils and all nozzles at roof is recommended.

T-1701/B (Urea Solution Tank):

Visual inspection was carried out from top manhole.

(a) Shiny surface was observed from inside.

(b) Weld joint condition was found satisfactory.

(c) Coil and its supports condition was found satisfactory.

(d) Overall condition was found satisfactory.

V-1101 (CO_2 Knock Out Drum):

(a) Epoxy paint was found peeled off from few locations. May be repainted.

(b) Demister pads were found intact in position. At few locations it was found chocked (covered) with yellow color debris.

(c) Brownish color patches were observed at scattered locations on shell surface.

V-1102 (NH3 SUCTION FILTER) :

(a) Oily surface was observed inside the vessel.

(b) Overall condition of the equipment was found satisfactory.

(c) Colouration of vessel was brownish from inside.

V-1103 (NH3 Suction Vessel):

(a) Coloration of vessel inside was blackish.

(b) The condition of longitudinal and circumferential weld joints was satisfactory.

(c) Oil layer and debris were found on the bottom-dished end.

(d) Proper cleaning is recommended.

V-1202 (Rectifying Column):

From Bottom manhole:

(a) Colouration of top cone was silver with black patches where as brownish coloration was found on bottom-dished end.

(b) Lot of oily material was found at the bottom and at the I.D. Of manhole, proper cleaning is recommended.

(c) Thick metallic layers were observed at scattered locations. Lab analysis of the same may be carried out.

(d) Weld joint condition was satisfactory.

From Top Manhole:

(a) Coloration of vessel was grayish at man hole position and blackish at dome and shell portion.

(b) Black hard scales were observed at the top dish end and also at the shell portion.

(c) Brownish grey hard scales were observed on the surface of trays.

(d) Condition of trays was found satisfactory and intact in position.

V-1203 (L. P. ABSORBER):

From Top End:

(a) Colouration of shell was observed grayish black.

(b) Perforated support grid just below top hand hole found intact in position.

From Bottom End:

(a) Colouration of shell was observed grayish black.

(b) Weld joints condition found satisfactory.

(c) Debris was found collected at the bottom dished end.

(d) Packing supporting grid was found intact in position.

V-1206 (Atmospheric Vent Scrubber):

(a) Demister pads were found intact in position and condition of the same was found satisfactory.

(b) All fasteners were found intact.

(c) Silver gray coloration was observed inside the vessel with brownish patch at East side.

(d) Overall condition was found satisfactory.

V-1207 (L. P. Scrubber):

The observations of visual inspection from top manhole and hand hole were as follows.

(a) Colouration of shell portion was observed blackish grey.

(b) Grating condition was satisfactory.

(c) Packing material were found lying at the bottom dish end, so proper cleaning is required for avoiding choking in the liquid out line at bottom.

(d) Irregular shape and insufficient welding was observed at ID of 4" nozzle at bottom end of the vessel in west direction.

V-1301 (2ND Desorber):

Bottom Compartment:

(a) Brownish coloration was observed inside the vessel.

(b) One clamp of the tray was found loose and dislocated.

(c) Nozzle condition was found satisfactory.

Top Compartment:

(a) Brownish coloration was observed inside the vessel.

(b) All fasteners and its clamp of the tray found in good condition.

(c) Top nozzle was found satisfactory.

(d) Minor scale inside the 4" nozzle at south end was observed.

V-1351 (HYDROLYSER) :

Visual inspection of vessel top and bottom compartment only was carried out.

Top Compartment:

(a) Top dish end and shell of top section has assumed brownish black coloration and brownish matter was found sticking on the edge of trays.

(b) Trays had brownish coloration.

(c) Fasteners were found intact in position.

(d) Condition of top tray was found satisfactory.

Bottom Compartment:

(a) Brownish coloration was observed from inside.

(b) Fasteners of trays were found intact in position

(c) Oil layer was observed all around.

(d) Overall condition was satisfactory.

(e) One no. of bolt of steam inlet flange was found loose.

(f) Clamping bolt of steam inlet pipe to shell was also found missing.

V-1352 (First Desorber):

Bottom Manhole:

(a) Brownish coloration was observed inside the vessel.

(b) One bolt of the tray was found missing.

(c) Weld joint condition was found satisfactory.

Top Manhole:

(a) Brownish coloration was observed inside the vessel.

(b) All fasteners were found intact

(c) Weld joint condition was found satisfactory.

(d) All internals were found intact in position.

V-1423 (1 ST Stage Evaporator Scrubber):

(a) Brownish coloration was observed from inside .

(b) Minor damage / chocking of the demister pads was observed, also its supporting ring was slightly lifted upward at few locations

(c) Solidified urea solution particles were found adhered at demister pads at few locations.

(d) Two bolts of the bottom plate were found missing.

V-1501 (4 ATA STEAM DRUM):

(a) Coloration of shell and Dish ends found brownish black.

(b) Distribution sparger found intact in position.

(c) Demister pads were found intact in position and condition of the same was found satisfactory.

(d) Water found at bottom of the vessel, proper cleaning is required

(e) Weld joint condition found satisfactory.

(f) Minor scaling was observed at both dished end.

(g) A cavity of approx. 10mm x 5 mm wide x 3mm depth was observed on North dished end at the west side just below the manhole elevation. Repairing is recommended.

V-1502 (23 ATA Steam Drum):

(a) Brownish black coloration was observed inside the vessel.

(b) All the internal fittings were found in good condition.

(c) Overall condition was found satisfactory.

V-1503 (9 ATA Steam Drum):

(a) (a) Coloration of Shell and dished end was observed grayish black for the bottom half where as brownish gray for top half.

(b) Scattered scales were observed on both the dished ends.

(c) Undercuts of approx. 0.5 mm depth were observed on the Manhole flange to dished end welding at scattered locations.

H-1814-A/B (L.O. Cooler of Hitachi Compressor) :

(a) Tubes and tube sheet were found satisfactory.

(b) Minor depositions were observed inside the tubes.

(c) Overall condition was found satisfactory.

P-1201-A/B (L.O Cooler):

CHANNEL COVER END:

(a) Rusting and corrosion observed on inside surface of channel cover.

(b) Minor pitting and cavities were observed on tube sheet face.

HEAD END:

Minor pitting and corrosion cavities were observed.

P-1102A/B/C (L.O Cooler):

(a) Tube sheet found satisfactory at both sides.

(b) Overall condition of exchanger found satisfactory.

ANNEXURE-1
UREA PLANT PIPELINE THICKNESS MEASUREMENT SUMMARY

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-1801-4 TH STAGE DISCHARGE	GA-1602-8"-F2	21.7	4.3
		4"	13.49			11.5	14.75
		3"	11.13			10.7	3.8
2	GA-1602-8"F2	8"	23.01	CO-2124-8"-F10	GA-1112-6"-F2	21.0	6.27
		3/4"	5.54			4	27.79
		4"	11.13			11	1.16
3	GA-1112-6"-F2	6"	14.27	PB COMP.K-1101-2	GA-1201-6"	16	NIL
		3/4"	5.54			6.7	NIL
		1.1/2"	3.68			3.6	2.17
4	GA-1201-6"	6"	13.33	GA-1112-6"-F2	H-1201	14	NIL
		1.1/2"	5.54			5.1	7.94
5	GA-1202-1"-F2	1"	6.35	GA-1112-6"F2	GA-1203-1"-X1	4.34	31.65
6	GA-1203-1"-X1	1"	4.55	GA-1202-1"-F2	HP SCRUBBER	3.7	18
		1/2"	3.73			3.5	6.1
7	GA-1204-1"F2	1"	4.55	GA-1202-1"-F2	---	3.8	16.4
		1/2"	3.73	GA-1203-1"-X1		2.8	24.9
8	GA-1603-4"-F2	4"	11.13	GA-1602-8"-F2	PIC-1810	12	NIL
9	6"-CO-E10-2123	6"	10.97	V-1813	HPCASE 4TH suction K-1801	10	8.87
		3/4"	2.87			2.6	9.40
		3"	7.62			8.5	NIL
		2"	5.54			5.1	7.94
10	6"-CO-E10-2122	6"	10.97	H-1813	V-1813	9.6	12.48
11	8"-CO-F10-2119-PP25	8"	23.01	HP CASE 3RD discharge K-1801	H-1813	22.9	0.48
		3/4"	6.35			5.5	13.38
		1.1/2"	7.14			7.1	1.96
		4"	13.49			14	NIL
12	18"-CO-A1-2104-PP25	18"	9.52	LP CASE 1ST discharge K-1801	1ST GAS COOLER H-1811	9.0	5.462
		1"	3.91			3.8	2.81
13	14"-CO-A3-2107	14"	4.79	1ST GAS COOLER H-1811	1ST SEP,V-1811	4.8	NIL
14	14"-CO-A3-2108	14"	4.78	1ST SEP,V-1811	2ND STAGE Suction K-1801	4.5	5.85
		3/4"	2.87			2.8	2.44
15	10"-CO-B20-2112-PP25	10"	9.27	2ND DISCHARGE LP CASE K-1801	2ND GAS COOLER H-1812	9.0	2.91
		12"	9.52			9.1	4.41
		10"	9.27			10.3	NIL
		3/4"	3.91			3.8	2.81
16	8"-CO-B22-2135	8"	6.35	2ND GAS COOLER H-1812	2ND SEPERATOR V-1812	5.6	11.81
17	8"-CO-B22-2114	8"	6.35	2ND SEP V-1812	3RD SUCTION HP CASE K-1801	5.2	18
		4"	3.05			2.8	8.1
		3/4"	2.87			2.8	NIL
18	30"-CO-A3-2102	30"	7.11	V-1101 KO DRUM	26-CO-A3-2102	6.1	14.2
19	26"-CO-A3-2102	26"	6.04	30"CO-A3-2102	1ST SUCTION LP CASE K-1801	5.4	10.59
		3/4"	2.87			2.9	NIL

20	2"-CO-A1-2105	2"	3.91	18"-CO-A1-2104-PP25	LINE BLINDED	3.9	0.25
		2"	3.91			3.8	2.81
21	1-1/2"-COF10-2152	1.1/2"	7.14	8"-CO-F10-2119-PP25	LINE BLINDED	7	1.96
22	4"-CO-E10-2139-SS	4"	8.56	6"-CO-E10-2122	4"-CO-E10-2140-CS	6.9	19.2
23	4"-CO-F10-2140-CS	4"	13.49	8"-CO-F10-2119-PP25	4"-CO-E-10-2139	12.7	5.85
		3/4"	5.56			3.5	37.05
24	3"-CO-B20-2134	3"	5.54	10"-CO-B20 2112-PP25	LINE BLINDED	5.2	NIL
25	GA-1103-30"-B3	30"	6.35	V-1101 KO DRUM	PB COMP K-1101/2	5.8	8.66
26	6"-CO-A3-2160	6"	3.40	14"-CO-A3-2108	26-CO-A3-2102	3.2	5.8
27	6"-CO-A3-2161	6"	3.40	6"-CO-A3-2160	END CAPPED	3.4	0.00
		6"	7.11			6.8	4.36
28	6"-CO-B22-2115	6"	3.40	8"-CO-B22-2114	8"-CO-B22-2109	3	11.76
29	16"-CO-A3-2110	16"	4.78	8"-CO-B22-2109	30"-CO-A3-2101	4.7	1.67
30	8"-CO-B22-2109	8"	6.35	10"-CO-HA2-2109	16"-CO-B22-2109	5.4	14.96
		18"	9.27			9.5	NIL
		8"	8.18			7.7	5.86
31	10"-CO-HA2-2109	10"	9.27	SM-1821 BLOW OFF SILENCER	8"-CO-B22-2109	8.6	7.22
32	PR-1230-6",X1	6"	15.24	MA-1203-4"-X1	H-1202 HP CONDENSER	14.5	4
		1.1/2"	5.08			4.2	17.32
33	PR-1638-4"-X4A	4"	13.49	PR-1637-3"-X4A	PR-1230-6"	12.8	5.11
34	PR-1231-3"	3"	8.12	H-1203 HP SCRUBBER	PRCV-1201,V-1203	7.6	6
35	PR-1206-4"-X1	4"	10.4	PR1210-10"-X6	H-1203 HP SCRUBBER	9.4	9
36	PR-1225-3"-X4	3"	7.62	PR-1638-4'	H-1203	6.9	9.44
37	PR-1212-4"X1	4"	10.40	SCRUBBER-H1203	AUTO CLAVE BOTTOM	9.5	8
38	PR-1208-4"-X1	4"	10.40	AUTO CLAVE TOP	PR-1206-4-X1	9.4	9
		1.5"	5.08			5.0	
39	PR-1202-10"-X1	10"	24.33	HP-STRIPPER H-1201	HP-CONDENSER H-1202	21.4	12
40	PR-1203-8"-X1	8"	19.58	HP-CONDENCER H-1202	V-1201	18.5	5
41	PR-1204-8"-X1	8"	19.58	HP-CONDENCER H-1202	V-1201	18.5	5
		1.1/2"	5.08	----	----	4.1	19.29
42	PR-1201-8"-X1	8"	19.58	V-1201	H-1201	16.4	16
43	PR-1205-8"-X1	8"	19.58	STRIPPER BOTTOM H-1201	PR-1205-6"	21.6	NIL
		1/2"	5.08			5.0	
44	PR-1205-6"-X1	6"	15.20	PR-1205-6"	RECTIFIING COLUM	11.9	21.71
		2"	5.54			5.1	NIL
45	PR-1213-2"-X4	2"	5.54	PR-1201-8"-X1	PR-1205-6"-X1	4.6	16.96
46	PR-1234-3"-X4	3"	7.62	P-1201-A	PR-1638-4"	6.7	12

47	PR-1224-3"-X4	3"	7.62	P-1201-B	PR-1638-4"	6.2	18
48	PR-1637-3"-X4A	3"	9.14	P-1201-C	PR-1638-4"	8.5	7
49	RV-1201C	4"	3.05	PR-1367-3"-X4A	PR-1228-4"-X3	2.1	31.14
50	PR-1666-2"-X4A	3"	5.54	PR-1367-3"-X4A	PR-1226-2"-X4	5.0	NIL
51	RV-1201B	4"	3.05	PR-1224-3"-X4	PR-1228-4"X3	2.8	8.19
52	RV-1201A	4"	3.05	PR-1234-3"-X4	PR-1228-4"X3	2.6	14.75
53	MA-1604-4"-E2	3"	7.62	P-1102C	MA-1604-4"-E2	6.4	16.01
		1.1/2"	5.08			4.8	5.57
		4"	8.56			9.1	NIL
54	MA-1604-4"-E2	4"	8.56	MA01604-4"-E2	MA-1605-6"-E2	7.5	12.38
		3/4"	3.91			3.2	18.15
		2"	5.54			5.2	6.13
		4"	11.13			12.0	NIL
		6"	14.27			13.7	3.9
55	MA-1607-4"-C2	4"	6.02	MA-1604-4"-E2	MA-1116-4"-E2	5.2	13.6
		3/4"	3.91			3.2	18.15
56	MA-1116-4"-E2	4"	8.56	MA-1126-4"-E2	V-1103	7.1	17.05
57	MA-1605-6"-E2	6"	14.27	MA-1123-4"-E2	MA-1106/B-4"-E2	13.3	6.8
		4"	8.56			9.9	NIL
		3/4"	3.91			3.8	2.8
58	MA-1123-4"-E2	4"	8.56	P-1102B	MA-1605-6"-E2	7.8	8.87
		1/2"	4.75			4.1	13.68
		6"	11.13			11.1	0.26
59	MA-1105-4"-C2	4"	6.02	MA-1106/A-4"-E2	MA-1116-4"-C2	5.5	11.96
		1"	6.35			7.1	NIL
60	MA-1126-4"-C2	4"	7.1	MA-1123-4"-E2	MA-1116-4"-C2	7.6	NIL
		1"	4.55			5.4	NIL
		2"	8.71			9.4	NIL
61	MA-1106/A-4"-E2	4"	8.56	P-1102A	MA-1123-4"-E2	7.8	8.87
		1"	4.55			4.3	5.5
62	MA-1202-3"-X4	3"	7.62	MA-1605-6"-E2	V-1201	7.2	5.51
		1.1/2"	5.08			4.3	15.35
		1/2"	5.08			5.1	NIL
63	MA-1106-B-4"-E2	4"	8.56	MA-1605-6"-B2	MA-1203-4"-X1	7.1	17.05
63	MA-1106-B-4"-E2	1.1/2"	5.08	MA-1605-6"-B1	MA-1203-4"-X1	4.2	17.3
		3/4"	5.54			5.2	6.13
64	MA-1203-4"-X1	4"	10.4	MA-1106/B-4"-E2	PR-1230-6"-X1	8.7	16.4
		3/4"	6.35			6.6	NIL
		4"	11.13			10.9	2.06
65	MA-11056"-C2	6"	7.11	V-1103	P-1102A	7.0	1.5
		1.1/2"	5.08			6.4	NIL
		1"	4.55			4.4	3.3
66	MA-1117-4"-C2	4"	6.02	RV OF P-1102A	MA-1105-6"-C2	5.4	10.29
		2"	8.71			8.4	3.55
67	MA-1122-6"-C2	6"	7.11	MA-1105-6"C2	P-1102B	6.0	15.61
		3/4"	3.91			3.7	5.37
68	MA-1125-4"-C2	4"	6.02	RV OF P-1102B	MA-1122-6"-C2	5.6	6.97
		4"	8.56			8.7	NIL
69	MA-1603-6"-C2	6"	7.11	RV OF P-1102C	MA-1122-6"-C2	6.1	14.20
		4"	8.56			7.8	8.87
		1"	4.55			4.1	9.89

70	MA-1609-4"-C2	4"	6.02	RV OF P-1102C	MA-1503-6"-C2	5.5	8.63
		1.1/2"	5.08			5.2	NIL
		1"	4.55			4.4	3.29
71	MA-1108-1"-B2	1"	2.77	MA-1102-6"-C2	MA-1108-3"-B2	2.4	13.35
		1"	3.38			3.0	11.24
72	MA-1113-1"-B2	1"	3.38	MA-1101-6"-C4	MA-1108-3"-B2	2.9	14.20
		1"	3.38			2.8	17.15
73	MA-1101-6"-C4	6"	7.11	COLD NH3 FROM STORAGE	H-1102	6.5	8.57
		3/4"				3.8	NIL
		1"				4.9	NIL
74	MA-1103-4"-C2	4"	8.56	MA-1103-6"-C2	MA-1101-6"-C4	8.7	NIL
			6.02			5.6	6.97
75	MA-1102-6"-C2	6"	7.11	H-1102	V-1102	7.1	0.14
76	MA-1103-6"-C2	6"	7.11	HOT NH3 FROM AMM. PLANT	MA-1102-6"-C2	5.8	18.4
		4"	6.02			6.6	NIL
77	MA-1104-4"-C2	4"	8.56	VAPOUR ELIMINATOR	V-1103	6.9	19.0
78	MA-1107-6"-C2	6"	7.11	MA-1104-4"-C	MA-1102-6"-C2	7.1	0.14
		3/4"	3.91			4.1	NIL
79	MA-1119-1"-B2	1"	4.55	VAPOUR ELIMINATOR	MA-1110-1"-B2	3.1	31.8
80	MA-1110-1"-B2	1"		MA-1101-6"-C2	MA-1108-3"-B2	3.0	NIL
		3/4"					
81	MA-1114-1"-B2	1"		MA-1103-6"-C2	MA-1108-3"-B2	3.0	NIL
		3/4"				3.0	
82	MA-1109-1"-B2	3/4"		MA-1102-6"-C2	MA-1108-3"-B2	3.0	NIL
		1"				3.0	
		3/4"				3.9	
83	MA-1104-3"-C2	3"	5.49	MA-1104-4"-C2 BYPASS	MA-1104-4"C2	4.8	12.56
84	MA-1108-3"-B2	3"		PR-1309-20"-B1	MA-1113-1"-B2	2.6	NIL
85	MA-1115-3"-B2	3"	5.49	RV-1102A	MA-1108-3"-B2	4.5	18.43
86	MA-1115-3"-B2(V-1103)	3"		MA-1115-3"-B2	V-1103		NIL
87	MA-1115-3"-B2(V-1103)	2.5"	5.16	V-1103	MA-1115-3"-B2	4.4	14.72
88	PW-1101-3"	3"	3.05	CO2 KO DRUM	H-1104 CO2 SPRAY COOLER	2.5	18
89	PR-1214-8"	8"	4.57	V-1202	H-1204	3.8	16
90	PR-1602-2"&3"	2"	2.77	P-1304C/D	V-1203	2.4	13
		3"	3.05			2.6	14
91	PR-1301-4"	4"	3.05	T-1301	P-1302A	2.5	18
92	PR-1351-4"	4"	3.05	V-1301	H-1301B	2.4	21
93	PR-1361-4"	4"	3.05	V-1351	H-1351A/B	2.6	14
94	SC-1507-3"	3"	5.48	P-1505 A/B	T-1501/ DEARATOR	5.1	7
94	SC-1243-16"	16"	9.52	H-1202	V-1501	10.5	NIL
95	SC-1239-16"	16"	9.52	H-1202	V-1501	8.9	6
96	4 ATA STEAM SUPPLY HEADER TO STOREGE	8"	8.18	------	-----	7.1	13.2
97	SC-1502-3"	3"	6.02	P-1501/6	V-1501	5.5	8
98	ST-1206-8"	8"	8.2	ST-1506	H-1204	7.7	6

99	ST-1502-8"/3"	8"	8.18	ST-1116	PICV-1502A	8.5	NIL
		3"	7.62	ST-1502	V-1503	5.9	22
		2"	5.54	-----	----	4.6	16
100	SC-1506-4"	4"	6.02	T-1501	P-1505	5.7	5
101	SC-1409-4"	4"	6.02	H-1424	T-1501	6.5	NIL
		2" & ½"				3.1 & 5.8	NIL
102	PR-1302-3"	3"	3.05	P-1302	H-1301	2.5	18
103	SC-1408-4"/3"/2"	4"		H-1422	SC-1530	6.1	NIL
		3"				2.8	NIL
104	ST-1508-4"/3"/2"	3"	5.5	------	------	4.4	20
		3/4"	3.91	ST-1506	PCV-1502	3.8	NIL
105	ST-1352-4"/3"	4"	3.05	23-ATA HEADER	HYDROLYSER	2.7	11
		3"	5.5			4.6	16
106	SC-1212-10"	10"	9.52	P-1204 A/B	H-1207	8.0	15
107	SC-1510-2"	2"	5.5	P-1502	PCV-1501	4.8	12
108	SC-1211-10"/8"	10"	9.27	H-1203	P-1204	9.3	NIL
		8"	8.18			8.5	NIL

Annexure-2

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	2.6	4.0
1.2	Journal bearing pads	1.70.4	
1.3	Journal bearing base ring	1.1	
1.4	Thrust bearing base ring	1.2	
1.5	Thrust collar	16.5	1.0
1.6	Thrust pads	1.4	
2	**Turbine North Bearing**		
2.1	Journal bearing shaft	1.9	
2.2	Journal bearing pads	2.2	
2.3	Journal bearing base ring	1.2	
3	**H P Case South Bearing**		
3.1	Journal Bearing Shaft	2.2	
3.2	Bearing Pads	1.2	
3.3	Bearing base ring	1.2	
4	**H P Case North Bearing**		
4.1	Journal Bearing Shaft	1.2	
4.2	Journal Thrust Collar	3.3	
4.3	Thrust Pads	1.2	
4.4	Journal Bearing Pads	1.1	
4.5	Journal Bearing Base Ring	1.2	
5	**L P Case South Bearing**		
5.1	Journal Shaft Portion	3.0	
5.2	Journal Bearing Pads	1.1	
5.3	Journal Bearing Base Ring	2.3	
6	**LP Case North Bearing**		
6.1	Journal shaft Portion	2.2	
6.2	Journal Bearing Pads	1.1	
6.3	Journal Bearing Base Ring	2.3	
6.4	Thrust Collar	2.5	
6.5	Thrust Pads	1.6	

Sr. No.	Component Description	Max. gauss reading	
		Before	After
7	**Gear Box**		
7.1	HP Pinion Shaft	1.2	
7.2	HP Bearing	2.2	
7.3	LP Pinion Shaft	1.2	
7.4	LP Bearing	0.9	
K-1101/1,CO2 COMPRESSOR			
1	**TURBINE FRONT BEARING**		
1.1	Journal Shaft portion	2.7	
1.2	Journal Bearing	3.4	
1.3	Thrust Collar	8.1	1.1
1.4	Thrust Bearing	1.5	
2	**TURBINE COUPLING END**		
2.1	Turbine Journal	2.2	
2.2	Turbine coupling Shaft Journal Bearing	1.2	
3	**COMPRESSOR COUPLING END**		
3.1	Comp. Coupling Journal Bearing	0.9	
3.2	Compressor Coupling end Journal Bearing Shaft	10.2	0.4
4	**COMPRESSOR THRUST END**		
4.1	Thrust Pads	0.9	
4.2	Thrust Journal Bearing	1.0	
4.3	Thrust end Journal Bearing Shaft	2.4	
	K-1101/2,CO2 COMPRESSOR		
1	**TURBINE FRONT BEARING**		
1.1	Thrust end Journal Shaft	1.6	
1.2	Thrust Collar	3.6	
2	**TURBINE COUPLING END**		
2.1	Coupling end Radial Bearing	1.3	
2.2	Coupling end Journal Shaft	1.9	

ANNEXURE-3

List of High Pressure drains & vent lines for which following inspection activities were carried out.

(a) Visual inspection
(b) DP of all weld joints upto first isolation valve
(c) Thickness of Pressure side pipe

CO2 System :

Sr. No.	Equipment	Description.	No. of vents/ drains
1	K-1101-2	Final discharge line drain with I/V between two dish. I/V	1
		Final discharge vent HICV-1122 U/S line with I/V.	1
		Final discharge header PR-1127 & local PI tapping.	2
2	K-1801	FR-1801 & FR-1803 tapping (HP & LP) lines with I/Vs.	4
		PT-1810 tapping line with I/V.	1
		Final discharge header RV U/S line vent (plugged).	1
		Discharge line 3 nos.PI tapping with I/Vs at bottom of H.P.Case.	3
3 .	FR-1201	HP and LP tapping	2
4	CO2 to H-1201	Header drain line with I/V near H-1201.	1
5	CO2 to H-1203	At G.F. drain line with two I/Vs. At P.T.Top 1. Drain line with I/V D/S of FICV-1202	2
		Drain line with I/V blinded D/S of NRV	1
		Drain line with I/V U/S of final I/V to H-1203.	1

NH3 System :

Sr. No.	Equipment	Description	No. Of vents/drains
1	P-1102 A	Tapping (Capped) with I/V u/s of both recycle .I/Vs	1
2		dish. pressure tapping & drain with between both dish. I/Vs.	2
3	P-1102 B	Disch. PI tapping with I/V	1
		Disch drain 1 No. U/s of both recycle I/Vs & 1 No. Between 2 disch. I/V's	2
4	P-1102 C	a) dish. RV b) 3 No's PI tappings	3
5	P-1102 A/B/C	dish. Header a) 2 No's vent with I/V (cap provided)	2
		b) PIC-1201 tapping line with I/V on First Floor.	1
6	PRC-1201	sensing line tapping with I/V & drain at V-1201 bottom.	2
7	FRCV-1201	HP & LP tappings	2
8	Ammonia to H-1202	a)Vent line with I/V.	1
		b)Blinded vent line	1
		c)Vent line with I/V U/S of MOV.	1

H.P.System :

Sr. No.	Equipment	Description	No. Of vents/drains
1	V-1201	a)Unloading line vent line with I/V blinded at G.F. b) Sample point tapping line with I/V at first floor. c) Top channel cover level tapping blinded	3
2	H-1201	a) Sample point tapping line with I/V at G.F. b) bottom drain blinded c) top vent blinded	3 1
3	H-1203	Offgas vent line with I/V (blinded) between PRCV-1201 & its I/V.	1
4	P-1201A/B/C	P-1201 A/B/C drain line with I/V between both dish. I/V. (PR-1638-4"X1A)	3

HPF line :

Sr.No.	Equipment	Description	No. Of vents/drains
1	H-1201	CO2 to H-1201 drain with I/V between both I/V (G.F.)	1
2	H-1201	H-1201 Sample point line. (G.F.)	1
3	P-1201A/B/C	Carbamate dish. Line drain with I/V between both I/V. (F.F.)	1
4	V-1201	NH3 to V-1201 – drain line with I/V and flushing line in between both I/V (Third Floor) & d/s of both I/V's	2
5	H-1203	Carb. To H-1203 – drain line with I/V between both I/V (above 4 th floor).	1
6	H-1202	Car. To H-1202 – drain line with I/V between both I/V (3 ½ floor).	1
7	H-1202	NH3 to H-1202 – drain line with I/V between both I/V (3 ½ floor).	1
8	H-1203	H-1203 drain line (Bottom) drain line with I/V (2 nos.) d/s of I/V .	1
9	H-1203	CO2 to H-1203 drain with I/V between both I/V . (P.T.Top)	1
10	P.T.Top	HPF bleeder with I/V. 1. Drain line with I/V of HPF to HIC-1202. 2. Drain line with I/V of HPF to PRCV-1201.	2
11	HPF pump	a) disch RV at Ground floor b) Disch PI tapping at ground floor	2
12	P.T. Top	HPF loop P.T. Top vent with I/V	1

OFFSITES & UTILITY PLANT

During Shutdown 2006, the following major inspection activities were performed in Utility Plant.

1. Inspection of BHEL boiler drums and furnace tubes.

2. Inspection of deaerator.

3. Inspection of expansion bellows of CW supply line to Urea plant and Underground cooling water line of 52" NB from Sump of P-4401 C/D to sump of P-4401 E.

4. Visual inspection of Instrument air receiver tank.

5. Inspection of Cooling Towers structures.

6. Thickness of pipelines as per Annexure-7.

The detailed observations on individual equipment are given below.

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:

1. The internal surface of the drum had assumed blackish brown coloration.

2. All the weld joints were found in good condition and free from any corrosion attack.

3. 02 nos. C clamp fasteners and 02 nos. angle support fasteners of distribution pipe on North side(2^{nd} & 3^{rd} counting from West side) found loose.

4. 4^{th} C clamp counting from West side found loose as a gap of approx. 5mm was observed between nut and angle support.

5. 1 no fastener missing of bottom plate just opposite 4^{th} C clamp and also 1 no. nut-bolt found loose of Separator plate on south side.

6. Blow down pipe(1"NB) inside the steam drum has got bulged at one portion. The measured outside diameter at bulged portion is 33.25 as against other portion where the Outside diameter is 31.85 mm.

Overall condition of the steam drum was found to be satisfactory.Ultrasonic thickness measurement was carried out. Min. thickness was observed to be 99.8 mm against nominal specified thickness of 97 mm in cylindrical shell area and 79.3 mm on dished end against nominal specified thickness of 77 mm.

Detailed report is attached at **Annexure- 1**

MUD DRUM:

1. The shell had assumed blackish brown coloration.

2. 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 81.3 mm in cylindrical shell area against nominal specified thickness of 78 mm and 56.1 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 :

1. One no. spring loaded safety valve located on the top observed to have leakage from “O” ring.

2. 5th sieve trays(counting from bottom) was found lifted dislocated from its position the same was repaired by Mech. Maint. Crew.

Deaerator Storage Shell :

1. Brownish coloration was observed inside the shell.

2. Condition of the weld joint was found satisfactory.

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. The Summary indicating the thickness of individual type of the tubes is given below:

SL. NO.	DESCRIPTION	MIN. THK. (MM)	DESIGN THK. (MM)	% RED	REFER ANNEXURE
1	SOUTH MANHOLE:				
(A)	BAFFLE WALL TUBES	4.2	4.5	-	**Annexure - 3,8**
(B)	D-PANEL TUBES	4.6	4.5	-	**Annexure - 3,8**
(C)	CUT CORNER TUBES	5.2	4.5	-	**Annexure - 3,8**
(D)	REAR WALL TUBES	5.1	4.5	-	**Annexure - 3,8**
(E)	FRONT WALL TUBES	4.4	4.5	-	**Annexure - 3,8**
2	NORTH MANHOLE:				
(A)	BANK TUBES	3.4	3.6	2.78	**Annexure - 4,8**
(B)	BAFFLE TUBES	4.8	4.5	-	**Annexure - 4,8**
(C)	NORTH SIDE WALL TUBES	4.7	4.5	-	**Annexure - 4,8**
3	PRIMARY SUPERHEATER TUBES INSIDE FURNACE (STAGE-I)	6.8	7.1	11.27	**Annexure - 5,8**
4	SECONDARY SUPERHEATER TUBES INSIDE FURNACE (STAGE-II)	5.4	5.6	10.71	**Annexure - 6,8**

COOLING TOWER AREA:

Visual inspection of all the cooling tower shell including its riser and distribution headers was carried out. The detailed observations made are as under:

Ammonia Cooling Tower, H-4401(1 to 8)

Tower Shell:

1. Vapour eliminators were found displaced from their slots at scattered locations and loose hard debris found adhered on its surface.

2. Partition wall between shell 3rd and 4th found to have one support broken which has resulted in displacement of wooden flats. Repairing is recommended.

3. Horizontal support (4th from bottom) of partition wall between 2nd and 3rd shell found broken at the place of its fasteners.

Cooling Water Return Header:

1. 36" NB riser at East side and 24" NB riser at West side found to have damaged wrapping/coating at its bottom and gap is observed between 24" NB riser and flooring. Application of wrapping/coating and cementing of flooring is recommended.
2. Vertical structural support for East & West side C.W. return header found corroded at its bottom half. Strengthening and repainting of structure is recommended.
3. Circumferential welding joint of 48" NB vertical pipe connecting two horizontal 48" NB pipe at East side of return header found to have undercut throughout the weld joint. Welding is recommended as insufficient welding is observed.
4. Blisters of paint were observed on riser pipe and scales/oxide films were found below it.
5. Puncture was observed on East side C.W. distribution pipe at the location of distribution valve for A-5 shell. Repairing is recommended.
6. Corrosion was observed on C.W. distribution pipe at the location of valve for shell no. A-3 on West side and below the valve.
7. Painting at following locations was found poor, repainting is recommended after proper cleaning:

   a. 18" NB line to cooling tower no. A-7 and A-8.

   b. Suction and discharge pipelines of CW pump P4418 A/B. Flooring around discharge line is broken causing gap around the line. Re flooring is suggested to avoid water logging around pipe.

   c. Pipe line connected to VAG filter A & B to cooling tower return header and cooling tower. Its support was also found corroded from bottom.

   d. Cable trench support structure found heavily corroded. Few clamps were also found broken. Strengthening of structure and repainting is recommended.

<u>Urea Cooling Tower (New) – H-4404 :</u>

Tower Shell:

1. 11^{th} and 4^{th} bottom most vertical support (counting from south side) at the sump of 5^{th} row (counting from west side) found to have cracks in almost full length of support.
2. 1^{st}, 2^{nd} and 3^{rd} horizontal & vertical support (from South side) at the sump of 4^{th} row (counting from west side) found eaten away at the bottom most junction of horizontal & vertical support. Replacement of the same is recommended.
3. Support of the fire water line at the North side of tower found corroded. Strengthening of support is recommended.
4. Vapour eliminators were found displaced from their slots at scattered locations and loose hard debris found adhered on its surface.

Cooling Water Return Header:

1. Riser at East and West side found to have damaged wrapping/coating at its bottom. Application of wrapping/coating is recommended.

2. Blisters of paint were observed on riser pipe and scales/oxide films were found below it.

3. Painting at following locations was found poor, repainting is recommended after proper cleaning.

   a. 6" NB line to cooling tower and flaw meter station piping at the North side of cooling tower.
   b. Fire water line.
   c. Structural support in surrounding area.

Urea Cooling Tower (Old) – H-4402 :

Tower Shell:

1. A wide crack was observed in the horizontal (East-West) wooden support at two places at the location of its fasteners, and bolt head has gone inside of the crack opening. (Location : 2^{nd} and 6^{th} row of support connecting from north side at a junction of 4^{th} support from the bottom).

2. Few wooden flats found displaced from the vertical partition wall between the shell compartments.
3. Drift eliminators found displaced at scattered locations.

C.W Return Header:

1. A gap was observed between wrappings provided at bottom of west side Riser pipe, which was resulted in rusting on pipe. Proper coating & wrapping is suggested.

2. Overall condition of both the riser pipe and distribution header was found satisfactory, however blisters of paint were observed on riser pipe, and scales/oxides were found below it. Painting is recommended after removal of oxide film/rusting.

3. Valve bonnet of the C.W distribution valves requires painting after removal of rusting/oxide films.

4. Cable trench at north side of C.T found corroded at its bottom half's. Strengthening and painting of the same recommended.

Sand Filter Area :

1. Channel support of 6" NB C.W line going to C.T basin found eaten away from its bottom. Replacement/repairing of the same is recommended.

2. Painting at the following locations was found poor, repainting is recommended after proper surface preparation i.e removal of oxide films and scales.

3. Pipe lines connected to old sand filter.

4. 4" NB elbow coming from the underground at the east-north end of the sand filter found badly corroded. Corrective actions are suggested to avoid leakage.

5. 4" NB fire hose line.

6. ¾" NB water line from west side riser pipe to metering station.

7. Flow meter station support structure bottom half.

8. 3" NB water line at the south side of urea C.T which is running from east to west on the C.T basin top.

9. NaOH tank top and ½" NB line from its top also found corroded. Repainting is recommended.

10. Apart from the above visual inspection, 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 as below.

Committee has inspected the following cooling towers

(a) H-4401 (6 cells for Ammonia plant)
(b) H-4402 (3 cells for Urea plant)
(c) H-4403 (2 cells for Ammonia plant, i.e. A-7,A-8)
(d) H-4404 (3 cells for Urea plant, i.e. New Cooling Tower)

Major thrust of inspection was given on the following areas.

1. Exterior wooden structures.
2. Interior wooden structures.
3. Exterior steel structures.
4. CT Return risers and distributor headers.
5. 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	√	
	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	√	
	H-4403(2 cells for Ammonia plant, i.e. A-7,8)		
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	√	
	H-4404 (3 cells for Urea plant, i.e. New Cooling Tower)		
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	√	

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	√	
	H-4402 (3 cells for Urea plant)		
1	Load bearing Columns	√	
2	Diagonals	√	
3	Partitions and doors	√	
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	√	

Sr. No.	Item	Satisfactory	Repair/ Replace
	H-4404 (3 cells for Urea plant, i.e. New Cooling Tower)		
1	Load bearing Columns	X	Few columns are found bent and needs partial repair/strengthening/replacement. Repairing / replacement of wooden members were carried out.
2	Diagonals	√	
3	Partitions and doors	√	
4	Drift eliminators	√	
5	Walkway	√	
6	Long rails	X	Few long rails are found bent and needs partial repair/strengthening/replacement. Repairing/ replacement of wooden members was carried out.

Exterior steel structures:

Sr. No.	Item	Satisfactory	Repair/ Replace
1	**H-4401 (6 cells for Ammonia plant)**		
	Steel structures a) Pipes supports b) Cable trays c) Ladders & hand railings d) Connecting platform for H-4403	X	At few places corrosion is observed and repair/replacement/painting is required.
2	**H-4402 (3 cells for Urea plant)**		
	Steel structures a) Pipes supports b) Cable trays c) Ladders & hand railings	X	At few places corrosion is observed and repair/replacement/painting is required.
3	**H-4403 (2 cells for Ammonia plant, i.e. A-7,A-8)**		
	Steel structures a) Pipes supports b) Cable trays c) Ladders & hand railings d) Connecting platform for H-4403	X	At few places corrosion is observed and repair/replacement/painting is required
4	**H-4404 (3 cells for Urea plant, i.e. New Cooling Tower)**		
	Steel structures a) Pipes supports b) Cable trays c) Ladders & 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	√	1) Radiography of bottom most cir seam was carried out and no indication of weld joint corrosion were observed. Thickness measurement was done & found O.K. 2) Coating wrapping of riser at the ground level needs repair.
2	Horizontal distribution headers	√	Thickness measurement was done & found O.K.
	H-4402 (3 cells for Urea plant)		
1	Return Risers	√	Radiography of bottom most cir seam was carried out and no indication of weld joint corrosion were observed. Thickness measurement was done & found O.K.
2	Horizontal distribution headers	√	Thickness measurement was done & found O.K.

Sr. No.	Item	Satisfactory	Repair/ Replace
	H-4403 (2 cells for Ammonia plant, i.e. A-7,A-8)		
1	Return Risers	√	1) Radiography of bottom most cir seam was carried out and no indication of weld joint corrosion were observed. Thickness measurement was done & found O.K. 2) Coating wrapping of riser at the ground level needs repair .
2	Horizontal distribution headers	√	Thickness measurement was done & found O.K.
	H-4404 (3 cells for Urea plant, i.e. New Cooling Tower)		
1	Return Risers	√	1) Radiography of bottom most cir seam was carried out and no indication of weld joint corrosion were observed. Thickness measurement was done & found O.K. 2) Coating wrapping of riser at the ground level needs repair
2	Horizontal distribution headers	√	Thickness measurement was done & found O.K.

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	X	Reinforcement bars are got exposed at few locations & needs reinforcement.

Expansion Bellows:

Expansion bellow of CW supply line to Urea plant was inspected visually in painted condition and following observations were made.

1. Cracks were observed on bellow outer surface between the fasteners, this was found all around on bellow near pillar no. 9 where as the same was observed at scattered location on bellow near pillar no.17.

2. Superficial cracks were observed on the rest of the outer surface of both the elbow.

3. Hardness measurement was carried out and found to be 85-96 shore A on both bellow.

4. **U/G COOLING WATER LINE (52"NB) FROM SUMP OF P- 4401 C/D TO P-4401-E :**

5. Epoxy paint found peeled off from many locations which had resulted in oxide formation at those locations.

6. Blisters of epoxy paint were also found at many locations.

7. Removal of oxide layers , blisters and application of epoxy paint at such locations is recommended to prevent any corrosion.

8. Epoxy paint of suction elbow of CW pump P-4401/C, P-4401/D and P-4404/E was also found damaged at many location, proper cleaning and application of protective coating is recommended to prevent corrosion.

Instrument Air Receiver Tank, V-5301:

1. The vessel inside was found brownish black in colouration.

2. Lot of scales and debris-oxide films were found collected at bottom dished end. Proper cleaning and removal of oxide film is recommended.

3. Scattered pitting up to depth of approx. 2.5 mm was observed on entire bottom dished end.

4. The vessel shell and top dished end found free from any corrosion attack as seen from bottom dished end.

5. Thickness measurement of vessel was carried out. Minimum thickness of 16.9 mm and 16.0 mm was found on bottom dished end and shell respectively.

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.

ANNEXURE -1

THICKNESS MEASUREMENT REPORT OF STEAM DRUM

SHELL	**Design Thickness : 97 mm**			
POINT NO.	**TOP**	**BOTTOM**	**NORTH**	**SOUTH**
(W to E)				
1	100.7	100.5	101.1	100.1
2	-	-	101.5	101.6
3	-	-	101.4	101.0
4		-	100.2	101.6
5	-	-	99.8	101.4
6	100.6	100.0	101.1	101.2
DISH END:	**Design Thickness : 77 mm**			
POINT NO.	**TOP**	**BOTTOM**	**NORTH**	**SOUTH**
East	80.0	84.8	85.8	83.8
West	84.3	79.3	83.1	83.7

ANNEXURE -2

THICKNESS MEASUREMENT REPORT OF MUD DRUM

SHELL:	**Design Thickness : 78 mm**			
POINT NO.	**TOP**	**BOTTOM**	**NORTH**	**SOUTH**
(W to E)				
1	81.4	82.0	81.8	81.5
2	82.3	81.8	82.1	81.9
3	82.1	81.7	81.9	81.7
4	81.8	81.7	81.9	81.9
5	82.0	81.3	81.8	81.9
6	81.8	81.6	81.6	81.8
DISH END:	**Design Thickness : 57 mm**			
POINT NO.	**TOP**	**BOTTOM**	**NORTH**	**SOUTH**
East	56.1	55.6	54.6	56.8
West	55.7	56.1	58.0	58.3

ANNEXURE -3

THICKNESS MEASUREMENT REPORT OF D-PANELTUBES ,CUT CORNER TUBES, REAR WALL TUBES, FRONT WALL TUBES & BAFFLE WALL TUBES

D-PANEL TUBES		
TUBE NO.	TOP	BOTTOM
1	5.2	5.4
6	5.3	5.4
11	4.6	5.3
16	5.4	5.2
21	5.2	5.5
26	5.1	4.9
31	5.4	5.4
36	5.1	5.1
41	5.4	5.4
46	5.5	5.5
51	5.2	5.2
56	5.2	5.2
61	5.2	5.2
66	5.5	5.5
71	5.7	5.6

CUT CORNER TUBES:		
TUBE NO.	TOP	BOTTOM
76	5.9	5.9
81	5.7	5.8
86	5.4	5.2
91	5.5	5.7
96	5.4	5.5
101	5.5	5.3

REAR WALL TUBES:		
TUBE NO.	TOP	BOTTOM
106	5.5	5.1
111	5.1	5.2
116	5.1	5.2

FRONT WALL TUBES:		
SL. NO.	TOP	BOTTOM
1	4.4	4.6
6	4.7	4.9
11	5.1	4.9
16	4.4	4.6
21	4.9	4.8
26	4.7	4.9
31	4.8	4.4
36	5.1	5.2
40	5.1	5.2

BAFFLE WALL TUBES:		
SL. NO.	TOP	BOTTOM
1	5.3	5.1
6	5.2	5.1
11	5.1	4.7
16	5.1	5.1
21	5.1	4.2
26	5.1	4.6
31	5.6	4.6
36	5.2	4.5
41	5.1	4.5
46	5.4	4.6
50	5.2	4.6
55	5.4	4.8
60	5.4	4.6
63	5.2	4.8

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**
1	3.6	3.4
6	3.4	3.4
11	3.5	3.4
BANK TUBES "B" WALL(Design Thickness : 3.6 mm)		
TUBE NO.	**TOP**	**BOTTOM**
16	3.4	3.6
BANK TUBES "C" WALL(Design Thickness : 3.6 mm)		
TUBE NO.	**TOP**	**BOTTOM**
21	3.5	3.5
26	3.5	3.4
27	3.5	3.4
28	3.4	3.4
30	3.8	3.5
BAFFLE ("D") WALL TUBES (Design Thickness : 4.5 mm)		
TUBE NO.	**TOP**	**BOTTOM**
1	4.8	4.8
6	5.1	5.1
11	5.1	4.8
13	5.3	5.2
NORTH SIDE WALL TUBES: (Design Thickness : 4.5 mm)		
TUBE NO.	**TOP**	**BOTTOM**
1	4.7	4.8
6	4.7	4.7
11	4.7	4.8
16	4.9	4.8
17	4.7	4.7

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.	**TOP**	**BOTTOM**
1	7.7	7.8
3	8.4	8.3
5	8.5	8.3
7	8.5	8.3
9	8.2	8.0
11	8.3	8.8
13	8.0	8.2
BEND-B		
TUBE NO.	**TOP**	**BOTTOM**
1	7.4	7.5
3	7.1	7.3
5	7.1	7.2
7	7.6	7.7
9	7.6	7.7
11	7.3	7.5
13	7.1	7.4
BEND -C:		
TUBE NO.	**TOP**	**BOTTOM**
1	6.9	6.8
3	6.9	6.8
5	7.2	7.1
7	7.5	7.4
9	7.4	7.3
11	7.2	7.1
13	7.2	7.0
BEND-D		
TUBE NO.	**TOP**	**BOTTOM**
1	7.1	7.0
3	7.1	7.0
5	7.5	7.4
7	7.2	7.0
9	7.2	7.1
11	7.3	7.2
13	7.3	7.1

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.	**TOP**	**BOTTOM**
1	6.7	6.6
6	6.3	6.2
11	6.1	6.0
12	5.8	5.8
16	5.9	5.9
NORTH WALL BEND		
TUBE NO.	**TOP**	**BOTTOM**
1	6.2	6.0
6	6.1	6.0
11	5.9	5.8
12	6.3	6.1
16	6.1	5.9
EAST WALL BEND		
TUBE NO.	**TOP**	**BOTTOM**
1	5.9	5.7
6	5.6	5.5
11	5.5	5.5
12	5.6	5.4
16	5.7	5.5

Note :

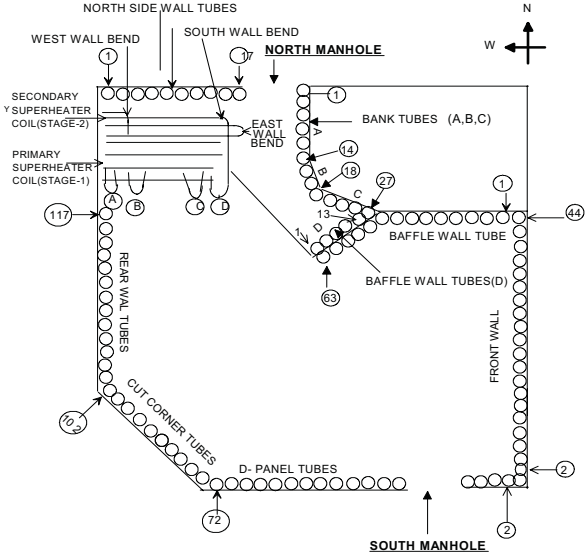
1. All readings are in MM
2. Refer annexure-7 showing tube layout & numbers identifying the individual tubes.
3. Design thickness of tubes : 5.6 mm

ANNEXURE-7

Thickness of following pipelines were carried out:

1. Riser & Distribution header for Ammonia C.T (H-4401- 1 to 8),(H-4402 -1To 3) and H-4404-1 to 3)
2. 6" NB steam inlet line to C.W. pump drive turbine Q-4403
3. 6" NB BFW line from boiler to BFW coil in ammonia plant & from BFW coil to Boiler.
4. Suction and discharge lines of all the C.W. Pumps.

ANNEXURE-8



BHEL BOILER FURNACE LAYOUT
(GT-2068)

Control valve : Maintenance jobs

FRCV- 1 : C/V diaphragm was opened and checked, found ok.General cleaning was done in positioner. C/V stroke was checked.

FRCV-2 : C/V was opened from bonnet and bottom flange. Plug stem was made new one in workshop & replaced. Also fine cut was taken on plug.Inpected seat rings & lapping was carried out for tight shut off. Prepared new gland follower bush. Replaced all gland packing. Actuator diaphragm was opened and checked, found ok. Replaced control valve postioner as there was leakage. 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 packings and stroke was checked.

PICV-14 : C/V was opened from bonnet. Plug and seat taken out for inspection did machining on plug-steam. All parts were cleaned, overhauled and assembled checked it for tight shut off on test bench. Provided new gland packings finally C/V stroke was checked.

MICV 1A TO 9A : Opened the control valve from line & Refixed after completion of pri.reformer revamp work. Finally Checked the stroke.

MICV-1, 8 & 9 : C/V were 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. stroke was checked.

MICV- 29 & 30 : C/V opened from line flanges. Diaphragm was opened and checked. Replaced by new one. Plug and seat were machined and lapped if required . All parts were cleaned and overhauled. C/V assembled & C/V stroke was checked.

LCV-134 : Control valve was opened from line, All parts were cleaned and overhauled. C/V assembled & reinstalled and finally stroke was checked.

PICV-137 : Control valve was opened from line, All parts were cleaned and overhauled. C/V assembled & reinstalled and finally 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.

LCV-16 : General cleaning was carried out & provided new gland packings & checked stroke.

LCV-18 : General cleaning was carried out & provided new gland packings & checked stroke.

LCV-19 : General cleaning was carried out & provided new gland packings. Replaced the hand jack assembly & checked stroke.

TRCV - 142 : General cleaning was carried out & provided new gland packings & 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 : C/V preventive Maintenance was done. Replaced the air volume booster and overhauled the slider valve of PICV-13A. Finally C/V stroke was checked.

FICV-9,10,11 : Preventive maintenance was carried out of all three valves. Checked the stroke found ok.
Relocated the I/P converter of FICV-9 control valve for that necessary tubing & cabling job done.

FICV-7,8,15 : (103J Antisurge control Valves) : ESP: All three valve were removed from line, maintenance was carried out & passing was checked on test bench. Provided new pneumatic volume boosters & quick exhaust in all three valves & necessary 3/8" ss tubing was done for quick opening of control valves operation. Checked the stroke found ok. provided new valve positioner in FICV-15 & it was calibrated for linear valve stroke.

PICV-3 ; C/V was opened from line,Plug,seat,cage were taken out, did machining by fine cut/lapping on plug and cage All parts were cleaned, overhauled finally assembled & it was checked for passing on test bench finally checked stroke.

PICV-1027 : C/V was opened from line, All parts were cleaned, overhauled and assembled & Plug and seat taken out for inspection did machining by fine cut/lapping on plug & it was checked for passing on test bench. checked it for tight shut off on test bench. Provided new gland packings finally C/V stroke was checked & handover valve to Technical Department to install at new location parallel with PICV-3 HTS outlet.

PICV-6 ; (V-27) C/V was opened from line,Plug,seat, were taken out, and did machining by fine cut/lapping on plug & seat. All parts were cleaned, overhauled & finally assembled& it was checked for passing on test bench. Replaced the valve positioner & reinstalled and adjusted stroke.

PRCV-4 : C/V was opened from line, Plug, seat, were taken out, and did machining by fine cut/lapping on plug & seat. All parts were cleaned, overhauled & finally assembled & it was checked for passing on test bench & reinstalled and adjusted stroke.

FICV-14 : C/V was opened from line. Plug,seat,cage were taken out, did machining by fine cut/lapping on plug and cage All parts were cleaned, overhauled, finally assembled & reinstalled and checked stroke.

General Maintenance & stroke checking :

In following control valves general /cleaning, greasing & preventive maintenance were carried out . Provided new gland packings. Also valve positioner was cleaned and air header & regulator also flushed finally stroke was checked.

1.	TRCV-142A	7.	PICV-20	14.	LIC-185
2.	V-7	8.	LICV -416	15.	PICV-100A & B
3.	V-5	9.	FICV-470	16.	MICV-22
4.	MICV-61	10.	PRCV-25	17.	MICV-56,57
5.	PRC-23	11.	PRCV-24	18.	MICV-13,14,15,16
6.	V-18	12.	PRCV-18	19.	PICV-139
7.	MICV-1 to 9	13.	MICV- 24 to 32		

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 This 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.

2. **HIC-101J :** General cleaning and overhauling of governor positioner carried out , replaced it's gauges, and air regulator, checked lock out relay, cylinder leakage . Positioner was fixed and stroke checking was performed.

Ammonia Refrigeration Compressor (105J):-

1. **Following jobs were carried out for installation and commissioning of 3500 series vibration monitoring system for Refrigeration Compressor :**

   a) Removed all old 7200 series BNC radial vibration , axial displacement, and speed probes and all proximitors along with relevant junction boxes and extension cables.

   b) 7200 Series monitor Rack in control room was removed and new 3500 series monitor rack was installed . Necessary cabling for powering up the rack and for earthing was done.

   c) New 3500 series proximitors were mounted in junction boxes and JBs were installed at respective locations. Installation of new compatible probes for axial displacement, radial vibration ,keyphasor and accelerometer along with extension cables and proximitors was carried out in field.

d) Individual loops were checked for continuity between field and control room.Probe characteristics were verified using TK-3 kit and gap voltages were set for all the installed probes.

e) Necessary changes were done in rack configuration ,data acquisition and operator display software for capturing the data for 105J in operator display PC in control room. Rack monitors were configured as per operational requirement. Functional checking of modules was performed.

f) One new TDX-net was installed and one existing TDX-connex was upgraded to TDX-net for interfacing with DM-2K computer. Necessary configuration was done in DM-2K software for capturing static and dynamic data from monitoring rack via TDX-net .

g) DCS communication was established for all radial vibration, axial displacement, trip relay , alarm relay and speed tags. The values of all points were verified by simulation with the help of TK-3 kit. Trip/alarm signals were also checked by simulation.

2. **PRC-9** – 105J Governor's pneumatic actuator assembly was checked . Replaced complete actuator assembly.. Checked Its stroke and lock-out relay functional .

Synthesis Gas Compressor (103J) :-

1. Removed all radial , axial and key-phasor probes alongwith relevant junction boxes, proximeters , speed pick-ups,T/C, pressure gauges and This 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.

2. **PRCV-12** general cleaning, overhauling and functional checking was performed. Its piston/cylinder were lubricated. It's air regulator, gauges was replaced. Checked air failure function. Stroke-checking from control room was performed.

3. **MIC-23** Governor positioner cleaning/checking was done, replaced its all PI's and its stroke checking was performed.

Revamping of 103J LP and HP case:-

1. Installed K type thermocouples in LP and HP case for measuring radial and thrust bearing temperatures and configured in DCS for indication. Laid 12 pair cable for 103J T/Cs. Glanding/Dressing of cable was carried out.

2. Installed new LP and HP case radial vibration and axial displacement probes at the new locations and adjusted the gap voltage.

3. Worked with Dresser-Rand engineers so as to provide proper placing and routing for all probes and T/Cs, and to provide hose for all the points.

4. Relocation and retubing of 103J local instruments was done.

5. Replaced two damaged probes of HP turbine point no. 4V,4H along with its extension cables and metallic conduits.

FIELD INSTRUMENTS JOBS:

1. Replaced four manually latching solenoid valves with new auto reset solenoid valves of following C/V—PIC-137,PIC-139,FIC-100A & B and for that necessary tubing and cabling was done.

2. TI-147: Replaced the heater outlet RTD with the new RTD.

3. LIC-105 and LIC-103 controller's general maintenance were carried out.

4. Removed thermo wells of 117-C, 118-C, and 119C and120-C and replaced with the new one.

5. Replaced TI-0046 and TI-0047 with new T/W and T/C at the inlet of 102-C.

6. 102J steam inlet damaged thermowell was replaced by new one.

7. Provided new cable, JB near auxiliary boiler for PDI-52A, PDI-52B, O_2 analyser O/P, POWER OF VS-1, PRC-19 I/P and PAL-199.

8. VS-4 : Provided additional solenoid valve in parallel with existing S/V for manual field operation and retubing was done. Interlock actuation and valve opening was checked and found ok.

9. Manual loader provided for Id fan and 104J to facilitate mech. job of overspeed checking.

10. Removed the 115JA and B instruments (Speed pickup, probes, T/Cs) to facilitate mech. Work for the inspection of bearings.

11. Removed the instruments of auxiliary boiler PSH-235, PSL-219, PSL-218, Steam flow Tx. to facilitate mech. Work for auxiliary boiler refractories.

12. MDEA tank level indicating tube replaced by new tube.

13. Shifting of FI-46 Tx. and FR-95 Tx. along with pitot tube to new location.

14. Replaced PT-80 with new Yokogawa Transmitter.

15. Provided new impulse line of PT-7 transmitter.

16. Mechanical DP measurement / Hydro testing machine tubing done. Provided high range pressure gauges for hydro test of vessels and lines

17. 102C: Hydrogen removing/Trace relieving job was carried out by mech. Facilitate mech to fix up T/Cs.

18. Removed Old pipe and JB's related to the 7200 series vibration monitoring for 105J compressor area to ammonia control room.

19. LIC-101:102EA CO2 stripper: Provided new stand pipe & reinstalled level transmitter (LI-101A) also provided pneumatic masonelian leveltrol for parallel indication. (LIC-101).

20. Start-up heater Igniters and solenoids valves were cleaned and functionally checked.

21. Instrument air headers flushing were carried out in different areas.

22. 104-J and 107-J solenoid valve opened to facilitate mechanical jobs and fixed back after completion of job.

23. 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.

24. Trip circuit of the all compressors were checked with production people and adjusted switches as per requirement and design trip value.

25. Opened O2 analyser, checked furnace, sample filter and electrode and finally checked calibration.

26. FIC-9: Relocated I/P near to C/V. rerouting of tubing and cable were carried out.

27. PIC-13A: tubing removed to facilitate mech. Dept. for changing of bonnet gasket and same was fixed back after completion of Work .pneumatic slider overhauling was done and replaced the booster with new one.

Primary reformer(Revamp) :

1. PT-48A to PT-56A , MIC-1A to MIC-9A and PRC-19A&B, PSH-236 were removed to facilitate revamping of prim. Reformer and same was fixed back.

2. 16 nos. Primary reformer bottom header thermocouple taken out and replaced all by new T/Cs with new thermowells.

3. Removed the entire tunnel T/Cs for inspection and refixed and replaced three T/Cs –TI-0071, TI-0073, TI-0077 with new T/Cs.

4. 4. TI-00117: Replaced thermowell and T/C with the new one.

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. Pushbutton provided for MT-IS7 Manual trip, MT-IS103G manual trip at auxiliary console and same was configured in PLC.

2. Logic modification as per the requirement of production people against MWO and checked the modified logic in presence of production people.

3. Checked all console push button, indicating, limit switch lamps and tightened the connections.

Technical Dept. Jobs :

1. Removed PICV-1027 from pre-reformer and installed it as MIC-003 parallel to PICV-3.

2. MIC-003 : Configured the loop in DCS and did ferruling at Tx, I/P,JB and control room side. Checked Continuity and stroke of the valve.

3. Relocated all the instruments --DG points, PDSL-52, O2 analyser to new locations near ID fan and done sample and air supply tubing job so as to facilitate technical dept. for installation of coils.

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. 5 nos. of Battery cells were replaced with the new cells in battery bank.(cell no. 69, 84, 121, 132 and 161).

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 1 cycle of discharging was carried out . Reading of each battery cell was taken.

5. Final check of UPSS & battery operation was carried out and found ok. Details are as under

Duration : 90 minutes	AC load current : 103 A
AC output voltage : 115 V ac	Battery discharge up to :200 V dc

Alarm and trip settings for UPS-1 and UPS-2 were found as below :

UPS-1 : a) Alarm setting - 200 VDC b) Trip setting : 193 VDC

UPS-2 : a) Alarm setting - 202 VDC b) Trip setting : 195 VDC

After completion of AMC jobs the Battery bank performance was found satisfactory.

YBL DCS

1. The preventive maintenance of DCS was carried by M/s YBL as per the AMC. All EFCD, EOPS, HIS ,EFMS and Engineering stations circuit PCB cards were removed from cabinet/panel and cleaned. Overhauled the fans, cleaned the filter, panels and cabinets.

2. All the jobs related with AMC were attended. Checked the redundancy for CPUs, MAC2 cards, power supplies and HF buses. Replaced the power supply card (PS40) in EFCD-2. Checked system components healthiness. All system components were found working O.K. Taken the latest backup of complete DCS on magnetic tape and CD.

3. System voltage measurement has been carried out. Voltage level was found within specified limit.

4. M/s YIL has done I/O mapping in I/O builder and generate control drawing for analog tags and digital tags. Cross checked and verified the vibration tag's (Analog & Digital) reading of Bentley system with CS3000 system- It was found O.K.

HIMA PLC

1. The preventive maintenance of HIMA PLC was carried out. 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. Checked Error code by removing every card and redundant card(If applicable),fuse etc. One out of the three power supply cards in PLC 1 was not taking the load. The whole system was checked in presence of PLC representative for fault diagnostic measure.

3. Prepared/modified/defined/wired/tested the (IS-7) Ammonia synthesis TRIP logic & (IS-103G) TRIP OF 103J in ELOP of PLC-1 ,wizcon operator station and sequence event recorder.(ESP JOB)

4. Modification was done in some of the existing logics as per the MWO—IS-101B ,I-20, IS-103H Logics, 101-F LOW LEVEL input provided in I-47 logic. MOS provided for output MIC-22 in IS-103A, for output TTV 116JTA in I-306, for input IS-5 in I-5B logic.

5. Cleaned all the five Power supply units (110VAC to 24VDC). Voltages of individual racks of all the PLCs are measured and found healthy.

6. Faulty F 6214 card at locations 2401 in PLC 2 was replaced by new F 6214 card.

7. Back up copy of all the programs (ELOP and Wizcon) were taken.

ABB CO2 and CH4 Analyser(AR-1 & AR-2)

1. The preventive maintenance of ABB make CO2 and CH4 analyser was carried out.

   a) CO2 and CH4 Analyzer was 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. **PDR-26,PDR-27,PDR-34,PDR-35,PDR-36,PDR-37**:- Replaced pneumatic Tx. By new smart electronic TX. Cable laying , cable tray job, S.S. impulse tubing and JB installation were carried out.

2. Installation of steam drum level monitoring system- “LEVELSTATE”. Replaced old electrode chamber with the new electrode chamber. Installed control box with its local indication near steam drum. Cable laying, JB installation were carried out. Installed remote indication of 101-f level at auxiliary panel in control room . Provision done for alarm and trip in DCS and PLC.

3. **LIC-41,LIC-42**:-Installation of new Radar type level Tx. for measuring level of 103J LP and HP case seal oil tank in place pneumatic leveltrol. Configured the loop in DCS and did ferruling at Tx, JB and control room side. Provision done for AOP start and trip in PLC.

4. Replaced 7200 series vibration system with the 3500 series vibration system for Refrigeration compressor(105J).

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 for the UPS1 and 2 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. Overhauled 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 were 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 were 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:**

   6.1) HIC-101J for 101JT: Carried out general cleaning and overhauling. Changed air regulator of Governor Positioner, stroke checked and overhauled.

   6.2) PRC-12 & MIC-23 for 103JAT & JBT: Carried out general cleaning and overhauling of Governor positioner, stroke checked and completely overhauled.

   6.3) PRC-9 for 105JT: General cleaning, overhauling of governor positioner was carried out and checked stroke.

7) **CONTINOUS IMPROVEMENT :**

8) Replaced old pneumatic PDR transmitters with new SMART electronic transmitters in primary reformer area for better reliability & performance.

9) Replaced old pneumatic level transmitters with new Guided wave Radar type electronic transmitters in 103J seal oil tanks for better reliability & performance.

10) **CALIBRATION OF INSTRUMENTS:** Safety & Quality affected instruments were checked & calibration carried out.

HITACHI (CO2) COMPRESSOR

1. All RTDs and Thermocouples were removed to facilitate Mech. Maintenance jobs. Checked and installed back after mech. maint. job was over/ completed.

   Following RTDs were replaced by new RTDs with pads.

   TI-1819-20, TI-1821-22, TI-1823-24.

2. All vibration probes extension cables and Proximeter were removed and checked and installed back to facilitate Mech. Maintenance jobs.

   Following probes were replaced by new one as they were damaged by fire.

   1. KE-1801, 2. XE-1801A, 3. ZE-1801B, 4.XE-1801B, 5. ZE-1801A.

   Following damaged cables were rectified.

   ZS-1847 and TE-1873 - Damaged portion of both cables were removed. These were rectified & made it alright.

3. Followings Trip and Alarm Switches were cleaned, checked and calibrated:-

   PSLL-1818A, PSLL-1818B, PSLL-1818C, LSHH-1822, PSLL-1843. LSHH-1806. LSHH -1808. LSHH -1804. PSHH-1843A. PSHH-1843B. PSHH-1843C. PSLL-1801A. PSLL-1801B. PSLL-1801C. PSL-1816 PSHH-1839A. PSHH-1839B. PSHH-1839C. PSLL-1838A. PSLL-1838B. PSLL-1838C. PSL-1812. PSL-1813. PSLL1844.

4. Local Control Panel and PLC Box were cleaned, all wiring connection were tightened.

5. All I/H converters were calibrated.

6. Followings transmitters were calibrated:-

   LICT-1821, LICT-1803, PI-1802, LICT-1805, LICT-1807 PI-1809, LT-1809, PT-1836.

7. FR-1801 (DCS) - Faulty manifold of the Transmitter was replaced by new one.

8. All junction boxes were cleaned, terminal tightened.

OLD CENTRIFUGAL AND PB COMPRESSOR

1. All vibration probes, extension cable of both compressor were removed and checked then installed back to facilitate mech. Maintenance jobs. Damaged AX-1155 Probe was replaced by new one.

2. All thermocouple of both compressors were removed to facilitate mech. Maintenance jobs. Checked and installed back.

3. Following trip and alarm switches were calibrated:-

   PHCO-1133, PHA-1133, PLCO-1101, PHCO-1127, PLCO-1124,PLCO-1145, PHCO-1126, PHCO-1132, PLCO-1166, LHCO-1123, PLCO-1153, PLCO-1167, PLCO-1160,

4. FRCV-1-1 Defective pneumatic Controller was replaced by good spare One. Set point transmitter and receiver were calibrated.

5. LICV-1123 - Level troll was calibrated after general overhauling.

6. Annunciator – Power supply Faulty unit of AU-10 was replaced by spare good one.

7. Panel was cleaned and all wiring connections were tightened.

CONTROL/ MARSHALLING ROOM:

1. Annual preventive maintenance of DCS, like cleaning of Cards, Software backup of FCS and all ICS, Batteries Voltage of all ICS and FCS were taken and found to be O.K .Functionality checking of FCS and all ICS by diagnostic software was carried out, by Yokogawa representatives and found to be O.K.

2. OMRON PLC Panel cleaning & checking of OMRON PLC also CPU Battery voltage were checked and found alright.

3. Cleaning wood ward Governor console was carried out.

4. Radiac Relay unit for LR- 1201 was calibrated.

5. Panel cooling fans of DCS - Faulty Panel cooling Fans were replaced by new one. (Total Nos. 36)

OTHER PLANT JOBS:

1. LRC-1201 and LH-1201 detectors were removed and installed back to facilitate Mech. Maintenance jobs.

2. 8 nos. HP Thermowell removed and hydro tested. And all thermowell were re-fixed. TR-1210 Thermo well was replaced by good one.

3. Preventive maintenance of turbine flow meter for cooling water was carried out.

4. 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.

5. All Plant J. B.s terminal were tightened.

6. FS-1101 - FS was removed from line for calibration the works of M/S Liquid control pvt. Ltd. Baroda. It was fixed back after calibration.

7. Following Transmitters were calibrated.

   LT-1203, LT-1235, LRC-1421TX.was replaced by new one with calibration done. PT-1282, PT-1481, LT-1481, LT- 1701 A & 1701 B. LRCV-1201. PT- 1202. LT-1202. PT -1201C ,

8. Following alarm and trip switches were calibrated.

9. PAHH-1194, PAH-1193, PHCO-1363A&B, PLCO-1102A, PLCO-1201A, PALL-1195, PLCO-1102B, PSLL-1101, LSL-1357.

10. Coordinated with Production/ Maintenance persons for miscellaneous plant Jobs related to instruments.

11. I/P Convertors of following control valves were replaced by new.

    HICV-1422A, HICV-1422B, PRCV-1201, PICV-1701A, PICV-1701B.

12. PR-1121 - Impulse tube was modified as tapping changed.

13. FR-1504 Orifice was opened from line. Orifice bore was changed to bigger size as per P/P'S requirement in our Mech. W/S then it was re-fixed in line.

14. TI -1703(PCS) - New Thermocouple was provided and new Loop was Completed and it was taken in line.

15. Instrument air header was flushed at various points.

16. LICV-1351 & LICV-1354 - Both Transmitter were shifted in new location to facilitate maintenance of the transmitters.

17. PT-1481 Impulse tube of Transmitter was replaced by new ½" S.S. tube.

18. FI-1204 The Transmitter removed for inspection. General maintenance done then it was boxed up in line .

19. N/C Ratio Meter- Capillary chocked was replaced by new one.

WEEP HOLE CHECKING OF HP VESSELS

1. Coordinated with production persons for weep holes tubings.

CONTROL VALVES

1. HICV-1801 and PICV-1810 Control valve were opened from bonnet. Machining done on plug & seat of both valves and carbon seal rings of both valves were replaced by spare one. Boxed up the valves and calibration carried out.

2. LRCV-1201 –Control valve was Dropped from line and following jobs carried out. Diaphragm changed with new one. Plug and seat were replaced by spare good one (repaired). Gland packing and sleeve replaced by new. Control valve was boxed up in line and Calibration carried out.

3. HICV-1201 The valve was dropped from line, over all maintenance was carried out including 1..diaphragm changed with new one, 2..Plug & Seat were replaced by spare good one (repaired). c/v body was replaced by spare good one (repaired)..Gland packing and sleeve were replaced by new. Control valve was boxed up in line. and calibration carried out.

4. PICV-1129 – Control valve dropped from line Plug was replaced by new one made in our mech. W/S as removed plug was in bad condition. Machining done on seat. Control valve assemble work done. Gland packing was replaced by new one. Pressure test done. Control valve was boxed up in line. Calibration carried out.

5. TRCV-1422 – Control valve was opened from bonnet. Machining done on plug & seat. Control valve assemble work done then control valve was boxed up in line. Calibration carried out.

6. PICV -1351 Control valve was replaced by new one.

7. FICV- 1351 Control valve was replaced by new one.

8. FICV-1102 Control valve was opened from bonnet. Lapping was done on plug and seat. Cage was replaced by new one as damage.Gland packing changed by new one. c/v was refixed in line. Calibration carried out.

9. PICV-1502A Control valve was opened from line. Machining done on plug and seat. Actuator was overhauled. O-ring set was replaced by new one as damage. Also new gland packing provided. c/v was refixed in line. Calibration carried out.

10. HICV-1422 Control valve was opened from line. Machining was done for plug and seat. .then c/v re-assemble work completed. Gland packing was replaced by new one. Pressure test done. c/v was fixed in line. Calibration carried out.

11. PCV-1502 Control valve was opened from line. Machining done on plug and seat. Actuator was overhauled. Completely serviced the valve. Pressure test done and c/v was re-fixed in line. Calibration carried out.

12. HICV-1221B Control valve was opened from line as flange leakage. Flange gaskets were replaced by new one then Control valve was boxed up in line. C/V stroke checked and made it alright.

13. PICV-1130 Control valve was opened from bonnet. Plug, seat and cage were repaired/modified. Provided new gland packing. Control valve was boxed up in line. Calibration carried out.

14. LICV -1502 A Control valve was opened from line. Machining & lapping work was done on seating portion of plug and seat. New gland packing provided. c/v was refixed in line with new lock nut. Calibration carried out.

15. LICV -1501 Control valve was opened from line. Machining done on plug and seat. Gear shaft was replaced by new one as damage. Control valve assemble work done. New gland packing provided. Control valve was re-fixed in line. Calibration carried out.

16. PICV-1221 Control valve was dropped from line. Plug and seat found slight damage machining done on plug & seat. Gland packing changed by new one control valve was boxed in line. Calibration carried out.

17. PICV-1979A & PICV-1979B - Both control valve were removed from line. Plug and seat of both c/v repaired by lapping. Gland packing of both c/v changed by new then both Control valve were re-fixed in line. .Calibration of both c/v carried out.

18. PRCV -1504 Control valve was opened from bonnet. Plug, seat & cage was repaired / modified. Provided new gland packing. Control valve assemble work done. Control valve was boxed up in line. Calibration carried out.

19. TRCV-1226 S.S. tubing of air supply and signal done.

20. PICV-1202 Control valve was opened from line. Machining done on plug & seat. Actuator was overhauled. Control valve assemble work done. Provided new Gland packing. Control valve was boxed up in line. Calibration carried out.

21. N/C Ratio meter - Monoblock valve was replaced by spare good one. (repaired).

22. Actuator of Prill Divert three-way valve was replaced with spare one as faulty.

23. TRCV-1202 & HICV-1222A - Modified tubing work of both valves were completed as C/Vs direction changed.

24. Following control valves overhauled & checked for operation.
    LICV-1203. HICV-1422A. HICV-1422B. PICV-1131. LCV-1502B. PICV-1502. LICV-1422, LICV-1301, PICV -1130. PICV -1422. PICV-1385. PRCV-1202. FICV-1352, PICV-1502A, LICV-1353, FICV-1204,FICV-1303, PICV-4801, FICV-1351, HICV-1581, PICV-1481, HICV-1802. HICV-1803. HICV-1022 TRCV-1202, FICV-1302, HICV-1208,

25. Painting and stroke-checking of Control valves carried out.

OFFSITES & UTILITY PLANT

BOILER PLANT:

Control Room Panel Related Jobs:

1. All the panel instruments were removed from Boiler Control Room.
2. All the Panels were removed from Boiler Control Room.
3. Eye-Hye Drum Level indicator was relocated.
4. BMS Panels were also removed.
5. Flame Scanners were relocated inside DCS cabinet.

DCS Related Jobs:

1. Operation of all the MOVs were checked from DCS operator panel and after that taken in line.
2. New power cable for O2 analyser was laid .
3. F.D. Fan bearing temp RTDs were taken in service.
4. FI-11 Air Flow transmitter was replaced by a new electronic one.

PLC Related Jobs:

1. All PLC related inputs were connected to MCD02 in Boiler Control
2. Room.
3. All the BMS loops were checked and then taken in line.
4. All logics of PLC were checked .

UPSS SYSTEM (Performance and reliability check):

1. Checked the reliability performance of M/s IL make stand by UPS System.

2. Checked the performance of batteries for M/s IL make UPS System by taking 10 minutes to 2 Hrs. load on batteries.

FIELD JOBS:

1. Following field switch set value were checked.

   (a) LSL-1, LSL-2, LSL-3 of steam drum level .
   (b) LLCO-5111, LAL-5111 and LAH-5111 of Deareator.
   (c) LAL-5171 and LAH-5171of LSHS day tank.
   (d) PSL-1 F.D. Fan lube oil pressure low AOP START.
   (e) PSL-11,PSH-12 of Furnace pressure.
   (f) PSL-24, PSL-25, PSN-26 & PSL-27 of Ignition and fuel gas line.
   (g) PSL-28 and DPSLL-29(atomising steam & atm. steam to oil pr. d/p)
   (h) 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.

(a) PAL-5114, PLCI-5113, PLCO-5112 for P-5111
(b) PAL-5113, PLCI-5112, PLCO-5111 for Q-5111
(c) PAL-5115, PLCI-5114, PLCO-5113 for P-5112
(d) PLCI-5115 M-5112 AOP

3. T/C of O2 Analyser was replaced with a new one. Also a new filter was installed.

4. TR-13 Furnace Temp T/C was replaced with a new one & configured in DCS.

5. 7 Kg/cm² air header in LSHS day tank area was rerouted.

6. **DAMPERS.**

   Following damper's limit switches, solenoids valves, air regulators etc. were overhauled and checked its operation.

   (a) F.D. fan inlet damper and F.D. fan outlet damper.
   (b) Air heater inlet damper and Air heater outlet damper.

7. **Steam Drum**: EYE-HYE Electrodes were checked and replaced all the terminal wire lugs by new ones.

8. Following transmitters were replaced by new Electronic one.(Yokogawamake)

   (a) FT-1, FT-2,FT-3, FT-11, FT-13, DPT-1, DPT-14, DPT-12.
   (b) PT-1, PT-2,PT-4, PT-5, PT-6,PT-7,PT-21,PT-22,PT-41,PT-50,DPI-1,DPT-12.
   (c) LT-1, LRC-2, LRC-4, LT-3, LT-5

9. Press.gauges PI-2, PI-3, PI-4 & PI-5 were calibrated w.r.t. Boiler Inspection.

CONTROL VALVES:

Following control valves & it's positioner were cleaned & checked the stroke.

a. FCV-1, 100% BFW C/V body was removed from line & sent to Valtek India Ltd. for overhauling.(Removed 2 nos. of broken bonnet studs from body) Pneumatic V/P was replaced with new Elecctronic one.

b. PCV-2, LCV-4, PCV-1, TCV-1, PCV-50.

c. Checked & replaced air diaphragm of BTV2-1 & HOHTV. Also replaced air supply regulator of BTV2-1.

d. BTV-1 & BTV-2 Ball valves were overhauled.(Replaced piston rings by new one)

IGNITORS

a) Both Burner's ignitor gun, spark plug, and gas & Oil flame scanners were cleaned and checked.

b) All furnace draft impulse lines were flushed with 7.0 kg/cm2 air.

c)

d) BFW Turbine and FD Fan turbine governor oil TRIP solenoid valves were cleaned and checked operation.

e) 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.

D.M. Water Plant:

1. Anion-I, V-3, & Anion-III, V-3 Outlet Control valve's were replaced by new one and checked it's stroke. CTMU flow c/v was overhauled as it's hand jack was not working properly.

2. Cleaned sampling system and measuring chamber of Silica Analyser and also calibrated it.

3. Cleaned and tightened all wiring terminals behind the Control panel.

NH3 STORAGE:

1. Controller & control valves of LSHS TankA,B&C were overhauled & checked.

2. All electrical & RTD JB were cleaned and tightened all wiring terminals.

3. SLPC indicators/controllers were replaced with US1000 (Yokogawa make) Cleaned, checked and tightened all terminals inside old,new & PLC panel.

COOLING TOWER:

1. Q- 4411 (Eliot Turb.) North and south side radial vibration probes , speed pick-up unit were removed & reinstalled to facilitate mech. maint.

2. Q-4411 Gear Box vibration probe fittings were found broken. Two nos. of new fittings of ½" NPT(M)X ¾" NPT(M)X 5/8" UNF (F) threads were prepared and fixed probe housing/ probe.

3. R.W. inlet flow element (ANNUBAR) was removed from line. Same was cleaned & fixed back.

4. PICV-5153 control valve was replaced with new Fisher make valve.

5. Checked Speed indicator of Q-4403.

I.G. Plant

Attended all running jobs**.** Servicing and calibration of ABB make H2 analyzer of new I. G. Plant. (Service engineer From M/s ABB has completed this work.)

Effluent Treatement Plant:

(1) Overhauling of SBA control valve and its valve positioner.
(2) Cleaning of sampling system and calibration of Ammonia analyzer.

Weigh Bridge (Main Gate):

1. Platform of weigh bridge was replaced with new one.

2. Replaced all the six Load cells with new one. Mounting and alignment of load cells was done in our presence by service engr. from “Ashbee” .

3. A new indicator was also installed & checked it’s calibration.

4. Calibrated the weigh Bridge with standard weights. (upto 40 tones)

Weigh Bridge (Mettler Toledo):

PC booting problem solved & boot sequence was ch

B & MH PLANT

(1) **Power build make automatic bagging m/c P/S No. 1,2,3 & 7**
(a) Checked wiring terminals in the main panel, local panel, Solenoid boxes, and loadcell boxes.
(b) Cleaned and checked CIC-25, relays board, fuses, and all sensors.
(c) Checked function and calibration of all Packer Scales.
Packer Scale No: 4 & 8
(d) Old panels were replaced by new ones.
(e) Oil lubricator was overhauled.

(2) **Computpak Panels**
(a) All PCB's inside the computpak panels were removed and cleaned.
(b) Relocation of Solenoid valves of UBM 9A and 9B.
(c) Calibrated Both UBM 9A/9B &10A/10B.

(3) **Auto Bag Placer**(Machine No. 9A&9B)
(a) Cleaned/checked all sensors of both auto bag placers.
(b) Cleaned the local panels and PLC Panels.
(c) Tightened all wiring terminals of local / PLC Panels for both auto bag placers.
(d) Oil lubricator was overhauled.
(e) A new Air Regulator was provided in DICV-601.

(4) **Weigh Scales** (Mettler-Toledo/Libra make)
(a) Cleaned the weighing scales , Digital Indicators.
(b) Cleaned the PCB of digital indicator.
(c) Calibrated all weighing scales.

(5) **Belt Weigher System**
(a) Cleaned/Overhauled the tacho-meter assembly.
(b) Checked the healthiness of loadcells, tacho-meter, digital indicator.
(c) Checked the load cell performance by actually putting weights and checking milli volts, the performance was found satisfactory.

(6) **Dust Extraction System**.
(a) Cleaned the Dust Extraction Panel.
(b) Cleaned all field instruments (C/V,FlowTx,LevelTx etc.) related to DES.

Preventive maintenance carried out on transformers: TR-6, TR-21 & TR-22 and the job details are as under:

1. Inspection of primary and secondary cable boxes, end termination, checking and tightening of connections.
2. Measurement for Insulation resistance, BDV of transformer oil.
3. Alarm & tripping contacts of Buchholz relay and MOG were checked.
4. Condition of silica gel was checked. Discharged silica gel was recharged.
5. Oil leakages from the transformers were attended and damaged gaskets were replaced.

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:

1. Checked the tightness of outgoing terminals.
2. Cleaned the feeder compartments.
3. Replaced damaged/ worn out contacts, etc.

Overhauled the following motors:
101BJ, 104J, 104 JA, 104 JT, 106J, 107 JT, 118 JB, 112J, 112JB, and 117J

Preventive maintenance of following MOVs were carried out:
SP1, SP3, SP4, SP5, SP70, SP152, SP 154, SP 158 & SP159.

Existing Limitorque MOV SP5 is replaced with new ROTORK actuator and modification in wiring is done accordingly.

1. Control wiring of SP154 is modified to operate from DCS in Remote condition.
2. Testing and calibration of relays installed in MCCs were carried out.
3. Preventive maintenance of LT SIEMENS Breakers and L & T Breakers installed in MCCs were carried out.

Preventive maintenance carried out on transformers: TR-7A, TR-7B, TR-17, TR-18, TR-20 and the job details are as under:

1. Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.

2. Measurement for Insulation resistance, BDV of transformer oil.

3. Alarm & tripping contacts of Buchholz relay and MOG were checked.

4. Condition of silica gel was checked. Discharged silica gel was recharged.

5. Oil leakages from the transformers were attended and damaged gaskets were replaced.

6. Transformer oil of TR-7A is filtered as its BDV value was found low.

Preventive maintenance of all the feeder compartment in MCC 6 and MCC 14, MCC 15 were carried out.

1. Checked the tightness of cable & wiring terminals in the feeders.

2. Cleaned the feeder compartments.

3. 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.

Following motors were Overhauled.

P1814 B, P1815 A, P1815 B, P1408, M1402 /1, M1402/2, P1131A, P1131 B, P1231 A, P1231 B, M1403/1, P1817, M1419, M1421, M1403/2, P1351/B, P1401 A, P1401 B, P1204 A, P1204 B, P1401 B, K1401/1, K1401/2, K1401/3, K1401/4, K1701 & K1702.

Preventive maintenance carried out on variable speed drives control panel i.e. P1102A, P1102B, P1102C, P1201A, P1201B, P1201C, and M1401A & M1401B.

Preventive maintenance carried out on all rope switches installed on conveyors: M1402, M1403, M1419 & M1421 and replaced defective one with new.

All corroded or damaged cable trays were replaced with new G.I.cable trays.

Testing and calibration of relays installed in MCCs were carried out.

Preventive maintenance of LT SIEMENS Breakers and L & T Breakers installed in MCCs were carried out.

OFFSITES & UTILITY PLANT

Preventive maintenance carried out on transformers:TR-1A, TR-1B, TR-1C, TR-4A, TR-4B, TR-15, and job details are as under:

1. Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.

2. Measurement for Insulation resistance, BDV of transformer oil were carried out on each transformer.

3. Alarm & tripping contacts of Buchholz relay and MOG were checked.

4. Condition of silica gel was checked. Discharged silica gel was recharged.

5. Oil leakages from on the transformers were attended and damaged gaskets were replaced.

6. Transformer oil of TR-1B & TR-4B was filtered as its BDV value was found low.

Preventive maintenance of all the feeder compartments in MCC-3 , DG MCC were carried out.:

1. Checking the tightness of cable & wiring terminals in the feeders.

2. Cleaned the feeder compartments.

3. Replaced damaged / worn out contacts, etc.

4. Tightness of the bolts of bus bars in DG Panel were checked.

Following motors were Overhauled.

L-45 and L-46 (DG Set CT Fan Motors)

New DG Hook- Up System was tested and commissioned.

Testing and calibration of relays installed in MPSS & 66KV Switchyard were carried out.

Preventive maintenance jobs were carried out in 66 KV switchyard.:

1. Cleaning of insulators of all the CT & PT units, bus bar support, lightning arrester, breakers , etc.

2. Insulation Resistance was measured of all the CTs & PTs.

3. All the moving parts of isolators were cleaned and lubricated.

4. 11 KV VCB panels were cleaned and outgoing cable terminals were checked for its tightness or hot spot.

5. Modification carried out in Feeder 52-Q by providing double bus bars to suit 1250 A breakers.

Overhauled the OLTC of TR-1A by lifting the entire D.O.V.A Inspection and cleaning of diverter switch and replaced the oil.

Preventive maintenance jobs were carried out in 11 KV MPSS :

1. Checked the tightness of outgoing terminals.

2. Cleaned the feeder compartment of both Jyoti and siemens panel Replaced damaged /worn out contacts, etc.

Preventive maintenance of HT SIEMENS Breakers installed in 11KV MPSS & 66KV Switchyard were carried out.

UTILITY:

Preventive maintenance carried out on transformers:

TR-2A, TR-2B, TR-3A, TR-3B, TR-8, TR-11, TR-12, TR-13 & TR-14 and the job details are as under:

1. Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.

2. Measurement for Insulation resistance, BDV of transformer oil were carried out on each transformer.

3. Alarm & tripping contacts of Buchholz relay and MOG were checked.

4. Condition of silica gel was checked. Discharged silica gel was recharged .

5. Oil leakages from the transformers were attended and damaged gaskets were replaced.

6. Transformer oil of TR-2A,TR-2B & TR-3B is filtered as its BDV value was found low.

Overhauled the following transformers by lifting the entire core. Inspection and cleaning of winding and replaced transformer oil.

TR-3A , TR-11 , TR-13.

Preventive maintenance of all the feeder compartment in MCC 1, 2, 2B/2E, 2A, 2F, were carried out.

1. Checked the tightness of cable & wiring terminals in the feeders.

2. Cleaned the feeder compartments.

3. Replaced damaged / worn out contacts, etc.

Following motors were Overhauled.

P4401 B, P5111/A, 5111/B, P5112/A, P5112/B, P5115 A, P4411B, P4403, P4412.

Checking of terminal box of all HT Motors i.e. P4402B, P4401C, P4401D, P4404 and E5112.

Checking of terminal box of all LT Motors above 25 HP.

Following existing MOVs actuators are replaced with new ROTORK actuators and modification in wiring is done accordingly .

1. Feed water main valve.
2. Feed water bypass valve.
3. Main steam stop valve.

Modification carried out on all MOVs in Boiler and shifted control cable to DCS

Shifted Soot Blower control panel at new location in control room and commissioned.

Testing and calibration of relays installed in MCCs were carried out.

All corroded or damaged cable trays were replaced with new G.I.cable trays.

B&MH PLANT

Preventive maintenance carried out on transformer: TR-5A, TR-5B, and the job details are as under:

1. Inspection of primary and secondary cable boxes, end termination, checking and tightening of connection.

2. Measurement for Insulation resistance, BDV of transformer oil were carried out on each transformer.

3. Alarm & tripping contacts of Buchholz relay and MOG were checked. Servicing of Buchholz Relay of Tr-5B was carried out.

4. Condition of silica gel was checked. Discharged silica gel was recharged.

5. Oil leakages from on the transformers were attended and damaged gaskets were replaced.

Transformer TR-5A overhauled by lifting the entire core. Inspection, cleaning, winding & replaced of transformer oil.

Preventive maintenance of all the feeder compartments in MCC 4, 4A & 9 were carried out.:

1. Checked the tightness of outgoing terminals.
2. Cleaned the feeder compartment.
3. Replaced damaged /worn out contacts, etc.

Following motors were overhauled.

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.

Preventive maintenance carried out on all rope switches installed on conveyors:
M2110, M2112, M2117, M2121, M2122 & M2123 and replaced defective one with new.

Bagging conveyor control panel (MIMIC PANNEL) was replaced by new modified panel and shifted to operator room for easy , reliable and safe operation. The panel was tested and commissioned.

Trailing cable of silo tripper, M-2114 is replaced with new one as existing cable was damaged at many places.

Testing and calibration of relays installed in MCCs were carried out.

AMMONIA PLANT

AUXILIARY BOILER:

1. Replacement of burner blocks for burners' No. 1 and 2.
2. Repairing of burner blocks for burner no. 3, 4 and 5.
3. Repairing of Header and other refractory work in side the auxiliary boiler.
4. Repairing existing hot point panels on west side of auxiliary boiler by insulating castable materials.
5. Relocation of Instrument pipe line opposite auxiliary boiler.

PRIMARY REFORMER:

1. Repair of insulation bricks along with back up insulation after the removal of old damaged refractory.
2. Removing / reconstruction of all tunnel walls in primary reformer including bottom floor, tunnel slabs.
3. Casting of trainsiction cones with refractory.
4. Replacement of AC sheets roofing for pent house area of primary reformer.

UREA PLANT

1. Repairing of scrapper floor by flling the joints of existing tiles and 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 ground floor area of Urea plant including column, slab, beam etc.

3. 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 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.

OFFSITES & UTILITY PLANT

WATER TREATMENT PLANT:

1. Repairing of acid proof brick linings in strong effluent tank No. A & weak effluent tank B.

2. Repairing of supports for pipeline in Water treatment plant & floor of H_2SO_4 tank near cooling tower sump side.

3. Repairing of floor by bitumastic lining for SB assembly unit and around Anion tank in water treatment plant.

Maintenance of strong and weak effluent channel and repairing of strong as well as weak effluent chambers in water treatment plant up to effluent tank.

FRV lining work for strong effluent channel and open channel near lagoon phase B area.

Epoxy grouting of nozzle in new cooling tower sump.

Replacement of screen support 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.

BOILER HOUSE:

1. Repairing of casting refractory for burners side, floor and superheated zone inside BHEL boiler.

2. Replacement of AC sheets in BHEL Boiler roof.

3. Modification of Control room by civil work.

B&MH PLANT

Following jobs were carried out during plant turn around 2006.

1. Repaing of Walk way for conveyor belt No. 2117 inside the Silo by epoxy monolithic plaster.

1. Epoxy painting of Transfer tower and conveyor gantry from Silo to B & MH.

2. Repairing of Hopper floor / Packer scale floor with epoxy monolithic plaster.

3. IP Net coating of RCC columns, ceiling, slab, beams and other RCC structure in Bagging plant at first floor and ground floor area.

4. White washing of ground floor ceiling and Syn. painting of MS structural for east and west side of the building.

5. FRV lining for dust removal plant of B & MH.

6. Replacement of AC sheets roofing for waste bags storage area and truck loading area and roof replacement of contractor cabin in B & MH.

7. Replacement of AC sheet for Loco shed.

MECHANICAL

Following CW lines modification jobs has been carried out:-

1. Separate 4'' CW supply line for recycle gas compressor (117-J) from 108C2A inlet line installed.

2. 450Dia -108C bypass line modification carried out to lower height and relocation of Butterfly valve.

3. 6'' NB Cooling water supply line to recycle gas compressor (117-J) tapping location change from existing bypass line to 108C2 inlet.

4. 175-C CW inlet /outlet lines removed from Tap-Off point (Near 110CA/CB) and cap has been provided.

175-C aMDEA cooler removal job:

175-C aMDEA cooler and associated aMDEA piping removed. Also, aMDEA filter 101L shifted to south side and aMDEA line tapping point relocated for giving sufficient pipe length upstream of FI.

Suction line (4'') for 113-J modified having tap off from 108C outlet.

Replacement of 6'' exhaust line of ID fan turbine(101BJT) & Installation of desuperheater:-

1. I.D. Fan turbine exhaust line size to be increased to 12'' and LP stem header removed along with 101-BJT exhaust RV and isolation valve.

2. Connection of TTV of ID fan , gland leak to LP Header provided.

3. Desuperheater removed from LS-76-4'' TO 171-C line and installed in ID Fan exhaust line along with associated DM water line and a thermo well point at Down stream side.

4. Existing LP steam header LS-24-8'' removed from main tapping header LP-3-12'' and new 1'' LP steam header installed.

Additional control valve in parallel to existing PICV-3 at HTS inlet line:-

MICV-1027(6''X900#) installed in parallel to existing PICV-003 at HTS inlet line V-4-6'' . Also distance piece provided in place of existing PICV-1027 in vent line from R112 outlet at Pre-Reformer section top platform location.

HTS vent valve (PICV-003) U/S isolation valve replaced with new alloy steel valve. HTS line D/S of isolation valve, size increased To 12'' with new isolation valve.

175-C aMDEA cooler removal job:

175-C aMDEA cooler and associated aMDEA piping removed. Also, aMDEA filter 101L shifted to south side and aMDEA line tapping point relocated for giving sufficient pipe length upstream of FI. Suction line (4'') for 113-J modified having tap off from 108C outlet.

Replacement of 6'' exhaust line of ID fan turbine(101BJT) & Installation of desuperheater:-

1. I.D. Fan turbine exhaust line size to be increased to 12'' and LP stem header removed along with 101-BJT exhaust RV and isolation valve.

2. Connection of TTV of ID fan, gland leak to LP Header provided.

3. Desuperheater removed from LS-76-4'' TO 171-C line and installed in ID Fan exhaust line along with associated DM water line and a thermowell point at Down stream side.

4. Existing LP steam header LS-24-8'' removed from main tapping header LP-3-12'' and new 1'' LP steam header installed.

Additional control valve in parallel to existing PICV-3 at HTS inlet line:-

MICV-1027(6''X900#) installed in parallel to existing PICV-003 at HTS inlet line V-4-6''. Also distance piece provided in place of existing PICV-1027 in vent line from R112 outlet at Pre-Reformer section top platform location.

Control valve's I/P Converter , accessories & associated wiring was completed for its operation through Ammonia C/ Room DCS .

HTS vent valve (PICV-003) U/S isolation valve replaced with new alloy steel valve. HTS line D/S of isolation valve, size increased to 12'' with new isolation valve.

Installation of BFW coil(E107A) at ID Fan inlet & duct modification job:

New boiler feed coil (E107A) has been installed downstream of LT convection zone. The coil was procured from M/s Phrogen , Chennai.

New duct/casing along with new supports has been fabricated . Inside duct Insulite -11 refractory provided. The job was carried out by M/s Shree Ganesh Engg.

Other Ammonia Plant Jobs:-

1. AG to tunnel burner tapping location changed from D/S of tail gas to U/S of tail gas.

2. Platform suitably extended for RV102Fand PRC-6 control valve to have better access.

3. Connecting platform between Absorber and Flash vessel provided for easier access and escape route.

4. Additional check valve (6''x150#) provided in ARC lines of both lines for 116J/JA.

5. Access platform provided (by extending platform of absorber) for RV101E and I/Vs.

6. PIC-410 outlet line modified to have increased vent height location (Approx. by 3 mtr.)

7. LP Steam jacket provided in LNG line (8'' size) to fuel line near PGR cold box.

INSTRUMENTATION

EWR No. CW-97 is completed:

Newly procured Level Indicator from M/s Pune Techtrol Pvt. Ltd. installation , calibration & commissioning were completed successfully for NaOH Tank T- 4404 on 07/04/2006 in Cooling Tower area.

Performance improvement of LP absorber:

Installation & commissioning of control valve (HICV-1206) on LP absorber off gases outlet line to ammonia scrubber (V-1207) with its associated wiring in AJB-13 at Pril tower top for its operation through Urea C / Room DCS is carried out .

Redundant FRCV-1421 control valve of M/s Parcol make with Cv of 187 is used as HICV -1206.

Provision of temperature measurement at inlet & outlet of cooler H-1208 at first floor is implemented.

Fire detection cameras hardware samples mounting stands for cameras tried in primary reformer for selection.

MECHANICAL

Performance improvement of LP absorber (V- 1203):

1. LP absorber feed cooler (H-1208) has been installed at discharge of process water pump P – 1302 C/D.

2. Existing cooler (H-1304) has been removed, and piping of inlet and outlet of cooling water changed to 6"NB.

3. Control valve (HICV-1206) has been installed in 3" line from LP absorber out let line.

4. Direct connection of P-1305 A/B discharge line going to existing H-1304 & outlet line going to H1352/H1205A has been carried out.

Provision of BF water make up control valve to CCS- II and shifting of BF water make up point to avoid wide pressure fluctuation in P- 1204 discharge.

1. 1" BF water tapping has been taken from upstream of the main isolation of RO (SC-1230- 0.5").

2. Isolation valves are installed and control valve will be installed after its delivery in plant running condition.

3. The existing high-pressure BFW 15NB line with R.O (3 Nos.) has been connected to CCS-II header.

Removal of flash tank scrubber (V-1421) and performance improvement of flash tank condenser (H-1421).

1. Flash tank scrubber (V-1421) has been removed.

2. Related piping modification in 20" line has been done.

3. Spray nozzle of process condensate has been installed.

4. 6" NB and 2" NB nozzle have been given in 20" NB line.

5. ¾" line connection has been given for flushing of spray nozzle and inlet nozzle of flash tank condenser (H-1421).

6. PI point has been given at out let nozzle of atmospheric flash tank (V-1406).

To provide pressure control valve on vapour line of ammonia suction vessel.

1. 2” tapping from ammonia suction vessel has been taken.

2. 2” tapping in down stream of control valve has been taken to new atmospheric scrubber (V-1206).

3. Isolation valve with blind flange has been provided.

4. Control valve will be installed in running plant after P.O delivery.

To provide DM water make up control valve for maintaining level of steam condensate tank(T-1501).

1. 2” by pass line has been given with isolation valve.

2. Spool peace has been given in place of control valve.

3. Control valve will be installed in running plant after P.O delivery.

Installation of water seal system on manhole of Urea Solution tank (T-1401).

1. Water sealing system has been installed on manhole of Urea solution tank.

2. Condensate inlet and drain line with isolation valve has been completed.

Installation of independent ejector system for pre evaporator.

1. Piping modification has been done.

2. Air in bleed connection has been given in ejector suction.

3. New ejector will be installed after P.O delivery.

To utilize cold DM water instead of hot condensate for CCS-I make up.

1” line tapping of surface condensate has been taken with isolation valve to CCS-! Over head tank(T-1201) with two isolation valve.

Re-rooting has been done in LPCC drain line connected to T-1301.

MECHANICAL

LNG Pre-heater installation for BHEL boiler:

1. Spare exchanger used for LNG Pre-heating has been installed.
2. Inlet outlet gas connection has been done with exchanger.
3. 2” NB LP steam connection provided to exchanger shell side with one isolation valve and one glove valve.
4. Drain connection with steam trap provided to exchanger.
5. Modification in 6” NB gas line due to fouling in walking area.